CONEXUS
Co-producing Nature-Based Solutions and Restored Ecosystems: Transdisciplinary Nexus for Urban Sustainability

Title: Integration of NBS in local governance contexts and urbanisation trajectories in CONEXUS EU and CELAC cities. Evidence from Barcelona, Buenos, Aires, Bogotá, Lisbon, Santiago, São Paulo and Turin.

Deliverable Number:	D2.2 v1.2
Version number	Version 1.2
Lead partner	UNIFI (Beneficiary no. 6) & PUJ (Beneficiary no. 5)
Due date	Month 18 (February 2022)
Deliverable Type (as per Grant Agreement)	Report
Dissemination level	**PUBLIC**
Authors	Fabio Salbitano, Cesar E. Ortiz-Guerrero, Beatriz Kauark Fontes, Jaime Hernández-García, Livia Marchetti and María Alejandra Cruz-Suarez.
Reviewers	Stephan Pauleit and Tom Wild

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 867564 tinyurl.com/CONEXUS-project

EXECUTIVE SUMMARY

The present report analyses the current state of integration in Nature-Based Solutions (NBS) governance and planning processes within and across scales and dimensions of all CONEXUS cities: Barcelona, Buenos, Aires, Bogotá, Lisbon, Santiago, São Paulo, and Turin. Different levels of cooperation and conflicts may arise within and between governance structures, making integration a key issue in urban governance, in particular in the development of NBS. Integration is crucial for co-production and co-designing NBS, while the NBS establishment can also play a central role in encouraging integrating approaches.

This report is an overview and analysis of NBS integration into urban governance and official planning within EU and CELAC CONEXUS cities. After this introduction and the explanation of the methodology, it addresses where we are in terms of NBS integration in both EU and CELAC, the process of NBS integration in the two places, key factors emerging from the findings, strengths, weaknesses, opportunities, and threats, and a comparison of the results encountered. The report followed a qualitative methodology. For both regions, it was composed of a content analysis of official planning documents from the municipalities, a collection of primary data through participatory workshops and expert interviews, culminating in a swot analysis. Given the early stage of the NBS concept in the CELAC region, a prospective exercise was added to the analysis to identify and classify the set of variables that affect the NBS planning process, and their relationship.

Findings show differences in contexts and on the state of NBS implementation within the two regions, but also similarities regarding the barriers and opportunities for integration in governance and planning. NBS integration in urban governance is novel in both EU and CELAC, but even more so in the latter. Initial efforts for NBS integration among the public sector, academia, and local actors were observed in the EU cities. Planning in silos still persists, impacting the potential confluence of actions and policies. In CELAC, the cities are still in the process of understanding and positioning NBS within their agendas and practices. The concept is still highly connected with conventional green space planning and struggling to make a stand. CELAC case studies further face obstacles to participation such as high levels of inequality and urban violence, while in EU, the “not in my backyard” (NIMBY) phenomenon was highly present.

Nevertheless, limited awareness about NBS benefits and limited levels of environmental education were found to be major barriers towards NBS advocacy and engagement with citizens both in EU and CELAC. The results also display that all the seven cities find themselves in a good position to enhance their state of integration. In both regions, there is a concentration of national and international plans and policies that are reflected in local NBS initiatives and creates an enabling atmosphere for the continuity and integration of NBS. Municipalities and citizens show an increasing interest in reconnecting with nature and therefore to be engaged in NBS co-design. In conclusion, our results indicate that the current conditions are suitable to further prioritise the integration of NBS within cities' agenda and to promote changes towards their co-design.

TABLE OF CONTENTS

1. Introduction

The concept of Nature-Based Solutions (NBS) is still under development in both the EU and CELAC (see literature review conducted in WP2.1). In CELAC, the use of the concept is relatively new compared to its usage in the EU. Still, in both regions, in particular in the last decade, it has been rapidly progressing, with a high number of studies and publications on these topics growing exponentially (ibid). The process of developing this concept reflects a transition conceptually and in urban planning.

Responding to the expansion of this concept, the H2020 project CONEXUS (CO-producing NBS and restored Ecosystems - transdisciplinary neXus for Urban Sustainability) addresses the 'inconvenient truth' that NBS are often peripheral to many stakeholders' working routines, planning cultures, and ways of thinking. This has knock-on impacts for research and a robust application of the NBS approach to urban governance, decision-making, and urban citizens' daily lives. A significant issue is establishing a deeply rooted way of operating Nature-Based Solutions through co-design and co-production processes. Integrating NBS in city planning and co-design opportunities means understanding and contextualizing the existing patterns that enable or block NBS planning and implementation.

The present report analyses the seven case studies of CONEXUS in Europe and Latin America, bringing evidence from Barcelona, Buenos, Aires, Bogotá, Lisbon, Santiago, São Paulo, and Turin regarding the degree of integration of NBS in urban socio-ecological systems, in governance, planning, and design components as well as in community awareness. This report aims to understand the current state of the top-down and bottom-up integration of Nature-based Solutions in urban governance and planning processes within and across scales and dimensions in the seven cities and their Life Labs. It aims to understand entry points, practices, and policies that can catalyse more agile cross-sectoral multi-level governance to champion NBS projects and barriers hindering this process.

This report looks into the two regions, identifying the state of integration of NBS in urban planning, and analysing the differences and similarities that NBS face within EU and CELAC, selecting common aspects of integration that can hinder or drive forward the concept across different contexts. Optimizing the contributions of NBS to the quality of life of urban dwellers requires an ongoing, robust dialogue between decision-makers and the public they serve. Co-design and co-production are forms of interaction that involve innovative, active, and profound collaboration between partners to define problems, find and implement solutions (Morello et al., 2018). This approach connects citizens' demands and realities to expert technical knowledge, identify missing key players through community knowledge, find local and community synergies, and enhance citizen's engagement and stewardship of NBS, all of which crucially depend upon an adaptive governance that connects multiple actors, fostering interactions within and across levels and scales.

The importance of an integrated approach to NBS is widely recognized but developing a framework of actions and providing an enabling environment for NBS seems rather complex. Following Gibson et al. (2000, p.218) definition of scales: “spatial, temporal, quantitative or analytical dimensions used by scientists to measure and study objects and processes” and levels as “units located in the same position within a scale, that can be ordered hierarchical or not” (ibid), this report examines how the seven cities of CONEXUS are integrating (or not) NBS among their municipal planning levels and scales. In this sense, this study investigates:

- Horizontal integration - among sectors.
- Vertical integration - among governance levels (municipal to national).
- Transversal integration - among different cities and different actors.

Integration of NBS in local governance contexts and urbanisation trajectories here is meant as 1) the incorporation of the concept and ideas of NBS in a strategic manner into the cities’ governance: their incorporation to and adoption by planning policies and instruments; 2) the integration of NBS in the environmental planning (or, as often quoted, "green" planning) of the cities, that is meant on the tactical level of co-producing integrative planning instruments; 3) collaboration at operational and community levels, i.e. integration of stakeholders and actors in the process of conceiving and implementing NBS. The latter, rooted in CONEXUS Life Labs activities, spans from experiences of co-design and co-management as resulting from the discourses of co-development, and indicates the degree of citizens empowerment in the NBS integrative agenda of the cities (Arnstein, 1969). In fact, integration of NBS goes hand in hand with citizen engagement and promotes “the redistribution of power that enables the have-not citizens, presently excluded from the political and economic processes, to be deliberately included in the future […] which enables them to share in the benefits of the affluent society” (Arnstein, 1969 p. 216).

2. Methodology

This study follows a qualitative methodology composed of 1) a review of official documents and literature from the municipalities, to take stock of the existing governance structure in place in said cities; 2) the collection of primary data through participatory workshops and expert interviews to confirm the knowledge acquired and gather further insights from the field, taking into account the perspectives of those closely involved in the municipality and Life Labs; 3) identification of strengths, weaknesses, opportunities, and threats (SWOT) of integration in NBS planning process; and 4) an analysis to identify short term key factors that significantly influence the planning process of the NBS in the cities studied in the long term.

2.1 Documents review

Firstly, content analysis of official documents was conducted taking stock of existing aims, strategies, objectives, plans, programs and projects on a municipal, national and international level. Document contents were screened to identify where NBS are integrated into the municipal planning, which documents are the main contributors of the city's NBS planning structure, and which are the city structures involved in the implementation of NBS. The selected documents were studied to understand in which capacity they contribute to the NBS agenda and the relevant NBS's visions, strategies, and actions in place in the cities. A second content analysis using keywords and text mining was conducted, with the components previously identified, to assess the different possible forms of integration presented by the city.

2.2 Primary data

The collection of primary data required an agreement phase with the Life Labs to apply the Delphi method, in which public, private, and academic stakeholders participated. The Delphi method is a methodological tool used to collect perceptions and knowledge from diverse stakeholders participating in the planning process of NBS. We applied this method using an iterative sequence of standardized questionnaires and feedback (Slocum, 2003; McDonald et al., 2009; Reguant & Torrado, 2016). Questionnaires were delivered and collected by email. To achieve consensus, all stakeholders were involved equally and were informed in detail about this study's goals and the analysis process conducted with this method. Informed consent was provided, and anonymity was maintained without interaction during answering the questionnaires (Reguant & Torrado, 2016).

For the development of this phase, two groups of actors were involved: Group No.1 includes actors that participate in top-down planning processes, including public administrators, heads of planning, heads of units, among others; Group No.2 engages actors that participate in bottom-up NBS advocacy, including users, community leaders, and NGOs, among others. All actors are connected through their influence and relatedness to cases studied by the life labs. In both regions, the Delphi method was used and adapted. This tool facilitates collecting and analysing pertinent information from different stakeholders by using

an iterative sequence of standardized questionnaires and feedback to gather a contextual understanding of NBS within the municipality.

In CELAC, interviews and a survey were conducted. A total of 24 questionnaires and 24 interviews were completed by these actors and distributed as follows:

Table 1. Number of participants in CELAC interviews.

City	Delphi method	Interviews
Bogotá	6	7
Buenos Aires	2	11
Santiago	9	1 group interview with 11 participants
São Paulo	7	5
Total	24	34

The pandemic conditions limited the number of actors. However, the composition of the groups reached a sufficient level of representativeness. Similarly, the Delphi method was restricted to two rounds due to these conditions. After each survey round concluded, opinions and perceptions were summarized and handed back to the interviews by email. After the final round, a feedback report describing the results was sent to participants in each city. Details of the methodology can be found within the Annexes.

However, in Europe, the Delphi methodology proved not to be the most suitable methodology for this task. In the EU, the participatory workshops' method was firstly applied in Turin city with the Valdocco Vivibile Life Lab, on 26th of May and 15th of July 2021, also restricted to two rounds. Activities impaired by the current COVID-19 situation proved very difficult to coordinate with partners and participants and vastly time-consuming while not delivering a clear vision of integration. During the workshop sessions, discussions instead moved to the main ideas behind the life labs, and the robustness of the information regarding integration was very low. Due to such perceived challenges, a contingency plan was put into place, and a different approach was trialled. Consequently, expert interviews following a Problem-Centred approach (Witzel, 2000; Witzel and Reiter, 2012) were conducted. Problem-cantered Interview (PCI) is a qualitative discursive-dialogic interview technique of collecting, reconstructing and validating knowledge about a relevant problem from the interviewed participants' perspective. It aims to embrace the available social scientific understanding of the researcher, while encouraging the subject's perspective and enabling the chance to discover novel aspects of particular difficulties. It uses the researcher's prior knowledge to design the research questionnaire. It acknowledges the respondent as a competent and self-reflective partner who can also interpret and clarify knowledge from the researcher. Likewise, it enables a collaborative relationship between interviewer and interviewee, so, between prior

theoretical knowledge and practical experience, it provides a chance for interactive interpretation and co-production of knowledge.

Throughout the literature review, four main stakeholder clusters relevant to NBS integration into the planning process have been identified: public sector, private sector (practitioners & businesses), research, and third sector and civil society, and defined as target groups**.** It was attempted to conduct expert interviews with actors from the two groups mentioned above (Group 1 & 2). One expert per each cluster of the single LL was interviewed. Representatives of civil society here are considered experts of the community in practice. However, due to the early state of Life Labs' development, an interview with all clusters was not always possible. The exercise was also repeated with key stakeholders of Turin to fill knowledge gaps left by the workshops.

According to the interviewee's preference, the interviews were conducted in Portuguese, Spanish, Italian or English. Interviewees were selected based on their 1) involvement with NBS or similar activity (i.e., urban forest, urban agriculture, green infrastructure); 2) involvement with the municipality (internal or external to it); 3) involvement with CONEXUS, and 4) availability.

Table 2. Number of participants in EU interviews.

City	Expert Interviews	Cluster Interviewed
Lisbon	4	Public sector, Research & Civil Society
Barcelona	2	Public sector & Research
Turin	3	Public sector & Research
Total	9	3 out of 4

2.3 Prospect Analysis

In CELAC cities, the Micmac method was applied for the analysis and identification of key factors. The Micmac (Multiplication Cross Impact Matrix Applied to a Classification) is a method developed by Godet (1993, 2000, 2001), which allows the identification and classification of the main variables that affect the evolution of a social system, in this case, the governance and planning of NBS, and the relationships between these variables. The method was conducted based on the qualitative data previously collected. In the CELAC cities, after the set of variables were collected, a focus group was carried out with the participation of local actors linked to different sectors (N=7) to complement the methodology and validate the results.

A double-entry matrix was then used to evaluate the relationships between the variables using their level of influence on a scale of 0 to 3. The matrix was assessed using the Micmac software to identify each variable's level of power and dependence on the planning systems

and classify them into four categories: driving, volatile, regulating, and levers. The Micmac analysis provides a graph named Plane of Influence and Dependence of the study system variables that reflect the location of the mentioned categories.

The results obtained are presented in terms of developing the central component of the prospective method, called cross-impact analysis (Micmac). This component identifies and exposes the variables that influence the planning process of the NBS in the cities studied, and that should be directly considered in the short term to mark the course of the desired trajectories. From the analysis of the variables, it is also possible to identify some salient relationships between specific variables. This aspect is particularly important to identify underlying causes that are not always transparent or visible to local actors.

2.4 Situational Assessment

To conclude, a situational assessment was conducted to gather, analyse, and synthesize the data collected. For this assessment**,** the SWOT Analysis method was chosen for the two regions, allowing us to understand and compare the different challenges that are being faced by the NBS planning process, and the ones which initiate the construction of an enabling environment, vital for the promotion and development of NBS in the EU and CELAC cities.

3. EU Cities

Evidence from Lisbon, Barcelona, and Turin.

This section discourses on the three European case studies of CONEXUS, Lisbon, Barcelona, and Turin. It presents the research conducted, the results found, and discussions emerging from the three cities and their Life Labs.

3.1 Where we are

Different cities have different backgrounds, different histories, different geographies, physical and spatial arrangements, climates, societies, and mindsets and as such follow different pathways when planning. In order to comprehend the state and ways of integration within the NBS planning process in the municipalities studied, it is necessary to understand the motivations, needs, and desires that drive their NBS agenda and where it stands. Based on the official documents revised, this section is aimed at providing a brief understanding of the municipalities' intentions and visions of and towards NBS.

Lisbon

Going against the urbanisation trend happening worldwide, Lisbon's population had been declining for the last four decades (INE, 2016a; INE, 2016b). Driven by car-centric policies that favoured urban sprawl and migration to Lisbon's metropolitan area, the city's municipal development left a deficit on the public transportation systems, and with the decline of its historical city centre, the city lost almost a third of its inhabitants (Santos et al., 2015). The city's population went from over 800,000 inhabitants in 1981 to around 500,000 in 2016 (INE, 2016a; INE, 2016b).

This process brought the city's economy, quality of life and its population wellbeing to a risk, leading to an in-depth review of the city's development model in the early 2000s (Observatório de Luta Contra a Pobreza na Cidade de Lisboa, 2018). Since 2005, the city's administration radically shifted its urban development approach towards a more people-centric urban regeneration. The city's quality of life became a major priority in its urban agenda. Along with pedestrian mobility, improved air quality, reduction of car traffic and public spaces, green infrastructure and nature-based solutions emerged as an important measure to increase urban wellbeing and the city's resilience to climate change. Following the vision of the agronomist Gonçalo Ribeiro Telles, the city aims towards an integrated approach, which conceives the city as an ecological and social organism. A large first step for the city was the implementation of the green infrastructure in its Master Plan. "By completing the Lisbon Green Plan, including the creation of a green corridor, it promoted the integration of the city's historical, cultural and landscape heritage" (Lisbon municipal archives, 2021).

Today, the city vision focuses on **“**making Lisbon one of the world's greatest cities to live in**”** (Municipality of Lisbon, 2021), and holds the improvement of its built and natural environment as a key point in its development. The city aims to reinforce the articulation with

the metropolitan ecological network, with the sustainability of the city and the re-naturalisation of its landscape as a central objective. There is an increasing willingness towards taking the necessary steps to making Lisbon a green and sustainable city. The city aims to become an example of green and sustainable governance in Europe and abroad. In 2020, Lisbon was awarded the *European Green Capital award* for its environmental sustainability strategy, and it was the first European Capital to acquire the *Sustainable Forest Management Certification* for the management of its Monsanto Park (Municipality of Lisbon, 2021).

The city administration has been implementing and promoting nature-based solutions through a diverse range of projects, programs and strategies that not only directly enhance the city's green area, but also raise awareness about the importance of nature-based solutions and the environmental, social, and economic benefits they can provide. Lisbon has committed itself to achieve 350 ha of green areas built and open to the public by 2022 (totalling 25% of the city territory), to hold plantations of at least 25,000 trees and shrubs every year, to enable 90% of the population to live within 300 m of a green space (of at least 2000 m^2) and to increase by 75% the area of biodiverse dry grasslands by 2030 (Municipality of Lisbon, 2020).

Amid this scenario, Lisbon's Life Lab, *Lisgreen,* is created by CONEXUS to simultaneously trial three NBS in the macro, meso, and microscales focused on ecological connectivity and social integration. Lisgreen is co-led by the Municipality of Lisbon (CML) and the Institute of Social Sciences/University of Lisbon (UdL) as a consortium representing local and regional governmental organizations, research institutes and civic organizations. It is composed of two pilot projects *Ruas Verdes+* and *RENATURA*, in the microscale, the municipal Eastern Green Corridor in the meso, and the municipality metropolitan area (LMA) in the macro. The city's Life Lab aims to "to improve city-region resilience and quality of life (food supply, water supply, biodiversity, cultural values, health benefits, economic costs, waste treatment, climate adaptation) and capture the importance of urban ecosystem services at neighbourhood scale through cost-effective NBS implementation to support decision-making, to inform urban planning, landscape management and governance and to provide feasible practical examples for upper scale" (Lisgreen Action Plan, 2021, p.8). At the time of this study, initial workshops, with the municipality and local stakeholders, for defining the Life Lab's shared visions were to take place.

Barcelona

Barcelona is a compact city, with a high residential density, a structural deficit of green spaces and mobility that is excessively dependent on motorized vehicles. The deficit of green space per inhabitant is evident when looking at its distribution: if considering the Collserola Natural Park (that represents almost 50% of the city's green infrastructure surface), it is 17.7 m^2 per inhabitant, but when excluding the park, this value falls to 7 m^2 of green space per city resident, quite below the European average of 18.2 m^2 (Ayuntamiento de Barcelona, 2021).

In this context, urban greenery is seen as a key point to move towards a new urban model for a healthy, natural, and liveable city by the municipality. The city declares the need for more greenery and a change in perspective about greenery, combined with a new sense

of joint responsibility with citizens (Ayuntamiento de Barcelona, 2021). The strategy to achieve this is based on the idea of a connected network of green spaces, conceived as a green infrastructure forming part and parcel of the city, serving environmental and social functions.

To work towards a more sustainable and resilient city, an urban transformation is being planned (Ayuntamiento de Barcelona, 2021; Ayuntamiento de Barcelona, 2018; Barcelona Superblock Plan), with the focus on increasing green areas, in particular in the less equipped neighbourhoods, to ensure a fair distribution of the ecosystem services and benefits that greenery and biodiversity can provide. The ultimate goal is a change of model, not just for managing urban nature, but also for the city itself. The aim is for greenery to play a more significant part and take a central place in other urban policies that greenery may affect, such as urban planning, mobility, public health, sustainability, social rights, and culture.

Moving in this direction, the Barcelona City Council is promoting the creation of new green areas and improving their distribution throughout neighbourhoods, to strengthen the nodes and subnodes of a new green network and to increase accessibility to green spaces for everyone. Furthermore, numerous other strategies in the direction of nature-based solutions for increasing greenery in the city that go beyond new green spaces are being implemented. Examples include improving the city's current greenery and extending it to spaces so far never considered for such purposes, as well as superblocks and initiatives in the citizens' sphere that help to green up the city, such as green roofs, walls, and balconies, or the strengthening of urban agriculture.

Barcelona's Life Lab, called *Urban Allotment Observatory*, has as its main objective to link urban agriculture and green infrastructures of the city. In fact, Barcelona has an articulated network of urban allotments, but there is no proper coordination and sharing of experiences. For this reason, the Life Lab aims to generate a community of learning to share knowledge, improve techniques, exchange plants, and implement NBS to increase biodiversity. The Barcelona Life Lab consists of 3 pilots, each of them focusing on a different action: Pilot 1. *Naturalising places. Monitoring naturalisation,* with the aim of identifying and characterizing the existing green infrastructure in the city and to plan its expansion and amelioration; Pilot 2. *Monitoring urban allotments. Social issues and ecosystem services,* aiming to describe the existing urban allotments, their characteristics, and the social, environmental and ecosystem benefits that they provide, through the creation of indicators, with the final objective of constructing a website for interaction and collaboration; Pilot 3. *Monitoring pollutants in urban allotments,* to fill the gap about risks for users' health due to contaminations derived from the urban environment.

Turin

Turin's historical urban development, mainly developed from the mid-1500s to the 1800s, influences the actual asset of the entire central city, which has strong limitations to adapt the urban core to modern challenges and to develop new infrastructures. At the same time, the incontrovertible growth of industry in the 20th century was the driver of further rapid expansion of the city and a massive influx of migration in only a few decades. It led to an unprecedented

scale of greenfield loss and created major social tensions as new residents struggled to integrate into the local sociocultural fabric. As the industrial hey-day came to a rapid demise, huge swaths of the city were abandoned by fleeing industry and population decline. The challenges generated by these economic and social transformations were immense: the loss of a quarter of the city's population and a demographic shift to an older, aging population, as well as a huge abandoned industrial space in need of remediation. And yet, Turin has made great strides reinventing and revitalizing itself over the past two decades.

Presently, Turin is still considered one of the Italian cities with the highest per capita availability of usable urban green spaces (20 m^2 per inhabitant, above the European average). The city has about 37% of its surface green and one of the greatest endowments of urban "historic green", a category that includes monumental trees, gardens, and parks that have artistic, historical, cultural, and landscape significance. Turin is surrounded by the Alps and flanked by hills. Its geographical localization is further characterized by the presence of four rivers, constituting important ecological corridors in the urban area.

Based on these privileged characteristics, the City Council acknowledges its ecological importance and defines strategies for greenery's enhancement (Piano Strategico dell'Infrastruttura Verde, 2020), for the increase of biodiversity and ecological connectivity, and for the quantification and strengthening of ecosystem services, necessary to cope with the critical factors of its environmental quality. The city has 1823 ha of municipally owned open spaces with a bit over 1600 ha used as recreational green spaces, 189 ha for urban agriculture and 32 ha of urban forests. According to the municipality, 93% of residents already live within 300 m of a recreational green space, but it is among its objectives to improve it (Valdocco Vivibile Action Plan, 2021; *Piano Strategico dell'Infrastruttura Verde, 2020*).

The city aims to build a more resilient, sustainable and liveable urban environment. It envisions a city that puts the well-being of its neighbourhoods and citizens, and an unparalleled quality of life in equilibrium with their environmental systems, at the centre of the future city (Municipality of Turin, 2021). The city's development plans place a significant emphasis on the urban environment, the green infrastructure of the city, and the promotion of a new, more circular economy towards an ecological transition (ibid). The city focuses on innovation of governance and management of public greenery and tree heritage alongside public and private partnerships, paying attention to the social function and to the participation that green spaces require, as well as to the safety of citizens and the management of emergencies.

Turin's Life Lab, *Valdocco Vivibile*, is composed of a NBS pilot focused on contrasting climate vulnerabilities with the goal of building the Valdocco area as a more liveable district. It is a single small-scale pilot but one that is defined as a "test site" for the implementation of the new environmental policies of the City playing a significant role within the municipality. It aims "to develop a dissemination and communication program on the City's strategies for climate change adaptation" (Valdocco Vivibile, 2021, p.7). The Life Lab then works towards interventions with high replicability and multifunctional benefits of design and ecosystem

services while focusing on communication and awareness raising. The activities of Valdocco Vivibile were initiated with engagement of local schools.

3.2 The process of NBS Integration

NBS governance spans across different scales and dimensions of planning. Planning and governance structures are complex, they can take a variety of forms and shapes, and often the absence of integration across urban governance both horizontally (between sectors) and vertically (among policy levels) is a strong barrier to the development of NBS. This section aims to assess the NBS governance process in place in the three cities, and their integration.

3.2.1 Official lines and domains of NBS governance

Lisbon

According to the city's governance structure, the strategies and plans towards NBS in the city of Lisbon are implemented by a set of municipal directories. The most influential sector for NBS planning is the mayor, followed by the directorates of Green Structure and Energy, and the Urban Planning and Urban Renovation.

The mayor's office is responsible for setting Lisbon's Government Program 2017-2021, that refers to the international and national agendas that the city has taken part of and determines the desired priority axis of development by the municipality (Lisbon's Government Program 2017-2021). The improvement of quality of life and urban environment is the number one priority in the plan. The program plans to strengthen the city's green structure and reinforce and articulate the metropolitan ecological network. It aims to consolidate and expand the city's green corridors, connect its green infrastructure, redevelop its public green spaces, increase the city's green cover through tree plantations, promote urban agriculture through the opening of new sites, monitor the city's urban forest, and utilize Nature-Based Solutions for water management and soil amelioration. The plan sets NBS as a key factor of Lisbon's urban development and sets grounds for a multifunctional incorporation of NBS by different municipal sectors.

The Urban Planning and Urban Renovation Directorate is the responsible body for the Master Plan strategy and management, including monitoring of strategic areas such as mobility, urban renovation and public space, as well as other territorial regulations and neighbourhood and urbanisation plans. There are currently nine active urbanisation plans, and twenty-nine active detail plans, all guided and regulated by the municipal master plan. The Municipal Master Plan (*Plano Diretor Municipal*) is the first regulation of the city's NBS planning. Approved since 2012 and reviewed every 2 years, the Master Plan comprises Lisbon's Green Plan (*Plano Verde*) that defines the most sensitive ecological areas, safeguards protection measures, promotes ecological sustainability, identifies priority areas for biodiversity, green public spaces and the creation of a continuous green structure based on the municipal green macro-corridors. The plan addresses the strengthening and

improvement of the city's Hydrological System, through the implementation of Retention Basins, permeable areas (green and paved), rainwater capture and storage in buildings, soil requalification; the increase of green spaces with minimal irrigation required and native species; and the incorporation of Urban Agriculture pockets with increase of "in situ" composting, and growing policies. It determines the creation of a treated water network for washing streets and irrigating green spaces, the usage of monitoring systems to regulate water needs for green spaces, and defines the creation of conditions for pedestrian and bicycle circulation in the city, in articulation with public transport and green spaces.

The regulations for public green spaces and streets from the Urban Planning Directory are further detailed by the Guide of Public Space 2018 (*Lisboa O Desenho da Rua - Manual do Espaço Urbano*) which has a specific session on streets and public space arborisation, addressing concepts of diversity, both aesthetic and ecological, and focuses on the balance of the built environment with pre-existing natural systems. Its greening objectives are in line with and refers to the city's master plan aims of increasing canopy cover in existing and new public spaces; improving species integration; protecting existing canopy cover; creating new street trees lanes when possible; preventing/mitigating tree disservices; and reducing maintenance effort and cost. The guide indicates the design elements necessary to keep in mind when incorporating trees in the urban environment. It provides guidelines on tree sizes and necessary above and underground dimensions, recommends local species (with pros and cons), suggested urban equipment, regulations for transplanting and cutting down trees as well as guides for green walls and rooftops, being an important document of external actors' capacity building. Yet under the jurisdiction of the Urban Planning and Urban Renovation Directorate, the Strategic Plan for Urban Development (*Plano Estratégico de Desenvolvimento Urbano do Município de Lisboa*), developed in 2015, also briefly touches upon the need for a more equal distribution of green spaces in the city and bring it as a measure towards the city's urban regeneration.

The Green Structure and Energy Directorate, the main body responsible for environmental strategies, focuses on strategic programs including green infrastructure implementation, energy and water efficiency, and it is responsible for the biodiversity strategy and action plan, climate action strategy, and the city's drainage action plan. The Biodiversity in the City of Lisbon: a strategy for 2020 (*Biodiversidade na Cidade de Lisboa: uma estratégia para 2020*) compiles the information on Biodiversity in Lisbon, and characterizes the situation of reference, setting the pathway for what is intended to evolve culminating in the Biodiversity Local Action Plan. The Biodiversity Local Action Plan (*Plano de Ação Local para a Biodiversidade em Lisboa*) puts into action the vision of the municipal strategy. It promotes a range of NBS solutions to tackle floods, drought, urban heat waves and above all increase biodiversity. Several sectoral programmes play a role in this, including the Urban Allotment Garden agenda, a bicycle and pedestrian network, and an adapted water design program. It aims to increase the city's biodiversity by 20%, and works to create a biodiverse connection within the city and with other municipalities, eliminating any possible existing barriers, and to increase the number, quality and diversity of green spaces in the city prioritizing indigenous species. The action plan counts with activities of awareness raising, education and

implementation as well as indicators for the monitoring of the plan's progress and impact. It establishes paths, panels and information for publishing about biodiversity values in Lisbon and aims to include Biodiversity in the municipal governance structure in a participatory manner. The Biodiversity strategy and action plan further generate the Biodiversity Indicators Framework and the monitoring tools.

Lisbon's Strategy for Adaptation to Climate Changes 2017 (*Estratégia de Adaptação às Alterações Climáticas*) adopts a comprehensive and green development approach. It brings ecological systems as one of the city's vital structures of territorial development and adaptation toward climate change. The action plan aims to adapt the management of green infrastructure towards resilience of high temperatures and droughts, to increase the presence of green spaces and green infrastructure in the most urbanized areas of the city, to connect green infrastructure to clean ways of mobility, such as cycling, and utilize green infrastructure to improve the city's water cycle. It identifies vulnerable areas within the city and provides a broad understanding of existing territorial management instruments towards NBS and how they can be integrated into the city's urban planning. The plan highlights and references the city's master plan and the Biodiversity plan, reinforcing the need for urban green spaces to not be seen as an isolated structure, but a fundamental and multifunctional part of the city and connected to a broader ecological system. It also sheds light on the impact that climate change can provoke on nature-based solutions and addresses the issue of implementing NBS that are resilient to said changes.

This strategy was the city's response to its subscription to the Covenant of Mayors for Climate and Energy in 2008/2009[1], the Mayor's Adapt in 2014[2], the Compact of Mayors in 2015[3] and the C40 Cities Climate Leadership Network[4] in 2019, in which Lisbon committed to reduce its CO_2 emission by 60% in 2030 and to be carbon-neutral by 2050. The city's response is further translated into the development of its Action Plan for Sustainable Energy and Climate 2018, Sustainable Energy and Climate Action Plan 2018, and an Action Plan towards municipal Adaptation to Climate Change, that is currently under process of approval. In light of Lisbon's international pledges and its European Green Capital nomination, the city has also developed a Green Commitment (*Compromisso Verde*) as a challenge to the city, public and private companies, organizations, associations, and institutions, to assume an ambitious agenda which includes achieving 350 ha of green areas built and open to the public by 2022 (totalling 25% of the city territory), holding plantations of at least 25,000 trees and shrubs every year, enabling 90% of the population to live within 300 m of a green space and to increase to 75% the area of biodiverse dry grasslands by 2030.

The Green Structure and Energy Directorate have also developed the Drainage Action Plan 2016-2030 (*Plano Geral de Drenagem de Lisboa 2016-2030*), driven by the concern of

[1] A European initiative to achieve and exceed the EU climate and energy targets.
[2] A sister initiative of the Covenant of Mayors that focuses on Climate Change Adaptation.
[3] Covenant of Mayors' global effort to pledge to reduce greenhouse gas emissions beyond their own national climate and energy objectives.
[4] C40 is a network of mayors of nearly 100 world-leading cities collaborating to deliver the urgent action needed right now to confront the climate crisis (C40, 2021).

developing an integrated solution for flood control for the city, with a set of structured drainage infrastructures that would prepare it for the challenges of the 21st century. The goal is to minimize the social and environmental impacts of floods, integrating the actions foreseen in this plan with the city's development as recommended in the Municipal Master Plan, with the climate adaptation policies and with the actions foreseen in other programs developed by the city, such as the One Square in Every Neighbourhood Programme, also part of Lisbon's Government Program. There is a close interrelationship between the Drainage Action Plan and all municipal planning tools that interact with all “NBS” water design solutions. The plan envisions the usage of recycled water for maintenance of NBS, at the same that it envisions NBS for management of rainwater runoff and the reduction of the damage to the city’s ecosystem and green areas. The municipality, under the Green Structure and Energy Directorate, also presents a Municipal Regulation of Lisbon's Forest (*Regulamento Municipal do Arvoredo de Lisboa*) 2012, Lisbon Tree Planting Project and a Forest Management Plan of the Monsanto Forest Park 2020 (*Plano de Gestão Florestal do Parque Florestal de Monsanto*), that defines the Monsanto Forest as "model forest' of Lisbon Metropolitan area, constituting it a "model NBS". A sustainable, biodiverse, biologically balanced, stable and resilient forest that serves as a multifunctional tool for the city, acting as a recreation space, environmental sensitization tool, nature-city and city-regional connection.

The Directorate of Mobility, responsible for the city’s mobility plans and strategies, is also a major actor on NBS planning. Although there is room for many conflicts between NBS and transportation systems, the latest version of the city's mobility vision, Move Lisbon, Strategic Vision for mobility 2030 (*Move Lisboa, Visão Estratégica para a mobilidade*) connects those two municipal infrastructures. The vision aims to consolidate a structured, continuous, safe, and functional cycling network that connects residential areas, large infrastructures, business districts, green and leisure zones, combining with tree plantation next to the pedestrian and bike routes in order to improve its attractiveness, comfort, and shading. However, in Lisbon's Pedestrian Accessibility Plan (*Plano de Acessibilidade Pedonal*) that aims to improve the pedestrian accessibility and experience in the city, improvement of pedestrian accessibility to and inside parks is foreseen, but street trees are mainly addressed as possible obstacles and barriers for pedestrians’ accessibility.

Lisbon's NBS planning and implementation is still influenced by the Urban Waste and Fleet Directorate**,** responsible for the municipal waste management and strategy, including recycled water, collection and recycling of green waste, and the Municipal Directorate of Urban Hygiene. The Municipal Waste Management Plan, 2015-2020**,** (*Plano Municipal de Gestão de Resíduos do Município de Lisboa 2015-2020*) implements home/community composting of organic waste in municipal green spaces and strengthens the use of composting in municipal urban gardens. It also collects and composts green waste from municipal and private green areas and promotes its valorisation in municipal parks — aiming to promote the shredding and reuse of tree branches and leaves from the thinning of trees and shrubs, using them on site for the improvement of local soil quality. This procedure is currently done in the Monsanto Park, and it is projected to be scaled up to other parks. The plan makes the consideration that

the lack of a biomechanical treatment installation makes the maximum use of the organic valorisation potential and the recyclable streams difficult.

NBS planning and implementation still further involves, to a smaller extent, the:

- Social Rights Directorate - strongly integrated with the public space team (Urban planning directorate) and involved in the Pedestrian Accessibility Plan.
- Financial Directorate - managing a wide range of commercial areas related to start-ups and smart-cities business and has been working particularly on Green Public Procurement and Environmental upgrade skills as well as the city participatory budget program that has been financing several NBS projects.
- Economy and innovation directorate - responsible for circular economy and innovation.
- Municipal Housing Directorate - ahead of the city's housing infrastructure and demands.
- Civil Protection and Safety Directorate - acts on hazard control and mobility inspection and monitoring, including in green spaces.
- Maintenance and Service Directorate - responsible for the maintenance of specific services, such as public lighting.

The directorates can count on the assistance or the collaboration of the municipal companies, such as the Municipal Company of Transport and Parking of Lisbon (EMEL), responsible for mobility services such as parking and bike-sharing, the Public Transportation Company of Lisbon (CARRIS), the Portuguese Company for Lisbon's Water (EPAL) and Lisbon e-nova, Lisbon agency for energy and environment. For instance, the Energy-Environmental Strategy for Lisbon 2008 (*Estratégia Energético-Ambiental para Lisboa*), developed by Lisbon e-nova, that aims to reduce energy consumption, water consumption and loss, and the demand and consumption of non-integrable in the Technosphere and biosphere, touches upon NBS in the form of green spaces, as a buffer for noise pollution, and as recipient for the usage of recycled water. The agency also collaborated with the municipal directories to create the municipal Biodiversity Strategy for 2020.

On a national level, the city's NBS planning structure is supported by the National Strategy for Sustainable Cities 2020 (*Estratégia Nacional para Cidades Sustentáveis*), a national proposal, applicable at the local level, towards a more sustainable future of Portuguese cities. It articulates four proposals for strategic themes of intervention in which NBS is integrated in their second priority theme Sustainability and Efficiency, addressing ecosystem balance, improvement of biodiversity, urban microclimate, urban-rural interlinkages, and natural resources.

The National Strategy for Climate Change Adaptation 2020 (*Estratégia Nacional de Adaptação às Alterações Climáticas*), extended up to 2025, developed by the National Environmental Agency also establishes objectives and a model for implementing solutions for adapting different sectors to the effects of climate change including: agriculture, biodiversity, economy, energy, forests, human health, safety of people and goods, transport, communications, and coastal zones. The strategy integrates measures from the National

Strategy for Sustainable Cities, National Strategy for Forests, and other plans. Sustainable cities is one of the priority areas identified and one for which an integrated approach among sectors and spatial regions (rural-urban, region and cross-cities) is incentivized. The strategy aims to promote urban agriculture, increase, improve and integrate urban green spaces, potentializing its role as carbon sinks and urban microclimate regulators.

Regionally, Lisbon Metropolitan Climate Change Adaptation Plan (*Plano Metropolitano de Adaptação às Alterações Climáticas*), stimulates Lisbon's NBS agenda in the metropolitan level. It envisions a territory where agriculture and forests are an essential pillar of a sustainable and durable metropolitan model of development, where the promoted agricultural, forestry and agri-food production systems are increasingly resilient and adapted to the projected climate variability and prepared for the management of its indigenous biodiversity, towards the protection and conservation of biodiversity and landscape, and the ecosystem services provided. It promotes the use of indigenous plants, that are less water demanding and more adapted to climate variability for green urban spaces, the establishment of urban green infrastructure to facilitate urban drainage, and the establishment of a metropolitan network of green infrastructure and a network of green and blue corridors, reflecting Lisbon's ambition of connected ecological systems. Lisbon's Regional Action Plan, which is currently under revision, follows similar principles with the promotion of green infrastructure, valorisation of ecological connectivity and biodiversity already being integral part of its objectives.

Additionally, the city responds to the Urban agenda for the EU, 2016, in order to stimulate growth, liveability, and innovation in the cities of Europe, in particular the Malta Partnership that directly addresses sustainable use of land and nature-based solutions. Lisbon's strategy and plans further refer to the EU Green Deal, the UN Habitat New Urban Agenda, the Aichi-Nagoya Declaration on Education for Sustainable Development, the achievement of the UN Sustainable Development Goals (SDGs), Kyoto Protocol and Paris Agreement.

Barcelona

The governance structure of the city of Barcelona is peculiar: there are different thematic areas of policy where plans, documents and processes are developed. The strategies and plans towards NBS are coordinated by the Ecology, Urban Planning, Infrastructures and Mobility Area *(Área de Ecología, Urbanismo, Infraestructuras y Movilidad)* of the Municipal Council, which covers a wide range of sectors that deal with sustainability and resilience of the city. Actions and programmes fostered by this Area are, on the one hand, influenced by international agreements and directories, and, on the other hand, are based on municipal intentions, trying to consider citizens' needs and requests.

Barcelona intends to have an extra 1 m² of greenery per resident by 2030. This is equivalent to 160 hectares of new green spaces. This expected achievement is one of the main points of the Barcelona Climate Plan 2018-2030 (*Plan Clima 2018-2030*), together with the reduction of GHG emissions by 45% per capita and the reduction of transport by private motor vehicle by 20%. In particular, the Climate Plan focuses on four aspects: mitigation, adaptation and resilience, climate justice and promoting citizens' action. The greenery

increase per resident is part of the adaptation and resilience focus, as a way to prepare the city so that it will be less vulnerable to climate change. This plan is once more the result of municipal subscription to the Covenant of Mayors for Climate and Energy in 2008/2009, the Covenant of Mayors on Adaptation in 2014, the Paris Agreement[5] in 2015, the Covenant of Mayors for Climate and Energy in 2017 and the Global Covenant of Mayors for Climate and Energy in 2017. Furthermore, since July 2021, the mayor of Barcelona, has been elected as Vice Chair of the C40 Steering Committee, the governing body providing strategic direction for the global network of 97 cities committed to addressing the climate crisis. In the C40 cities context, Barcelona is included in the 9 cities that are being supported to deliver action to simultaneously address the connected issues of climate change, inequality, social justice and access to decent jobs. These innovative approaches and policies, which will be tailored for the specific context of each city, will help deliver local inclusive climate action and inspire other cities. Furthermore, Barcelona responds to the New Urban Agenda of the United Nations in its implementation of a well-planned and well-managed (new) sustainable city.

The Barcelona Climate Plan, with its goal of "increasing urban greenery by 1m^2 per current resident by 2030, adapting the city more powerfully to the possible effects of climate change", on one side, come in response to municipal pledges such as the Citizen Commitment to Sustainability for 2012-22 (*Compromiso Ciudadano por la Sostenibilidad 2002-2012*), which promotes the "re-naturalisation of the city", and, on the other side, dialogues directly with the objectives and goals of urban green infrastructures planning. In fact, going in this direction, the City Council has established its Programme for Promoting Urban Green Infrastructures (*Green-Infrastructures Impetus Plan, 2017*), a government measure aiming to improve the quality of life for citizens by increasing greenery in the city. This Programme has been integrated in a new plan called Pla Natura Barcelona 2021-2030, which defines municipal government and citizens' commitments for urban green infrastructure increase, biological diversity conservation and urban nature recovery. These measures are the materialization of the previous Greenery and Biodiversity Plan 2012-2020 (*Plan del Verde y de la Biodiversidad de Barcelona 2012-2020)*, under which the City Council established its goal to "achieve a green infrastructure that offers maximum ecosystem services in a city where nature and town interact and strengthen one another", responding to the EU Biodiversity Strategy for 2020 and the strategies laid out by the UN by means of the Aichi Biodiversity targets[6].

The Pla Natura Barcelona 2021-2030 is organized into three strategy areas, with two cross-cutting themes. The first strategy area is geared towards more greenery and biodiversity. This should mainly be achieved by planning how to boost vegetation in the city, taking into account an equal distribution in different areas, strengthening the green infrastructure and its connectivity, particularly with green spaces in the metropolitan area: Collserola and the riverbeds of the Llobregat and the Besòs. It also states that it is essential

[5] The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016.
[6] Targets developed in the Strategic Plan for Biodiversity 2011-2020, in the frame of the UN Convention on Biological Diversity.

to identify areas with a deficit of greenery and plan actions there, as well as to introduce greenery in spaces such as rooftops, walls, interior courtyards and streets. The second strategy area refers to the conservation and improvement of greenery and biodiversity, moving towards a green management and the promotion of more natural spaces: sustainable use of resources and protection of natural heritage and the environment, that, in turn, address people's health. The idea behind making green spaces in the city more natural is also to favour the spontaneous appearance of flora and fauna. The third strategy area refers to the importance of working on the city's greenery with the public. Barcelona embraces and facilitates citizen initiatives and makes specific proposals so that local people, organizations, businesses and administrations can play an active role in promoting and conserving urban biodiversity and get involved in managing and improving it.

From another point of view, the Greenery and Biodiversity Plan for 2020 already foresaw how the city urban gardens and allotments could contribute to biodiversity, supporting the "promotion of ecological agriculture in urban and peri-urban spaces" and the "design of a shared community-managed allotments and gardens programme". Moreover, the Programme for Promoting Urban Green Infrastructures was already including initiatives such as creating school and community allotments and gardens, involving users or organizations in municipal allotments, promoting ecological agriculture in urban and peri-urban spaces and vacant lots, and promoting allotments, balconies, terraces, roof terraces, green covers, walls and gardened courtyards. In this context, the current Urban Agriculture Strategy 2019-2030 (*Estrategia de agricultura urbana 2019-2030*) is a tool for planning the initiatives needed to improve and increase agricultural land areas in the city under an agroecological model**.** Urban allotments and gardens are intended to maximize environmental and social services and increase the presence of nature in the city for the benefit of the people and biodiversity conservation. The vision for 10 years from now is one of an ecological, healthy and resilient city, whose citizens are involved in the management of its allotments, promoting agroecology and food sovereignty.

Another important action at the municipal level is the Tree Master Plan for Barcelona 2017-2037 (*Arboles para vivir – Plan director del arbolado de Barcelona 2017-2037*), which aims for a tree-covered area constituting a real green infrastructure and reaching the maximum endowment and connectivity with the surroundings (urban and natural). This would be possible through the provision of a biodiverse, healthy, protected, and safe tree-covered area with an efficient and sustainable management to obtain the maximum environmental, social and economic services of trees and to provide a tool for global change adaptation through an adapted and resilient tree-covered area. The quantity and quality of trees, and their role as part of the city's green infrastructure, are significant factors for the city's sustainability: a strategy of adapting and anticipating change is needed to guide municipal action in planning and managing all the trees in the city. The city's tree biomass is a universal natural resource that connects people with urban nature and provides the current and future generations with health and a habitable space thanks to its environmental, social, and landscaping aspects. Conservation of this heritage is driven by Barcelona City Council by involving everyone, both the public and private sectors, as well as organizations and the general public. The Tree

Master Plan is supposed to increase 5% of tree-covered area in the city, reaching 30% of urban tree-covered surface; to guarantee that, within the urban context, 40% of tree species will be climate-change adapted, instead of the actual 30%; and to reach a biodiverse tree heritage, with no tree species representing more than 15% of the total.

The **"**Hands on the green" Programme 2020-2023 (*Programa "Mans al verd"*) encompasses all initiatives for the involvement of citizens and social agents of Barcelona in the care of the green spaces of the city. It aims, on the one hand, to encourage citizens to take the initiative by cultivating public or private spaces and empowering themselves on this subject and, on the other hand, to promote more green spaces that contribute to the good health and well-being of men, women, people and biodiversity, in the framework of a model of collaborative management of public spaces.

Still in the municipal framework, the Barcelona Superblock Plan (*Pla Superilla*) is a transformational plan proposed by the City Council to make daily life the central concern of the city, bringing cohesion to neighbourhoods, and driving the ecological transition, including the implementation of NBS for these purposes. The Plan intends to become the street transformation model for the entire city, through the reclaiming for citizens of part of the space currently occupied by private vehicles. The goal is to create a healthy, greener, fairer and safer public space that promotes social relations and the local economy. Following small-scale initiatives carried out in areas such as Poblenou, Horta and Sant Antoni, Superblocks are now taking a leap in scale and pace. Barcelona City Council has conducted a detailed analysis of the city: citizen flows and mobility, neighbourhood facilities, green spaces, building and social fabric and so on. It is through this comprehensive approach that a road hierarchy has been created enabling some streets to be freed of road traffic and the creation of a network of green hubs and squares where pedestrians have the priority. This network is helping to create a new map of the city where citizens are the central players.

At the metropolitan level, the Barcelona Metropolitan Area (AMB - *Àrea Metropolitana de Barcelona*) is developing the new Metropolitan Urban Master Plan (PDU - *Plan Director Urbanistico Metropolitano*), which will substitute the previous General Metropolitan Urban Development Plan (PGM - *Plan General Metropolitano de Ordenación Urbana*) and redefine it to adapt to the actual urban, environmental, social and economic needs, as well as to new technological demands. The contents of the Metropolitan Urban Master Plan are being generated in an open, multidisciplinary and cross-cutting process, which makes it possible to build the foundations of urban planning for the future metropolis. The objectives go from improving the efficiency of urban metabolism and minimizing environmental impacts to promoting active and sustainable mobility by rethinking metropolitan infrastructures and fostering social cohesion through housing, public space, facilities and public transport. To analyse what challenges and opportunities emerge from the analysis of the various spaces, actors and flows that make up the metropolis, the plan is articulated in six thematic areas that are complexly interrelated. One of the areas regards the Green Infrastructure, really crucial since most of the metropolitan area is made up of areas with high environmental and social value, such as natural parks, river areas, beaches and agricultural land, as well as urban

parks, squares and streets. The metropolitan green infrastructure is very rich in ecological and landscape terms, and contains more than 60 habitats with a significant area with more than 5,300 species recorded, which provide ecosystem services to improve the environment. Furthermore, the AMB has a Sustainability Plan (*PSAMB 2014-2020*), with the vision of consolidating the AMB as a reference in the implementation of policies with sustainability criteria, strengthening environmental protection, biodiversity and climate change mitigation and adaptation, for a better quality of life for citizens. This plan should become a transversal action plan that integrates in a coordinated way criteria of environmental sustainability in all metropolitan sectoral policies (water, waste, urban planning, mobility, etc.) that are the responsibility of the AMB. In addition, responding to the Paris Agreement endorsed by the EU in 2016, the AMB established its Climate and Energy Plan 2030 (*Plan Clima y Energía 2030*). It constitutes the metropolitan strategy for energy transition and climate change by 2030 in order to move towards carbon neutrality. It promotes the increase and the potentializing of urban greenery and green spaces to improve the urban soil permeability, water cycle and municipal vulnerability to heat islands, as energy efficient measures.

On a regional level, Catalonia has different strategies that contribute (or have contributed) to the NBS planning in the city. The main one is the Natural heritage and biodiversity strategy of Catalonia (*Estratègia del patrimoni natural i de la biodiversitat de Catalunya, 2018-2030*), a strategic planning document that defines the pathway of nature conservation policies in Catalonia until 2030, responding to the EU Biodiversity Strategy for 2030 and the strategies laid out by the UN by means of the Aichi Biodiversity targets. Furthermore, the Catalan adaptation strategy to climate change (*Estratègia catalana d'adaptació al canvi climàtic, ESCACC, 2013-2020*[7]), whose strategic goal is for Catalonia to become a territory less vulnerable to the impacts of climate change, is also connected with the Sustainable development strategy of Catalonia (*Estratègia de desenvolupament sostenible de Catalunya, EDSCAT, 2026*), which guides the evolution of Catalonia towards scenarios of greater social economic and environmental sustainability until 2026. Finally, the city of Barcelona is part of the Cities and Towns Network for Sustainability (*Xarxa de Ciutats i Pobles cap a la Sostenibilitat)*, association of Catalonia's municipalities committed to the environment to move towards sustainable development. It is currently a platform for cooperation and exchange where municipalities find an appropriate framework to discuss their problems, concerns, needs, experiences, and promote and carry out projects of common interest. Its aim is to promote networking between municipalities and partners of the network to improve local environmental management and deepen a model of sustainable development.

On a national level, the city's NBS planning structure is supported by the National Green Infrastructure, Connectivity and Ecological Restoration Strategy 2020-2050 (*Estrategia Nacional de Infraestructura Verde y de la Conectividad y Restauración Ecológica*), directly referring to the EU Biodiversity Strategy for 2030 and explicitly citing NBS as crucial instruments for supporting and developing green infrastructures intended as effective tools

[7] The new Catalan adaptation strategy to climate change 2021-2030 is under development.

that brings ecological, economic and social benefits through natural solutions. Other instances contributing in NBS planning are: the Spanish Strategy for Urban Local Sustainability (EESUL, *Estrategia Española de Sostenibilidad Urbana y Local*), initiative of the Ministry of Transport, Mobility and Urban Agenda, elaborated in 2011 and aiming to serve as a strategic framework that includes principles, objectives, guidelines and measures to progress in the direction of greater urban and local sustainability, without invading competences of the different administrations; the Network of Sustainable Local Development (RdR/DLS, *Red de Redes de Desarrollo Local Sostenible*), established in 2005, under the protection of the Ministry for the Ecological Transition and the Demographic Challenge, which is a forum for debate and exchange of experiences between the different networks at regional and provincial level working for Local Agenda 21. With the purpose of promoting the concept of compact, complex, efficient and socially cohesive cities, considering the appropriate balance between urban and rural environments, the RdR/DLS has developed the Urban Environment Strategy of the Network of Sustainable Local Development (EMAU, *Estrategia de Medio Ambiente Urbano de la Red de Redes de Desarrollo Local Sostenible*). This Strategy, realized with the aim of adapting the Spanish context to the 2006 European Thematic Strategy for Urban Environment, aims to establish guidelines for Spanish towns and cities, and is structured around the thematic areas of the European Strategy (urban planning, building, mobility and urban management), adding a new section dedicated to urban-rural relations.

Additionally, the city of Barcelona is involved in other Horizon2020 European projects regarding Nature-Based Solutions, such as Naturvation (https://naturvation.eu/cities) and UrbanA (https://urban-arena.eu/about/), confirming its commitment with the issue. Finally, Barcelona's strategy and plans further make reference to the EU Green Deal, the UN Habitat New Urban Agenda, and the achievement of the UN Sustainable Development Goals (SDGs).

Turin

Nature Based Solutions in Turin are regulated and controlled first and foremost by the City's Mayor, followed by the Municipal Department of Environment, composed of the offices of Environment Area, Public Green Service, Environmental Policies Service, Animal Protection Office and the Technical Environmental Compliance Service. The Department of Environment is the main responsible body towards NBS development and implementation in the city. It coordinates a variety of green infrastructure, ranging from urban farms to urban wildlife and green cycling system, and is responsible for the city's Climate and Resilience Plan, Strategic Green Infrastructure Plan and Corporate Forest Plan, which were developed in parallel in 2020 through a collaboration of the Environment Area, Public Green Service, Environmental Policies Service Offices and today guide the city's main NBS efforts.

The Climate Resilience Plan 2020 (*Piano di Resilienza Climatica*) looks into the city's climate vulnerabilities, and creates an interdepartmental working group to set short, medium and long-term actions towards improving the city's resilience, in particular towards urban heat island/heat waves and extreme weather events like flooding. NBS is distinctly incorporated in the plan as a major adaptation measure for the city. The plan directly connects urban heat areas with the lack of urban greening and specifies the need to scale up and improve NBS in

the municipality. The plan also analyses the current resiliency of the municipal green infrastructure itself, and defines priority areas for improvement: the management of the evolution of urban ecosystems in the face of new climate scenarios, the development of a culture of climate-proof design in public works and increase in the awareness among its citizens regarding NBS benefits. The resilience plan contains design guidelines for open, green and street landscapes and is intrinsically connected with the Strategic Green Infrastructure Plan.

In view of the rising importance of NBS in urban environments, Turin launched its first Strategic Green Infrastructure Plan 2020 (*Piano Strategico dell'Infrastruttura Verde*)**.** Based on the Turin Greenprint, a very extensive spatial analysis of the city's current green infrastructure with the identification of gaps, needs and implications for the production of new green spaces in the city, the Green Infrastructure Plan covers recreational green spaces, urban gardening and agriculture, ecosystem planning, sustainable management and disaster management. It intends to renew and re-naturalise municipal parks and playgrounds to respond to novel lifestyles, funnel investments into critical areas of high potential use, and ensure universal access by 2030. As a system-wide strategy the plan aims to convert into public spaces all areas designated as such in the city's master plan, beginning with the expansion of river corridors and hillside parks, and maximize the ecological and environmental potential of new green areas. It addresses NBS as a multifunctional infrastructure and tries to promote all its facets. The plan further envisages climate resilient green infrastructure, incorporation of circularity in its design and promotes innovative approaches to NBS through demonstration and research projects and the introduction of new forms of public-private partnership for the strengthening of the green system. It creates room for planned, semi-planned and spontaneous green spaces and community participation with the creation of tools such as an interactive web portal to make its open-space system more accessible to its citizens and facilitate its use.

Although the development of the Strategic Green Infrastructure Plan was led by the municipal Environmental Department, the plan was developed in close collaboration with the municipal services of Mobility, Civil Protection, Tourism and Development. Due to that, the plan represents a comprehensive approach addressing issues such as green tourism and the promotion of green economy, bicycle connections along arterial roads with the system of urban and peri urban parks as well as streetscape, and emergency measures with the identification of green areas potentially suitable for use for the management of emergencies. The plan determines measures to preserve, manage and scale up the multifunctionalities of the municipal infrastructure in relation to those fields. Other main contributors to the development of the plan are Turin's Metropolitan Water Society, Piemonte's Regional Agency for Environmental Protection, Turin's Institution for Responsible Education and the Po Hill, through UNESCO's Man and the Biosphere Programme. The Strategic Green Infrastructure Plan, however, does not only regulate and guide the development of existing green infrastructure, but it developed a municipal Corporate Forest Plan 2020 as a tool for the sustainable management of the city's urban forest.

The Corporate Forest Plan 2020 (*Piano forestale aziendale 2020*) develops the management strategies and operational steps to sustainably manage the city's urban forest, maximize ecosystem services, in particular CO_2 sequestration, biodiversity, storm water management, soil conservation and recreational benefits. The plan quantifies and adds monetary value to the urban forests' ecosystem services, to understand and disseminate the monetary benefit they produce. The Corporate Forest Plan 2020 aims to allow the City of Turin to manage its forest heritage in a sustainable, innovative and effective way, responding to the needs of citizens and identifying the potential of the forest resource in addressing the environmental criticalities expected in the years to come. Its objective is to enhance the forest's provision of ecosystem services to the city's residents. The plan subdivides the interventions planned in the woods of the Turin hills in 3 phases of 5 years each, and prioritizes the re-naturalisation of coniferous forests and the extraction of invasive species.

The Climate and Resilience Plan, Strategic Green Infrastructure Plan and the Corporate Forest Plan are a result of the municipal plan Turin 2030 Sustainable | Resilient – action Plan for the Turin of the future (*Torino 2030 Sostenibile/Resiliente - Piano d'azione per la Torino del futuro*)**,** developed by the Mayor's Cabinet. The plan defines actions to achieve the city's vision of citizen wellbeing and quality of life. It holds four core values: participation, dynamism, liveability and solidarity. NBS is a main priority of developing a liveable city. In the vision, building a sustainable and resilient city means paying attention to the urban environment, the green infrastructure of the city, places of aggregation, local commerce, cultural sites, accessibility and connections between neighbourhoods. It means coping with inequalities, promoting new productive activities with low environmental impact, an ecological economy, including through business incubators and research centres, and the designation of new poles of technological innovation, investing in the urban green system from the city hills to its large parks, creating ecological corridors that connect the city territory with the alpine one. The city's resilience and sustainable vision and action plan was responsible also for the revision of the Municipal Master Plan, scaling up the presence of NBS and other resilience measures.

Turin's Municipal Master Plan (*Piano Regolatore Generale Comunale*) is the urban planning tool through which the municipality regulates the use and transformation of its territory and resources. The current Plan in Turin was drawn up by Vittorio Gregotti and Augusto Cagnardi together with the technical offices of the City of Turin, and was approved in 1995. Since more than 20 years have passed since its approval, the City Council considered necessary to review and update the Master Plan, as the reference framework has completely changed in terms of economic, social and regulatory conditions. The new Plan promotes urban quality, protects the environment, offers services fairly distributed throughout the territory, enhances universities and research, gives a new impulse to work, regulate commercial activities, and expresses a perspective for the future of the city. The redefinition of the Municipal Master Plan is ongoing. It is divided into working groups that work on seven main themes: environment as a resource, identity and beauty, well-being and quality of life, young people and the city, work production and trade, simplifying the rules, beyond the borders. Between these themes, the importance of a renewed, connected and resilient green

infrastructure is highlighted and there is a declared intention of integration with the coordinated sectoral plans (such as the Strategic Green Infrastructure Plan, the Energy Plan, the adaptation of the Building Regulations, etc.). Furthermore, the Plan intends to integrate actions at local and supra-municipal level, in coherence with supra-ordinate planning (such as Regional Territorial Plan, Regional Landscape Plan, and Metropolitan Plans).

In fact, Turin's municipal structure is well-connected with its metropolitan region. The municipality is currently building new alliances between the city of Turin and its territory, based on integration and complementarity, rather than opposition and otherness. The municipality has recently commissioned the Metropolitan Strategic Plan 2021-2023 (*Piano Strategico Metropolitano*), a plan that seeks a new balance between city and territory, development and environment. Organized in six thematic areas, the plan unfolds in strategies and actions towards a region with equal rights and equal opportunities for all its inhabitants in every point of the metropolitan city. The second priority thematic area is the one responsible for NBS planning at a regional level. It envisions a greener and more ecological Turin metropolis, and aims to reduce the region's ecological footprint and develop a circular system to address climate change. It promotes the intelligent reuse of brownfields and existing heritage towards re-urbanisation or re-naturalisation or energy use, the connection of the system of protected mountains, hills and river areas in a metropolitan network of green infrastructures, to re-wild parts of the metropolitan territory and connect its green infrastructure with pedestrian and cycling routes. The metropolitan plan is structured in accordance with the Next-Generation EU, and in coherence with the objectives defined by the Italian Recovery and Resilience Plan.

At the metropolitan level, we cite the example of the Landscape Plan of Pinerolo Hill (*Piano Paesaggistico della Collina di Pinerolo*), which does not intend to increase urban planning regulations, but rather provides a parallel and supplementary planning of the urban level offering guidelines for the proper use of the territory. This Plan is included in the Territorial Plan of Provincial Coordination (*PTC2, Piano Territoriale di Coordinamento Provinciale*), presented in 2011, which is referring to climate change adaptation, environmental protection and territorial vision, and is expressed through the systematization of territories, taking territorial diversity as a value. The Plan has been the result of a co-planning process between the different stakeholders and local authorities of Turin's Province. The PTC2 has a specific section regarding the Province "Green system", with the aim of constructing a provincial ecological network, which includes parks and natural reserves, forests, landscape heritage and river corridors, in a strict connection with the peri-urban and urban green structure.

On a regional level, the NBS planning structure of the city is further influenced by the Regional Territorial Plan (PTR, *Piano Territoriale Regionale*) and the Regional Landscape Plan (PPR, *Piano Paesaggistico Regionale*), launched in 2011 and 2017 respectively, by the Piedmont Region. These two plans are complementary acts of a single planning process aimed at the recognition, management, protection, enhancement and requalification of the Region's territories. The coordination between the PTR and the PPR took place through the definition of a system of common general strategies and objectives, then articulated in specific objectives relevant to the specific aims of each plan. The strategic environmental assessment

process, carried out in a complementary manner from a methodological point of view, has guaranteed the correlation between these objectives and the connection between the regulatory systems of the two instruments. Common strategies and objectives between the two plans address in a broader way NBS implementation. Specifically, they are: 1. spatial redevelopment, landscape protection and enhancement; 2. environmental sustainability, energy efficiency; 3. spatial integration of mobility, communication and logistics infrastructures; 4. research, innovation and economic-productive transition; 5. enhancement of human resources, institutional capacities and social policies. In this context, the Regional Strategy for Sustainable Development of Piedmont (*Strategia Regionale per lo Sviluppo Sostenibile del Piemonte*)**,** firstly presented in June, 2021, is a unifying framework with the objective of changing the current working method and sectoral approach to policy making and territorial action. This innovative approach aims to allow a "break" of sectoral logics that hinder policy integration; to recognize and bring to light what is already present and "virtuous" in terms of sustainability and which can coalesce interests and activate new common projects; to activate and promote learning processes among territorial actors (public authorities and civil society) in order to build new contents and reference values in a shared way.

Nationally, Turin's NBS planning is supported by the National Strategy of Urban Greenery (*Strategia Nazionale del Verde Urbano*). Defined in 2018, it sets out criteria and procedures of urban greening to be followed by the administrations involved in drawing up genuine territorial plans, especially municipalities and metropolitan areas. The Strategy sets a national reference framework, on the specific theme of green areas. It supports a new model of urban planning and design that is more attentive to the mitigation of and adaptation to climate change, but also to the removal of pollutants by urban greenery. In short, it is more attentive to the well-being of citizens, to the protection of biodiversity and to the reduction of artificial urban spaces, and therefore more attentive to the reduction of soil consumption, promoting this agenda nationwide. The Strategy further promotes the necessity of cities to develop their own municipal urban green plans, to understand their specific needs and way forwards.

Turin is also under the 1) National Strategy for Sustainable Development (*Strategia nazionale per lo sviluppo sostenibile*, 2017), that establishes national priority for a sustainable urban development in line with balancing the built and natural environment for Italian cities, improving their environmental quality and enhancing their local socio-economic resources and their fair distribution; 2) the National Strategy for Biodiversity 2010 (*Strategia Nazionale per la Biodiversità)* and its mid-term review until 2020 (considering that a new strategic document to 2030 is starting to be developed by the Ministry of Ecological Transition), which constitute a tool for integrating the needs of conservation and sustainable use of natural resources into national sector policies, in line with the objectives of the EU Biodiversity Strategy. The Strategy has a specific working area on urban environments, which are called upon to combat habitat loss and degradation by integrating green management plans into land-use plans, and a working area on "Forests" that recognizes the important role for biodiversity of both urban forests and those associated with agricultural crops (such as peri-urban forests); and 3) the National plan for adaptation to climate change (*Piano nazionale di adattamento ai*

cambiamenti climatici) that includes among its specific medium- to long-term actions an increase in territorial connectivity and green infrastructure to reduce impacts from heat islands, heavy rainfall and flooding in urban settlements.

The city's NBS agenda and structure is furthermore largely connected with international agendas and commitments. The city is a signatory of the Covenant of Mayors, Compact of Mayor's and Mayor's adaptation, having committed to reduce carbon emissions by 40% by 2030, through measures that incorporate NBS. The municipal strategies and plans are also in line and refer to UN's SDGs, UN Convention of Biological Diversity, the New Urban Agenda, the framework for action for sustainable urban development in the EU, and the EU Biodiversity Strategy to 2030.

In the case of Turin, it is important to highlight that the city has undergone elections in the beginning of October 2021, and a new mayor was elected. Although elections were also recently held in the municipality of Lisbon, in Turin the change of government is also changing the municipal governance structure, including structures responsible for NBS. The Department of Environment, for instance, has been merged with civil protection and emergency management. Changes are still being made, so further changes to the city's NBS planning structure may occur.

Brief Comparison of NBS governance processes in the three cities

The three cities demonstrate an integration of NBS in a range of policies varying from planning and territorial policies to climate change and resiliency, with some common priorities emerging. In the three case studies, there is a direct link between the integration of NBS and the discourse towards better well-being and better quality of the built environment, as well as towards the mitigation of and adaptation to climate change, all of which is also connected with making the city more resilient. NBS is further integrated in different policy levels, from municipal to national, with the indication of high influence of international agendas. The cities, likewise, present singularities. Lisbon prioritizes ecological connectivity and the increase of biodiversity, while Barcelona focuses on increasing its greenery to bring nature back into the city and Turin on managing and protecting its existing urban nature. Lisbon was the city that presented the highest number of policies that integrated NBS on a municipal and metropolitan level, possibly demonstrating a cross-sectoral and transdisciplinary approach to NBS governance, while Turin was the municipality that relied on the lower number of policies, indicating a more centralized approach.

Table 3. Summary of Lisbon's NBS integration at different levels.

Policy	Level	Thematic Area	Emerging NBS priorities
Lisbon's Government Program 2017-2021	*Municipal*	Governance	To improve the quality of life and urban environment

LISBON	Municipal Master Plan		Urban Planning	To balance the built environment with natural systems. To strengthen the hydrological system
	Guide of Public Space 2018			
	Biodiversity in the City of Lisbon: a strategy for 2020		Environmental Planning	To create a biodiverse connection within the city To increase the number, quality and diversity of green spaces in the city, prioritizing indigenous species
	Biodiversity Local Action Plan			
	Forest Management Plan of the Monsanto Forest Park 2020			
	Strategy for Adaptation to Climate Changes 2017		Climate Change	To adapt the green infrastructure towards resilience of high temperatures and droughts (climate change events). To increase green infrastructure connectivity with other infrastructures
	Green Commitment			
	Drainage Action Plan 2016-2030		Waste & Water Planning	To minimize the social and environmental impacts of floods, increase management of rainwater runoff and recipient of municipal composting
	Municipal Waste Management Plan, 2015-2020			
	Move Lisbon, Strategic Vision for mobility 2030		Transportation	To improve transportation infrastructure attractiveness and comfort, and shadowing and serve as a leisure destination
	Pedestrian Accessibility Plan			
	Energy-Environmental Strategy for Lisbon 2008		Energy	To buffer noise pollution and recipient of recycled water and compost
	Lisbon Metropolitan Climate Change Adaptation Plan	*Metropolitan*	Climate Change	To increase resiliency to the projected climate variability and connect ecological systems
	Lisbon's Regional Action Plan	*Regional*	Territorial Planning	To enhance ecological connectivity and biodiversity

	National Strategy for Sustainable Cities 2020	*National*	Urban Planning	To potentialize their role as carbon sinks and urban microclimate regulators
	National Strategy for Climate Change Adaptation 2020		Climate Change	To enhance biodiversity connectivity and urban-rural linkages

Table 4. Summary of Barcelona's NBS integration at different levels.

	Policy	Level	Thematic Area	Emerging NBS priorities
BARCELONA	Pla Natura Barcelona 2021-2030	*Municipal*	Environmental Planning	To increase urban green infrastructure, conservation of biological diversity and to recover urban nature.
	Urban Agriculture Strategy 2019-2030			
	Tree Master Plan for Barcelona 2017-2037			
	"Hands on the green" Programme 2020-2023			
	Barcelona Superblock Plan		Urban Planning	To create a healthy, greener, fairer and safer public space.
	Barcelona Climate Plan 2018-2030		Climate Change	To increase urban greenery to adapt the city to possible effects of climate change.
	Citizen Commitment to Sustainability for 2012-22		Sustainable development	To promote the "re-naturalization" of the city for the improvement of citizens' the quality of life
	Metropolitan Urban Master Plan	*Metropolitan*	Urban Planning	To improve the efficiency of urban metabolism, minimizing environmental impacts.

	Climate and Energy Plan 2030		Climate Change	To improve the urban soil permeability, water cycle and municipal vulnerability to heat islands.
	Sustainability Plan		Sustainable development	To implement policies strengthening environmental protection, biodiversity and climate change mitigation and adaptation.
	Natural heritage and biodiversity strategy of Catalonia	*Regional*	Territorial Planning	To promote nature conservation policies.
	Catalan adaptation strategy to climate change		Climate Change	To limit the vulnerability to the impacts of climate change.
	Sustainable development strategy of Catalonia		Sustainable development	To favour scenarios of greater social economic and environmental sustainability.
	National Green Infrastructure, Connectivity and Ecological Restoration Strategy 2020-2050	*National*	Urban Planning	To support the development of green infrastructures intended as effective tools that bring ecological, economic, and social benefits.
	Urban Environment Strategy of the Network of Sustainable Local Development		Sustainable development	
	Spanish Strategy for Urban Local Sustainability			

Table 6. Summary of Turin's NBS integration at different levels.

	Policy	Level	Thematic Area	Emerging NBS priorities
TURIN	Turin 2030 Sustainable | Resilient – action Plan for the Turin of the future	*Municipal*	Governance	To improve citizen's wellbeing and quality of life.
	Municipal Master Plan		Urban Planning	To promote urban quality, protect the environment, offer services fairly distributed throughout the territory, and express a perspective for the future of the city.
	Strategic Green Infrastructure Plan 2020		Environmental Planning	To renew and revitalize urban green spaces, sustainably manage the city's urban forest and to max. ecosystem services.
	Corporate Forest Plan 2020			
	Climate Resilience Plan 2020		Climate Change	To improve the city's resilience towards urban heat island/heat waves and extreme weather events like flooding.
	Metropolitan Strategic Plan 2021-2023	*Metropolitan*	Territorial Planning	To seek a new balance between city and territory, development and environment through climate change adaptation, environmental protection and territorial vision.
	Territorial Plan of Provincial Coordination			
	Regional Territorial Plan	*Regional*	Territorial Planning	To recognize, manage, protect, enhance, and requalify the Region's landscape in an integrated sustainable manner.
	Regional Landscape Plan			

	Regional Strategy for Sustainable Development of Piedmont		Sustainable development	To promote a uniform sustainable management of the territory.
	National Strategy of Urban Greenery	*National*	Environmental Planning	To improve the well-being of citizens, the protection of biodiversity and the reduction of the artificialization of urban spaces with promotion of reduction of soil consumption.
	National Strategy for Biodiversity			
	National plan for adaptation to climate change		Climate Change	To increase territorial connectivity and green infrastructure to reduce impacts from heat islands, heavy rainfall and flooding in urban settlements.
	National Strategy for Sustainable Development		Sustainable development	To balance the built and natural urban environment, improving environmental quality and enhancing local socio-economic resources and their fair distribution.

An important finding of this analysis is that all three municipalities do use the terminology NBS, but infrequently. The terminologies Green Infrastructure, urban greening, green spaces are more widely used. The few plans and policies that use the term NBS, do not directly provide the definition, which they follow, but it can be inferred that all municipalities use the definition of the European Commission (EC) of actions “inspired by, supported by or copied from nature; both using and enhancing existing solutions to challenges, as well as exploring more novel solutions” to “help societies address a variety of environmental, social and economic challenges in sustainable ways" (European Commission, 2015, p.24). Although not largely used, the EC concept of NBS is intrinsically present in most of the policies reviewed for the three cities. In the three cities, the notion of creating cities actively connected and inspired by nature has emerged, not only to address a single issue but also to support the cities in addressing environmental, social, and economic challenges. Therefore, although not explicitly using and defining the concept of NBS, all documents reviewed (regarding i.e., green infrastructure, urban forest, green public spaces, urban agriculture) are pertinent and part of the NBS governance process. However, given the various extent to which the reviewed policies and plans incorporate NBS in all municipalities, only the most relevant documents for

the governance of NBS were incorporated in the next section. Documents which lightly touch upon NBS or that do not currently hold a high influence within NBS's agenda, such as Lisbon's Pedestrian Accessibility Plan, were excluded from the analysis as the data provided by them was limited. The list of policies and plans reviewed here can be found within the figures of each city.

3.2.2 Integration within NBS formal planning system

Lisbon

As a vision for sustainable, resilient, and green urban development arises in the city's agenda, the collection of official strategies and plans from the municipality of Lisbon show an increasing interest and effort in adopting a comprehensive and integrated approach to planning NBS as well as in advancing its agenda. Within the city's planning, NBS is incorporated in a diversity of urban development strategies and plans, and a clear direct and indirect dialogue among them can be found. NBS are built in urban planning mechanisms, as the city's Master Plan and its Guide to Public Space Design; natural environmental protection and development instruments, as the municipal Biodiversity Strategy and its action plan, the Forest Management Plan of the Monsanto Forest Park and the municipal urban forest regulations; climate change adaptation tools, as the city's Strategy for Adaptation to Climate Changes and its action plan that is currently under development; mechanisms towards the improvement and resilience of the built environment as the municipal Drainage Plan and the Waste management plan; and mobility instruments, as the Move Lisbon plan, that indicates a municipal exploration of the multifunctionality of NBS.

In terms of integration, although the municipal territory is highly regulated by the municipal Master Plan, the current governance system in place that reviews the plan every 2 years, allows for the Master Plan not only to guide further urban development plans, but also to incorporate insights of them. The current Master Plan, in effect, directly interacts with the city's Strategy for Adaptation to Climate Changes, the municipal Drainage Plan, the Waste Management Plan, the Biodiversity Strategy and Move Lisbon, in terms of NBS actions and measures. The Master Plan has also set the pathway to the development of the city's Guide to Public Space Design. Integration among other municipal plans regarding NBS can also be perceived. Strong references, overlays and complementary goals can be found among the environmental strategies and plans: the municipal Biodiversity Strategy and its action plan, the Forest Management Plan of the Monsanto Forest Park and municipal trees and urban forest regulations. The Municipal Strategy for Climate Adaptation, developed in 2017, takes a step forward and interacts beyond silos, generating opportunities and interactions between the city's Master Plan, the Drainage Plan and the Waste Management, as well as the municipal Biodiversity Strategy and the Energy-Environmental Strategy for Lisbon. These interactions are formal, present and documented in the development of the strategy, in the form of collaborations between different departments in the elaboration of the plan as well as different municipal actors (people).

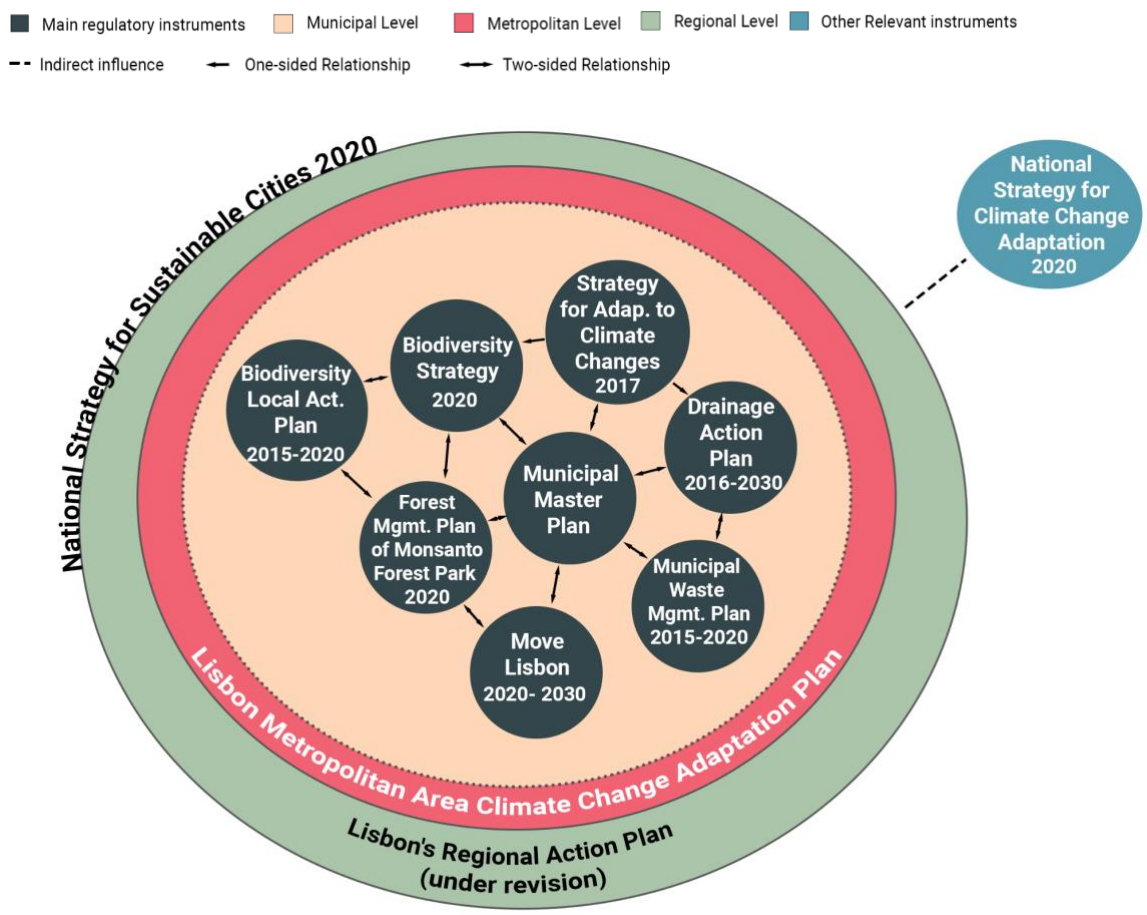


Figure 1. Integration among the main Strategies and Plans regarding NBS in the city of Lisbon.

This integration is further translated into programs and projects, such as the One Square in Every Neighbourhood Program and the Green Corridors Program, a main initiative from the municipality to create environmental connected green corridors towards improved biodiversity, soil and water permeability, air quality and the promotion of outdoor recreation activities and soft mobility modes (walking and cycling). The Urban Allotment Garden is also a good example, being present in the Master Plan, the Biodiversity and the Climate Adaptation plan. The municipal strategies and plans that concern NBS are also integrated with regional and national strategies. The National Strategy for Sustainable Cities 2020, developed in 2015, have guided the development of the municipal strategy, and the National Strategy for Climate Change Adaptation, 2015, dialogues with the Metropolitan Area Climate Change Adaptation Plan 2019, that in its turn was also influenced by the municipal Strategy for Climate Adaptation 2017, and now influences Lisbon's Action Plan towards municipal Adaptation to Climate Change that is under process of approval. The Regional Action Plan, currently under revision, poses a further possible strengthening point for inter municipality collaboration and planning integration.

Lisbon's NBS planning structure has also been moving in the direction of an integrated approach regarding the integration of different actors. Firstly, the city is promoting the collaboration of different municipal actors in NBS development. A diverse range of municipal sectors are involved in NBS plans promoting conflict resolution and synergies (e.g., the mobility department) as well as promoting the understanding of NBS multifunctionality (e.g., the involvement of the local energy agency, and the Waste and Fleet directorate). The development of the Action Plan for Biodiversity, for instance, was led not only by the Directorate of Environment, Green Infrastructure and Energy, but also by the Urbanism Directorate and the Education and Sports Directorate. The large part of the city's plans and strategies were also developed through participatory approaches and inclusion of key stakeholders. The Strategy for Adaptation to Climate Changes, for instance, indicated that key actors were identified, involved in the process of developing through collaborative workshops and consulted once the strategy was concluded. Workshop results and feedback of the stakeholders can be found in the official document, alongside the list of participants. Similar processes can be found in the development of other municipal strategies and plans.

Secondly, the vision, strategies and plans of the municipality clearly highlight the need to develop a NBS integrated planning with the city's broader community (non-administrative actors). Participatory planning is widely defended and held in the city's NBS planning structure. It advocates for citizenship, public participation, and involvement of citizens in local decisions and projects, aiming to listen and understand the wishes and concerns of those who live, work and/or enjoy the city, to inform the citizens, sharing relevant data that allow for the generation of more informed opinions and involve stakeholders in the whole life cycle of the city's transformation.

Lisbon’s Government Vision brings participation as its 5th priority theme. It envisions the development of an open, participative, and decentralized governance. The program defends participatory process of negotiation, discussion and co-decision in all instances and levels of the municipality, in particular participative process at community/neighbourhood level. It acknowledges citizens' movements and civic associations as priority actors in the construction of new solutions for the city. The Municipality has committed itself to welcome, support, and promote the various forms of citizen participation, and to develop a municipal plan for active democracy and to experiment new territorial and thematic participative approaches. The municipal Biodiversity Action Plan calls for a more diverse governance with the participation of partners external to the city's administration, in particular civic society, and the private sector. Similar discourses can be seen in the Climate Adaptation Plan, and other instruments.

An important instrument emerging from Lisbon, that has been contributing to the city's NBS development and public participation, is its Participatory Budget. The Participatory Budget (PB) corresponds to an active exercise of citizen intervention in the decision of a portion of the Lisbon Municipal Budget. Through this mechanism, citizens contribute in the decision of which projects should be financed and can contribute with the project proposal and implementation themselves. The PB supports a range of projects, and NBS related projects have been a leading thematic category of the budget, receiving about 35% of the funds. It is

currently aiming to contribute to the European Ecological Pact, the Climate Action Pact and the European Capital of Sport 2021, focusing its budget on the submission of projects that enhance physical and mental health, and the environment of the city.

Table 6. Integration of stakeholders in Lisbon's document analysis.

Actors Involved	Number of inclusive Plans*	Which Plans	To what Capacity	Participatory Tools
Public Sector	17	All	- Collaboration in the elaboration of the documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities.	- Intersectoral commissions.
Civil Society	11	Metropolitan Climate Change Adaptation Plan; Guide of Public Space 2018; Biodiversity Local Action Plan; Lisbon's Government Program; Municipal Master Plan; Municipal Waste Management Plan; Biodiversity in the City of Lisbon: a strategy for 2020; Strategy for Adaptation to Climate Changes; National Strategy for Climate Change Adaptation; National Strategy for Sustainable Cities 2020; Lisbon's Regional Action Plan.	- The documents call for the involvement/ integration of the sector on planning and implementation activities.	- Participatory Budget - Public consultation - Workshops with key stakeholders
Research	9	Biodiversity Local Action Plan; Lisbon's Government Program; Municipal Master Plan; Biodiversity in the City of Lisbon: a strategy for 2020; Strategy for Adaptation to Climate Changes; Drainage Action Plan; National Strategy for Climate Change Adaptation; National Strategy for Sustainable Cities 2020; Lisbon's Regional Action Plan.	- Collaboration in the elaboration of the documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities.	- Workshops with key stakeholders
Private Sector	6	Lisbon's Government Program; Lisbon Green Commitment; Biodiversity in the City of Lisbon: a strategy for 2020; Biodiversity Local Action Plan; Strategy for Adaptation to Climate Changes; Drainage Action Plan.	- Collaboration in the elaboration of the documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities.	- Workshops with key stakeholders - Green Commitment agreement

**Number of inclusive/integrated plans towards said actors. For the public sector, this is the number of plans that hold any form of integration among more than one public administration body.*

However, the review of official documents also revealed that the integration in NBS planning is novel within the municipality, and it is still in its infancy. Efforts and progress are being made towards integration, but Lisbon's current NBS planning structure shows integration gaps and areas of weakness that need to be addressed. Integration among strategies and plans should be broadened, further boosting the collaboration among public sectors. Although an increasing number of municipal sectors come together in the elaboration of plans and strategies, this collaboration does not occur in all pertinent activities. For instance, despite the municipal vision for mobility, Move Lisbon, being a result of an integrated approach with the collaboration of different public administrations and the connection of NBS with transportation infrastructure, the Pedestrian accessibility plan lacks said integration. The documents themselves showed that there is an intention of applying an integrated approach to NBS, but often the vision is not yet spread across all policies. This may occur due to different timelines in which the plan and the strategy were developed, but it is a clear example of a gap in the integration of Lisbon’s planning structure, and its recent uprising. Furthermore, the integration of municipal sectors in the Move Lisbon strategy is limited. The strategy was still developed by the two main interested parties (the department of mobility and the department of urban planning) leaving other directories on the side. In this case, given the conflict between transportation and urban greening, and the benefits that this collaboration can bring to the urban environment, citizens and the mobility and NBS agendas, the integration of the Environmental Directory would be extremely beneficial.

Regarding NBS, a lack of integration with the School and Education Directorate can also be found in Lisbon's planning structure. Besides the Biodiversity Action Plan, no other instrument analysed exhibited an integration with this directory in the NBS planning, although the need to raise awareness and promote NBS education was constantly present and highlighted by the plans. Notably, another area that lacks integration, maybe due to being a national responsibility, is the health sector. NBS discourse and purpose in the city is intrinsically connected with better health, wellbeing, and liveability, but does not integrate the health sector.

In terms of external actors, there is a clear imbalance towards the integration of the private sector. The city is starting to make an effort to integrate and collaborate with the business and private enterprises, but it is still at a small level. The private sector has been integrated, to some extent, in the elaboration of some planning instruments and its participation is referred to as relevant to the up scaling regarding NBS, however no further integration of the sector could be found. The city's Green Commitment has invited private companies to assume the commitment alongside the municipality. Over 250 organizations have adhered to the commitment, but the NBS is not present among the display commitments, and it is unclear if and how the sector could be involved in NBS through said initiative.

Civic participation is more strongly present in Lisbon's planning structure, in almost all documents reviewed, but challenges to this integration can be already perceived and displayed in the instruments. They indicate an excess of bureaucratic procedures, mismatch of NBS desire and lifestyle choices, and misconception regarding NBS benefits. The municipal

Climate Adaptation Strategy reports that at the time of NBS implementation, many people find inconveniences attributed to them. Lastly, it is reported that, despite a metropolitan plan, competition between Lisbon and the other municipalities in the region damages integration on a regional and metropolitan level, including NBS planning. A gap that once again could be overcome with the ongoing Regional Plan.

Barcelona

Barcelona's NBS governance shows an increasing interest and effort in adopting a comprehensive and integrated approach in NBS planning. The city has been one of the pioneers in Europe in the inclusion of NBS in its green agenda, mainly through the Greenery and Biodiversity Plan 2012-2020, under which the City Council aimed to achieve a green infrastructure that could offer maximum ecosystem services to the city and proposed solutions that looked at NBS as a potential instrument of change. This Plan started to submit a dialogical view of green infrastructures, and it has been integrated in the current Pla Natura 2021-2030.

Looking at the actual NBS planning structure (figure IV), it is possible to observe a clear dialogue between the main strategies and plans on a municipal-to-national scale. The core of the NBS planning structure at the municipal level is the Pla Natura, a recent plan for the management and implementation of green infrastructures in the city, with a specific attention on NBS. On a hierarchical view, the Pla Natura is directly linked to the PDU (Metropolitan Urban Master Plan), specifically in relation to its Green Infrastructure section, in which ecological connectivity, connection of green areas, creation and enhancement of green corridors are central points and are integrated with the preservation of existing natural areas in the entire metropolitan area. The PDU is currently being developed, and poses a further possible strengthening point for inter-municipality collaboration and planning integration, including NBS in the vision of a new metropolitan area. Going further ahead in the hierarchy, the Pla Natura dialogues with the Natural Heritage and Biodiversity Strategy of Catalonia (at the regional level) and with the National Green Infrastructure, Connectivity and Ecological Restoration Strategy (at the national level). All these strategies look to 2030 and beyond, explicitly including NBS planning and development as concrete solutions for green infrastructures and biodiversity preservation/enhancement in the urban context.

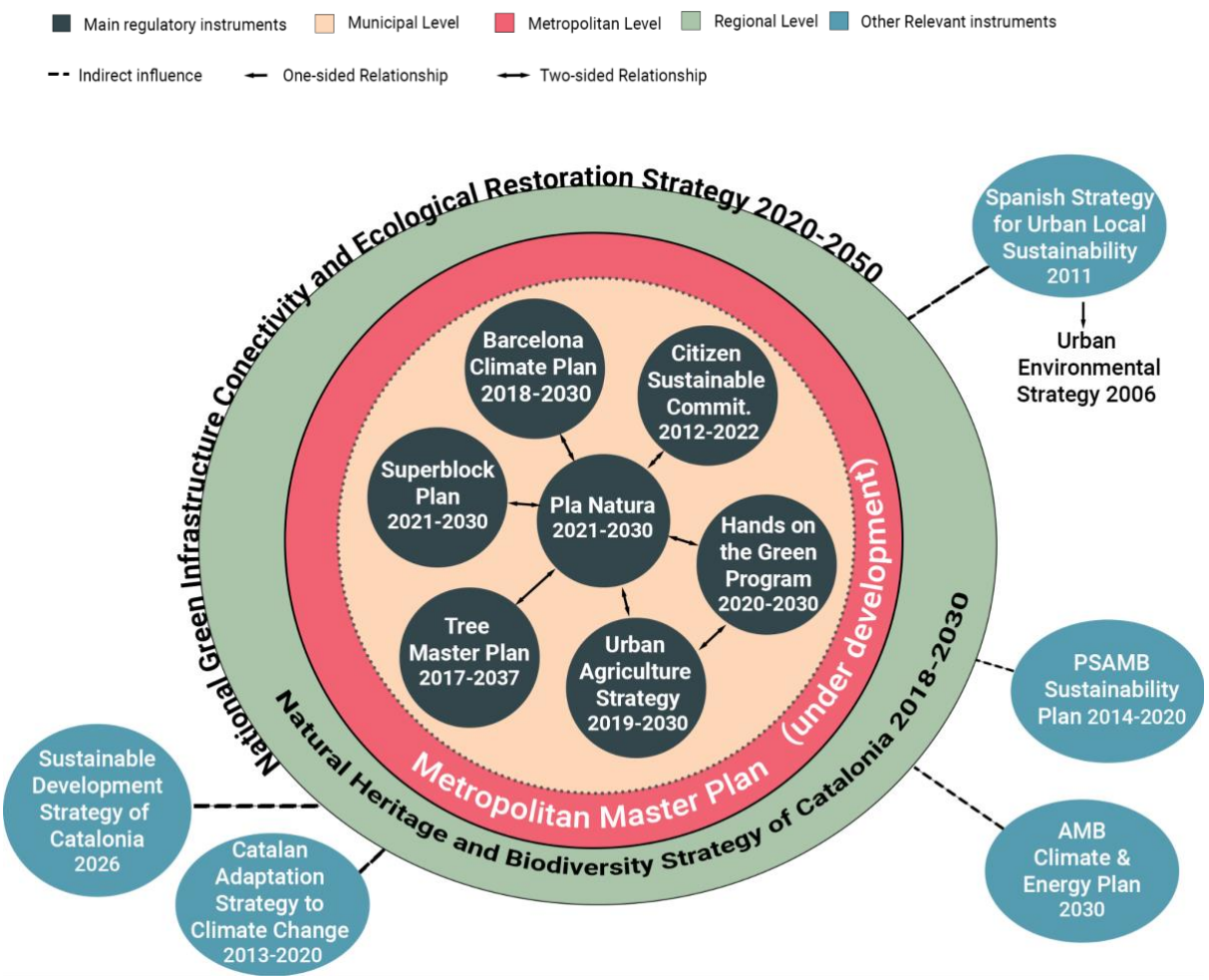


Figure 2. Integration among the main Strategies and Plans regarding NBS in the city of Barcelona.

At the same time, the *Pla Natura* is integrated with other municipal strategies and plans, constituting a central structure of NBS planning. On the one hand, it is dialoguing with the Urban Agriculture Strategy and the "Hands on the Green" Programme for what concerns the coordination and improvement of urban gardens and allotments, seen as crucial strategies for the implementation of an articulated green infrastructure in the city, also through the involvement of citizens and social agents of Barcelona in the care of green spaces. On the other hand, the Pla Natura is integrated with the Tree Master Plan, seeing trees as central elements in the NBS planning that can contribute to the interconnection of the green infrastructure of the city. The integration with the Superblock Plan, which has the further intention to improve and connect the green infrastructure, is also considering NBS as crucial instruments, integrated with the green corridors model, which is also proposed in the PDU. Furthermore, the Pla Natura is one of the municipal responses to the Citizen Commitment to Sustainability and to the Barcelona Climate Plan, which, in turn, is dialoguing with the metropolitan and regional climate change adaptation strategies. Actually, almost all the NBS

strategies and plans in Barcelona are to some extent connected to the climate commitments in the different levels of governance, responding to the international agenda.

Barcelona's NBS planning structure has also been moving in the direction of an integrated approach regarding the inclusion of different actors. A common point of integration in most strategies and plans at the municipal and metropolitan level is the declared intention of adopting a participatory approach. The city of Barcelona is a pioneer in the constitution of participatory governance structures, since the 80s, with its first map for decentralization by district in 1984 and the consequent approval for regulations for organizing citizens participation. The City Council has a well-structured Citizen Participation Office, constituted by different committees to guarantee the rights of participation, and an official Regulation for Citizens Participation approved in 2017. Furthermore, from 2020, a Participatory Budget is being promoted for the city as a whole to decide part of the municipal investments in the districts. The Participatory Budget is a participatory process through which Barcelona's residents can present, define, prioritize, vote on and, in short, choose investment projects that Barcelona City Council will carry out in each district.

In terms of participatory governance in NBS planning, the Pla Natura, the Urban Agriculture Strategy, the Barcelona Superblock Plan and the PDU (Metropolitan Urban Master Plan) have been (or are being) co-designed with external actors through participatory processes during the documents' drafting. Citizens have been (or are being) involved in the document designing process in terms of communication and consultation on the actions taken, however generally at final stages, through the web platform *Decidim Barcelona*, as well as through open sessions, offering a chance for debate and for the formulation of suggestions and proposals. In particular, the Pla Natura declares to include two key working areas looking at integration of citizens. Firstly, an *increase in knowledge*, through the addressing of the conservation of biodiversity in the urban environment and the valorisation of the link between nature and health, specifically monitoring and analysing the transformations already being caused by the climate emergency. Secondly, a *shared governance of the plan*, through an approach that includes citizens and other key stakeholders from the city, to create a network with all interested parties in the conservation and biodiversity of urban greenery. Likewise, the Urban Agriculture Strategy is guided by a participatory democracy, prioritizing values like ecological justice, inclusion and social justice. As a matter of fact, the municipal urban agriculture programme aims to promote inclusion and social cohesion through community activation, and should ensure that urban allotments are egalitarian, plural and democratic spaces, guaranteeing equal access to resources. Furthermore, the strategy promotes shared governance and citizen participation and responsibility. In fact, the aim of promoting urban agriculture through an agroecological vision is to contribute to the sustainable management of urban greenery and to improve the quality of the urban space to promote people's health and mitigate the effects of climate change.

Table 7. Integration of stakeholders in Barcelona's document analysis.

Actors Involved	Number of inclusive Plans*	Which Plans	To what Capacity	Participatory Tools
Public Sector	10	All	- Collaboration in the elaboration of the documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities.	- Intersectoral commissions.
Civil Society	6	Barcelona Climate Plan 2018-2030; Citizen Commitment to Sustainability 2012-2022; Pla Natura 2021-2030; Urban Agriculture Strategy 2019-2030; Natural Heritage and Biodiversity Strategy of Catalonia 2018-2030; National Green Infrastructure, Connectivity and Ecological Restoration Strategy 2020-2050.	- Collaboration in the elaboration of the documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities.	- Web portal (Decidim Barcelona). - Open sessions. - Citizen science.
Research	4	Barcelona Climate Plan 2018-2030; Pla Natura 2021-2030; Natural Heritage and Biodiversity Strategy of Catalonia 2018-2030; Spanish Strategy for Urban Local Sustainability 2011.	- Collaboration in the elaboration of the documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities.	- Citizen science.
Private Sector	3	Barcelona Climate Plan 2018-2030; Citizen Commitment to Sustainability 2012-2022; National Green Infrastructure, Connectivity and Ecological Restoration Strategy 2020-2050;	- The documents call for the involvement/ integration of the sector on planning and implementation activities.	-

**Number of inclusive/integrated plans towards said actors. For the public sector, are the number of plans that hold any form of integration among more than one public administration body.*

Another interesting tool of integration is the cited "citizen science", that is mentioned in the Pla Natura, in the Barcelona Climate Plan and in the Natural Heritage and Biodiversity Strategy of Catalonia. In these plans, the citizen science is intended as an instrument for integration of the community in the actions that will be implemented, but it is also already used, for example, in the monitoring of the natural heritage of Catalonia through different platforms of citizen science, which permitted to increase the data collection on biodiversity in the region.

However, gaps in Barcelona's integration in NBS planning can also be perceived. For example, integration among strategies and plans can be broadened, further boosting the collaboration among different public sectors. Despite the establishment of inter-sectoral commissions for the elaboration of several plans, no more information in this sense have been found in the documents reviewed, nor a clear relation between them and how they collaborated for this purpose. For what concerns civic participation, it is to be noticed that in most plans the formal involvement of the community happens mainly at final stages of plans' elaboration, possibly, because the intention is directed to informing and acknowledge the community about the decisions, more than to an actual co-design process. Furthermore, when looking at participation, most of the documents call for participation in numerous directions but actually do not put in action participatory tools towards the integration of external sectors. There is a clear imbalance towards the integration of the private sector, which is almost not mentioned in the plans and strategies, the integration of the research sector is also scarcely shown within the documents.

Turin

In recent years, with the launch of Turin's 2030 Sustainable Resilient Plan, Climate Resilience Plan 2020, the Strategic Green Infrastructure Plan 2020 and the Corporate Forest Plan 2020, NBS has been widely integrated in the city's planning agenda. In all plans, NBS are held as a priority for the city's development. In particular, the development of the Strategic Green Infrastructure Plan was a milestone for the city, largely mainstreaming NBS into city planning and being the core of the NBS planning structure. The plans also promote an integrated approach, and show a large integration with each other, with a hierarchy being perceived among them: Turin's 2030 Sustainable Resilient Plan is indicated as the driver of the other three plans, setting the pathway for their development. The Climate Resilience Plan 2020, the Strategic Green Infrastructure Plan 2020 and the Corporate Forest Plan 2020 dialogue among themselves, with the Strategic Green Infrastructure Plan being intrinsically connected with the Corporate Forest Plan, as the latter was initially developed as an annex of the first, but now has its ecosystem services monetary evaluation, being scaled up for all municipal green infrastructure and adopted as one of the bases for the Strategic Green Infrastructure Plan. This set of new plans, and the new direction of planning that they follow, are currently being integrated in the new municipal Master Plan.

The city's NBS planning structure is further integrated with the Metropolitan Strategic Plan of the Metropolitan City of Turin, working on the connectivity of its NBS across municipal boundaries, and dialogizing with the vast natural environment of the region. Direct and indirect links can be seen again on a provincial and regional level. The municipal Climate Resilience Plan, for instance, was developed in direct accordance with regional plans (i.e., Regional Environmental Energy Plan; the Regional Air Quality Plan; Draft revision of the Water Protection Plan) and regional entities as the Arpa Piemonte (Regional Agency for Environmental Protection). The Green Infrastructure Plan follows the same trend, and it is directly inserted in the regulatory framework that includes the Territorial Plan of Provincial Coordination (PTC2), as well as the Regional Landscape Plan and other subordinate plans. It

also responds to the National Strategy for Urban Greening, following NBS planning guidelines deriving from it and encouraging the evolution of symbiotic planning approaches in subsequent NBS metropolitan and regional scale planning phases.

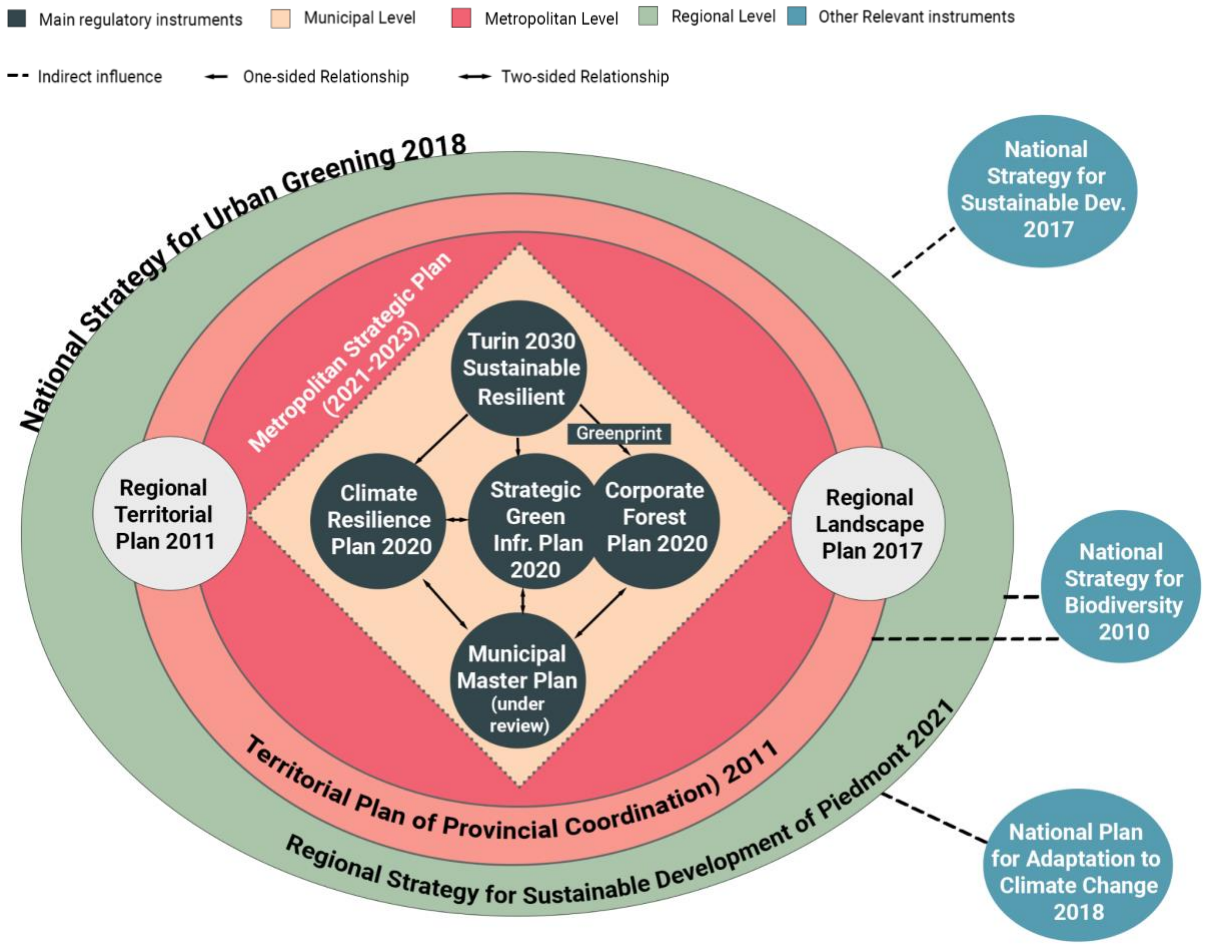


Figure 3. Integration of Main Strategies and Plans of NBS in the city of Turin.

When looking at integration from a provincial to local level, the Territorial Plan of Provincial Coordination (PTC2) is an interesting example of planning and programming tool-process that takes place in the “systematization of local specificities” proposing a comprehensive territorial structure. This is possible thanks to an integration model that is implemented through “local” strategic plans (municipal plans) that find an “overall direction” in the PTC2. Therefore, the Plan seeks the territorial coherence of policies and interventions in the various sectors and municipalities that operate and interact in its social-economic-environmental sphere. It claims to recompose the separate and yet sometimes "contradictory" visions that characterize the different "sectors" and "actors" operating in the territory. In this way, the Plan is an important mechanism that seeks territorial coherence and integration of policies and interventions in the different sectors. On an international level, Turin's NBS planning structure highly incorporates the international discourse on urban green, in particular

by the European Commission. It constantly refers to it and adopts its guidelines and vision in its plans.

In the context of integration across actors, the document analysis demonstrates that the city of Turin has been widely adopting an inter-sectoral planning approach. Firstly, all NBS related plans reviewed have been developed through the collaboration of several municipal bodies, and called for further collaboration and integration of the different municipal sectors on NBS planning and implementation activities. The development of the Climate Resilience Plan stands out with the creation of an interdepartmental commission with representatives of 15 municipal services and offices to work in a joint and coordinated way for the identification of adaptation options in the short and long term, examining, within the different sectors, any best practices and existing measures, and promoting the definition of actions and guidelines to build adaptive capacity at the local level. A Group that worked both through a series of over 20 one to one meetings and through joint meetings. The Green Infrastructure Plan has also been elaborated by an inter-sectoral group that was set up in 2005 with representatives of the technical sectors of the City (town planning, mobility, public green, vice-directorate general technical services), the Po Torinese Park Authority and the Coordination of Environmental Associations.

Secondly, the city is also making a large effort to incorporate sectors which are external to the public realm. The four main municipal plans were developed through participatory approaches that involved the civil society, research and education centre as well as the private sector. The above-mentioned Climate Resilience Plan, for instance, prior to its elaboration sought knowledge exchange with experienced cities and involvement of other regional, private and civic partners as the Piedmont Region, the Turin Universities, the Turin Metropolitan Water Company, companies providing public services, associations, businesses, and trade associations, and also brings co-design as one of its priorities.

Likewise, the Turin Sustainable Resilience Action Plan was elaborated through the participation of citizens in the neighbourhoods of the city. In fact, participation constitutes the number one principle of the plan. The plan sees participation, co-production and co-design as "one of the core principles of a sustainable and resilient city". It highly promotes active citizen participation and sets a number of municipal actions towards the citizen engagement named "Torino Partecipata". Through this initiative, the plan indicates that it aims to develop and test adaptive methods, with a simple and accessible toolkit for co-design and design for citizen participation (e.g., IDEO Human Centred Design Toolkit), based on the design thinking approach, already experimented at an international level for social inclusion and urban regeneration. Particularly, in regard to NBS, the city creates the "the green that I would like" (*Il verde che vorrei*) action that acknowledges the need to adopt a highly participatory approach when rethinking urban green and commit the municipality to adopt a set of approaches, methodologies and tools to involve citizens in the design of green spaces at the neighbourhood level. Said tools are not further described, but the plan displays several other initiatives towards public participation and engagement that it is or can be transferred and utilized towards NBS. Among them, the city proposes "Decidi Torino", a communication

platform that allows citizens to express themselves on multiple issues of government and city transformation (including NBS), while increasing the city's transparency; Turin Educational City, a multipurpose education program to contribute to a paradigm shift, building a wide local network of actors involved in education and education around a shared project, that has the potential to integrate NBS and contribute to awareness raising and capacity building; the Neighbourhood Social Design Lab that promotes the sustainable co-design of homes' outdoor or interior.

Continuing the trend, The Municipal Master Plan that is currently under development is announced to be following a “bottom-up approach”, through a process intended to be participatory, structured in open and interdisciplinary working groups and with a transparent communication through an online portal. It is considered a municipal experiment that aims to renew the fundamental instrument for the management of the city in collaboration with local authorities, universities, professional associations, entrepreneurs, trade unions, the third sector and citizens. This process is enabled by the Participation Office, a municipal sector established in 2020 by the City Council to respond to the need for coordination in the field of listening, participatory planning and active citizenship. The Participation Office adopts, within the framework of urban requalification projects and processes, a working method based on the activation of synergies both with local networks working on projects with the direct and active involvement of citizens, and through inter-sectoral, central, decentralized, and interdepartmental working groups.

Furthermore, the city has developed another web instrument, "Torino Vivibile", through which citizens can contribute to the achievement of the objectives proposed in the Turin's 2030 Sustainable Resilient Plan reporting a good practice to learn from or suggesting a collaboration with a pioneering actor or project in terms of sustainability and resilience. On a regional level, the documents point out that integration of internal and external actors are also present on National, Regional and Metropolitan NBS planning instruments to some extent. For example, the National Strategy for Sustainable Development was developed by an Inter-Ministerial Committee, the Region of Piemonte has developed an inter-sectoral working group, trained on an objective training course, to understand, raise awareness and act on the phenomenon of climate change and its effects on the environment, economy and society of the region at the same time that it has integrated participatory approaches in its Sustainable Development Strategy.

On an overall analysis, the municipality of Turin presents a very comprehensive integration on NBS planning. It directly aims towards its co-design and co-production, and this can be seen throughout the major NBS documents analysed.

Table 8. Integration of stakeholders in Turin’s document analysis.

Actors Involved	Number of inclusive Plans*	Which Plans	To what Capacity	Participatory Tools
Public	14	All	- Collaboration in the	- Intersectoral

Sector			elaboration of the documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities.	commissions. - "Objective" training course.
Civil Society	10	Climate Resilience Plan 2020; Strategic Green Infrastructure Plan 2020; Turin 2030 Sustainable Resilient; Territorial Plan of Provincial Coordination; Regional Strategy for Sustainable Development of Piedmont; Regional Territorial Plan 2011; National Strategy for Sustainable Development in Italy; National Strategy for Biodiversity 2010; National Strategy for Urban Greening 2018; National Plan for Adaptation to Climate Change 2018.	- Collaboration in the elaboration of the documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities. - The documents put in action participatory tools towards the sector integration.	- Interviews with citizens. -Collaboration agreements between administration and citizens. - "Decidi Torino" - "Neighbourhood social design lab". - Web communication portals. - Surveys. - Design toolkit
Research	11	Climate Resilience Plan 2020; Strategic Green Infrastructure Plan 2020; Turin 2030 Sustainable Resilient; Metropolitan Strategic Plan 2021-2023; Territorial Plan of Provincial Coordination; Regional Strategy for Sustainable Development of Piedmont; Regional Territorial Plan 2011; National Strategy for Sustainable Development in Italy; National Strategy for Biodiversity 2010; National Strategy for Urban Greening 2018; National Plan for Adaptation to Climate Change 2018.	- Collaboration in the elaboration of the documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities.	- Workshops with stakeholders. - Promotion of specific technical training towards innovation. - Creation of a multidisciplinary research group with local university for plan's elaboration.
Private Sector	7	Climate Resilience Plan 2020; Turin Sustainable Resilience Plan 2030; Green Infrastructure Plan. Metropolitan Strategic Plan 2021-2023; National Strategy for Sustainable Development in Italy; Territorial Plan of Provincial Coordination; Regional Strategy for Sustainable Development of Piedmont.	- Collaboration in the elaboration of plans, strategies or other documents. - The documents call for the involvement/ integration of the sector on planning and implementation activities. - The documents put in action participatory tools towards the sector integration.	- Donation, sponsorship or collaboration schemes.

**Number of inclusive/integrated plans towards said actors. For the public sector, are the number of plans that hold any form of integration among more than one public administration body.*

The plans are integrated with one another and at different levels (municipal, regional, and national) and integrate different municipal and inter-municipal actors in the NBS planning process. Similar to the other cities studied, Turin displays a smaller number of plans that integrate the private sector, however, the documents reviewed showed, to some extent, a collaboration of the private sector on the elaboration of plans and called for the further

integration of the sector on NBS planning and implementation activities. Furthermore, they also put in action participatory tools towards the integration of the sector, indicating room for improvement, but a step forward in comparison with the other cities analysed.

Within its NBS strategy and visions, the municipality of Turin indicates permanent mechanisms to incentivize the collaboration of the private sector as a donation scheme that can be part of a company's social responsibility actions, private sponsorship in which a company can be entitled to sponsor a city greening activity, collaboration agreements towards the administration of small public green spaces, and collaboration pacts in which the municipal administration can agree with specific private parties to develop individual projects or broader initiatives towards common goods on urban greening (as a reforestation project and new public areas).

Lastly, the municipality demonstrates a large increase in learning and testing NBS co-production and co-design, and aims to increase environmental awareness and education, however an integration with the education department was not found. For instance, the main sectors involved in the elaboration of the Green Infrastructure Plan are the Green Area Department, the Mobility Department and the Tourism Department, with no mention of the municipal education department. This gap is also extended to the public health sector.

Presented NBS governance & planning integration within the three cities

The NBS governance and planning, presented by the official documents in the three cities, display an increasing state of integration. Different levels of integration can not only be seen throughout the documents, but in a stronger presence in the newer strategies and plans, indicating municipal efforts towards an adaptive NBS governance. Within the documents of all municipalities, the integration of the public sector (integration of different public actors within the NBS governance) is more present than any other sector, with the elaboration of plans through interdepartmental commission and inter-sectoral work in all the three cities (although not in all the plans). In Barcelona and Lisbon this is followed by integration of civil society, while in Turin by the research sector. Tools for participatory approach and decision-making with science were also found in Lisbon, Barcelona, and Turin. Lastly, in all cities, the private sector is the least present within the documents, indicating a possible limit of integration of this particular sector. Actions for the integration of the private sector were only presented by the city of Turin, while absent in the other three cities.

The analysis also reviewed dialogues between the plans, revealing a **s**ystematic thinking and efforts towards integrative planning. The relationship among plans does vary within each city and between cities. On one hand, in Turin, the plans follow a more hierarchical approach with the Turin 2030 Sustainable Resilient enabling the others, and the Strategic Green Infrastructure Plan hosting the Corporate Forest Plan. On the other hand, Lisbon, shows a less hierarchical governance process with many two-sided relationships among plans and back and forth communication.

However, to gather a full understanding of the cities' state of integration in NBS governance, there is a need to look beyond the image officially presented by the municipalities

and assess how the analysed plans and governance structure is reflected in practice. How are the NBS governance processes outside the papers? How are NBS in the three cities being governed in real life?

3.3 Key Factors of NBS within the region

After the analysis of the presented integration of the official documents collected for the three cities, this subsection presents the integration perceived in practic**e**. Insights from the field were collected through workshops conducted in Turin and expert interviews with key stakeholders in Lisbon, Turin and Barcelona, and compiled. This chapter aims to present how the integration of the NBS planning process found in the documents' analysis is translated into the field, and what is its actual state.

Interactions between actors and levels in planning systems

From an overall perspective on the perceived integration in the three European cities, the interviews confirmed that the intention for the implementation of co-designing and co-production process appears as priority in all the cities' agenda, however it is still a recent initiative from all the municipalities and for this reason it is generally at early stages and demonstrates some lacunas and barriers. To some extent, one city can appear more advanced than another, but in practice the three cities are in an initial but progressive state of integration, attempting to integrate different scales at different levels (national, regional and municipal) and with the different stakeholders' involvement. The workshops and interviews have confirmed prior knowledge acquired through the analysis of the municipal documents but reported overall differences between the presented and perceived state of integration of the municipalities. One possible reason for this is that, during interviews, elements that hardly appear or are evidenced in the official documents were discussed in more detail and pointed out by the participants.

The interviews highlighted issues related to integration that are specific to a particular city and others that are common to all. Two major insights that emerged in all municipalities is a general lack of awareness and education regarding the benefits and requirements of NBS, and the confirmation of the lack of integration of municipal education departments into the planning process of NBS. These elements are intrinsically connected with one another. The lack of awareness and education regarding the benefits of NBS have been reported to occur within the local community and within municipal decision makers. Such a barrier damages the allocation of budgets and resources towards the implementation of NBS as well as the dissemination of adequate knowledge, and as such the need for integration of other sectors, e.g., the education department. The absence of an integration of NBS with the education department further hinders knowledge dissemination and the lack of awareness by the local community. Furthermore, experts note a considerable mismatch between urban dweller's interest in NBS and their current lifestyle, the **"**not in my backyard" (NIMBY) phenomenon. Many dwellers were in favour of the implementation of NBS, however when it came to

implementing it in the proximity of their houses or offices many were opposed due to loss of parking space, possible attraction of insects and so on. An issue that was not evident in the official documents and a crucial barrier to the scale up of NBS that could be overcome if synergies with the municipal education and communication were enabled. In Lisbon and Turin, this conflict was often cited between new green spaces and/or trees along streets and the consequent reduction of available parking for private vehicles. The actual comprehension by citizens of the importance of NBS in the city context is, thus, limited by the daily needs and habits, difficult to change.

Another common element between the three cities that has been confirmed in the interviews is the municipal intention of co-producing NBS with citizen**s**, with different levels of actual application of participatory tools for this objective, and with different stakeholders' perceptions. For example, in the case of Lisbon, the only city in which it was possible to interview a community actor, despite the appreciation of the openness of the municipality towards citizen involvement, the practical details of co-production could be improved. The interviewee perceived a non-transparent and not so inclusive process. Likewise, during the workshops realized in Turin, in which different community stakeholders participated, critics of the actual approach of the municipality towards co-production emerged. There was a low awareness regarding the benefits of co-producing NBS. It was reported a resistance towards co-design and co-production by technical practitioners in the municipality, and an unclear understanding of their benefits, with municipal technical actors questioning their necessity. This aspect, combined with the slow and bureaucratic process of the city's NBS governance, provoked an imbalance among the presented integration in NBS planning process by the municipality and the actual integration and NBS co-production happening in practice. In addition to this, due to its novelty, municipal actors were also perceived to struggle with how to identify the best way to proceed on or implement a co-production.

Limits in the integration of NBS policies between the municipal and metropolitan level were likewise discussed in Barcelona and Lisbon. Segregated competencies, different governments, and political agendas as well as political competition challenges the establishment of a spatially integrated NBS planning approach across municipal borders. Furthermore, a change in the municipal political leadership was further mentioned by Turin and Lisbon as an influencing factor of the current NBS planning structure that can provoke meaningful beneficial or harmful consequences.

Regarding the integration of external actors, a lack of transparency of actions and steps has been highlighted, as well as a delay in including local communities in the NBS planning process. There was an evident lack of integration concerning the inclusion of citizens' needs and opinions in all levels of planning that determined difficulties in local ownership and stewardship of said co-interventions. Bias in the inclusion of stakeholders was also reported, with more chances of collaboration being given to specific stakeholders' groups than others, through invitations or specific accessibility channels. Likewise, an overall difficulty to integrate and collaborate with the private sector was found. Interviewees perceived that, in practice, the integration of this sector "walks a fine and complex line" that is often hard for the municipalities

to navigate. Cities have been making an effort, but there is a need to understand how to scale up NBS co-production with private companies in a transparent and efficient way.

Table 9 and 10. Perceptions on integration in the three cities, presented integration and new insights.

a. Confirmed Knowledge

Lisbon	Barcelona	Turin
- High intention of co-producing NBS, but struggling on how.	- Co-design is presented within the municipal agenda.	- Co-producing NBS is high on its political agenda.
- Large bureaucratic procedures that difficult co-design processes.	- Legal bureaucracy that limits integration and collaboration for co-design processes.	- Municipal investment in learning and trial NBS co-production & co-design.
- Growing but still reduced integration among municipal sectors in practice.	- Relatively good integration between municipal sectors, but more common at the step of planning/ drafting of plans than during the implementation of NBS.	- Integration of plans, strategies and regulations towards NBS.
- Participatory Budget promoting NBS projects.	- Existence of ongoing participatory processes towards NBS.	- Ongoing participatory process towards NBS: participatory tools launched and working.
- Difficulty on integrating the private sector.	- Lack of integration & collaboration with the private sector.	- Effort towards private sector integration, but still novel.
- Lack of integration with the education and health department & initiatives.		- Lack of integration of NBS with health initiatives/systems.
- Lack of active inter municipal integration.		- Existing inter municipal collaboration despite conflict of agendas.

b. New Insights

Lisbon	Barcelona	Turin
- Lack of integration with the communication sector / activities.	- NBS are seen as an “academic concept” that hardly reaches people/citizens.	- Require broader integration with education & communication.
- Joint interest from the city and citizens towards the urban green, in particular after the pandemic.	- Increased citizens' interest, but there is a gap between the declared intention of participatory approach in the plans and the actual use of participatory tools.	- Increased NBS interest since the pandemic.
- "Not In My Backyard" NIMBY.	- "Not In My Backyard" NIMBY.	- "Not In My Backyard" NIMBY.
- Low awareness on the	- Limits in the integration of NBS	- Lack of education and

importance of integration/ or resistance towards it by practitioners.	between the Metropolitan Area due to segregated competencies.	information of decision makers, lack of a real interest and of funds allocation, limits due to the general slowness of public processes.
- Need for more public transparency towards integration.	- Delay in the community involvement at the level of the Life Lab, determining a lack of information on the civil society point of view in terms of perception on integration. - Civic integration is present, but not always translated into real co-designing and co-production processes towards NBS.	- NBS proposed “from above” without the involvement of people until a later stage, promoting a lack of citizens’ interest, and a consequent absence of ownership & stewardship. - Bias on the invitation towards participatory process ("pre-selection" of stakeholders).
- Change of political leadership provokes changes in NBS planning structure.		- Change of political leadership provokes changes in NBS planning structure.

In the context of integration and co-production in Conexus, experts perceived that the current exchange among Life Labs, recently begun, has already shown itself valuable for the exchange of experiences and the development of co-production. In particular, it has been evidenced that Life Labs are collaborating and/or creating synergies with at least one more project in each of the municipalities.

An interesting common perception that has surfaced in all three municipalities is the Covid-19 pandemic. Despite the economic crisis that it caused, the pandemic has appeared in the three cities as a booster of citizen’s interest in urban green spaces and nature. The emerging need and desire for accessible open green spaces for all citizens that the pandemic brought is a perceived stimulus for citizens to actively engage with the municipalities in the decision-making process and co-production of urban green. This trend can considerably boost NBS co-production and co-design and drive a change of mentality in the direction of NBS implementation in the three cities and Life Labs.

3.4 SWOT Analysis

The analysis of the integration of the NBS planning process presented by the municipalities and the one perceived by the stakeholders demonstrates challenges, gaps and opportunities towards NBS co-production and co-design. Hereafter, main results are assessed by a SWOT analysis to recognize the internal and external factors (strengths, weakness, opportunities, and threats) that can benefit or prevent the integration of NBS into urban governance and planning (Fig. 4).

The examination of relevant official documents combined with the conducted workshops and expert interviews demonstrates that the cities investigated are still facing challenges and barriers towards the integration of NBS, some from internal causes, and others external. The results reveal that internally, despite the cities’ efforts to advance NBS co-production in their agendas, the municipalities are still facing challenges due to strictly hierarchical and sectoral

government structures and complex bureaucracies (e.g. tender process, financing procedures, private collaborations on public domains), and a lack of awareness and education on NBS and co-production benefits by actors from the municipality (decision makers and technical bodies) and in the community in general.

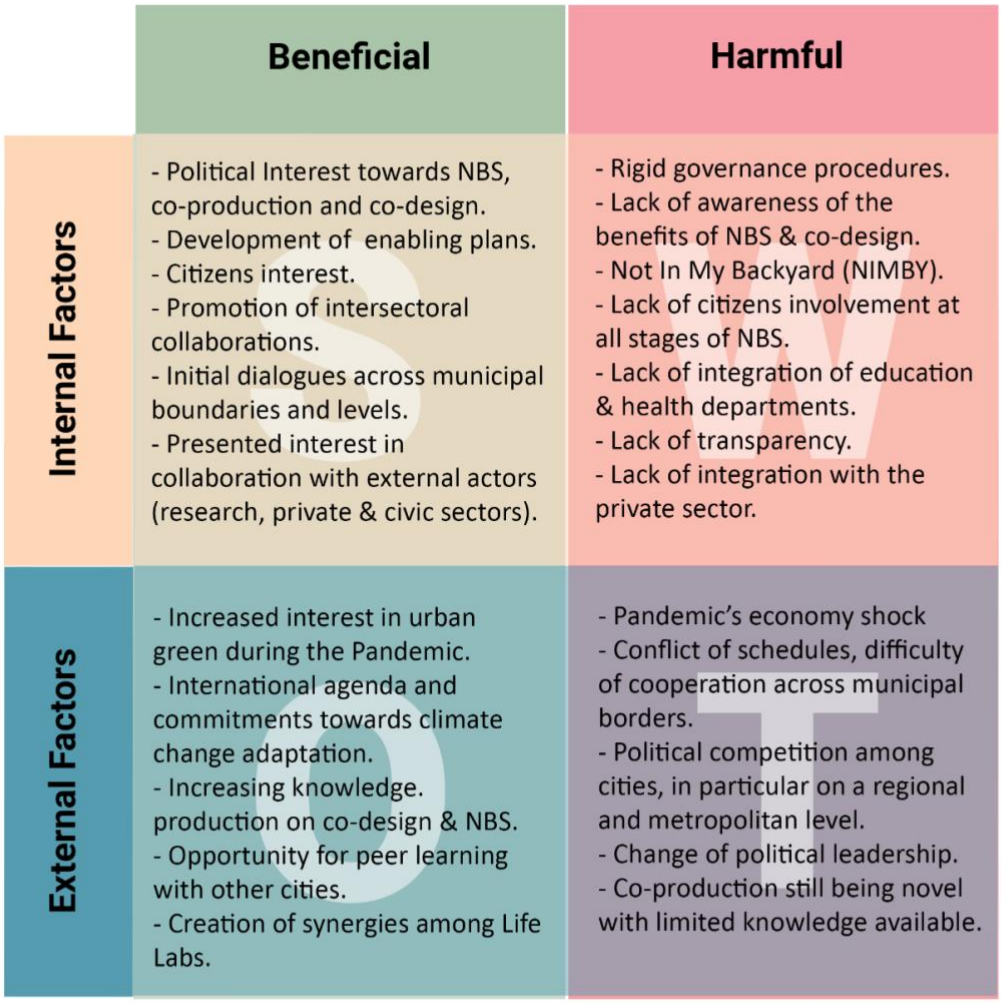


Figure 4. SWOT analysis for the three EU cities.

Factors that confirm that governance in silos and limited collaborative governance, limited knowledge, data and awareness are persisting challenges in NBS integration and co-design (Dorst et al., 2022; Egusquiza et al., 2019; Kabisch et al., 2016; Sarabi et al., 2020; Wamsler et al., 2020). The results, however, add to the literature underlying further integration gaps and weaknesses that can be contributing to the persistence of those barriers. The analysis shows a move towards "breaking the silos" within specific departments (i.e., the transportation sector), but there is lacuna regarding the integration of the education and communication municipal departments. This in turn can contribute to the lack of knowledge

and awareness within internal and external actors. The lack of awareness about NBS benefits and requirements also reduces the community's appreciation for NBS. As found in a case study in the Netherlands (Dorst et al., 2022), the municipalities here studied likewise reported a "not in my backyard" phenomena. The research also shows a lacuna in the involvement of citizens in the initial stage of the NBS intervention, often with participation only being enabled in a later phase by all or key-stakeholders (Ramirez-Agudelo et al., 2020; Zingraff-Hamed, 2020), what damages community's ownership and stewardship of NBS and participation in decision-making.

The private sector integration is also largely imbalanced, posing a weakness for the co-production and co-design of NBS as well as its financing. Financing is a large barrier to NBS's agenda, and despite the potential of integrating the private sector within co-design process for unlocking financing methods (Mahmoud & Morello, 2021; Toxopeus & Polzin, 2021), the municipalities showed limited knowledge on how to engage the private sector in NBS, and difficulty to integrate it with complex legal bureaucracies. External to the municipalities' domain, external economic shocks as the COVID-19 pandemic, threatens the co-design of NBS as it further damages already scarce budget allocations (Dorst et al, 2022; Mahmoud & Morello, 2021; Kabisch et al., 2016; Toxopeus & Polzin, 2021). Conflict of agendas and political competition among neighbouring cities hinders an integrated spatial planning across municipal borders. Lastly, change in political leadership and therefore in agendas, combined with the novelty (uncertainty) of NBS further threatens NBS integration in the long term. Two out of three cities had undergone political change and strongly mention concerns regarding the state of NBS governance in the long term.

A very important outcome of the analysis is the fact that the cities find themselves in a good position to enhance their state of integration and move towards an adaptive governance, demonstrating a leverage point for NBS. Municipalities and citizens show an increasing interest in co-developing NBS. Strategies and plans, in particular the ones more recently drafted, are creating an enabling atmosphere for a co-development of urban green, with the promotion of inter-sectoral collaboration, participatory approaches, inclusion of external actors and integrated planning. The lack of integration of NBS and co-design on a municipal level was a barrier indicated in the literature (Mahmoud & Morello, 2021; Sarabi et al., 2020). Our results demonstrate progress towards closing this gap, and an essential signal that can facilitate the actions towards the long-term (Zwierzchowska et al., 2019).

The awareness of the importance of a spatially integrated approach is also present, with dialogues among municipalities initialized. Externally, the cities are empowered by international agendas and commitments that strengthen and promote the need of NBS in cities and their co-production. The pandemic brings momentum to urban green spaces that can highly benefit the co-production of NBS. Empowered by this momentum and international movement, municipalities are also benefiting from peer learning with more experienced cities, such was the case of Turin that shared learning with Northern American municipalities. Given the rise of NBS in international agendas, there is also a growing amount of scientific and practical knowledge on the subject and trials of integration, which can be advanced by the

municipalities here investigated with the cooperation and synergies of the Life Labs. Conexus and the Life Labs, then, come in good timing and in an enabling environment for the co-production and co-design of NBS in the three cities, giving the opportunity to trial different possible solutions towards the enhancement of integration in its planning process.

4. CELAC Cities

Evidence from Bogotá, Buenos Aires, Santiago and São Paulo.

This section discourses on the four CELAC case studies of CONEXUS, Bogotá, Buenos Aires, Santiago, and São Paulo. It presents the research conducted, the results found and discussions emerging from the four cities and their Life Labs.

4.1 Where We are

Although the NBS concept is not yet an active part of the planning processes in Buenos Aires, São Paulo, Santiago and Bogotá, the current development of these cities is allowing the consolidation of urban and planning approaches that are moving in that direction. Consequently, and from the different consultations and case studies included in this study, it was possible to identify a series of normative elements of intervention in public space and citizen efforts that are making the implementation of projects increasingly closer to the NBS perspective. These aspects are reflected in cases such as the recovery of rainforest areas in São Paulo; the approach to the wetland system linked to the EEP (Main Ecologic Structure) in Bogotá; the recovery of the Coipos lagoon in Buenos Aires applying principles of socio-ecological restoration; and the integration of plans for the improvement of green areas, adaptation to climate variability and corridors for biodiversity from the regional scale in Santiago.

These initiatives are characterised by combining the application of new approaches to green infrastructure, such as new combinations of funding sources and new forms of collaboration between stakeholder groups, and clearly moving towards a paradigm shift. This shift refers to the transition from the traditional perspective of green infrastructure, which seeks to integrate nature into the process of urban growth and mitigate its impacts, to a more fundamental approach, which simultaneously seeks to reconnect us with nature and improve ecosystem health.

From this point of view, it is possible to identify an emerging typology of projects (Table 1) and initiatives that advance the cities towards this shift of paradigm. For this purpose, a generic typology is presented below that allows: a) to have a general framework for the identification of the diversity of possible forms and approaches in this field; b) to emphasize the diversity of NBS and its conceptual and operational value; c) to highlight the diversity of scales and levels that planners, activists and local organizations need to consider for conducting the process towards the adoption of NBS; d) to pay special attention to the integration of disciplines, sectors and interest groups that connect and promote different types of NBS; and e) to consider suitable NBS depending on the features of the city such as the hydrological conditions in Bogotá and Buenos Aires, and climate conditions in Santiago.

Table 11. Emerging typology of NBS in CELAC cities.

1. NBS linked to the time scale: It responds to problems related to frequencies, phases or stages.
a. Permanent NBS: These NBS are linked to the conservation, remediation and restoration of ecosystem services and services to the economy (e.g., Sustainable Urban Drainage Systems - SUDs in Bogotá). b. Temporary NBS: These types of NBS are linked to problems of a transitory nature, (e.g., community nurseries supplying materials in forest recovery initiatives), complementary and supportive (e.g., urban gardens and rain gardens to improve food security in São Paulo).
2. NBS linked to the spatial scale: They respond to differentiated problems in the urban, peri-urban and rural areas of the city.
a. Specific/local: These are specific sites playing complementary roles to ongoing initiatives or designed to answer to specific demands (e.g., pocket forests in São Paulo). b. Community/neighbourhood: These solutions address communitarian initiatives and demands for improving city areas (e.g., the "Eco-barrios" initiative in Bogotá and the program "I love my neighbourhood" in Santiago). c. The city Scale: at the city scale, the multiple benefits for people and nature provided by NBS, in urban and peri-urban landscapes, are promoted through networks of interconnected NBS. (e.g., the wetland policy in Bogotá, aimed at strengthening the EEP). d. Nodal: connect networks of green spaces, (e.g., corridors and linear parks in Santiago and Bogotá). e. Regional: oriented to cover a broader spatial and ecosystem level, overcome the political-administrative division and provide a framework for integration (e.g., protection of remnants of the Atlantic Forest in São Paulo).
3. NBS linked to the functional scale: they respond to differentiated or complex problems.
a. Mono-functional: oriented to provide support or restore a specific social-ecological relationship, (e.g., incorporation of energy efficiency criteria in transport and construction in Bogotá and Buenos Aires). b. Multifunctional: aimed at contributing to the solution of different problems that converge in the same space (e.g., school and urban food gardens to encourage environmental education and improve food security present in the four cities).
4. NBS linked to the jurisdictional scale: they respond to problems shared at the global or national level and are reflected in the regulations in force in land use plans.
a. Global: oriented to participate in international agendas, treaties or global actions (e.g., treatment of climate variability through green roofs and walls to mitigate heat islands, and restoration of forests and wetlands contributing to global carbon problem. Currently being disseminated in all four cities). b. National: Respond to widespread problems such as deforestation, road infrastructure and wastewater treatment (e.g., sustainable infrastructure, wastewater treatment plants along watersheds). c. Local: Respond to local regulations related to land use planning (e.g., conservation soils for the protection of water sources supplying aqueducts. Acualcos and Aguas Doradas urban aqueducts in Bogotá).

5. NBS linked to coupled socio-ecological dynamics: they respond to society's demands that go beyond environmental or social problems and seek to strengthen society's connection with nature.
a. Social Connectivity: Improving social interaction between people from diverse social and ethnic backgrounds using green infrastructure. They strengthen the appropriation of these spaces, consolidate collective identity and improve the integration of vulnerable social groups (e.g., green spaces for art, recreation and sport being developed in all cities). b. Ecological Connectivity: Improving ecological connectivity through the protection or restoration of specific niches or biomes to ensure functions such as pollination or seed dispersal (linear parks, recovery and naturalization of rivers and urban streams). c. Socio-ecological Connectivity: They seek to merge the social fabric with the ecological fabric, which generates impacts that cannot be observed in individual solutions that privilege one of the two dimensions. (e.g., botanical gardens in the four cities).

**Source: Interviews and questionnaires applied in the four cities.*

As mentioned before, this is an emerging typology that demands higher levels of basic interdisciplinary research to achieve not only a better understanding of the potential of NBS in CELAC, but also to enable the expansion of their use at the suggested scales and levels. Likewise, the identification, design, and implementation of any of the elements suggested in this typology, regardless of their scale and level of application, should be based on scientific criteria that allow clarifying not only the form and structure of the solution, but more importantly, the function and impacts it will have on the identified problem.

On the other hand, the NBS, unlike conventional green space planning, characterized by its massive and in many cases indiscriminate application, should be treated from a differentiated perspective to address the specific biophysical, urban, and social context and be accompanied by elements that guarantee its appropriation and continuity. For this reason, the suggested typology should be used in a flexible manner to guarantee systemic responses in each space, time, and level.

However, the progress in green infrastructure cannot be discarded and, on the contrary, the identified typology allows suggesting that the NBS should be complementary and coupled to the advances achieved. In this direction, green infrastructure can be understood as the biophysical framework on which most of the elements identified in this typology can be accommodated. For example, wetland restoration can be understood from the point of view of NBS in terms of the environmental services it provides, but also in terms of its multifunctionality reflected in complementary aspects such as environmental education, environmental quality, recreation, risk management, response to global agendas (e.g., Ramsar sites) and socio-ecological connectivity.

Finally, it is worth highlighting the attribute of multifunctionality of the NBS, which from participatory designs (i.e., co-design) allows to generate synergies among actors, land uses, access, forms of use, perceptions, and consequently to consider the political role that NBS can play in the urban space regarding structural aspects such as marginality, equity and the

integration of vulnerable groups. These aspects are clearly related and play a crucial role in the planning and governance of the differentiated space where the NBS is introduced. From the point of view of a local actor, it is about "recognizing through the NBS the ecological, archaeological, cultural and social value of these areas, in order to be able to argue in function of consolidating and governing this space as a reserve, urban or peri-urban".

4.1.1 Levels of Knowledge and Perceptions of NBS

From the perspective of a local actor: "for me one of the fears that can happen is that the NBS is a new concept that is going around, and that only helps to green the discourse and then nothing ends up happening".

The above perception clearly illustrates the incipient level of knowledge about NBS, both in the public and private spheres. For the different actors consulted in the four cities in CELAC, these solutions must be managed and planned from a perspective in which the gradual integration of society in nature is privileged, for which the knowledge, perceptions, and skills of the different actors in the process of identification, co-design and implementation of the NBS must be systematized. For this reason, it is necessary to have both a scientific knowledge base that allows guaranteeing the sustainability of the NBS, and a detailed knowledge of the expectations and experiences of the users with respect to the functions and services provided. Aspects such as the preferences of the actors and social groups, cultural particularities, the type of socio-ecological interaction required, the opening of spaces for concertation and decision-making, the levels of social and ecological marginality are, among others, key elements to be considered in the planning and management process of the NBS.

In the same direction, results from our study show that it is important to avoid several extremes: a) the unilateral transfer of responsibilities from public administrators to users, under the pretext of citizen participation, the appropriation of the NBS and the commitment to their maintenance and care. Consideration of a collaborative planning dynamic is essential throughout the project cycle, together with the guarantee of public resources to ensure continuity in the operation, maintenance, monitoring, and evaluation of the NBS; b) avoid emphasis on the "sustainability" of the NBS, or ensuring that the production, process, or mechanism we use to implement the NBS remains stable or increases. The constant dynamics of change in the urban structure and its social-ecological attributes, as well as global forces of change, demand the introduction of a sufficient level of flexibility to respond to these challenges; and c) include every possible and desirable objective in the concept, design, and implementation of the NBS (environmental conservation, health and education improvement, gender equity, participatory democracy, peace, etc.). This may confuse the trajectory of the NBS, its differentiation with respect to specific problems, and generate a superficial treatment of structural conflicts and pre-existing environmental damage.

In general, the level of urban development, cultural and biophysical attributes, as well as the profound social and territorial inequalities of the four cities studied give rise to the possibility of different perceptions and expectations about the concept and role of the NBS, the most salient of which are: (a) the improvement of the levels of well-being and physical and

mental health; (b) the maintenance and good condition of the solutions to promote a greater and more frequent use of them; (c) in turn, the deterioration and discontinuity of the solutions could decrease their use and lead to changes in land uses; (d) unsafe, poorly lit or inadequately maintained spaces can decrease the interest of citizens, even when they are located in the daily environment of the user; e) perceptions about possible tax increases and impacts on heritage if there are failures in their administration; f) an enormous distance between the imaginary and demands of citizens and environmental and planning regulations; and g) perceptions about environmental benefits are deployed in a gradient that goes from urban to rural, with a greater and clearer perception in peri-urban and rural areas.

Also, the perception of the need to promote basic research processes and the generation and transfer of technologies that respond to the demand for new forms of NBS is a generalized conviction. These aspects also contribute to the need to specify the regulations and jurisprudence to promote and regulate the implementation of NBS. Likewise, the four cities coincide in two important aspects: a) the need to overcome the deficiencies in the field of coordination among state institutions and between these and the other actors involved in the management of the NBS, and b) the need to improve the relation between the missionary objectives of the public institutions with the integrating concept of the NBS.

In the field of the economic dimension, two perceptions related to the viability and sustainability of the NBS were identified. On the one hand, the availability of resources throughout the cycle of the projects and the flexibility in their application to make viable both the support to community initiatives and the contest of the private sector. On the other hand, it is indispensable to consider the socio- economic improvement of the communities, to guarantee concrete forms of citizen participation, in particular the necessary time to take part in the project cycle and the administration of the responsibilities shared with public institutions, and the access to users, but also to economic benefits generated by the NBS.

Regarding knowledge, an important gap is perceived. Access to knowledge on the NBS cannot be limited to public institutions and academia. In this sense, access to knowledge by social organizations and public and private actors is considered highly important. In this direction an important challenge is faced, which consists of the need to move from a technocratic and excluding discourse to a shared understanding of socio-environmental problems and the solutions they demand. Establishing partnerships with universities and the third sector to develop projects, research and methodologies to promote the co-design and measurement of the impacts and benefits generated by the NBS is a shared perception in the four cities.

Finally, an important set of perceptions related to structural effects of the NBS was identified in relation to environmental justice, the hope of finding new forms of urban growth, the increase of trust, reciprocity and cooperation among neighbours, and community empowerment, especially in the field of access to decision-making by groups affected by higher levels of marginality and equity. A major qualitative leap is needed, reflected in the need to move from experimental designs to planned strategies with citizens.

4.1.2 Boosters of NBS in the Planning Systems of CELAC

As already mentioned, the concept and practice of NBS is still in an early stage in CELAC cities. For this reason, an important set of drivers were identified that can be used to enable a faster take up of NBS in the context of CELAC cities, such as public policies, the urban planning system, pre-existing programs, and global agendas.

Regarding public policies, a fairly broad set was identified that affects both the form of management and the particularities and requirements for the introduction of NBS in the field of urban and rural land use planning. Although it was not possible to detail this structural framework in the four cities, Annex V presents this framework for the case of Colombia.

On the other hand, a set of ongoing initiatives and programmes were identified that make concrete provisions and regulations, common in the four cities studied, and that can function as an operational framework on which it is possible to manage the introduction of NBS. Although it is necessary to advance in the design of differentiated regulations, this set of regulations already works as an important driver that is channelling the gradual introduction of NBS in planning practice. Main objectives of initiatives and programs emerging in the four CELAC cities from interviews and questionnaires realized are:

- Sustainable urbanism and construction (e.g., SUDs and energy efficiency): wetlands policy, management plans for urban and rural ecological reserve areas, private reserve areas, urban forests, improvement of vegetation cover s (gardens, green roofs and walls, urban and peri-urban food gardens), integrated solid waste management, guidelines for urban and rural land use planning (see Annex V).
- Programs to channel global agendas that respond to structural crises: climate variability, SDGs, food security and biodiversity.
- Efforts to combine public/private initiatives: the program “Yo quiero mi barrio” (I love my neighbourhood) in Santiago, and the program “Florestas de Bolso” (pocket forests) in São Paulo.

On the other hand, aspects such as the organization and participation of citizens are considered key drivers that allow for collaborative action in the face of new urban problems (e.g., risks due to climate variability, migration). In the context of the process of decentralization and deepening of democracy in CELAC, citizen participation is a key driver for the dissemination of the NBS at any scale, as well as a central mechanism to ensure adequate evaluation, monitoring and sustainability of NBS. From the point of view of a local actor: "citizen participation is an element that we have to incorporate and make part of transversally for all public investment, whether it is large scale or local scale".

The introduction of NBS in urban planning must have clear answers to the problem-solution-benefit relationship, but also to the recognition of the efforts made by local actors to participate, their knowledge of the context, constraints and imaginations, and more importantly to the prestige that depends on this recognition. In this field of citizen participation, it is important to pay special attention to citizen movements of different types that include important environmental agendas and that represent an important driver to speed up the introduction of

NBS, among others it is worth highlighting the initiative of eco-neighbourhoods in Bogotá and Birds of Buenos Aires. Another example, in the four cities, is a gradual abandonment of the concrete lining of rainwater canals and urban basins and their replacement by differentiated schemes of restored watercourses, and the recognition and revaluation of wetlands and artificial forests.

In an economic perspective, drivers were identified related to the need to build public and mixed financing schemes to guarantee the necessary resources for the implementation, monitoring and evaluation throughout the project cycle and the lifespan of the NBS. In this field, a key driver is financial planning to ensure that, through the confluence of public, private and international cooperation resources, the necessary resources for the continuity of the strategy and the sustainability of the NBS are available. However, it is important to draw attention to the difficulty of identifying studies that approach the NBS from the perspective of the economic assessment of their viability and impacts.

It is important to differentiate between the drivers listed above and the means to channel these efforts and resources. The following were identified as part of the set of means for the creation and promotion of the NBS: 1) environmental education for public officials and social organizations, and training of human resources; 2) spaces for socialization, awareness raising, collaboration and co-construction of NBS, where both the socio-environmental problem and the differentiated context for the introduction of NBS can be specified; 3) economic alternatives for marginal communities; 4) responses to global agendas and channelling of international cooperation resources, such as the prevention of risks and threats due to climate variability and/or landscape transformation; and 5) scientific knowledge in the stages of identification, design, implementation and evaluation.

Finally, although the four cities studied have relatively robust urban planning systems, it is important to consider the influence of the administrative political division and the need to make this spatial approach more flexible in order to guarantee a more effective introduction of the NBS. Socio-ecological relations do not recognize these boundaries, so it is necessary to think of mechanisms (e.g., intermunicipal association networks) that make the introduction of NBS at this level feasible. In this field, in the four cities there is a gradual consolidation, through the policies and regulations for land use planning contained in the land use plans, of three important aspects: 1) the increasing introduction of urban and environmental parameters (i.e. biodiversity) in public green areas, (e. g. rain gardens in São Paulo) and the use of native vegetation (e.g., in Santiago); 2) active use of the reserve land category to consolidate urban and peri-urban protected areas (e.g. land use plan of Bogotá); and 3) mechanisms to incentivize green infrastructure in urban developments (e.g. incorporation of energy efficiency criteria and SUDs in all cities).

The actors interviewed also highlighted the importance of complementing existing planning systems from the perspective of collaborative planning. This aspect is particularly important since, even though there are instances of citizen participation in the four cities, they are usually used as instances to validate decisions already adopted, which distorts the sense of citizen participation and prevents the access of local actors to the active decision-making

process. In the words of a local actor: "when the projects have the support of the community it is easier to convince local and regional governments as well as larger scale governments to invest in projects that have an NBS perspective".

In summary, as it can be seen, in the area of public policy there is an important set of programmes and a broad normative base that makes the positioning of the concept and the implementation of NBS feasible. It is important, however, to advance in the delimitation and regulation of a normative framework to promote both the approach to the mission objectives of the different public instances, as well as to make viable the integration of programmatic and financial efforts for its implementation, monitoring, follow-up and evaluation of its results and impacts.

4.2 The process of NBS Integration

Although in the cities studied the concept of NBS is in a process of becoming established; the empirical experiences of local actors, the lessons learned throughout the process of agency of different forms of green and blue infrastructure, and the demands coming from the private sector, social organizations, NGOs and social movements in favour of the reconnection of cities with nature; has allowed the identification of a series of aspects in the field of governance that are described in this section. These experiences and lessons learned are pertinent and useful, regarding how to govern the process of reconnecting with nature through the introduction of NBS in CELAC urban contexts.

4.2.1 The governance structure and the role of adaptation

In general terms, the governance of NBS can be understood as a social structure and at the same time as a political process, through which collective action is made possible allowing a confluence of actors, including the public sector or a particular level of government, who make decisions through consensus to govern, and define the functions and trajectory of a particular NBS. In the analysed cases, it is possible to observe a conjunction of legal, social, economic, political, and cultural rules of the game (institutions) that are used during the process of designing, implementing, and managing the solution (Budds & Hinojosa, 2012; Bodin & Crona, 2009; McGinnis & Ostrom, 2014; Pahl-Wostl & Knieper, 2014). However, it is important to start by the proper understanding of the composition of a governance structure of NBS, and the role of adaptation in the context of the agency and operation of the NBS in CELAC cities. Regarding the composition of the governance structure, this research identified seven central common elements, that were considered by the participants as strategic, in order to promote and create the necessary governance structure for each type of NBS:

a) to guarantee a diversity in the composition of the actors: public, private and mixed actors must converge in the agency and implementation (i.e., networks of actors) of NBS;
b) to consider the positions held by these actors (e.g., heads of planning offices and presidents of community aqueduct boards) in the public and private realm, as well as the potential to enhance the networks of actors mentioned before;
c) to consider the functions performed by these actors, (e.g., implementation of land use regulations and agency of solutions to socio-environmental problems) and their

missionary goals to identify current and potential interactions and coordination of actions oriented to support NBS.

d) to identify the levels and dimensions at which the actors execute their functions (i. e. municipality/locality, region, department/province, nation, international) to enhance the network of actors and channel new resources and alliances.
e) to map the relations among the actors that participate in the construction of a specific NBS (e.g., relations around technology transfer, and power relations between the participating actors) to improve the process of decision making and flow of resources.
f) to identify the institutions, formal and informal rules of the game, that regulate the relations between the actors and control the flow of resources.
g) to map and manage the flows of resources, different forms of capital (financial, human, social), knowledge and technology necessary to consolidate this type of solution.

These seven features of a governance structure work as a blueprint to characterize the multiple possibilities of composition of this structure, i.e., each type of NBS will be generated and governed by a particular governance structure. From this point of view and particularly in the urban and peri-urban environment, it is not possible to deal in a general way with the form and structure that governs each NBS. Likewise, in a particular urban context we will find different governance structures, as many as the typologies of the NBS in each city. In some cases, it is also possible to identify overlaps between these structures, for example, in the Coipos Lagoon in Buenos Aires, there is a governance structure for the restoration of the artificial wetland and a governance structure related to the reserve area that hosts it, suggesting the possibility of nested governance structures.

Besides the form and composition of the governance structure, a central coincidence among participants in this research is that adaptation should be the main feature and the central approach when orienting specific types of NBS. Rapidly growing CELAC cities and the increasing complexity of the urban and peri-urban environment, together with the necessary channelling of efforts from the complex composition of actors that participate in NBS initiatives and that develop their efforts from different levels of intervention, demand an adaptive form of governance.

Adaptation refers to the capacity of the set of actors to respond to the evolution of the problems addressed through each NBS and the need to ensure or recover the actors' capacity for reorganization and the complement of the necessary institutions (rules of the game) to face the processes of change, global crises and, in general, the set of internal and external variables that affect a particular NBS. Learning and assimilation of lessons learned in this process is an additional element to consider. Learning and experimentation also allow the uncertainty and complexity inherent to NBS to be managed collaboratively (Folke, et al, 2005; Morris & de Loe, 2016; Pahl-Wostl, 2009).

Moreover, adaptation is characterized by a differentiated approach to NBS, to manage the necessary resources in a coordinated way, within an adaptive and collaborative learning environment. Learning emerges from the unfolding of practical experiences and collaborative

decision-making processes, which is fundamental to the governance of the NBS. This is an aspect shared in the context of the four cities analysed, where the importance of transferring concepts and lessons learned among the actors is highlighted, through multi-sectoral meetings and workshops and with the participation of representatives of public and private actors from different levels.

Although these aspects are corroborated in the different cases analysed in the CELAC cities, it is still not possible to find concrete evidence of the impacts of this type of governance on the levels of efficiency and sustainability of the NBS, in comparison with the traditional or monocentric form of government existing in other cases (e.g., blue infrastructure). Although the concept is used in a general way, it is necessary to specify it in the context of each city and to clarify the mechanism of operation in each case.

Five additional elements were identified, through interviews and questionnaires, for consideration in NBS governance. First, the agency and administration of the NBS must overcome the sectoral basis, i.e., the control and responsibility of different governmental agencies with little or no coordination among them; the NBS are holistic mechanisms that require an integrated and inter-sectoral management approach. Second, the need for a NBS management and administration that recognizes the different levels and scales that converge in each one of the solutions and consequently guarantees the participation in the governance structures and in particular in the decision-making processes of the actors directly related to each NBS. Third, NBS demand an active participation of the private sector. Fourth, the efficiency and trajectory of a governance structure will depend on the transparency with which the actors relate and the availability of resources to guarantee their active convergence. Fifth, positive results will not always be observed, depending on the coevolution of the governance structure with the socio-ecological dynamics involved, its level of composition and the level of response to the above points. In the words of a local actor: *the natural landscape of the city is not the same 100 years ago as it is now, and the city was not built in the same way either, understanding that to implement NBS has a lot of value, before I think we were more disconnected, it has been an evolution over time*.

4.2.2 Governance: Composition of Actors and Networks

Through the cases referred to in the interviews and questionnaires applied, a diverse set of actors participating in the NBS agency process was identified. Although it was not possible to identify a complete set of actors due to the current emergent state of the NBS in CELAC, we found that these actors can be aggregated into three sets of networks: network of public actors (e.g., the four metropolitan governments, the integrated municipalities, and international cooperation agencies), network of private actors (e.g., private companies, individual and organized actors) and network of mixed actors (e.g., academia and social movements). These actors are linked to the governance structure described above and develop a series of relationships, mediated by formal and informal institutions, in order to collaboratively manage, implement and govern the solutions they demand to improve their level of well-being using different elements of an ecosystem nature. This trend, which is growing in all the cities studied, reflects a form of relationship between the urban and peri-urban social fabric and the

biophysical and ecosystem fabric on which the long-term sustainability of urban centres and their inhabitants depends. These dynamic relationships can be clearly observed in cases such as the peri-urban Aguas Doradas aqueduct in Bogotá.

The actors identified were aggregated into different categories to detail the three sets of networks mentioned and the central forms of articulation between them (Fig. 5). From this exercise, three aspects have been highlighted: a) the influence of global agendas and political parties on the composition and orientation of the mission agendas of public institutions; b) the relationship between the places where NBS are introduced, the internal and external variables that affect these solutions and the livelihoods of local actors; and c) the interaction between the networks of actors described. Consequently, Fig. 5 reflects the general composition of an NBS governance structure in CELAC. This composition will have specific particularities in each case, as well as the set of internal and external variables and the specificities of the relevant public legislation, however, the suggested core patterns of relationships are common for all cases.

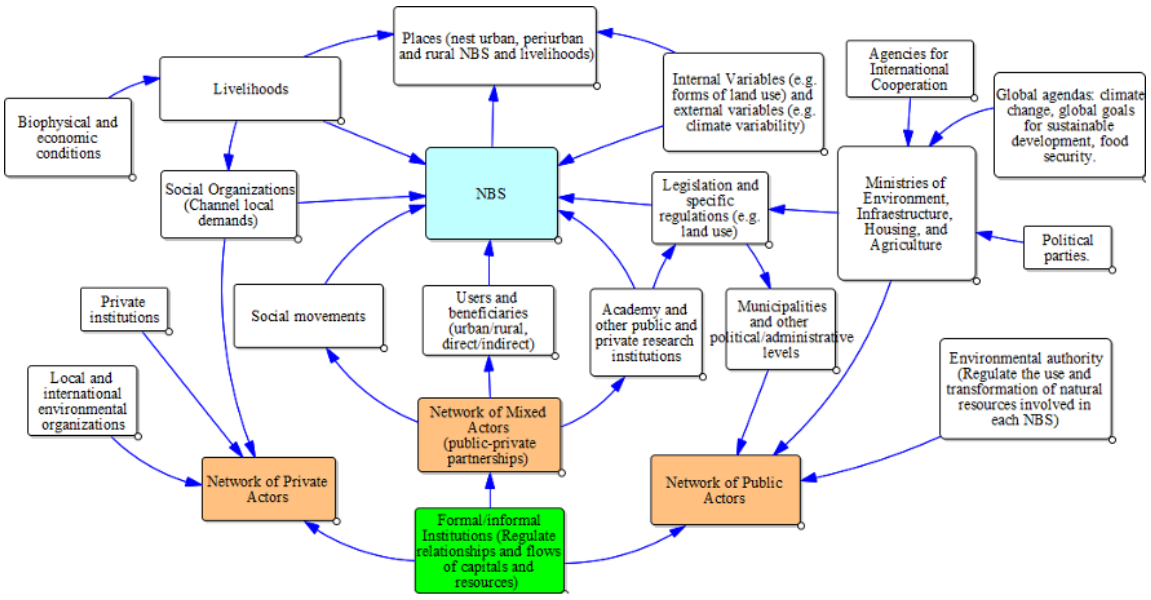


Figure 5: Governance structure of the NBS in LA.

Source: Interviews and questionnaires conducted in the four cities. Prepared from Vensim Software (2021).

4.2.3 Cooperation and Conflict Management in Governance of NBS

In the context of the four cities studied, the interaction within the dynamics of planning and governance, and between these and the biophysical dynamics involved in each solution, generates diverse approaches to enhance cooperation and conflict management among the actors participating in the governance system. These elements of cooperation and conflict management identified must be recognised and assumed in the planning process to guarantee

an adequate development of the NBS. In this section, these elements of cooperation and conflict management are aggregated in three scales: policy, technical and economic.

a) Elements of cooperation and conflict management in urban policymaking

In urban policymaking, some of the main sources of conflict are the provisions and limitations established in legislation and plans for land use. The need for an adequate land use planning process emerges as a result of the conflicting interaction of various forms of demand for land. These conflicts are frequent and arise as a result of three central aspects that take their effect individually or in combination when developing NBS: a) population growth, its level of and the pressure that this growth exerts on space in general, and on soils and natural resources in particular; b) governmental and private-community initiatives for development, which involve a greater or more active use of specific areas and places; and c) public and private-community initiatives for the conservation of biodiversity and ecosystem services.

Consequently, in the NBS planning process, it is key to consider current and potential land uses and the form and consequences of the interaction between different interests. This is an aspect that directly influences the process of emergence of governance structures and the trajectory they take. The objective of this analysis in the context of the NBS should be oriented towards establishing the best possible balance between socio-economic benefits and ecological conservation-restoration. In the words of a local stakeholder: "what is proposed does not appeal to all people, so the land conflicts are an endless list".

The second element regarding urban policymaking refers to the level of coordination among public institutions and the positive or negative effect it has on the NBS planning process. For example, unclear areas in the normativity can generate conflicts between policy areas of the same municipal administration and between these with other neighbouring municipalities and other levels of government. This is an important aspect in the case of regional NBS, such as those linked to the provision of drinking water for the metropolitan areas of the cities studied.

The third element refers to the level of citizen participation in the NBS planning process. In this field, the main aspect refers to the need to reconsider citizen participation, understood as a consultation process through public instances (e.g., Territorial Planning Council in Bogotá), and the validation of pre-established decisions in working tables. The NBS demand a type of active citizen participation in the decision-making process throughout the cycle of each project. By making viable a form of participation focused on co-responsibility and collective action for the agency and implementation of NBS, the emergence of a particular governance structure is made viable, i.e., a mechanism of interaction is created among the actors that participate and that will allow dealing with emerging conflicts, making consensus viable, clarifying rules of the game and shared responsibilities between the levels of government and the users of the NBS. Consequently, it is important to recognize the difference between a citizen participation process to make the implementation of a NBS feasible and a

citizen participation process as a mechanism to guide the governance and trajectory of this solution.

Regardless of the level reached by a specific NBS (see typology in section 2), the governance structure must make feasible the active participation of the actors directly and indirectly related to the NBS so that through a cooperation process, from the socio-environmental problem and the qualitative details of the solution to the concrete activities for its operation, monitoring and evaluation are defined. This is because only in the context of the governance structure of each NBS can the different endogenous and exogenous variables that affect the solution and how to manage them be clarified. From this point of view, the governance structure does not make top down (or command and control) decisions viable but integrates the dynamics of the decision-making and knowledge building process in two directions (top down and bottom up). In the words of a local actor: "not everything has to come from the top down, on the contrary, everything should emerge from the swarm that is generated through the governance structure".

The cooperation between institutions must be dealt with in parallel to the problems generated by the political-administrative division and the spatial and jurisdictional area of influence of public, private and mixed institutions. In this sense, the NBS through the governance structures can enable these interactions. In relation to this aspect, it was observed in all the cities studied that the issue of cooperation is not restricted to the field of action of public institutions, but it is also present between NGOs and social organizations.

Coordination and cooperation between actors located at different scales of governance structures is equally important for the reasons described above, but this aspect is particularly important in peri-urban spaces, as they are marginal areas both for municipalities, which only see them as land reserves for city growth, and for departments or regional governments, which in turn read them as future urban areas, and consequently become gaps for both legislation and public policy and investment.

The fourth element on the policymaking field refers to the continuity of public agendas and policies. In the cities studied, the instability of these agendas was identified, which occurs due to political transition and the introduction of new political agendas as public administrators and government teams succeed one another at different political-administrative levels. In all the cities, this phenomenon was identified as the "political will" of the public administrations, which calls the attention to consider two important sources of conflict in relation to the NBS, the ideology promoted by the prevailing political party in the government of the day, and the clientelism that makes viable the exchange of goods and services for political support and shared by related interest groups. In the words of a local actor from Buenos Aires: "with the Meninism the old Puerto Madero was created as a large urban and real estate development complex, then the ecological reserve already created was losing institutional power".

Finally, the above aspects allow highlighting how in the four cities analysed the planning process for the promotion of the NBS is clearly a political process, in which the gap that exists between the perception of the community and the planning process plays an important role.

b) Elements of cooperation and conflict on the technical scale

Technology is a key element in the process of positioning and integrating NBS in the urban planning agendas. Although it was not possible to identify specific challenges in the field of technology, there is agreement on three elements of a technical nature related to governance. The first refers to the collaboration of actors in the governance structure, but more importantly to the need to enable the integration of knowledge, experiences and resources to build shared decisions, channel the necessary technology, and make the implementation of NBS feasible. Perspectives that allow for the recognition and management of intergenerational (diachronic), cultural and gender differences are fundamental in this regard.

The second concerns cooperation between public institutions. Although here there are difficulties for joint intervention due to differences in mission, there is an interesting and constant dynamic of collaboration and exchange of knowledge among the technical teams of public institutions, and between them and academia. Similarly, there is an exchange of knowledge between levels of public institutions, e.g., between botanical gardens, research institutes and academia. Finally, in the four cities it was observed that, although there are different types of conflict in the policy making dimension, in the practice of planning there is an important approach between the actors that allows them to share their interests, perceptions, experiences and difficulties to promote new initiatives that go beyond the mission objectives of the public and organizational institutions to which these actors are linked. It is important to highlight this aspect because it plays an important role in the field of informal institutionalist, a central aspect in the dynamics of governance structures.

c) Elements of cooperation and conflict at the economic level.

Three central aspects were identified in this field. The first one refers to the difficulties faced by the actors to access public resources for the identification and, above all, for the experimentation that allows development of new types of NBS. Lack of funding restricts the development of the NBS, but it also affects the emergence of new governance structures that promote the introduction of new forms of solutions. In this same direction, an important delay is observed in the provision of financial resources that allow the improvement of capacities and training of human capital to improve the intervention capacity of the actors involved.

The second aspect refers to the need to promote experimentation, not only in the technological field, but also in the financial field, which can allow, on the one hand, a clearer recognition of the contributions coming from local actors, which are not always monetary (e.g., seeds, tools, time, etc.) and, on the other hand, the identification of new forms of financing (crowdfunding, reciprocal guarantees, etc.) that can actively involve the private sector.

Finally, the successful implementation of any type of NBS will generate an increase in property and real estate values and in the provision of public and private services, which must be clarified and guarantee the appropriate distribution of benefits in the network of participating actors. Otherwise, this aspect may encourage migration or gentrification processes. In the words of a local actor: "here with all this investment, if with an ecological reserve next to it,

with the Santa María de los Aires project there, on the waterfront, of course people will probably end up being displaced".

4.2.4 NBS Governance Challenges

The concept and practice of governance needs sufficient time to be established. The elements identified in this report can clarify the way in which it should be applied and speed up its positioning in CELAC's urban planning systems in order to encourage the NBS. In this direction, five challenges shared by the actors consulted in the four cities were identified:

- It is important to move from the generic use of the concept to the mapping and characterization of specific governance structures.
- Understanding the influence of the governance structure on the trajectory of the NBSs is key, in order to connect the governance structure with the specific function and orientation of each NBS to solve the socio- environmental problems that drove its design and implementation.
- Consideration of the influence not only of public policy and the difficulties of cooperation that emanate from planning and the emphasis on mission objectives is important, but even more important is the influence of the political dimension and the conflicts that emanate from it, in particular the consideration of conflicts of interest and clientelism.
- The search for mechanisms and incentives to increase collaboration and learning across the sets of actors that make up governance structures.
- Consideration of the influence of global agendas is important to differentiate their potential as a driver of NBS from the unidirectional and sectoral influence they usually exert on the trajectory of NBS governance structures. The autonomy of governance structures becomes a particularly important principle in this field. Global agendas can be an important driver of the NBS only if we steer them through the planning process to integrate them into governance structures and thus respond not to sectorized objectives but to local socio-environmental demands and problems.

In synthesis, it is important to reconcile through the planning process of the NBS, the precepts and theoretical bases of governance, with the practice and empirical experience of the local actors that make possible the construction of governance structures to encourage the introduction of new NBS. This is also an important aspect to overcome the idea of connecting the NBS only to the environmental dimension, as it can be observed in the previous elements, the governance structures of the NBS make a discussion that goes beyond the environmental problems and takes them to a more complex socio-ecological dimension.

4.3. Key Factors of NBS within the region

The emerging process of introducing NBS in CELAC, demands the construction of medium and long-term strategies and actions in each city that allow laying the foundations for their positioning in the planning systems. With the objective of generating a framework of recommendations that will allow moving towards desirable scenarios, this section presents the main results of the prospective analysis carried out with the participation of local actors.

The prospective analysis allows clarifying and analysing the set of strategic variables that currently affect the planning systems in CELAC regarding the introduction of NBS. This set of variables allows starting the identification of possible convenient trajectories and coordinated actions to achieve the future objective of consolidating the process of construction and positioning of the NBS in the planning systems of the cities studied.

The most important contribution offered by this analysis is the possibility of using the results as a tool for consensus building, facing the future imagined and shared by the actors who participated in this study. In this shared future, the actors consulted expect a clear positioning of the NBS in the planning systems of each city, as a collection of transformed spaces in which social capacities and ecological potentialities of the territory converge, which represents a context that allows exploring and building new forms of growth and development of the cities analysed.

As suggested by Godet (1993), the success of any social undertaking depends on collective appropriation, in which the capacity for motivation and, from there, mobilization through collective action stand out. As observed in the previous sections of this document, a strategic condition for the consolidation of the NBS in CELAC is clearly represented in the active participation of citizens in the decision-making process to guarantee the appropriation of the NBS and the increase of the sense of belonging to the places and spaces where they can potentially be introduced. The appropriation and the sense of belonging is cause and consequence of the processes of social anticipation and of action that will allow the positioning of the NBS. Therefore, it is essential to recognize the context in which social interactions take place and where current and potential actions that will allow the consolidation of the NBS perspective in CELAC are framed.

The results obtained are presented in terms of the development of the central component of the prospective method, called cross-impact analysis (Micmac). This component identifies and exposes the variables that influence the planning systems that will manage NBS in the cities studied and that should be considered in the short term in a direct way to mark the course of the desired trajectories.

4.4.1 Cross-impact Analysis

Foresight seeks to understand the main variables that influence environmental change, such as political, economic, social, cultural, environmental, technological, organizational, or institutional, which define the current scenario. In this way, as a result of the reflection spaces, 16 variables that directly influence the planning process of NBS were identified. The list of variables and their description are presented in Annex VII. The total number of variables were evaluated by their level of influence on a scale of 0 to 3, to understand which ones are driving, volatile, regulating and levers. The result of the rating is shown in Annex VII. The result of the analysis of direct and indirect influence relationships between variables is presented in Fig. 6.

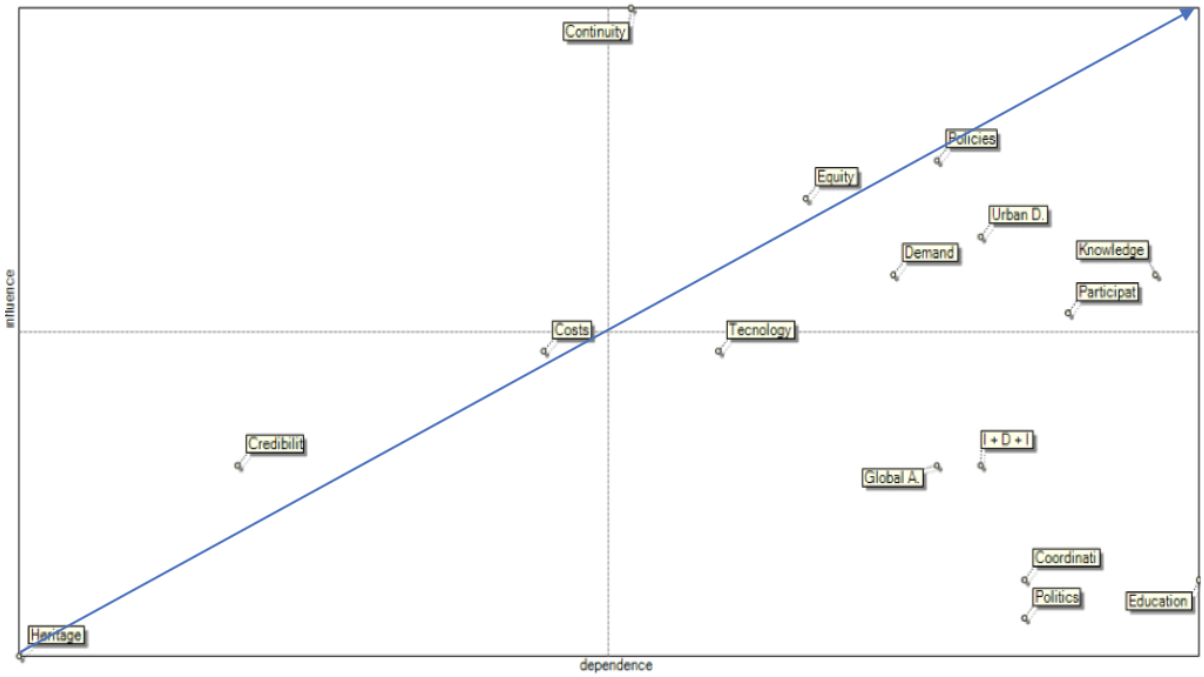


Figure 6. Relationship of direct and indirect influence among variables.

Source: based on Micmac software (2021), where quadrant I represents the variables with the greatest influence on the planning systems or driving forces, quadrant II the variables with the greatest influence and dependence or volatile variables, quadrant III the variables with lower influence and dependence or regulating variables, and quadrant IV the result variables or levers with higher dependence and lower influence. The blue bisector represents the strategic trajectory.

Fig. 6 provides five important results:

1. The most influential variables on the planning system (I) are: continuity of the planning process for NBS agency and implementation costs. These variables exert the greatest mobility (mobile variables) and if they are not attended to, they may in the future drive a collapse of the system. These variables suggest that one of the main objectives to be considered is to maintain the NBS planning process and ensure the continuity of the identified solutions throughout the project cycle.

2. The most influential and dependent variables (II) are: public policies, equity, urban growth and development, demand, knowledge, and citizen participation. These variables are also called volatile, because their level of influence and dependence can drive changes on the driving ones, but at the same time on the most dependent ones. This double characteristic makes this the main set of strategic variables to consider, since short-term actions that directly address them can boost the planning system of the cities studied and make a greater level of effectiveness and efficiency of the objectives feasible. Not considering these variables can generate a negative effect on the planning system and on the project cycle, also generating the possibility of an undesired trajectory of the governance structure.

3. The least influential and dependent variables (III) are: costs, credibility in the public sector and equity. Although these variables do not represent major threats or obstacles to the development of an agency strategy in the short term, they must be actively considered in the long term, if the driving and volatile variables are transformed.

4. The most dependent and least influential variables (IV) are: technology, research, development and innovation, global agendas, inter-institutional coordination, policy agendas and environmental education. These variables are levers of the volatile and driving variables and must be considered to drive the actions or strategies that are designed in relation to the strategic variables. It is important to highlight that this set of variables acquires, due to their location, an important level of transversality that can accompany/permeate the actions of all the variables.

5. The variables that need to be addressed to drive a strategy in the short term (until 2030) are those that acquire a higher level of influence and that are closer to the strategic bisector (see Diagram 2). From this perspective, the main goals of the planning system in the cities studied should be to speed up the introduction of public policies to position NBS as a mechanism for reorienting urban growth and development under the guiding principles of equity and citizen participation in the decision-making process, and to promote the development of the necessary technology for their consolidation. It is important to recognize that in the context of each city there are variations in the process of prioritization of these variables and the design of short-, medium- and long-term planning strategies.

4.4.2 Analysis of direct relationships between variables

From the analysis of the variables, it is also possible to identify some salient relationships between specific variables. This aspect is of particular importance to ensure the treatment of the way in which some variables affect the behaviour and evolution of others, and not always in a way that is transparent or visible to local actors. Fig. 7 shows these relationships.

These diagrams can be elaborated from the perspective of the degree of direct influence between the variables (rating scale 1 to 3). Figure 7a shows all possible direct relationships (100%), while Figure 7c reflects only 10% of the possible and highest degree relationships on the scale. In this way, it is possible to zoom in or out to capture different types of relationships and to analyse all possible relationships in detail. In this way, it is possible to identify loops of relationships between variables that are very useful to feed into the development of the planning strategies in the short, medium, and long term.

Figure 7. Direct relationships between variables

Figure 7a. Direct influence graph 100%

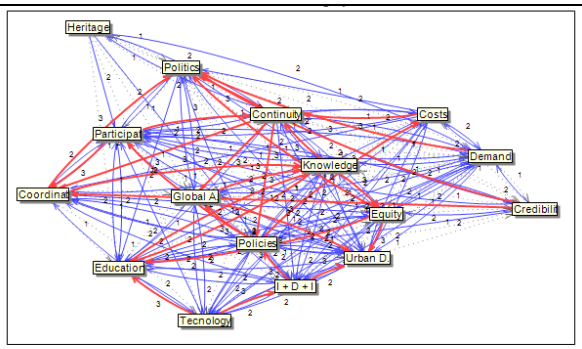


Figure 7c. Direct influence graph 10%

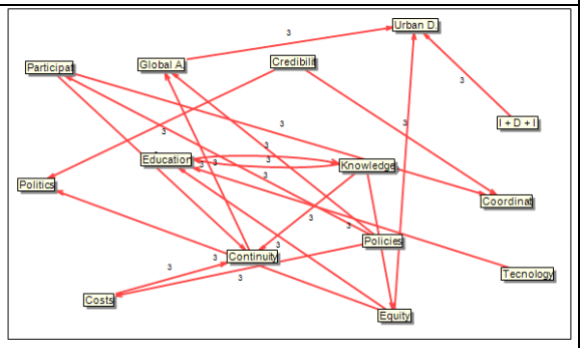
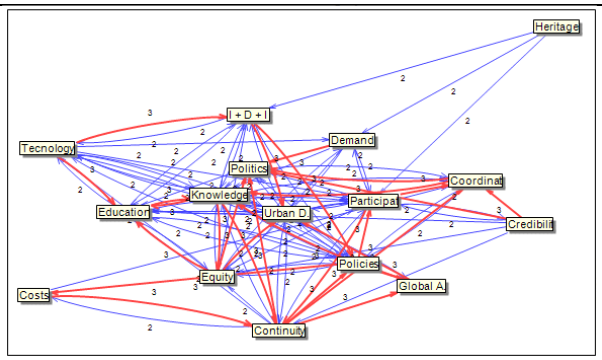


Figure 7b. Direct influence graph 50%



Conventions

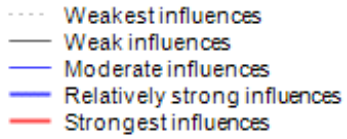


Figure 7: Direct relationships among variables.

Source: Interviews and focus groups conducted in the four CELAC cities. Prepared with Micmac software (2021).

Fig. 8 presents two examples. In the example of the left of the diagram, it is observed how the increase of scientific knowledge and the recognition of the legitimacy of traditional ecological knowledge generate an opportunity of marked influence in the orientation of environmental education; which in turn influences the evolutionary trajectory of research, development and innovation, generating in turn the possibility of constructing a pertinent and more adequate technology to the specific requirements of NBS in each city. In the example on the right, it illustrates the current dynamics of the influence of global agendas on the change in the orientation of urban growth, which makes viable better spaces and opportunities for the increase of citizen participation, thus influencing the continuity of the functioning and provision of the services expected from NBS.

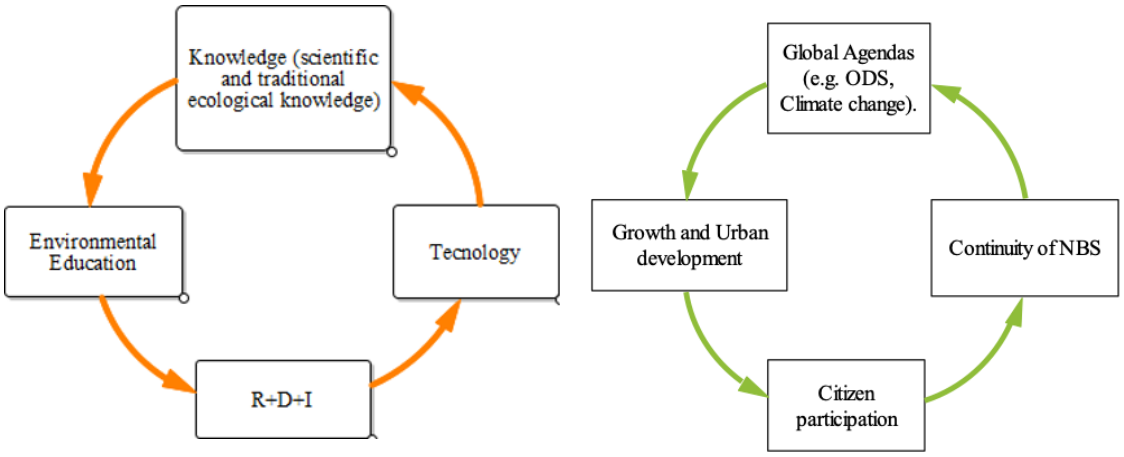


Figure 8. Direct relationship loops among variables.

Source: based on the results of the assessment of direct relationships between variables.

4.4.3 Interactions between actors and levels in planning systems

The previous sections described the challenges faced by the governance structures of the NBS, as well as the challenges faced by the NBS themselves (SWOT analysis) and the challenges faced by the planning systems (Micmac analysis) in the four cities studied. This section presents a synthesis of the implications of the results presented above for the interaction between actors and levels in planning processes and governance of NBS in LA.

Implications for NBS planning

One of the main implications for planning comes from the process of agency of the NBS. In this process, two sets of dynamics are observed, a downward dynamic and an upward dynamic. The downward dynamic follows from the mission objectives, public policies, and the programmes and projects through which public institutions (international, national, regional, and metropolitan) invest public financial resources to leverage the implementation of NBS (Fig. 9). This dynamic then happens across different scales, from global to local, and is influenced by interactions between different public actors at the same scale (e.g., through the influence of development plans and land-use plans), and public-private interactions across scales. The upward dynamic (Fig. 9) follows from the interactions among different private actors, mixed actors, social movements, social organizations, and NGOs, that demands from the public sector improving the living standards of communities, transform the urban reality and achieve better levels of equity and environmental justice.

In this sense, diagram 5 also shows the dynamics of influence of four sets of constraints on the upstream and downstream relationship: biophysical, policy/politics, financial and operational. The efficiency and effectiveness of NBS depends on the outcome and quality of these interactions, as well as the transparency of their agency process throughout the project cycle.

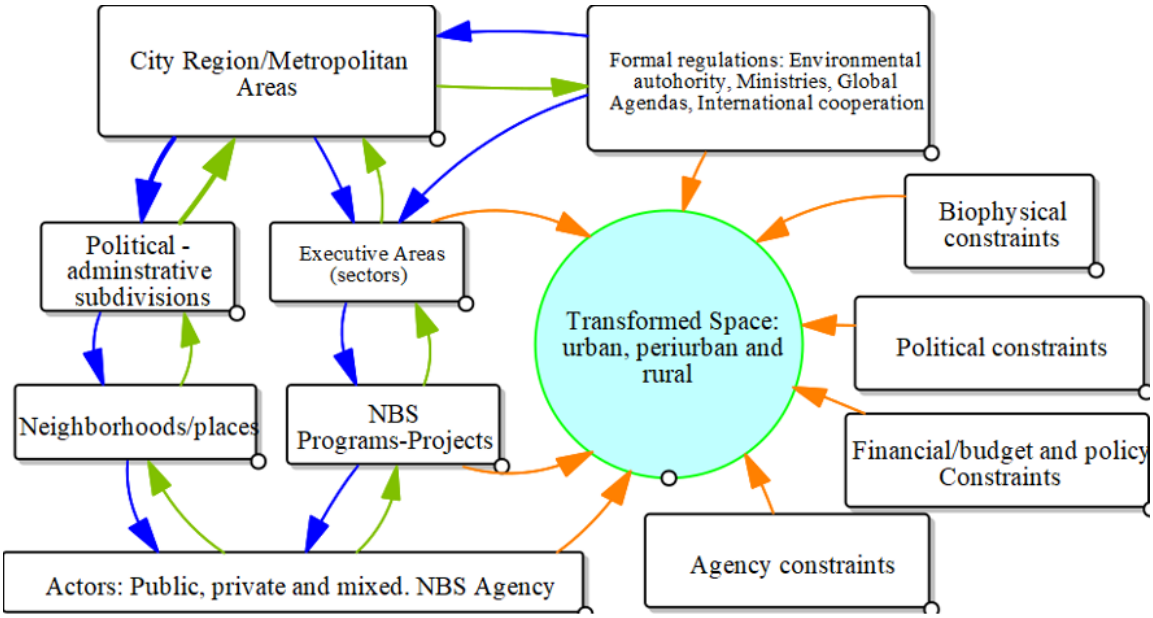


Figure 9. Top down and bottom-up interactions to promote and implement NBS.

Source: Interviews and local stakeholder survey. Conventions: the blue arrows illustrate the top-down processes, through which public institutions develop public policies and channel resources and knowledge through the international, national, metropolitan, and local levels. The green arrows illustrate the process of agency (bottom-up), through which private actors and social organisations channel demand. The orange arrows illustrate the different restrictions and regulations that must be considered in the planning process of the NBS and on which depends, together with the agency, the impact of the NBS in the transformation of the space intervened with this type of solutions.

The second implication relates to the challenge of concerting and coordinating public and private actions across scales and levels. This implication varies depending on the trajectory of urban development in each city, the composition of public-private actors interested in participating, the mission objectives and the level of influence of the aforementioned constraints. Identifying misalignment and opportunities to strengthen cooperation and creating spaces and mechanisms to address them is a central activity in this direction.

Another fundamental implication that must be considered in the planning process concerns the socio-environmental problems that are the focus of the NBS effort. Due to the highly complex nature of this type of issues, it is necessary to actively consider the need and possibility of creating new approaches to the co- design of NBS, the consideration of the diverse interests that converge in the planning and implementation process of the NBS by virtue of the confluence of different actors and levels, and the understanding and channelling of the different values and mental models that converge in each NBS.

Also, perceptions about nature and NBS, expectations about the capacity of NBS to solve contemporary socio-environmental problems, and the possibility of building forms of confluence of scientific knowledge and traditional ecological knowledge invested in public and private actors, is fundamental in this field.

Finally, it is necessary to highlight the need to consolidate a type of collaborative planning that moves away from technocratic and only normative positions to other positions and

perspectives. It is necessary to make viable in a transparent and flexible way, both the participation of citizens in the decision-making process throughout the project cycle and the feasibility of the different types of NBS that may arise in each urban environment; and to recognize and formalize the efforts and contributions of different forms of capital that come from the private sector, local communities, and social movements.

Implications for NBS governance

In the field of NBS governance, different implications arising from the process of interaction between actors, scales and levels illustrated in diagram 5 are also identified. The most important implication refers to the need to differentiate the role of governing, vested in public institutionalism and channelled through top-down interactions, from the complex responsibility shared by all actors in governance structures to guide the development of NBS. In this direction, it is key to consider the characteristics and attributes of governance structures that invite us to work in a horizontal and structural way, moving away from the traditional perspective of top-down dynamics.

Moreover, governance structures in relation to NBS demand the consolidation of a higher level of knowledge than we currently have. This is a political scale that is complexioned by the diversity of forms of NBS that we can arrange in CELAC context, and consequently by the diversity of governance structures that will emerge from each type of NBS. Likewise, these forms or types of governance structures are differentiated and reflect particular characteristics in the urban, peri-urban and rural context. In this way, not only a structural differentiation arises, linked to the concrete typology in each city, but also a spatial differentiation linked to the particular metropolitan contexts.

An additional key implication is to think about and enable a different form of NBS management process. In this direction, the linear approach and focus on the optimization of urban ecosystems, which characterizes the management of different types of infrastructure (e.g., green and blue), should not be automatically transferred to the field of NBS management. A major qualitative shift in this direction is needed. This shift is reflected in the need to recognize three important aspects: a) the multifunctional attributes of NBS, and linked to this the recognition of the non-existence and impossibility of achieving an optimal state of urban ecosystems; b) NBS are highly complex mechanisms that enable processes of urban transition towards a reconnection of society and nature and consequently involve high levels of uncertainty; c) the need to embrace different types of understanding and perception of nature (i. e. mental models) and the legitimacy of traditional and scientific ecological knowledge invested in the diversity of actors involved.

From the above point of view, the administration of the NBS demands then to consider that the governance structures respond to the complex socio- ecological character of NBS, and consequently it is necessary to start building and approaching a type of administration focused on the management and governance of the resilience of the NBS to guide the transformation of the urban space.

4.4. SWOT Analysis

The set of factors identified through the SWOT Analysis method allows both understanding different challenges faced by the NBS planning process and initiating the construction of an enabling environment, which is vital for the promotion and development of NBS in the CELAC context. This section highlights the most important strengths, weaknesses, opportunities, and threats from the perspective of local actors. The complete list of these factors identified in the four cities analysed in this study is provided in Fig. 10.

For what concerns strengths, the most important ones are multifunctionality, capacity to respond to problems of a socio-ecological nature, and cooperation among sectors - on which the actors consulted in the four cities agreed. Multifunctionality refers to the multiple, and sometimes simultaneous, functions that NBS can perform in an urban context. Multifunctionality allows the concertation of national programmes reflected in regional initiatives, which can boost the implementation and broaden the scopes of the different types of NBS. In turn, driving strategies from different functions can respond to demands coming from different levels and can facilitate the process of emergence of adaptive governance structures driven by public and private cooperation processes. A second strength refers to the potential of NBS to solve or intervene in structural problems of a socio-ecological nature.

One of the characteristics of contemporary urban environmental problems is their increasingly complex nature, which no longer circumscribes them to the environmental dimension, so they must be treated from a relational perspective that interweaves the dimensions of society and nature simultaneously. NBS can play a central role in the treatment of this type of problem. Finally, a third strength considered refers to the growing level of cooperation between academia, the third sector and the private sector. This dynamic of interaction generates a gradual consolidation of the interface between universities, NGOs and private actors, which represents an already existing potential to increase scientific and technical knowledge on NBS, to advance experiments in different urban contexts and to actively disseminate this knowledge. The public sector can act as a driver of this interface and at the same time benefit from its results.

Regarding weaknesses, one of the central factors identified as an obstacle refers to the limited existing knowledge on NBS both in public institutions and within social organizations. This lack of sufficient knowledge is related to four aspects: a) a limited understanding of the concept of NBS; b) limited availability of basic research results in the field of social-ecological relations that are at the core of the NBS; c) the difficulties to make viable the integration of scientific knowledge with local knowledge on the NBS; and d) all the above are reflected in an obstacle related to the difficulty to build a common language that helps the convergence of actors and resources in this field. An additional factor identified refers to the difficulties arising from the limited levels of cooperation between public institutions. These levels of cooperation are influenced by the emphasis on the fulfilment of mission objectives and the framework of relevant legislation and regulations in each city (see example in the Annexes), which has been called planning in silos.

	Beneficial	Harmful
Internal Factors	- The multiple functions that NBS can play. - Potential to solve structural socio-ecological problems. - Potential for increasing knowledge about the NBS from the interface between NGOs, universities, and local actors. - Current confluence of institutional management, academic and socio-cultural processes. - Contribution of experience and diversity of empirical knowledge of local actors. - Good relations between officers from public institutions and academics. - Availability of people with willingness, knowledge and perspectives of environmental care. - Third sector institutions dealing with the issue of NBS.	- Limited knowledge of the NBS hampers NBS advocacy in the public and private sector. - Limited levels of cooperation between public institutions. - Unconsolidated funding sources and mechanisms. - Continuity of emphasis on conventional green space planning. - Lack of clarity on the project cycle according to the identified typology. - Limited availability of empirical and scientifically based evidence. - Difficulty to involve interdisciplinarity, local knowledge and new organizational forms in practice. - The problems of scaling up, planning and centralism are reproduced within big cities. - Obstacles to participation (inequality and urban violence). - The idea of homogeneity linked to urban planning. - Limited levels of environmental education. - Limited knowledge of urban socio-ecology. - Perception of rural areas only as reserve land to make city growth viable.
External Factors	- Growing public interest and increasing awareness of the population to reconnect with nature. - Collaborative planning to make NBS co-production feasible, and convergence of public and private institutions throughout the project cycle. - Broad public policy framework and global agendas. - Enhanced efficiency in the use of ecosystem services and natural resources. - Agency of urban spaces to promote participation, and cultural change. - Protection and increase of ecologically important areas. - Eco-urbanism and sustainable construction as a framework for NBS insertion. - Consideration of marginalized and vulnerable communities. - Equity and social, productive and political inclusion. - NBS as spaces for meeting and exchange of knowledge and environmental education. - Energy efficiency, carbon capture, ecological and social connectivity. - Enhancement of urban and rural, public and private heritage.	- Limited understanding and management to achieve a balance between development and conservation in urban and rural environments. - Appropriation of NBS benefits for political patronage. - Limited availability of relevant technology for NBS development. - Impacts of climate change and detriment to environmental quality. - Public perception of potential tax increases. - Limited continuity of policies and support programmes from the public sphere. Slow implementation processes. - Need to accumulate scientific, technological and empirical evidence. - Rapid population growth and transformation of strategic peri-urban and rural areas. - Limited understanding of the role of governance structures. - Limited understanding of the need to differentiate NBS (typology), forms of administration and forms of governance to be promoted.

Figure 10. SWOT analysis for the four CELAC cities.

These difficulties in cooperation between public institutions become a major obstacle to channelling intervention and recognizing the contributions of private actors. In turn, the coordination problem is replicated among social organizations, an aspect that should also be considered to guarantee a more efficient planning process, which allows promoting the consolidation of the implementation and dissemination of NBS. Furthermore, the institutional mandates to respond to global agendas are clear, but those at the local level restrict the necessary flexibility to promote the dissemination of the NBS and, more importantly, hinder the intrinsic expression of the potential multifunctionality of these solutions. The third important factor that acts as a major obstacle when planning for NBS, is the availability of financial resources, not only for financing new NBS, but also for promoting basic research in this field, generating mechanisms and services for technology transfer, making experimentation and innovation viable with a solid scientific basis, and exploring markets and financing mechanisms.

For what concerns opportunities, one of the most significant for consolidating the planning process to promote NBS is reflected in the growing public interest in increasing their levels of well-being on the basis of a clearer and more structural reconnection with nature. This growing interest makes it possible to mobilize the confluence of actors and resources and to channel the public and private institutional efforts that emerge from different levels. A complementary factor is represented in the framework of collaborative planning (Healey, 2003), which makes the co-production of NBS and the convergence of public and private institutions throughout the project cycle viable. The planning of NBS in the context of the cities studied currently demands the deepening of citizen participation in the decision-making process, an aspect that is difficult to improve without a sensitization of the planning systems in this direction. The third major factor in this field concerns the growing influence of global agendas on improving ecosystem health and controlling planetary boundaries. Global agendas addressing climate change, sustainable development goals, food security and energy security, among others, can play an important role as drivers for urban NBS.

Finally, in relation to threats, one of the main elements in NBS planning process refers to the difficulties in finding a balance between the planning process for the development of cities, in constant growth, and the public demands to make viable and increase the reconnection with nature. This is a complex issue in which different elements related to poverty, culture, ethnicity, gender, and social classes are amalgamated. An additional important threat relates to the limited availability of relevant technology for NBS development. This aspect requires not only time to accumulate sufficient scientific and empirical evidence, but also an essential coupling with the current state of legislation for the generation and transfer of technology, which faces privatization processes in CELAC and hinders the creation of easily accessible programs for the transfer of the technology generated. Finally, one of the most important threats refers to the possibility of appropriation of the benefits generated by NBS for the benefit of political clientelism. In the context of CELAC cities, the political agendas face ever deeper difficulties, which also generate a weakening of the credibility of public institutions.

5. Integration in NBS governance and planning in EU and CELAC cities

In this report, we have discussed the level of integration of NBS in policy, planning and implementation, in other words, in the governance structures of the CONEXUS cities. This section presents a comparison between the EU and CELAC cities of CONEXUS, for understanding how the NBS governance and planning integration differ and coincide within the two regions. It presents the lessons learned from each region and how they can be translated into the others.

In CELAC cities, NBS are in an emerging process. This emerging status has not allowed their formal entry into public decision-making processes, neither have they been positioned in concrete public urban policies. In the four CELAC cities, the focus of urban planning continues to be cantered on green infrastructures. As a result, both the concept of NBS and the socio-ecological principles and criteria for their design and implementation have not been mainstreamed into formal planning structures, while Conexus EU cities have been, since the first introduction of the concept, gradually working towards their integration in different planning structures and governance process. In general, the EU cities have recognized in their public policy NBS as an important concept and methodology to tackle climate change, increase biodiversity, improve the urban environment and social welfare. This is a central aspect that differentiates the current state of the NBS planning and governance between EU and CELAC cities.

Regarding this difference, in CELAC cities the concept of green infrastructure is now clearly established, partly in response to the search for better levels of wellbeing for the population and partly in response to new trends in eco-urbanism and sustainable construction that respond to the global agendas of sustainable development and climate variability. Nevertheless, this approach is being addressed as conventional green space planning, which prevents it from responding clearly to two central aspects. On one hand, the need to increase the adaptive capacity of urbanites to mitigate the impacts generated by the phenomenon of climate variability, and to adapt urban social groups to its impacts are aspects particularly important especially in marginal and peri-urban areas. On the other hand, the emphasis on green infrastructure does not have sufficient capacity to respond to contemporary problems such as i) urban growth, particularly in metropolitan areas; ii) complex intercultural relations, driven by rural-urban and international migrations; and iii) in general the way in which natural resources permeate social relations in urban environments; calling for the establishment of the NBS within the region.

The EU cities studied, being more advanced in the NBS concept, show, with slight differences between the three cities, higher levels of NBS integration into most planning and territorial policies in the municipal, regional and national levels, as well as in municipal government programs with a comprehensive social-economic and environmental approach. They are especially linked to adaptation to climate change, biodiversity loss, and the improvement of urban space and well-being, connecting themselves with international policies

and directives. Articulation with specific fields, such as health and education, are yet not clear; and appraised to be especially missing. In terms of integration to policies, it can be said that NBS in EU cities of Conexus are blooming, however, the actual implementation is a different story. Rigid and complex governance structures and procedures, difficult to change, are hindering integration and the adoption of an adaptive governance of NBS.

From this perspective, CELAC cities share with EU cities a challenge regarding the implementation of co-design and use of NBS as a tool to identify and create new approaches for urban growth, and reconnection with nature, while simultaneously addressing ecosystem health. To address this challenge in CELAC, public and private actors are working in diverse initiatives, close to the concept of NBS, that allow to observe a differentiation in terms of forms, functions, levels, and scales. Nevertheless, in this region, there is still an important gap in considering peri-urban and rural areas in both groups of cities. In the EU cities, significant efforts of co-production and co-design of NBS have been put in place, with various results, but it is still something that needs further development, particularly in terms of more and better involvement of communities and the private sector. A lot has been achieved in recent years, but still NBS is not fully integrated in the streamline of planning and governance in Conexus cities.

The participation of different actors in understanding, co-creating, and projecting NBS is another point that can be importantly improved in the CELAC and EU cities. Knowledge, awareness, and usefulness seem to be at the centre of this, despite the differences in integration of NBS in the planning and governance process differs. For the different actors consulted, NBS must be managed and planned from a perspective in which the gradual integration of society in nature is privileged, for which the knowledge, perceptions, and skills of the different actors in the process of identification, co-design, and implementation of the NBS must be systematized. For this reason, it is necessary to have both a scientific knowledge base that allows guaranteeing the sustainability of the NBS, and a detailed knowledge of the expectations and experiences of the users with respect to the functions and services provided. Aspects such as the preferences of the actors and social groups, cultural particularities, the type of socio-ecological interaction required, the opening of spaces for concentration and decision-making, the levels of social and ecological marginality are, among others, key elements to be considered in the planning and management process of the NBS.

Although in the EU, policymakers, various levels of the public administration, and parts of the civil society, including academia, seem to have a clear idea of what NBS are, of their environmental and social benefits, and the importance of an integrated governance, this knowledge is not shared by all. Still further knowledge, awareness and citizen acceptance are missing, in order to develop the full potential of NBS in the EU Conexus cities. Municipal staff, particularly those dealing with the implementation of the policies and co-creation processes with communities, are also not always aware of the importance of NBS co-design, and do not pay the appropriate attention to it. Private sector is the other actor that is currently scarcely integrated within NBS governance in both regions, possibly connected to the apparent high costs of these initiatives in the short term, and difficulties to engage in co-design from a

bureaucratic point of view, but also arguably due to the lack of understanding and awareness of NBS business models.

The analysis of the NBS from the perspective of the SWOT framework, allowed the identification of some commonalities and differences within the strengths and weaknesses towards NBS integration. A shared strength is represented in the multifunctional nature of the NBS that allows the integration within national programmes that are reflected in regional initiatives, which in turn can boost the implementation and broaden the scopes of the different types of NBS. Driving strategies from different functions can respond to demands coming from different levels and can facilitate the process of integration towards adaptive governance structures driven by public-private cooperation processes. The SWOT analysis also showed four main aspects to the shared obstacle of limited existing knowledge on NBS above-mentioned: a) limited understanding of the concept of NBS; b) limited availability of basic research results in the field of social-ecological relations that are at the core of the NBS; c) difficulties to make viable the integration of scientific knowledge with local knowledge on the NBS; and d) all the above are reflected in an obstacle related to the difficulty to build a common language that helps the convergence of actors and resources in this field. An important difference regarding weaknesses is a more limited availability of financial resources in CELAC cities, not only for financing new NBS, but also for promoting basic research in this field, generating mechanisms and services for technology transfer, making experimentation and innovation viable with a solid scientific basis, and exploring markets and financing mechanisms.

A common threat to the integration of NBS in the planning process refers to the difficulties in constructing a balance between the planning process for the development of cities, in constant growth, and the public demands. This is a complex issue in which CELAC cities face a critical challenge regarding the use of NBS as an answer to elements related to poverty, culture, ethnicity, gender, and social classes. While EU cities face the difficulties in implementing NBS and dealing with the “not in my backyard” (NIMBY) phenomena, very much grounded on current lifestyles oriented towards consumerism that heavily impact the socio-ecological relationship that champion NBS. A shared opportunity in both groups of cities for consolidating the integration of NBS in the planning process is reflected in the growing public interest in increasing their levels of well-being based on a clearer and more structural reconnection with nature. This growing interest makes it possible to mobilize diverse actors and resources and to channel the public and private institutional efforts that emerge from different levels. The results also show that the pandemic has further increased the interest in NBS, particularly in the relationship with nature and finding a more balanced way of life, creating an even more enabling ground to develop and integrate NBS.

The most central challenge that emerges from this study for the planning of NBS in CELAC and EU urban contexts, consists of the need to adapt to the new framework of NBS programmatically (i.e., in which program each type of NBS is adopted), financially (budgetary and financial challenges), instrumentally (types of plans), discursively (a new jargon and forms of communication are demanded) and spatially (levels in which the NBS are about to be

introduced). This appears crucial to promote in the public space a new issue that must be coordinated between institutions and the local population. In other words, planners must face old and new challenges and barriers to position and channel this type of solutions for the benefit of reconnecting urban society with nature.

A highly significant similarity between EU and CELAC cities is a shared understanding of NBS governance, as an adaptive governance: a multi-level and multi-actor social structure that can plan and manage NBS from a participatory perspective in which public and private institutions should be integrated and collaborating. However, in both contexts it is still not possible to find concrete evidence on the impacts of this type of governance on the levels of efficiency and sustainability of the NBS, in comparison with the traditional or monocentric form of government existing in the cases of green infrastructure, posing as a possible room for future research. Although the concept is used in a general way, it is necessary to specify it in the context of each city and to clarify the mechanism of operation in each case. Aspects related to different levels of cooperation and conflicts, and flows of economic and political power, that may arise within and between governance structures built by local actors need also to be addressed in both groups of cities. Furthermore, a better understanding of the influence of the governance structure on the trajectory of the NBS is necessary, to connect the governance structure with the specific functions and orientation of NBS to solve the socio-environmental problems that drove their design and implementation. An interesting reflection of this comparison between regions, is that as the NBS agenda in the EU is more advanced, the integration of NBS within its governance process is more present. This raises the question if integration is a requirement to advance NBS, or is it a product of the NBS concept advancement? Maybe this is something to look for in the upcoming years within the NBS development in CELAC cities.

Finally, much has been achieved in the EU CONEXUS cities in regard to developing NBS from theory, policy and practice, including circulating knowledge, awareness and usefulness, but still there is much room to improve, particularly in the communities and the businesses. Conversely, in CELAC cities the concept is still at its beginning and so is their state of integration, presenting much room to grow. Although perceived as less advanced, the early stages of integration in which the CELAC cities are, gives the region plenty of opportunities for development and learn from the EU experiences. Government cooperation and networking between agencies and levels of government from the EU experience can be interesting to explore in CELAC cities. Similarly, the regional integration, or at least agreements between countries or cities, can be helpful to get NBS into larger scales of public policies, in addition to the signature of international agreements such as on climate change and biodiversity, for example. In hand with this, funding opportunities are valuable to share, to jointly explore, and even to advocate for global results.

Both regions have their differences, but the search for mechanisms and incentives to increase collaboration and learning across the actors and levels that compose governance structures is a work in progress in both contexts.

6. Conclusion

The analysis on the degree of integration of NBS in urban socio-ecological systems, in governance, planning and design components as well as in community awareness in the seven CONEXUS cities outlines a rather complex mosaic of patches and pathways of approaches and strategies towards integration. The qualitative study performed shows that the integration of NBS in mainstream urban development and governance is moderately advanced in European cities, while it is at the early stages in CELAC cities. In some cases (as for Turin and Lisbon), the process is decisively progressing, and the roadmap appears clearly shaped.

In the case of CELAC cities, the research went through an analytical approach to identify which variables would be most influential in speeding up the process of introducing and consolidating NBS in actual public policies as a key strategic issue to drive urban governance towards a sustainable future. *Continuity in planning and implementation budget* are key variables to consider in order to avoid future failures of positioning of NBS in urban policies and, finally, their integration in the governance processes of CELAC cities. Strategic variables to achieve and consolidate results in NBS governance and integration are *sound public policies* clearly targeting and integrating NBS, meanwhile *equity, knowledge and citizen participation* appear as keystones to achieve success in that. The analysis of NBS governance and planning, presented by the official documents in the three EU cities, highlights an increasing state of integration. The framework of European policies on green issues and the overall European strategies and active policies on green deal, natural capital, green infrastructure and NBS, can be considered as referential, supporting and beneficial to the mature integration of NBS in the frame of multi-scalar urban policies. Different levels and pathways of integration emerge throughout the documents, as well as in substantial strategies and plans, indicating municipal efforts towards an adaptive NBS governance. Within the institutional documents, the integration of the public sector is prevailing, but the integration of civil society and research sectors is also evident. Furthermore, tools for participatory approach and decision-making with citizen science appear also in an ongoing development. An identified common gap in EU cities was traced in the lack of inclusion of the private sector: actions for integrating the private sector were only presented by the city of Turin.

The research conducted brings evidence beyond the EU cities, where most of NBS studies were developed in the last decades, particularly referring to the research stream on NBS governance and their integration in urban strategies. Thanks to a comparative approach, it was possible to check the degree of integration in CELAC and EU cities not only in terms of *structure of multi-scalar integration* but also investigating the *perception of integration* by a range of stakeholders. The reported results develop knowledge, not only about the existing and potential barriers to NBS integration, but highlight current and actual opportunities and entry points to bridge gaps that can limit the inclusion of NBS in urban governance and

planning (e.g., integration of the education department and communication among departments) and the inclusion of actors in this process.

The in-depth analysis of different pathways and velocities of CONEXUS cities demonstrates that NBS can be fruitfully included in urban governance dynamics in an integrated manner. As a major outcome, it indicates as a pillar, the initial construction of an adequate enabling environment articulated in policy structure (*strategic framework*), norms and legislation architecture (*regulatory framework*), and collaborative tools (*community of practice*) so as to ensure the systematic consideration of NBS in the city governance (Wamsler et al., 2020). Therefore, including NBS in urban governance dynamics, strategies, and capacities represents not only a mere lifting of contents in the documents of the cities but an essential landmark facilitating the social-ecological transition of cities in long-term perspectives (Zwierzchowska et al; 2019). The performed analysis states clearly that NBS barriers and opportunities are context based but simultaneously globally common. Efforts are being made towards a *break of silos* and *adaptive NBS governance*, although there is a long way still to go (in particular in CELAC cities).

Lastly, we should conclude that, as stated initially, the term NBS is not yet widely used within the governance contexts of both regions. This simplistic but true result can be interpreted as representing a strength as having room for improvement towards the overall capacity of a city administration to provide a reliable and consolidated framework for enabling a shared governance and an effective and continuous participation process consistent with the NBS co-creation. That remains the main challenge of this study, and the development of a structured framework for integration can hopefully provide grounds to support cities in developing their contextualized optimal pathways to NBS.

Research Gaps

Limitations of this study were that, due to the current state of the pandemic, not all primary data collection could be conducted in person. All interviews were conducted online, and a closer interaction between the researchers and the cities investigated, as well as their actors, were not possible. This may have impacted the quantity of data collected and, to some extent, the quality of the interaction, always limited by the “virtual” reality, if compared to the “real" one. This also impacted the application of the Delphi method that was only applied with two rounds. Furthermore, the early stage in which the Life Labs are, made it challenging to identify community stakeholders in all cities. For example, in the city of Barcelona, it was not possible to engage any community / citizen stakeholders, since they have not yet been involved in the Life Lab process, and this limited the analysis results. Moreover, the gaps related to the integration of the private sector that was highly mentioned, and evident throughout the research, does continue in our investigation.

7. References

Arnstein, S. (1969.) *A ladder of citizen participation*. Journal of the American Planning Association, 35(4), 216–224.

Arquivo Municipal de Lisboa (2021). Remodelação da Avenida da Liberdade (1955-1958): a visão de Gonçalo Ribeiro Telles. http://arquivomunicipal.cm-lisboa.pt/pt/investigacao/varia/documento-do-mes/marco-2021/

Bodin Ö., Crona B.I. (2009). *The role of social networks in natural resource governance: What relational patterns make a difference?* Global Environmental Change 19(3): 366-374. doi:10.1016/j.gloenvcha.2009.05.002

Budds J., Hinojosa L. (2012). *Restructuring and rescaling water governance in mining contexts: The co-production of waterscapes in Peru*. Water Alternatives 5(1): 119–137.

Dorst H., van der Jagt A., Toxopeus H., Tozer L., Raven R., Runhaar H. (2022). *What's behind the barriers? Uncovering structural conditions working against urban nature-based solutions*. Landscape and Urban Planning 220: 104335.

Egusquiza A., Cortese M., Perfido D. (2019). *Mapping of innovative governance models to overcome barriers for nature based urban regeneration*. IOP Conference Series: Earth and Environmental Science 323: 012081.

Folke C., Hahn T., Olsson P., Norberg J. (2005). *Adaptive Governance of Social-Ecological Systems.* Annual Review of Environment and Resources 30(1): 441-473. doi:10.1146/annurev.energy.30.050504.144511

Gibson C. C., Ostrom E., Ahn T.K. (2000). *The concept of scale and the human dimensions of global change: A survey.* Ecological Economics 32(2): 217-239. https://doi.org/10.1016/S0921-8009(99)00092-0

Godet M. (1993). *De la anticipación a la acción, Manual de prospectiva y estrategia*.1 ed. Marcombo S.A.: Barcelona, España.

Godet M. (2000). *La caja de herramientas de la prospectiva estratégica. El rigor de una indisciplina intelectual.* Cuaderno No 5. Available at: www.cpps-int.org/attachments/fortalecimientocpps/INTRODUCCION%20GODET.pdf

Godet M. (2001). *Manual de prospectiva estratégica*. Dunod: Paris, France.

Healey P. (2003). *Collaborative Planning in Perspective*. Planning theory 2(2): 101-123. https://doi.org/10.1177/14730952030022002

INE (2016a). Recenseamento da população e habitação - Censos 1981, 1991, 2001, 2011.

INE (2016b). Estimativas anuais da população residente.

Kabish N., Frantzeskaki N., Pauleit S., Naumann S., Davis M., Artmann M., Haase D., Knapp S., Korn H., Stadler J., Zaunberger K., Bonn A. (2016). *Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action*. Ecology and Society 21(2): 39.

Mahmoud I., Morello E. (2021). *Co-creation Pathway for Urban Nature-Based Solutions: Testing a Shared-Governance Approach in Three Cities and Nine Action Labs*. In: Bisello A., Vettorato D., Ludlow D., Baranzelli C. (eds), Smart and Sustainable Planning for Cities and Regions. SSPCR 2019. Green Energy and Technology. Springer: Cham, Switzerland. https://doi.org/10.1007/978-3-030-57764-3_17

McDonald D., Bammer D., Deane P. (2009). *Research Integration Using Dialogue Methods*. ANU E Press: The Australian National University (ANU), Canberra.

McGinnis M.D., Ostrom E. (2014). *Social-ecological system framework: initial changes and continuing challenges.* Ecology and Society 19(2): 30. http://dx.doi.org/10.5751/ES-06387-190230

Morello E., Mahmoud I., Gulyurtlu S., Boelman V., Davis, H. (2018). *CLEVER Cities guidance on co-creating nature-based solutions.* Available at: https://clevercities.eu/fileadmin/user_upload/Resources/D1.1_Theme_5_Co-creation_framework_FPM_12.2018.pdf

Morris M., de Loe R.C. (2016). *Cooperative and adaptive transboundary water governance in Canada's Mackenzie River Basin: status and prospects*. Ecology and Society 21(1): 26. doi:10.5751/es-08301-210126

Observatório de Luta Contra a Pobreza na Cidade de Lisboa (2018). Retrato de Lisboa, Infografia 01. Available at: https://observatorio-lisboa.eapn.pt/ficheiro/Retrato-de-Lisboa_-_Infografia-01_2018_-_Analise.pdf

Pahl-Wostl C. (2009). *A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes*. Global Environmental Change 19(3): 354-365. doi:10.1016/j.gloenvcha.2009.06.001

Pahl-Wostl C., Knieper C. (2014). *The capacity of water governance to deal with the climate change adaptation challenge: Using fuzzy set Qualitative Comparative Analysis to distinguish between polycentric, fragmented and centralized regimes*. Global Environmental Change 29: 139–154. doi:10.1016/j.gloenvcha.2014.09.003

Ramírez-Agudelo N.A., Porcar Anento R., Villares M., Roca E. (2020). *Nature-Based Solutions for Water Management in Peri-Urban Areas: Barriers and Lessons Learned from Implementation Experiences.* Sustainability 12: 9799.

Reguant Álvarez M., Torrado Fonseca M. (2016). *El método Delphi.* REIRE - Revista d'Innovació i Recerca en Educació: 9(2): 87-102.

Santos A., Branquinho C., Gonçalves P, Santos-Reis M. (2015). *Lisbon, Portugal – Case study portrait*, part of a GREEN SURGE study on urban green infrastructure planning and governance in 20 European cities. 10.13140/RG.2.1.4000.9121.

Sarabi S., Han Q., Romme A.G.L., de Vries B., Valkenburg R., den Ouden E. (2020). *Uptake and implementation of Nature Based-Solutions: An analysis of barriers using Interpretive Structural Modeling*. Journal of Environmental Management 270: 110749.

Slocum D.N. (2003). *Participatory Methods Toolkit: A Practitioner's Manual.* King Baudouin Foundation; Flemish Institute for Science and Technology Assessment (viWTA).

Toxopeus H., Polzin F. (2021). Reviewing financing barriers and strategies for urban nature-based solutions. Journal of Environmental Management 289: 112371.

Wamsler C., Wickenberg B., Hanson H., Olsson J.A., Stålhammar S., Bjorn H., Falck H., Gerell D., Oskarsson T., Simonsson E., Torffvit F., Zelmerlow F. (2020). *Environmental and climate policy integration: Targeted strategies for overcoming barriers to nature-based solutions and climate change adaptation*. Journal of Cleaner Production 247: 119514.

Witzel A. (2000). *The problem-centreed interview.* Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, 1(1). https://doi.org/10.17169/fqs-1.1.1132

Witzel A., Reiter H. (2012). *The Problem-Centreed Interview: Principles and Practice*. SAGE: New York, USA.

Zingraff-Hamed A., Hüesker F., Lupp G., Begg C., Huang J., Oen A., Vojinovic Z., Kuhlicke C., Pauleit S. (2020). *Stakeholder Mapping to Co-Create Nature-Based Solutions: Who Is on Board?* Sustainability 12: 8625.

Zwierzchowska I., Fagiewicz K., Lupa P., Mizgajski A. (2019). *Introducing nature-based solutions into urban policy – facts and gaps. Case study of Poznań*. Land Use Policy 85: 161-175.

8. Analysed Documents

AAVV & Ministero dell'Ambiente e della Tutela del Territorio e del Mare (2010). *La Strategia Nazionale per la Biodiversità*. Available at: https://www.mite.gov.it/sites/default/files/archivio/allegati/biodiversita/Strategia_Nazionale_per_la_Biodiversita.pdf

Agência Portuguesa do Ambiente & Ministério do Ambiente (2015). *Estratégia Nacional de Adaptação às Alterações Climáticas (ENAAC 2020)*. Available at: https://www.dge.mec.pt/sites/default/files/ECidadania/Educacao_Ambiental/documentos/enaac_consulta_publica.pdf

Área Metropolitana de Barcelona (2018). *Plan Clima y Energía 2030*. Available at: https://www.barcelona.cat/barcelona-pel-clima/sites/default/files/documents/plan_clima_juny_ok.pdf

Área Metropolitana de Lisboa (2019). *Plano metropolitano de adaptação às alterações climáticas - Resumo não técnico*. Available at: https://www.lisboa.pt/fileadmin/atualidade/noticias/user_upload/plano_metropolitano_de_adaptacao_as_alteracoes_climaticas.pdf

Ayuntamiento de Barcelona (2012). *Compromiso Ciudadano por la Sostenibilidad 2012-2022*. Available at: https://ajuntament.barcelona.cat/ecologiaurbana/sites/default/files/CompromisoCiudadanoSostenibilidad.pdf

Ayuntamiento de Barcelona (2013). *Barcelona Green Infrastructure and Biodiversity Plan 2020*. Available at: https://ajuntament.barcelona.cat/ecologiaurbana/sites/default/files/Barcelona%20green%20infrastructure%20and%20biodiversity%20plan%202020.pdf

Ayuntamiento de Barcelona (2017a). *Árboles para vivir. Plan Director del Arbolado de Barcelona 2017-2037*. Available at: https://ajuntament.barcelona.cat/ecologiaurbana/sites/default/files/Pla-director-arbrat-barcelona-CAST.pdf

Ayuntamiento de Barcelona (2017b). *Government Measure: Stimulus programme for the city's urban green infrastructure*. Available at: https://bcnroc.ajuntament.barcelona.cat/jspui/bitstream/11703/104928/1/eng_Mesura%20de%20govern%20increment%20verd_08_06_2017.pdf

Ayuntamiento de Barcelona (2018). *Plan Clima 2018-2030*. Available at: https://www.barcelona.cat/barcelona-pel-clima/sites/default/files/documents/plan_clima_juny_ok.pdf

Ayuntamiento de Barcelona (2019). *Estratègia d'Agricultura Urbana A la Ciutat de Barcelona 2019-2030*. Available at: https://bcnroc.ajuntament.barcelona.cat/jspui/bitstream/11703/116590/3/EstrategiaAgriculturaUrbana_Abril2019_def.pdf

Ayuntamiento de Barcelona (2021). *Pla Natura Barcelona 2021-2030*. Available at: https://ajbcn-decidim-barcelona.s3.amazonaws.com/decidim-barcelona/uploads/decidim/attachment/file/12162/Pla_Natura_Barcelona_2030_digital.pdf

Câmara Municipal de Lisboa (2012a). *Relatório ambiental - Plano Diretor Municipal de Lisboa*. Available at: https://www.lisboa.pt/fileadmin/cidade_temas/urbanismo/pdm/Relatorio_Ambiental.pdf

Câmara Municipal de Lisboa (2012b). *Manual Técnico do Plano Diretor Municipal de Lisboa*. Available at: https://www.lisboa.pt/fileadmin/cidade_temas/urbanismo/pdm/Manual_tecnico_PDM_LX_com_errata_set_2019_retificado.pdf

Câmara Municipal de Lisboa (2012c). *Regulamento do Plano Diretor Municipal de Lisboa*. Available at: https://informacoeseservicos.lisboa.pt/fileadmin/download_centre/normativas/regulamentos/urbanismo/Regulamento_PDM.pdf

Câmara Municipal de Lisboa (2012d). *Regulamento Municipal do Arvoredo de Lisboa*. Available at: https://www.am-lisboa.pt/documentos/1501161034Q8mFK3ex7Ck80HK4.pdf

Câmara Municipal de Lisboa (2012e). *Relatório Plano Director Municipal de Lisboa*. https://www.lisboa.pt/fileadmin/cidade_temas/urbanismo/pdm/Relatorio_proposta_plano.pdf

Câmara Municipal de Lisboa (2013). *Plano de Acessibilidade Pedonal de Lisboa.* Objetivos e Enquadramento, Volume 1. Available at: https://www.am-lisboa.pt/documentos/1518801486X6zHF8ec9Pe37RE2.pdf

Câmara Municipal de Lisboa (2014). *Plano Estratégico de Desenvolvimento Urbano (PEDU) do Município de Lisboa*.

Câmara Municipal de Lisboa (2015a). Lisboa: o Desenho da Rua. Manual de espaço público. Available at: https://www.lisboa.pt/fileadmin/cidade_temas/urbanismo/espaco_publico/Manual_espaco_publico.pdf

Câmara Municipal de Lisboa (2015b). *Plano de Ação Local para a Biodiversidade em Lisboa*. Available at: https://www.lisboa.pt/fileadmin/cidade_temas/ambiente/biodiversidade/documentos/Plano_Acao_Biodiversidade_Lisboa_2020.pdf

Câmara Municipal de Lisboa (2017). *Estratégia Municipal de Adaptação às alterações climáticas de Lisboa (EMAAC)*. Available at: https://www.am-lisboa.pt/documentos/1500047537N7kAH7uz5Of28CP9.pdf

Câmara Municipal de Lisboa (2018). *Grandes Opções do Plano para a cidade de Lisboa 2019-2022*. Available at: https://www.am-lisboa.pt/documentos/1545323718T4cDF1de1Ud05OZ5.pdf

Câmara Municipal de Lisboa (2020a). *Move Lisboa. Strategic vision for mobility 2030*. Available at: https://www.lisboa.pt/fileadmin/cidade_temas/mobilidade/documentos/Lisbon_Mobility_Strategic_Vision_MOVE_2030_EN.pdf

Câmara Municipal de Lisboa (2020b). *Plano de gestão florestal do Parque Florestal de Monsanto*. Available at: https://www.lisboa.pt/fileadmin/cidade_temas/ambiente/monsanto/Plano_Gestao_Florestal_Parque_Florestal_Monsanto.pdf

Câmara Municipal de Lisboa, & AAVV (2015). *Plano Geral de Drenagem de Lisboa 2016-2030*. Available at: https://www.lisboa.pt/fileadmin/cidade_temas/ambiente/qualidade_ambiental/documentos/PlanoGeralDrenagem_2016_2030.pdf

Câmara Municipal de Lisboa & Direção Municipal de Higiene Urbana (2016). *Plano Municipal de Gestão de Resíduos do Município de Lisboa 2015-2020*. Available at: http://www.lisboaenova.org/images/stories/Noticias_docs/plano_municipal_gestao_residuos_cml_discussao_publica.pdf

Câmara Municipal de Lisboa & Lisboa E-Nova (2012). *Biodiversidade na cidade de Lisboa. Uma estratégia para 2020*. Documento técnico. Available at: https://www.cbd.int/doc/nbsap/sbsap/pt-sbsap-lisbon-pt.pdf

Câmara Municipal de Lisboa, Universidade de Lisboa & Instituto de Ciência Sociais (2021). *Lisgreen Action Plan. The Lisboa Life-Lab.*

Città di Torino - Divisione Infrastrutture e Mobilità (2010). *Piano Urbano della Mobilità Sostenibile - Sintesi non tecnica*. Available at: http://geoportale.comune.torino.it/web/sites/default/files/mediafiles/pums_sintesi_non_tecnica.pdf

Comissão de Coordenação e Desenvolvimento Regional de Lisboa e Vale do Tejo (2014). *Plano de Ação Regional de Lisboa 2014-2020*. Available at: https://lisboa.portugal2020.pt/np4/%7B$clientServletPath%7D/?newsId=20&fileName=PAR_Lisboa_2014_2020.pdf

Comitato per lo Sviluppo del Verde & Ministero dell'Ambiente e della Tutela del Territorio e del Mare (2018). *Strategia Nazionale del Verde Urbano*. Available at: https://www.mite.gov.it/sites/default/files/archivio/allegati/comitato%20verde%20pubblico/strategia_verde_urbano.pdf

Comune di Torino (2020). *Vision Turin 2050*. Available at: https://www.covenantofmayors.eu/index.php?option=com_attachments&task=download&id=1015.

Comune di Torino (2019). *Torino 2030 Sostenibile/Resiliente - Piano d'azione per la Torino del futuro*. Available at: http://www.comune.torino.it/sfogliato/TORINO2030/TORINO2030/files/assets/common/downloads/publication.pdf

Comune di Torino & Assessorato per le Politiche Ambientali (2020). *Piano di Resilienza Climatica 2020*. Available at: http://www.comune.torino.it/torinosostenibile/documenti/200727_Piano_Resilienza_Climatica_allegati.pdf

Comune di Torino & Assessorato per le Politiche Ambientali e Verde Pubblico (2020). *Piano strategico dell'infrastruttura verde*. Available at: https://www.torinovivibile.it/wp-content/uploads/2021/04/piano_strategico_infrastuttura_verde_2021.pdf

Comune di Torino & Divisione Urbanistica e Territorio (2020). *Revisione Piano Regolatore Generale Torino - Proposta tecnica del progetto preliminare*.

Generalitat de Catalunya (2010). *Estratègia per al desenvolupament sostenible de Catalunya 2026.* Available at: https://mediambient.gencat.cat/web/.content/home/ambits_dactuacio/educacio_i_sostenibilitat/desenvolupament_sostenible/estrategia_per_al_desenvolupament_sostenible_de_catalunya/archivos/estrategia_per_al_desenvolupament_sostenible_de_catalunya_2010.pdf

Generalitat de Catalunya (2018). *Estratègia del Patrimoni Natural i la Biodiversitat de Catalunya 2030*. Available at: https://mediambient.gencat.cat/web/.content/home/ambits_dactuacio/patrimoni_natural/estrategia_patrimoni_biodiversitat/ESNATURA.pdf

Lisboa E-Nova (2010). *Plano Verde*. Available at: https://lisboaenova.org/images/stories/Outros/Outros2010/PlanoVerde/Lisboa-Plano%20Verde_Apresentacao_26102010.pdf

Lisboa E-Nova - Agência Municipal de Energia e Ambiente & Câmara Municipal de Lisboa. (2008). *Estratégia Energético-Ambiental para Lisboa*. Available at: https://informacoeseservicos.lisboa.pt/fileadmin/cidade_temas/ambiente/qualidade_ambiental/documentos/Estrategia_Energetico_Ambiental_para_Lisboa.pdf

Lisboa E-Nova & Câmara Municipal de Lisboa (2008). *Plano de Acção para a Sustentabilidade Energética de Lisboa*. Available at: http://www.lisboaenova.org/images/stories/PactoAutarcas%20Mayors/seap.pdf

Lisgreen (2021). Lisgreen Action Plan. CONEXUS: Co-producing NBS and restored ecosystems - transdisciplinary nexus for urban sustainability. CONEXUS. Unpublished.

Ministerio de Medio Ambiente y Medio Rural y Marino & Ministerio de Fomento (2011). *Estrategia Española de Sostenibilidad Urbana y Local (EESUL)*. Available at: https://www.fomento.gob.es/NR/rdonlyres/1668CD1E-0B11-4C9E-84E2-E664DD3464C1/111503/EESULWEB2011.pdf

Ministério do Ambiente & Direção-Geral do Território (2015). *Cidades Sustentáveis 2020*. Available at: https://www.dgterritorio.gov.pt/sites/default/files/ficheiros-cidades/cidades_sustentaveis2020.pdf

Ministerio para la Transición Ecológica y el Reto Demográfico (2021). *Estrategia Nacional de Infraestructura Verde y de la Conectividad y Restauración Ecológicas*. Available at: https://www.boe.es/boe/dias/2021/07/13/pdfs/BOE-A-2021-11614.pdf

Ministero dell'Ambiente e della Tutela del Territorio (2017). *Strategia nazionale per lo sviluppo sostenibile*. Available at: https://www.mite.gov.it/sites/default/files/archivio_immagini/Galletti/Comunicati/snsvs_ottobre2017.pdf

Ministero dell'Ambiente e della Tutela del Territorio e del Mare (2018). *Piano Nazionale di Adattamento ai Cambiamenti Climatici (PNACC)*. Available at: https://www.mite.gov.it/sites/default/files/archivio/allegati/clima/pnacc.pdf

Ministero della Transizione Ecologica & Regione Piemonte (2021). *Strategia Regionale per lo Sviluppo Sostenibile del Piemonte*. Available at:

https://www.regione.piemonte.it/web/sites/default/files/media/documenti/2021-07/la_strategia_regionale_impag_03bassa.pdf

Provincia di Torino (2011). *Piano territoriale di Coordinamento Provinciale*. http://www.cittametropolitana.torino.it/cms/risorse/territorio/dwd/pianificazione-territoriale/ptc2/PTC2_Rel_ill_dcr121_2011.pdf

SEAcoop STP & Città di Torino (2020). *Piano Forestale Aziendale 2020*. Available at: http://www.comune.torino.it/torinosostenibile/documenti/Piano%20Forestale%20Aziendale_Torino.pdf

Urban Allotment Observatory (2021). The Barcelona Life Lab. CONEXUS. Unpublished.

Valdocco Vivibile, (2021). Valdocco Vivibile Life Lab Action Plan.CONEXUS. Unpublished.

9. Supplementary material

Annex I - List of NBS Keywords used for EU cities

Annex II - List of Integration Keywords used for EU cities

Annex III - Problem Centred Interview Questionnaire for EU cities

Annex IV - Turin Workshop Materials

Annex V - Main Colombian public policies on territorial planning

Annex VI - Description of variables used for CELAC cities

Annex VII - Results of the qualification of the variables used in CELAC cities

Annex I - List of NBS Keywords used for EU cities

English	Portuguese	Italian	Spanish	Catalan
Green	Verde	Verde	Verde	Verd
Nature	Natureza	Natura	Naturaleza	Naturalesa
Trees	Árvore	Alberi	Árboles	Arbres
Natural	Natural	Naturale	Natural	Naturals
Urban Forest	Arboredo	Foresta urbana	Bosque urbano	Bosc urbà
Urban Agriculture	Agr. Urbana/Horta	Agricoltura urbana	Agricultura Urbana	Agricultura Urbana
Gardens	Jardins	Giardini	Jardines	Jardins
Parks	Parques	Parco	Parques	Parcs

Annex II - List of Integration Keywords used for EU cities

Category	English	Portuguese	Italian	Spanish	Catalan
Participation	Participation Participatory Citizenship Co-production Co-design Co-management	Participação Participativo(ado) Cidadania Co-produção Co-design Co-gestão	Partecipazione Partecipativo Cittadinanza Co-produzione Co-progettazione Co-gestione	Participación Participativo Ciudadanía Coproducción Codiseño Cogestión	Participació Participatiu Ciutadania Coproducció Codiseny Cogestió
Public Sector	Department Sector Directory Office Commission	Departamento Setor Direção / Diretório Gabinete Comissão	Dipartimento Settore Direzione Ufficio Commissione	Departamento Sector Directorio Oficina Comisión	Departament Sector Directori Oficina Comissió
Civil Society	Association NGO Community Cooperative Citizen(s)	Associação ONG Comunidade Cooperativa Cidadã(o)(ões)	Associazione ONG Comunità Cooperativa Cittadino(i)	Asociación ONG Comunidad Cooperativa Ciudadano(os)	Associació ONG Comunitat Cooperativa Ciutadà(ns)
Research	Research University Academia Science	Pesquisa Universidade Academia Ciência	Ricerca Università Accademia Scienza	Investigación Universidad Academia Ciencia	Investigació Universitat Acadèmia Ciència
Private Sector	Private sector Business Green Jobs Company Circular Economy	Setor Privado Negócios Emprego verde Empresa Economia circular	Settore privato Affari Lavori “verdi” Impresa Economia circolare	Sector privado Negocios Empleos “verdes” Empresa Economía Circular	Sector privat Negocis Treballs “verds” Empresa Economia Circular

Annex III - Problem-Centred Interview Questionnaire for EU cities

ENGLISH VERSION

Purpose of the Interview

The interview comes with the purpose of confirming prior knowledge acquired by the researchers on the state of integration in NBS planning in the municipalities & Life Labs studied. This exercise is aimed to understand the different state, forms and shapes of integration that is present in the cities and projects to identify possible ways of integration and synergies on how to improve and enable a more efficient scale up on NBS.

Interview Agenda

1. **Introduction** - *15 minutes*

    a. Interviewers' introductions
    b. Interviewee introduction
    c. WP2 & T2.2 introduction
    d. Exercise introduction

2. **NBS in the Municipality** - *35 minutes*

    a. How are you familiar with NBS? Prior to CONEXUS were you aware of/involved with NBS projects in your city?

    b. [Intro] How do you see this reflected in its governance structure? In your perception, what are the main municipal sectors/departments involved in the NBS planning process? How do you see their dialogue within each other?
        i. Health Department
        ii. Transportation
        iii. Water and Waste
        iv. Energy

    c. [Intro] In your opinion, how is the city connecting itself to the international agendas?
        i. Do you see the prioritization of NBS in your municipality as a response (initially driven) to an international movement or an inner growing need of the city?

    d. [Intro] In terms of NBS design and planning, how do you perceive the dialogue and involvement with external sectors (in particular the community and private sector)?

i. How is the response of the Community towards NBS?(if the response is positive, what generated this enabling environment?).
ii. How is the private sector involved within the city?
iii. What participatory tools exist in NBS planning?

e. Due to the living nature of NBS, an important factor of their longevity and provision of ecosystem services is connection. How do you see the municipality involvement on a regional level?
   i. Collaboration with other municipalities?
   ii. Urban-Rural linkages? (Peri urban projects…)

f. Based on your knowledge, how do you assess the existing NBS in your city (from a qualitative point of view, its effectiveness/usefulness, etc.)?
   i. Would you say that the existing integration among bodies and policies within your city is successful to scale up and effectively co-produce NBS?
   ii. Could you indicate any aspects that you see that could *limit or favour* the use and integration of NBS?

g. In your opinion, which actors could mostly influence the development and management of NBS?

3. Life Lab & Conexus Integration - *30 minutes*

a. [Intro] In which phase of development is the Life Lab?
b. [Intro] How was the involvement of the community during the project conception?
   i. Was the community included in the decision-making?
   ii. How were the NBS chosen and identified?
   iii. And their location?
   iv. How was this communicated to the broader community?

c. [Intro] In your opinion, how is the current involvement of the community?
   i. How is the response of the local community?
   ii. Was the broader community also invited to participate?
   iii. Which participatory approach is being used in the project? -
   iv. Are there any barriers perceived towards NBS co-production?
   v. Do you see any opportunities for further integration found?

d. [Intro] On your perception, how is the collaboration with other projects working?
   i. Municipal Projects?
   ii. International Projects?
   iii. Within Conexus?

e. [Intro] How is the regional approach towards NBS taking place?
   i. Policies?
   ii. Direct collaboration with other local municipalities?
   iii. Project connection with other urban, peri urban, rural projects?

f. [Intro] In your opinion, how is the involvement of the private sector occurring within the Life Lab?

g. To conclude, In your view, which are the most pressing challenges and/or point of entry towards the co-production of NBS?
   i. The encountered challenges were already predicted, or new ones have emerged?
   ii. How about opportunities?
   iii. Is there the need for further integration?

4. **Is there anything you would like to add, ask, or comment about?** - *10 min*

Annex IV - Turin Workshop Material

Participatory Workshops in Turin (Italy) – Life Lab Valdocco Vivibile

The Turin *CONEXUS Life Lab* (Valdocco Vivibile) performed two participatory workshops on May 26th, 2021, and July 15th, 2021, using and adapting the Delphi methodology.

1° PARTICIPATORY WORKSHOP – May 26th, 2021

The 1° workshop has been held in virtual form, on Zoom, due to the social distancing measures imposed by the Covid-19 pandemic. Several actors from different local realities participated in the workshop, including people from the district and the municipality. Questions and themes discussed in the workshop had been elaborated by the Prof. Fabio Salbitano, from the *Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali* (DAGRI) of the University of Firenze. The workshop was given by the *Urban Lab* of Turin.

Objectives

1. Understand and investigate perceived and acquired knowledge between actors regarding *Nature Based Solutions* (NBS) in Turin (relevance, state of activation, and/or achievement, etc.);
2. Jointly define problems and solutions for NBS's integration in the governance, planning and design of NBS in Turin;
3. Investigate limits or problems for carrying out NBS in Turin, discussing with the actors involved the need for integration with planning, local action, and citizen participation.

Workshop program

The workshop lasted 2 hours, divided into two sessions of 50/55 minutes.

- The first session presented the Conexus and Valdocco Vivibile projects to the participants, with a specific focus on NBS and its role in mitigating climate change;
- In the second session, participants have been invited to express their opinion about different aspects characterizing NBS's implementation in Turin.

Participants

15 people coming from different groups (NGO, third sector, institutions, academia, experts and professionals, associations and collective of citizens, activists, etc.) participated. The

presence of different actors has been important to provide a broader view, as some consider themselves beneficiaries and some others feel conflicting with NBS activation.

Instruments and techniques

For the two sessions, two types of instruments have been used:

- Poll on Zoom, for closed questions;
- Google *Jamboard* de Google, to transcribe the answers to open questions.

Questions addressed to participants

Problem definition

1. Do you know any NBS experience carried out in your city?
2. Could you provide any specific example?
3. Based on your knowledge, how do you assess the existing NBS in your city (from a qualitative point of view, its effectiveness/usefulness, etc.)?
4. Could you indicate which aspects you know that could limit or favour the use and integration of NBS?

Inclusion of NBS in city planning

5. Do you think that in Turin there are enough NBS implemented? Which ones?
6. Do you know about active/ongoing processes in Turin in which NBS are integrated with other types of policies/projects/citizens programs?
7. Do you know any NBS included in planning and programs that have been approved in Turin in the past (European projects, local projects, etc.)?
8. Do you know any NBS included in current designing tools?
9. Do you know any business model including NBS in its development (that is, models in which NBS plays a role of economic valorisation in the design context)?

NBS, community and citizens

10. How do you think the citizens community of Turin (organizations, citizens, economic actors, third sector, etc.) perceives the concept and practice of NBS?
11. In your opinion, which actors could mostly influence the development and management of NBS?

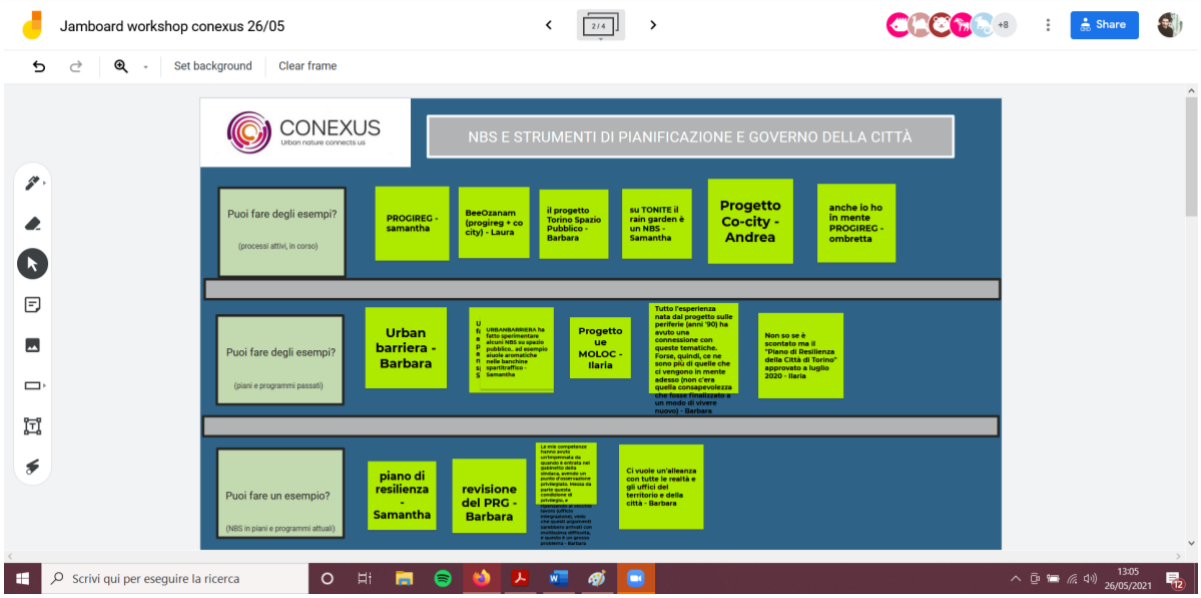
Results

The workshop provided a first assessment on participants' perception and knowledge about the existing NBS in Turin. Most of the participants declared themselves aware of NBS carried

out in the city, but, at the same time, the majority highlighted various limitations of existing initiatives. These limitations are linked, on the one hand, to their effectiveness and usefulness and, on the other, to integration with citizen policies and with design and implementation instruments.

Regarding the perception on NBS of the community of Turin, participants highlighted that, despite an ever-greater sensitivity of young people, a collective awareness about the importance of such practices is still lacking. To achieve that, an inclusive communicative language would be important, to broaden the perception and to reach all citizens.

Finally, the participants indicated as important actors for the development of NBS in the city children and youth (and, consequently, educational spaces such as schools), the public administration, the media, and possibilities of public-private partnerships.



2° PARTICIPATORY WORKSHOP – July 15th, 2021

The 2° workshop has been held in person, at the Italo Calvino Library in the Valdocco district, in Turin. Different local actors, from the Valdocco district and from the city, participated. Questions and themes discussed in the workshop had been elaborated by the Prof. Fabio Salbitano, from the *Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali* (DAGRI) of the University of Firenze. The workshop was given by the *Urban Lab* of Turin.

The meeting resumed contents from the first workshop, furthering participants' perceptions about NBS and their awareness about the different solutions available, their function and their different applicability in specific urban contexts.

Objectives

1. Deepen the understanding of NBS application in the city context, analysing the specific context of Turin and its problems associated with extreme weather events. This, based on the results of the first workshop, in particular the contributions of participants;
2. Explore and understand the interventions that will take place in the pilot project Valdocco Vivibile, analysing the options chosen by the administration with the collaboration of technicians. This will happen in dialogue with citizens and local organizations, for a confrontation on the degree of citizen's participation, the features and selection criteria of the NBS that will be implemented in the fall;
3. Analyse in details the interventions through planimetry, in order to perform a visit in the area, in particular the parking lot near the former San Pietro in Vincoli cemetery, to include the participants' exchange of perceptions.

Workshop program

The workshop lasted 2 hours. It started with an overview of themes such as biodiversity in urban context and its equilibrium, the complexity of analysis and the diversity of actions and areas involved. Afterwards, the need for dialogue between the various dimensions that compose the urban ecosystem and the necessity of coordination between administrative, legislative and economic processes for the implementation of NBS have been addressed.

Participants

12 people participated, all of whom had already participated in the 1st workshop.

Instruments and techniques

The participatory workshop held in person allowed several moments of free exchange, reflection and dialogue between participants, useful to better understand the complexities and specificities and to collectively prepare proposals for the Valdocco Vivibile project in Turin.

The instruments used were essentially three:

- Projector, to summarize impressions and responses from the previous workshop. Successively, through new closed questions, new reflections and questions were stimulated to deepen together opinions, doubts and proposals;
- Pencil and paper, to anonymously collect impressions and requests from participant regarding 5 direct questions, successively briefly analysed by the coordinator;
- Map of the first plot of the pilot project Valdocco Vivibile, in which participants, using adhesive labels, could spontaneously express their feelings and proposals, anonymously and not compulsorily, about 4 frameworks: expected benefits, obstacles, perceptions, solutions.

Questions addressed to participants

1. In your experience, how did the NBS planning process integrate/take into account the perception of citizens and the community?
2. In your opinion, how and with what instruments (communication, dissemination, awareness, etc.) is it possible to influence the NBS adoption process?
3. In your opinion, what are the main and most important knowledge/skills needed for successful adoption of NBS?
4. From you point of view, what is the level of collaboration between different planning sectors, different departments and competencies for the adoption and implementation of NBS?
5. In your opinion, what could be the concretely activable instruments/opportunities (resources, funds, rules, etc.) to improve the adoption and effective success of NBS?

Results

The workshop allowed the participants to elaborate their own opinions and considerations regarding the NBS, from a general point of view and specifically referring to the reality of the Valdocco district in Turin.

It is worth to mention some criticisms arisen about the lack of citizens' and local actors' involvement in the design of the transformations that will take place in the district starting from this fall. Likewise, the participants expressed the desire for more radical choices in favour of sociality, alternative mobility and cultural development. The presence of some representatives of the City Council allowed a confrontation and the explanation of some needs and links that forced the final choices.

In addition, the participants evidenced the need to act on several fronts to fill the existing gaps, such as training and development of specific competencies, dialogue between institutions and citizens, financial and training support instruments, national and local legislative framework to favour the adoption of urban resilient systems such as the NBS.

All the participants expressed the potential of NBS adoption, also as an active instrument of communication and environmental education to be applied in the territory; furthermore, participants expressed the desire for NBS application in other areas of the city, at a broader and more structural level.

The workshop, also based on the experience of Prof. Salbitano, made it possible to connect the main actors and the various needs – even opposite ones – linked to the pilot area. In this way, the understanding of NBS became more accessible, comprehensible and exportable, both for specialists and non-professionals.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 867564
tinyurl.com/conexus-project

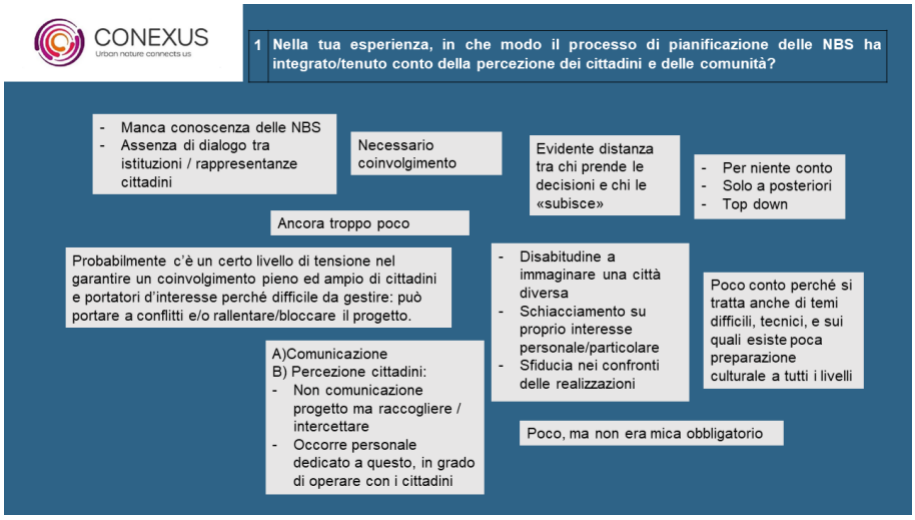
CONEXUS: Co-producing NBS and restored ecosystems - transdisciplinary nexus for urban sustainability
SC5-13-2018-2019b: Strengthening EU-CELAC international cooperation on sustainable urbanisation using NBS

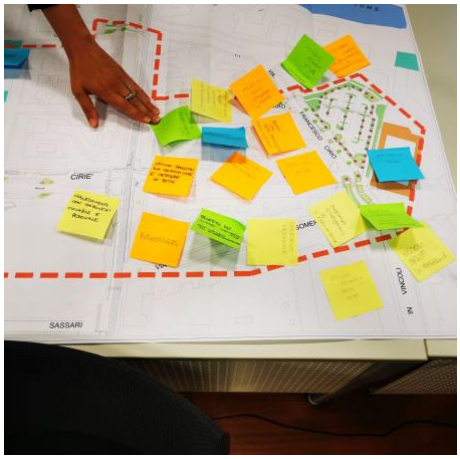
LIFE LAB VALDOCCO VIVIBILE
2° WORKSHOP PARTECIPATIVO

INPUT E RISPOSTE DEI PARTECIPANTI

Allegato 1 - Report Workshop

15 luglio 2021
Biblioteca Italo Calvino
Torino (TO)





Annex V - Main Colombian public policies on territorial planning

List of the main public policies on territorial planning for land-use planning. The table presents a list of the main public policies that are in force in Colombia and that represent the legislative framework that influences the introduction of the BSS in the planning process of Colombian cities.

Laws and Decrees	Outreach
Decree Law 2811 of 1974	By which the National Code of Renewable Natural Resources and Environmental Protection is dictated.
Decree Law 1333 of 1986	Whereby the Municipal Regime Code is enacted.
Law 9 of 1989	By which rules are issued on municipal development plans, purchase and sale and expropriation of property.
Law 3 of 1991	By which the National System of Social Interest Housing is created, the family housing subsidy is established, and the Institute of Territorial Credit, ICT, is reformed.
Law 21 of 1991	Approving Convention No. 169 concerning Indigenous and Tribal Peoples in Independent Countries

Law 70 of 1993	By which the black communities in rural riparian areas of the Pacific Basin and their traditional production practices are recognized.
Law 99 of 1993	By which the Ministry of the Environment is created, the Public Sector in charge of the management and conservation of the environment and renewable natural resources is reorganized, and the National Environmental System, SINA, is organized.
Law 128 of 1994	Whereby the Organic Law of Metropolitan Areas is enacted.
Law 134 of 1994	Whereby rules are issued on mechanisms for citizen participation.
Law 136 of 1994	By which rules are issued to modernize the organization and operation of municipalities.
Law 152 of 1994	Whereby the Organic Law of the Development Plan is established.
Law 388 of 1997	By which Law 9 of 1989 and Law 3 of 1991 are amended.
Law 507 of 1999	Whereby Law 388 of 1997 is amended.

Law 546 of 1999	By which housing regulations are issued.
Law 614 of 2000	By means of which Law 388 of 1997 is added and territorial integration committees are created for the adoption of land-use plans.
Law 617 of 2000	Whereby Law 136 of 1994 is reformed and other norms are issued to strengthen decentralization and rationalize national public spending.
Law 715 of 2001	By which organic norms are dictated in terms of resources and competencies in accordance with articles 151, 288, 356 and 357 of the Political Constitution and the provision of education and health services, among others, is organized.
Law 1083 of 2004	By means of which some rules on sustainable urban planning are established.
Law 1152 of 2007	By which the Statute of Rural Development is dictated and the Colombian Institute of Rural Development - Incoder is reformed.
Law 1454 of 2011	By which organic norms on territorial planning are dictated.

Decree 3600 of 2007	Regulation of Law 388 introduces the municipal ecological structure as a structuring element of possible sub-regional rural zoning models in the form of Rural Planning Units (UPR).
CONPES 3700 of 2011	National climate change policy and national risk management system
Ministry of Environment 2012	National Policy for the Integrated Management of Biodiversity and its Ecosystem Services
Decree 1077 of 2015	Single Regulatory Decree of the Housing, City and Territory sector.

Source: Official Journal of Colombia: http://svrpubindc.imprenta.gov.co/diario/

Annex VI - Description of variables

Description of the variables identified.
Source: questionnaires, interviews and general bibliography.

Continuity: stable support plans and programmes to maintain NBS and ensure continuity of expected services and functions.

Relation to Global Agendas: Climate variability, biodiversity loss, food security and SDGs: Example: deepening of the effects of climate variability on the urban environment become an important stimulus for identification and implementation. Other global agendas are considered here: SDGs, food security, biodiversity. The effect on the other variables is similar so they are not individualized.

Costs: implementation costs and regulatory frameworks for investment. Fiscal and financial incentives can help subsidize implementation and operating costs.

Knowledge: facilitate the confluence of three types of knowledge on the concept: the population, the public administration and the academia.

Demand: pressure from the population towards public institutions to obtain resources and forms of support that allow them to solve socio-environmental problems in specific places where they live and develop their livelihoods. These problems are of a socio-ecological nature.

Inter-institutional coordination: confluence of resources and actors, between institutions, scales and within institutions and social organizations, to implement flexible NBS to contemporary problems that go beyond the purely environmental. Cooperation around specific typologies, coordination of actions across scales to address cases in a differentiated manner. In this case, housing policies and environmental management policies go separate ways.

Political agendas: political party agendas and instability of government plans affect the continuity of NBS.

Public policies: The emerging status of the NBS has not allowed their formal entry into the public decision-making process on urban green spaces. The trend continues to be green infrastructure and both the concept of NBS and the socio-ecological principles and criteria for their design and implementation have not been mainstreamed. Legislation plays an important role: enabling, hindering (NBS not considered, or rigid regulations).

Environmental education: increasing knowledge about NBS and its link with socio-ecological dynamics and urban ecology.

Credibility in the public sector: growing distrust caused by problems of corruption and clientelism.

R&D&I (research, development and innovation): Research to concretize impacts, connection with development and innovation dynamics in designs, responses and financing.

Heritage: Various forms of tangible and intangible, public and private heritage that may be stimulated by the implementation of NBS, there is no clarity on the effect of NBS in this key field. May attract private interests.

Technology: permeates all scales and dimensions of NBS. Its availability and accessibility are fundamental for the dissemination and implementation of the NBS.

Growth and urban development: here the demand is considered from the socio- spatial growth of the city and the way in which this growth is managed.

Citizen participation and agency: this is a key aspect that must be guaranteed due to the very nature of NBS that seek solutions to socio-ecological problems. Participation must take place throughout the project cycle. Citizen participation makes viable and strengthens community empowerment.

Equity: A skewed distribution of an object of value, e.g., income, health care, drinking water, among individuals or groups. Inequitable access to natural resources and environmental services and factors of production continue to be a major source of inequity between individuals and social groups. Therefore, the type, quality and coverage of each NBS must respond to specific socio-environmental issues. There is often a perception of conflict between NBS and social problems. It is always questioned whether an area should be converted into popular housing or an urban park.

Annex VII - Results of the qualification of the variables

	1 : Continuity	2 : Costs	3 : Knowledge	4 : Coordinati	5 : Global A.	6 : Demand	7 : Politics	8 : Policies	9 : Education	10 : Credibilit	11 : I + D + I	12 : Heritage	13 : Tecnology	14 : Urban D.	15 : Participat	16 : Equity
1 : Continuity	0	2	2	3	3	2	3	3	2	1	2	2	1	2	2	2
2 : Costs	3	0	1	2	1	2	2	1	2	0	2	0	2	2	2	1
3 : Knowledge	3	1	0	2	2	1	0	2	3	1	2	0	2	1	2	3
4 : Coordinati	0	0	3	0	1	1	3	2	1	0	1	0	1	2	2	0
5 : Global A.	0	0	3	1	0	1	2	1	2	0	2	0	2	3	2	1
6 : Demand	1	2	2	1	2	0	3	1	2	1	2	1	1	2	2	2
7 : Politics	0	0	2	2	2	1	0	1	2	1	1	1	0	1	1	1
8 : Policies	0	3	2	2	3	2	2	0	2	1	2	0	2	2	3	2
9 : Education	1	0	3	0	1	1	0	2	0	0	2	0	2	1	2	2
10 : Credibilit	2	1	1	3	1	2	3	1	2	0	0	0	0	0	2	2
11 : I + D + I	0	0	2	2	2	2	1	3	2	0	0	0	2	3	0	1
12 : Heritage	2	0	1	0	1	2	1	1	1	0	2	0	1	0	2	1
13 : Tecnology	0	2	2	2	2	2	0	2	3	0	3	0	0	2	2	1
14 : Urban D.	2	2	2	2	2	1	2	2	2	1	2	0	2	0	2	2
15 : Participat	3	2	2	3	1	2	2	1	2	2	1	0	0	2	0	1
16 : Equity	1	1	2	2	1	2	3	2	3	1	2	0	2	3	2	0