

Urban Inclusive and Innovative Nature

Fundaments and Practices for the Co-creation
of Nature-based Cities

EDITORS

Isabel Ferreira, Beatriz Caitana, Nathalie Nunes



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Editors: Isabel Ferreira, Beatriz Caitana, and Nathalie Nunes

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Viale Pasubio 5, 20154 Milano (MI) www.fondazionefeltrinelli.it

ISBN 978-88-6835-519-7

First digital edition July 2024

Director: Massimiliano Tarantino

Research Activities Coordination: Francesco Grandi

Editorial Coordination: Caterina Croce

This publication was produced within the framework of the project “URBiNAT - Healthy Corridors as drivers of social housing neighbourhoods for the co-creation of social, environmental and marketable NBS” that has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 776783.



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INTRODUCTION

URBINAT - URBAN INCLUSIVE & INNOVATIVE NATURE

URBiNAT, a project funded by the European Union's Horizon 2020 programme, embarked on a transformative journey across seven European cities: Porto, Nantes, Sofia, Høje-Taastrup, Brussels, Siena, and Nova Gorica. At its core, URBiNAT's mission was to co-create healthy corridors – clusters of nature-based solutions (NBS) within public spaces, developed through community-driven design processes. These corridors aimed to forge connections between social neighbourhoods and disadvantaged residential areas, fostering the co-creation of new urban, social, and environmental relations across diverse neighbourhoods.

This ambitious endeavour was pursued hand in hand with local citizens and diverse stakeholders, embodying a collaborative purpose that transcended borders and disciplines. URBiNAT's inclusive and innovative approach to urban regeneration also attracted European observers, namely from the Netherlands and Cyprus, and extended beyond Europe, welcoming non-EU observers from Iran, Brazil, China, Oman, and Japan into its vibrant community of practice. Notably, the city of Khorramabad joined the URBiNAT cities in co-creating with inhabitants.

Central to URBiNAT's model of intervention are NBS – sustainable alternatives that respond to social, economic, and environmental challenges. These solutions draw inspiration from, support, or emulate nature, bridging the gap between ecological features and urban regeneration processes. In challenging conventional definitions, URBiNAT's catalogue of NBS encompasses not only territorial and technological innovations but also participatory and solidarity approaches, enriching the dialogue between physical structures and social dynamics within public spaces.

Each URBiNAT city endeavoured to co-plan a healthy corridor – a flexible and innovative NBS integrating myriad micro-solutions. A healthy corridor, as envisioned by URBiNAT, transcends mere physical infrastructure, serving as a pathway and a multifaceted platform for social, cultural, and educational exchange. Rooted in the well-being of citizens – both physical

and social it embodies the project's commitment to fostering inclusive and innovative urban environments. In this framework, URBiNAT stands for an urban, inclusive and innovative nature.

Comprising an international consortium of cities, experts, practitioners, companies, research centres, and universities, the URBiNAT community brought together a mosaic of perspectives, expertise, and experiences. Over its six-year duration, from its inception in 2018 to its conclusion in 2024, the project unfolded as a multifaceted exploration of the intersection between urban, social, and environmental realms.

FUNDAMENTS AND PRACTICES

This Ebook serves as a comprehensive exploration of the URBiNAT project. It delves into its analytical, scientific, and methodological dimensions, offering critical reflections and insights into the project's approaches. Another URBiNAT Ebook presents the roadmap for the co-creation of healthy corridors and its application in eight URBiNAT cities. Therefore, this Ebook addresses the importance of inclusive public spaces, the biophysical environment's role, comprehensive co-creation approaches, the integration of culture, a plurality of economic perspectives on NBS, and the multiple uses of green spaces towards health and well-being. These themes are crucial not only for understanding URBiNAT's achievements but also for guiding future endeavours in the science and practice of NBS.

The chapters that compose this Ebook adopted diverse formats and strategies for their collaborative elaboration, reflecting the challenges and richness of the project's interdisciplinary nature. The notions of 'fundaments' and 'practices' underpin each chapter, representing the concepts, principles, and perspectives brought together by the diversity of URBiNAT partners, aiming at serving the target audience for this Ebook, which includes practitioners and professionals seeking practical knowledge and critical reflections on urban regeneration with NBS.

By offering an entry point to the URBiNAT experience, this book aims to facilitate a deeper understanding of the project's scientific and methodological background and lessons learned, fostering inclusive dialogue. It represents a culmination of the diverse perspectives and expertise brought together by the URBiNAT project. Across its six chapters, the Ebook weaves a comprehensive narrative of inclusive urban regeneration, each chapter contributing a unique lens through which the project's multifaceted approach can be understood. From the co-creation of inclusive

public spaces to the integration of cultural and economic dimensions and the promotion of health and well-being through NBS, every chapter underscores the innovative and collaborative spirit that defines URBiNAT.

Additionally, the chapters organise evaluation results to contribute an overall scheme for the benefit of future urban regeneration projects. Given that green areas and NBS do not automatically ensure social justice and inclusive development, the project's foundation is anchored in socio-ecological, social sciences, and humanities disciplines. By proposing a people-centred analysis model, it addresses the lack of evaluation on the social dimension of NBS. This comprehensive approach highlights the importance of integrating multiple disciplines and perspectives to create truly inclusive and sustainable urban regeneration projects.

SIX CHAPTERS

The six chapters unfold as follows:

- Chapter 1. Inclusive Public Space. *Coordinators: Gonalo Canto Moniz (CES-UC), Marco Acri (UNG), and Milena Tasheva-Petrova (UACEG)*

Chapter 1 begins by introducing the concept of inclusive public space, emphasising its significance as an urban regeneration strategy. It explores how inclusive public spaces serve as living labs, fostering community engagement and innovation. The focus then shifts to the inclusive urban regeneration of social housing neighbourhoods, with case studies illustrating effective approaches. The importance of public space in urban regeneration, particularly in public housing neighbourhoods, is further examined. Moving forward, the chapter explores healthy corridors and NBS, detailing strategies for their co-creation and implementation. Lessons learned and main challenges in implementing healthy corridors are discussed, followed by guidelines for creating inclusive public spaces based on key insights.

- Chapter 2. Biophysical Environment As Natural Basis For Healthy Corridors. *Coordinators: B atrice B chet (CNRS-IRSTV) and Jos  Miguel Lameiras (BIOPOLIS)*

Chapter 2 delves into the biophysical environment's crucial role as the natural foundation for healthy corridors. It begins by examining how the biophysical environment serves as a fundamental aspect of implementing healthy corridors. The evaluation of thermal comfort and the urban thermal environment, including issues like urban heat islands and overheating,

is explored through physical indicators. The chapter also addresses urban soil as a resource for food growing, covering soil functions, fertility, and pollution. Urban stormwater management is discussed, focusing on hydrological evaluation and the performance of NBS like swales. Additionally, the chapter explores trees' role in carbon storage. Lastly, it examines various NBS and their environmental effects, including slope stabilisation and renaturalization of impermeable spaces. Lessons learned and recommendations conclude the chapter, offering insights for future implementations..

→ Chapter 3. Co-Creation In Urbinat: Approaches, Practices And Guidelines. *Coordinators: Isabel Ferreira (CES-UC) and Knud Erik Hilding-Hamann (DTI)*

Chapter 3 introduces the comprehensive co-creation approach utilised in URBiNAT, elucidating the diverse methods and actors involved in the process. It delves into the practices and approaches to participation across various types of NBS typologies within the project. It also explores how participatory NBS, territorial NBS, social and solidarity economy NBS, and technological NBS are collaboratively developed. Additionally, the chapter examines the methodologies and stages employed throughout the co-creation process, offering insights into methods utilised in each stage. Furthermore, it discusses the utilisation of cross-cutting dimensions, addressing ethical, human rights, and gender dimensions, and citizen engagement guidelines to ensure inclusivity in NBS co-creation. Lastly, the chapter outlines the key structures facilitating co-creation in URBiNAT, such as living labs, municipal roadmaps, and digital enablers, emphasising their role in NBS implementation.

→ Chapter 4. Culture In, For, As Inclusive Urban Regeneration. *Coordinators: Nathalie Nunes (CES-UC), Susana Leonor (GUDA), Sofia Martins (GUDA), Américo Mateus (GUDA), Marco Acri (UNG), Mariapiera Forgione (Siena Municipality), Laetitia Boon (Brussels Municipality), Ribal Aman Eddine (CES-UC)*

Chapter 4 unfolds URBiNAT's roadmap for rethinking inclusive urban regeneration through the lens of culture. It begins by exploring why culture, broadly conceived beyond mere heritage, should be considered at the heart of sustainable urban development. It then examines in depth how URBiNAT cities have methodologically and practically integrated culture into the co-creation participatory processes of NBS, through cultural mapping, community-based arts, and creative forms of communication

and interaction to engage local communities. The chapter closes by discussing the integration of culture in the results of the co-creation process, both as a means and as an end, shaping several NBS, and providing a platform for meeting and discussion. Emphasis is also placed on the monitoring and evaluation of the cultural dimension of the co-creation process, as a step towards cultivating cities that aspire to be more inclusive, democratic, and sustainable.

→ Chapter 5. The Plurality Of Economic Lenses In The Design And Implementation Of NBS' Healthy Corridor. *Coordinators: Beatriz Caitana (CES-UC) and Emma Björner (IKED)*

Chapter 5 delves into the economic perspectives surrounding NBS within the context of healthy corridors. It explores the intersection of NBS with social and solidarity economy paradigms, emphasising the potential of nature-based organisations in addressing societal and environmental challenges, particularly in deprived urban areas. Through empirical evidence from URBiNAT cities, the chapter examines various community-led economic initiatives, social and solidarity economy actors, and nature-based organisations, providing insightful examples. Overall, it offers a roadmap for future NBS initiatives within healthy corridors, highlighting the importance of inclusive urban regeneration and equitable distribution of economic benefits.

→ Chapter 6. How Nature-Based Solutions Promote Health & Wellbeing. *Coordinators: Marcel Cardinali (OWL) and Philippe Bodéan (Nantes Municipality)*

Chapter 6 explores the multifaceted relationship between NBS and human health in urban environments. It begins by discussing the interconnectedness of nature and human well-being, highlighting the potential of NBS in reducing environmental stressors, restoring capacities and inviting for a more (inter-)active lifestyle. The chapter then delves into specific aspects of health addressed by NBS, such as the mitigation of air pollution and the enhancement of thermal comfort. Additionally, it examines the role of allotment gardens in promoting well-being and social cohesion within urban communities. Furthermore, the chapter explores how NBS can encourage healthy behaviour among urban residents, offering insights into understanding behavioural patterns. Concluding with recommendations for practitioners, the chapter underscores the importance of effectively implementing NBS to improve health and well-being in urban settings.

CO-CREATION OF NATURE-BASED CITIES

The six chapters of this Ebook delve into the project's approaches, laying the foundation to explore key aspects for the co-creation of nature-based cities. In this sense, knowledge-based evidence underscores that diverse use of green corridors and re-naturalization with vegetation and autochthonous trees can enhance health and well-being, while fostering social cohesion. Socio-economic impacts emphasise the role of NBS in bolstering resilience through non-financial outputs. Additionally, co-creating healthy corridors is crucial to mitigate gentrification and promote a sense of belonging, alongside the environmental benefits of territorial NBS implementation. The influence of local cultural ecosystems on NBS activation, coupled with community-based communication and participatory processes, further contributes to NBS social cohesion and transformative potential.

In this context, the multidimensional, layered, and diverse framework of URBiNAT confirms its innovative character in responding to contemporary societal challenges. Operating on various scales, from neighbourhood streets to district levels, the project mobilised diverse assets. Its multi-sectoral approach involved active collaboration among public bodies, universities, and local social organisations, fostering the co-production of knowledge across scientific domains.

The diverse group of authors in this Ebook and their roles in the project reflect the richness of a collaborative endeavour. Coordinators, researchers, practitioners, and local stakeholders from various cities and backgrounds have contributed their insights and experiences. This diversity has been crucial in developing practical guidelines and reflections that are valuable for practitioners, professionals, and urban regeneration enthusiasts.

The contribution of this Ebook extends beyond the immediate target audience of urban regeneration practitioners. It offers valuable insights for other audiences, including policymakers, researchers, local organisations, and communities. We expect the practical applications and lessons learned within these pages to help foster more inclusive, sustainable, and vibrant urban environments.

We extend our heartfelt thanks to the diverse community of authors, coordinators, and stakeholders whose dedication and expertise have been instrumental in shaping the URBiNAT journey. Your contributions have laid a strong foundation for continuing this collaborative effort towards inclusive and innovative urban regeneration with NBS.

We wish you an enjoyable, useful, and inspiring reading experience, and look forward to seeing the impact of these collective efforts in future urban regeneration projects.

The editors

Isabel Ferreira (CES-UC)

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CHAPTER 1.

INCLUSIVE PUBLIC SPACE

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*Keywords: Public space; Inclusive urban regeneration;
Nature-based solutions; Living labs; Social housing
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1. INTRODUCTION

Gonçalo Canto Moniz, Marco Acri

In the historic city, until the 20th century, the public space is the open space, the space that is not built - the street, the avenue, the square or the park - where people meet and interact as a community. It is the opposite of the private space, where people live, work, study. Giambattista Nolli's plan of Rome (1736-1748) was the first to expand this dichotomy by representing as public space the ground floor of buildings that have a public character, namely the churches and public institutions.

Meanwhile, during the 20th century many of these public spaces (open and closed ones) lost their character, use and public representation, due to the peripheralization of the cities and consequent abandonment of the city centre. According to Thierry Paquot (2009: 91), "it is not only the legal regime of land ownership that decides the fate of a soil, but the practices, uses and representations that take place in it". In the same vein, Manuel Delgado (1999) asserts that "public space is the space of interaction" putting the emphasis on the social production of space.



Figure 1: Giambattista Nolli, plan of Rome, 1736-1748.

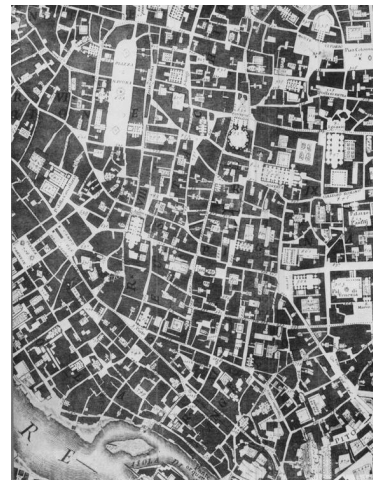


Figure 2: Giambattista Nolli, extract of the plan of Rome, 1736-1748.

Outside the historic centres of cities, the public space took on multiple forms that are not recognized and appropriated by citizens. In fact, the Modern Urbanism that transformed cities and urbanized the territory did not always manage to qualify the open spaces. The main exception in the practice could be seen today in socialist housing, especially in the former Yugoslavia, where social housing was combined to high standards of public space and public services to be provided to neighbourhoods according to their dimension. The total absence of private space was meant to spread a broader sense of ownership, not based on property but based on use. The shift of the former socialist countries into a liberal economy immediately generated ownership oriented managements of the public space, contrasting with the increasingly weaker influence on it by public authorities.

Accordingly, it is urgent to rethink the public space, in the centre and in the suburbs, combining the contemporary challenges related with the environmental and social dimension. There is also an opportunity of engaging the citizens in the co-production of their space. As stated in the Public Space Charter (2013: 5), “the inhabitants have the right to be involved through participatory processes in the creation and management of public space”. In this way, the open space can become public and inclusive with urban life, as claimed by Henri Lefebvre (1991, p.286), because “it is not only supported by social relations but is also producing and produced by social relations”.

The inclusive public space aims to be at the centre of doing and living the city as an open system with diverse values of society, culture, religion, ethnicity and environment (Sennett, 2006). This open and democratic character needs to be supported by the engagement of different actors, to entail a horizontal decision-making process, where all the voices are heard and have the same space.

The healthy corridor concept and strategy can find the answers and the solutions, namely the NBS, in a multiplicity of actors and issues, instead of simply in regulations and other abstract forms of administration or land management. The planner or designer must develop mechanisms that create a public space made “by and with the people”, with effective participation - sharing and exchanging power, knowledge and experience - and not “for the people” (Sanoff, 2000).

The public space “as a forum for (...) strangers to interact” (Sennett, 2000, p. 4) is not only a physical space but is also a social space that results from the interaction produced during the co-creation process. The ones

involved in this process developed a sense of belonging with the space as well a sense of responsibility to manage it and to activate future solutions. Which means that the inclusive public space is in permanent transformation integrating new narratives (environmental, cultural, social, among other), as well as different forms, shaped by new solutions for new challenges. This resonates on the three dimensions proposed by Sennett (2006, p. 3) for the democratic spaces: “1. passage territories; 2. incomplete form; 3. development narratives”.

In URBiNAT, the inclusive public space is the result of the co-creation of the healthy corridor by the local communities in the frame of an inclusive urban regeneration process. This fundament - inclusive public space - was developed in each URBiNAT city during the co-creation process, where nature-based solutions were selected to face needs and challenges identified during the local diagnostic. The following stages - co-design, co-implementation and co-monitoring - not only activated the NBS and the healthy corridor, but also aimed to improve the sense of belonging of citizens and stakeholders in relation to the territory, where not always their voice was heard. In this sense, the inclusive public space is the representation of the right to the city, where citizens have the right to use it but also to co-produce it according to their needs, perceptions and ambitions.

Figure 3: Paths near Falcão social housing in Campanhã, URBiNAT before the construction of the healthy corridor, 2020. Credits: Carlos Barradas.



Figure 4: Street in Nadezhda, URBiNAT intervention area, before the construction, Sofia, 2020. Credits: Gonçalo Canto Moniz



2. INCLUSIVE PUBLIC SPACE AS AN URBAN REGENERATION STRATEGY

Gonçalo Canto Moniz

The urban plan developed in the frame of URBiNAT consolidated an inclusive urban regeneration strategy, as a methodology and as a practice tested in seven European cities and in one city located in the Middle East. These actions were complemented by five workshops to co-create healthy corridors with local communities that took place in Khorramabad (Iran, 2019), Natal (Brazil, 2019 and 2023), Portimão and Coimbra (Portugal, 2023).

This concept was explored in several deliverables and publications taking advantage of the work developed in the cities, namely in the social housing neighbourhoods that are being intervened in the scope frame of URBiNAT. It is urgent to develop urban policies and strategies to improve the open space of the suburbs towards a public space that offers quality of life to the life and work in these urban areas in order to democratise the production of space.

In fact, the inclusive urban regeneration concept is rare in the literature until 2017. The H2020 call for projects “SCC-02-2016-2017 – Demonstrating innovative nature-based solutions in cities” (European commission, 2015) is quite innovative by asking proposals to address specifically “Nature-based solutions for inclusive urban regeneration”, explaining that “Actions should address nature-based solutions for inclusive urban regeneration – including regeneration of deprived districts, or neglected or abandoned areas”. This is a target that the four innovation actions selected in the call – URBiNAT, Clever Cities, proGInreg and edicitnet – are pursuing since 2018 by associating nature-based solutions to an inclusive urban regeneration, exploring the environmental and social dimensions together.

The 2nd edition of the book “Urban Regeneration” edited by Peter Roberts, Hugh Sykes and Rachel Granger and published by Sage in 2017, when URBiNAT was being planned, ends with a section on Current Challenges and Future Prospects, where the last sentence highlights the community engagement in the urban regeneration programmes:

“Community engagement has also made substantial progress; from token consultation in the 1970s to a more substantial degree of community control, this agenda has expanded as the central state retrenches. Most important, it is now an accepted tenet of practice that the community should be fully involved in setting the initial objectives of a regeneration programme and in all stages of its implementation” (p.335).

This approach is also developed by other authors, such as Pengcheng Xiang, Yuanyuan Yang, Zongyu Li (2020) with the text “Theoretical Framework of Inclusive Urban Regeneration Combining Nature-Based Solutions with Society-Based Solutions”. It is interesting that the Chinese academics are working on the same page as the European ones, analysing several best practices in Chinese cities. The authors propose an inclusive urban regeneration based on four pillars: environmental conservation, social participation, cultural creativity, and economic impact.

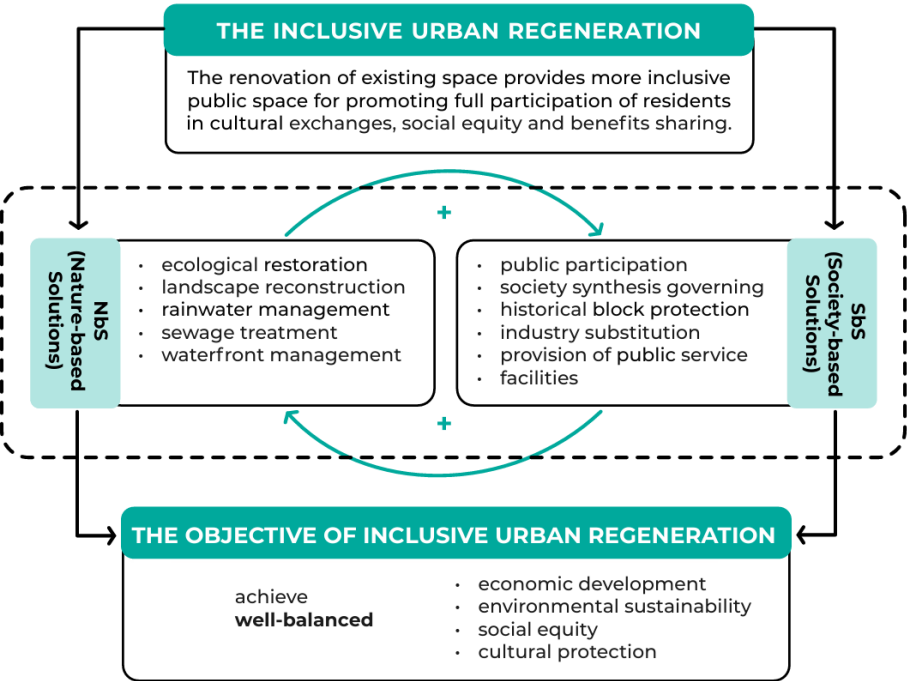


Figure 5. The theoretical framework of inclusive urban regeneration. From Xiang et al. (2020).

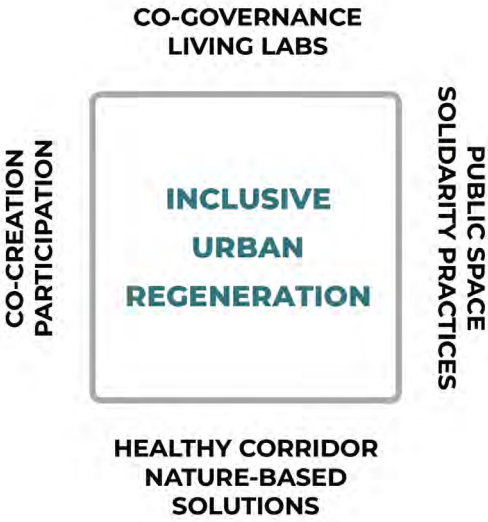
In the setting frame of URBiNAT, inclusive urban regeneration is based on the co-creation of nature-based solutions, by activating living labs. In this sense, inclusive urban regeneration puts in dialogue four themes: co-creation (participation); nature-based solutions (healthy corridor); living labs and co-governance, public space (social practices).

With the frame of Nature-based solutions (NBS), the challenge of co-producing a healthy corridor (HC) is an opportunity to rethink the concept of NBS through a social approach. To inspire the co-production process, URBiNAT developed a living NBS catalogue that organises territorial and technological solutions, embracing products and infrastructures; and also participatory, and social and solidarity economy, comprising processes and services (URBiNAT, 2021b).

Considering the co-governance approach, the co-production of the HC urban plan in URBiNAT was developed under the living labs activated in each community to promote a bottom-up process, where citizens could gradually take the control of the participatory process by developing solutions for their needs together with other actors, (Steen & Van Beuren, 2017; URBiNAT, 2021a). The inclusive urban regeneration is focused on the public space, as a space that links and connects the urban areas, but it is also a territory of interaction where the local community has the right to the city, by having voice and quality of life.

The inclusive strategy of urban regeneration is not only a buzz word to dialogue with the sustainable discourse. It needs to create the environment for co-production through the identification of actors interested in

Figure 6. Inclusive Urban Regeneration proposed by URBiNAT. Design by Ribal Aman Eddine & GUDA



being involved, taking into consideration four dimensions. Firstly, the interdisciplinary research to integrate different complementary knowledge, to harmonise concepts and methodologies from different perspectives, to understand the distinct scientific positions and to manage the tension between the material and immaterial dimensions such as Architecture, Landscape Architecture, Engineering, Sociology, Geography, Economy, Psychology, among other; secondly, the intersectoral research to involve different sectors of society, to deal with power relations between institutions and groups, to establish democratic relations and decision-making between different actors, namely academia, local and regional government, third sector, companies (quadruple helix) (Carayannis, Campbell, 2009); thirdly, the intercultural research to share knowledge produced by different cultures, to explore North-South and East-West dialogue; to un-

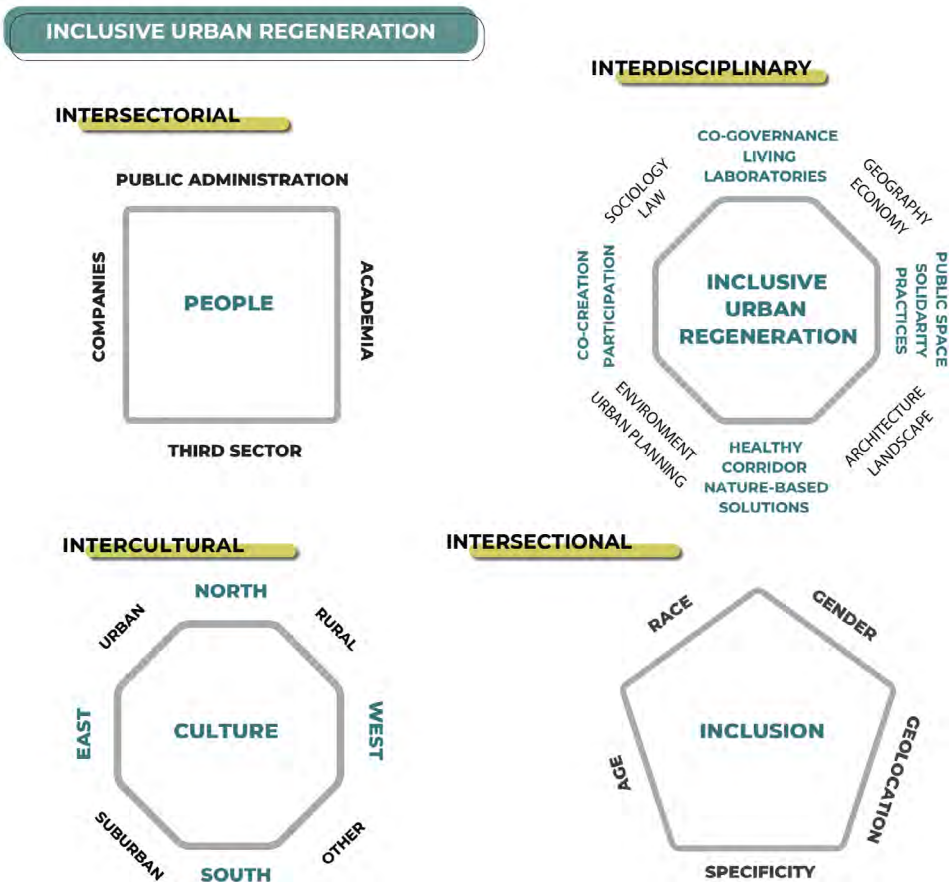


Figure 7: Inclusive Urban Regeneration, Intersectorial, Interdisciplinary, Intercultural, Intersectional, URBiNAT diagram. Design Ribal Aman Eddine & GUDA

derstand minority culture; to avoid colonising attitudes, namely North-South, East-West; Urban, Rural, Coastal, Forestal; finally, the intersectional research to promote the inclusion of different groups working in the field, to overcome social stigma, to democratise the dialogue between different groups, namely race, gender, age, geo-location, specificities.

INCLUSIVE PUBLIC SPACE AS A LIVING LAB

Inclusive public space can be achieved through an urban regeneration strategy to improve social housing neighbourhoods by activating living labs. On the one hand, it will explore the definition of inclusive public space taking in consideration the idea of “open city” from Richard Sennett (2006) and the “space of inclusive presence” from Madanipour (2018). On the other hand, it will present the participatory methodology to achieve an inclusive public space in three moments. Firstly, the urban regeneration strategy to take in consideration of the municipal urban plan for the intervention area to be put in dialogue with the diagnostic made by technicians, but also by the local community. Secondly, the improvement of social housing neighbourhoods that were developed in the second half of the 20th century in the outskirts of cities. The modern planning generated an island effect where the large complexes of buildings were built without an infrastructure that integrated it in the consolidated city. Thirdly, the activation of living labs is a bottom-up strategy where citizens organize themselves to co-create solutions for their territorial, social and economic needs. To solve their needs, they may call the academia, the municipality, companies, and local associations.

This democratic space creates a community of interests that can activate a living labs or a forum, to co-create solutions for the public space. URBiNAT is taking advantage of the living lab concept defined by the European Network of Living Labs (2018):

“Living Labs (LLs) are open innovation ecosystems in real-life environments using iterative feedback processes throughout a lifecycle approach of an innovation to create sustainable impact. They focus on co-creation, rapid prototyping & testing and scaling-up innovations & businesses, providing (different types of) joint-value to the involved stakeholders. In this context, living labs operate as intermediaries/orchestrators among citizens, research organisations, companies and government agencies/levels. Within a wide variety

Figure 8: Porto - Camapanhã Living Lab, 07/12/2019, Community Workshop to prepare the walkthrough, Local diagnostic. Source: Fernanda Cury.



Figure 9: Nantes - Nantes Nord Living Lab, 07/10/2020, Fête de la science: activities on soil, climate and water in relation with well-being – activities with schools and with inhabitants. Source: Nantes team.



Figure 10: Sofia - Nadezhda Living Lab, 20/06/2020, Citizen workshops for 4 places of intervention. Source: Sofia team.



of living labs, they all have common characteristics, but multiple different implementations.”¹

URBiNAT Living labs are laboratories activated in local communities based in research action processes where citizens play an active role throughout the co-creation process, since the first moment and “no one should be left behind”, as we can see here, by engaging citizens, stakeholders, municipalities, local associations, as well as the local champions

¹ European Network of Labs, <https://enoll.org/about-us/what-are-living-labs/>.

Figure 11. Co-creation target groups in URBiNAT: the municipality, local stakeholders (organisations, agents, companies, etc.), champions, community residents.



In this sense, the co-creation process is organised in four stages: co-diagnostic, to map the local participation culture and identify needs; co-design, to ideate and develop proposals; co-implementation, to build together material and immaterial solutions; co-monitoring, to evaluate the impact of the processes and the solutions in the community.

The activation of the Living Labs was achieved by means of local diagnostics carried out by the Frontrunner and Follower cities (D2.6) in which citizens, participating in URBiNAT activities as individuals or as members of associations, share, discuss and design solutions and directions for the implementation of NBS with researchers and municipal stakeholders. Activities were organised according to the co-creation methodology and toolkit with large (>100), medium (>15) and small groups (<5). From public events to workshops and proximity meetings, a significant number of citizens and stakeholders are involved in the co-creation process in each city, and some are already integrated, taking the lead in the organisation of activities related to the new NBS, such as the solidarity market in Porto.

The number of citizens engaged is relevant, but their level of diversity is more meaningful. In the Frontrunner cities, citizens participated in the co-design of NBS for the Healthy Corridor and then were integrated in working groups in order to activate the co-implementation stage, according to the strategy of the Stakeholder Advisory Boards. In the Follower cities, co-diagnostics involved children and adults in activities which would help to identify needs and dreams for the study areas. Elderly adults were also participating. Local associations and institutions, such as schools, were important informal partners due to their permanent commitment to URBiNAT, whose goals they closely share. Citizens with other specificities have also been engaged, including Roma people, migrants, those with functional differences, etc.

City		Porto		Nantes		Sofia		Høje-Taastrup		Brussels		Siena		Nove Gorica		Khorram abad	
		F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Children 0-10	C-LD*	600		46		150		43	29	50	45	240		36	26	49	25
	C-D*	74		2		4	7	10			10	8	2	86	128		
	C-IM	50+40		0		55	67										
Young 11-20	C-LD	5	1	15				92	107	10	15	5	6	22	20	20	40
	C-D	4	3	54				45			115	28	19	78	86		
	C-IM	5	4	31		155	163										
Adults 21-65	C-LD	147		295		242	130	95	57	41	26	24	14	48	46	160	220
	C-D	25	20	232				20			15	17	18	72	58		
	C-IM	30	20	85		333	420										
Advanced Age > 65	C-LD	04	04	62				4	7	10	10	5	5	52	56	50	60
	C-D	02	02	85		27	14	5			10	7	5	68	54		
	C-IM	02	02	1		121	89										
Race and Ethnicity diversity	All	Roma Children at school		Data not recorded in France		Roma and immigrant background		Different ethnicities		Migrant persons and long-term inhabitants				Nova Gorica and Gorizia,		3 different groups (Lor, Lak and Luti)	
Functional diversity	C-LD	Cerebral Palsy 1+3		Data not collected						No		Blind - 01		2	1		
	C-D	02	02							No		0	0				
	C-IM	02	02														
Association	All	40		20				03		20		07		05		02	
Primary Schools	All	06		01		02		0		0		03		01		01	
High Schools	All	01		01		02		03		1		01		01		01	

Table 1: Table with the citizens engaged in each living lab in co-diagnostic (C-LD), co-design (C-D), and co-implementation stages (C-IM) by gender (F-Female, M-Male).

3.

CHALLENGES AND OPPORTUNITIES IN SOCIAL HOUSING NEIGHBOURHOODS

Gonçalo Canto Moniz

The project URBiNAT has developed an inclusive urban regeneration approach focused on social housing neighbourhoods built in the second half of the 20th century in the peripheral areas of the cities. On the one hand, these areas have, in European cities, common characteristics that can be addressed in parallel, learning together how to face the same challenges. On the other hand, in the last two decades of the 21st century, the urban regeneration took place in the city centre and on the waterfront. The periphery and the citizens that live and work there were, most of the time, forgotten by the public policies.

Nevertheless, it is important to highlight that this strategy of involving the local community in the urban regeneration process to co-create or co-produce inclusive public space, and is relevant not only in the suburbs, but also in the city centre, or even in rural, forest and coastal areas².

SOCIAL HOUSING NEIGHBOURHOODS

The urban structure changed dramatically during the 20th century, when the street as corridor became planned as a viaduct without a direct relationship with the built structures, namely the housing ones. Although Le Corbusier was the great promoter of this idea, the first steps were already given by the urbanists of the Garden City. For the urban planners,

² A new European project, coordinated by CES team, is developing this strategy by amplifying URBiNAT methodologies, see More than green - Lighthouses of transformative nature-based solutions for inclusive communities, Grant agreement ID: 101084628, link <https://cordis.europa.eu/project/id/101084628>.

the big challenge to solve was the need to expand the city with housing neighbourhoods, to give a house to all the people that were moving to cities, to work in industries, commerce, and services.

The neighbourhoods built in the 1950s, 1960s and 1970s abandoned low-density housing models and opted for large, high-density complexes built first according to the Athens Charter schemes and then according to the neighbourhood units model. The state, municipalities, and cooperatives developed these housing complexes, which can be recognized on the outskirts of European cities. A new urban structure was created, the suburb, and European cities entered the age of suburbanization, where the housing areas, called "oases of order", became places of "feigned spontaneity" (Bandeirinha, Correia & Mota, 2017, p. 9; Davidovici, 2017, p. 46).

Motorways and train lines were planned to connect these neighbourhoods with the city centre. When the motorway was not built, the neighbourhood became isolated, but when it was built with one exit or station to each neighbourhood, it became autonomous, like a small city. On the one side, these neighbourhoods are now surrounded by roads and railways, although people living there have limited access to them. On the other side, some of these neighbourhoods were built without sanitary infrastructure, which led, for example, to the canalisation of streams being used for sewage.

The rehabilitation of these neighbourhoods today is imperative not only to physically re-qualify the houses and the open space but also to offer inhabitants effective integration into the city. This cannot be imposed on the residents by the technicians of the municipality, politicians, urban planners, or social scientists. It must arise from the people on the basis of their interests, motivations and aspirations, reopening some well-known participatory processes abandoned in the late 1970s, such as the Portuguese SAAL (Bandeirinha, 2007) that was truncated by the imprudence of a young democracy.

Thus, the peripheral areas of large and medium European cities, where the various social housing districts are located, nowadays have enormous potential for urban regeneration, environmental projects and social dynamism.

URBINAT CITIES: CASE STUDIES FOR AN INCLUSIVE PUBLIC SPACE

The case studies are located on the outskirts of seven European cities – Porto, Nantes, Sofia, Hoje Taastrup (Copenhagen), Brussels, Siena and Nova Gorica – in areas of urban expansion planned in the period 1940-1950 and built over the following decades through housing estates, predominantly for the most disadvantaged social classes.

In this way, it was intended to guarantee a set of common characteristics between the neighbourhoods of these cities. On the one hand, sharing a strong potential: architectural quality of housing estates, quality of the urban environment due to the rural matrix of the land, strong sense of community, active presence of groups and existence of cultural, social and sporting associations. On the other hand, less favourable aspects are also identified: conditioned access to the urban centre, limited access to school, health and cultural complexes, multicultural and aged population, high unemployment amongst the working population, low level of schooling, high rate of insecurity (Ferilli et al., 2019, 2021).

These social neighbourhoods are products of modern urban planning that guaranteed a rapid housing process, either for the rural populations that arrived every day in the city at the height of the industrialization process, as in Porto with the Campanhã parish (Fig. 12 and 13), in Sofia with the Nadezhda district (Fig. 16 and 17), in Copenhagen with the suburb of Hoje-Taastrup (Fig. 19 and 20), or for the people who saw their homes destroyed by World War II, as in the case of Nantes, with the urbanization of



Figure 12: Porto Urban Plan. Plano de Melhoramentos, 1956-66. Credits: Porto Municipality Historic Archive, <http://www.cm-porto.pt/osplanosdoporto/plano-de-melhoramentos-para-a-cidade-do-porto-1956-1966>



Figure 13: Cerco do Porto neighbourhood, 1961. Credits: Porto Municipality Historic Archive



Figure 14: Aerial view of “La Boissière”, 1960. Credits: Archives Municipales de la Ville de Nantes
Figure 15: Plan de Nantes, 1948. Credits gallica.bnf.fr / bibliotheque Nationale de France.

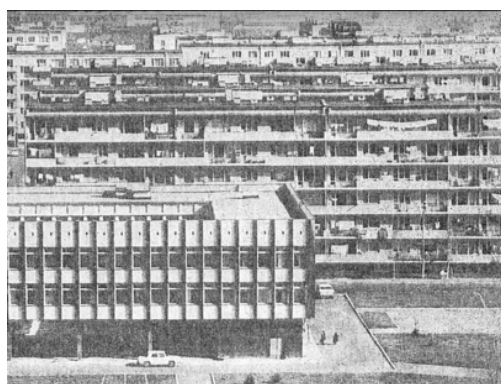
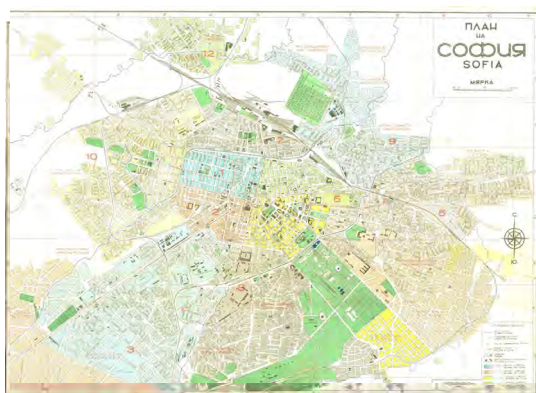


Figure 16: Sofia urban plan 1947. Credits: <https://www.rerumromanarum.com/2019/01/mappa-di-sofia-1947.html?m=1>
Figure 17: Nadezhda, 1972. Credits: Sofia magazine, December issue, 1972

the Nantes-Nord district (Fig. 14 and 15). This changing event also created new geopolitical relations, which developed new cities, such as Nova Gorica, the new frontier city of the Yugoslav government led by Tito (Fig. 18 and 19) (Moniz & Ferreira, 2019). The case of Khorramabad, in Iran, neighbourhood is the result of an informal development in the close periphery of the historic centre.

The urban plans for these areas were developed in a macro scale defining the new zones for housing, for industry, for health and educational facilities, according to the zoning modern principles. The housing estates followed urban and architectural projects that were replicated in several areas of the cities according to the pre-fabrication guidelines. Nevertheless, there was a lack of the intermediate scale where the public space with streets, squares and parks takes the role of connecting the new areas and being the “stage” of everyday life, as defined by Hilde Heynen (2013).

Although some of these suburbs of social housing are already integrated in the consolidated structure of the city, many others are dependent on fragile connections that put the citizens with a lack of access to work, services and leisure. These conditions improve the level of inequalities and create abyssal lines, as defined by Boaventura Sousa Santos (2007), that take the form of visible and invisible walls. These lines move according to the social transformations that take place in the city but they are difficult to erase. At these neighbourhoods, where URBiNAT has worked, it is still possible to hear people saying that they go to the city, underlying their feeling of exclusion.

Nevertheless, the peripheral areas of the cities result from different occupations and uses, that are, in some way contradictory. There is an opposition between agriculture and industry, old farms and social housing, old roads (Roman or medieval) and highways, green areas and gray areas, nature and pollution, etc. This palimpsest creates rich memories that are significant for the local communities although not valued by the centre, by the outsider. In fact, “the periphery is the territory of opportunity”, as mentioned by Andreas Philippopoulos-Mihalopoulos in the “About the City” conference of 2018. It is where things can be done in a different way by correcting the mistake of massive urbanization. There are ruins of buildings from the past, there are urban voids waiting to play an active role, there is still a relation with agriculture, there is still a relation with rural traditions, there is a strong activism and associationism, there is an autochthonous flora and a rich biodiversity.



Figure 20. Hoje Taastrup, aerial view before the construction of the city, Gadehavegård, 1966. Credits:



Figure 21. Hoje Taastrup urban plan, Gadehavegård, 1966. Credits:



Figure 22: Map of Brussels, Neder-over-Heembeek. Credits: Encyclopaedia Britannica/ UIG / Bridgeman Images.



Figure 23: Robert Coutois, Versailles urban plan, 1969-1972. Source: Carbon, Contrat do Quartier durable, diagnostic, p. 36-37, <https://www.calameo.com/read/0010576456e8db8bd4cf8>



Figure 24: Siena city map, 1940. Source: <https://www.ilpalio.org/pianta12.htm>



Figure 25: Via Valdambrino, Passeggiate senesi (III): Ravacciano, in "Eretico di Siena", 18 settembre 2014 <http://www.eticodisiena.it/2014/09/18/passeggiate-senesiiii-ravacciano/>

4. PUBLIC SPACE FOR URBAN REGENERATION: PUBLIC HOUSING NEIGHBOURHOODS

Joana Restivo & José António Ferreira

I.

In Europe, the massive migration towards the main urban centres, consequent to the industrialization process, was the main reason for the emerging public health concerns that led to the first public interventions on housing in the early 20th century. After the Great Depression, the state's role as a housing provider increases with the establishment of the social welfare state. The mass construction of public housing³ occurred all over Europe when the need for reconstruction of the cities after World War II superposed, in some countries, the pre-war housing deficit. The building conception had to be highly optimized regarding the global cost/total number of dwellings ratio. Notwithstanding the scale, the site plan strategies, or the construction methods locally adopted, the image of the housing estates built during the 1950s and 1960s is often quite recognizable, also due to their usual location on the outskirts of the major cities. Despite the differences that may be observed, these areas, sometimes extensive, became, in many cases, degraded and problematic, with a high concentration of population in socio-economic deprivation, witnessing the decay of the model that had conceived them (Ball et al. 1988, Turkington et al. 2004, Scanlon et al. 2014).

Most frequently, these neighbourhoods present a generous ratio regarding green space area per resident, despite the occupancy density that may be observed (if considering a habitable area per person, density might be high depending on the dwellings' reduced area). High-rise buildings

³ A housing stock provided by the Estate, still owned, managed or allocated by public local entities for the population most in need, presents an opportunity for a programmed intervention.

have been put down in many cases, and replacement or reuse has long been debated (Van Kempen et al. 2005, Jonge 2005, Gruis et al. 2006, Thomsen & Flier 2008). More often discussed which intervention should be undertaken to requalify these social neighbourhoods buildings – from a partial refurbishment to a more extensive intervention (Druot et al. 2007, Riccardo 2008, Restivo 2015, Lepratto 2021) –, the public space of these settlements has also been taken frequently as an opportunity to set off an urban project, transforming these areas more positively for its effective regeneration.

Even if accurately designed, the public space of these ensanches in some cases resulted from the leftover land in between the buildings distributed in the given area, with minimum earthmoving or slope treatment, failing to comply with some of the present regulations and living standards (e.g. fire safety, accessibility, and parking). One main problem stands at the origin: beyond its social homogeneity (higher or lower depending on the eligible population, and thus on the housing policies and allocation models of each country), these recognizable public housing estates (as cost and time-saving demanded), ordinarily built in the peripheral urban areas, were the hope of a brighter future – a home –, but also an urban fabric extension “detached” from the city. Their road infrastructure, commonly in *cul-de-sacs* or with a few accesses, meant these neighbourhoods were to arrive or to leave and rarely to be crossed over.

Nowadays, some of these housing estates have become part of the inner city, often corresponding to stigmatized and deprived areas, despite their potential transformability into liveable parks, natural areas and community spaces, for which the connections to the city must be strengthened. The unique property, in many cases, is an opportunity for a programmed intervention, whether it might adopt other partnership schemes.

II.

In Portugal, the 1950s and the 1960s witnessed the implementation of improvement plans in the two major cities, Lisbon and Porto, the latter being the municipality where the weight of social housing is more representative in the context of the country⁴ (INE 2022). Most of these social

⁴ The national census 2021 showed that 3% of the total conventional dwellings then-occupied as ordinary residence in Portugal was public property (0.8% central administration and 2.2% local administration). In Porto, this percentage scales to 14.1% (1.9% and 12.2%, respectively), making it the municipality where the weight of social housing is more representative in the context of the country.

dwellings in Porto are city property, and nearly half correspond to the housing ensembles built by the Improvement Plan for the city of Porto (1957-66) in carefully designed urban settlements but with very limited areas. Due to their degradation, the municipality has gradually refurbished these neighbourhoods in the last two decades, the interventions being directed to the buildings' envelope and common circulation area (i.e. partial refurbishment). In a few cases, the public space was also improved. The neighbourhoods to receive the first interventions are currently undergoing another partial refurbishment. The municipality is now tackling a more systematic intervention in the public space, aiming to regenerate those areas more effectively.

Refurbishment with typological reconfiguration (i.e. renovation) has been performed in two municipal cases (single or two-family housing with one or two floors, grouped in semi-detached or terraced houses with yards) in Porto, showing the decrease in population density (persons per hectare) for the same construction volume after renovation. Due to the significantly reduced area of the original housing units, only after renovation are the dwellings adequately occupied if 'area per person' (occupancy density) is considered (Restivo et al. 2012; Restivo 2015). A subsequent transformation of a third municipal neighbourhood (multi-family housing with four floors) followed the same strategy: reconfiguring and merging dwelling typologies but unaltering the construction volume. The ongoing works in a fourth municipal case – for which an urban project sets off the buildings' refurbishment and the public space renovation – previewed the demolition of some buildings of the set, though not changing dwelling typologies of the buildings to preserve. In this latter case – an extensive neighbourhood – there would be a change in the area's population density for the same buildings' occupancy density: from the beginning of the project, public space and housing buildings were taken together for more effective urban regeneration of the area. The public space was eventually redesigned due to a political decision not to put down any buildings.

III.

“Not to find one's way around a city does not mean much. But to lose one's way in a city, as one loses one's way in a forest, requires some schooling. Street names must speak to the urban wanderer like the snapping of dry twigs, and little streets in the heart of the city must reflect the times of day, for him, as clearly as a mountain valley. This art I acquired rather late in life (...).” Benjamin (2006)

There is a confluence (or what you wish to call it) between the public space, where people talk, argue, demonstrate and shout, and the physical place, represented by the street or square, where the talking, arguing, demonstrating and protesting, gains momentum. In that boundless territory, shouted slogans give it identity and materialize the sense of collective and progress. That place is where “we get lost”; it is the place we want to visit. A restricted place. Historical. Political. It is a place we identify as central. Never peripheral.

The periphery is where, in an opposite and irritating logic, the public housing projects are usually located (the *bairros* as they are usually identified), as do the ones we are addressing here. Even if the metropolis tries to seize them, like in Cerco do Porto and Falcão, and not so much in Lagarteiro (all places that URBINAT wishes to debate). There, too, talking, discussion and protest take place. Nevertheless, there are no demonstrations or marches in those places. The urban centre is always the choice. The city centre is where we think the public space is different, a place that gives us prominence because it is generally well kept, and where we see ourselves in its plenitude (we live in a “modern” place but aspire to a “historical” one). Here is where the world makes sense. Not in the “periphery”. Because it is less reflexive and “representative”. In the city centre, the public space is “capital”, and its fruition is absolute, open and whole, while in the *bairros*, the same place is personal, exclusive and dogmatic. Here, strangers must beware, as does public space. However, in the *bairros*, the public space gains a new dimension – a new category. The local dwellers make it their own – something to be proud of. They use it – and abuse it. They demand it adapts to the modern life – their life. They make it, for various reasons, an extension of their lives. They define this diachrony as no one else does. In Porto, a sizable public space is added to the tiny public houses (60 m²). People, therefore, use it and abuse it. (The weather helps, too, and the space is appealing.)

In his way, to interpret the territory that has been the base of our intervention, one must consider (canonically speaking) the three nodes (Cerco do Porto, Falcão and Lagarteiro) as a reference and not as an end, also, not as a beginning, but a reason. We must design the academic interstitial space between the *bairros* and the surrounding environment (which, in the eyes of local dwellers, is very distant – even if it is right by their side) so that the historical centre flows through. Moreover, find a corridor that rescues the *bairros* (and the city to which they arduously belong) from the unnatural and unsolvable situation in which the studied areas find themselves.

5. THE HEALTHY CORRIDOR STRATEGY FOR THE CO-CREATION OF NATURE-BASED SOLUTIONS

Gonçalo Canto Moniz, Andrea Conserva
Contributions: Isabel Ferreira, Beatriz Caitana, Vitório
Leite, Marcel Cardinalli, Ribal Aman Eddine

NATURE-BASED SOLUTIONS

Nature-based Solutions (NBS) are defined as solutions that use nature features and processes to address societal challenges (European Commission, 2015). The strength of the NBS concept is to simultaneously address multiple environmental and socio-economic challenges (Cohen-Shacham et al. 2016; European Commission 2015) and to provide co-benefits. Compared to conventional technical solutions, NBS aims at protecting the ecosystems, to be more resilient to change, as well as energy and resource efficient (Everard et McInnes 2013).

In practice, urban NBS can be tangible physical actions like urban projects or management interventions but they are also, at strategic and discursive levels, like plans. In the city context, NBS are connected with (i) traditional fields of intervention in urban areas such as architecture and civil engineering, landscaping intervention and urban planning, but also land and nature management fields such as ecological engineering, bio-technologies and agriculture interventions. Several typologies of NBS have already been proposed through European Commission research projects and are usually collected into repositories (Conserva et al, 2021, p.31).

The URBiNAT understanding of NBS is in line with the definition and key principles of NBS previously developed in literature. Nevertheless, URBiNAT proposes an innovative expansion of the NBS concept by presenting

as NBS in their own right, certain NBS implementation models (i.e. participation - social and solidarity economy). The aim is to emphasise the core importance of these implementation models in the development of NBS, by putting them at an equivalent level, as technical and design developments. Indeed, the implementation of NBS is not limited to the selection of adapted and pre-existing methods, but involves profound changes and innovations in the ways of making and managing the city.

Accordingly, the URBiNAT NBS catalogue challenges conventional NBS definitions by not only integrating solutions inspired by nature, including territorial and technological solutions, comprising products and infrastructures, but by also including participatory and social and economic solutions, comprising processes and services, that reinforce the dialogue between the physical structure and the social dimension of the public space. The goal is to bring these two levels of the public space into a living interaction, building collective awareness around commonalities, both material and immaterial and, by raising the collective understanding of human and non-human urban dimensions, promoting the co-creation of solutions inspired by nature and in human-nature.

Technological Nature-Based Solutions are characterized by the use of advanced techniques and materials for their design and manufacturing processes and by the integration of ICT systems for their maintenance and monitoring. The term “technology” is considered here as a support tool for nature. The marriage between nature and technology opens new opportunities to address the latest challenges in the design of urban space and facilitates the integration of NBS in the urban environment.

Territorial NBS are actions sustained by nature that will make a significant contribution towards urban biodiversity, urban resilience to climate change, and storm-water management. These solutions promote urban regeneration and entail social and economic benefits through locally adapt-

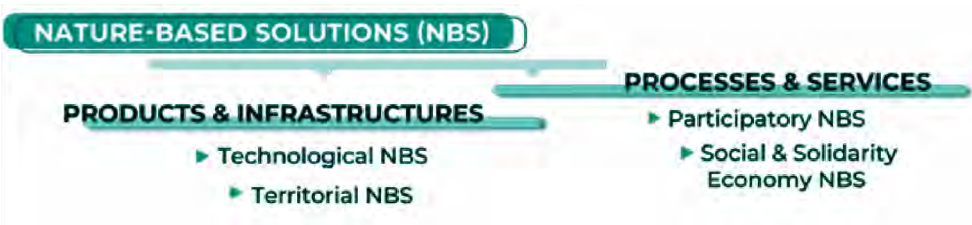


Figure 26: NBS typologies developed in URBiNAT.

ed implementations of a wide range of ecosystem services. Territorial NBS use living materials and are implemented on different organic supports: 1) plant-based material; 2) soil; 3) water.

Participatory NBS are solutions that aim to address needs, aspirations and knowledge of residents and users of public spaces in URBiNAT intervention areas. The aim with Participatory NBS is to operationalize the co-creation process by putting in dialogue those needs, aspirations and knowledge with political, technical and scientific views. As URBiNAT operates within an urban governance framework, the main actors to design and implement participatory NBS are residents and users, municipal actors and academic practitioners. But conceptualizing participation as an NBS and enlarging its meaning requires a grasp of the role it plays beyond its use as a strategy to the use of natural features and processes for addressing societal challenges. In this sense, three main arguments are used to address participation as an NBS: 1) overcoming the artificial separation of humans and nature, 2) its implications in citizenship status, and 3) use of participation as a natural interaction strategy that advances the process of horizontalization and reconnection between humans and nature. It is a symbolic but strong statement that redirects the discussion from territorial and technological solutions as “the solutions” for urban regeneration to the social, intergenerational and ecological perspectives and social values and imaginaries that sustain the process of designing and implementing solutions.

Social and Solidarity Economy NBS are assumed by URBiNAT to be opportunities for changing the social, political and economic relations among people who live in the neighbourhoods covered by the project. The project recognizes this as part of a broader socio-economy dimension based on practices whose ultimate goal is not profit (or its absence), but solidarity and cooperation. The SSE can be seen as an NBS that achieves inclusion through participation, added economic value and local resilience, unification of place-based and socio-economic dimensions, implementation of co-creation process and the community of practice. Based on a holistic conceptual viewpoint on NBS concept, the SSE expands the key aspects, contributing to achieve the goals of inclusive urban regeneration through four dimensions at least: economy, ecological, social, urban space.

HEALTHY CORRIDOR

The Healthy Corridor concept is based on the “green corridors” concept. According to Isabel Ferreira (2005) the green corridor is defined as systems of linear spaces that are planned, designed and managed with multiple and synergetic uses, namely ecological, economic, recreational, cultural or aesthetic, compatible with the sustainable use of the territory. As Hammerschmidt (2016) proposes, more than the traditional green corridors that cross our cities, the Healthy Corridor aims to contribute to the overall health of the surrounding community. In this sense, the green areas can be more than green if the local communities that will use it are engaged in the process from the first moment in order to co-create solutions to address their social and environmental challenges.

Taking this in consideration, healthy corridor is a public space, both material and immaterial, that connects and links neighbourhoods as a pathway and as a social, cultural and educational platform. It integrates not only nature-based solutions but also human-centred ones, providing a double effect on the environment and people’s health and well-being.

It can occupy public and private urban plots or commons that can connect different spaces and different communities while promoting mobility between them; creating better living conditions, based on a safe and healthier environment; decreasing the existing segregation effect through



Figure 27: Healthy corridor video. Link: <https://youtu.be/FzF1BcMVfes>, source URBiNAT. Credits: GUDA

social and urban cohesion; and increasing urban resilience to climate change.

In this sense, the URBiNAT healthy corridor activated in several living labs, placed in the city's modern periphery, and implement a set of nature-based solutions NBS that are material and immaterial, co-created with the local citizens and stakeholders (URBiNAT partners, municipal technicians, and political decisions makers).

URBINAT NBS CATALOGUE

The URBiNAT NBS catalogue builds on existing collections of NBS. Research has been carried out to understand the work undertaken by other research projects. Most NBS repositories classify NBS according to different criteria and, although the same NBS can sometimes be found in more than one project, the approach used for their classification is never the same since it depends on the main objective of each specific project. One of the most cited classification method is defined by Eggermont et al (2015) that uses two criteria: "How much engineering of biodiversity and ecosystems is involved in NBS?" and "How many ecosystem services and stakeholder groups are targeted by a given NBS?"

Many NBS repositories find inspiration in the Eggermont classification to define their own system of organising NBS, even in cases where the system differs from the one proposed by Eggermont. Despite the fact it is not easy to group the criteria used for the classification of analysed NBS repositories since, as mentioned, they all differ, there are some similar aspects. Some are focused on the ecosystem affected by the NBS (e.g. green infrastructure, water system, urban areas, etc.) or by the type of effect generated (e.g. erosion regulation, climate regulation, water treatment, etc.). Others only consider the location or the element where the NBS is applied (e.g. building, public green space, natural areas, etc.); and others, as is the case with the URBiNAT catalogue, are based on the nature of the NBS itself (e.g. social, technological, etc.). For each category of repository, the information of the NBS is usually represented by means of a template. The content of the latter usually includes: a general description of NBS, a technical description that could include social and economic aspects (e.g. amortization period, investment required, etc.), challenges the NBS aims to address, and the impact of the NBS usually measured in a qualitative way.

URBiNAT's NBS Catalogue does not claim to be an exhaustive repository of existing NBS. It aims to embrace the variety of NBS while keeping a limited number of NBS in the catalogue in order to keep it easy to use during participatory activities. The catalogue is inspired by and works on the model of a reference book used by architects or landscape architects in the process of conception. It consists of a database of solutions to be used in participatory processes, in particular as an inspirational method and tool, for example, to: introduce to participants the concepts around NBS; broaden the perception on the existence of NBS in the city; expand the concept of NBS; raise awareness on the different aspects addressed by URBiNAT for an inclusive urban regeneration; address not only the problems of a territory (people, places and resources), but also the solutions that its assets can inspire as being nature-based, locally meaningful and sustainable.

URBiNAT's tailoring of participatory methods and tools applied in participatory processes takes into account the mapping of current local participatory cultures, that is who, how, when and why participation happens. It also introduces and tests new elements and ways of doing, opening up a space for innovation. In particular, in the case URBiNAT's NBS Catalogue, the first main challenge is to shape it in such a way that it can properly communicate its concept and message among different groups of stakeholders. In this sense, being the catalogue a participatory method and tool to city cultures for the co-design and co-implementation of NBS processes, its format should aim at communicating with different target groups, from the technicians to the citizens, from younger people, to adults.

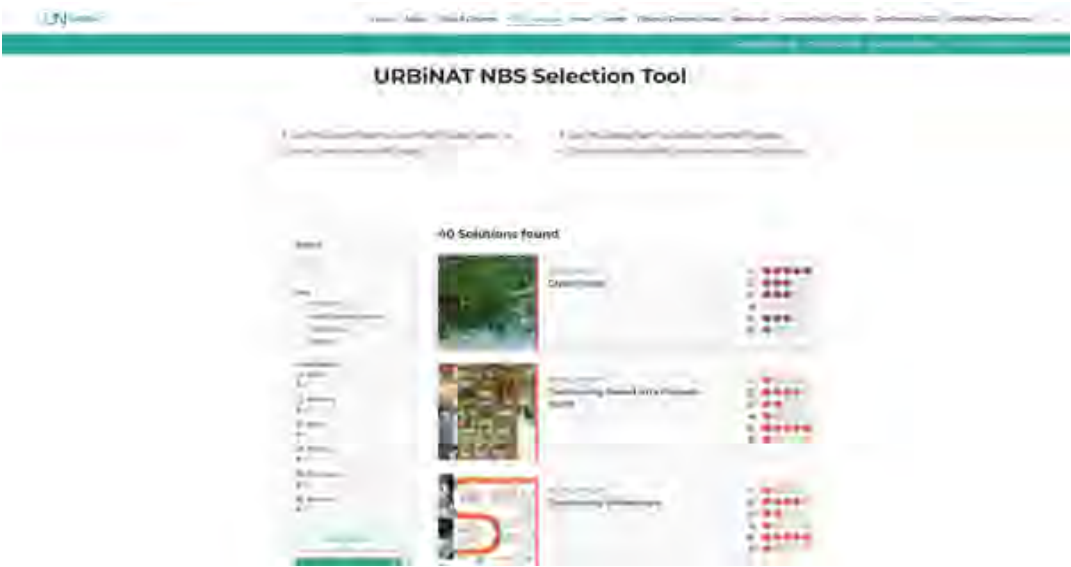


Figure 28: NBS Catalogue Selection Tool, <https://urbinat.eu/nbs-catalogue/>, source URBiNAT.

According to these considerations the catalogue is available in four different levels of detail. Each of them addresses a different target group, kind of participatory activity that will implement it and step of research from where start to continue investigating on one of the NBS. From the less to the most detailed, the five ways of representing the URBiNAT NBS “living” Catalogue are: NBS poster; NBS Cards, NBS factsheet; NBS protocol, NBS selection tool.

CO-CREATION OF NBS AND HEALTHY CORRIDOR

The co-creation process is the methodological framework to establish a healthy corridor in an urban area with the local community, the academia and the local authorities. The methodology identifies the above mentioned four main stages – co-diagnostic, co-design, co-implementation, co-monitoring, as well as the actions, objectives, phases, steps, narratives, and activities, as described in the co-creation diagram (Fig. 33). This process is organised in a linear structure, but the participatory nature of URBiNAT may challenge each city to go back and forward in order to promote a more solid or coherent outcome. For each stage, the model proposes a set of actions to be adapted by each city, according to their local participatory culture and to the local social and political context. It was possible to identify what is similar and what is different in each city urban plan, in the co-creation stages, considering that frontrunners went through the four stages and followers only developed the co-diagnostic and co-design.

During the **co-diagnostic stage**, the frontrunner and follower cities developed activities related to the three main steps – presentation of URBiNAT, mapping local culture, and participatory activities. The analysis of the co-creation process chapter in each city reveals the commonalities. Frontrunner cities did a public event to present the project – Porto (kick-off meeting) and Nantes (*Printemps Festival*), Sofia (during the consortium meeting) – but the follower cities made the presentation to small groups without a big public kick-off event. Nevertheless, Nova Gorica took advantage of the capital of culture dynamic and did some mid-size events with an exhibition of NBS and with the involvement of political representatives.

The eight cities followed the steps proposed to involve citizens with workshops, photovoice and walkthroughs to know the territory and understand their needs, due to the low level of effort and high level of results of these tools. In fact, the cities used different strategies to activate the living lab: Porto did activities in 4 primary schools and open a living lab room in the secondary school; Nantes with the Bus, Sofia used the com-

munity center, Hoje Taastrup used the municipality hall, Brussels created a “ludomobile”, a bike with a mobile public living room”. Siena took advantage of the school commitment, and Nova Gorica used the Innovation Hubs, due to the quality of the facilities and the centrality of it.

To engage the communities, the cities developed the mapping of participatory culture that identified key partnerships in the territory – Porto with the schools and several association; Nantes with schools, libraries, associations; Sofia with the community centre, associations and school; Siena with the school, the “Contrada” (urban district in Siena) and the Ravacciano association; Brussels with the Conseil de quartier of NOH, Sustainable Neighbourhood Contract team; Hoje Taastrup with the school and the community house; Nova Gorica with the university and the X-Center; Khorramabad with the primary school.

As a result, the teams develop a proximity process with the community



Figure 29: Corujeira Primary School, NBS Poster, May 2019. Photos by Carlos Barradas



Figure 30: Corujeira Square, NBS Game, October 2019. Photos by Carlos Barradas

establishing a dialogue based on trust and commitment from both parts. Nevertheless, some diagnostic methods were not implemented due to the effort that was needed, in terms of human and financial resources. The health and well-being survey was implemented in Porto, Sofia, Nantes and Nova Gorica. The behavioural mapping was implemented in the front-runners but not in the followers. Khorramabad developed a survey more focused on the challenges of the local context (e.g., illiteracy and unemployment).

At the **co-design stage**, the cities develop parallel processes taking into consideration the co-design steps establish in the methodology: transformation; self-projection; ideation; design; validation; argumentation; sys-

tematisation; and development. Similarities can be identified between the eight cities. Related to the transformation step, the eight cities developed activities to promote the appropriation of URBiNAT by the citizens, namely by presenting the local diagnostic (LD). Porto presented the local diagnostic in an online session, due to the covid-19 lockdown. Sofia organised an open-air exhibition. Brussels developed an “artistic synthesis” with the data from the local diagnostic, Siena produced a booklet with the LD translated into Italian.

During the self-projection step, citizens (children and adults) were asked to reflect on their contribution to URBiNAT in order to involve them in a common vision. The ideation of new NBS was based in the local diagnostic needs, where some proposals had already been made, and in this common vision. At this stage, workshops were made to identify NBS ideas and relate them with specific places. Porto prepared an exhibition with the NBS posters in the schools; Sofia organised a workshop to present and select the NBS with NBS cards; Siena and Nova Gorica translated the NBS cards to the local language to promote the appropriation.

Experts explained NBS to the citizens. The design phase was in some cases articulated with ideation. Workshop were developed to define the strategy for the healthy corridor, taking in consideration the ideas that came from the citizens and also to develop specific NBS, or places. In Siena, Municipality contract an external team that promote co-design activities in several places with a new canvas that is integrated in the co-design tools. Brussels and Hoje Taastrup took advantage of the expertise of the partner SLA, to develop the healthy corridor. Nova Gorica developed an urban plan for the Koren park with the expertise of the academic partner, UNG, involving students and Igriva Arhitektura.

The validation and argumentation of the new NBS and the healthy corridor concept promoted discussions between citizens, municipal technicians and political representatives in a democratic stage. The validation was organized in workshops and meetings where the healthy corridor strategy and the NBS proposals were presented and discussed. These meetings were complemented with experiments to test some NBS, namely in Hoje Taastrup and Siena. The systematisation of the healthy corridor concept was developed by the local taskforces with the organisation of the citizens' proposals and the feedback from municipal technicians. The last phase development was focused on the final political validation to prepare the memorandum of understanding and to integrate the healthy corridor in future urban plans, such as the European Capital of Culture of Nova Gorica in 2025 or the plan Parco del Mura, in the case of Siena.

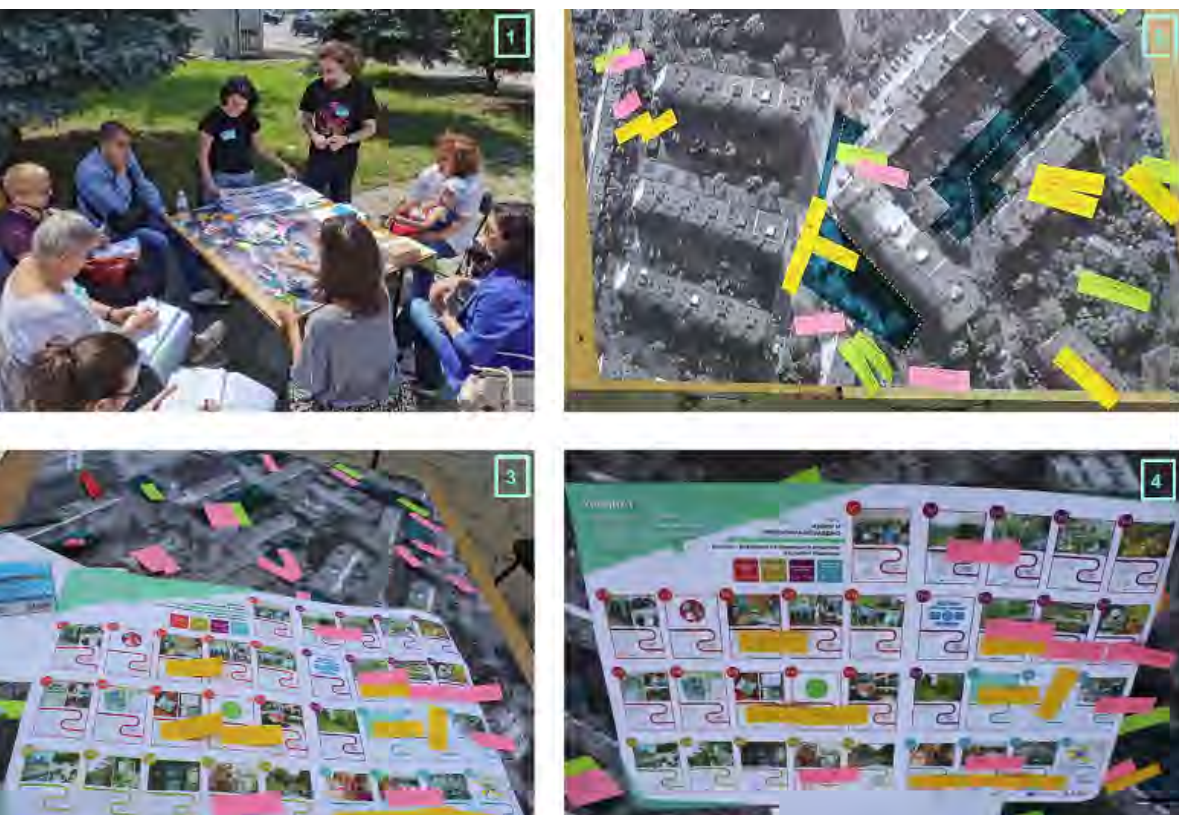


Figure 31: Operationalisation of the NBS draft catalogue for the purpose of idea generation and connection to different locations in Sofia. Source: Sofia team

The **co-implementation stage** was developed in the frontrunners in two parallel and complementary processes. On one hand, the material and territorial solutions were integrated in the urban plan and followed the current implementation process with licensing or approval by the local authorities. Public tenders were opened with different models, for the construction in Porto, for the design/construction in Sofia and for specific NBS in the case of Nantes. The citizens, namely children from schools, planted trees in the healthy corridor green areas.

On the other hand, the immaterial solutions were co-implemented with the citizens and the local partners organized as stakeholders advisory board. In Sofia, this group was constituted by open call applications, in Porto, the citizens, local associations and municipal technicians were organized in working groups according to the types of NBS (Culture and sports, social economy, education and environment). In Nantes the NBS were integrated in existing commission. These groups activated the NBS during the URBINAT project and are guaranteeing its sustainability after the project life.

The **co-monitoring stage** evaluated the co-creation process during the 70 months of the project and the impact of the healthy corridor with a before and after monitoring. The co-creation was evaluated with interviews and focus groups where the different actors could express their perceptions and contribute to improve the process. The impact of the healthy corridor was evaluated in five dimensions: health and well-being through a survey; an economic one through interviews based on the Social Return on Investment (SROI) methodology; the governance through interviews and focus groups to the several actors and a social dimensions with on-site observation, photographs and interviews; finally, the environmental one was analysed with several techniques, namely soil analyses and heat sensors.

URBINAT NEW NBS CATALOGUE

The URBiNAT NBS catalogue was an inspiration to active the co-creation process in each city where a new catalogue of NBS was co-produced. The cities developed new thematic groups to organise NBS proposed by participants related with the municipal departments structures to better support the co-creation process. Public space, related with the green NBS, were proposed in all cities, as well as sport and recreation and the social and solidarity practices. Most of them proposed educational solutions, except Hoje Taastrup and Brussels. Porto, Sofia, Siena and Brussels explored the cultural dimension.

The goal is to bring these two levels of the public space into a living interaction, building collective awareness around commonalities, both material and immaterial and, by raising the collective understanding of human and non-human urban dimensions, promoting the co-creation of solutions inspired by nature and in human-nature.

The cities developed this approach in order to co-create a healthy corridor that are not only green. In this sense, the cities and citizens were inspired by the URBiNAT NBS catalogue but the co-creation process developed a specific catalogue in each city, with different groups, according to the local culture, but keeping the solutions that are products and infrastructure (material) and others that are processes and services (immaterial), as already referred.

The following table relates the NBS proposed by the cities with the four typologies established by URBiNAT – Territorial, Technological, Participatory, and Social and Solidarity Economy. It demonstrates that the follower cities validate the proposal of the frontrunners and combined the material NBS, related with public space and nature, with the immaterial ones, related with education, culture, sports and socio and solidarity practices.

Living lab									
Stage	Activation			Co-creation				Empowerment	
Phase	Engagement	Place	SAB	Co-diagnostic	Co-design	Co-implementation	Co-monitoring	Continuity	New actions
Porto	878 people Schools Associations Citizens	Schools Espaço Todos	COT.CS working groups	Health and use Surveys Territorial Mapping Interviews Walkthrough Photovoice Behavioural mapping	Healthy corridor and NBS	Parque de Cartes Campmarket Germinário - urban garden Campanh'up Pedagogical garden Walking with Yoga Heritage route	Observation Use Survey Interviews Co-walks Photography	CampMar ket Germinári o Campanh' up Pedagogic al garden Walking with Yoga Heritage route	New projects COMMUNIC ITY NBRACER
Nantes	240 people Schools Associations Citizens	Bus La Mano	working groups	Health Survey Behavioural mapping Territorial Mapping Walkthrough	Healthy corridor and NBS	healthy corridor Green loop Urban garden Playground Geodese Petit Lieu Library benches	Health Survey Interviews Environmental quality	Urban garden Playgroun d Geodese Petit Lieu Library benches	Project Global
Sofia	886 people Schools Associations Citizens	Social Centre	SAB	Health Survey Territorial Mapping Local Task Force Behavioural mapping Walkthrough Photovoice	healthy corridor, Swimmin g pool, NBS	healthy corridor Open air Theatre Greenhouse Sports facilities Playground	Health Survey Interviews Behavioural mapping	Open-air Theatre Greenhou se Sports facilities Playgroun d	Swimming pool
Høje - Taastrup	434 people Schools Associations Citizens	Municip ality	SAB	Territorial Mapping Cultural mapping Walkthrough	Healthy corridor and NBS	"Meeting Place for Young People" with Arki-Lab. Planting in the community garden area implemented Healthy corridor integrated into redevelopment plans for Gadehavegård and the Yellow City.		Communit y Centre Yellow City Developm ent project for Gadehave gård	
Brussels	437 people Schools Associations Citizens	Bike	Neighb ourhoo d Council of NOH-M	Cultural mapping Walkthrough Territorial Mapping	Healthy corridor and NBS	"Coulée verte" transversal project; adjacent small- scale project for the healthy corridor TRANS-lighthouses	End-of-project evaluation with local stakeholders	"Coulée verte" project "CQD Versailles"; bike working group of the "Coordinat ion sociale"	TRANS- lighthouses
Siena	404 people Schools Associations Citizens	Circolo Archi	No	Walkthrough Territorial Mapping Focus group Photovoice	Healthy corridor and NBS	Within the frame of Parco delle Mura	Observation survey interview behavioural mapping	Rigenerar Si	Parco delle Mura plan
Nova Gorica	616 people Schools Associations Citizens	X Centre	No	Health and use Surveys Territorial Mapping Interviews Walkthrough Photovoice Behavioural mapping	Healthy corridor and NBS	Treated Koren area and kiosk Implementation within the frame of Capital of Culture GreenInCities		GreenInCit ies EPIC Green Belt	Kromberk- Extension G.Spots and mobility

Table 2. Summary and key highlights of the project implementation in the eight cities living labs.

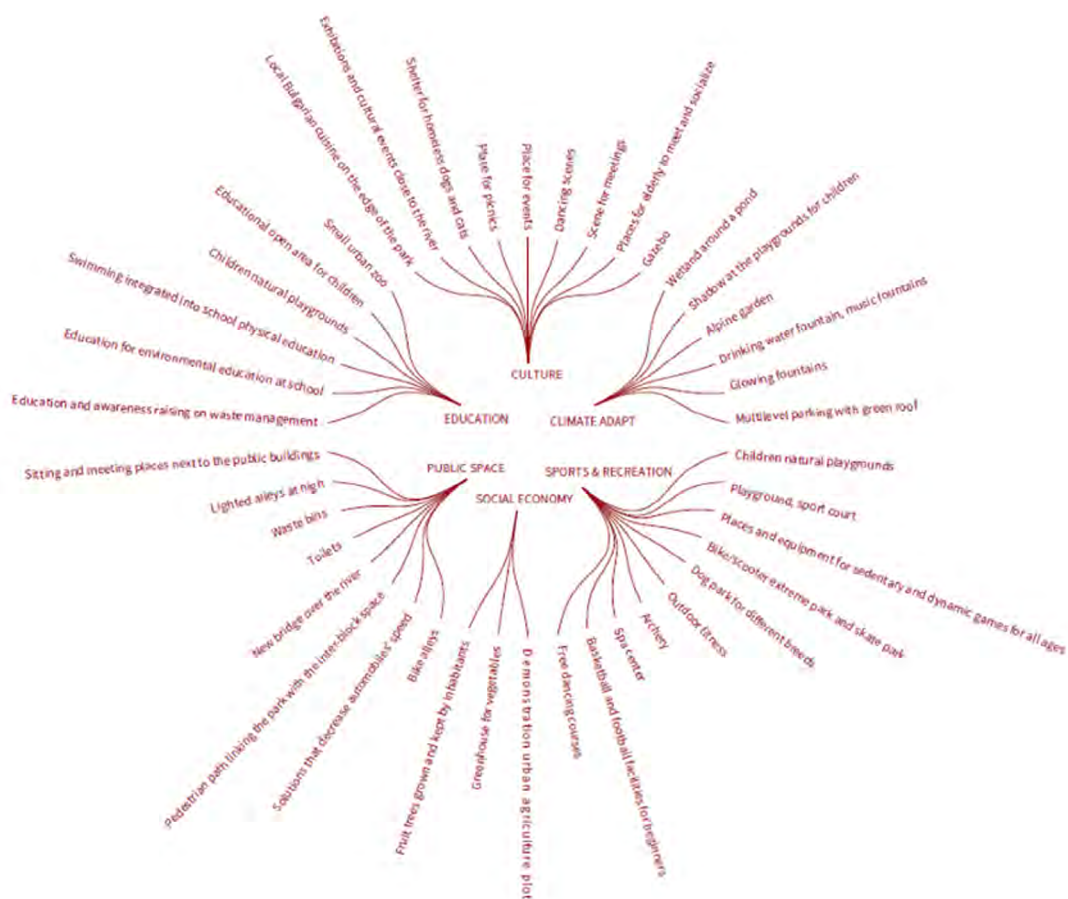


Figure 32: Summary of the ideas for NEW NBS gathered through different participatory methods implemented in the Living Lab in Sofia. Credits: IAAC

HEALTHY CORRIDOR STRATEGY

The healthy corridor has been defined as “a pathway, a public space that connects the neighbourhood with the city”. As the frontrunners demonstrated, the healthy corridor can take different shapes and strategies, according to each local context.

Three Healthy corridor strategies can be identified in the cross-examination of the healthy corridors in URBiNAT’s 8 cities:

- **Path:** one main pathway with several “hot-points” that goes across the neighbourhoods connecting two main urban elements, as in the case of Sofia for the frontrunners, and the case of Hoje-Taastруп, Brussels and Khorramabad;
- **Loop:** one circular pathway with several NBS that goes around the neighbourhoods connecting several urban areas, as in Nantes and Siena;

NBS categories	Porto	Nantes	Sofia	Høje-Taastrup	Brussels	Siena	Nova Gorica	Khorram abad
Public space and Nature	X	X	X	X	X	X	X	X
Sport and recreation	X	X	X	X	X	X	X	X
Socio-economy and solidarity practices	X	X	X	X	X		X	X
Education	X	X	X			X	X	X
Culture (and heritage)	X		X		X	X		

Table 3. NBS typologies and NBS categories co-created in each city.

→ Park: the network of paths supported by a green structure connecting several streets and squares located between several neighbourhoods or urban urban areas, as developed for Porto and Nova Gorica.

The different strategies proposed for the frontrunners to relate the healthy corridor with the neighbourhoods – between, across, around – are associated with the shape of the corridor – park, path, loop. In all the cases, several units, as clusters of NBS, were identified to create places for the community, such as squares, buildings, or informal open spaces. These NBS combine the territorial and technological ones, related with the public space and based on green solutions with the participatory and social and solidarity economy ones, exploring cultural, educational, sports and economic dimensions, based on human solutions.

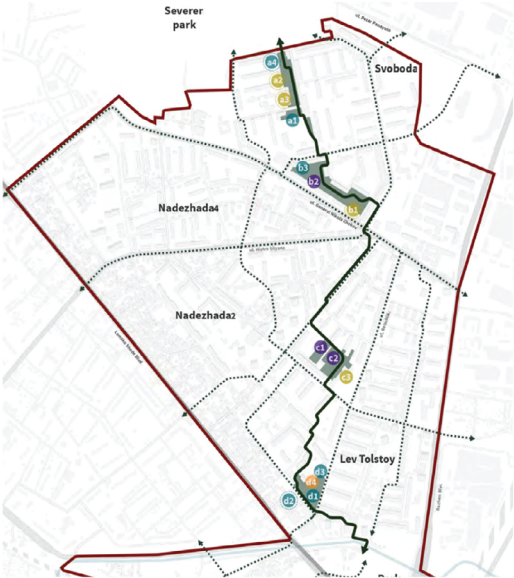
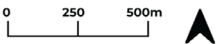
The following table presents a visualization of the healthy corridor plans in the 8 cities, with the same scale, classified according to the corridor shape.

HEALTHY CORRIDOR AS A CONTRIBUTION TO THE HEALTHY CITY

Rethinking the public space towards a healthy city is framed by the sustainable development goal 3 “Ensure healthy lives and promote well-being for all at all ages”. URBiNAT aims to explore the health and well-being impact of the NBS through the co-creation of the healthy corridor.

Recognizing the tangible impact of these spaces on daily life could promote overall well-being and mitigate health issues. In this context, the project “Curacittá” (CareCity), coordinated by Alessandra Capuano (2020,

PATH: Across the neighbourhood



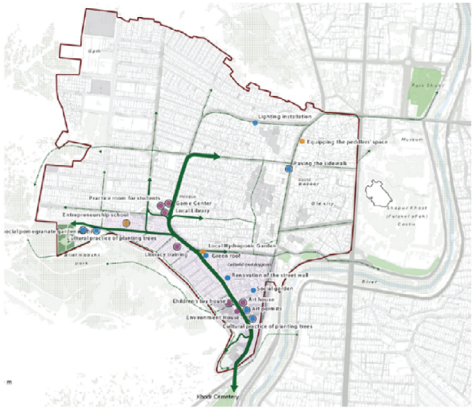
 Sofia



Brussels

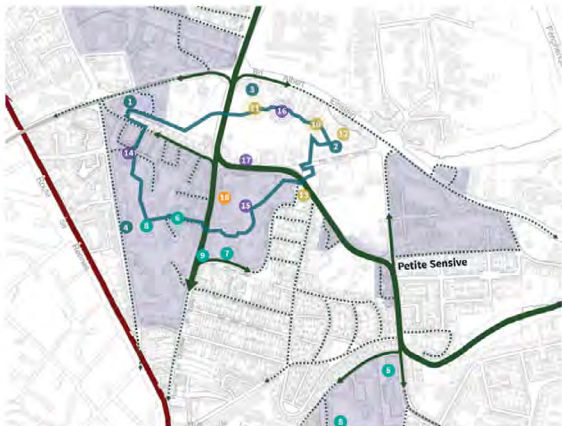



Høje-Taastrup



Khorramabad

LOOP: Around the neighbourhood

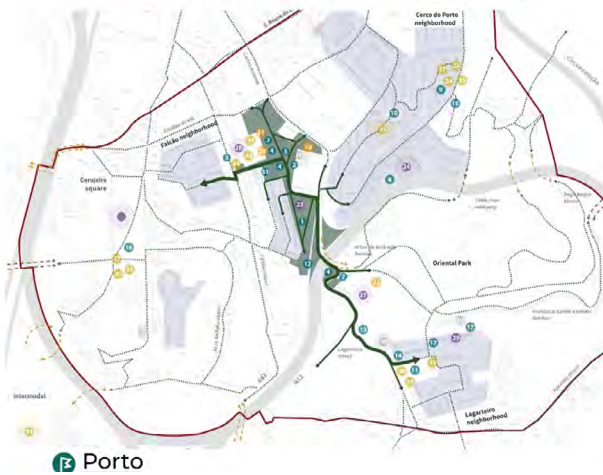


 Nantes



Siena

PARK: Between neighbourhoods



Nova Gorica

Table 4. Urban plan strategy of the healthy corridors, designed by Vitório Leite and Ribal Aman Eddine, with Djime Dourado (GIS version).

p.243), proposes three types of actions to promote a healthy city: “Sustainable Networks”, including transport, reducing vehicular roads, ground level zero, and path connections; “Equipped Surfaces”, such as vital roads, urban oasis, and health-scapes; and “Nodes and Attractors”, namely public buildings, urban farms, and workplaces. These actions align with the “right to health” principles: literacy and self-awareness, access to motor practices, food culture, rediscovery of walking, school-based prevention programs, inclusion of vulnerable groups, health determinant studies, and bike usage initiatives (Capuano, 2020, p.110).

These actions in public space and rights to health are complemented in URBiNAT with citizen engagement, enriching the social health dimension. In fact, URBiNAT is developing its health approach based on the World Health Organization's definition, exploring three dimensions of health: physical, mental, and social. The goal is to promote the health and well-being of the community through its relationship with public space.

The process of co-creating public space aims to contribute to social health through the valorisation of knowledge and individual experience in the construction of the common good and a just society. In addition, the use of these spaces promotes physical health through daily routes, social activities and physical exercise, and the relationship with nature and the community also aims to promote mental health. (Nunes, 2019, p.201; Cardinali & Volk, 2019, p.123-125).

LESSONS LEARNED FROM THE CO-CREATION OF THE HEALTHY CORRIDOR

The healthy corridor concept developed by the three frontrunner cities and the five follower cities demonstrated the relevance of the concepts and methodologies proposed. Its implementation in the cities was adapted according to the local culture, but also contributed to improve it. In this sense, it is possible to identify main findings and results related to three topics.

Firstly, the inclusive dimension of the urban regeneration is based on the dialogue between social actors in all phases of the project, which implies a transformation of architectural and urban practices, as well as in the other disciplines. The challenge is to promote the dialogue between different knowledges – scientific, technical and empirical. In this sense, it is important to establish a flexible and adaptable co-creation process, that needs multiple activities to involve the various actors and activate a community living lab to co-create solutions. It is important to develop tactical actions to test innovative and inclusive solutions, and act punctually but seek wider impact. This innovative process generates ideas that need to re assess urban regulations, although there is a resistance of technicians and politicians to change procedures.

Secondly, in terms of NBS, the healthy corridor can be a pathway, a network of pathways or a green infrastructure, taking the spatial form of an urban park or a linear park. It should combine material and immaterial solutions, which means products and services. As well as a cluster of territorial, participatory and social and solidarity economy NBS, complemented by technological ones, when possible. In this sense, it is important to organize the NBS co-created by citizens in categories that are related with municipality urban policies and local associations goals to develop synergies, such as, environment, education, culture, sports, among others. Thirdly, the co-creation process needs to follow the stages, goals, and activities in order to achieve results. The actors need to be prepare for a long co-creation process because it is important to do multiple activities to involve different actors. Nevertheless, the process needs financial support to local individuals and associations to reward their participation and to support a long and structured participation. In this sense, a facilitation team needs to be contracted to guarantee transparency. Although, the participatory process will find resistances from technicians and politicians to change procedures due to the limitations of urban regulations.

6. CO-IMPLEMENTATION OF THE HEALTHY CORRIDOR: CHAL- LENGES AND LESSONS LEARNED

Milena Tasheva – Petrova

*Contributions: Gonçalo Canto Moniz, Veneta Zlatino-
va, Beata Tzoneva, Velin Kirov, Philippe Bodenau*

The co-implementation of the healthy corridor is the effective activation of the inclusive dimension of the public space. It is when the transformation of the public space with material and immaterial NBS creates the condition for its use and interaction by all the citizens according to the needs and expectations identified in the co-diagnostic.

The co-creation of the healthy corridor is anchored on a multi-stakeholder approach, where citizens and social organizations are part of the planning and decision-making process, within the municipal governance structure. Thus, the co-creation is essential part of the “narratives” and “activities” developed and fitted in the URBiNAT cycle and the co-implementation steps: transforming (inspiring the community); development (fine-tuning); piloting (experimenting solutions and future businesses); validation (defining); activation (Igniting); construction (participating in the Healthy Corridor implementation); activation (Implementing the immaterial NBS); and preparation of next steps (monitoring, management and adding new clusters of NBS).

The implementation of the URBiNAT Healthy Corridor (HC) is based on co-production and co-governance perspectives, whereas the co-implementation model is related with reaching pre-defined results in the framework of co-production and co-evaluation. The co-implementation is the phase where “the material and immaterial solutions meet and the Healthy Corridor innovative promise is tested” (Moniz, ed., 2021b, p.15) in the context of intensive interaction between scientific and non-scientific knowledge(s) and between experts and non-experts.

The co-implementation stage as part of the co-creation process comprises of a set of “Actions” to organize: Stakeholders Advisory Board (SAB), Tender/Approval, First Stone, Co-production of NBS, NBS Maintenance Planning. The three front-runner cities, Porto, Nantes, and Sofia, clarified their Healthy Corridor strategies taking into consideration the possibilities to incorporate the specificities of implementing products and physical solutions (material NBS), as well as processes and social solutions (immaterial NBS). The first ones faced several administrative challenges (licensing, procurement, construction), while the second ones had to give continuation to the ongoing participation of citizens.

The co-governance strategy (discussed in chapter 3) was based in the activation stakeholders advisory board that supported the co-implementation process. The organisation of citizens in these boards followed different methodologies and the boards had different roles. In Sofia, a call invited citizens and stakeholders to constitute a SAB, with the aim of addressing the community proposals and recommendations for the URBiNAT project: to promote active citizenship; to debate on public policies that affect the urban regeneration of Nadezhda district; to negotiate and seek a balance between different public interests; to refer to Sofia Taskforce in case of public issues within the competence of the project; To assist the communication links between Sofia Taskforce and the civil society; and to assist Sofia Taskforce and other participants in planning, design, implementation, monitoring and evaluation of the project activities. In Porto, a dynamic Stakeholder Advisory Board was organized to follow the project and to co-create the immaterial solutions. Two commissions were created, one to develop the NBS in the frame of three working groups - Social and Solidarity Economy; Culture and Sports; Education and Environment - and the other to establish a space of debate and decision-making with all the actors to meet every year. Nevertheless, The NBS were co-designed and tested in public experiments that helped to prepare a sustainable plan for activation and resulted in five NBS - Campmarket; Campanh’up, educational garden, Walking with Yoga / Heritage route, a community garden (Germinário). In Nantes, the project has to governance groups: one with technicians - URBiNAT team, Global Project team, Thematic Working groups (Education and Environment, Food production, Social and solidarity Economy, Sports); other with technicians, citizens and elected representatives (Local district commission, Municipal Advisory Board, based on Fruit and Vegetable Working Group, District meetings). Many of the 18 NBS co-created were already tested or implemented such as the geodesic greenhouse, Canada urban park, solidarity vegetable garden, green loop, among others.

On one hand, the implementation of material NBS are based on the physical construction by planting of green areas, urban farms, sensorial gardens, trees, recreational areas, small pavilions, paths, walls, drainage systems, light infrastructure, etc., that were identified in URBiNAT as technological and territorial nature-based solutions (NBS). On the other hand, the immaterial NBS are co-implemented with citizens and stakeholders through the activation of processes and social solutions, such as a social market, a community kitchen, communication platform, cultural events, sports activities or educational practices. Together, the cluster of these two types of NBS constitute the Healthy Corridor.

The co-creation process identified different needs and different solutions for each intervention area that were systematized in the healthy corridor concept and the urban plan. In this sense, each city developed different strategies for implementing the healthy corridor. This diversity underlines the flexibility and adaptability of the URBiNAT methodology, respecting the local participatory process and the local urban planning culture.

The approach and the type of the urban planning project was determined by the character of the selected territorial NBS, the size and distribution of the public plots and the necessary procedures for administrative coordination and licensing. As a result, the co-creation process of the URBiNAT Healthy Corridor Urban plan focused on a Public Park in Porto, a loop that integrates NBS in the public spaces in Nantes, and a path with four intervention areas with clusters of NBS in Sofia. Thus, the scale and the scope of the Healthy Corridor resulted in landscape design project in Porto (developed by CIBIO/BIOPOLIS/UC), several small projects developed by Nantes Metropole, and a plan for public works in the public space in Sofia (Developed by Interhold Ltd.).

The construction and planting of NBS in public spaces in the URBiNAT frontrunner cities had to follow different legislations and municipal procedures, according to the scale and context of the intervention. Furthermore, the different NBS that constitute the healthy corridor of Porto, Nantes and Sofia required different procedures of implementation. In addition the relative levels of independence of the plan implementation in three cities were also different - the Urban plan of Porto became very ambitious and complex to implement within URBiNAT budget and timeframe; in Nantes URBiNAT interventions were coordinated with the ongoing implementation of the Integrated project (Project Global) and the procedures were con-

trolled by the municipality; in Sofia a public procurement call was opened in order to guarantee the design-and-construction process subjected to a high level of supervision on behalf of the municipality.

The project in Porto followed all the licensing process with several steps of municipal and court approval followed by a public tender to select the construction company, while in Nantes the approval was mainly internal and the construction services were in most cases provided by municipal teams and in Sofia the Healthy Corridor Concept was approved by the Municipal Council and then a design-and build public procurement was conducted.

The schedule of the standard sequence of stages for implementing investment projects according to the Bulgarian legal framework and the usual administrative practice comprises: public procurement for design, design, public procurement for construction, and construction. The last was also the approach applied by Porto Municipality, as the design was developed by a URBiNAT partner. Based on the previous experience on the length and risks of the public procurement procedures, Sofia Municipality decided to call for a design-and-build open public procurement procedure for the design and construction of the healthy corridor in Nadezhda. In Nantes, there was no single public procurement for the implementation of the whole design project. NBS were developed separately, in the frame of individual public procurements or directly by the municipal services. This sequencing approach made it possible to achieve visible changes in the neighbourhood early on in the project (2021). The aim was to keep citizens involved and motivated in the co-creation process, particularly as the Urbinat project in Nantes Nord is part of a wider project whose developments will also take place over several years.

Territorial NBS / Public Space and Nature



School square
Porto



Path and playground
Nantes



Path and urban forest
Sofia

Technological NBS (IAAC)



Pedagogical garden
Porto



Benches to read and plant
Nantes



Educational greenhouse
Sofia

Participatory NBS / Education, Culture, Sports



Art experiment with trash
Porto



Citizens Dialogue Bus
Nantes



Open air amphitheater
Sofia

Social and Solidarity Economy NBS



Campmarket
Porto



Canada urban garden
Nantes



Planting activity
Sofia

Table 5. Examples of co-implementation of NBS in the frontrunners cities. Source: URBINAT archive.

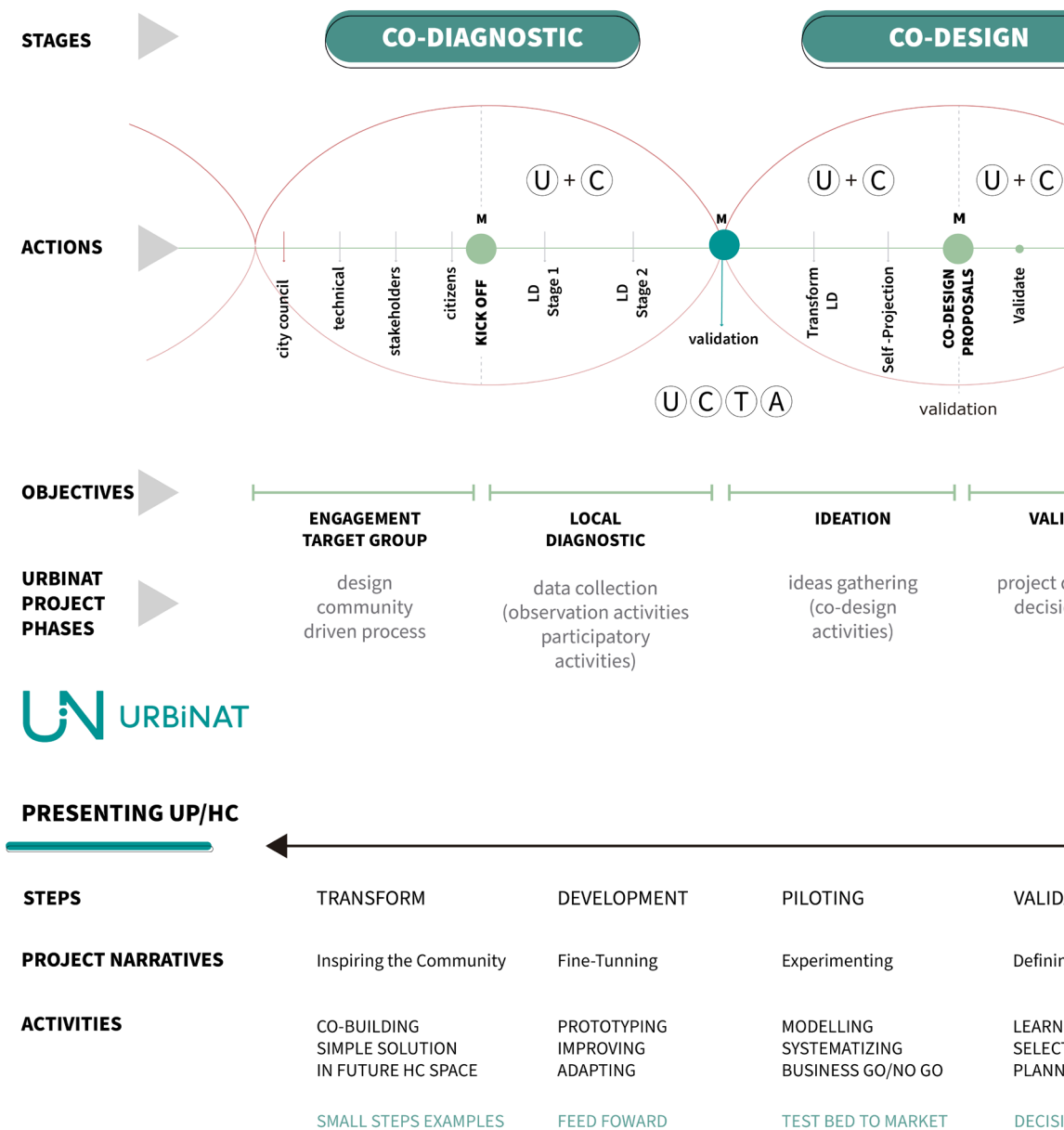


Figure 33: Co-creation steps with a focus on co-implementation step. Design: GUDA

LESSONS LEARNED OF THE CO-IMPLEMENTATION PROCESSES IN THE FRONTRUNNER CITIES

Involvement of a great number of actors with different and sometimes controversial aspirations in the co-creation of the Healthy Corridor created the possibility to integrate different experiences, expectations, and visions reflecting the local needs by respecting local identity and deficiencies. Yet the same achievement might lead to potential conflicts and privatization of public space beyond the URBiNAT time frame.

The Stakeholders Advisory Board was established as a main tool for inclusive participation in the course of the co-implementation and management of the Healthy Corridor. Coordinated and appropriated by the municipality, the Advisory Board was intended to co-monitor the developed solutions during and beyond URBiNAT. However, In Sofia, the low level of participation and citizens' involvement in the Advisory Board were significant challenges in the course of the implementation - during 13 meetings organized during the co-design process, a small number of different participants attended most often with their personal motivations or professional interest in the topic discussed. In Porto, the working groups involved 15 citizens and 6 municipal technicians that demonstrate fatigue several times during five years of activity. Some citizens drop out, but other were involved later.

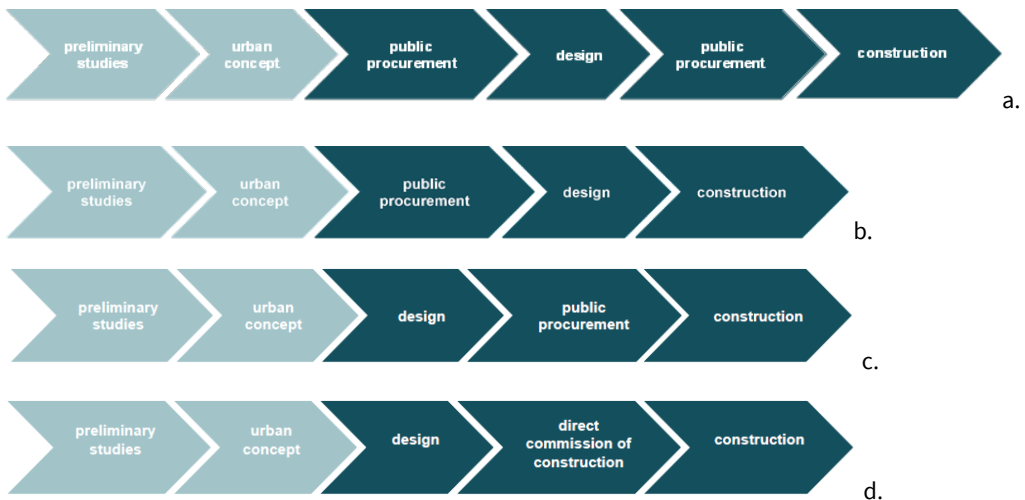


Figure 34: Implementation of Healthy Corridor: a) In Sofia, the schedule of the standard sequence of stages according to the Bulgarian legal framework and the usual administrative practice of Sofia Municipality; b) Schedule of the sequence of stages for the URBiNAT Healthy Corridor implementation in Nadezhda District; c) Schedule of the sequence of stages for the URBiNAT Healthy Corridor in Porto; d) Schedule of the sequence of stages for the URBiNAT Healthy Corridor in Nantes, where the public procurement is replaced by direct commission of construction works.

The intensity of the inclusive and participatory activities and the number of involved during the co-implementation process are defined by the type, scale, and complexity of the NBS and/or the cluster of NBS. This proved the difference in the level of (im)balance between expert and non-expert knowledge (activities). While the engineering and architectural design and construction work need to be proofed to ensure the public health and security of the future users of the facilities, furniture, and pavements, the planting activities and the immaterial NBS (with the proper help of mediators) could more extensively rely on inclusive processes during the construction and activation of the Healthy Corridor.

Most of the material NBS relied on built infrastructure and upgraded public space, therefore a major share of the NBS was implemented as means for activating the Healthy Corridor and are still expected to be continuously sustaining the liveability of the upgraded urban open spaces.

A critical retrospective on the traditional approach and action to design and built practice implemented, indicates that tactical interventions might be equally important as the investment project approach to inclusive urban regeneration.

MAIN CHALLENGES OF CO-IMPLEMENTATION

During the implementation of the co-creation phases the Task Forces had to handle some problems related to the exogenous factors as the COVID-19 pandemic, inflation, elections (local and Parliamentary). Nevertheless, a workflow and effective communication within the task force and between the entities involved was established and the project's tasks were persistently implemented.

The length of the coordination, approval, and licensing of the public procurement procedures for the construction coupled with the inflation resulting from the war between Ukraine and Russia. The inflation led to a significant shrinkage of the URBiNAT budget for the construction while at the same time, the cost of the construction materials and the construction costs were rising. This challenge was overcome in Porto and Sofia by the decision of the municipality to fund part of the construction works

The long period of coordination of the design, the final design, and the intensive construction works from the first stone in June 2023 to January 2024 ended with the granted exploitation permit of the Healthy Corridor.

In Sofia, the planting and weeding of some sections were postponed to the beginning of March 2024, due to the unfavourable winter climate from December to February. Nevertheless, around 170 trees were planted together with the inhabitants of Nadezhda and several events for the activation of the Corridor were organized in March. In Porto, the construction of the first phase ended in February, and the events for planting took place in the end of February and beginning of March, namely during the consortium meeting (7-9 March 2024).

Compared to Sofia and Porto, Nantes was able to conclude the construction in less time as the NBS selected were more independent. This allowed different time frames for the development and construction of the separate NBS.

	Process	Coord.	Implementation Project	Validation	Activation	After URBINAT	Main NBS
Porto	Material	Municipality Academic	Execution Project by academics	Licensing	External Construction Company	Municipality management	Paths, Square Rainwater basins Old house Amphitheatre Pedagogical garden prototypes
	Immaterial	Municipality Academic Associations Schools	Management plan	COT.CS validation	Intermediate Experiment	Associations and citizens partnership	Campmarket Campanh'up Walking with yoga Heritage routes Community kitchen, Concert Germinário
Nantes	Material	Municipality Library	Parallel Projects by municipality	Licensing	External Construction Company And Municipal services	Municipality management	Green Loop Street crossing Canada Park Playground Geodesic garden Benches to read and plant
	Immaterial	Municipality Academic Associations		Citizens Commission	Event	Associations partnership	Petit Lieu Urban gardening
Sofia	Material	Municipality	Execution Project by construction company	Licensing	External Construction Company	Municipality management	Main path Bridge Amphitheatre Greenhouse Playground Sports facilities Eco-Parking Swimming pool
	Immaterial	Municipality Academic Associations School		SAB	Final Event	Associations partnership, cultural centre	Concerts Classroom Urban garden Sports events Tasty garden

Table 6. URBiNAT Co-implementation table.

7. GUIDELINES FOR AN INCLUSIVE PUBLIC SPACE

Gonçalo Canto Moniz

In URBiNAT, the public space became inclusive due to the co-creation of healthy corridor with nature-based solutions in the living labs of each frontrunner and follower cities.

URBiNAT identified public spaces in the peripheral social housing neighbourhoods with similar social and environmental patterns. This option was important to scale and replicate methodologies and practices among the partners. Nevertheless, the selected public spaces had different characteristic - terrain vague, green areas, brownfields - with different needs and opportunities. Although the municipalities defined the study area according to their urban strategies, in most cases, the co-creation process selected the main plots and key pathways to define the intervention area. This flexibility is important to relate the healthy corridor with the real needs of the community.

The engagement of citizens, associations, institutions, academia and municipalities took different forms according to the local culture. Although many of these actors were involved, others were not due to several constraints that need to be overcome in order to achieve better results - participation fatigue, lack of time, difficult communication, etc. The schools (primary or secondary) were important stakeholders in all cities, with an important participation of children, families, teachers and staff. Other important contribution came from local associations that established synergies with URBiNAT by co-creating NBS that were related with their aims. In this sense, schools and associations are key stakeholders in the activation and sustainability of the living labs.

The co-creation of NBS followed the stages and steps defined in the URBiNAT methodology - co-diagnostic, co-design, co-implementation, co-monitoring - but the activities and the goals were adapted the experience of the local teams and the common strategy developed in each city.

The selection of NBS with cards, poster or digital tools (Superbarrio and NBS Selection tool) was a challenge in all cities because the concept of NBS is new and difficult to appropriate. In this sense, it was important to expand the concept of NBS and integrate proposals related with education, culture, sports, social and solidarity economy that can be framed by the healthy corridor approach.

The co-design of the healthy corridor is a challenge to the real participation because the technical dimension of the NBS can create limitations to the citizens engagement. The legislation, urban regulations or the municipalities way of doing can also be barriers to the dialogue with the citizens and stakeholders. In this sense, transparency and openness to discuss solutions and practices can overcome the limitations to the dialogue. The municipal roadmap and the stakeholders advisory board are important strategies to face these challenges. Experiments (tactical actions) to test the nature-based solutions were an important way of keeping the participatory process active and contributing to the development of the technical solutions. In fact, these strategies require transformations in the spatial planning practices, as well as in other practices/professions.

The co-implementation of healthy corridors followed different tracks in URBiNAT cities. The territorial NBS may require specialised companies for the implementation of NBS, namely construction or technological ones, related with hydroponic system, as an example. In this cases, the collaboration of citizens was more difficult, but possible with planting. Nevertheless, the co-implementation was more relevant with the human-based solutions focus on the process, such as the ones related with participatory NBS (education, culture, sports) and social and solidarity NBS (market, urban farms, community kitchen).

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CHAPTER 2.

BIOPHYSICAL ENVIRONMENT AS NATURAL BASIS FOR HEALTHY CORRIDORS

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Keywords: Urban environment; Territorial Nature-based Solutions; Monitoring and evaluation; Microclimate; Thermal comfort; Soil quality; Urban gardens; Stormwater management; Vegetation; Carbon footprint; Carbon sequestration; Carbon neutrality

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1. INTRODUCTION - BIOPHYSICAL ENVIRONMENT AS A FUNDAMENT OF HEALTHY CORRIDOR IMPLEMENTATION

Béatrice Bechet and José Miguel Lameiras

Ecological corridors, green and blue corridors, Nature-based Solutions - these are just some of the regulatory tools and ecological engineering proposals that have accompanied public policies strongly encouraging the development of nature in the city since 2000. Introducing more nature into the city or redeveloping natural spaces is proposed as a way of dealing with certain urban environmental issues, such as flooding, urban heat islands and the loss of biodiversity, but also, as a corollary, of responding to societal issues of health, safety, etc. Over the last fifteen years or so, for example, there has been a growing demand in western metropolises for access to a plot in a community garden. Another example is that the COVID crisis has led to some people formerly living in urban centres moving to the city outskirts, or even to the countryside.

This return to the political agenda of an urban nature that has long been annihilated or controlled brings us back to the more relevant field of study of the urban environment, which takes objects of study reserved for the natural sciences, but to describe and analyse the effects or impacts generated by human activities. The specific nature of the urban environment means that its biophysical components should be systematically examined through the prism of the social sciences, through phenomena intrinsically linked to the organisation of society and forms of habitat (Cronon, 1996).

The study of the urban environment therefore includes the observation and analysis of the social (and economic) actions and practices that take place there, but is also closely linked to the fields of expertise on air, water, soil, microclimate, vegetation and animal livability (Senecal, 2007).

Nature-Based Solutions (NBS), and in particular territorial solutions, as defined in URBiNAT (NBS catalogue, Conserva et al, Deliverable 4.1), are actions designed to respond to various environmental, social and economic challenges, which are inspired, supported or copied from nature (EC, 2015) and have been promoted by various international institutions (World Bank, IUCN, EU) since the 2010s (this ebook, Chapter 1). In line with the idea of green corridors, URBiNAT proposes to select - on the scale of one or more neighbourhoods to enhance landscape connectivity -, several NBS to form clusters of material and immaterial solutions, namely healthy corridors. A healthy corridor represents an opportunity, within urban landscapes, for a new vision of public spaces, particularly green spaces, in order to address the links between urban form, social issues and the environment and to redevelop or deploy NBS in an optimal way (Bodenan and Bechet, 2023).

A healthy corridor must be designed to address aspects that are little taken into account by urban regeneration, such as physical and mental health, the quality of use and aesthetics of public spaces, and residents' attachment to their living environment. The chapter 5 of this ebook focuses specifically on these aspects from the angle of the link between NBS and health and well-being. Based on the principle that NBS use natural characteristics and processes, for example plants and their root systems to stabilise soils, or wetlands to manage stormwater, the biophysical environment is at the heart of this chapter, in order to specify how it can be characterised in its various dimensions (diagnosis) and evaluated in terms of positive and negative impacts. The components of the biophysical environment addressed in this chapter are air, soil, water and vegetation through some of their properties, such as respectively, microclimate, soil quality, water management and carbon storage by trees. Air quality and the impact on health will be addressed within chapter 5. The first stage is to characterise the biophysical environment before implementing territorial NBS, which will take advantage of the various environmental compartments. This initial diagnosis, based on indicators chosen according to the NBS planned, is the baseline state to which the post-implementation state will be compared, in the ecosystem service or disservice assessment phase.

The section 2 of the chapter refers to the evaluation of thermal environment by physical indicators. At the heart of the heat island issue, a theoretical part provides an understanding of the concept of indicators and introduces the notion of hydroclimatic service of NBS. The example of a demonstrator (a reduced scale partly vegetated canyon street) illustrates the relation with vegetation, but also soil and water. The section 3 analyses the potential of urban soil for food growing, one of the most restrictive

criteria when designing new plots for urban agriculture or gardening. Soil typology is questioned, in relation to agronomic properties and soil pollution, in the context of vegetable production in community gardens, highly popular NBS in western countries. Stormwater management, in parallel to rainwater reuse, is a major concern worldwide, which efficiency relies on various types of NBS, named operationally as SUDS - Sustainable Urban Drainage Systems. Section 4 then provides an overview of the quantitative and qualitative aspects of urban water resources management. Finally, the carbon storage function of trees will be presented in section 5, to support the advantages of establishing trees in parks or streets in urban environments. The cities benefit then from multifunctional NBS, due to the many ecosystem services of vegetation.

The chapter will conclude with a number of recommendations aimed at providing an understanding of the quality of the urban environment ante/post implementation of NBS, but above all at demonstrating the importance of assessing the urban public spaces quality to enhance the efficiency of a healthy corridor, as a cluster of NBS.

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2. EVALUATION OF THER- MAL COMFORT AND URBAN THERMAL ENVIRONMENT BY PHYSICAL INDICATORS

*Sophie Herpin, Pierre-Emmanuel Bournet, Katia Chancibault,
Etienne Chantoiseau*

URBAN ENVIRONMENTS, URBAN HEAT ISLANDS AND OVERHEATING

Climate change and its consequences are among the biggest global concerns of this century (IPCC, 2023). The year 2023 was 1.48°C warmer worldwide than the climate of the pre-industrial era, confirming that it was the hottest year in history for the planet.

In the city, a phenomenon characterised by abnormally high air temperatures in downtown areas and better known as the Urban Heat Island (UHI) adds to the consequences of climate change. The UHI phenomenon is defined as the air temperature difference between the centre of a city and the neighbouring rural area, between sunset and sunrise (Oke, 1973). The name “urban heat island” comes from the fact that the representation of the spatial evolution of the air temperature presents a temperature peak similar to that of an “island” at the level of urban areas (Bouyer, 2009). Urban overheating, which is a local microclimate phenomenon, can be defined in the same way as the urban heat island phenomenon, but occurs at a smaller scale, on the street scale for example.

The intensity of UHI is closely linked to the thermal and radiative properties of urban surfaces (which absorb and retain solar heat), to the low plant cover (which reduces evapotranspiration), to population density, heat release in the city. UHI therefore displays some spatial variability within the city, with the change in land cover or sky view factor from one

district to another. The intensity of the UHI can exceed 10 °C for the city of Athens (Santamouris et al., 2001) and 11°C for the city of Paris (Cantat, 2004). The effect of the UHI is mainly observed at the end of the afternoon and during the night, when building and paving materials release heat that was accumulated during the day. It is considered to be one of the biggest environmental problems of the 21st century caused by urbanisation and the industrialisation of our society (Rizwan et al., 2008).

The UHI can be assessed through a network of meteorological stations within the city and in the rural surroundings, but also through mobile measurements or land-use classification such as Local Climate Zones (Stewart and Oke 2012). It can also be evaluated thanks to microclimate models. The MAPUCE project (Bocher et al., 2018) assessed the UHI in 42 cities in France, using land-use classification and the MESO-NH and TEB models. In Nantes, for a typical summer day, with low wind speed coming from the North (Figure 1), the UHI can reach up to 3.7°C in the city centre, and spreads out to the suburbs, with a lower intensity. For example, with the Northern wind, the UHI is also present in Bouguenais in the Southern suburbs of Nantes, where the reference Météo France weather station for Nantes is located.

As it can be seen with the mapping of the vegetation fraction in Nantes urban area (Figure 2), the UHI spatial distribution is directly linked to the vegetation fraction in the city: the higher the vegetation density, the weaker the UHI intensity. Indeed, the city centre, where the UHI is the strongest, is the neighbourhood where the vegetation fraction is the lowest. On the contrary, the neighbourhood in the Northern district of Nantes is more vegetated, and less impacted by the UHI. This points out the potential role of some Nature-based Solutions (NBS) such as large urban parks to reduce the UHI.

ASSESSING HUMAN COMFORT THROUGH INDICES

Climate change and its amplified consequences in urban areas also affect the thermal comfort of city dwellers. Human thermal comfort has important effects on human health and productivity. This has been proven by numerous research projects in this area undertaken over the last decades (Moujalled, 2007). It depends on heat exchanges between the human body and the environment (Figure 3), and therefore on several meteorological variables: air temperature, but also air humidity for sweat evaporation, wind speed for convection, and solar radiation and surface temperatures for radiation exchanges.

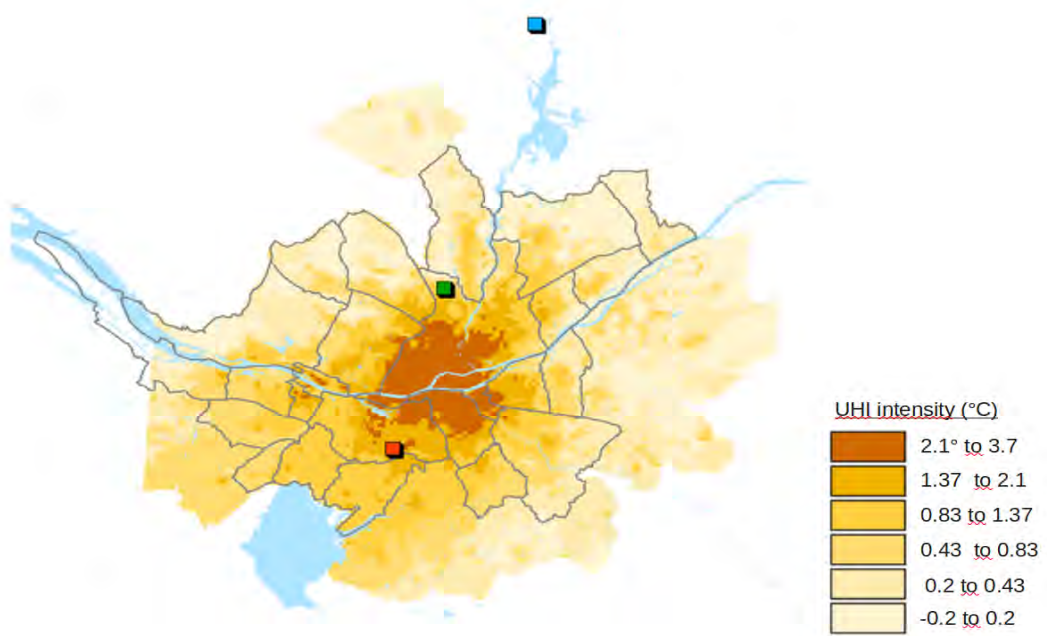


Figure 1: Urban Heat Island (UHI) intensity in the urban area of Nantes, France, calculated in the MAPUCE project, with SURFEX model (Bocher et al, 2018), for a typical summer sunny day, with a low wind coming from the North. Meteorological stations from Météo France in Bouguenais (orange) and Nort-sur-Erdre (blue), with the ONEVU Urbinat station from Stendhal middle school (green) are shown on the map (square symbols).

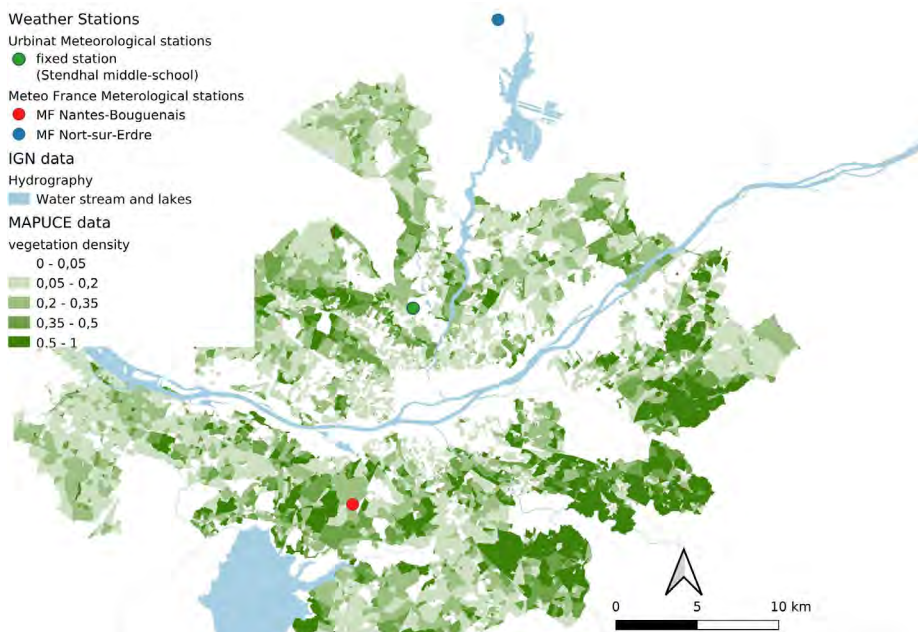


Figure 2 : Vegetation density (ratio between 0 and 1) in Nantes urban area from MAPUCE ANR project (Bocher et al. 2018). Note that Nort-sur-Erdre is outside of Nantes urban area, therefore there is no vegetation data at this point, but the area is fairly rural.

It can be assessed using thermal comfort indices, generally based on a thermal balance of the human body. This balance can be computed by measuring or modelling these meteorological variables. Among these indices, the Universal Thermal Climate Index (UTCI) (Bröde et al., 2013) is one of the most advanced, since it takes into account all meteorological variables, clothing and the individual's level of activity. It uses also a thermo-physiological model of the human body (Fiala, 2010) to calculate the effects of thermoregulatory mechanisms (sweating, vaso-constriction and vaso-dilation). The Predicted Mean Vote (Fanger, 1972) is also widely used as it can be directly compared to an individual thermal perception (see chapter 5). In urban areas, the presence of buildings and trees can generate localised effects with shading and wind, and thermal comfort is thus generally studied at a fine local scale, typically at the pedestrian and street scale.

The thermal comfort in Stendhal middle-school in the northern district of Nantes city, France, was studied during a yearly period, from February 2022 to January 2023, with an on-site meteorological station and the computation of UTCI thermal comfort index (Figure 4). The thermal stress was the highest in July between 14:00 and 15:00 UTC, reaching a maximal value of 36°C. corresponding to a strong heat stress. This value corresponds to a strong heat stress, and Nature-based Solutions are especially important to cool down the human body during this period.

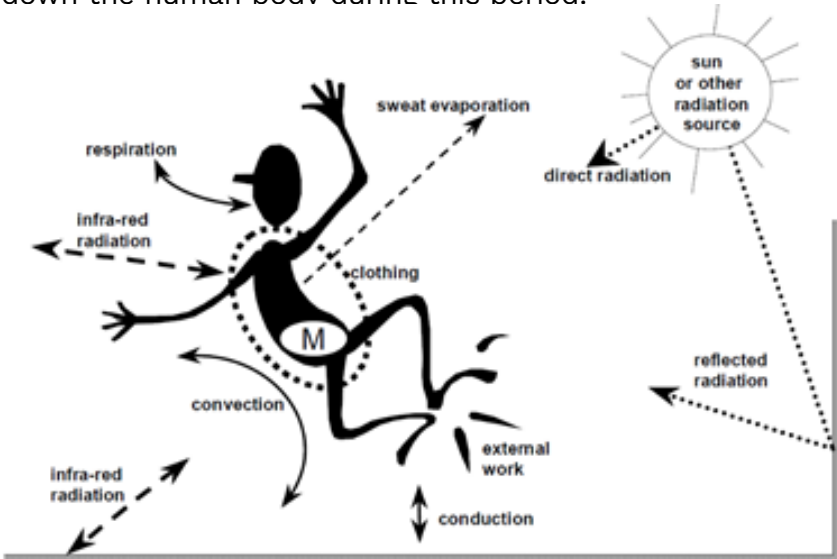


Figure 3 : Heat balance of the human body (Havenith, 2005). The human body produces heat with its metabolism (M). It also exchanges heat with the environment through direct and reflected radiation from the sun, infra-red radiation from the surrounding surfaces, or from direct contact with surfaces (conduction). This heat can be dissipated through convection (heat transport with wind) and sweat evaporation.

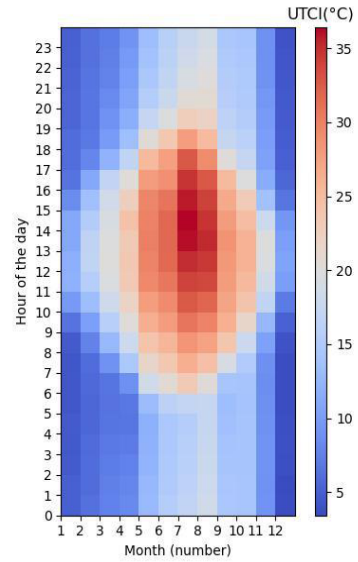


Figure 4: The meteorological station at Stendhal Middle school in the Northern district of Nantes, France. The station is equipped with all necessary sensors to evaluate thermal comfort: air temperature and air humidity sensors, an anemometer for wind speed and direction, and a black globe thermometer to evaluate the mean radiant temperature. The Universal Thermal Climate Index (UTCI) computed with this meteorological station between February 2022 and January 2023, is shown on the right, with the average values per month and per hour of the day.

FINDING A WAY TO REDUCE UHI AND IMPROVE THERMAL COMFORT IN CITIES

To reduce the effects of UHI, a set of levers can be used, such as: promote natural ventilation and limit electric air conditioning, prefer reflective building materials on high surfaces (roofs) to increase urban albedo, better conserve and manage rainwater (this water can be re-evaporated, evaporation being a refreshing factor), etc. But the solutions consisting in revegetating or reforesting cities and their surroundings appear as the most promising.

Indeed, given the ecosystem services they provide via their transpiration and shading, plants can be a solution to cope with the urban heat island phenomenon and, consequently, improve the thermal comfort of city residents. An example of thermal effect of well-watered trees during a typical summer sunny day in a north-south oriented reduced scale canyon street is provided in Figure 5 (Mballo et al., 2021). Given the sunny

conditions, a strong heat stress is observed in the mineral (non-vegetated) part of the street at midday, when the walls do not provide shading any more. At that time of the day, the trees in the vegetated zone of the street reduce UTCI by 8°C, mostly thanks to shading, making the street more comfortable.

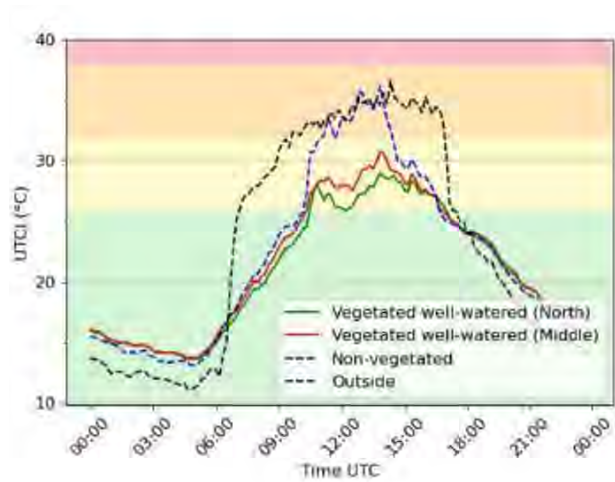


Figure 5. Left: Scale model of a canyon street with North-South orientation to study urban overheating and the impact of street trees on human thermal comfort. The trees are well-watered ornamental apple trees, located on the central axis of the street. Right: The thermal stress evaluated in this street with microclimate measurement and the Universal Thermal Climate Index (UTCI), during a typical summer sunny day, with the different thermal stress categories: no thermal stress (9 to 26 °C UTCI, green), moderate heat stress (26 to 32 °C UTCI, yellow), strong heat stress (32 to 38 °C UTCI, orange), very high heat stress (38 to 46 °C UTCI, red). (adapted from Mballo et al., 2021)

CONCLUSION

The urban climate is strongly linked to land cover, with the urban heat island being induced by the replacement of natural surfaces by construction materials. Strong thermal stress can also be experienced during daytime in summer. Nature-based Solutions such as urban parks or street trees can help improve thermal comfort of inhabitants, through evapotranspiration and shading. The importance of providing both sunny and shaded vegetated areas within the city, in order to accommodate with a wide range of meteorological conditions, and also to provide habitants with some control over their thermal comfort, will be investigated into more details in chapter 5 (“How Nature-based Solutions Promote Health & Wellbeing”). Stakeholders should also keep in mind that plant benefits rely on water availability (necessary for the transpiration of plants and their good development), which may become a real challenge considering the increase in competition for the uses of water and the scarcity of resources in our latitudes.

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3.

URBAN SOIL AS A RESOURCE FOR FOOD GROWING

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SOIL FUNCTIONS AND ECOSYSTEM SERVICES

Soil has been defined as a natural body consisting of layers (soil horizons) that are composed of weathered mineral materials, organic material, air and water. Soil is the end product of the combined influence of climate, topography, organisms (flora, fauna and locally human) on parent materials (original rocks and minerals) over time. As a result soil differs from its parent material in texture, structure, consistency, colour, chemical, biological and physical characteristics, even more when it consists of wind deposits (FAO 2024 <https://www.fao.org/soils-portal/about/all-definitions/en/>). The rate of soil formation is 0.017 to 0.036 mm/year (it takes 8,300 to 17,600 years to form a 30 cm layer), which means that soil is a non-renewable resource on a human time-scale.

Soil is a living medium, an interface that performs a number of functions essential to the environment and society. The functions describe the processes within the soil and the interactions with the other compartments of the ecosystem (e.g. biodiversity reservoir, water infiltration, chemical buffer, carbon storage, etc.). In this way, the soil provides a number of services that meet human needs, be they physiological, health, safety, social relations or personal development. These ecosystem services are grouped into four main categories: support, provisioning, regulation and cultural services (MAE, 2005, <http://www.millenniumassessment.org/en/Synthesis.html>).

The supply service is particularly crucial, as it affects people's food security, among other things. Crises such as the COVID epidemic, or simply the rise in the cost of living, have shown just how important it is to

encourage the development of gardens or farms in towns and cities, enabling local and economically sustainable vegetable production. However, the characteristics of urban soils are often modified by past and present human activities (FAO, 2022) and are highly heterogeneous in space (Greinert, 2015).

Assessing soil quality in agronomy is a common practice, reflecting the soil's capacity to perform certain functions, and in particular to provide the service of food productivity. In urban areas, soils are often stripped, filled, mixed, compacted and supplemented with artificial materials. The soil structure is modified, and built structures and drainage infrastructures are introduced. Under these conditions, producing (food growing) and encouraging the development of garden sites are challenges in terms of selecting sites with soils that have a level of fertility and absence of contamination that are suitable for growing vegetables. NBS can improve soil properties. It consists of solutions based on soil modifications, improvement of soil functions and, consequently, the resilience of the built ecosystem to external factors. These solutions are based on the concept of soil health (Brady and Weill, 2008). To achieve this, knowledge of the physical, chemical (including pollution) and biological properties of the soil are essential indicators for assessing soil quality.

Mapping soil data and soil typology in an urban environment is a major challenge for assessing the degree of naturalness of soils and their fertile potential. In addition, the quantification of harmful substances remains a prerequisite for any development plans. These issues are addressed in the remainder of this section, with the case study of the Eglantiers garden in Nantes.

TYPOLOGY, FERTILITY AND SOIL POLLUTION

Depending on natural and anthropogenic factors, several types of soil (called soil units) co-exist within a given area. In a natural environment, there are around sixty different types of soil in an area of 3,000 km². In an urban environment, predictive models for natural soil units are difficult to apply because the horizontal and vertical spatial disorganisation and sealing of urban soils seem to compromise any effort at deterministic mapping. However, since the 2000s, more robust knowledge of these soils has been made possible by specific studies, but often restricted to the

surface horizon. At present, efforts are being made to identify urban soil units and their characteristics in order to improve regional planning.

Each soil unit has bio-physical-chemical characteristics that give it a specific agronomic quality. The agronomic quality of a soil depends on its ability to support plant growth. For plants, soil is both a support and a reservoir of water, air, nutrients and biological life. To ensure that the soil functions properly over the long term, agronomic quality means maintaining a high level of biodiversity to support processes such as the carbon and nitrogen cycles.

The agronomic quality of soils is assessed using a series of indicators based on 3 pillars: physical, chemical and biological fertility (Figure 6). In 2019, the French National Agency for Energy and Environment (ADEME) published a summary on this subject (Calvaruso et al., 2019). The joint assessment of these indicators is necessary in order to define recommendations adapted to a type of soil use.

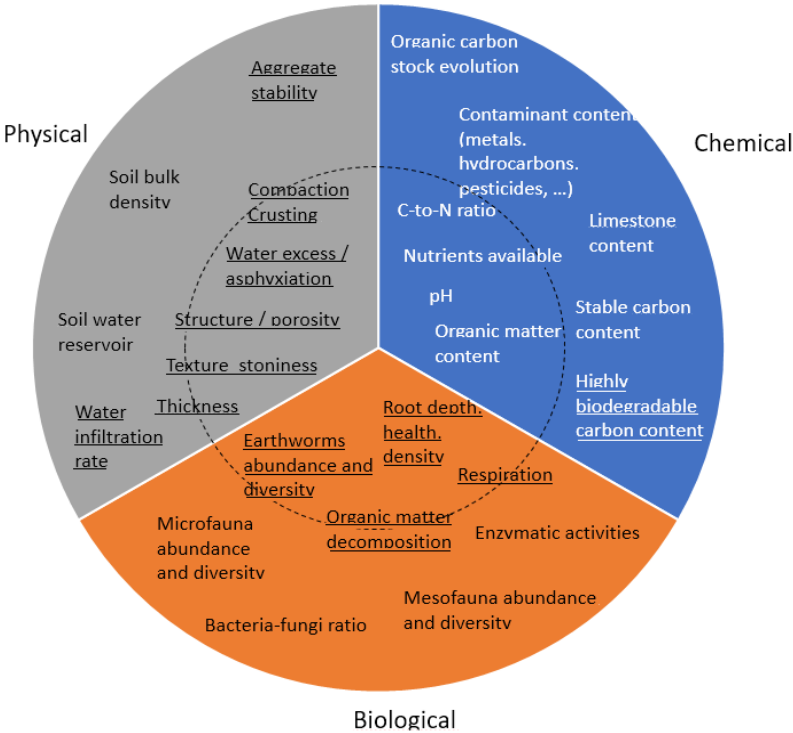


Figure 6 : Agronomic soil quality indicators based on the 3 physical, chemical and biological pillars. The underlined indicators are field indicators that do not require specific equipment for measurement. Inside the dotted circle is a minimum set and outside the dotted circle a more complete set. Adapted from Calvaruso et al. (2019).

In addition to these indicators, optimum values have been defined to meet food production needs in comfortable plant conditions. For example, the level of organic matter in soils should be between 2 and 5%. This is much lower than in organic soils such as forest soils, where the rate is over 40%. The acidity of the soil, assessed by measuring the pH, should be around neutral, between 6.5 and 7.5, a range that is favourable to the availability of most of the soil's nutrients to plants. A soil has optimum water autonomy for plant consumption if its water reserve is greater than 1.5 mm of water per centimetre of soil. If we consider a crop that takes root up to 50 cm, the soil needs to have a reserve of at least 75 mm of water. This represents autonomy of around 15 days in summer without watering. Finally, another important criterion for plant growth is soil density or soil compactness. It is recommended that this should be in the range 1.2 to 1.5 g of soil per cm³ of soil. Above 1.6 g/cm³, root growth is limited because the soil is too compacted.

The sanitary quality of urban soils is a major concern, in a context of increasing development of food production in highly urbanised areas (Zwolak et al., 2019). The mineral contaminants and synthetic products potentially present in soils are very diverse: trace metals such as arsenic or lead or organic substances such as pesticides. These pollutants are the result of human activity and/or the alteration of parent rock (natural origin). As trace elements are not degradable like organic pollutants, trace element contamination is a lasting environmental threat to human health. Gardeners can be exposed to substances that are hazardous to their health by inhaling dust or eating contaminated vegetables. Total concentration of metals and metalloids is still the most useful common chemical indicators of soil pollution (Weissmannová and Pavlovský, 2017). Conventionally, the problem is assessed by comparisons with soil quality standards based on background soil concentration levels.

MAPPING OF SOILS AND SOIL QUALITY INDICATORS FROM NANTES METROPOLE, A FRONTRUNNER URBINAT CITY

As part of the H2020 URBiNAT project, Nantes Métropole was one of the frontrunner cities and proposed the city's northern districts as a study area for the implementation of a healthy corridor. This vast, very green area of the city is home to several priority sub-neighbourhoods

under the city's urban policy, and is the subject of a major urban renewal program. The diagnostic phase, prior to the co-creation of the healthy corridor, involved soil mapping and analysis (physico-chemical parameters and pollutants).

Mapping of the northern districts of Nantes has been developed over an area of 300 ha. This area was urbanised after the Second World War, and the land is used for a wide variety of purposes: housing estates and blocks of flats, schools, offices, shops, a detention centre, car parks, roads, grassed or stabilised sports facilities, wooded parks, a cemetery and a forest. To reflect the typology of urban soils, it is necessary to determine their morphological degradation leading to the partial or total disappearance of their original horizons, through truncation, mixing or covering. The degree of denaturation was assessed by considering the depth and number of horizons impacted in relation to the expected morphology of natural soil had there been no artificial development (Ducommun et al., 2023).

Auger soil borings were used to verify the urban soil unit hypotheses obtained by cross-referencing GIS data from the 1:250,000 regional reference soil map (Ducommun, 2017), the 1:50,000 geological map (BRGM), the 1:25,000 digital terrain model (IGN) and the urbanisation pattern of the soils captured by aerial photographs (IGN). The soil map is at a fine scale (1:10,000) and comprises 26 soil mapping units (Figure 7). The description of soil denaturation in this sector, in relation to the change of land-use, finally showed that 71% of the surface area had been little impacted from a pedological point of view. These results are in line with the proposal of Libessart et al (2022) who showed that the historical trajectory and the number of land-use changes could be used to describe the evolution of the soil profile of the Greater Paris Metropolis on a small scale.

Soil samples were taken from various locations in the study area: existing gardens and areas where growing food was planned, with the aim of assessing the agronomic quality and the risk of pollution. Two soil layers were sampled: the cultivated layer (0-30 cm) and an underlying layer. Two indicators are shown in Figure 8 : a) total carbon content, which provides information on the organic matter content essential for plant growth, and b) lead content in the soil. This metal is toxic when ingested through contaminated water or food (e.g. vegetables).

CARTE DES SOLS URBAINS Quartier Nantes Nord - Orvault

Auteurs de la carte : Christophe Ducommun & Clementine Duvigneau

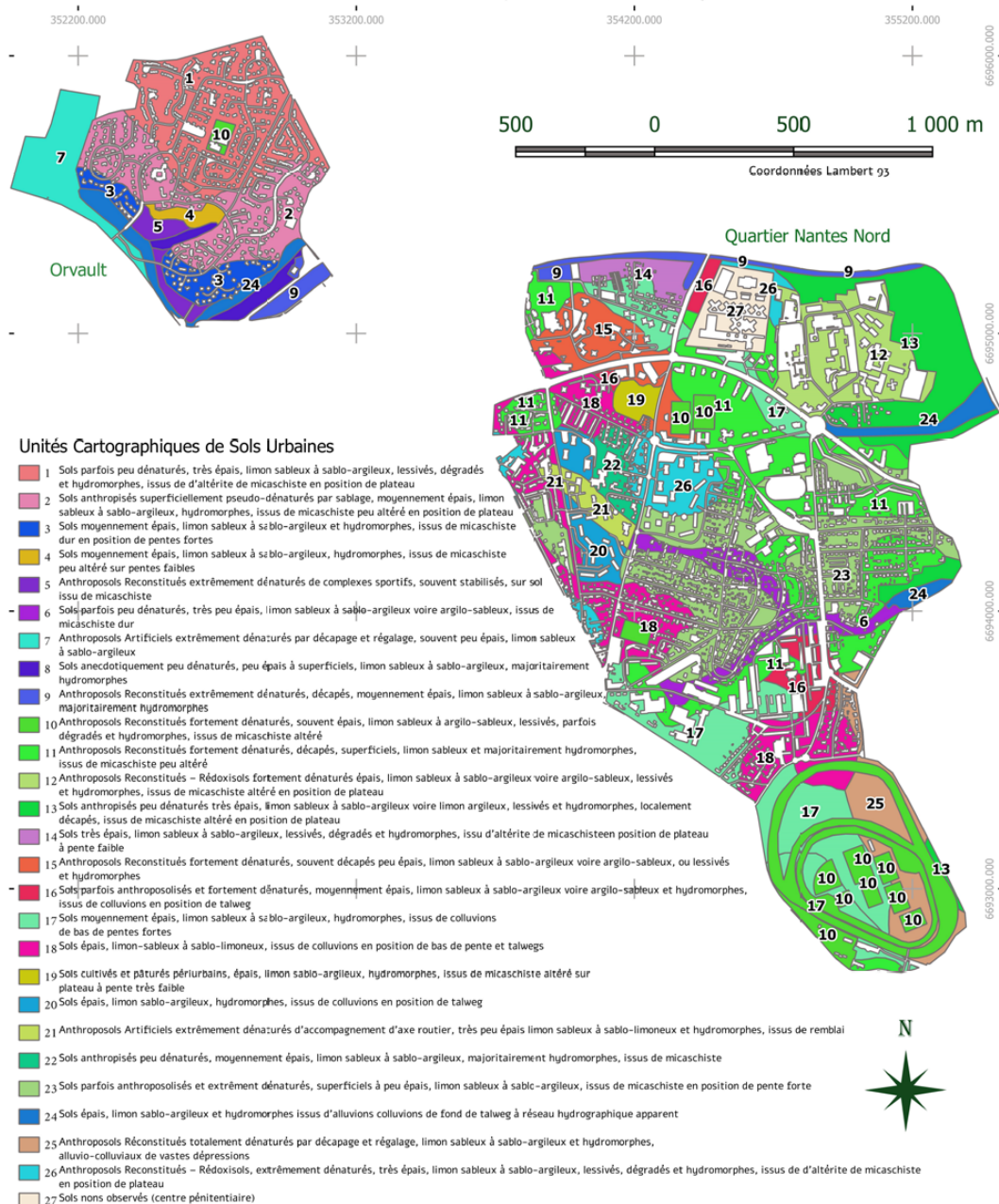


Figure 7 : Map of soil mapping units (1/10 000) of North Nantes district (designers C. Ducommun and C. Duvigneau). Fine field investigation made the small-scale soil mapping relevant to illustrate the heterogeneity of soils related to anthroposols (soil deeply transformed by human activities (21, 12, 13), natural profiles on former rural area (24, 6, 14) or refilling (11, 26)).

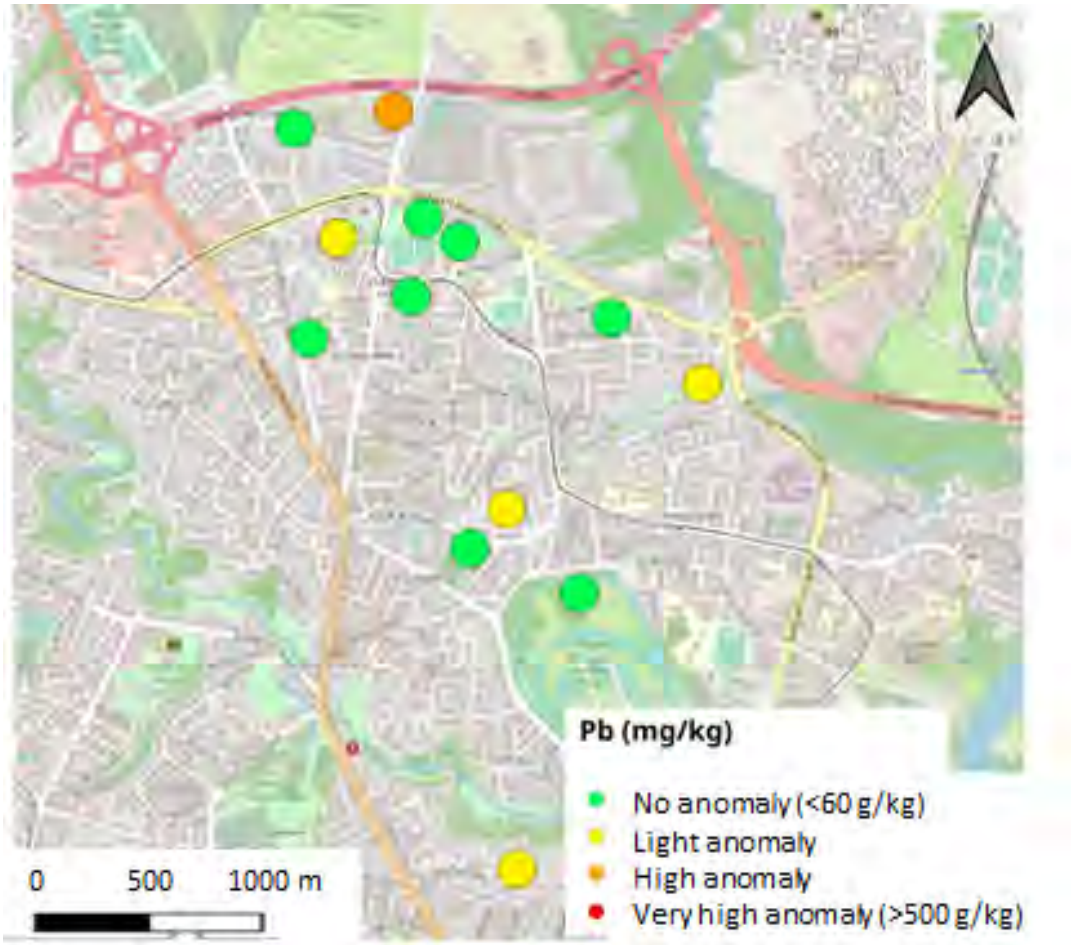
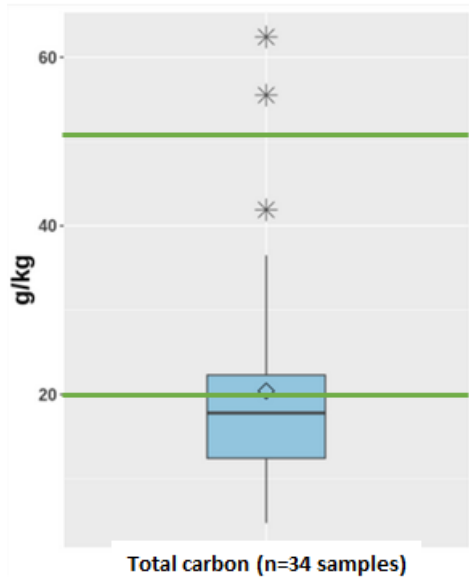


Figure 8 : a) Mapping of lead concentrations (mg/kg of surface soil) inside the URBINAT study area- Each point represents a sampling zone - Green colour : the value is below the local natural reference value; yellow to red : various level of anomalies; b) total carbon concentrations in soil samples (the green lines define the optimal value range).



PORTO'S ALAMEDA DE CARTES PARK INTERVENTION: REUSE OF TOPSOIL FOR FUTURE ESTABLISHMENT

The Alameda de Cartes park is situated in the easternmost part of Porto city (Campanhã parish), at the interface between three municipal public housing neighbourhoods: Falcão, Cerco do Porto and Lagarteiro, where an area of intervention was identified by the Porto city council (Figure 9) of particular relevance due to its potential for social and territorial cohesion, and proximity between housing areas, equipment, services and parks for public use.

In the project, it was expected to remove the topsoil layer (0 to 20 cm depth) and keep it within the site for reuse upon the future establishment of the vegetation cover. So, to evaluate its quality, soil analysis was done into six areas of the park with distinct soil uses: an urban garden where the local inhabitants grow food (1); a construction waste landfill (2); a glade with low growing vegetation (3); an expectant terrain (4); old agricultural fields (5); and a road slope (6). Nineteen soil samples were taken at a depth of 0-20 cm. For each site, it was analysed the pH, electric conductivity, bulk density, organic carbon, and presence of potentially toxic heavy metals (chromium, nickel, copper, zinc, cadmium, mercury, and lead).



Figure 9 – Area of intervention identified by the Porto city council for the future Alameda de Cartes municipal park installation. Yellow circles represent the points for soil sampling, and red dots represent the samples collected.

The park’s topsoil layer (0 to 20 cm depth) is slightly acidic (6.1 – 6.6), contrasting with the strongly to moderately acidic nature of the natural soils of this geographic area, reflecting the anthropogenic intervention. The electric conductivity values indicate non-saline soils and bulk density varied between 0.68 g/cm³ at the road slope area (6) and 1.48 g/cm³ at the urban garden (1), which is good for root growth. It contains between 3 and 4% organic carbon (SOC), which are within the expected values for soil that is not mobilised and has permanent herbaceous cover. The heavy metal concentrations (Figure 10) were below the maximum values proposed by the Portuguese Environmental Agency for the evaluation of soil quality (APA) for generic soils, which represent the ones at the park area and soil use.

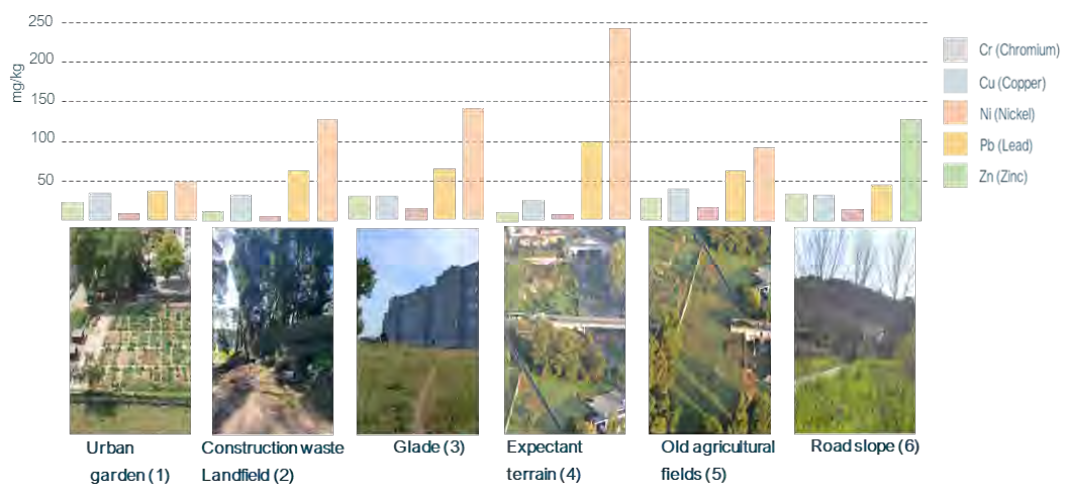


Figure 10 – Topsoil concentration values of heavy metals in six areas of the park with distinct soil uses.

Considering the analysed parameters, overall, the topsoil of the park before its intervention presents favourable conditions for plant establishment, and its reuse can be further considered. This topsoil was conserved in situ during the intervention process in two piles. Closer to the date of its reuse in the park, the soil piles were analysed, focusing on pH, organic matter content, heavy metal contamination and agronomic indicators. A decrease in soil pH and enrichment in arsenic, mercury, and lead concentration were observed, probably resulting from soil mobilisation. Also, in one of the piles (closest to the entrance), the soil presented some defi-

ciency in plant nutrients such as phosphorus, magnesium, calcium, manganese and boron and excessive potassium, copper and iron levels. This mainly resulted from the soil exposure to the environmental conditions that facilitate chemical transformations. The pile with the highest rate of cover vegetation was less modified. So, the reuse of topsoil for the future establishment of the vegetation cover has plenty of advantages, mainly related to maintaining the original soil's physical characteristics, but soil correction measurements from the chemical point of view must be considered for the success of the intervention foreseen with the planting of several trees and cover crops.

SOLUTIONS FOR IMPROVING THE SOIL QUALITY FOR FOOD GROWING

In response to the revival of urban gardening and urban agriculture in northern countries, local authorities are looking into the risks associated with growing crops in the open on urban soil. Soil fertility and potential contamination need to be assessed using conventional sampling and analysis methods. Microbiological quality is also a parameter that is taken into account in the overall assessment of soil health (Joimel et al., 2018), as well as the presence of macrofauna (i.e. earthworms). This new concept of soil health makes it possible to understand all the components that regulate the ecosystem services provided by soils.

Where soil characteristics are unfavourable to plant development, a major lever for improvement is the use of organic soil amendments. These amendments are known to improve the agronomic properties of soils, thereby improving crop yields and quality, provided they are applied every 1 to 2 years to compensate for annual losses (Yadav et al., 2020). In the presence of pollution, a number of soil management solutions are possible: excavation and in-situ treatment are the most conventional for heavily polluted sites, but in the case of mixed or moderate pollution over small areas, changes of use or stabilisation/de-pollution by plants (phytomanagement) may be recommended. It should be kept in mind that although phytomanagement provides a number of ecosystem services (landscape aesthetics, biodiversity, cooling the city) in addition to depollution, it has one major limitation: the time-scale of its depollution action, which can take several years to decades. However, this constraint can be overcome by including plant management as soon as the decision is taken to redevelop a site/neighbourhood.

One of the community gardens in the URBiNAT study area is a good example of small-scale soil management. The Eglantiers garden has already undergone a very in-depth investigation of soil quality at plot level in 2011. After the diagnosis revealed lead and arsenic of natural origin, linked to an over-concentration in the near subsoil, different solutions of site management were implemented: the part of the plots with low lead and arsenic anomalies remained under cultivation, a part was raised by the addition of non-contaminated soil, and the last part was transformed into orchard (Figure 11). An experiment with gardeners was also carried out to test the combination of vegetables that accumulate very little lead (potatoes, green beans, cabbage, tomatoes) with brown mustard, which is known to accumulate lead (Bouquet et al., 2024). The aim was to maintain gardening despite the constraint of being able to grow only authorised vegetables until the brown mustard had extracted enough lead. The ultimate aim was to return to gardening without any constraints.

The results showed that it was indeed possible to grow certain vegetables on contaminated soil without risk, but because of the variability from one species to another, it was necessary to maintain vigilance over cultivation practices.

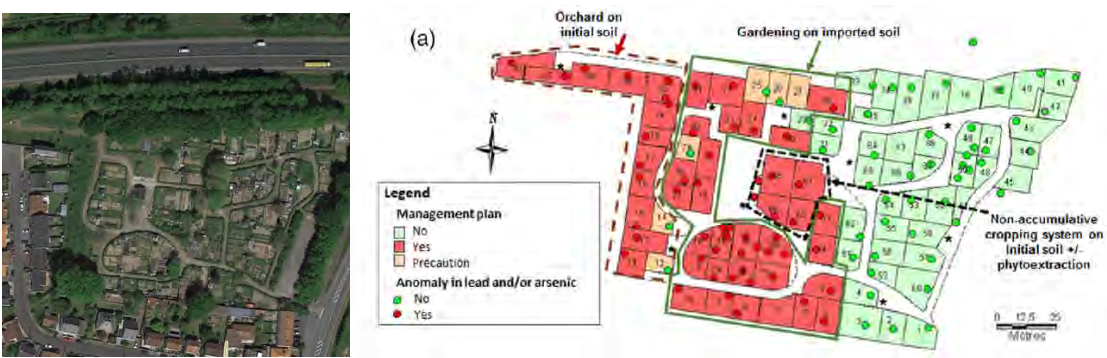


Figure 11 : Aerial view of the Eglantiers allotment garden near the north ring road of Nantes and management plan of contaminated soil in relation to the arsenic and lead concentrations (from Le Guern et al., 2018).

CONCLUSION

Food growing on urban soil is challenging due to the lack of knowledge on soil typology and properties, either fertility or pollution. But Nature-Based Solutions to manage poor quality of soils were extensively implemented and assessed. Urban gardens where amendments or soil treatments are proposed to improve the soils are themselves NBS, as a multifunctional natural system contributing to well-being and health of citizens.

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4.

URBAN STORMWATER MANAGEMENT

Fabrice Rodriguez

URBAN PLANNING AND STORMWATER MANAGEMENT

Urban water management is one of the major challenges facing cities today. For a long time, urban water was considered a threat (flooding), a vector for contaminants, and a waste product for urban discharges. In the current context of global change, urban water can be used as a resource for the buildings (Opher et al., 2019), or for soil and vegetation ('*Sponge cities*' Nguyen et al., 2021, Dahlke et al., 2018), especially through Nature-based Solutions (NBS), which play a growing role in urban planning. In terms of stormwater management, these developments are designated with many terms in literature (Fletcher et al., 2015). They are very interesting because they enable stormwater and urban run-off to be managed at source. Most of these source control solutions are vegetated (Figure 12), as they encourage infiltration and evapotranspiration, and are therefore more effective in preventing run-off and controlling pollutants produced by the city. These benefits are in addition to urban noise reduction, biodiversity restoration (Rathnayke and Srishantha, 2017), combating Urban Heat Island and landscape enhancement.

From a hydrological point of view, NBS are supposed to have many benefits, but the assessment of these benefits is sometimes subjective, based as it is on their design principles, or on modelling work (Ferrans and Temprano, 2022; Ortega Sandoval et al., 2023). The installation of measuring equipment is an asset when it comes to estimating the hydrological performance of this type of structure, whether in the case of pilot schemes or real in situ developments. In the literature, numerous studies examining some specific NBS such as the hydrological performance of green roofs can be found (Yilmaz et al., 2016; Zheng et al., 2021) or the pollutant removal capabilities of swales (Fardel et al., 2018; Fardel et al., 2021). The aim of this section is to show how measurement can be used



Figure 12 : Examples of NBS associated to stormwater management in urban areas - a) Green roof; b) Vegetated swale; c) Rain garden; d) Small bioretention basin

to objectivise the hydrological interest of NBS, with a specific focus on the behaviour of a vegetated swale in urban context.

HYDROLOGICAL EVALUATION OF NBS PERFORMANCE

A NBS usually collects run-off from a given catchment or a simple impervious area, and the run-off water can either infiltrate, evapotranspire or flow further downstream. The evaluation of the hydrological and pollution removal impact may be assessed through a large set of metrics (See a French guide), including hydrologic indicators relative to water flows or volumes, and pollutant loads or concentrations indicators (Flanagan et al., 2019) (Figure 13). For illustration purposes, two metrics are used here and are estimated for every rainfall event. At the NBS scale, we can estimate the run-off Volume reduction HV, as the relative difference between the upstream and downstream flow volume, and the peak-flow reduction (HQ), as the relative difference of the upstream and downstream maximum flow-rates during a rain event.

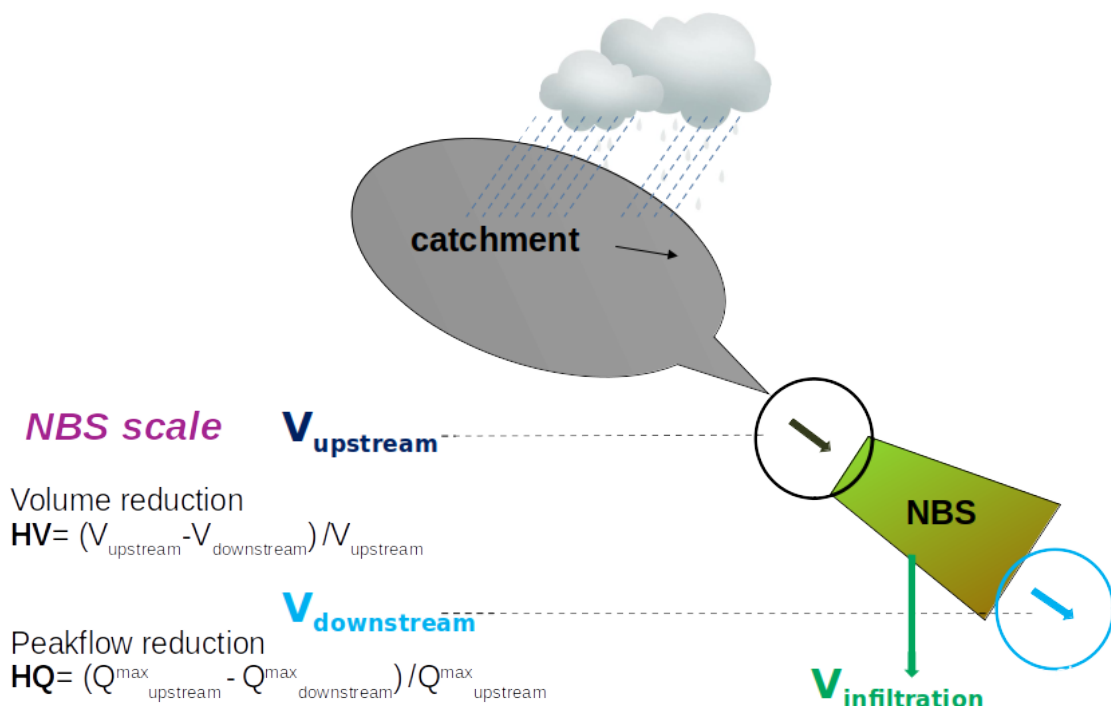


Figure 13 : Example of indicators and hydrological metrics useful for NBS performance evaluation

HYDROLOGICAL AND POLLUTION TREATMENT PERFORMANCE OF A SWALE

The data presented here were monitored on a research observatory ONEVU, located in the city of Nantes, west of France. The objectives of this observatory are to monitor water, pollutant and energy balances of several catchments or neighbourhoods on the long term, thanks to a large set of sensors. On this observatory, we have a specific eco-neighbourhood, Bottiere Chenaie, where various NBS have been implemented: green roofs, swales, small retention basins. In this neighbourhood, there is no stormwater sewer, that means that all the run-off is flowing within vegetated swales. We will focus now on a specific swale, located downstream a small 1.7 hectare catchment drained by a swales network.

This swale has been instrumented with the measure of the upstream and downstream water depth (converted into a flow-rate using a rating curve), and the soil moisture. The hydrological behaviour of this swale dur-

ing two successive rain events occurred in November (Figure 14a) shows (i) the rapid soil moisture increase related to the water infiltration, and (ii) a similar tendency for the upstream and downstream water depth variation, with a reduction of water upstream. The estimation of the metrics shows the performance of the swale for the first rain event with a large flow-rate reduction for both volume (HV) and peak-flow (HQ) (~no downstream flow), and a smaller performance for the second rain event. In the year 2018, with about 80 rain events occurred whose cumulative rainfall height of more than 2 mm, both HV and HQ vary between 0.6 and 1, which is summarised in the boxplot (Figure 14b).

Within three combined research projects in Nantes, Lyon and Ile de France, we did this kind of analysis on a large set of stormwater alternative devices, including technical solutions (as porous streets), larger centralised basins and specific NBS (Gromaire et al., 2019). When we classify

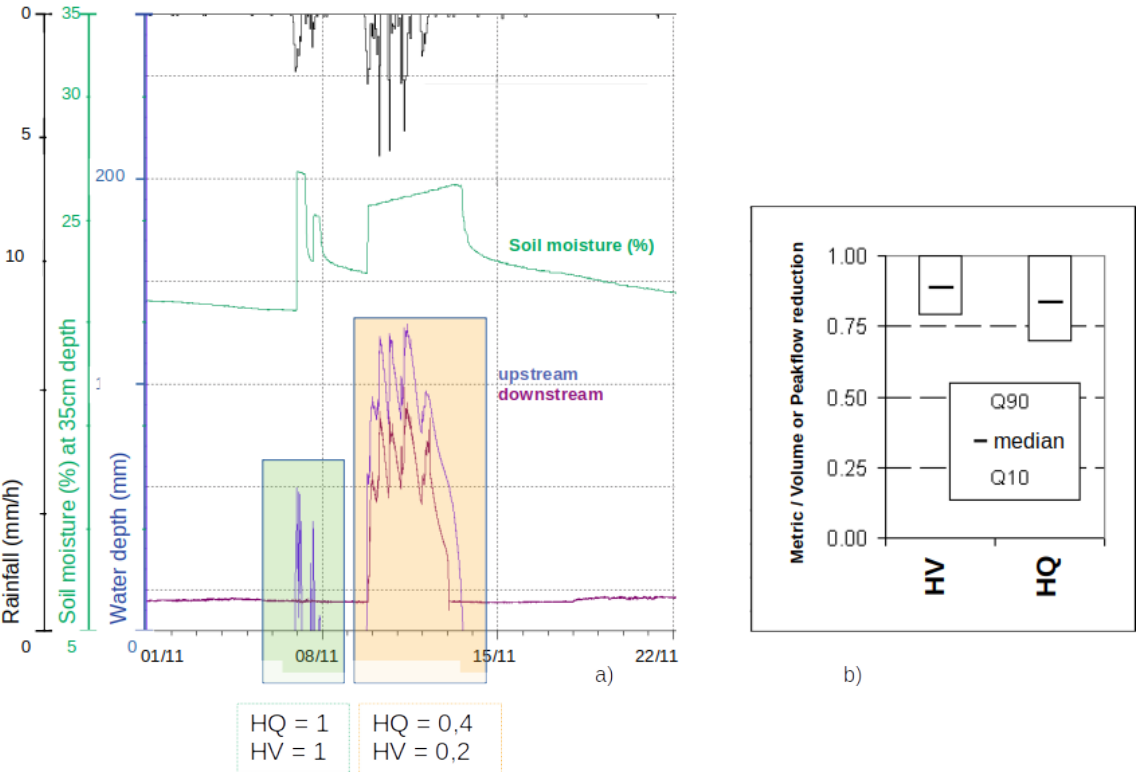


Figure 14 : a) Hydrological observations during a 5 mm rain event occurring in Nantes, November 10th, b) Statistics on the Volume reduction (HV) and Peak Flow Reduction (HQ) of a vegetated swale (year 2018) - Noue Dumont (ONEVU, Nantes)

the solutions along with their performance, using the HV indicator, we highlighted the very good performance of NBS compared to the other solutions. Most of NBS has a median Volume reduction indicator of 0,9, which is remarkable.

Some water samplings were performed in the same set of stormwater management devices during rain events, upstream and downstream, to evaluate the pollution level. The main contaminants present in urban run-off were analysed : Suspended Solids, PolyAromatic Hydrocarbons, metals as Copper, Zinc and some organic micropollutants. The concentration reduction of each device was quite variable from one micropollutant to the other, and from one solution to the other, but the NBS has shown an overall better performance than the other, which highlights the benefit of these solutions.

CONCLUSION

The impact of NBS on the water balance can be demonstrated through measurements combining flow measurement at the inlet and outlet of the device, where possible, measurement of the soil moisture and sampling of the water to estimate the degree of contamination by the main pollutants from urban run-off. Measurements carried out as part of recent research projects show that vegetated stormwater management devices favouring infiltration perform better than those based on civil engineering. In URBi-NAT project, the city of Porto experiments in the intervention area the implementation of various NBS dedicated to the management of stormwater, even vegetated or technical solutions to infiltrate water and release it in natural watercourses.

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5. TREES AND CARBON STORAGE

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FUNDAMENTALS

The ongoing discussion about climate change mitigation strategies focuses on the existence of Greenhouse Gases (GHG) in the atmosphere, with the most important ones being carbon dioxide, methane, and nitrous oxide, usually referred to as carbon dioxide equivalent (CO_2eq). Current national and international environmental/climate regulations contemplate, in the short term, the reductions of GHG emissions and, by the middle of the present century, carbon neutrality (*i.e.*, the emissions must be equal to the sequestration of CO_2eq).

The most efficient and sustainable systems for carbon dioxide sequestration on Earth are the trees in forests or perennial crops. Indeed, the carbon that constitutes the trees' biomass results from the chemical transformations of atmospheric carbon dioxide during photosynthesis. Consequently, when trees are alive and growing, they continuously contribute to removing carbon dioxide from the atmosphere and sequestering it on its biomass. About fifty percent of the dry trees' biomass corresponds to the mass of sequestered carbon. Estimating the trees' biomass present in a selected region allows the calculation of sequestered carbon and the corresponding annual increase. Taking into consideration that the carbon present in the biomass results from atmospheric carbon dioxide, the multiplication of the mass of carbon in the biomass by 3.67 ($=44/12$) allows the calculation of CO_2eq sequestered in the tree and/or in the annual contribution of the tree to that sequestration.

Any balance about climate change mitigation strategies must include perennial trees and their contribution to the sequestration component. This is why arborised urban parks are so important when community-scale GHG inventories are being developed. Indeed, the accounting and reporting of carbon emissions in cities should be gradually neutralised in structures like urban parks so municipalities can become carbon neutral by the middle of the XXI century.

METHODOLOGY FOR THE CALCULATION OF CARBON SEQUESTRATION IN THE TREES' BIOMASS

The carbon sequestration potential of the trees in a park can be estimated using an allometric modelling approach. Allometric models are constructed by considering correlations between the morphology of the trees (such as diameter at breast height, DBH, and height, H) and their biomass, followed by conversion of this latter parameter into sequestered carbon (in CO₂eq).

An allometric equation is used to determine the aboveground dry biomass of trees (Martins, 2023; Mora, 2023), constructed by multi-model averaging different allometric equations based only on DBH (Martins, 2023; Mora, 2023; Chave et al., 2001). This resulting equation is corrected (Martins, 2023) based on comparison with a multi-parametric equation (Ferreira, 2021), which is based on both DBH and H. This comparison was performed by considering the data provided for the trees to be planted, in which both trees H and DBH were available for different trees (Martins, 2023). The equation is as follows (Martins, 2023):

$$\text{Aboveground dry biomass} = 0.0998 \times [\text{DBH}]^{2.5445} \times 0.41$$

where aboveground dry biomass is in kg, and DBH in cm.

The total dry weight of a tree (biomass) can then be determined by considering the ratio between above-ground and below-ground biomass (Ferreira, 2021). Below-ground biomass accounts for 24% of the above-ground biomass weight (Cairns, 1997). The total dry weight is converted into total carbon using a known carbon-to-total-weight ratio (0.47) (Ferreira, 2021; Kirby et Potvin, 2007; Martin et Thomas, 2011). Finally, the amount of sequestered carbon is obtained in ton CO₂eq by multiplying by 3.67 (=44/12).

The constructed allometric model is then applied to all existing trees in the Park, to estimate the amount of carbon currently sequestered by the trees of this Park.

Finally, the annual carbon sequestration potential of the trees of the Park, after intervention (tree planting and felling), is estimated by considering the total number of trees to be preserved and planted (based on the available data) and annual estimates provided by the European Environment Agency (Martins, 2023; EEA, 2023).

THE EXAMPLE OF THE ALAMEDA DE CARTES PARK (PORTO)

The Alameda de Cartes Park (Porto) suffered an intervention that involved, besides soil mobilisation, the elimination of some non-indigenous weedy trees and the planting of others. The question to be answered in this case was to assess the impact on the carbon sequestration of this urban park of the cutting down of the weed trees and growing new indigenous trees.

TREES BEFORE THE ALAMEDA DE CARTES PARK RESTRUCTURING

Before the restructuring, 502 trees were identified in the Alameda de Cartes Park. 305 were identified as trees to be felled (Table 1), while 197 were identified as trees to be preserved (Table 2).

This situation corresponds to a total of about 420 tons CO₂eq sequestered by all the trees present in this Park. The group of trees to be preserved is responsible for the sequestration of 65% of total stored carbon (275 tons CO₂eq), while the group of trees to be felled account for 35% of total sequestered carbon (146 tons CO₂eq).

SITUATION AFTER TREES FELLING

As indicated above, the trees present in this park can be divided into two main groups: trees identified as to be preserved (197) and trees marked for felling (305). The former group has sequestered 275 tons CO₂eq, while the latter is responsible for the sequestration of 146 tons CO₂eq. Given this, the proposed removal of 305 trees will reduce the amount of sequestered carbon, by the existent tree population, in the Park itself from 420 tons CO₂eq to 275 tons CO₂eq (Tables 1 and 2). It should be noted that when a tree is felled, it can release (part of) the carbon sequestered in its biomass to the atmosphere as CO₂. The resulting emissions depend on how the trees are disposed of, with conversion into (longer-term) wood products still allowing for (some) carbon storage.

SITUATION AFTER NEW TREES PLANTATION

The planned intervention in the Alameda de Cartes Park will cause significant changes in its tree population by planting several hundred new trees (Figure 15).

Trees diameter	Number	Sequestered Carbon
		Ton CO ₂ eq
< 8 cm	75	1
[8 cm and 30 cm]	186	48
[30 cm and 60 cm]	40	69
[60 cm and 100 cm]	4	27
Total	305	146

Table 1: Groups of the existent trees identified to be felled, divided into subgroups according to different trunk diameters, their number, and current levels of estimated sequestered carbon (in ton CO₂eq).

Trees	Number	Sequestered Carbon	
		Ton CO ₂ eq	Ton CO ₂ eq/year
Olea europaea	1	7	0.02
Platanus x hispanica	4	27	0.09
Populus nigra	23	157	0.51
Quercus coccinea	4	7	0.09
Quercus suber	3	21	0.07
Quercus robur	3	21	0.07
Salix atrocinera	5	34	0.11
Nonidentified Conifers	4	1	0.09
Trees planted in the framework of the project "100 000 Árvores"	150	0.2	3.30
Total	197	275	4

Table 2: Existent tree species identified to be preserved, number (based on provided data), and their estimated current levels of sequestered carbon (in ton CO₂eq) and annual contribution to carbon sequestration (ton CO₂eq/year).

Considering all these changes, the new tree population of the Park will contribute annually to the sequestration of 16 tons of CO₂eq (Table 2). In turn, the trees to be preserved will contribute annually with the sequestration of 4 tons CO₂eq (Table 1). Thus, the entire tree population is estimated to contribute annually to the sequestration of 20 tons CO₂eq. The new trees to be planted contribute 79% of this value, while 21% is attributed to carbon sequestration by the existing trees marked for preservation.

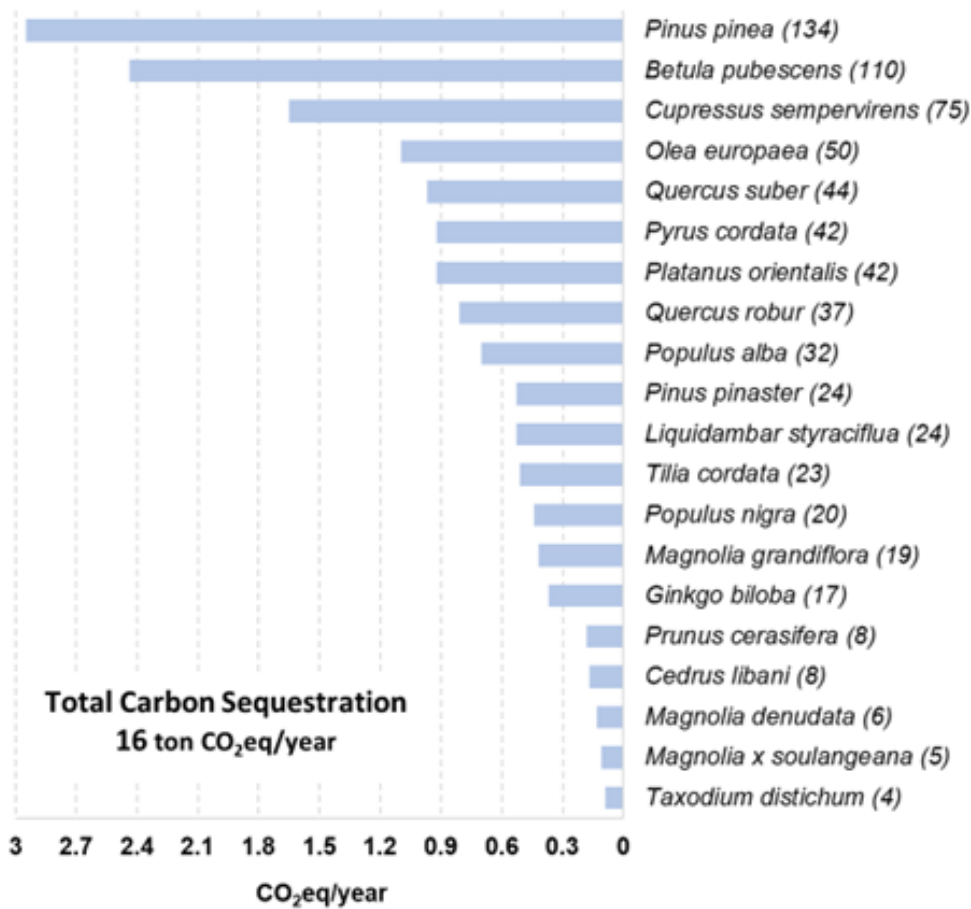


Figure 15: Tree species proposed to be planted, number in brackets (based on provided data) (total of 724 trees), and their estimated annual contribution to carbon sequestration (ton CO₂eq/year)

CONCLUSION

This section contributes to the issue of the influence of urban parks on the carbon neutrality of cities. The annual carbon sequestration potential of the Alameda de Cartes Park due to the trees' biomass is about 20 tons CO₂eq/year, which can contribute to the carbon neutrality aims of the Porto municipality. Besides the annual carbon sequestration due to the trees, soil also contributes to the annual carbon dioxide sequestration of the soil organic matter. However, in the Alameda de Cartes Park, trees constitute the primary natural sequestration mechanism, accounting for about 71% of the park's total annual sequestration potential. Soil contributes about 29% of the total.

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6. NATURE-BASED SOLUTIONS AND THEIR ENVIRONMENTAL IMPACT: THE CASE OF PARQUE DA ALAMEDA DE CARTES

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Maques, Rosendo Silva, Gonçalo Canto Moniz*

Nature-based Solutions (NBS) are increasingly recognised for their potential to address urban environmental challenges, particularly in the context of climate change. These solutions leverage natural processes to provide sustainable and resilient infrastructure. Parque da Alameda de Cartes, located in the easternmost part of Porto within the parish of Campanhã, serves as a pivotal example of NBS and their environmental impact (Figure 16). This park connects three municipal public housing neighbourhoods—Falcão, Cerco do Porto, and Lagarteiro—highlighting its significant role in promoting social and territorial cohesion. The strategic placement of Parque da Alameda de Cartes links residential areas, public facilities, services, and parks, thereby enhancing urban cohesion. Through a network of pedestrian and cycling paths, residents of Campanhã can move along a social, ecological and functional green structure that connects key points of the territory. This chapter explores the park's key NBS components and their environmental impacts, offering insights into sustainable urban development practices.

SLOPE STABILISATION AND NATIVE URBAN FOREST

In the steeper areas of Parque da Alameda de Cartes, slope stabilisation is achieved primarily through the use of native plants. Autogenous vegetation is strategically planted to reinforce soil structure and prevent

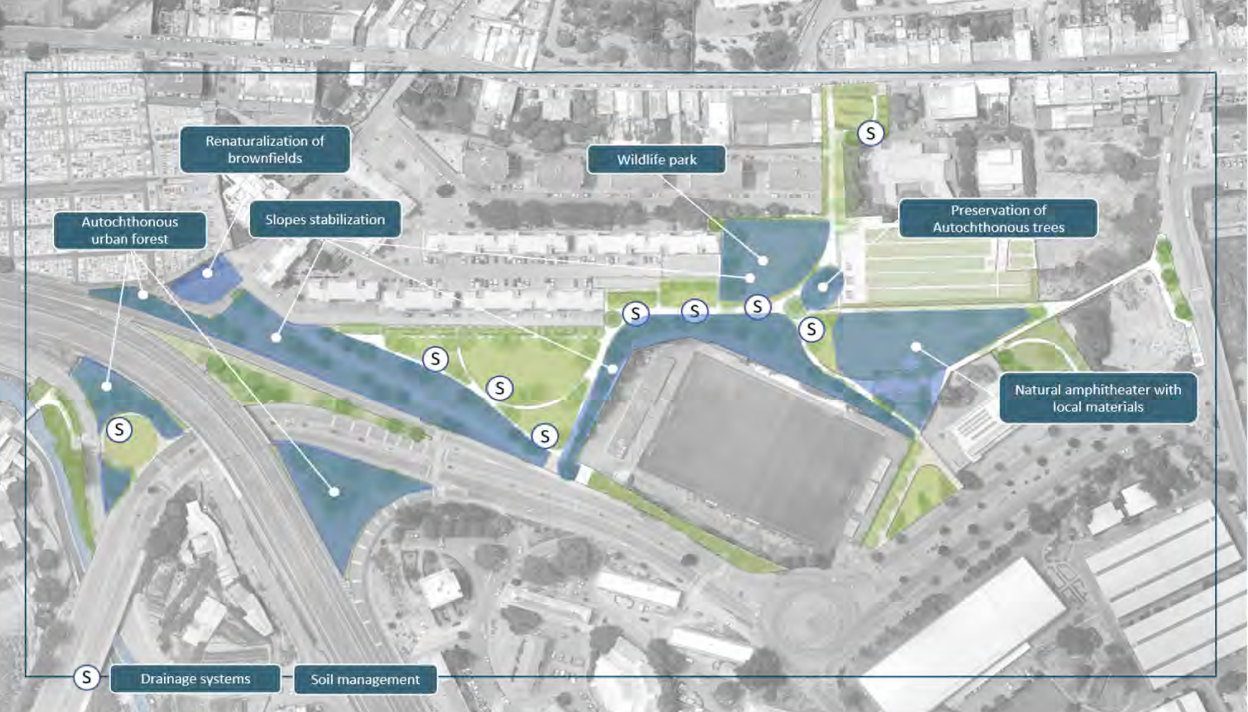


Figure 16 : Masterplan of Parque da Alameda de Cartes, highlighting examples of implemented NBS.

erosion. This approach not only stabilises the slopes but also contributes to the park’s biodiversity, creating a resilient and self-sustaining urban forest. By prioritising native species, the park enhances local ecosystems and provides habitat for indigenous wildlife. The steep slopes were reprofiled and softened to increase the structural stability (Figure 17). This strategy aligns with the park’s broader goals of improving safety and meeting the needs of its residents, while also mitigating visual, sensory, and environmental impacts from major infrastructures, such as the soccer stadium.

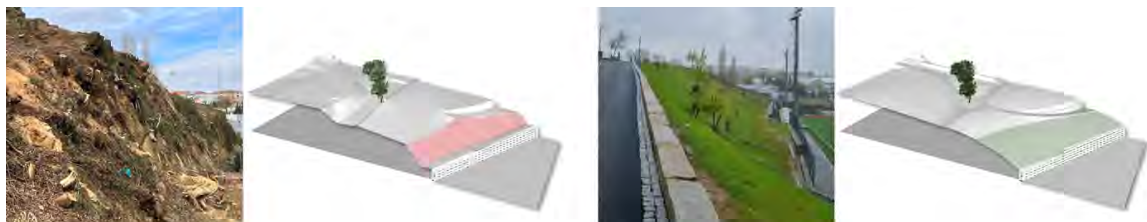


Figure 17 : Slope stabilisation through slope attenuation and planting of autochthonous plants (left before, right after).

NATURAL DRAINAGE SYSTEMS: STORMWATER INFILTRATION, RETENTION, AND MANAGEMENT

Porto faces increasing challenges from climate change, including more frequent and intense rainfall. As a pilot project, Parque da Alameda de Cartes demonstrates innovative stormwater management by ensuring 100% on-site infiltration and retention (Figure 18). The park employs a series of sustainable drainage systems, including water retention basins and permeable surfaces composed of crushed rocks of different sizes. These features guide stormwater from both paved and non-paved areas into retention zones, facilitating groundwater recharge. This method not only mitigates flood risks but also enhances the local aquifer, contributing to the region's climate resilience. The recharged aquifer supports tree growth and evapotranspiration, improving thermal comfort and local climate conditions. This sustainable water management practice is crucial for the climate resilience of Porto, ensuring a healthier aquifer that contributes to local climate regulation and thermal comfort.



Figure 18: Stormwater management and infiltration NBS's (the system has already been tested during heavy rains, lower centre and right images).

MAINTENANCE AND BIODIVERSITY

The park covers four hectares, with diverse management practices to promote urban biodiversity. Three hectares consist of dry meadows, which are mowed 3-4 times a year, enhancing biodiversity and requiring minimal

water. These meadows are located on steeper, less trafficked areas. The remaining hectare includes irrigated meadows in high-use zones, which, while water-efficient, are designed to withstand prolonged droughts if irrigation is reduced due to climate change. The low-maintenance approach involves periodic mowing, reducing resource consumption. Approximately 1,000 new plants, including trees and shrubs, are planted in clusters to maximise ecological benefits and resilience (Figure 19). This clustering approach amplifies the systemic effect, offering greater ecological benefits than planting the same number of plants individually or in single-species alignments.



Figure 19 : All existing non invasive trees have been protected during construction. Planting design strategies for climate resilience and urban biodiversity through the use of multispecies clusters.

RENATURALISATION OF IMPERMEABLE SPACES

In several areas of the park, previously paved surfaces have been removed and replaced with permeable, green spaces (Figure 20). This renaturalisation strategy, inspired by successful implementations in cities like Paris, improves thermal comfort by reducing heat-reflective surfaces. It also enhances stormwater infiltration and supports urban biodiversity, making the environment more pleasant and sustainable. By removing paved surfaces, the park reduces temperature increases caused by reflective materials, thereby enhancing the overall thermal comfort and ecological health of the area.

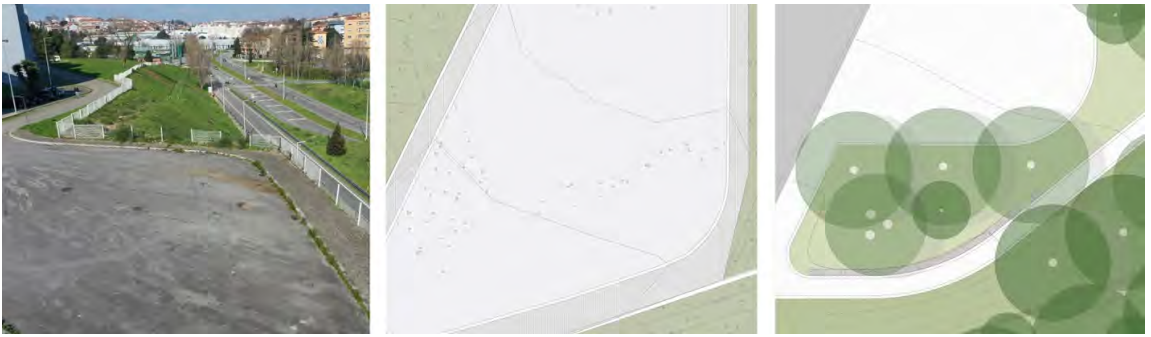


Figure 20 : Depaving of large asphalt areas.

EARTHWORKS AND SOIL MANAGEMENT DURING CONSTRUCTION

The landscape design of Parque da Alameda de Cartes prioritised sustainable earthworks and soil management. No soil or earth was imported or exported, ensuring on-site material reuse (Figure 21). Excavated soil was repurposed within the construction site, maintaining ecological balance. During construction, 20 cm of topsoil was carefully removed, stored, and covered with nitrogen-fixing plants to preserve fertility. Post-construction, this enriched soil was redistributed, supporting healthy plant growth without the need for additional external resources (Figure 22). This sustainable approach minimised environmental impact and promoted long-term soil health. By storing the fertile soil in 1-meter-high storage areas and planting nitrogen-fixing species, the project ensured the soil remained nutrient-rich and ready for redistribution across the park.



Figure 21: even though construction will move 10.000 cu.m of soil, in the end there is earthwork balance. Earth grading is required for slope stabilisation, creating conditions for human use, designing for water retention and infiltration, creating areas for active recreation. In red cut areas, in blue fill areas.

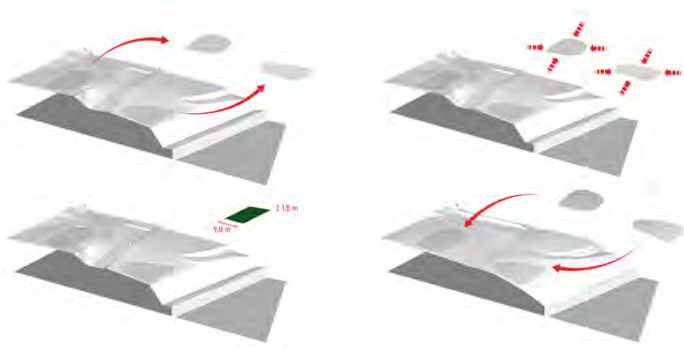


Figure 22: Removal and preservation of topsoil (20cm), and latter redistribution on graded areas, after earthworks.

WILDLIFE GARDEN

The park’s wild garden integrates diverse plantings, including meadows, shrubs, and biodiversity-enhancing trees, to create a rich urban ecosystem (Figure 23). Careful selection of climate-resilient species and habitat design promotes urban biodiversity. Additionally, invasive exotic species, such as acacia trees, were removed to support native flora and fauna. This holistic approach to planting enhances ecological resilience and creates a

vibrant, sustainable urban landscape. The wild garden not only increases biodiversity but also provides a resilient green space capable of enduring climate change impacts.

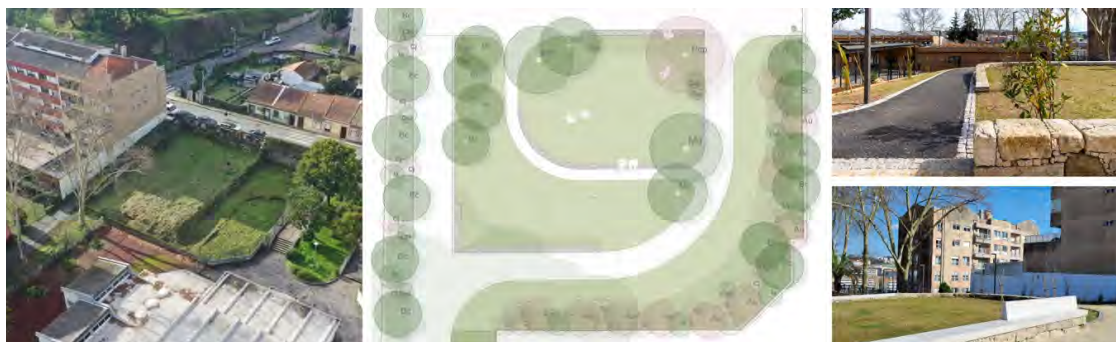


Figure 23: Wildlife promotion garden, near Falcão school . Project started through participatory design, it represents the opportunity for an open-air classroom for the school, on environmental education.

CONCLUSION

Overall, Parque da Alameda de Cartes exemplifies the integration of Nature-based Solutions within an urban context, significantly enhancing environmental quality and social cohesion. By prioritising biodiversity, sustainable water management, and soil fertility, the park contributes to the creation of healthy corridors and improves the urban biophysical environment. This project underscores the potential of green spaces to foster ecological resilience and provide multifaceted benefits to urban communities, making it an ideal case study for understanding the impact of Nature-based Solutions on urban environments.

7. LESSONS LEARNED AND RECOMMENDATIONS

Assessing the state and quality of the biophysical environment is an essential stage, before the implementation of NBS, and even more before those of a healthy corridor, as assuring connectivity between the various sub-areas is crucial. Local authorities are aware of this major interest, and are helped in this by certain regulations that generally precede major works programmes. As part of URBiNAT, the diagnosis based on existing data at city level and the additional environmental studies carried out have made it possible, for example, to validate the potential use and cultural value of warm groundwater in Sofia, to highlight the major asset of the large vegetated areas in Nantes Nord, or to work with the natural hydrographic network in the study area of Porto to propose a new storm-water management system improving biodiversity.

Of course, carrying out in-depth analyses of all the compartments of the urban environment is costly, and it is often necessary to prioritise according to the issues at stake and the ecosystem services expected.

However, because of the interactions between the various environmental compartments, a systemic approach is recommended, at least in a pre-diagnosis, in order to highlight the interrelationships, for example between the type of vegetation and access to water resources, and to work on the scale of the healthy corridor. This makes it possible to take a more detailed approach, that of the NBS, and to refine the diagnosis in order to 'size' the relevant solutions, for example implementation of a vegetable garden following a historical documentary analysis of the site and soil analyses.

In relation to the various issues addressed in this chapter: thermal comfort, food production, stormwater management and carbon storage, in addition to the general considerations above, a number of recommendations are made concerning the ecosystem services expected by biophysical environment:

- Hydroclimatic services: the link between plant density and UHI is highlighted, in relation to human comfort. In terms of diagnosis, the pedestrian or street scale is relevant for calculating the Universal Thermal Climate Index or other climatic index. However, this requires access to small-scale observation data. A combination of solutions is recommended: grey solutions (acting on materials), blue solutions (managing and re-using rainwater), green solutions (vegetation implementation). But a major challenge is currently the competition for water use as regards the scarcity of water.
- Stormwater management: Nature-based Solutions (NBS) play a growing role in urban planning, also as run-off source control solutions. Most of them are vegetated and promote infiltration and evapotranspiration to prevent run-off and control pollutant wash-out from the impervious surfaces. Additional benefits are urban noise reduction, biodiversity restoration, Urban Heat Island reduction and landscape enhancement. The hydrological and pollution treatment performances of NBS were proved to be better than other solutions, such as storage of water in tanks or constructed basins. The recommendation is then to consider preferentially the stormwater management by NBS, taking advantage of the co-benefits of the systems.
- Food provisioning: even if they are necessary for assuring food quality and safe land-use, data on urban soils (typology and properties) are rarely available for practitioners, except in some cities such as Paris or Berlin. Moreover due to the various historical land-use, the urban soils suffer from a small to large-scale heterogeneity. Therefore in case of urban gardening or farming projects, the main recommendation is to sample soils for physical and chemical analyses. Standards for fertility and background geochemical data will help to analyse the results. Hazardous organic chemicals should be avoided.
- Tree carbon storage: the most efficient and sustainable systems for carbon dioxide sequestration on Earth are the trees in forests or perennial crops. Trees also provide hydroclimatic services and offer support for biodiversity, among others. Planting trees is nowadays very popular in communities and practitioners. In this domain the recommendation could then be to optimise the choice of tree species, in regard to the soil properties and physiological needs, especially water. Practitioners should be aware of the scarcity and variability of water resources due to climate change.

Understanding the strengths and weaknesses of our urban environments, and being aware of the existing interactions between soil, water, vegetation and microclimate are some of the elements that will ensure the success of NBS.

It is also important to be able to capitalise on experience and monitor the development of healthy corridors. In this sense, the development of urban environmental observatories is to be encouraged to contribute to improve the quality of urban life.

CHAPTER 3.

CO-CREATION IN URBINAT: APPROACHES, PRACTICES & GUIDELINES

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*Keywords: Co-creation of NBS; Co-governance;
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1. INTRODUCTION: OVERALL CO-CREATION APPROACH IN URBINAT

Chapter 3 is structured to gather an overview of the main components that entail the co-creation process of NBS throughout the lifespan of URBiNAT. As argued in section 1.1, there is no universal formula for urban regeneration. The specific combination of biophysical and infrastructural aspects of each territory and social and cultural features of its communities compose different realities. Therefore, chapter 3 is dedicated to present the main strategies, approaches and methodologies used in URBiNAT, always informed by local participatory culture, organisational contexts of local partners and tailored within community-driven processes.

The authors roam the pathway of the participatory process in its different stages, connecting it with the main concepts, approaches and methodologies that resulted from the collaborative work between a large and diverse range of partners. The implementation of the co-creation process is summarised regarding the main approaches, practices and lessons learned among the different partners and cities. The chapter, summarised in table 1, systematises the participatory methods adopted and analyses their application, gathering evidence resulting from the work conducted regarding the co-creation process of NBS in URBiNAT' cities.

The introduction section includes a summarised explanation on what co-creation approaches consist of, establishing a link between participation, co-creation and co-governance (section 1.1). Following this section a brief explanation on the co-creation stages (section 1.2) and what are the actors and citizen segments for co-creation (1.3) are presented. The implementation of the co-creation process is summarised regarding the relation between participatory approaches and creation of different typologies of NBS (2.). In section 3, the co-creation methods are presented according to the main co-creation stages. Guidelines for co-creation to



Kick-off public event in Høje-Taastrup

Picture by Knud Erik Hilding-Hamann



Kick-off public event in Porto
Picture by Carlos Barradas



Kick-off public event in Sofia
Picture by UACEG



Greeters walk in Nantes during URBiNAT's consortium meeting in July 2019

Source: URBiNAT

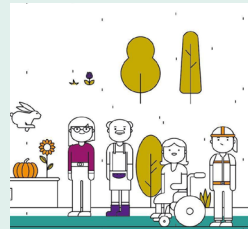


URBiNAT workshop in Khorramabad: training sessions about local diagnostic, co-creation process and NBS catalogue

Source: URBiNAT



Kick-off event in schools in Porto
Picture by Carlos Barradas



[URBiNAT video animation](#)
Credits: URBiNAT/GUDA



Workshop in Sofia during URBiNAT's consortium meeting in January 2029

Source: URBiNAT



Designing the children's city in Siena

Source: Siena



Workshop on inclusive and participatory design of public space in Brussels (27th Sep. 2022)

Picture by Nathalie Nunes



URBiNAT activity with children in the framework of Nova Gorica's "Playful Architecture" programme (2022)

Source: Nova Gorica



Mobil'O Bus (mobile living lab)

Source: Nantes Métropole

Objectives	Sections	Topics
Summary of the main elements and approaches that structure the design-of the co-creation process	1. Introduction: Overall co - creation approach in URBiNAT	Approaches Stages Actors
Articulation/integration/interface between participatory processes with the other NBS (territorial, technological, social, and solidarity economy)	2. Practices and approaches to participation by NBS typology	Practices and approaches NBS catalogue
Methodologies and techniques in the participatory process: assessment on the methods of participatory solutions by co-creation stage	3. The co-creation methods and stages	Results Assessment
Guidance for more sustainable, fair and democratic NBS	4. Using cross-cutting dimensions and categories of citizen engagement guidelines for inclusive NBS co-creation	Guidelines
Participatory process models associated with the NBS implementation	5. Co-creation models in URBiNAT: role for the NBS implementation	Cases/examples Porto, Nantes, Sofia

Table 1: Objectives, sections and topics of chapter 3. Source: Author's own elaboration.

support more sustainable, fair and democratic NBS are presented in section 4.; section 5 entails an overview of the main participatory models, including living labs, municipal roadmap and digital enablers, and their role in the implementation of NBS.

1.1 THE CO-CREATION APPROACHES

Isabel Ferreira and Joana Santos

Since its inception, URBiNAT intended to design the co-creation of healthy corridors with a broader focus on the process, putting citizens as the main beneficiaries not only of the physical public space and its NBS but simultaneously as the mentors of its co-design, according to their aspirations, agendas, interests and needs. For doing so, significant efforts have been dedicated to map and analyse the culture of participation in each intervention area of the URBiNAT cities. From there, it was possible to understand and set realistic and extensively achievable goals in terms of introducing innovations in the participatory processes towards more collaborative approaches to create and produce NBS. Moreover, a municipal roadmap was established to create enabling environments for active

participation in the decision making moments present in many co-creation stages. The roadmap had the main objective of (re)generating a broader awareness of the opportunities, challenges and benefits of collaborative approaches to municipal governance of public space.

The review on several EU-funded projects dedicated to NBS, led by Harriet Bulkeley (2020) questions the efficacy of participation to address inequalities under NBS projects by alerting to four dangers: 1) of reducing it to “working towards consensus and minimising conflict”; 2) that the participatory methods are themselves exploitative by just legitimising solutions that provide little contribution to the needs and ambitions of the communities, 3) entrench or widen social inequality and 4) that crystalised institutional practices limit the envisioned social cohesion effects of NBS. This has emphasised even more the need for reflecting on the needs of tackling the challenges for citizens to really own and exercise their citizenship rights towards public space and city, but also to address the challenges and opportunities that URBiNAT opens to its municipal partners to communicate their agendas, interests and norms of conduct. The combination of the challenges of the different actors in each city guides the need and opportunity to introduce innovations in the urban planning practices within the municipal governance scope.

Therefore, in URBiNAT the approach to regenerating the territory has been sustained in a co-creation process designed to combine diverse solutions, emerging from the grassroots level and the projects living catalogue. This strategy has allowed the integration of social, economic, cultural and ecological dimensions in the planning and implementation of the urban setting, according to the needs and aspirations that emerged in the local Living Labs. This emerging acts out as a starting point for the manifestation of active citizenship and, as the co-creation steps advance, it entails the acknowledgment of urban regeneration as an ongoing process and not an isolated act of intervention in the realm of public space.

While having its own specificities which are distinguishable from planning a new or growing urban area, urban regeneration has no universal formula of implementation. The existence of an overall methodology that guides co-creation is systematically complemented by local governance arrangements, diverse social characteristics and physical features. The approach to participation must occur in a contextualised manner, following a community-driven process.

Living labs	URBiNAT has established Living Labs in each city, acting as the platform and ecosystem that sustains the NBS co-creation by the participating actors (organised and unorganised citizens, public officers, political representatives and researchers). In frontrunner cities, the Living Labs entailed co-design, co-develop, co-implement and test NBS. In follower cities, Living Labs followed the same processes of co-creation and co-development, replicating and adapting NBS to their own urban contexts within an urban plan. The living labs have materialised through many forms of participation in URBiNAT research and activities throughout the co-creation process, namely workshops, focus groups, roundtables, local task forces, interviews, advisory boards, walkthroughs, etc. (See section 5.1)
Living catalogue	The NBS catalogue of URBiNAT combines material and immaterial NBS: territorial, technological, participatory, social and solidarity economy. The initial catalogue gathered a number of solutions brought by URBiNAT partners. These were used to exemplify, inspire and support the co-creation of NBS in each city according to its local reality, needs and ambitions. The catalogue is a living compilation of NBS that has been regularly updated with the solutions created in the living labs. (See section 2)
Municipal roadmap	A municipal roadmap was used as a methodological approach to tackle 1) the need for opening and reinforcing the input channels for proposals resulting from the co-created work; 2) the need for reinforcement of the commitment to co-creation between organised and non-organized citizens, elected politicians, technicians and researchers; and 3) the level of strengthening the institutionalisation of new governance structures that pursue the consolidation of channels of participation within local governance. (See section 5.2)
Advisory boards	Advisory boards or municipal committees gather citizens, municipal decision-makers and researchers in a regular and formal governance structure that is dedicated to making decisions collaboratively. They aim to redirect or leverage the co-creation energy and efforts to institutional changes and allow the consolidation of citizen engagement channels. The main goal for its establishment in some URBiNAT cities (Porto and Sofia; Nantes used an already established committee) was to consolidate citizen engagement in the process of co-creating NBS, by offering opportunities for: opportunities for direct interaction between citizens, researchers, public authorities and elected representatives, possibilities to influence, discuss and negotiate decisions. (See section 5.2)
Digital enablers	Digital enablers have the potential to reach a greater number of citizens/users over a shorter period of time than is the case for other traditional means to promote participation. The proliferation of diverse communication channels, such as the Internet, cellular technology, social media, etc., blends with digital convergence in underpinning growing network effects. The greater the number of people who are interconnected and the lower the costs of access, processing, and diffusion, the greater the potential for widespread reach and inclusion. (D3.3, 2020). Digital enablers in URBiNAT include “My edible neighbourhood”, “circular cities” café; “superbarrio”; Campanh’up. (See section 5.3)

Table 2 - Main co-creation and co-governance approaches in URBiNAT.
Source: Author's own elaboration.

Co-creation entails the ambition of a collective initiative to create NBS by different typology of actors (organised and unorganised citizens, researchers, public officers and political representatives). Rooted in the concept of participation, it distinguishes from other forms of participation for high intensity levels of engagement both in operational and strategic components of NBS. It reflects a continuous effort of dialogue to integrate different needs, ambitions and social specificities of the beneficiary communities, throughout the cycle of stages for co-diagnostic, co-design, co-implementation and co-evaluation of NBS. Other projects add to these four stages some key features of NBS co-creation, including upscaling, co-scaling, replication or co-amplification stages (European Commission, 2023). Some projects also consider co-governance as a co-creation stage, but in URBiNAT the collaborative governance approach has been addressed as a transversal component crossing all the stages of co-creation. Collaborative approaches to governance have taken shape mainly through local task forces (researchers/technicians), workshops (researchers/technicians but also (researchers/technicians/citizens), roundtables and advisory boards (organised and unorganised citizens/public officers/political representatives/ researchers).

Even with different intensities, the opportunities for cooperation, collaboration and co-production distinguish co-creation from other forms of producing or creating solutions for urban regeneration. Living labs, living catalogue, municipal roadmap, advisory boards and digital enablers are the main approaches that compose the co-creation approaches in URBiNAT. While differing in intensity of investment, commitment and innovativeness in each city, these concepts take an overall common shape in all the URBiNAT cities, as detailed in Table 2.

1.2 THE CO-CREATION STAGES

Isabel Ferreira

The typification of stages used in URBiNAT served the purpose of unfolding the overall co-creation process in the main sequential phases that usually compose the cycle of NBS creation and through which URBiNAT has organised its research and activities. From the perspective of an urban planning action that aims to re-design the public space of the URBiNAT' intervention areas, or material regeneration, the stages mirror the main

phases of the development cycle of urban public policies and instruments: diagnostic, design, implementation and evaluation. From the perspective of an urban planning process that aims to revitalise the liveability of public space in those areas, or immaterial regeneration, the stages mirror an on-going process that sustains the emergence and maturation of competencies in terms of the participant’s abilities to engage in collective initiatives.

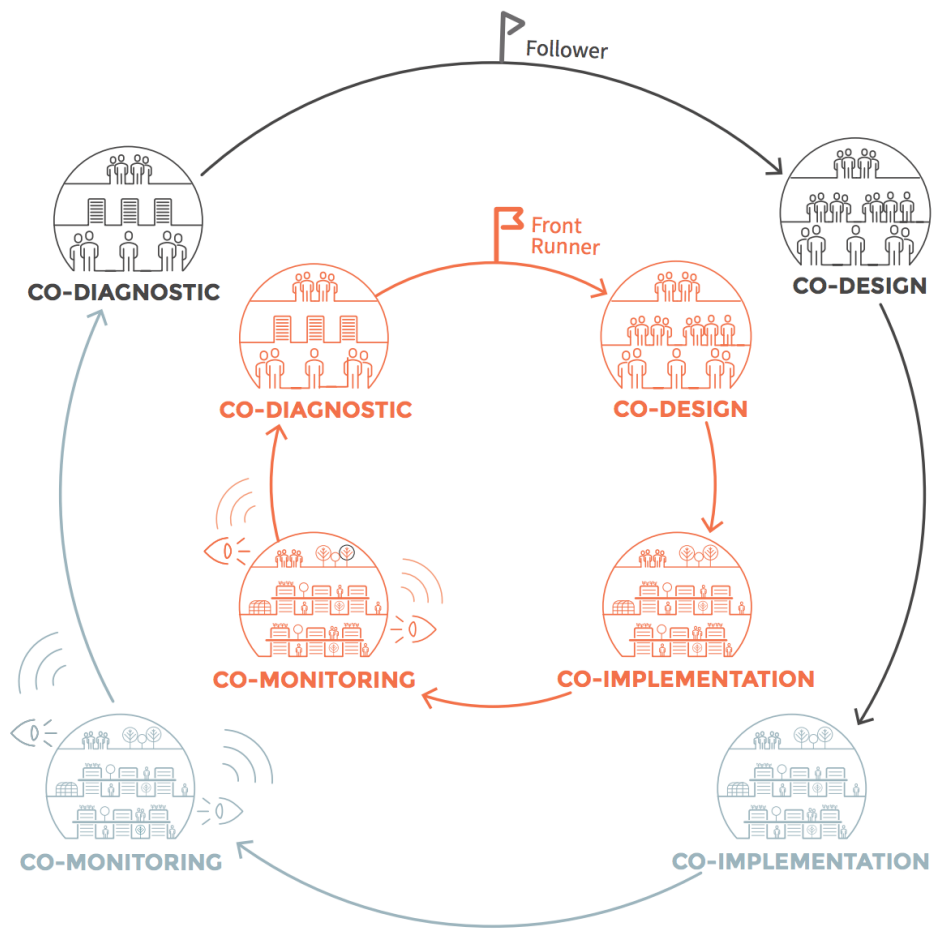


Figure 1: Co-creation Stages in URBiNAT.
Source: URBiNAT/GUDA.

This typification of the co-creation stages is not exempt from the simplification of urban planning and governmental processes, which are very complex and contingent and that can hardly be simplified in a linear way (Howlett and Giest, 2015). This is the case of the omission of the deci-

sion-making phase considered in environmental planning, strategic planning or public policy cycles. Its exclusion is based on the consideration that decision-making is likely to take place at any of the stages of development of municipal governance instruments. Thus, in general, this typification composes models of representation and analysis of a more complex reality (Ferreira, 2022).

The co-diagnostic includes the definition of objectives and the inventory and analysis of the existing situation regarding the material component of the territory (Ferilli, 2019; Ferilli, 2021), and the immaterial component of the territory, or social, economic and cultural aspects of it. For the latter, the co-diagnostic stage entailed the identification of needs, ambitions, visions and conflicts for implementing co-created NBS (Ferreira, 2022). Citizen and other actors participation at this stage contributed to the degree to which the instruments and solutions were able to map and integrate needs, ambitions, visions, solutions and knowledge beyond those identified by local actors and/or municipal actors (Mahmoud & Morello, 2021; Ferreira, 2022). The mapping of local participatory culture was the approach used by URBiNAT to comprehensively map relevant initiatives, interactions, practices and norms that constitute the participatory culture in each URBiNAT city (Ferreira et al, 2022).

The co-diagnostic corresponds to the definition of the political agenda in the public policy formulation cycle (Howlett and Giest, 2015), when defining the problem and designing a set of solutions. Other authors consider the initiative to the process to be more complex in nature, and the identification of problems or priorities of intervention can be initiated by different actors, including civil servants and citizens, or emerge from new scientific evidence (Peters & Pierre, 2018).

The co-design is a creative phase, the one that most often includes participatory processes and corresponds to the stage in which the solutions take shape in terms of its specific design features considering goals, functionalities and beneficiaries. It entailed ideation activities led by citizens and other actors that collaboratively designed the features of NBS, considering goals, functionalities and beneficiaries. It was supported by detailed technical studies and greater or lesser contributions from the actors and, in some cases, included the development of alternative scenarios. It is assumed that it is a phase that requires a holistic view of the problems or and intervention needs (Amaro, 2009), the clarification of its

rationale and forms of evaluation (Pérez Serrano, 2016) and the collaborative design of urban regeneration interventions - NBS (Morello et.al, 2018).

It presupposes “interdisciplinary contributions (engineering, ecology, local history, transport planning, architecture, etc.) as well as consultation and negotiation at different administrative levels and between different actors” (European Council, 2011: 8). Correspondence with the public policy formulation cycle is made with the policy formulation phase, in the sense of developing concrete options and discarding options that are not viable. In terms of the participatory process, it is the phase in which the various actors make efforts to favour their preferred solutions (Howlett and Giest, 2015).

Co-implementation refers to the phase that follows the approval of the solutions as defined in the co-design phase. In this phase, tools, activities and procedures are developed in detail and implemented, built or operationalized. It can also take the form of the production of public goods and services (Ferreira, 2022). It corresponds to the fourth phase of the public policy cycle, the one in which governments put their decisions into action (Howlett and Giest, 2015). The co-implementation can eventually be leveraged to collaborative arrangements towards the co-production of NBS, including collective efforts for deploying and maintaining actions (Morello et.al, 2018). A very good example of these collective efforts took place in Oporto where participants from some working groups were highly reflexive and proactive in planning the implementation and deploying the solutions.

The co-evaluation entails the process of systematically measuring, with the participating actors, the value, effectivity, efficiency, relevance and coherence of the co-creation process. The evaluation stage includes the monitoring and evaluation processes of local co-created NBS and their governance instruments, closing the cycle of their development and possibly leading to new phases in a process of continuous review, adaptation and adjustment. In the strategic planning approach, it corresponds to the set of indicators that allow monitoring the effects of the implementation of governance instruments. It also corresponds to the fifth phase of the public policy cycle, in which policy results are monitored, which may lead to the reconceptualization of political problems and solutions (Howlett and Giest, 2015). Evaluation is also considered a fundamental assumption for government transparency (Sintomer et al, 2011) and for improving future actions (Pérez Serrano, 2016).

1.3 PARTICIPATING ACTORS AND CITIZEN SEGMENTS FOR CO-CREATION

Knud Erik Hilding-Hamann

URBiNAT's local ecosystems are made up of the following participating actors:

- *Citizens* (as community members and inhabitants, as owners of property or as tenants, as sources of interests, knowledge, insights and skills, as having special needs in terms of social, economic or cultural advantages or limitations, as NBS active or passive users and with various levels of engagement and roles in society and the local community.
- *Public organisations* (government bodies, municipalities, social housing etc. as funders of NBS, as regulators, as technical resource and as governing bodies on Urban planning)
- *Voluntary, Non-Governmental Organisations*, associations and informal social organisations (as communication channels for specific NBS related interests, access points to engagement of citizens and as key hosts and enablers of co-creation processes)
- *Social Enterprises* (with the purpose of helping citizens in need, as developers of NBS, as access points to citizen engagement and hosts of co-creation processes).
- *Businesses* (both as developers, technical resource and funders of NBS, with variable local social and environmental commitments and as potential beneficiaries of NBS)

Concerning citizens we emphasise the need to engage in an inclusive and diverse way. This means engaging in a non-discriminatory way in relation to people's time and availability, mobility, geography, language, culture, skills, knowledge, age, gender, status (economic, owners/tenants, in job, out of job, in education) and network. In the engagement, citizens may take on different roles during co-creation activities, such as an interacting role, group-oriented role, task-oriented role or a production oriented role (Barcellini, Prost & Cerf 2015).

The interacting role covers participation in discussions in meetings and workshops and interacting via digital platforms as well as taking initiative in opening and closing remarks. The group-oriented role concerns the co-ordination of others in groups (facilitation), participation in decision-making processes and offering support to other participants. The task-oriented role involves the transfer of knowledge from users and other participants to the design process; act as subject experts contributing with specific input to the process. Finally, the production role involves actually producing designs, prototypes and installations whether immaterial or material that can be tested, viewed, discussed and examined and evaluated.

Facilitators in the URBiNAT city projects have included employees at the municipalities, teachers and researchers with facilitation skills as well as champions among citizens with a keen interest in specific NBS or with personal goals for the improvement of lives of specific target groups through the realisation of the healthy corridor.

The facilitations in URBiNAT have been aimed at inspiring and empowering citizens to take on several roles and continue their involvement during the evolution of the NBS projects. We have found it important to recognise as a baseline that citizens' local and cultural insights are vital for the local integration of NBS in well-functioning health corridors. The group-, task-, and production-oriented roles will often require certain skills and competences and therefore also the individual confidence and motivation to apply such skills and competences.

Public organisations face strong incentives to co-create NBS and healthy corridors as it may help to solve social, environmental, health and economic problems. At the same time, public authorities represent a number of departmental “silos” all working on the topics in isolation and from different goal perspectives. In URBiNAT, developments have centred around generating consensus across public departments in relation to main objectives of NBS co-creation. In certain situations, this leads to public-private partnerships of two or more actors jointly co-developing and maintaining Nature based solutions with citizen engagement at the core of the process. It is vital, however, that the engagement is driven by motivation and common belief in the purposes behind the nature based solutions to be developed. This can be difficult to achieve especially when engaging both private and public actors and within public authorities different public departments with specific interests in the social, environmental, economic or other domains (Pestoff, 2012).

Voluntary organisations and associations are often operating with the specific purpose of enhancing and promoting nature based solutions. Others have a specific purpose of offering members or the local community healthy leisure (e.g. sports) activity options or services that enable citizens of different categories to lead a better life. As such these organisations are important or even essential partners for the engagement and grounding of NBS co-creation projects. To get the full attention and commitment of these organisations, there has to be a strong link between their interest/purpose and those of the NBS and the healthy corridor project.

Social enterprises are businesses that put the interests of people, nature and the environment ahead of shareholder gain (do not generate a profit for owners). Often they will generate revenue to serve a cause which could be to offer people with special needs a place to work and train, a way of enhancing nature with the help of volunteers while generating enough revenue to support the continuation of the activity. Social enterprises therefore may also be a strong player in an NBS project and its long term sustainability.

Private businesses increasingly commit themselves to social and environmental goals including investing in the continuous enhancement of the living environments in the local community through donations, projects and events. Private and social enterprises will often have strong resources (e.g. employees with NBS relevant skills) and private businesses or entrepreneurs may own property and facilities that are important for the development of a healthy corridor. As such, private businesses are also important actors for the co-creation of NBS and healthy corridors. For some of these businesses, the success of the healthy corridor may also be reflected directly in an increase in their revenue.

There are certain fundamentals to address when engaging stakeholders and citizens to empower participation and co-creation. This include:

- Emphasising the need for a mix of skills and resources across the participating organisations and citizens to allow for co-creation. The skills needed are exemplified in five personas: ideator, optimizer, analyser, visualizer and influencer skills. These will allow teams or groups to generate ideas, optimise or improve the ideas through additional knowledge and input, analyse the potential socio-economic impact, visualise the ideas, make them tangible and prepare the ideas for communication and finally influence others to try out the idea and invest further resources in the ideas;

- Creating alliances between stakeholders or even citizens groups that jointly can relate to a common vision – this would require both a strong demand from citizens and other users and a likely strong supply fraction that are willing to work together to deliver the NBS and subsequent healthy corridor;
- Ascertaining how additional activities through new alliances and sustainable business models may be set in motion to further strengthen the drive towards maximised quality of life for the communities to be using the healthy corridor;
- Identifying and activating new alliance partners to expand and scale-up the activities and benefits to local populations including those with less resources or who are less obvious as potential beneficiaries.

For facilitators to address the above fundamentals, they need to identify and involve the specific insights, skills and competences of participants to ensure inclusive processes, motivating roles and contributions from all to the NBS project (Lucas dos Santos, 2018, D1.2). The facilitators may also, through stakeholders or champions, reach out to and bring on board certain people that can bring valuable insights or skills, but up until then have not yet contributed. Within the URBINAT project at city level this was carried out during the stakeholder and behavioural mapping and continuously through the task forces as new elements of the municipal NBS projects were initiated to widen participation and fill holes in the insights required and the skills and competences needed .

The facilitators should also look for opportunities to create largely self-managed sub- or side-projects by bringing together relevant stakeholders and citizens to sustain inclusive momentum for the bigger NBS project, expand value-adding participation and build empowerment among the NBS project participants. Within the URBiNAT project this has largely been done through the key hubs engaged and via locally developed strategies, applying codes of conduct and by engaging local champions/ambassadors that were running related activities and had connections to relevant citizens groups through which they were able to run such activities as part of the larger NBS project (Nunes et al., 2019). It has led to a wide participation of different groups of citizens and stakeholders in a range of activities although it has been a challenge to retain the same people in participation over the whole period of NBS and healthy corridor development.

2. PRACTICES AND APPROACHES TO PARTICIPATION BY NBS TYPOLOGY

In URBiNAT, urban regeneration is focused on the co-creation of nature-based solutions (NBS) with the local communities in living labs. The collaborative process of developing solutions for the public space challenges expands the “traditional” NBS into human-centred ones. In this sense, URBiNAT proposed a NBS catalogue to inspire the co-creation process organised in four categories: Territorial NBS and Technological NBS, as material solutions; Participatory NBS and Social and Solidarity Economy NBS, as immaterial solutions. The aim is to co-create clusters of NBS that complement each other and together constitute a healthy corridor, as explained in chapter 1 on Inclusive Public Space. Nevertheless, each one of the NBS categories has specific co-creation guidelines and challenges that will be developed in the following sub-chapters.

2.1 CO-CREATING PARTICIPATORY NBS

Isabel Ferreira and Joana Santos

The central objective of URBiNAT to increase the participation of citizens and local actors in the design of solutions for urban regeneration is rooted in two main assumptions. The first one is related with the ambition to generate enabling environments for co-creating fair, inclusive and nature based solutions, accommodating different knowledges and understandings of what are solutions based, inspired and respectful of nature and nature ecosystems. The second one is related with the participatory feature that is present in many interactions among nature’s beings that define co-operation actions from which nature ecosystems benefit (Pennis, 2005). The interactions and collective efforts among species inspired URBiNAT to root participation as a NBS per se, and inspired the approach to citizens engagement also as a co-creation process to be crafted with all the actors involved.

The deep understanding of regeneration approaches and impacts calls for new understandings of what is the role of citizens and of nature in urban contexts. For citizens and natural ecosystems to take part in the regeneration processes, it requires mapping, experimenting and investing on initiatives that bring on board more plural perspectives on how a solution can simultaneously be nature based, but also contribute to fair ecological, social and economic transition towards inclusive public spaces. This perspective is being extensively developed in TRANS-lighthouses project, building upon the pathway of URBiNAT to reposition participation as a natural solution to produce urban regeneration, complementing the cultural components that underpin different participatory and governance cultures.

The importance of participation is related to the notion that it is an act that takes part of community life. It is a common strategy of survival and co-existence among many species. The separation of human and non-human is an artificial construct which tends to frame participation as an exclusive human behaviour, but it is in fact a behaviour adopted by many species to improve their performance in what concerns daily matters: “cooperation is omnipresent in human society, and in nature in general” (Pennisi, 2005). Furthermore, the inclusion of specificities related to human diversity in the co-creation process also represents a common strategy used by species and ecosystems to improve cooperation: “diversity deserves to be considered as a fundamental mechanism towards the emergence of cooperative behaviour” (Van Segbroeck et al, 2010). Given these ideas and notions, URBiNAT has adopted participatory methodologies as solutions that are nature based, therefore putting forward the institutionalisation of participation or co-creation, as a fundamental element in sustaining the NBS lifecycle.

Based on those assumptions, URBiNAT cities have co-created tailored community driven processes. The methodologies adopted by different partners (in frontrunner cities as well as follower cities) have the underlying intention of involving different actors (see section 1.3) with various functions and responsibilities when it comes to public space. Given that participation is conceptualised as a Pillar of NBS in its own right (being both a means and an end), it is conceptualised as being a fundamental aspect in the emergence and implementation of NBS. It reinforces and converges with the SDGs, namely in the concretization of sustainable cities and communities as well supporting the emergence of processes associated with peace, (social) justice and strong (democratic) institutions. The methodologies adopted by different partners (in frontrunner cities as

well as follower cities) have the underlying intention of involving different stakeholders (public, private and civic) with various functions and responsibilities when it comes to public space. This approach to the diagnosing, designing, implementing and monitoring the co-creation process has been introduced by URBiNAT as a means to promote equity and diminishing barriers related to hierarchical dispositions in the decision-making process. Its use and appropriation

Promoting a trustworthy and respectful interaction among the different social actors involved in the co-creative process implies the recognition of existing power relations that underpin matters related to decision-making and governance in the process of deliberating and implementing solutions related to the sustainability of public space in the short and long term. Participation in terms of implications regarding governance and decision-making processes is related to the fact that it constitutes an arena that facilitates the creation of new political subjectivities by involving a particular set of actors in collaborative problem-solving (Cornwall et. al, 2007). Assuming participation as a pillar of NBS opens way to polycentric forms of governance that break with classical forms of hierarchical and market governance (Ostrom, 1990). It leads to a (re)conceptualization of collective action (subjectivities in political matters) and modes of governance in: a) structural terms (authority, policies, regulations, rules, plans); b) in terms of human resources (relation between people and organisations); c) in political terms (the exercise of power; coalitions, negotiation, conflict) and last but not least d) in symbolic terms (beliefs, meanings, organisational culture, myths, ceremonies).

URBiNAT approached the production of NBS as a process sustained on a combination of actions that encourage and benefit from co-creation, collaboration and co-operation among nature systems and beings (human and non human). Citizens with diverse backgrounds are invited to be at the centre of a co-creation process with researchers, technicians and politicians and to guide the design of nature and human based solutions that better fit the environmental and social experience of their community and the livelihood of public space.

Returning to the initial idea of the artificial nature of the separation between human and non-human beings, reinforces the notion that nature-based solutions are solutions also composed by human nature. This idea inevitably involves participation in various affairs which is constitutive of the livelihood undertaken on a daily basis by different members of society. When reflecting upon the act of participation on behalf of people, it is

important to recognize that participation is a core element when it comes to the intersections established between family, organisations and the overall collective realms of lived reality (Ferreira, 2022). Therefore participation is a natural strategy employed in processes of interaction that creates bridges in what regards the private and public spheres of action, thus reflecting the liveability of public space. In URBiNAT, the attempt to approach public space through the lenses of the social dimension of the territory as well as its ecological dimension, enhances participation as the key element in re-acknowledging the existing relationship between humans and nature.

An aspect to be highlighted is related to the notion of co-existence of perspectives and different systems of thought and action in a specific territory, which enriches the process of co-creation, given that it implies a reflexive exercise of co-identifying past, present and (possible) future solutions for a given challenge or situation. This can be seen as an adaptation from Santos perspective on “alternative thinking of alternatives”, based on a plurality of knowledge and inter-knowledge, also called ecology of knowledge (Santos, 2020). Participatory NBS is therefore a typology that aims to design, in each neighbourhood and city context, the best possible solutions and combination of solutions, as a means to instigate co-operation and collaboration among many different social actors and with a plurality of voices, needs and aspirations. Thus, it opens the possibility of the emergence of a process of empowerment to take place - given that it implies negotiation and recognition of different agendas, and interests - in the decision-making processes that occur in and during the implementation of NBS in any given context. Participatory NBS may pave the way for a more inclusive way of governing, acting upon and intervening in what concerns the coexistence of citizenship and non-citizenship (Santos, 2020), thus as it promotes the hearing of a plurality of voices and recognizes the different lived experiences and perspectives of diverse social actors that cohabit and coexist in a given context.

In URBiNAT, the participatory solutions (see Table 5 - Methods and techniques by co-creation stage, section 3.1) were regularly analysed by the participants in the Living Labs and through this approach, the process gained room when compared to the weight that it traditionally had in what concerns urban regeneration. In other words, the process became as important as its outcomes (product). The co-creation of the public space was grounded in the democratic quality of the process as a strategy to stimulate its liveability, accommodating not only green infrastructures, but also

social and solidarity projects and collective activities and initiatives. The appreciation of the process is the necessary linkage that offers favourable conditions concerning the (future) sustainability of urban regeneration in the intervention areas, after the lifespan of the current project.

2.2 CO-CREATING TERRITORIAL NBS

Gonçalo Canto Moniz

The territorial solutions are the conventional nature-based solutions related to the environment that require a physical implementation. These solutions are usually designed by architects and landscape architects due to the high level of technical specifications that need validation from public authorities.

According to D1.2 (Lameiras, 108-109, 2018), “The territorial nature base solutions will add the urban landscape layer to the project, the one that can be mapped and is visible and usable by the people. This will be achieved through the development and site specific customization of each NBS from the URBiNAT catalogue: Wildlife Park; Autochthonous Urban Forest; Watercourse restoration; Renaturalization of brownfields, abandoned infrastructures and degraded ecosystems; Green Roof; Rainwater management and recirculation in residential areas; Urban Vegetable Gardens; Urban Mobility Charing; Treesolution Groasis; Bee hive provision and adoption.”

In URBiNAT, during the co-creation process, the territorial solutions are understood as the green infrastructure that gives support to the other solutions, related to socio-economy, culture, education, sports, etc. In fact, the territorial NBS were integrated in the urban project of the healthy corridor of the 8 cities and were approved according to the urban planning regulations of each city. As a consequence, the cities developed two parallel urban plans - one material, with the territorial and technological solutions, and one immaterial with the participatory and socio-economy solutions. Although the two plans are articulated, there are challenges in the integration of material and immaterial dimensions due to the conflict between the dominant technical knowledge of the material solutions and the enhanced empirical experience of the immaterial ones.

Nevertheless, the majority of the territorial solutions emerged from a participatory process that took place during the co-diagnostic stage, where needs and challenges were identified by the participants, and dur-

ing the first steps of the co-design, named as “ideation”. Due to the technical dimension of the territorial NBS, the engagement of the citizens was more limited during the development of the urban plan, with the formalisation of the healthy corridor details, the licensing and the execution project. The limitation is extended to the construction works that require construction companies to develop the heavy and technical endeavours. Nevertheless, the local community was involved, despite in a more operational manner, in the last step of the implementation stage, related to planting, as an example.

Despite the technical specifications of territorial NBS, the co-creation process contributes to tailor solutions that attend local community needs and the specificities of the local context. The contribution given by the local community was also important in changing ways of doing of the municipal technicians and elected representatives of the municipalities involved in the co-creation process. The participatory process gave voice to the local community since their knowledge is valued and acknowledged.

However, the co-creation process was not always fully accomplished in all the cities. Some territorial NBS were defined by the technical team to establish the green infrastructure of the healthy corridor and to face some ecological challenges, such as water drainage systems to take advantage of the rainwater. In these cases, the technical knowledge surpassed the availability to integrate other kinds of knowledge.

Most of the territorial NBS included in the NBS catalogue were integrated in the healthy corridor of each city as a result of a participatory process by using participatory NBS (walkthrough, photovoice, mapping, design thinking, online collaborative design). Some of the territorial NBS were co-created in several cities with different aims and tools, as can be seen in the following table.

Territorial NBS	Participatory NBS contribution
Rehabilitation of the ruin	<p>PORTO</p> <p>After various discussions, it was decided that the ruins of the old farm “Lagar do Falcão” would be integrated in the healthy corridor while keeping the memory of the old farm. During the co design online activities, using design thinking, the citizens proposed to develop two programmes in the ruin - the informal market and the open air amphitheatre.</p>
Paths	<p>PORTO</p> <p>The need for more accessible paths for all citizens to promote pedestrian connections were identified by several methods and during participatory activities of the local diagnostic (walkthrough, mapping, photovoice).</p> <p>NANTES</p> <p>The green loop was a proposition made by inhabitants in two previous workshops before URBiNAT. Due to COVID-19, the walkthroughs and face to face interviews inside the bus dedicated to citizen dialogue with a video of the loop took place after the summer, in September and October 2020 and allowed on the one hand to map the improvements needed on public space (benches, accessibility issues ...) and on the other hand to physically design the loop and collect wishes and aspirations for the activities.</p> <p>SOFIA</p> <p>During walkthrough and workshop, citizens identified the need to connect the North and the South Park, by renovating a bridge and the main walkway. The walkway should have a new pavement and cross four places/squares with different facilities - amphitheatre, playground, sports fields and ecological parking.</p>
Open air amphitheatre	<p>PORTO</p> <p>The need for community spaces for socialisation and entertainment opportunities were identified in the co-diagnostic activities and methods. The Amphitheatre was proposed by a group of artists, and then developed in several participatory activities: Citizen workshop with adults; Face-to-face interview with local facilitator; Workshop and walkthrough with citizens and municipal technicians; Online workshop to co-design four NBS.</p> <p>SOFIA</p> <p>The Local Diagnostic outlined that the only place recognized for organised outdoor events is the North Park. The green amphitheatre comes to fill the gap of small public space for events and informal cultural activities. During the workshops, interviews, and focus groups, it was found that there are inhabitants who are ready and willing to participate and provide dance classes or other educational or cultural activities for free.</p>

Table 3. Territorial NBS co-created in front-runner cities.
Source: Author’s own elaboration.

2.3 CO-CREATING SOCIAL AND SOLIDARITY ECONOMY NBS

Beatriz Caitana and Ronize Cruz

The Nature-based Solutions (NBS) and the Social and Solidarity Economy (SSE) are intimately linked to the extent that SSE contributes to socio-economic adaptive capacity of the NBS. On the one hand SSE, relates to territoriality and stimulates the connection between physical space and new ways of sociability. On the other hand, the connection with the community is grounded in a democratic management of the initiatives. In order to connect the NBS with SSE, URBiNAT project has highlighted six Social and Solidarity Economy Nature-based Solutions: “Local currencies for natural based circular economy”, “Time Bank Solutions”, “Solidarity Fairs/Markets”, “Farmers Markets Network”, “Community social currencies for inclusive urban regeneration” and “Bread Houses”.

The main goal of the “Local currencies for natural based circular economy” is to promote waste recovery through a socially efficient separation strategy, in order to separate mixed waste into different fractions, organic and plastic in particular, to properly recycle each of them. This enables citizens to look at the waste of a community as a natural resource in a metabolic perspective and give a reward to citizens that can be used in local commerce which fosters the diffusion of this perspective. It is seen as a deep and effective dose of wealth and leads to the increasing of local transactions. Best practices and references: La MOLA (Liberated Organic Matter) - <https://lamolamonedasocial.cat/>; IRATI – Local Complementary Currency - <https://mancomunidad-irati.es/residuos/>

Time Bank is a system that encourages a solidary exchange of knowledge, services and products not using money as an intermediary. It meets both the offer and demand of services provided by participants. The key principles of Time Bank include: “everyone’s skills are useful” and “everyone needs to give and receive time”. This solution strengthens the social networks of support, as well as the sense of belonging to the community, it is also a great opportunity to reduce loneliness and amplify models of valuing mutual care and time among and between neighbours. Best practices and references: Experiences in Portugal: Graal – Banco de Tempo: <https://bancodetempo.pt/>

In the Solidarity Fairs / Markets, the products, knowledge and services are manufactured by the participants themselves, and they are exchanged by using (or not) social currencies as intermediary mechanisms. The markets/fairs contribute to a broader movement focused on the rediscovering of the local and popular economy. It innovates by combining three distinct elements in the space/society relation: the social ties of proximity, solidarity consumption, and the use/occupation of public spaces. In the markets we find the figure of the “prosumer” who refers to the person who is both consumer and producer. Best practices and references: URBiNAT solidarity market in Porto (CampMarket).

The Farmers’ market (FM) is an alternative food network that provides shorter delivery circuits of farmers’ products to local communities through direct interaction with farmers in the urban environment. This NBS helps restore the connection of inhabitants of bigger cities to land, fresh and good quality food of a healthy origin. It raises people’s awareness on nature-friendly farming practices, provides access to good quality local production, thus leading to healthier lifestyles, new social networks and relations. The farmer-consumer cooperatives or other organisations could join efforts in bringing together farmers and acting as a platform in securing that farmers meet a set of requirements concerning access and organisation of farmer market venues and events. Best practices and references: FM in several neighbourhoods in Sofia, as well as monthly farmer market fests in the centre of Sofia. Hrankoop Cooperative has led the process in Sofia.

In the “Community social currencies for inclusive urban regeneration”, the social currencies are created with physical (or virtual) support and managed by a community with the aim of promoting local economy, especially in places where there are vulnerabilities. The main goal is not to replace the official currency or to seek the accumulation or capitalization but to expand exchanges between people with products of different value, facilitating exchanges that would hardly occur from direct exchange. The necessary basis for its circulation is the democratic management and the mutual trust relationship. Best practices and references: Currency Mor in Portugal (link: <https://moedamor.pt/>); Spain: Vila Watt – energy and social currency (link: <https://vilawatt.cat/es/>)

The Bread Houses Network (BHN) is an initiative of the International Council for Cultural Centers Association that creates and unites centres for community-building, creativity, and social entrepreneurship. The main goal of BHN is to inspire individuals and communities to develop their

creative potential and cooperate across all ages, professions, gender, special needs, and ethnic backgrounds through collective bread making and accompanying art forms. The network strives to empower the people to connect with each other and find hope and solutions to their challenges. Best practices and references: The Sofia Bread House cooperation with the Health and Social Development Foundation was dedicated to educational bread making sessions/lessons for children of Roma origin between 4 and 8 years old.

2.4 CO-CREATING TECHNOLOGICAL NBS

Andrea Conserva and Joana Santos

URBiNAT applied a qualitative methodology as a way to sustain and feed the co-creation process. Each participant had different roles and responsibilities in the process previously mentioned. The common goal of the different participants is related to the co-designing of a solution that would address education, environment and inclusion. Worth mentioning are the two technological NBS “Ceramic Green Wall” and Mobile Vegetable Garden that emerged from the participatory process in the phase of co-design with students (aged between 8 and 12 years old), teachers from six schools (located in Porto), experts from various fields namely, sociology, urbanism, architecture – design and postgraduate students from the Institute of Advanced Architecture of Catalonia.

The participatory process that took place in Porto as a means to create a healthy corridor integrated within the actions foreseen in URBiNAT, developed into two co-designed solutions: Mobile Vegetable Garden (MVG) and a Vertical Vegetable Garden (VVG).

These two solutions were co-selected by different (social) actors, from the neighbourhood and URBiNAT local experts (including the Porto Municipality) through several focus group meetings, by using the URBiNAT catalogue of NBS (Conserva, A., Farinea, C., Villodres, R. (eds.) 2021). The accomplishment of the overall objective of materialising these two NBS solutions, involved different phases and took place as follows:

Vertical vegetable garden



Mobile vegetable garden

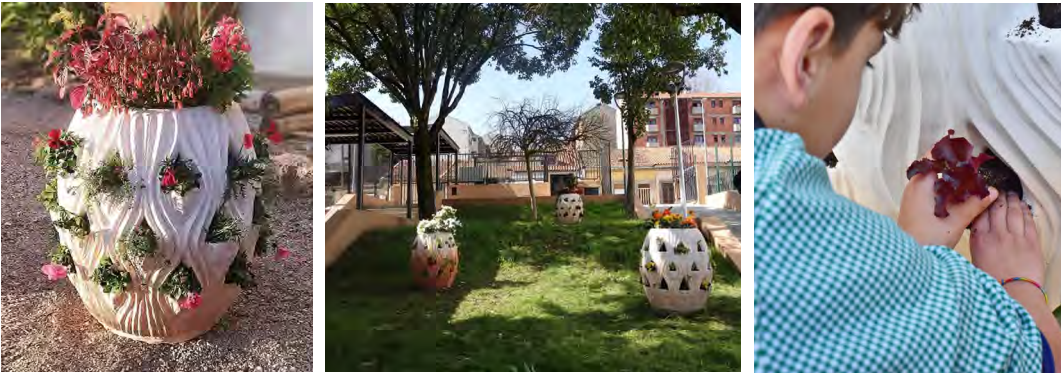


Table 4. A Vertical Vegetable Garden and a Megetable Garden in Porto.
Source: IAAC, 2024.

PHASE 1 - UNDERSTANDING THE INTENTIONS

- Activity 0 (URBiNAT experts): Co-selection of the NBS to be implemented in schools through focus group meetings with Porto municipality.
Outcome: vegetable garden NBS for children.
- Activity 1 (Teachers and kids): The gathering of children's preliminary ideas by teachers after a training effort conducted by Urbinat experts.
Outcome: analysis and selection of possible locations of the vegetable garden in each school; the recollection of the preference between vertical vegetable garden and mobile vegetable garden.
- Activity 2 (Urbinat experts + teachers and children): Children's Communication to experts, concerning their preferences (in terms of the two NBS chosen). A walkthrough with URBiNAT experts guided by the children considering the different locations of NBS within school grounds; co-design of the function of vegetable gardens with the children (reflection on biodiversity and ecosystems; analysis of requirements for the maintenance of both solutions with teachers and URBiNAT experts).
Outcome: coloured drawings and balsa models of the vegetable garden project produced by the children; presentation of the children's projects to the URBiNAT experts.

PHASE 2 – PROPOSALS

- Activity 3 (Urbinat experts + IAAC students): IAAC students developing design alternatives inspired by the children's projects; these alternatives include structures for gardening and textures inspired by Porto's "azulejos" as a means to enhance and stimulate a sense of belonging to a place.
Outcome: scaled models produced with advanced manufacturing and parametric design Techniques.
- Activity 4 (Urbinat experts + teachers + children): Children, supported by URBiNAT experts, evaluate design alternatives, this was done by applying an adaptation of emotional mapping to children and by bridging projects developed in activity 2 with activity 3 (design alternatives proposed by IAAC students).
Outcome: Qualitative and quantitative evaluation of design alternatives.

PHASE 3 - FINE TUNING

- Activity 5 (Urbinat experts + IAAC students): IAAC students fine-tuning the design alternatives.
Outcome: real scale prototype of vegetable gardens portions.
- Activity 6 (Urbinat experts + teachers): Co-adaptation of design alternatives to be implemented.
Outcome: infrastructure requirements' analysis for each school.
- Activity 7 (Urbinat experts): IAAC researchers developing the final design for each school.
Outcome: final design of the vegetable garden for each school.

PHASE 4 - CO-IMPLEMENTATION

- Activity 8 (Urbinat experts + teachers and children): Co-implementing the solution together.
Outcome: vegetable garden implemented in each school.
- Activity 9: Is related to Co-Monitoring which in turn can only occur after co-implementation. It means to assess the implementation phase in terms of functions and execution for an ideal period of one academic year. This activity can be assured by the completion of a questionnaire on behalf of teachers and students to be shared with design coordinators. This enables the assessment of needs and their resolution.

Between February 26th and March 9th, 2024, a series of six workshops were conducted to finalise Activity 8. Each session, held at various schools, focused on student participation in planting activities. Engaging students who had previously participated in co-design workshops, the activity was supported by local facilitators representing both the Porto Municipality and CES, with expertise in education and botany. Together, students and school teachers planted a diverse array of plant species, including vegetables, herbs, and flowers. Following the planting session, the students and their teachers presented the project to other classes to ensure future maintenance of the wall and to share their sense of belonging.

The last activity of the methodology, related to co-monitoring, is ongoing and will be carried out in the following months.

3.

THE CO-CREATION METHODS AND STAGES

This section is dedicated to offering not only an overview of the methods applied by co-creation stage (section 3.1), but also give a more detailed account of what composed each co-creation stage. Therefore, it is organised in a manner that respects the order of the co-creation process, assessing the co-diagnostic stage (section 3.2) in which issues relating to participatory culture arise; the co-design stage (section 3.3) where issues that derive from the horizontal and vertical aspects entailed in the co-design stage are explained; the co-implementation stage (section 3.4) in which an account on the construed pathway of the co-creation process led to the implementation of NBS, and how this occurred; the co-evaluation and co-monitoring stage (section 3.5) where the analytical approach, dimensions to be assessed and how this was carried out is presented. Thus, it enunciates the methods by dimension, city and the necessary steps taken concerning each method/technique.

3.1 OVERVIEW OF METHODS BY CO-CREATION STAGE

Isabel Ferreira, Andreia Barbas and Joana Santos

URBiNAT as a project with the overall goal of intervening in public space and creating processes associated to nature-based solutions found itself impelled to use a comprehensive framework given that it enables valuing the role of each individual/social actor regarding the construction of a reality. The methodology adopted by the project had the underlying intention of involving, as much as possible, different stakeholders and taking into account their views in what concerns urban regeneration. Thereby, the project works with different techniques as a means to enhance people's participation but also capture the diverse opinions/views and subjectivities that underpin the process of creating (new) solutions in a collaborative manner (involving different social actors, with diverse social, technical, economic backgrounds). Hence the methodological approach applied is based on qualitative techniques of collecting data from the different cities that are a part of the URBiNAT project. Central to the whole

project is the concept of co-creation, which in short, is understood as a process that implies the involvement of different stakeholders (concerning a certain issue) with different resources, knowledge and networks coming together to discuss and resolve a challenge which cannot be resolved on individual or solemn organisational terms or boundaries. It implies the emergence of new forms of collaborative interaction between social actors who have different levels of power in the decision-making process. Therefore, the co-creation process and the qualitative approach adopted by the project, brings many insights regarding (new) governance models. It also allows testing ways of engaging citizens in decision making processes as a means to promote active citizenship and reinforce democratic values.

The co-creation process is composed of different stages: co-diagnostic, co-design, co-implementation; co-monitoring & co-evaluation. The URBiNAT project intended to involve citizens as well as other stakeholders in the whole process. Therefore certain tools were used in each stage as a means to sustain the participation of the different social actors in developing NBS for each city. Accordingly, urban regeneration was promoted through a collaborative approach. Each stage of the co-creation process has its specificities and needs, thus the use of different tools and methods to induce participation as well as assess the best strategies in employing NBS to each social, economic, and political context. The use of tools, methods and activities by stage were carried out as follows, according to the a workshop held with the participation of public officers from each city engaged in the project (workshop 2a WP5/T5.5, held on 29th March 2023):

In conclusion, some activities and techniques appear in more than one stage. This essentially has to do with the fluid interaction and intersection established between the different social actors (political representatives; researchers; citizens; technicians and others) involved in each stage of the co-creation process, but also connected to the process as a whole. One must highlight that given the level of interaction involved in the co-creation process among social actors, the use of (qualitative) techniques served not only the purpose of collecting data for analysis. It also was used as a strategy to engage all the different stakeholders in arriving at NBS solutions concerning the livelihood of their city. Therefore, the process of collecting data and inducing participation among stakeholders is characterised by a flexible nature in terms of applicability, suitability and relevance regarding methods, activities and techniques. This is strongly linked to the bottom-up conceptual framework adopted by the URBiNAT project in approaching the field/context in what concerns the contribution and role of NBS to an inclusive urban regeneration.

Co-creation process (stages)	Methods and techniques
Co- diagnostic stage	territorial data collection, cultural mapping; walkthrough; photovoice; focus groups; face-to-face interviews; questionnaires; behavioural mapping; territorial mapping, local task force; children workshop; involvement activities before co-design
Co- design stage	walkthrough; design thinking; workshops; one-day experiments; creation of local task forces; working groups/ateliers; mapping; field visits; co - creation/tactical urbanism; school laboratory; co - design activities; exhibition in the public space; citizen dialogue bus; meeting with deputy mayor; mobile kiosk.
Co- implementation stage	local task forces; working groups; workshops; operational activities like map of green loop or planting trees.
Co-monitoring and evaluation stage	in-depth interviews; focus groups; participant observation; visual sociology – photography; static observation; local task forces.

Table 5 - Methods and techniques by co-creation stage.
Source: Author’s own elaboration.

3.2 CO-DIAGNOSTIC STAGE: CULTURAL MAPPING AND PARTICIPATORY CULTURE

Isabel Ferreira and Joana Santos

Culture, in the broad constituent sense of “cultural traditions, beliefs, values, and fundamental convictions that constitute individual and collective identity” (Kangas and Sokka, 2015: 141) represents the social anatomy in which motivations and collective imaginaries set up the context for the sustainability of NBS. The context of inclusive urban regeneration is composed of many challenges and interacts with many factors, so cultural mapping and local participatory culture are essential elements in handling the complexity involved in such an endeavour. Mapping of the local participatory culture implies to grasp participatory methods and tools and to put forward their application in city culture when it comes to co-design and co-implementation of NBS processes (Ferreira, 2022). The project

identified four target groups: municipalities and local publicly owned institutions; local organisations, agents and companies; champions; community residents (Ferreira et al, 2022). Mapping local participatory culture is part of the strategy of working within the realm of a comprehensive framework towards complex social issues, such as urban regeneration.

The objective of gathering qualitative data encompasses gathering information on participatory local culture, namely norms, values and practices related with participatory initiatives – formal and informal – led by citizens and the municipality. It includes a perspective that sheds light on the (past and present) engagement of citizens in public life (in general) and their involvement in urban governance (in particular). There are other aspects to be considered under the practice of mapping local participatory culture, namely the acknowledgement and identification of networks of local organisations, champions, resident’s or neighbourhoods, associations and business actors or companies; the existence of public services and facilities; specificities considering citizens living in Urbinat’s neighbourhood/intervention areas; geo-referenced data regarding public space and formal and informal locations that serve as collective and public meeting points. A comprehensive paradigm that entails qualitative methods was applied in each city according to contextually rooted needs. Contacts were conducted through workshops, formal and informal meetings and semi-directional interviews, making it possible to identify the formal and informal community networks and understand the local participatory culture beyond institutionalised frameworks. We are therefore before a highly flexible approach concerning the use of methods and techniques regarding fieldwork and strategies of involving different stakeholders in the process of co-creation of NBS.

The adoption of a qualitative approach and comprehensive nature in what relates to cultural mapping, enables access to the view on intangible aspects related to social and cultural experiences and dimensions. Acknowledgement of the importance of material aspects as well as the interconnection of both (intangible and tangible aspects of urban livelihood and process of urban regeneration) is also contemplated when it comes to cultural mapping. Thereby, cultural mapping consists of collecting, recording, analysing and synthesising information to describe the cultural resources, networks, links and patterns of usage of a given community or group (Stewart, 2007).

The following table expresses a set of indicators regarding participatory culture. It means to assess through diverse (at the individual level and in group) meetings, workshops (depending on the target groups, previously

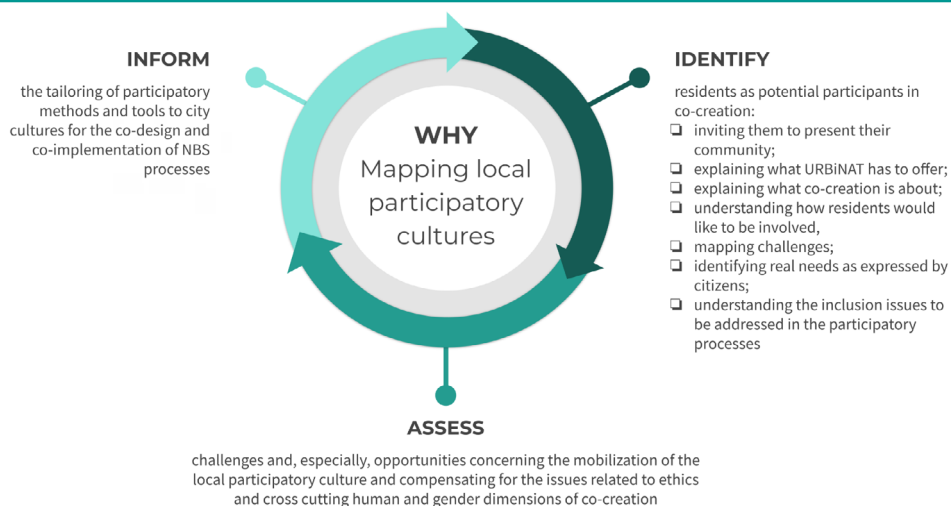


Figure 2: Cycle of mapping local participatory cultures.
Adapted from URBiNAT's deliverables D3.1 (2019) and D3.2 (2019), and Ferreira (2022).

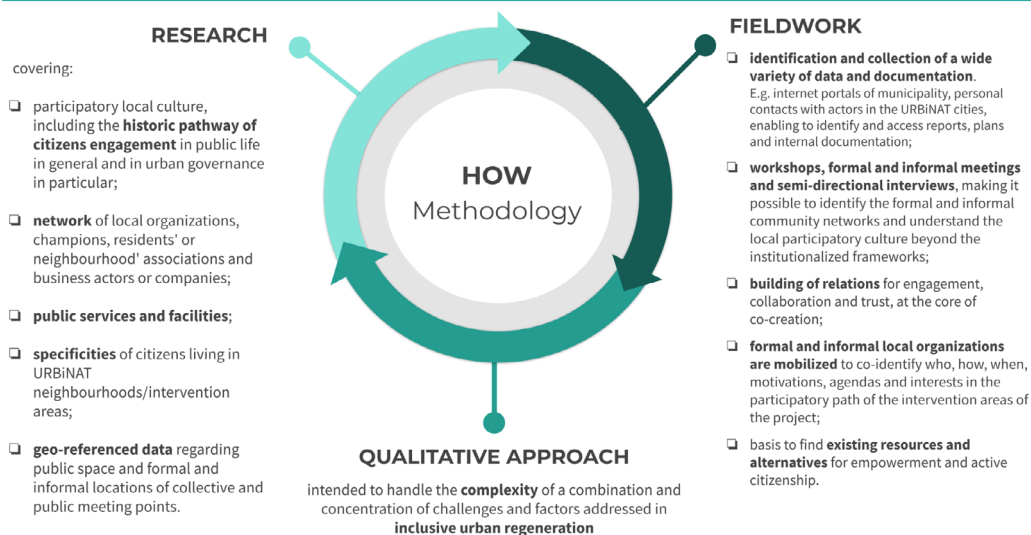


Figure 3: Cycle of application of qualitative approach.
Adapted from URBiNAT's deliverables D3.1 (2019) and D3.2 (2019), and Ferreira (2022).

mentioned), and consultation of documentation, the existence of cultural assets, agents and organisations that were active concerning participatory activities and endeavours in each given context and/or urban setting within the scope of URBiNAT.

Both tangible and intangible dimensions of culture help define communities (and help communities define themselves) in terms of cultural identity, vitality, sense of place, and quality of life. In order to integrate

Table 6: Indicators, results and outputs to support the mapping of participatory culture.
Source: deliverable 3.1, Ferreira (2020).

Participatory culture - INDICATORS
The existence of "champions" and energisers among the participating citizens to lead the way and mobilise others
Citizen's presence/participation in decision-making processes
The existence of individuals representing citizens in the public sphere (residents or neighbourhood associations, elected citizens members of municipal bodies...)
The existence of specific mechanisms for involvement in participatory processes (including historic of participatory processes)
Characteristics of citizens who usually participate (age, race, ethnicity, gender, religion, education ...)
The existence of business participation and contribution in participatory processes
Co-creation and co-production experience in the private sector (initiatives co-initiated, co-created, co-implemented, co-monitored and co-evaluated by the private sector and the municipality; ex: partnerships for waste management, water management, etc.)
Co-creation and co-production in the public sector (initiatives co-initiated, co-created, co-implemented, co-monitored and co-evaluated by the municipality or other public institutions with citizens; ex: urban gardens)
Social and solidarity economy: <ul style="list-style-type: none">- existence of specific mechanism, local legislation to support social or solidarity economy initiatives;- existence of specific sector, department in public administration to support social or solidarity economy initiatives;- supply of public services in articulation with local agro-ecological production;- incentives for individuals in socio-economic vulnerability to start their own business;- public social incubator or public support structure.
Participatory culture - RESULTS of stocktaking and research these issues were included in the semi-structured interviews
Which interactions with the neighbourhoods' residents?
What participatory initiatives exist?
Initiatives from the Municipality or initiated by citizens or local organisations
Activities organised by the residents
Which, by whom, when, where, for whom
Social Activist/Claiming Movements and Groups
Agents that act in the community
Local organisations
Formal and informal associations, cultural and sports groups, etc.

culture into URBiNAT, a multi-layered approach was needed, enabling to break it down into different dimensions of: cultural assets, resources, organisations, agents, expressions of place; everyday social and cultural practices of resident; histories and heritages of place; local identity(ies); residents' imagination and expectations towards the future.

3.3 CO-DESIGN STAGE: HORIZONTAL AND VERTICAL SEGMENTS OF ACTION

Américo Mateus

Retrospectively, the steps taken by URBiNAT in what concerns the co-design stage and co-design methods that presented more difficulties in terms of implementation were steps concerning the validation phases: (a) validate the best ideas; (b) the city feedback; (c) negotiate with decision makers; (d) systemize into a collaborative Urban Plan, mainly applied in the frontrunner's cities of Porto and Sofia. Furthermore, the initial co-design steps of the ideation phases that were successfully implemented in all frontrunners cities are: (a) transformation of the local diagnostic information; (b) promotion of citizens Self-projection in the future space; (c) ideation of NBS collaboratively and (d) the design of corridor solutions.

URBiNAT project adopted two different segments of action (horizontal and vertical) relating to the implementation of the co-creation process. The horizontal segments, in terms of time and space of action, includes a macro view and a micro view. The macro view defines the four major sequential stages of the process that would lead us to the expected final result, the construction of three healthy corridors and the creation of four (plus one in Korramabad) urban plans for the construction of healthy corridors in the follower cities, always based on the active involvement of citizens and all stakeholders in throughout the different stages of the process. The micro view defines the different layers of the process by questioning the diverse perspectives that the process implied:

- The citizens' perspective - where the definition of the sequence and flow of information from the citizens' point of view emerge.
- The perspective of the needs of the project itself - where the definition of the objectives for each of the Macro Steps and guarantee the fluidity of the sequence of information were put in place.

- The perspective of the participatory process itself - where the methodological focus concerning each of the phases of the process was defined.

Given that phases result from the different perspectives, it was possible to draw the vertical segment of the URBiNAT Model (figure 1), which enabled the projection of a sequence of actions and activities that allows the emergence of a relation between divergence/convergence in each stage, therefore defining Steps, Narratives and Activities. The referred relation opens way to the accomplishment of results at each stage, which, after dialogue and validation with stakeholders (Milestones), is the information that constitutes the starting point for the next stage.

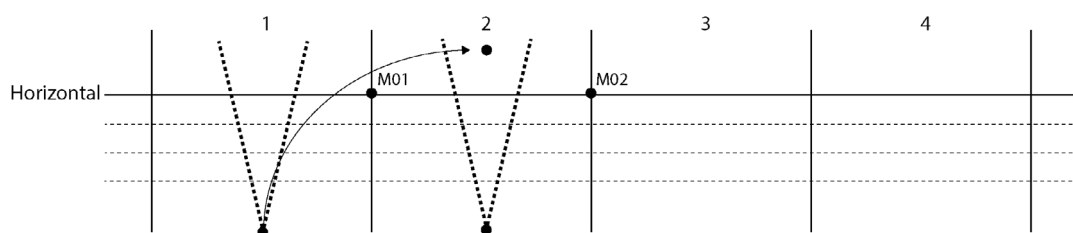


Figure 4. Verticality of the URBiNAT co-design model.
Source: Mateus & Leonor, 2023

The design stage that starts with Milestone 01 - Validation session with Citizens and Stakeholders of the Local Diagnostic, is divided into two main areas: co-design activities with citizens and urban plan development and ends with the final Milestone 02 that relates with the final co-design solution:

- In terms of the Project Perspective, the objectives of this phase are the ideation of NBS with Citizens and the collaborative Validation of these NBS with Stakeholders and Citizens.
- In terms of the Process Perspective, the definition of co-design activities with citizens entailed to collaboratively seek to bring together ideas regarding the citizens own NBS, as well as their involvement in the development of the urban plan and in the decision-making process.
- In terms of the Citizen's Perspective, at the centre of this process, it intended to involve the citizens in the creation of ideas and in the design of solutions. In this way, this phase is important for citizens as a means to involve them with the purpose of the healthy corridor and to become the owners of the final concept.

Regarding the relation between divergence, convergence and result, several activities and tools (see Table 5, section 3.1) were created and allowed thinking about future scenarios for the corridor and activities focused on the clustering and final selection of ideas and NBS to be placed in the Healthy Corridor.

3.4 CO-IMPLEMENTATION STAGE: PATHWAY FROM CO-CREATION PROCESS TO NBS

Vitório Leite

During the URBiNAT co-implementation stage, the balance between the proposals and developments from previous stages and the feasibility of the NBS proposals motivated a delicate and fruitful process between all the actors involved.

Finding, including, selecting, excluding and developing the urban challenges and new proposals were moments of close collaboration among all the people involved in the participatory process. During co-implementation, the established common ground and dialectic relationship among most of the participants played a crucial role in resolving conflicts and addressing problems that emerged from the dialogue and the pressure to validate and implement.

In some of the cities, certain NBS have already been built and implemented, while others are currently under construction and development through the URBiNAT process. Many of the healthy corridors, including those not yet completed, are already being used and tested by citizens, local associations, partner institutions, and the school community.

For the URBiNAT team, the profound critical proximity (Latour, 2015; Cruz, 2019) enabled by the project helped in developing the communication and governance tools that played an important role in what concerns the complex project process. These tools challenged the typical separation between technical work and the socio-spatial and ecological systems in which the project is intervening.

This process was crucial in combining usually disconnected methods to collectively initiate the transformation of the space. It facilitated the preparation of potential future uses, experimentation with place-making for spatial organisation and the definition and characterization of different

types of interventions and occupations, ranging from temporary to more permanent ones.

During the co-implementation process, sharing all the information produced and systematised on the previous stages was very important to improve the level of understanding and commitment among municipalities and citizens, including the discussion on (old and new) solutions that do not integrate nature-based principles and may not be aligned with the project's goals.

The way this information was systematised and mapped - proposals, ideas, challenges and aspirations - was discussed with participants as a collection of micro-scale projects, micro-opinions and micro-perspectives, while adopting an approach that emphasises composition as a means of achieving a general and collective transformation, ultimately contributing to the municipal roadmap, which was being created.

These discussions included conflicts, but also moments of close togetherness, and URBiNAT team struggled to keep the so called critical proximity among all the stakeholders involved: sustaining and evolving the common ground and co-governance approach, while remaining open to new narratives and proposals, even if the project and some NBS were already decided, designed and being implemented, demanded a great amount of time for negotiation and some flexibility for last minute changes and opinions.

On this phase, combining different methods and tools to facilitate the co-implementation and integrating academic or professional methodologies with everyday features and considerations enabled the cross-pollination of the two sectors and collective decision-making, ultimately creating new governance structures for co-creation, which helped during this negotiation.

And, finally, confirm and test the projects that are ready to be implemented, recurring to methods such as experimentation, modelling, 1:1 scale drawings, performances or other approaches, even if the project requires more technical or professional implementation, helped to maintain this constant negotiation and implementation alive, ensuring the participation of citizens and helping to foster a sense of ownership of the areas that are about to be intervened.

3.5 CO-MONITORING AND CO-EVALUATION

Beatriz Caitana and Andreia Barbas

The URBiNAT project adopts Weiss's (1997) research evaluation methodology, utilising social science research to enhance the systematic and accurate nature of the judgement process (Weiss, 1997, p.4). The author emphasises the significance of integrating social sciences research methods into the evaluation processes to provide a more comprehensive under-



Figure 5. Activity to co-implement IAAC wall farm on Corujeira school, Porto.
Source:
Vitório Leite

Figure 6. Evening site visit with inhabitants during the construction of Porto's Healthy Corridor.
Source:
Vitório Leite



standing of the analysed subject. Following this perspective, the URBiNAT project employs six techniques from the social sciences to evaluate the Healthy Corridor (HC), namely in-depth interviews, focus groups, participant observation, co-walks, visual sociology and static observation. These techniques collectively serve the purpose of monitoring and evaluating the co-creation process taking into consideration the resources available from the local task forces in each frontrunner city (Nantes, Porto and Sofia) and followers cities (Brussels, Høje-Taastrup, Nova Gorica and Siena).

The significance of monitoring and evaluation in urban planning becomes evident, especially when dealing with a diverse group of stakeholders holding varying expectations and objectives. Following the evaluation research methodology is crucial as it not only assesses the different stages of the process (co-creation, co-design, and co-implementation) but also allows for the evaluation of the suitability and impacts of nature-based solutions proposed by different cities. This becomes particularly significant in addressing issues related to asymmetries, such as socio-economic exclusion and gender inequalities, while simultaneously valuing and legitimising the inclusion of diversity in urban plans.

The evaluation process acts as an opportunity to enhance participant engagement through participatory approaches. It also contributes to improving and expanding accountability strategies and transparency in the adopted approach. The verification of accomplished results becomes a means to confirm whether the intended changes and impacts have been achieved, constituting an integral part of the benefits of the evaluation process. By incorporating a collaborative dimension into evaluation strategies, the project ensures that information is understandable to all stakeholders and that details regarding intervention goals, evaluation costs, and results are accessible to everyone involved.

Furthermore, co-evaluation, through observation and listening tools, allows for the verification of changes in usage patterns and practices in the urban environment. In this way, it is possible to recognise the 'social markers' present in urban spaces contributing with answers to the phenomenon of exclusion. Moreover, co-evaluation permits us to understand, from the participant's perspective, the circumstances under which co-creation processes effectively foster active engagement in urban regeneration and the implementation of nature-based solutions (NBS).

Based on the project’s analytical framework, two scientific dimensions - public space and co-creation process - were monitored and evaluated using social sciences methods. Various techniques were applied for each dimension considering their objectives and coverage. The table below illustrates the assessed dimensions, traces the corresponding methods for each one provides insights into the empirical context in which they are applied, and specifies the stage of the co-creation that was implemented, based on the URBiNAT model.

Considering the participation of multiple cities in the URBiNAT project, a guidance document was designed, outlining information on the application of data techniques, referred to as the “Methods Protocol”. This document guaranteed the standardisation of applied techniques, ensuring the comparability of data collected across diverse cities and by various stakeholders. It is noteworthy that each city had the flexibility to choose techniques that aligned best with its specific context and necessities. Each local task force applied the selected evaluation techniques to assess the two dimensions of the Healthy Corridor. The following table displays the methods chosen by each city.

Dimension	Qualitative technique	Empirical context	URBiNAT stage
Urban space	Visual sociology (photography)	Healthy corridor intervention area	Follower cities
	Static observation		- Co-design
	Co-walks with interviews		Frontrunner cities
Co-creation		Participatory activities & co-creation process	- Co-implementation (ex-ante and ex-post)
	In-depth interviews		All cities
	Focus group		- Co-design
	Participant observation		- Co-implementation
			- Co-monitoring and co-evaluation

Table 7: Summary of analysed dimensions using qualitative techniques, empirical context and URBiNAT stage. Source: URBiNAT Deliverable 5.6. (2024).

It is significant to mention that the process of co-monitoring and co-evaluation involves the active participation of a spectrum of stakeholders, including political representatives, municipal staff, citizens, and researchers, and additional groups, such as schools and associations,

collectively engaged in project activities. Consequently, this inclusive approach facilitates a comprehensive understanding and broader perspectives of the diverse individuals engaged in the process, encompassing both formal and informal aspects and moments.

Methods Selected		IN-DEPTH INTERVIEWS	FOCUS GROUP	PARTICIPANT OBSERVATION	VISUAL SOCIOLOGY	STATIC OBSERVATION	CO-WALKS
Front-runner Cities	NANTES	X	X	X	X	X	X
	PORTO	X	X	X	X	X	X
	SOFIA	X					X
Follower Cities	BRUSSELS	X	X				
	HOJE - TAASTRUP	X		X			
	NOVA GORICA	X					
	SIENA	X	X	X	X		

Table 8: Summary of the methods selected by each city.
Source: URBiNAT Deliverable 5.6. (2024).

By actively listening and observing the various actors engaged in the process, valuable insights were gathered regarding the social dynamics of public spaces and the characteristics of the co-creation process. In terms of evaluation outcomes, the URBiNAT project, as a whole, has been a beneficiary of positive monitoring aspects, due to the acknowledgement of the need to obtain feedback from all the different stakeholders throughout the different stages of the project. The data reveals a range of challenges, strengths, and unique local characteristics that illustrate the cities represented in the project.

The evaluation process entails more than just advantages. Despite the low financial costs associated with its implementation, local teams must dedicate themselves to this evaluative endeavour. This commitment is particularly crucial given the time required to organise and carry out the various interactions throughout the project. The teams need to invest in the deepening the knowledge and skills, especially if those leading it lack

formal training in the social sciences and need to introduce themselves to data collection techniques, as was the case with the training provided in the URBiNAT and reinforced by the guidance document “Methods Protocol”.

The process of co-monitoring and co-evaluation should extend beyond the analysis of results. It is crucial to actively disseminate the findings so that all stakeholders can provide feedback on the work conducted. This feedback mechanism enables participants to feel that their opinions, suggestions, and assessment have been acknowledged and considered.

The table 3 “Overview of qualitative techniques, steps, advantages and disadvantages and required resources/equipment” delineates each qualitative technique, outlining the steps for implementation and the necessary resources and the equipment. Furthermore, it provides insights from cities that utilised these techniques, highlighting the primary advantages and disadvantages associated with each one.

Qualitative Technique	Steps	Resources/ Equipment
Visual sociology (Photography)	1. Engaging with the community through rooted presence and attentive listening	- 1 person or more - Camera
	2. Partnering with a well-informed insider who resides in or belongs to the community	
	3. Gathering photographic documentation	
Static observation	4. Evaluating and analysing the collected photographs	- 1 person or more - Paper or digital observation script - 1 pen
	5. Engage in discussions with participants and the community to review and interpret the results	
	Advantages: versatile with clear outputs, visually appealing results, rapid involvement of diverse participants, and added context on territory and culture	
Static observation	Disadvantages: Time consuming and participants' involvement	- 1 person or more - Paper or digital observation script - 1 pen
	1. Establish criteria for observation focus	
	2. Define observation parameters, including locations, periods, frequency (daily, weekly, and so on), and other relevant details	
Static observation	3. Develop an observation script for documentation	- 1 person or more - Paper or digital observation script - 1 pen
	4. Gathering the observation documents filled	
	5. Evaluating and analysing the collected observation scripts	
Static observation	6. Engage in discussions with participants and the community to review and interpret the results	- 1 person or more - Paper or digital observation script - 1 pen
	Advantages: Highly beneficial for comprehending territory usage	
	Disadvantages: Time constraints, establishing trust, ensuring adequate conditions, impracticality in busy areas, and ethical concerns	

Table 9: Overview of qualitative techniques, steps, advantages and disadvantages and required resources/equipment.
Source: Source: URBiNAT Deliverable 5.6. (2024).

Co-walks with interviews	<ol style="list-style-type: none"> 1. Create a list of open topics for discussion during the walk 2. Collaboratively plan a flexible route with the participants 3. Remain attentive to the themes introduced by participants during the co-walk 4. Ensure all participants take turns walking the route with the microphone 5. Transcribe the collected dialogues 6. Evaluating and interpreting the gathered information 7. Engage in discussions with participants and the community to review and interpret the results 	<ul style="list-style-type: none"> - 1 person or more - Recorder
	Advantages: Knowledge about territory	
	Disadvantages: Restricted to a limited group of individuals	
In-depth interviews	<ol style="list-style-type: none"> 1. Develop an interview script outlining relevant topics for evaluation 2. Establish a schedule for interviewing a quiet and comfortable local for the interview 3. Transcribe the interview 4. Analyse the content of the discourse 5. Initiate discussions with participants to review and interpret the results 	<ul style="list-style-type: none"> - 1 person - Recorder
	Advantages: Engage absent stakeholders in the process and allow revise the processes	
	Disadvantages: Time limitations for conducting, transcribing, and interpreting data	
Focus group	<ol style="list-style-type: none"> 1. Develop a focus group script outlining relevant topics for evaluation 2. Identify the profile of participants and ensure the diversity relevant for the purpose 3. Transcribe the focus group 4. Analyse the content of the discourse 6. Initiate discussions with participants to review and interpret the results 	<ul style="list-style-type: none"> - 2 people (Facilitator and note taker) - Recorder
	Advantages: Gathering opinions and perceptions regarding a specific group or target within the process	
	Disadvantages: Restricted to a limited group of individuals	
Participant Observation	<ol style="list-style-type: none"> 1. Establish topics and criteria for the observation (relationships, emotions, dialogues, and so on) 2. During the participant observation capture the details, sequence atmosphere, roles, actions, but also the absences 3. Gathering the participant observation documents filled 4. Evaluating and analysing the collected information 6. Engage in discussions with participants and the community to review and interpret the results 	<ul style="list-style-type: none"> - 1 person or more - Paper or digital observation script - 1 pen
	ADVANTAGES: Understanding strengths and weaknesses allows for effective adjustments to be made to the process	
	DISADVANTAGES: Challenges include the complexity of real-time information registration, the need for specialised skills, and the inherent subjectivity of the observer	

Table 9: Overview of qualitative techniques, steps, advantages and disadvantages and required resources/equipment (continued).

4.

USING CROSS-CUTTING DIMENSIONS AND CATEGORIES OF CITIZEN ENGAGEMENT GUIDELINES FOR INCLUSIVE NBS CO-CREATION

Given the complex nature of issues relating to participation and NBS, the chapter is dedicated to highlighting some of the issues and features that URBiNAT used as a means to enhance citizens engagement, particularly considering the dimensions that assumed a cross-cutting aspect along the lifespan of the project. Therefore, section 4.1 offers an explanation of the cross-cutting dimensions that are fundamental in encompassing participation within the scope of URBiNAT, such as ethics, human rights and gender. The following section (4.2) entails aspects that relate to guidelines for citizens engagement, tackling issues that relate fundamentals in citizens engagement, the living framework as well as the building blocks. These involve categories that emerged from fieldwork for citizens engagement and the co-creation of NBS. Both sections undertake an approach that opens ways for the conveyance of lessons learned and the emergence of recommendations consistent with each of the themes upheld.

4.1 CROSS-CUTTING DIMENSIONS: ETHICS, HUMAN RIGHTS, AND GENDER

Nathalie Nunes and Joana Santos

Ethical requirements, along with human rights and gender considerations, are foundational for inclusive citizen engagement and co-creation of NBS. These aspects serve as cross-cutting dimensions, spanning various aspects of the project and providing lenses through which to analyse research and innovation content, as well as guide activities at every stage.

ETHICAL REQUIREMENTS

URBiNAT neighbourhoods encompass a variety of cultural and socioeconomic backgrounds, including vulnerable individuals and groups. In this

context, recognising and respecting the specific needs and circumstances of individuals and groups is crucial for inclusive urban planning. This justifies targeting certain segments of citizens, such as children, gender, people with disabilities, older adults, race and ethnicity, citizenship status, and religious diversity. These individuals and groups are identified throughout the co-creation process, enabling participatory activities to utilise strategies tailored to their specific needs and circumstances, as outlined in the URBiNAT Code of Ethics and Conduct.

URBiNAT's methodologies and integrated strategies aim to foster safe and creative environments while empowering individuals' autonomy and adhering to the project's ethical principles. This commitment to ethics is demonstrated through the promotion of integrity, democratisation, solidarity, interculturality, intersectionality, and accountability, all upheld through a transparent procedure that includes informed consent and adherence to legal requirements throughout the participatory process. Furthermore, an 'Ethics Commission' serves as an independent, multi-disciplinary advisory body, ensuring adherence to ethical principles and facilitating conflict resolution when necessary.

Figure 7: Photomontage of screenshots by Nathalie Nunes from two interview videos with the citizens' voices and dreams:

Video 1 – Documentary of the kick-off event in Campanhã, Porto, held on the 12th of October 2019. Produced by Maximilien Michaux and Fernanda Curi, November 2019 ([link](#)).

Video 2 – Dreams of a Healthy Corridor for the district of Campanhã, Porto. Produced by Visões Úteis, June 2020. ([link](#)).



RIGHTS-BASED APPROACH AND INTERNAL GENDER TASK FORCE

A rights-based approach and gender mainstreaming are also particularly crucial as foundational frameworks for anticipating the impact of URBiNAT's inclusive urban regeneration, facilitated through its co-creation process. The URBiNAT framework for a rights-based approach is guided by the following principles:

- *People as citizens* - holders of rights and capable of claiming their rights;
- *Full citizenship* - for all, through the empowerment of discriminated groups of persons, including active participation in political, economic, social, and cultural life;
- *Applying all rights* - as universal and indivisible human rights, encompassing multiple dimensions (civil, political, economic, social, environmental, and cultural rights both individually and collectively);
- *Participation and access to the decision-making process* - as the basis for active citizenship and sustained multi-stakeholder partnership;
- *Non-discrimination and equal access* - of all groups and persons, with a focus on their specificities based on age, gender, functionalities, social and citizenship status diversities, and vulnerabilities;
- *Inclusivity* - by identifying and addressing multiple discriminations based on ableism, ageism, classism, homophobia, racism, sexism, transphobia, and xenophobia among others;
- *Accountability* - promoting accessible, transparent, and effective mechanisms of accountability by rights holders;
- *Transparency and access to information* - with information available in accessible formats for all, including for groups and persons with specificities; and
- *'Do no harm'* - analysing and avoiding unintended negative impact in terms of human rights, including exclusion and stigmatisation.

The table below demonstrates the application of these principles in shaping people-centred methodological approaches for inclusive and participatory design of public spaces. Specifically, it emphasises participation, inclusivity, non-discrimination, and equal access.

Furthermore, the URBiNAT consortium felt it necessary to establish an internal task force to address gender balance measures. This initiative has



Pictures by Nathalie Nunes

On the occasion of the consortium meeting organised in Brussels in September 2022, the municipality promoted a workshop on inclusive and participatory design of public space, aiming at making use of the consortium visit and URBiNAT partner's expertise, and building a common expertise and reflection. The workshop was designed, organised and facilitated by Laetitia Boon and Sassia Lettoun.

Following a preliminary gathering of inputs from citizens and inhabitants gravitating around a case study site, the main aspects of the workshop covered:

- How to design spaces that have inclusivity at the core of their problem definition and design solution?
- How can the space be designed to make potential users feel most at ease?
- How to improve accessibility?
- How to orient people with handicaps?
- How to create safe spaces?

Moreover, applying an intersectional approach to inclusive and participatory design of public space, the following specificities were taken into account:

- Age, namely children, youth, older people, who frequent a playground for 0-6 years old, and where equipment may accommodate seating for the elderly;
- Gender, including accompanying adults, people of colour, and focusing on feeling at ease;
- People with a (physical) handicap, considering edge of sidewalks, urban furniture, playground equipment;
- Other types of handicap, such as deafness, blindness, being neuro-atypical, taking into consideration orientation and safety.

Table 10. Workshop on inclusive and participatory design of public space (27th Sep. 2022). Adapted from URBiNAT's deliverable D1.10 (2023).

spurred discussions on human rights issues and related specifics, focusing on three key areas that extend beyond the internal functioning of the consortium:

- *Gender mainstreaming* - emphasising gender balance and adopting a gender lens in the project's codes of ethics and conduct, public events (i.e. gender responsive approach), decision-making bodies (e.g., steering committee and general assembly), internal meetings, and interactions.
- *Gender in practices* - prioritising gender balance and adopting a gender lens in urban plans, public space design, participatory activities, and educational programmes.
- *Awareness raising and analysis* - compiling, analysing, and reporting on gender and intersectionality in deliverables/reports, as well as applying a gender and intersectionality analytical approach. Additionally, adopting gender balance and a gender lens in the project's communication activities and website (i.e. gender sensitive communication).

The establishment of URBiNAT's gender task force has furthered the project's agenda for women by facilitating the exchange of challenges, experiences, and practices from diverse contexts. Efforts to integrate a gender perspective and enhance gender balance as a central cross-cutting theme across organisational, event, and research contexts have heightened awareness of practices and promoted reflexivity.

KEY LESSONS LEARNED AND RECOMMENDATIONS

The global health crisis caused by COVID-19 has accentuated the need to apply these cross-cutting perspectives to a more intricate array of societal challenges. However, this complexity is not solely theoretical; it is also practical. Integrating these themes as integral dimensions of URBiNAT presents initial challenges, including ensuring their continual presence in activity planning and development. It is essential to engage as many consortium partners as possible in adopting these perspectives within their internal and organisational agendas, analyses, and perspectives on the project's progress and results. This may require changes in established procedures, cultures, values, and practices among partners and stakeholders.



Figure 8. Adopting gender issues as part of the participatory process, in action, research, and internally. Source: URBiNAT's deliverable D1.10 (2023).

Regarding the gender task force, encountered challenges and shortcomings underscore that gender balance transcends mere representation of females and males. Thoroughly analysing gender dynamics, including the distribution of strategic and operational responsibilities, formal and effective leadership, and overall gender inclusiveness, necessitates adequate time and space for assessment. Collecting, systematising, and publicising relevant information, particularly concerning intersectional perspectives related to gender issues and inequalities, is imperative.

In strategic terms, cross-cutting dimensions function as lenses unveiling deep-seated inequalities that need to be overcome. Operationally, they aid in designing strategies that promote diversity, acceptance of complexity, and improved conditions for participation. Essential steps and tools for implementing these cross-cutting dimensions and perspectives include:

- Establishing principle guidelines on ethics tailored to the specific needs and circumstances of individuals and groups.
- Developing ethics regulations, procedures, and tools.

- Adopting a rights-based approach framework, with particular emphasis on gender analysis.
- Integrating these principles into codes related to both conduct and communication/dissemination activities.
- Being aware of and effectively managing controversies and complaints.
- Recognizing that the conduct of project researchers, technicians, and field experts — such as being accessible, responsive, and transparent — is central to these interactions.
- Efforts for wider communication and dissemination to enable not only understanding of such themes but also to instigate changes in social practices that move towards equality and equity.
- Providing adequate time and space for assessment, based on the collection, systematisation, and publicization of relevant information, particularly concerning intersectional perspectives.

The table below highlights URBiNAT's international conference as a pivotal opportunity to explore scientific and practical proposals, welcoming contributions from the scientific community, practitioners, and social movements. Significantly, it served as a platform to share and disseminate an intersectional approach in co-creation and inclusive urban regeneration.

INTERSECTIONAL SCIENTIFIC AND PRACTICAL EXCHANGES



Theatre Company "Era uma vez... Teatro" from the Portuguese Cerebral Paralysis Association (APPC) at the URBiNAT's kick-off event in Porto (12th Oct. 2019), with the presentation of the play "Viagens Cruzadas", adapted from Mia Couto's essay "The seven dirty shoes". Picture by Carlos Barradas.



Exploratory walks to draw attention to the experiences and sensations of women in the city, organised by the association Garance in Brussels. Picture by Johanne Verbockhaven.



URBiNAT workshop designing the children's city in Siena



URBiNAT workshop in Khorramabad: training sessions about local diagnostic, co-creation process and NBS catalogue

During URBiNAT's international conference,¹ held on June 16th and 17th, 2022, in Milan, Italy, the project's partners proposed twenty sessions to foster discussion on concepts, methodologies, and practices related to nature-based solutions, co-creation processes, and inclusive urban regeneration. The conference aimed to explore URBiNAT's scientific and practical proposals by welcoming contributions from the scientific community, practitioners, and social movements.

Human rights and gender were cross-cutting issues addressed across various sessions and themes of the conference, including co-creating nature-based solutions for sustainable cities, innovating public space for inclusive cities, transforming governance for innovative cities, engaging citizens for healthy cities, and changing the economy for equitable cities.

Some specific sessions paved the way for an intersectional approach in co-creation and inclusive urban regeneration. These sessions namely considered feminism, functional diversity, the active involvement of children and youth, and disruptive approaches for citizen engagement.

Table 11. Intersectional scientific and practical exchanges at URBiNAT's international conference (17th June 2022).

¹ link: <https://urbinat.eu/conference-2022/>.

4.2. CATEGORIES OF GUIDELINES FOR CITIZENS ENGAGEMENT

Nathalie Nunes and Joana Santos

Researchers and practitioners involved in URBiNAT have conducted extensive research and fieldwork on citizen engagement and the co-creation of NBS, particularly relevant in the context of inclusive and innovative urban regeneration. By identifying significant factors influencing citizen engagement, URBiNAT has developed a dynamic framework of guidelines, continuously enriched and refined through ongoing knowledge exchange and learning with practitioners both within and beyond the URBiNAT community.

IDENTIFICATION OF SIGNIFICANT FACTORS IMPACTING CITIZEN ENGAGEMENT

URBiNAT's framework of guidelines for citizen engagement and the co-creation of NBS evolved through URBiNAT's collective and participatory knowledge production pathway, which unfolded as follows:

- Partners accumulated insights drawing from a diverse array of perspectives in academic, technical, and political realms, laying the theoretical and methodological foundations of the project.
- These insights were systematised into categories representing significant factors influencing citizen engagement.
- Partners engaged in sharing and learning sessions with practitioners both within and beyond URBiNAT, refining and adjusting the categories based on observations and input from these contributors.

The initial table image provides an overview of the 25 categories of guidelines that arose from this collective and participatory knowledge production process. The varying shades of grey represent the prioritisation ranking by participants in workshops and webinars held in 2019, highlighting the most critical aspects of citizen engagement across different contexts, including communication and interaction, behavioural changes, and trust.

Focusing on enhancing participation in urban regeneration, particularly concerning NBS co-creation projects like URBiNAT, this framework underscores the crucial factors influencing citizen engagement—the fundamental levers or key ingredients for successful citizen involvement. Within URBiNAT’s guideline structure, these categories are delineated into strategic and operational guidelines, encompassing essential prerequisites, core facilitators, and methods, tools, and approaches for co-creating NBS in socially disadvantaged neighbourhoods (see Nunes et al., 2021 for the detailed initial framework).

Designed to address citizen engagement and NBS co-creation based on local and specific priorities, contexts, and challenges, this framework ensures that the particular needs of various segments of citizens are met. It aligns citizen engagement with the participatory cultures of cities and the diversity of practitioners. Indeed, when intervention is required in a certain territory, the prioritisation of categories/guidelines varies depending on the local context and the diversity of practitioners cohabiting and coexisting within the defined area. Consequently, this flexible (or ‘living’) framework allows for combinations of guideline categories that inspire and promote ownership of the process.

LIVING FRAMEWORK

As a ‘living’ framework, URBiNAT’s guideline categories continue to evolve through ongoing assessment of their relevance, completeness, and usefulness, and how practitioners can incorporate them into future work. On the one hand, in 2022, exchanges with city representatives and local task forces reaffirmed the importance of these guideline categories as influential factors shaping citizen engagement and their interconnectedness (see URBiNAT’s deliverable D3.6). This framework has also demonstrated its relevance in two significant areas:

- *Continuous evaluation of participatory processes* - By offering insights to practitioners and participants in living labs, it facilitates the tailoring of participatory processes to meet local needs and aspirations effectively.
- *Advancement of living knowledge generation* - It facilitates the documentation of best practices for sharing among cities and strengthens the linkages between knowledge within municipal administrations, private and public organisations, and academia.

On the other hand, the European Commission has been actively promoting clustering activities to amplify the impact of both the Horizon 2020 and Horizon Europe programmes. These activities aim to unite EU-funded NBS projects through task forces dedicated to exploring the development of joint guidelines on NBS co-creation (NetworkNature, 2023). Collaborations within Task Force 6 on co-creation and co-governance have capitalised on URBiNAT guideline categories, combining them with the experience and knowledge generated by other European project partners. This combination paved the way to set the scene for the co-creation and co-governance of NBS based on a ‘building blocks approach’ (Nunes & Lupp, 2023).

As depicted in the second figure in the table below, the ‘building blocks approach’ operates under the premise that the co-creation of customised NBS hinges on a robust foundation of essential elements crucial for successful implementation. These ‘building blocks’ are interconnected, emphasising specific aspects without excluding others, with their relevance and interconnection contingent upon the practical context and stage of the NBS co-creation process. They are categorised into four main dimensions for designing and implementing a co-creation process (Nunes & Lupp, 2023). First, the ‘guiding principles’ blocks establish the fundamental tenets of the co-creation process. Secondly, ‘stakeholder engagement’ blocks ensure broad outreach, extending beyond traditional stakeholders to include and empower those often overlooked. Thirdly, ‘context-specific’ building blocks are tailored to suit the unique characteristics of each context, essential for effectively engaging stakeholders. Finally, ‘inclusive approaches’ aim to harness stakeholders’ skills, creating added value and multiple benefits through the design of NBS.

KEY LESSONS LEARNED AND RECOMMENDATIONS

An analysis of local participatory cultures and the identification of significant factors impacting citizen engagement have facilitated access to and integration of diverse stakeholder knowledge. The ‘guideline categories’ emerge as valuable tools for practitioners, aiding in the strategic planning of citizen engagement before initiating NBS projects. By leveraging established participatory initiatives and the strengths of relevant stakeholders, they ensure that fundamental conditions necessary for effective citizen engagement are taken into account. Additionally, they help identify crucial components for optimising the social, economic, and environmental impact of NBS.

As practitioners and researchers continue to collaborate, ‘guideline categories’ for citizen engagement will evolve, incorporating new insights into their application, combination, and impact. Ongoing assessment of participatory processes and learning from diverse contexts can inspire further refinement of these categories and corresponding guidelines, taking into account lessons learned, and best practices. This iterative process enables the diagnosis of challenges, formulation of strategies, and testing of hypotheses, fostering innovation.

Therefore, in developing strategies for citizen engagement and NBS co-creation, it is essential to consider the following aspects:

- Comprehensive analysis: conducting a thorough analysis of local participatory cultures and identifying key factors influencing citizen engagement are foundational for informing NBS design and implementation.
- Collaborative knowledge sharing: collaboration among participation experts, city-level practitioners, and stakeholders facilitates the production, sharing, and accessibility of knowledge on citizen engagement and NBS co-creation, fostering innovation and best practice dissemination.
- Flexibility and adaptability: embracing a flexible and ‘living’ framework allows for continuous evolution and adaptation of guidelines, enabling practitioners to respond effectively to changing circumstances and stakeholder needs.
- Cross-context learning: sharing experiences and lessons learned from diverse contexts enriches understanding and inspires further guideline development.
- Continuous monitoring and evaluation: ongoing monitoring and evaluation of participatory processes and NBS activities are crucial for assessing effectiveness, identifying areas for improvement, and ensuring the ongoing relevance of guidelines.

LIVING FRAMEWORK OF GUIDELINES: FROM CATEGORIES TO BUILDING BLOCKS

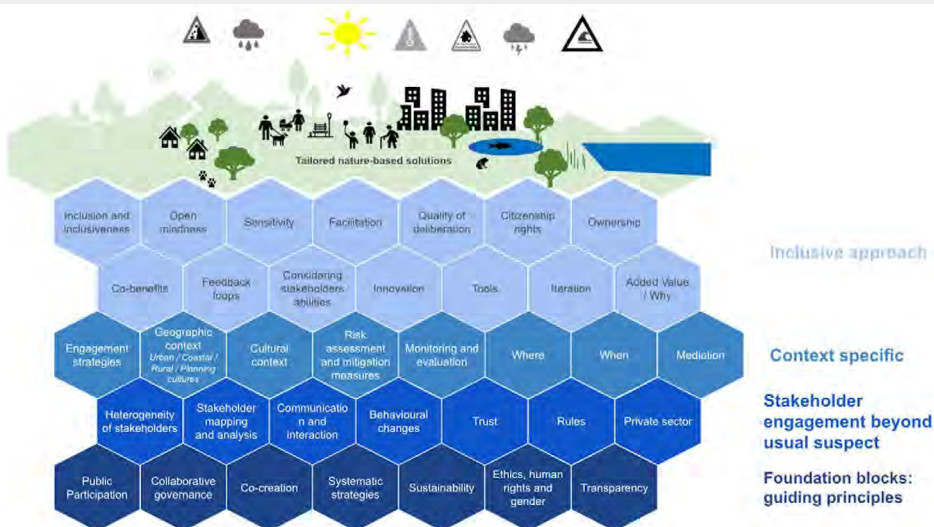
Overview of guideline categories addressing core leverages for successful citizen engagement in the co-creation of NBS

COMMUNICATION AND INTERACTION	BEHAVIOURAL CHANGES	TRUST	CO-PRODUCTION	INCLUSION
Communicating specificities for interacting with citizens.	Instigating behavioural adjustments, or changes in behaviour, in some particular respect.	Improving or creating relationships of trust between citizens, and between citizens and city staff, politicians, and other agents.	Stimulating and improving the co-production of public services, participatory processes, and product development.	Having specific guidelines to guarantee the inclusion of all citizens groups.
REGULATION	GOVERNANCE	INNOVATION CYCLE	TRANSPARENCY	INTENSITY AND LEVELS OF PARTICIPATION
Clarifying rules and regulations for equal rights in the expression of visions and priorities.	Balancing interactions among citizens, city staff, politicians, and other agents.	Adopting processes of rupture and searching for alternative solutions to address concrete social problems.	Arguments for encouraging efforts to act in a transparent manner.	Setting different approaches and levels of participation depending on the goals and real conditions for participation.
CITIZENSHIP RIGHTS	CULTURAL MAPPING	FACILITATION	QUALITY OF DELIBERATION	WHERE
Broadening the meaning of the appropriation of social, urban, political, and cultural rights, both internally in the collective imagination, and externally in rejuvenated relationships with local powers.	Articulating and making visible the multi-layered cultural assets, aspects, and meanings of a place.	Having specific guidelines to address facilitation that include other participatory guidelines.	Setting a meaningful deliberation process.	Having guidelines for the spaces in which the participatory events are held.
WHEN	SUPPORTIVE METHODOLOGIES AND TECHNIQUES	INTEGRATION OF PARTICIPATORY PROCESS' RESULTS	PRIVATE SECTOR	MONITORING AND EVALUATION
Identifying the best moment for the participatory events.	Using specific methodologies and guidelines to support mobilisation and inclusivity.	Enlarging the scope of co-creation to validate the ideas developed.	Mapping the relevant private sector actors with interests in, and input to, the NBS targeted areas.	Addresses monitoring and evaluation of the participatory process.
RISKS ASSESSMENT AND MITIGATION MEASURES	OWNERSHIP	CULTURE OF PARTICIPATION	WHY PARTICIPATION	MEDIATION
Identifying the factors influencing co-creation processes, as well as those leading to the failure of co-creation and co-production.	Citizens having ownership of both problems and solutions.	Enabling regular interaction with and between citizens and increasing the culture of participation.	Being clear as to why we need to engage citizens and support participatory processes.	Dialogue and collaboration.

Source: Adapted from [URBiNAT's deliverable D3.2](#)

See Nunes et al. (2021) to consult URBiNAT's detailed initial framework, which incorporates strategic and operational guidelines.

Devising a co-creation process based on a building blocks approach



Source: Nunes & Lupp (2023)

Table 12. Living framework of guidelines: from categories to building blocks.

5. CO-CREATION MAIN STRUCTURES IN URBINAT: ROLE FOR THE NBS IMPLEMENTATION

The activation of the URBiNAT living labs in Frontrunner and Follower cities was achieved during the activities related with the local diagnostic to collect data through a participatory process (D2.1 and D2.6). To setup these activities, local taskforces engaged several actors that played different roles: citizens that live, work and study in the study area; stakeholders, as associations, institutions, companies, that develop their activity in the study area; the municipal technicians that support the implementation and management of NBS in the Healthy Corridor; elected representatives that have responsibilities in study area. Beyond the expected results, the observer city Khorramabad, Iran, also activated a living lab, demonstrating the replication capacity of URBiNAT methodology outside of the European context. The activation of the living lab created a strong interaction between these groups that didn't know each other before and promoted new synergies beyond URBiNAT, as stated by many of these actors.

5.1. LOCAL TASK FORCES: COLLABORATION BETWEEN PUBLIC OFFICERS, RESEARCHERS, PRACTITIONERS AND FACILITATORS

Gonçalo Canto Moniz and Joana Santos

The creation of the local task forces is related to the overreaching practice and concept of participation and the implementation of the “Living labs” framework (see section 5.2). The creation of these organisations and their constitution are based on the principle of collaboration between different actors and different fields of knowledge. Therefore these organisations are both intersectoral and interdisciplinary which gives them several positive attributes concerning participatory processes. These attributes include a highly flexible nature that enables them to tackle eventual

setbacks and/or needs. The co-creation of the healthy corridor in each city is coordinated by the local task force, constituted in the first moment, by public officers, scientific partners, practitioners and facilitators who meet regularly to plan, manage and operationalise all the backstage work to implement, animate, care and monitor the activities of the living labs. and in the second moment, by local institutions and stakeholders that are involved in the co-creation process.

In relation to a collaborative perspective, the local task force, operationalizes what is designated as a quadruple helix, given that it constitutes an innovative process that enables and enhances dialogue between four different sectors: Government, Academic Research, Civil Society (and culture) and Business sector. The opportunity of joining different entities, may they be public or private, in dialogue paves the way for the constitution of communities of practice at the city level (Schütz, 2019).

Concerning duties and roles associated with the local task force, they are related above all to engendering a collaborative relation between different actors that supports the planning, operationalisation and production of benefits and outcomes concerning the co-creation process itself and the NBS and their implementation. These duties and roles are common to the three frontrunner cities (Porto, Nantes and Sofia), however the entities involved at the different levels in each respective city vary according to the cities own organisational culture: just to give an example while in Porto (at the high management level) coordination is executed by environment planning and management department, in Nantes and Sofia coordination is at the hand of the Urban Planning Department. Despite these slight differences in terms of public entities involved in the local task force, what is important to highlight is that each city was able to enforce the creation of the local task force with the underlying intention of promoting a steady dialogue between different stakeholders and was able to establish partnerships at different levels which reassures and reinforces the notion of shared responsibility and collective work concerning what urban regeneration, management of public spaces and the implementation of NBS should look like.

Each task force developed their plan of action following the co-creation methodology combined with the local culture, the municipality strategy and the synergies created with other public and private projects. The local community was engaged from the beginning, with different groups and in several activities. The local task forces also cooperated in the reporting of the project activities. For instance, Deliverable 3.1 is the outcome of close

dialogue with the three cities’ task forces that allowed the sharing of scientific and technical knowledge through an internal participatory process where the structure, methodology, analyses of data and presentation of results was developed together.

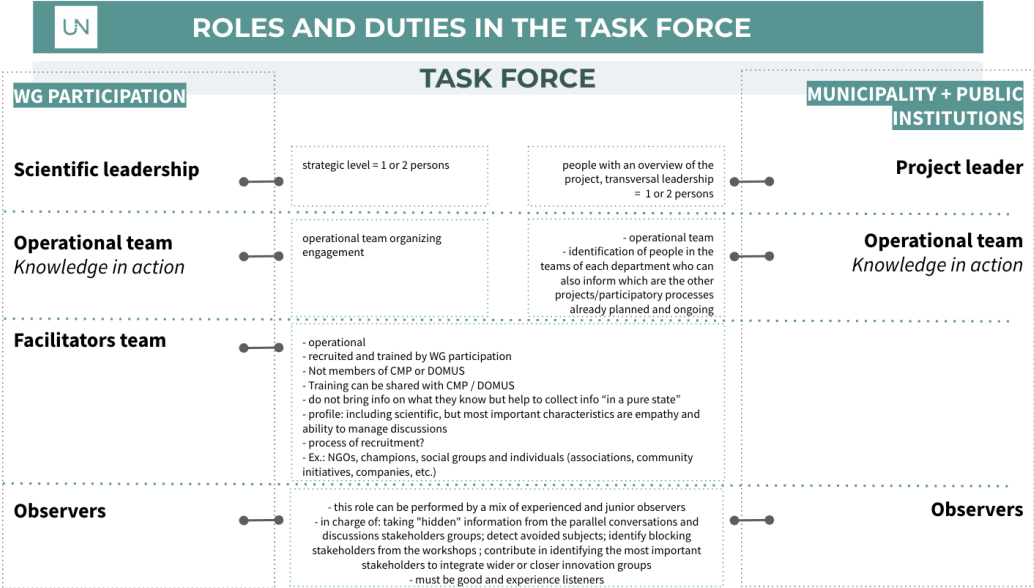


Figure 9 - Roles and duties within the task forces. Source: Deliverable 3.1 (2019).

5.2 LIVING LABS

Knud Erik Hilding-Hamann

Living Labs are open innovation ecosystems in real-life environments using iterative feedback processes throughout a lifecycle approach of an innovation to create sustainable impact. They focus on co-creation, rapid prototyping & testing and scaling-up innovations, providing different types of joint-value to the involved stakeholders. In this context, Living Labs operate as intermediaries among citizens, research organisations, companies and government agencies/levels (ENoLL 2017).

The role of citizens and stakeholders in developing and implementing an inclusive urban regeneration process is set within the framework of the Living Labs that are active in each URBiNAT city, together with the building up of a CoP between URBiNAT cities and other partners who come to establish a scientific or practical dialogue within the project.

The Living Lab of each city is a platform and ecosystem for the NBS co-creation to take place. It is populated by people as participating stakeholders, who then develop the Healthy Corridor with its NBS. In frontrunner cities, the Living Labs will co-design, co-develop, co-implement and test NBS. In follower cities, Living Labs will follow the same processes of co-creation and co- development, replicating and adapting NBS to their own urban contexts within an urban plan.

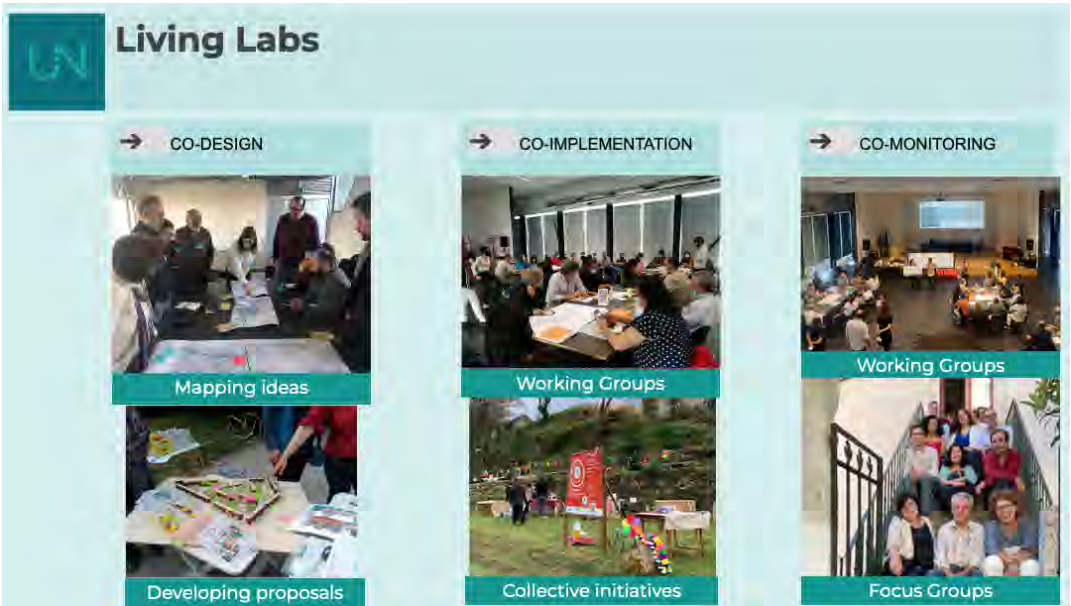


Figure 10. URBiNAT activities with participants from the Living Lab in Porto.
Source: URBiNAT, from 2019 to 2023.

Each city identified a district in which to locate the Living Lab in accordance with criteria proposed by URBiNAT, namely: (a) areas under urban regeneration, (b) areas on the periphery of the cities urbanised in the post war period (1945–1970), (c) areas with a predominance of social housing neighbourhoods; (d) areas with social challenges and inequalities.

Within these districts, the URBiNAT task force defined, during local diagnostics, the study area and then the intervention area, according to the needs of the citizens and the public lots available for the physical implementation of the Healthy Corridors. These are the URBiNAT neighbourhoods and Living Labs.

With the creation of these Living Lab spaces that engage with the relevant community groups, new ideas and possibilities that will ultimately inform the evidence base of the future healthy corridor are designed, tested and assessed. Different stakeholders operate in this space covering the public and private sectors as well as social stakeholders that operate in public-private partnerships and therefore can try out and test new ideas that take the best from public and private sectors and turn them into new NBS implementations that enhance the reach and impacts of the resulting healthy corridors.

The URBiNAT Living Lab ecosystem exploits openness, multiculturalism and multi-disciplinarity. As such it benefits from diversity and enables the materialisation of breakthrough ideas, concepts and scenarios resulting in adoptable innovative solutions (Mateus, Leonor and Martins, 2018).

In frontrunner cities, the Living Labs co-implement and test NBS. In follower cities, Living Labs will follow the same processes of co-creation and co-development, replicating and adapting NBS to their own urban contexts within an urban plan.

The implementation task of stakeholders in respective Living Labs is to prepare for the use of NBS in support of the up-take and benefits of NBS. This requires understanding the local context, the nature of the NBS to be implemented and how stakeholder capabilities, digital tools and applications can support the process.

The very purpose of the implementation in the Living Lab is to bring about a lasting change in perception, mindset, and behaviours, possibly implicating increased self-confidence, a sense of “can-do”, that can lead on to follow-up initiative. Co-implementation is also framed by the organisation of the advisory boards according to the municipal roadmap, where citizens, association, municipal technicians and elected representatives establish the steps for the implementation of material and immaterial NBS of the healthy corridor.

The role of the Living Lab is also to contribute to an ongoing assessment of participatory processes, by providing practitioners and participants of Living Labs with insights for evaluations on what works and does not work / what worked or did not work. This information will serve as a basis for the development of adjustments regarding NBS and healthy corridors.

In Porto, the Living Lab comprises local partners (Porto Municipality; Domus Social, EM; and CIBIO) and horizontal partners (CES; GUDA and UC). These partners have been responsible for the establishment of the Living Lab. In doing so, the Living Lab integrates the specific skills, insights and influences from municipal decision makers, technicians, and school managers. The Living Lab was also able to establish a permanent base for its activities in a room provided by Secondary School Cerco do Porto. From here the URBiNAT processes, activities, and selected working groups have been orchestrated engaging individual citizens and 16 or more social organisations and associations in the vicinity of the Living Lab designated area. Through the URBiNAT processes and development activities more than 40 NBS ideas were co-created and tested for implementation in the healthy corridor in Campanhã. Many of these ideas are integrated into the actual implementation underway in Porto. Soon it will be up to the municipality, citizens and the social organisations and associations to implement, develop and sustain healthy and value-adding activities in the corridor exploiting the co-created physical Nature-based solutions (Pombeiro et al, 2021).

In Sofia, the Living Lab comprises partners from UACG and Sofia municipality, the local municipality of Nadezhda, citizens, some chairs of the property owners' associations, representatives of NGOs, teachers and directors of local schools and kindergartens located in the district. In the Living Lab the stakeholders conducted open workshops with citizens and could also engage people in activities at places in the designated area where citizens would normally pass/transit, gather and rest in larger numbers (e.g at the leisure club for children in the area). The Living lab in Sofia has had a few physical locations of which the most frequently used is the Local cultural institute of Nadezhda and the NBS may include a future Living Lab pavilion. Co-creation workshops and events have taken place in each of the four intervention themes of the healthy corridor leading to a wide range of NBS ideas. The four overarching themes developed (co-place, health energy, aqua vita and green assembly) lead to co-designs that will enhance life around existing public spaces and stimulate active life and healthy lifestyles among citizens (Tasheva-Petrova & Zlatinova-Pavlova, 2021)

The living lab in Nantes Nord worked with citizens through regular meetings with citizens at Youth Centres. These Youth Centres provided by the city served as hubs for residents to engage with URBiNAT project partners, fostering a sense of ownership and community in the project. Central to the success of the Nantes living lab has also been the involvement of local partners Nantes Métropole and IRSTV alongside numerous local associations.

A Mobil'O Bus served as a mobile living lab initiative and became a dynamic space for citizens to discuss and co-create the healthy corridor. This approach brought the project directly to the people, enhancing accessibility and engagement. Serving as an innovative mobile meeting point, the bus has facilitated direct exchanges with local residents about the ongoing project and the Nature-Based solutions being implemented in the district. Travelling throughout Nantes Nord and making the project accessible and inclusive, it allowed citizens to gather and discuss, brainstorm and provide feedback on the various aspects of the Healthy Corridor and other NBS interventions (URBiNAT, 2024).



Figure 11: Mobil'O Bus.
Source: Nantes Métropole.

5.4 MUNICIPAL ROADMAP

Isabel Ferreira and Joana Santos

Despite the efforts made in engaging citizens in the co-diagnostic and co-design stages, in regard to other stages of the co-creation process, the role of citizens in the co-implementing and co-monitoring stage weren't very clear, specifically concerning negotiation and deliberation (the decision – making moments). Therefore, addressing NBS and the edification of healthy corridors implies to tackle structural dimensions that underpin the dynamics of negotiation and participation within the sphere of the co-creation process and thus of the existence of processes associated to co-governance. The participatory process always produces exclusions, but it is always possible to uncover who has a voice and who does not and return to the decision-making process to integrate those who are excluded (Ferreira, 2022). The municipal roadmap is a living process that uses democracy and diversity as lenses to reinvent and remake itself through successive attempts. It was used as a methodological approach to tackle 1) the need for opening and reinforcing the input channels for proposals resulting from the co-created work; 2) the need for reinforcement of the commitment to co-creation between organised and non-organized citizens, elected politicians, public officers and researchers; and 3) the need of strengthening the institutionalisation of new governance structures that pursue the consolidation of channels of participation within local governance. In addition to reinforcement, this municipal roadmap strategy is also an opportunity to situate the perspectives of municipal actors, unpacking the complexity of the municipal decision-making process and identifying what are the political reasons, technical understandings and administrative aspects that prevent or drive progress of innovations.

The materialisation of new structures that consolidate the channels of participation in governance, namely advisory boards in the front runner cities, aimed at reinforcing the mechanisms for renewing the design and decision processes. The proposal to establish advisory boards was elaborated in the form of guidelines so that each city could adapt its composition according to its own culture of participation (see Section 3.2), namely (Ferreira, et al. 2022):

- 1) Occupation by citizens, organized and non-organized, of a space normally restricted to planners and policymakers, expanding the space of intersection between technical, political and citizens decision-makers;

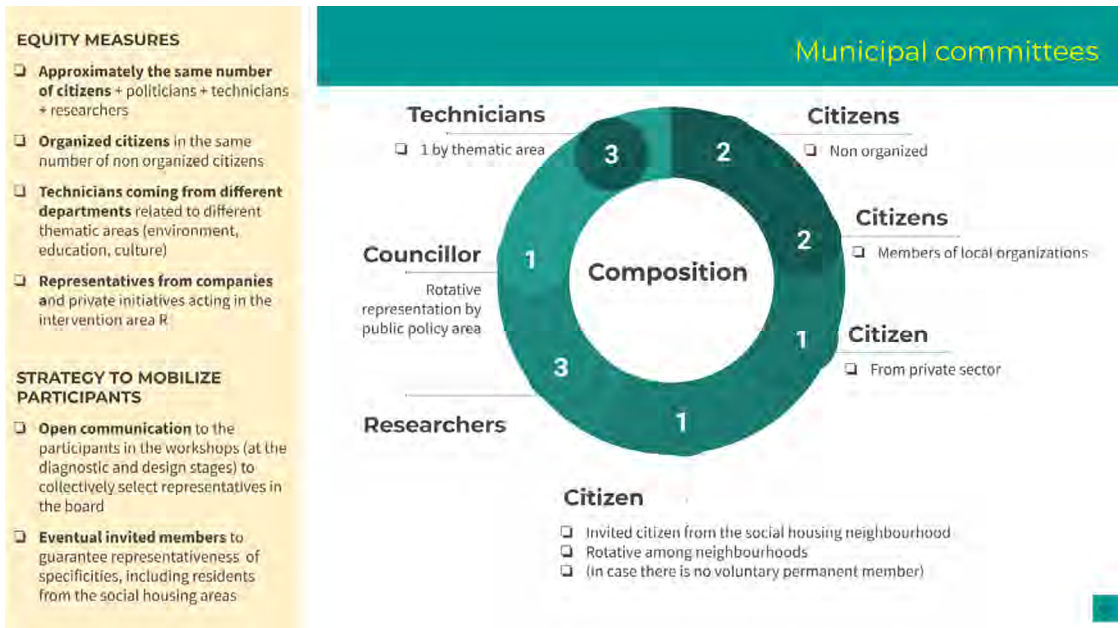


Figure 12: Composition of Municipal Committees. Adapted from internal document: Ferreira, Nunes and Caitana (2020) Guidelines for URBiNAT advisory boards and committees.

- 2) Expanding opportunities for “learning-by-doing” practices of speaking, leadership and negotiation;
- 3) Widening networks of contacts, and thus of influence, of the participating individuals;
- 4) Shortening the distance between the participatory and representative dynamics of democracy;
- 5) Informal intermediation carried out by the members of the committee/board, bridging the different agendas and interests of the citizens with whom they live.

The three frontrunner cities activated their advisory boards at the end of the co-design phase (2021), in order to create a space of dialogue between the several actors involved in the co-creation of NBS and the Healthy Corridor.

The advisory boards are a means to monitor processes associated with co-design and co-implementation, aiming for a plural influence on the decision-making process. These boards emerge as a tool to engage and




PORTO	NANTES	SOFIA
		
Picture by URBiNAT	Picture by Nantes Métropole	Picture by URBiNAT
<p>Activation of commission and working groups:</p> <ul style="list-style-type: none"> - working commission for the healthy corridor COT.CS (meets every 6 months); - working groups on education and environment, culture and sports, solidarity economy) (meet every 15 days to develop proposals). 	<p>Work with existing groups of citizens:</p> <ul style="list-style-type: none"> - fruits and vegetables working group (meets every 3 months); - general assembly of the neighbourhood; - thematic working groups for the implementation of NBS on food, education and environment, sports, social and solidarity economy. 	<p>Launch of Sofia Advisory Board (SAB) in June 2021:</p> <ul style="list-style-type: none"> - open call for citizens; - over 30 applications; - several online meetings already conducted.
<p><u>Participants:</u> political representatives (3); municipal staff (17); URBiNAT team members (7); citizens (6); associations (20); companies (1).</p>	<p><u>Participants:</u> political representatives (2); municipal staff (3); URBiNAT team members (3); citizens (5); associations (9).</p>	<p><u>Participants:</u> political representatives (1); municipal staff (3); URBiNAT team members (5); citizens (10); associations (3).</p>

Table 13. Advisory boards in front-runner cities.
Source: URBiNAT's deliverable D3.6 (2022).

empower citizens towards dialogue and negotiation between the different actors. Concerning the frontrunner cities Porto, Sofia and Nantes, each one of them activated the advisory board at the end of the co-design stage, aiming for space of dialogue to be maintained during the other co-creation stages. Despite the common guidelines (figure 12) for the creation of the advisory boards, each city, given its specific characteristics, adopted different strategies concerning the composition of the advisory boards. Nevertheless, the three cities were able to join together in dialogue with the different actors and meet on a regular basis in order to discuss issues related to the implementation process of NBS in each particular setting composed by particular needs. The advisory boards served as a starting point for the activation of several working groups (definition of themes and areas of intervention according to each cities needs) in the three cities and therefore it gave an important contribution to the emergence of a more democratic (and participative) process concerning planning and regeneration of public space, as well as a (positive) shift towards collaborative modes of governance.

The advisory boards were an important tool for experimenting new forms of guiding the decision making process when it comes not only to NBS but also in what refers to other issues that affect a certain community or society at large. Given that it enables and instigates the emergence of active participation and dialogue, through a kind of intercultural translation among different social actors with different backgrounds, interests and senses of belonging, it may produce novel outcomes regarding the diverse social, environmental and economic challenges that manifest in the contemporary world.

5.5 DIGITAL ENABLERS

Ingrid Andersson

The ongoing advance of Information and Communications Technology (ICT) has led to a massive increase in the reach and speed of communication. In the urban environment, digital tools such as smart sensors, 3D maps, location services, are increasingly applied in the planning, implementation and operations of urban infrastructure projects as well as services development, spanning public space, transport, social life, governance, and so forth.

URBiNAT has undertaken a comprehensive review of past and ongoing practices in regard to the application of Digital Enablers, with the aim to build a profound understanding how they can best be applied in support of co-creation by citizens of NBS. Digital Enablers have further been part of the co-creation processes instigated by URBiNAT, ranging from co-diagnostics to co-monitoring. Continued experimentation and learning in this respect have been accompanied by extensive communication and consultation, for further validation of the results and their relevance for diverse sets of citizens and stakeholders. The URBiNAT Observatory itself represents a specific digital enabler, in this case serving as a repository for the data gathered during the project.

For digitalisation to contribute effectively to co-creation of NBS and associated value-creation, digital tools need to be embedded in broader comprehensive vehicles, referred to as digital enablers. Our work has concluded on the importance of creating required functionality by making use of four kinds of main building blocks; purpose, method, content, and tools (Andersson, 2021a). The success of digital enablers hinges on synchronised packaging and usage of these four elements, tailored to specific situations and users (cf. Figure 11). Typically, methodologies and content should be

suited to fulfil defined purposes, while the choice of digital tools critically depends on the requirements at hand for reaching targeted local subjects.

Combinations of building blocks are considered in Andersson (2021a), along with observations of results achieved under varying circumstances. Separately, Andersson (2021b), devises novel applications, selected through close consultation with local task forces featuring citizens in selected study areas of the URBiNAT cities. These applications relate to the portfolio of NBS introduced for deployment in the project, and also their combined, aggregate constructs experimented with to shape Healthy Corridors, aimed to counter issues of fragmentation and polarisation in each city. In Nantes, for instance, a municipally-managed platform, Patrimonia, offers space for discovery and exchange around heritage, promotes diversity and bestows each citizen with the means to exert impetus on their city district (<https://patrimonia.nantes.fr>). Another digital platform, Impact Track, enables entrepreneurs, foundations, and investors to measure and communicate their impact on sustainability (<https://impacttrack.org/fr>). In Sofia, the municipality developed special platforms for the targeted district tailored to engaging the local citizens (<https://grajdanite.bg/home>). Drawing on a digital map of Sofia’s tree network, the URBiNAT Task Force has engaged to inspire citizen-led mapping of Nadezhda (<https://ednodarvo.io/>). In Porto, a social and community communication platform, Campanh’UP, mobilises and activates particularly young communicators, while bridging between generations (Novos Percursos para Campanhã).

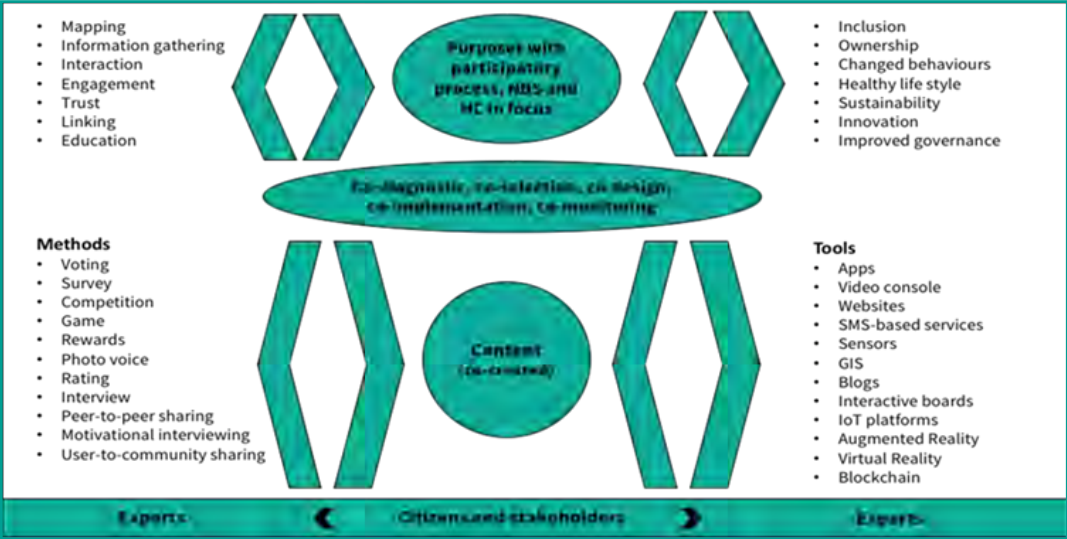


Figure 13: Building Blocks of Digital Enablers.
Source: Andersson et al. (2021a).

Adequately deployed, digital enablers add value, compared to other means of participation, due to specific advantages, or strengths, in effect representing the rationale for their application (Andersson et al., 2021a). These include speed, reach, and precision when it comes to connecting with large numbers of users - and also with specific categories - of citizens and/or stakeholders. Notably, suitable methodology and content development offers great scope for targeting and tailoring in this respect. Means of linking and strengthening bonds within sub-groups are similarly at hand. Here, so-called Communities of Interest (CoI), can be built upon and leveraged with a view to realising their shared specific interests.

In this, a challenges/solutions-driven approach should be distinguished from one that is identity/strength-based. The former places focus on bonding in response to commonly perceived threats, riding on shared fears and concerns. With the latter, positive connotations are picked up, e.g., joint appreciation for arts, food, “green”, gardening, or sports. Members of a community may mobilise to fortify and upgrade such themes in a particular neighbourhood. Especially when tailored also to enhance measurement and certification, digital enablers can help build public awareness and instigate better-informed demand for “green” and socially responsible products and behaviours. The resulting momentum may push for sustainability through both market mechanisms and pressures on policymakers (McQuaid et al., 2022).

Social factors, blended with attributes such as skills, age, gender, etc., remain greatly important determinants of habits, motivations, and behaviours impacting online communication (Silver et al., 2019). Adequately framed digital enablers, such as Campanh’UP, offer means of effectively reducing tensions between previously opposing groups and perspectives, laying new ground for collaboration and compromise. More generally, digital enablers are uniquely equipped for building or extending collaborative networks (Guerrero et al., 2015; de Vries et al., 2018). A fundamental element here is the impetus on mindset, shifting from a narrow “what is in it for me?” to “what is in it for us?” Coming into play are design methods and the framing of participatory processes that operate at community, or group level, with social relations awarded strong attention (Nam and Pardo, 2011). Albino et al., (2015) recommend “integrated approaches” which include both “hard” aspects – technology-based, material compensation – and “soft” (social) rewards.

Throughout, care is required to counter possible downsides, such as dependency on proprietary vendors or excessive government support (UR-BACT, 2019). Many bottom-up initiatives are trapped by freely available, mainstream social media channels, such as Facebook or Instagram. Gains in terms of accessibility and convenience tend to be compromised, however, by data misuse, privacy violation, and user manipulation (Saad-Sulonen and Horelli, 2017). Risks in this regard correlate with lacking affordability, hurting vulnerable groups the most (Marler, 2018).

By contrast, the use of platforms that run on open systems, avoiding dependency on proprietary vendors, requires substantial effort, investment, and development work, possibly including support by experts in ICT, at least in the short term. On the other hand, the latter puts users in control of their own data and development, leaving them less vulnerable to commercial exploitation and with greater development potential. National and local authorities generally lean towards the former, however, explicitly, or implicitly playing into their hands.

These conditions underpin the need for safeguards for protecting privacy, enabling adequate authentication and authorisation of IT systems, the rule of law, and civic rights. Innovations have brought some remedial action, including new forms of “digital counselling”, some offered by the private sector and others by local communities growing their own skills and promoting measures supporting safety online. (Kitchin and Dodge, 2019; Ismagilova, 2020). Even so, more is required to frame mechanisms for greater control by citizens of personal identities and data.

To conclude, digital enablers have the potential to support and facilitate the various steps in the implementation processes of NBS. One of the key opportunities has to do with monitoring and visualisation of impacts and thereby bringing awareness about benefits of NBS. In URBiNAT cities, sound examples are at hand of digital enablers, e.g., the Naonair app in Nantes, that serve to empower citizens, in this case enabling pedestrians and bikers to respond to variation in air quality. Their ability to check and share information on conditions at emblematic cultural sites, sports venues, local parks, etc., pressure public and private providers to improve local conditions. In this way, a range of recent advances are at hand thanks to digital enablers engineering improved quality measurements and alerts, GIS-embedded maps of green spaces, participatory budgets, voting systems, and the availability of healthy, locally produced food.

CONCLUSIONS

Chapter 3 focused on the structure, components, and strategies for co-creating NBS throughout the URBiNAT project. It can be used as a source of inspiration and guidance to other urban communities, experts and policymakers in Europe and worldwide. URBiNAT has exemplified an overall co-creation approach that integrates various stages and practices to foster inclusive and innovative urban regeneration. It stands out as a remarkable initiative in urban regeneration, spanning across seven European and one Middle Eastern urban contexts.

Over the course of the 6-year project implementation, URBiNAT partners demonstrated a remarkable level of commitment, actively engaging in collective action and co-creation within urban spaces alongside a diverse array of stakeholders, including citizens, organisations, and policymakers, throughout the participatory process. However, this journey was not without its challenges. Various obstacles emerged, such as differing interpretations and approaches to co-creation, disciplinary divides, logistical hurdles, cultural clashes, and participation fatigue. Particularly notable were the challenges surrounding co-creation and co-governance processes, often stemming from resistance to changing established rationalities and methodologies, as well as the need to reconsider deeply ingrained values and norms.

Nevertheless, a number of solutions that were developed and deployed during the full co-creation cycle of URBiNAT lifetime are now running in front-runner cities, particularly in Porto and Sofia where the efforts to introduce innovations in the participatory processes were more intensive and even disruptive in comparison with previous practices. Through the implementation of participatory methods and approaches, URBiNAT has succeeded in co-creating NBS that address both tangible and intangible needs in urban spaces. The co-creation approaches employed in URBiNAT have been comprehensive, spanning across different stages of co-diagnostic, co-design, co-implementation, and co-monitoring and co-evaluation. Each stage has involved active participation from various actors, contributing to the development and implementation of NBS typologies tailored to the specific contexts of the participating cities. Furthermore, by adopting cross-cutting dimensions such as ethics, human rights, and gender, URBiNAT has ensured that citizen engagement guidelines are in-

clusive and responsive to the diverse needs and perspectives of urban communities.

The co-diagnostic stage was pivotal, establishing the groundwork for community-driven processes. Efforts were directed towards mapping the local participatory culture, identifying key actors, and assessing the needs and aspirations within the intervention areas as expressed by diverse participants, including citizens (both organised and unorganised), public officers, elected representatives, and researchers. Values and practices associated with co-creation and co-governance were also pinpointed, incorporating a variety of knowledges, such as local, informal, political, technical, and scientific. The mapping process was instrumental in identifying social specificities, key actors, champions, organisations, and institutions, while also serving as an introduction to the project's scope. Furthermore, mapping activities served as a catalyst for mobilising participants to integrate into living labs and establish clear boundaries regarding the scope and objectives of co-creation, focusing on material and immaterial NBS within the public spaces of the intervention areas. Cultural events during this stage provided essential opportunities for informal gatherings, enabling actors to acquaint themselves with NBS concepts and co-creation, central to the URBiNAT approach to urban regeneration.

The co-diagnostic stage is where the structure and main components of co-creation begin to take shape: the composition and dynamics of the Living Labs; the assortment of different NBS typologies to facilitate the regeneration of public spaces; the formation of local task forces to ensure consistency and ongoing oversight of the co-creation process; and the identification of digital enablers to support overall participatory efforts.

In the co-design phase, community-driven processes were emphasised, utilising Living Labs as spaces for dialogue and interaction among citizens, organisations, researchers, and public officials. Living labs progressively evolved into safe spaces for voicing different kinds of knowledge, including local, informal, political, technical, and scientific. They achieved this by stimulating, acknowledging, and integrating the emergence of different perspectives and reasoning. A catalogue of solutions served as inspiration for co-designing new NBS. At a more advanced stage of the co-design phase, municipal roadmaps were proposed as a strategy for introducing renewed or new opportunities for dialogue, interaction, negotiation, and deliberation to address difficulties in collective participation during decision-making moments. Advisory boards or municipal committees played fundamental roles in facilitating regular interaction between participants

and elected representatives, particularly in distinguishing more clearly the responsibilities of public officers and elected representatives. While more of a back-and-forth process than a linear progression, Living Labs were privileged spaces for reimagining new opportunities for dialogue and renewed interactions among the diverse participating actors.

During the co-implementation phase, various types of NBS were combined to address both material and immaterial needs in public spaces. The meetings of the local advisory boards fostered ongoing citizen engagement at every step of the process and supported increased involvement in decision-making by discussing and negotiating urban plans and construction works. The participatory process was further energised by critically reflecting on how to create an enabling environment for co-production. In both the co-design and co-implementation stages, facilitation approaches were not only relevant but also focused on the process itself. They prioritised building relationships between actors, facilitating interactions without leading them, and maintaining flexibility to accommodate participants' varying needs regarding the appropriation of concepts and the design of activities.

The stage of co-monitoring and co-evaluation, by actively listening and observing the various actors engaged in the process, gathered valuable insights regarding the social dynamics of public spaces and the characteristics of the co-creation process. The data also reveals a range of challenges, strengths, and unique local characteristics that illustrate the cities represented in the project. Local advisory boards play a pivotal role in this monitoring and evaluation process, contributing to transparency and accountability. Roundtables and focus groups serve as platforms for reflective dialogue and interaction among participants, where limitations are acknowledged, and opportunities to reconsider and refine the co-creation approach are identified and explored.

Looking ahead, the lessons learned from URBiNAT's co-creation approach can serve as valuable insights for future urban regeneration initiatives, considering both achievements and limitations. Central to the co-creation process in URBiNAT are the main structures such as Living Labs, municipal roadmaps, and digital enablers. These structures have provided essential frameworks for collaboration, dialogue, and innovation, enabling the effective implementation of NBS in urban regeneration projects. However, these structures constituted overarching strategies that needed to be appropriated and tailored to the existing and evolving participatory cultures, based on trials and consequent adjustments, as well as consistent investment. By leveraging these structures, URBiNAT has

not only facilitated the co-creation of NBS but also promoted the democratisation of decision-making processes and the empowerment of local communities and all actors involved.

In this sense, both co-design and co-implementation stages emphasised critical proximity and collaboration among social actors, leading to transformations towards more collaborative approaches to governance regarding interventions in public spaces. The constant presence and interaction of local teams require considerable investment when these dynamics need to be established. Local teams also need to dedicate themselves to the evaluative endeavour, investing in social sciences and data collection techniques training and tools. Additionally, the process of co-monitoring and co-evaluation extend beyond the analysis of results. It is crucial to actively disseminate the findings and establish feedback mechanisms that enable participants to feel that their opinions, suggestions, and assessment have been acknowledged and considered.

Overall, by prioritising citizen engagement, embracing participatory methods, and leveraging cross-cutting dimensions of inclusion, projects like URBiNAT are replicable and have the potential to transform urban spaces into more sustainable, resilient, and equitable environments for all. Implementation process highlighted the importance of integrating participatory processes with NBS, evolving participation as both a means and an end, and leveraging different typologies of NBS to address tangible and intangible needs in urban regeneration. These lessons underscore the significance of citizen engagement in promoting sustainability and liveability in public spaces. In this sense, URBiNAT has exemplified a holistic and participatory approach to urban regeneration, demonstrating the importance of co-creation in addressing complex urban challenges.

In the context of URBiNAT, the intertwining of participatory processes with other NBS is paramount, not only for refining co-created solutions but also for ensuring a balanced allocation of resources such as time, energy, and focus on the process itself. As the project has progressed, participation has evolved beyond merely generating co-created solutions; it has become a catalyst for activating stronger citizenship practices and fostering imaginative engagement with urban spaces, essential for the sustainability and livability of the public realm. By embracing various typologies of NBS, both material and immaterial, URBiNAT embraces a holistic approach to urban regeneration. This comprehensive approach aims to produce solutions that are not only meaningful but also contribute to the overall well-being and health of public spaces.

Critical proximity played a central role in cultivating a productive and effective relationship among all social actors engaged in the participatory process. By employing a combination of methods and tools that facilitated the involvement of diverse actors, new forms of governance emerged, accompanied by significant contributions to the transformation of public spaces in terms of their definition, conceptualization, utilisation, and proposed interventions. Collaboration stands as the fundamental element of the entire participatory process, serving as the gateway to a collective (re) appropriation not only of public space but also of the decisions that shape its future.

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CHAPTER 4.

CULTURE *IN, FOR,* AS INCLUSIVE URBAN REGENERATION

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*Keywords: Culture; Nature-based Solutions; Sustainable
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INTRODUCTION

In defining a city, Italo Calvino speaks of “the relationships between the dimensions of its space and the events of its past” (Calvino, 1978). This perspective underpins an emerging discourse in inclusive urban regeneration, where culture intersects with economic, social, and environmental ‘pillars of sustainability’ (cf. Hawkes, 2001; Greffe, 2012). The integration of culture in the Sustainable Development Goals, specifically Objective 11, and initiatives such as the ‘Group of Friends of Culture-Based Climate Action’ during COP 28 in Dubai, highlight the growing calls to meaningfully put “arts, heritage and creative industries at the heart of climate action” (Europa Nostra, 2023). Similarly, the UNESCO report *Culture: Urban Future* recommends leveraging culture as a sustainable resource for inclusive economic and social development in cities (UNESCO, 2016), a perspective that resonates with the New European Bauhaus.

From the outset, culture has been the underpinning of the inclusive and innovative urban regeneration promoted by URBiNAT. One of the motivations to integrate socio-economic and solidarity practices into the project’s definition of Nature-Based Solutions (NBS) has been the recognition of the intrinsic role of culture in fostering human cooperation dynamics and as a resource for local development. Each of the project’s eight front-runner and follower cities has embraced this approach, adapting it to their unique local contexts and participatory cultures, resulting in various moments, opportunities, and insights into the intersection of culture and NBS.

This chapter unfolds URBiNAT’s roadmap for rethinking inclusive urban regeneration through the lens of culture. It begins by exploring why culture, broadly conceived beyond mere heritage, should be considered at the heart of sustainable urban development. It then examines in depth how URBiNAT cities have methodologically and practically integrated culture into the co-creation participatory processes of NBS, through cultural mapping, community-based arts, and creative forms of communication and interaction to engage local communities. The chapter closes by discussing the integration of culture in the results of the co-creation pro-

cess, both as a means and as an end, shaping several NBS, and providing a platform for meeting and discussion. Emphasis is also placed on the monitoring and evaluation of the cultural dimension of the co-creation process, as a step towards cultivating cities that aspire to be more inclusive, democratic, and sustainable.

Figure 1 illustrates URBiNAT’s cultural roadmap through cases from URBiNAT’s eight frontrunner and follower cities, discussed in this chapter, which underscore ‘culture’ as an underpinning *foundation* (explored in detail in section 4.1), *method* (discussed in section 4.2), as well as a tangible and intangible *result* (section 4.3) of inclusive urban regeneration with nature and people.

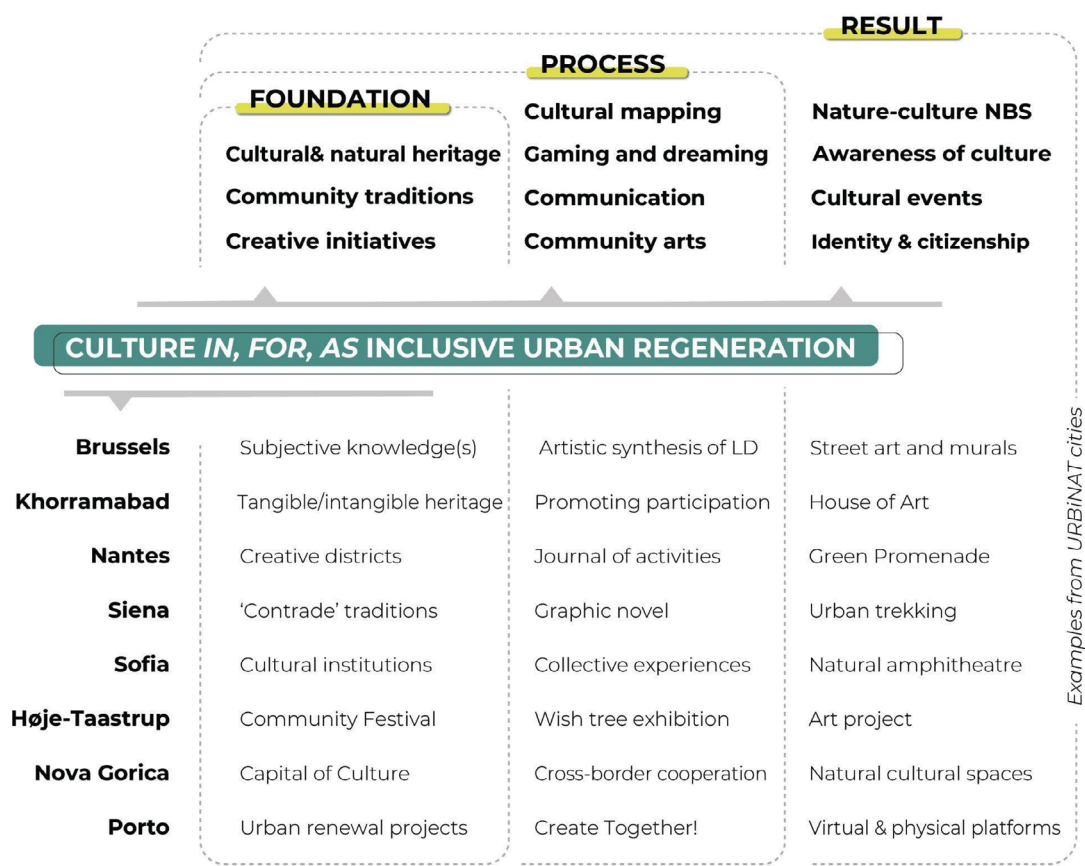


Figure 1: Culture as a foundation, method, and result of inclusive urban regeneration in URBiNAT cities. Graph created by Ribal Aman Eddine.

1. CULTURE AT THE HEART OF SUSTAINABLE URBAN DEVELOPMENT

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ENTERING THE SUSTAINABLE DEVELOPMENT OF CITIES

The destruction of the Second World War brought to light the vulnerability of cultural histories, underlined by the destruction and loss of cultural heritage during that conflict. In response, the international community, thanks to the United Nations and its specialised agency, UNESCO, along with the Council of Europe, has since drawn attention to culture as a key domain for achieving peace and mitigating the risks of future local and global conflicts. Documents and conventions have progressively broadened their focus from tangible heritage and monuments (ICOMOS, 1931; UNESCO, 1972) to include cities, communities, and landscapes (ICOMOS, 1975; ICOMOS, 1987; CoE, 2000; UNESCO, 2005; UNESCO, 2011), as well as intangible heritage, traditions, and cultural diversity (UNESCO, 2003; UNESCO, 2005; CoE, 2005). These documents have highlighted the importance of culture in territorial sustainability, finding their most recent achievement in the UNESCO report of 2016 *Culture: Urban Future. Global Report on Culture for Sustainable Urban Development* (UNESCO, 2016), prepared for Habitat III in Quito, which elaborated the fundamental role of culture in shaping the future by giving value to the past.

Indeed, a large array of efforts internationally, especially since 2000 – from local to international-scale, and involving scholars, practitioners, planners, and policy-makers at various levels – gradually advanced the

recognition of culture as a cross-cutting topic in local/urban sustainability (Hristova et al., 2015; Hosagrahar, 2012; Duxbury & Jeannotte, 2012). Furthermore, an anthropological perspective on culture enabled a more holistic vision on the social components of urban dynamics, boosting participatory planning beyond socio-economic assessment. The social space (Lefebvre, 1974) was finally recognised as a mix of tangible and intangible components intertwined preserving and producing continuous forms of culture. The URBiNAT project made use of and contributed to the development of a conceptual framework that integrates culture as the fourth pillar of sustainability (together with the environmental, social and economic pillars), activating it as an asset of urban vibrancy, while simultaneously considering environmental responsibility, social equity, economic prosperity and cultural vitality (Jeannotte & Duxbury, 2015, pp. 84–85).

However, if culture has been increasingly of interest and relevance for the sustainable development of cities, the road travelled encompasses a series of intertwined conceptual and operational challenges related to implementing local cultural policies and plans, namely: i) limitations due to legislative frameworks, targeted policies, bureaucratic silos, and administrative reluctance; ii) the complexity of the cultural sector and the cultural features of the community; iii) inadequacy of indicators, measurement, and evaluation of progress and impacts; and iv) underlying issues of citizen participation, attention to gender, and overcoming segmentation (Duxbury et al., 2016). Additionally, there is the challenge of recognition of cultural layers; lack of awareness about heritage qualities, authenticity and integrity; and low adherence to the international standards for preservation, among other obstacles.

A VAST CONCEPT

Moving beyond just a fourth pillar that contributes to the other three, culture can play a synergistic central role in line with a sustainable development approach (Grefe, 2012). This is because culture is, in anthropological terms, a vaster concept than simply tangible and intangible heritage. Culture is the ground and glue where sustainability flourishes. In fact, a comprehensive definition of culture would include all human activities that characterise social groups, that is: the set of beliefs and practices common to a society or a specific social group, including knowledge, art, law, morals, customs and all other skills and habits that people acquire as member of a society (Etienne et al., 2004, p. 120).

Cities are the main sites of collective identity (Panjabi and Winter, 2009 in de León et al., 2020), where culture is practised and lived. Urban culture corresponds to a specific set of social practices, mentalities and lifestyles that are forged, communicated and reproduced in the city (Fortuna, 1997, p. 3). Cultural phenomena in an urban environment are inscribed more than ever in a way of being, behaving and investing in places of meaning (Dupont & Augustin, 2005, p. 2). The city also offers a diversity of cultural models, justifying the use of the notion of urban culture in the plural. It comprises several manifestations around art, music and sports practices that participate widely in other urban imaginaries and expressions in the public space that must be taken into account (Dupont & Augustin, 2005, p. 2).

Squares, streets, public gardens, sidewalks, greenways and many other outdoor or indoor public spaces not only represent a vital component of urban life, but also a solid and essential part of the so-called historic built environment, both emerging from the historic urban context and still responsive to the contemporary needs of users (Acri & Dobričić, 2017). This means that these public spaces encompass intrinsic and accredited cultural, social meanings and values, and embody potentials to be disclosed and reinterpreted. In this context, any historical approach in design practice, beyond its preservation attitude, starts with a profound interpretation of the given context, since the sense of a place refers to its present use and also reflects its historic development, naturally its *genius loci* (Norberg-Schulz, 1992).

A culture-led urban approach, however, also draws some criticism of which urban planners and researchers should be aware. One danger is its potentially displacing local communities and favouring economic interests over community needs (creative gentrification) (de León et al., 2020; Gonzalez & Lorena, 2013). Another is the issue of inclusivity and representation. Often, the narratives and place-identities developed can be one-dimensional, failing to represent the diverse histories and contributions of all communities within a city (Aman Eddine, 2024). This selective portrayal can lead to a sense of alienation and under-representation among minority groups, including immigrants and refugees, challenging the very notion of cultural heritage as a unifying and inclusive force (c.f. Oliveira, 2019). Adopting a cultural approach aligned with local sustainability must consider these issues, taking an integrally plural perspective to revealing and understanding the cultural dimensions of a place, considering the longer-term implications of development actions, and integrating an inclusive sensitivity and care in the involvement of the residents of a place in local actions and proposed plans.

CULTURAL AND NATURAL HERITAGE

As we have seen, cultural and natural heritage are the most iconic forms of culture in the popular imagination. The wonders of the World Heritage List, comprising cultural and natural monuments and sites and landscapes of outstanding global significance are referential for most. European cities are at the forefront of the World Heritage List, showing the incredible complexity, heterogeneity and diversity of tangible heritage in the continent.

URBiNAT, since its conceptual phase, looked at heritage as one of the defining conditions of the potential healthy corridors. The cities confronted cultural heritage during the co-creation of their healthy corridors, in varying levels and different ways. Already in the frontrunners, these issues emerged, in both the material and immaterial sense: culture as a physical, but also a social construct. The focus of URBiNAT's frontrunners is on the peripheral social housing neighbourhoods that emerged in the inter-war and post-war periods in response to the massive migration towards the city centres, where modernist planning principles were experimented with and established. These neighbourhoods often emerged in previously agricultural landscapes, leaving scars of this history in the form of old walls, paths, gardens, and farmhouses – “undisciplined landscapes” within the modern city grids (Aman Eddine, 2024). While follower cities also select under-served peripheral neighbourhoods for their interventions, three cities focus on areas very close to the historical centres (peri-central neighbourhoods) – the Koren area in Nova Gorica, Ravacciano in Siena, and Gel-Sefid and Bajgiran in Khorramabad – leading to new experiments within URBiNAT on dealing with historical urban landscapes in a more conventional sense.

For example, Nova Gorica links the socialist city centre – built according to the principles of modernist architecture after 1947 – to the historic city of Gorizia through the Koren stream dissecting the long-standing ‘borderscapes’ (Aman Eddine, 2024). The city relied on its designation as the European Capital of Culture in 2025 as an opportunity to showcase its rich heritage in relation to NBS. Similarly, Khorramabad emphasises the regeneration of peripheral zones of the city's historic centre. The city draws inspiration from its ancient NBS, such as the qanat system, a traditional communal water management system. Here, participation is very important, not only to learn from the community what sites were important for them, but also in order to bring to their attention the ones so far ignored, giving pride in the urban heritage.

URBiNAT's follower city of Siena, whose centre has been a World Heritage Site since 1995, was particularly interesting in experimenting with the healthy corridor concept in a World Heritage context. Siena is celebrated for its rich cultural heritage and surrounding rural landscapes. The provincial area is typically hilly and used for agriculture, especially vineyards, olive trees and forests. The old city is located up on hills and structured as a mediaeval settlement, circled by ancient walls. The connection with nature remains strong thanks to the visual openness towards the surrounding environment, with limited built-up areas, and especially due to the inner green valleys that are still well conserved, covering over 50% of the area within the ancient city walls. Siena is famous also for its mediaeval fresco by Piero Lorenzetti in the town hall named "Allegoria ed Effetti del Buono e Cattivo Governo" (Allegory and Effects of Good and Bad Government), which represents the importance of a good, fair and equitable government of the peri-urban surrounding lands. The fresco is mentioned in the World Heritage List nomination, together with: Piazza del Campo, the main public space of the historic centre and an outstanding example of social space; the Bottini, the underground channels redistributing fresh water all over the historic centre, etc. Lorenzetti's fresco is often used by academics to introduce the concepts of landscape and governing of the commons, recalling the concepts of aesthetic or heritage community (CoE, 2005; CoE, 2000; Greffe, 2012; Aciri & Dobricic, 2017; Ostrom, 2012).

The commons of Siena are distinctive, based on the city's mediaeval framework with the inner city organised into 17 neighbourhoods, called *Contrade*. The *Contrade* were created with primarily social functions, which are still maintained today because the spirit of belonging and sharing is still very strong. They are derived from the mutual aid societies of the mid-nineteenth century, with the aim of improving the material and moral conditions of the poorest sections of the population, through a new form of mutual solidarity that went beyond the concept of traditional charity. Over time, alongside their social function, the *Contrade* have contributed to the formation of Siena's identity, an identity both individual and collective. This cultural dimension of Siena satisfies the fundamental human need for social connection and interaction, providing a sense of belonging to its citizens. All this is rooted in the history and culture of the city, becoming a collective memory handed down from generation to generation. *Contrade* are a historical and cultural landmark, offering individuals a feeling of stability and continuity. Collective remembrance helps to build a sense of shared identity and belonging, creating a link between past, present and future in an ever-changing world.

The urban landscape of Siena includes, in addition to the historical centre, a first urban expansion to the north close to the old city, and, after the 1956 master plan, several satellite neighbourhoods. Drawing from this rich heritage, the ‘healthy corridor’ of Siena connects Ravacciano, a neighbourhood just north-east of the mediaeval city but disconnected from it by a green valley, as a pilot for integrating the urban neighbourhoods around the old city. This integration capitalises on the green infrastructure present around the walls, which will be addressed by the municipality through the “Parco delle Mura” strategy. It also integrates disparate urban elements such as the historic Fonte d’Olive, a historical fountain related to the ‘Bottini’.

INTANGIBLE CULTURAL HERITAGE AND TRADITIONS

NBS represent a paradigm shift in addressing environmental challenges by integrating nature-based elements into sustainable strategies. This innovative approach gains added significance when intertwined with traditions and traditional knowledge, forming a harmonious alliance that not only safeguards ecosystems, but also preserves intangible cultural heritage. NBS encompass a spectrum of strategies that leverage the inherent resilience of ecosystems to address contemporary challenges (Laureano, 2001). These solutions include but are not limited to reforestation, green infrastructure, and ecosystem restoration. By aligning human activities with natural processes, NBS mitigates the impact of climate change, enhances biodiversity, and ensures the provision of ecosystem services. These characteristics of resilience and adaptation based on the *genius loci* and the *oikos* - management of the house as leading and starting concept of economy (Klamer and Throsby, 2000) find a leading inspiration in traditional local knowledge.

Traditional knowledge, passed down through generations, encapsulates the wisdom acquired by communities living in close harmony with nature, evolving slowly (up to the industrial revolution) in continuous symbiosis through experimentation with the surrounding environment. This wealth of information encompasses sustainable agricultural practices, indigenous resource management, and intricate understandings of local ecosystems. Embedded in cultural practices and rituals, traditional knowledge is a living repository that holds the key to fostering resilience and balance. The

integration of traditional knowledge into NBS is not merely a pragmatic approach; it is a recognition of the profound connection between communities and their environments. Indigenous practices often align seamlessly with modern ecological principles, offering practical insights into sustainable resource use, waste management, and conservation efforts.

Traditional knowledge forms part of intangible cultural heritage, together with rituals, social oral practices, performing arts, and crafts (UNESCO, 2003). These form an integral part of a territorial identity, shaped by social groups and communities over time. As NBS incorporate these elements, they contribute to the preservation of cultural diversity. For instance, indigenous farming methods that rely on agroforestry not only promote sustainable agriculture but also safeguard the rituals associated with planting and harvesting, preserving the cultural fabric of the community. URBiNAT has been aware of the intrinsic connection between traditions and traditional knowledge and the urban environment, as well as being conscious of the often historic roots of modern NBS, starting looking for them inside their partners' reality.

MORE EXAMPLES FROM URBiNAT CITIES

In various ways, all URBiNAT cities illustrate how culture is central to sustainable urban development, as exemplified in the following boxes, namely: subjective knowledge(s) of place (Box 1. Brussels); catalysing locally meaningful practices (Box 2. Khorramabad); creative districts (Box 3. Nantes); historical districts and communities (Box 4. Siena); key cultural organisations (Box 5. Sofia) and events (Box 6. Høje-Taastrup); being awarded cultural capital (Box 7. Nova Gorica); and revitalising places and memories (Box 8. Porto).

Box 1. Brussels - “Village des irréductibles”



Image: Bruxelles - Géographie subjective de NOH (CIFAS, 2016)

Credits: Pierre Cahurel, Catherine Jourdan

→ The subjective map presented here was an artistic project facilitated by Catherine Jourdan in the context of a collaboration with a local cultural centre and the CIFAS in 2016.

→ Through workshops with inhabitants, elements of local identity and subjective knowledge(s) of place were drawn out and brought together in a map designed to get an insight into the neighbourhood.

→ The title, “Village de irréductibles”, makes reference to a comic book “Asterix and Obelix”, to indicate the local resistance of a place that feels threatened by outer sources, and attempts to actively preserve its heritage.

→ As with all subjective representations of place, the perspective of this map is partial, but it remains a good entry point into understanding the dynamics, experiences, and everyday subjective experiences of place in Neder-Over-Heembeek.

Contributor: *Laetitia Boon*

Box 2. Khorramabad - Cultural practice of planting pomegranate trees



→ The URBiNAT team in Iran considered the following cultural and natural aspects for the implementation of nature-based solutions in Khorramabad: the greenery of the city, the presence of many gardens, and the existence of agricultural and horticultural culture.

→ The participants of collaborative workshops and focus groups emphasised the proposal of implementing a community garden, as well as of hydroponic cultivation, which revealed interest in implementing agriculture-related measures.

→ The pomegranate tree was chosen for planting due to its historical record in Iran and to the famous pomegranate gardens of Khorramabad since ancient times.

→ Considering the lack of a project like social gardens, it was necessary to introduce the planting practice in the framework of participatory activities. Pomegranate saplings were prepared for planting in selected local places and house yards, which were chosen by those interested.

→ Accordingly, the nature-based solution was named “cultural practice of planting pomegranate trees”.

→ Most of the participants were women and children.

Image: Event on the cultural practice of planting trees (2 March 2023)

Credits: ICCIMA - URBiNAT team in Iran / Amin Azadbakht

Contributors : *Aida Dodangeh, Mohsen Ameri*

Box 3. Nantes - *The Creative City*



Image: L'Éléphant en marche. Les Machines de l'Île, Nantes, France

Credits: Picture by Pascal Bernardon at Unsplash

- Beyond cultural facilities, the island hosts higher education and research establishments and a diversity of economic actors.
- Nantes Métropole has also contributed to the promotion of the city as a creative destination with [“Voyage à Nantes” \(A Journey to Nantes\)](#), which is both an annual summer event and a permanent artistic journey through the city throughout the year.

Contributor: *Philippe Bodénan*

- Nantes has emerged as a creative city based on spontaneous and public initiatives for the development of creative districts.
- These districts concentrate artist collectives and professionals of culture and creativity, who have, on one hand, revitalised areas such as the old docks and shipbuilding warehouses, and, on the other hand, have been promoting free public art.
- In this framework, the island in the centre of Nantes, surrounded by two branches of the river Loire, hosts the street theatre company *La Machine* and its attractions, namely an oversized mechanical elephant and a marine-themed carousel, building upon Jules Verne's creative legacy.

Box 4. Siena - *Contrade of Siena*



Image: Members of the Sieneese contrada Onda parading in ceremonial garb

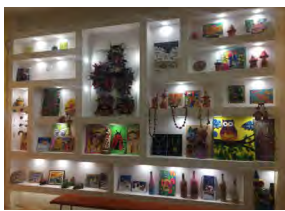
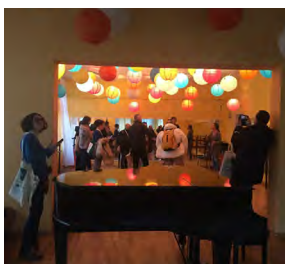
Credits: Picture by K. Lastochka at the English Wikipedia, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=14979018>

- In the URBiNAT study area (which is not part of any Contrada) it was very interesting to note how citizens are used to 'grouping' and how they have brought some of the dynamics of Contrada life to Ravacciano's neighbourhood as well. The challenge for the future is to be able to bring new discussion topics within their agenda (e.g., sustainability) and to involve new citizens.

Contributor: *Mariapiera Forgione*

- The Contrade define very unique characteristics of the Sieneese community. The glue of these communities is the sense of belonging and identity towards its flag, its colours and the symbol it carries. Each contrada has its own symbols, but all 17 constitute a network that helps create a sense of cohesion and social bonding. They are in fact a catalyst for solidarity and social interaction, strengthening ties and creating a community of individuals with a common goal.
- These institutions, more than in other places, have been guarantors of the preservation of traditions and a strong sense of belonging to and caring for the city. They comprise a social structure that has promoted a secular and democratic culture of civic engagement and participation, an example of which is the adhesion of many to them to the Regulations for the Shared Administration of Common Goods. Many of the green areas within the historic centre are in fact managed by the Contrade or by associations and groups of citizens who take care of them.

Box 5. Sofia - Cultural institute at the heart of the neighbourhood



→ Located at the heart of the Nadezhda district in Sofia, the [Centre for Arts, Culture and Education](#) offers a rich programme of cultural activities, including dance, music, theatre and foreign language teaching to residents of all ages.

→ It is supported by Sofia Municipality, and has sister institutes across the city, catering to hundreds of school age children as well as their parents.

→ The institute's staff has been able to conduct outreach and engagement activities with local residents, and encourages them to participate in activities aimed at preserving their cultural and natural heritage.

Contributor: *Milena Tasheva*

Images: Visit at the Centre for Arts, Culture and Education during URBINAT partners' meeting, in January 2019

Credits: URBINAT

Box 6. Høje-Taastrup - Gadehavegård Festival - making it happen in the neighborhood



■ Every year in May, the social housing association arranges a festival together with inhabitants of Gadehavegård and neighbouring housing areas. It is a 1-day event with music, theatre, food and workshops. The organising board of this local neighbourhood festival invites and gathers different members of the area, such as associations and schools.

→ The Gadehavegård festival is aimed at broadening the perspective about the neighbourhood, since it is not only about an afternoon and not only to change the image of the area. It also constitutes a platform to talk, in between festivals, an excuse for making it happen. In this context, the main challenge of the festival is to shift its organisation to a bottom-up initiative, i.e., having inhabitants doing the festival themselves and providing its activities.

Images/Credits:

1. Poster of 2023 Gadehavegård Festival. Credits: Gadehavegård Festival ([Facebook page](#))
2. URBINAT drawing workshop at Gadehavegård Festival. Credits: Photo by Laura Bøndergaard Andreassen

■ The URBINAT project has taken advantage of this festival. The project organised a drawing workshop together with the housing association, and had a stand at the festival. URBINAT's local task force brought information posters about the project, its development plan and giant maps of the area. During this open workshop, many kids participated and contributed with their ideas for the intervention area, while adults had conversations about the plans for the area.

■ Whereas in this setup it was difficult to host a highly organised workshop, and the activities were therefore loosely facilitated, there were many ideas for playgrounds and green urban spaces, such as an urban farm with pets, a zipline, a butterfly park, and a construction playground.

Contributors: *Laura Bøndergaard Andreassen, Knud Erik Hilding-Hamann*

Box 7. Nova Gorica - Becoming a European Capital of Culture



Image: The axes of the Go!Borderless2025 strategy

Credits: [Go!Borderless2025 Bid Book](#)



Image: URBINAT partners at the EuropeSquare in Nova Gorica, Slovenia - Gorizia, Italy

Credits: URBINAT

→ Nova Gorica holds an intense significance for cultural tangible and intangible heritage due to its border status with the Italian city of Gorizia, as well as its set of historical facts and witnesses connected mostly to the 20th century and the two World Wars. Such cultural density was recognised by URBINAT in shaping the healthy corridor.

→ Nova Gorica was awarded the title of European Capital of Culture 2025 in December 2020, in the framework of a cross-border cooperation with neighbouring Gorizia in Italy. The candidacy was under the slogan "GO Borderless 2025".

→ "Becoming a European Capital of Culture brings benefits that extend far beyond the title year: the cultural, economic, urbanistic and social legacy of this initiative revamp the city's present and future, as well as those of the communities that inhabit it". <https://www.go2025.eu/en/>

→ "Nova Gorica and Gorizia are working together to overcome barriers. Divided by wars and united by cooperation and close friendship, the two cities have set themselves the ambitious goal of becoming a cross-border European Capital of Culture." <https://www.go2025.eu/en/>

Contributors: *Marco Acri, Saša Dobričić*

Box 8. Porto - A city of memories



Image: Book covers of *Urban do Vale de Campanhã* and *Um Porto de memórias: Vidas em Campanhã*.

Credits:

- Pimenta, M., Costa, C., & de Sousa, V. (Eds.). (2001). *Urban do Vale de Campanhã*. Fundação para o Desenvolvimento do Vale de Campanhã.

- Pombo, A. P., Andrade, P., Amaral, R. M., & Ribeiro, S. (2005). *Um Porto de memórias: Vidas em Campanhã*. Fundação para o Desenvolvimento Social do Porto.

■ Rehabilitated spaces such as *Casa* and *Quinta de Bonjôia* are examples of activating local memories that boost local culture through participatory processes, by involving different sectors and activating a very positive image, united and capable of responding to joint challenges with the endogenous elements of the locality.

■ In this sense, the URBAN programmes have greatly influenced transformations that activate communities to develop local and sustainable opportunities, i.e., a systemic quality of life that affects both space and human capital.

Contributor: *Susana Leonor*

■ Inclusive urban development has been promoted at the European level since the 1990s, namely with the community initiative programmes of URBAN, which have funded the intervention "Urban do Vale de Campanhã" in Porto.

■ The city of Porto has undergone in-depth transformations over time, particularly in urban areas such as Campanhã, which has been facing social asymmetries, urban degradation, social exclusion and poverty.

■ The response to these challenges includes reshaping the urban fabric, deepening connections between territories, interventions in social housing, and changing the stigmatised image of the area.

■ Inclusive transformations focus both on the material and immaterial levels, encompassing the quality of life of citizens, accessible routes for people with disabilities, the activation of spaces for leisure and sport which promote social diversity, and the creation of memories that define the city of Porto as it is today.

2. CULTURE IN THE CO-CRE- ATION OF NBS

Authors: Nathalie Nunes, Nancy Duxbury, Laetitia Boon, Marco Acri, Mariapiera Forgione, Sofia Martins, Susana Leonor, Américo Mateus, Ribal Aman Eddine

Contributors: Aida Dodangeh, Mohsen Ameri, Philippe Bodénan, Laura Bøndergaard Andreasen, Knud Erik Hilding-Hamann, Milena Tasheva

For URBiNAT, the success of inclusive urban regeneration hinges on the involvement and commitment of communities for a balanced nature-and-human-centred approach. Here, the concept of Urban Living Labs has emerged as a participatory model involving public-private partnerships, including educational institutions, municipalities, and people, aimed at regeneration through co-creation. With its focus on participation as both a ‘means’ and an ‘end,’ it also shows how participation and engagement of communities is central in realising the potential of their heritage and in highlighting the relevance of intangible cultural heritage for inclusive regeneration, not only as a product (NBS), but also as a process in itself.

The use of supportive methodologies and techniques for social mobilisation and citizen engagement are at the cornerstone of an inclusive approach to the co-creation of NBS (Nunes et al., 2021). It not only involves identifying and considering guidelines and methods to engage people at different stages of the co-creation process, but also being aware of the local participatory culture, the conditions for participation of the different citizens and social groups, and the stakeholders landscape (Nunes & Lupp, 2023).

In devising people-centred projects, URBiNAT cities have experimented using languages, culture and arts in the co-creation of inclusive corridors for

and with all citizens, supported by diverse participatory methods such as cultural mapping and community-based arts. In this framework, ‘communication and interaction’ has been essential and at the core of co-creation processes for tailored NBS, also highlighted by practitioners as a top critical aspect for citizen engagement (Nunes & Lupp, 2023; Nunes et al., 2021).

CULTURAL MAPPING

In terms of process, the method of cultural mapping allows for a community-centric approach to urban regeneration, where the voices and memories of local residents play a crucial role in shaping the urban landscape. In the framework of the co-creation process for an inclusive and innovative urban regeneration with NBS promoted by the URBiNAT project, cultural mapping was adopted in its early stages as a participatory approach and foundational methodology to ensure that cultural dimensions are integrated into the project. Cultural mapping was initially applied during the co-diagnostic phase, in order to map both tangible and intangible cultural assets, which are typically more qualitative in nature and not easily counted or quantified.

Cultural mapping has proven very good at detailing tangible assets that can be counted, such as physical spaces, cultural organisations, public art, and other material resources, with a growing interest in mapping intangible dimensions of culture. These intangible dimensions are of particular relevance in current research, in artistic and architectural works, and in urban and community planning practices (Duxbury et al., 2019; Longley & Duxbury, 2016). The focus of these many initiatives and projects is to make visible the ways that local stories, practices, relationships, memories, and rituals constitute places as meaningful locations, through focusing on, for example, values and norms, beliefs, language, community narratives, identities, and shared sense of place (Duxbury et al., 2019; Duxbury & Redaelli, 2020).

Cultural mapping as a methodology for entering into the field of study and work produces a fertile context for in-depth interactions and relation-building within the Living Lab, integrating the local task force into the existing network of actors. A complementary variation in methodology is its combination with an ethnographic approach, as the latter is equally focused on qualitative interactions with persons in a place. The organic interactions emerging from these combined approaches can naturally lead to the building of synergies with local actors, as in the case of Brussels

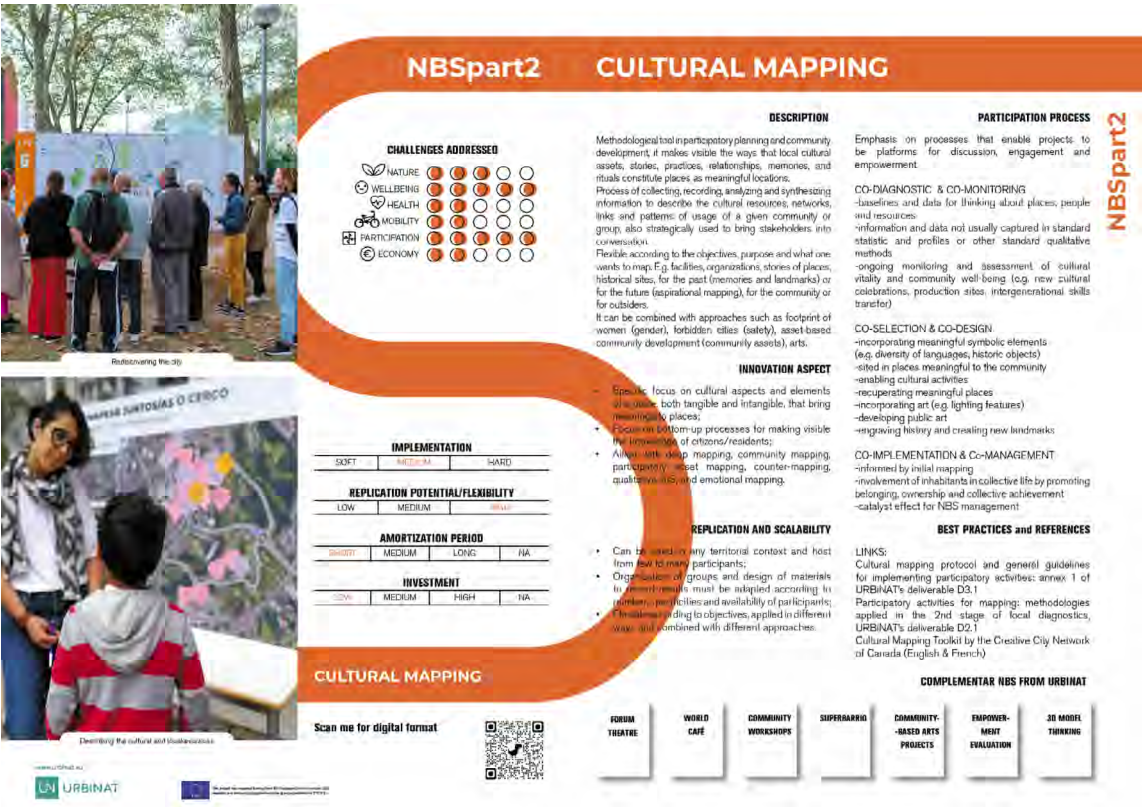


Figure 2: Participatory NBS cards - Cultural mapping
<https://urbinat.eu/nbs/cultural-mapping-2/>

where festive events became key moments of collaboration. For example, the URBiNAT team of Brussels participated in the “Fête de la place” organised by the Neder-Over-Heembeek francophone cultural centre in 2022 (Figure 3), with the “ludomobile” that was created by the URBiNAT team, to conduct participatory activities outdoor (Figure 4), and with copies of the artistic synthesis of the local diagnostic (Box 8). These festive events are a natural outcome of the cultural context and showcase culture-in-the-making.

In particular, cultural mapping invites a sensitivity to the diversity of people living in a neighbourhood; tuning in to their particular cultural practices, what brings them together, and what builds community can have the added benefit of building sensitivity to intersectional concerns in a neighbourhood. The key is to talk to, and interact with, as wide a variety of people as possible, to build up a broad yet fine-grained understanding of the lived experience of a place. Involving schools is a way to meet the



Figure 3: Participation of the URBiNAT team of Brussels in the “Fête de la place” organised by the Neder-Over-Heembeek francophone cultural centre on Saturday 28th May 2022
<https://urbinat.eu/articles/find-the-urbinat-brussels-team-at-the-fete-de-la-place/>



Figure 4: The “ludomobile” in action in Neder-Over-Heembeek (picture by Bazile Oriol)

newest generations, but also to make teachers and families interact. In the URBiNAT experience in Siena, the experiment with schools (kindergarten and elementary schools) through drawings made it possible to collect very heterogeneous data, but extremely rich in inspiration. The drawings of 193 children were analysed through a gender lens that made it possible to highlight the behaviours and desires most present among girls and boys regarding the use of green spaces.

As a variation to cultural mapping, the URBiNAT project also welcomed the method of the five senses named “Perception Mapping” (Ost & Saleh, 2021), experienced by the University of Nova Gorica in a parallel H2020 project named CLIC (www.clicproject.eu), and formulated within the context of the assessment of the Historic Urban Landscape (HUL). The core of perception mapping is that the sense of place is made of tangible and intangible cultural and social qualities that may be assessed by local users and citizens, beyond experts. Thus, perception mapping is a sense-making process by which people are asked and enabled to relate to assets in respect to the place they live (CLIC, n.d.; Saleh & Ost, 2020). Based on an initial listing of the tangible and intangible values as derived from their five senses, participants may formulate their opinions, ideas, needs and aspirations but mostly raise concerns and highlight conflicts related to the management, conservation and preservation of the cultural capital for future generations. The mapping is carried out by means of the participants’ five senses and with the help of a physical map that permits localisation of the assets related to the senses’ findings, with the common question being, “What do you think in your city when using the taste, sight, smell, etc.?”. Perceptions mapping demonstrated itself to be a very useful tool to recall and reinstate on the map some lost intangible heritage assets.

All in all, in the case of URBiNAT, it has been useful to think about cultural mapping as a field of interdisciplinary research as well as a methodological tool increasingly used in the context of participatory planning and community development. In other words, to view it both as a process and a research methodology (Duxbury et al., 2024). Figure 5 below systematises cultural mapping thinking across the research structure and work plan of URBiNAT, which has supported to explore its relevance for an inclusive and innovative urban regeneration with NBS in the following three dimensions further detailed in Table 1:

- *in* sustainable urban development, with cultural mapping supporting data collection and analysis on how culture is articulated or expressed within one society (1st yellow dimension on the left of Figure 5);
- *for* sustainable urban development, using cultural mapping as a communications platform to engage citizens and stakeholders (2nd blue dimension on the right of Figure 5);
- *as* sustainable urban development, cultural mapping consisting of a participatory NBS and new platform aiming at creating an integrated picture of a place and supporting community development (3rd green dimension on the top of the circle in Figure 5).

Table 1 also enters into opportunities and challenges in applying cultural mapping, further evidencing it as a means of supporting participatory planning and as an end of interdisciplinary research and community development (Duxbury et al., 2024). In regard to the latter, in particular, the third section of the present chapter addressing “culture as a result of NBS co-creation” (section 4.3), puts greater emphasis on cultural mapping as an outcome and not only as a methodology or tool, i.e. considering that URBiNAT cities have integrated culture as an end in the co-creation of NBS and by establishing platforms for empowerment as a result of participation in the process.

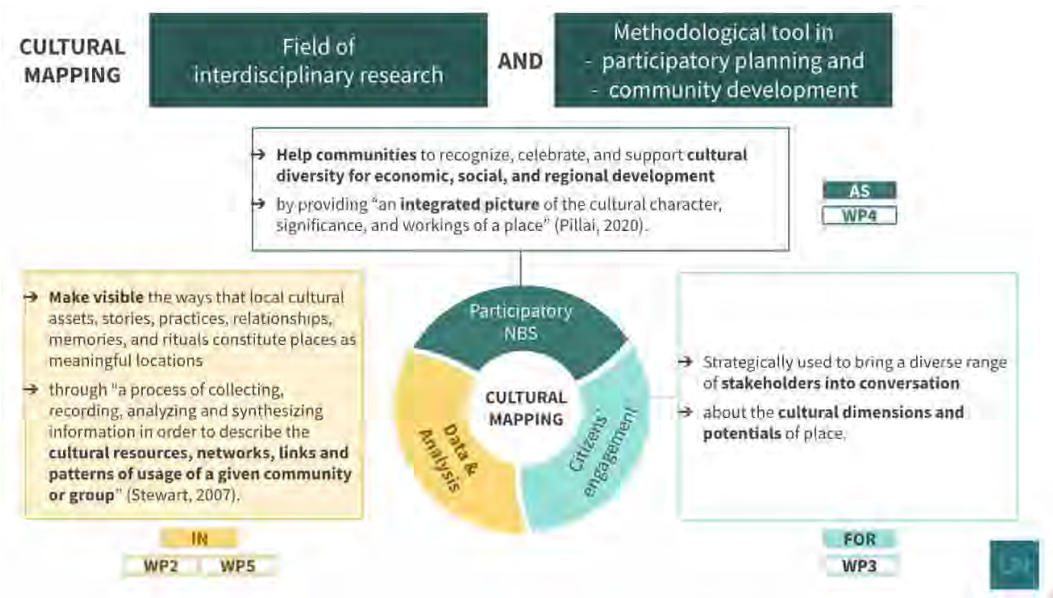


Figure 5: Cultural mapping thinking in URBiNAT
Graph created by Nathalie Nunes

CULTURAL MAPPING		
"in" sustainable urban development	"for" sustainable urban development	"as" sustainable urban development
Data & Analysis	Citizens' engagement	Participatory nature-based solution
<i>How culture is articulated or expressed within one society</i>	<i>Communications platform prioritising individual and diverse perspectives</i>	<i>Building of a new platform</i>
<p>→ Cultural mapping tries to identify and articulate those cultural aspects of a society, making visible the assets, stories, practices, relationships, memories, and rituals that constitute places as meaningful locations, as well as the patterns of usage of a given community or group and their cultural resources, networks, buildings, etc.</p> <p>→ This perspective fits into the data collection in the study areas of the project and the corresponding production of analysis (Work package 2 - Living Labs of URBiNAT cities and Work package 5 - URBiNAT's Observatory)</p>	<p>→ Using mapping as a place where people can come together to discuss shared community and bring them into conversation.</p> <p>→ This is about how to engage citizens and stakeholders in support of NBS, to enable the co-creation of healthy corridors and establish community-driven processes (URBiNAT's Work package 3).</p>	<p>→ In terms of cultural mapping, it is about creating this integrated picture of the cultural character, significance and workings of a place in order to help communities to recognize, celebrate and support their cultural diversity for their own development going forward in different aspects.</p> <p>→ This perspective projects cultural mapping into the NBS catalogue of URBiNAT (Work package 4) as a participatory solution, that is, a process which constitutes itself as a means, by supporting the co-creation process, and as an end, by establishing platforms for empowerment as a result of participation in the process.</p>
<i>In context - Opportunities and challenges</i>	<i>In context - Opportunities and challenges</i>	<i>In context - Opportunities and challenges</i>
<p>→ Opportunities: approaching cultural mapping as an end of interdisciplinary research</p> <p>→ Challenges: common understanding and consensus on specific actions to focus on the cultural dimensions of the urban capital, both tangible and the intangible ones</p>	<p>→ Opportunities:</p> <ul style="list-style-type: none"> - approaching cultural mapping as a means of supporting participatory planning - educational component for the creation of reflective communities, namely about society's relationship with nature and by rethinking many aspects of life in the city <p>→ Challenges: common understanding and consensus on specific actions to take advantage of the catalyst effect of cultural mapping for co-implementation and co-monitoring</p>	<p>→ Opportunities: approaching cultural mapping as an end of community development, an outcome and not only a methodology or tool</p> <p>→ Challenges: contextualising cultural mapping in a broader context to clarify the approach both in theory and in practice, which result in a wide variety of outputs, often much more than a map (Duxbury et al., 2024, Annex A)</p>

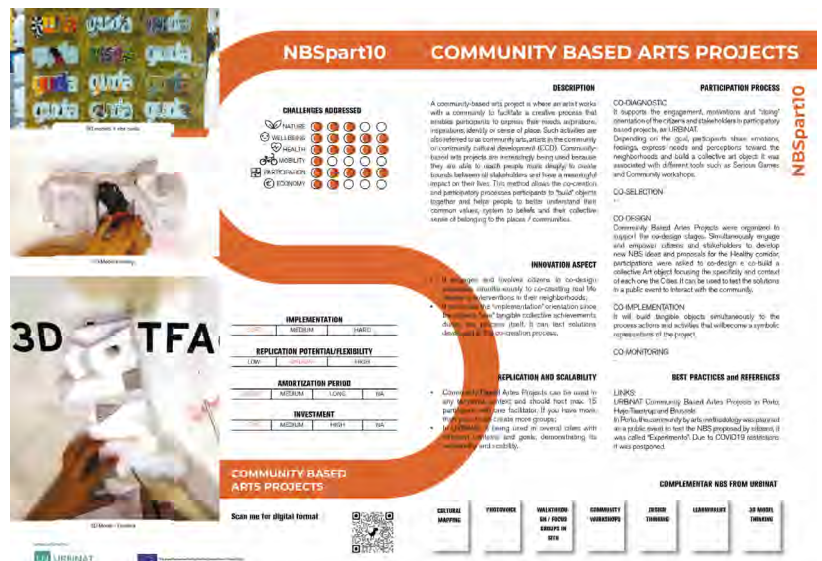
Table 1: Relevance of cultural mapping for an inclusive and innovative urban regeneration with NBS
Adapted from Duxbury et al. (2024)

COMMUNITY-BASED ARTS

A community-based arts project is where an artist works with a community to facilitate a creative process that enables participants to express their needs, aspirations, inspirations, identity or sense of place. Such activities are also referred to as community arts, artists in the community or community cultural development (CCD). Community-based arts projects are increasingly being used because they are able to reach people more deeply, to create bonds between all stakeholders and have a meaningful impact on their lives. This method allows for co-creation and participatory processes in which participants “build” objects together and helps people to better understand their common values, system of beliefs and their collective sense of belonging to the places/communities. It engages and involves citizens in co-design processes simultaneously to co-creating real life objects or interventions in their neighbourhoods. It reinforces the “implementation” orientation since the citizens “see” tangible collective achievements during the process itself. It can also test solutions developed in the co-creation process.

When the creation of a work is shared by several people, then it also then becomes an opportunity for socialising. Making a wall aesthetically pleasing, rethinking a place through a mural has lately become one of the most popular ideas, both in big cities and small towns. In Siena (Ravacciano), the symbol of a small green space cared for by the community is a mural, created together with the students of the art school. Today, that discoloured image should be replaced, and a new effort is being made to involve the art school to create together a new distinctive image.

Figure 6: Participatory NBS cards - Community-based arts projects <https://urbinat.eu/nbs/community-based-arts-projects-cap/>



COMMUNICATION AND INTERACTION

All in all, the URBiNAT international and interdisciplinary consortium has been building creative and innovative tools by engaging with local communities to imagine and build together healthier cities for a sustainable and inclusive future. These participatory tools underpin a co-creation pathway that promotes communication and interaction with the participants of living labs in URBiNAT's intervention areas, which is mainly based on: understanding and connecting with the neighbourhoods by valuing the experience and knowledge of residents as solution holders who can make changes last, and focusing on reaching and the involvement of those who must be included in reimagining our cities inspired by nature. In the framework of the participatory activities, emphasis is also placed on the communication around nature-based solutions, talking about and interacting with nature-based solutions, which has catalysed the creation of additional ones.

In particular, Mapping, Dreaming, and Gaming participatory tools (Table 2) have enabled researchers and residents to reveal the main assets of a neighbourhood and introduce to participants the concepts around nature-based solutions. The three interrelated activities were firstly tested in the URBiNAT participatory process of Porto to diagnose the main assets – tangible and often intangible – of the intervention area, assets that are not always discernible to people from outside these neighbourhoods. URBiNAT teams wanted to reveal the assets which residents do not often have the opportunity to express, but also to learn about what they would like to change or improve about their neighbourhood. Discussions on the right to participate are also impactful, not least when insisting on the importance of the voices of children being heard and their added value in addition to the ideas of adults.

Novel means of communication and interaction are key in this dialogue as a means and to connect with people of different backgrounds and ages. The results were revealing, especially due to the relaxed way in which people participated, their willingness to contribute with information, and how they happily demonstrated a sense of belonging to the community. These tools informed a qualitative and quantitative analysis, which was translated into different results with various dimensions – social, economic, cultural, ethnic, among others.




Mapping	Gaming	Dreaming
 <p>URBiNAT workshop "Let's imagine our cities together!" at the New European Bauhaus Festival 2022 in Brussels (Picture by Nathalie Nunes)</p>	 <p>Outdoor board game at the URBiNAT Kick-off event in Porto, in 2019. (Picture by Carlos Barradas)</p>	 <p>Children's dreams for their city during URBiNAT's activity "This is my neighbourhood!" at the Europe Day 2022 in Brussels. (Picture by URBiNAT)</p>

Table 2: Mapping, Gaming, Dreaming.

Within this framework, a proposal also emerged of a conceptual evolution from *co-creation* to a *co-nature'ing* model (as termed by Américo Mateus - GUDA). Co-nature'ing is about getting together, identifying synergies between all stakeholders, aligning visions, sharing purposes, and jointly creating cooperative culture. Essentially, it is about creating human bounds, and envisioning not for the short run but for meaningful future creation and development strategies for a better world for all. The conceptual model is rooted on three pillars: Humanity, Planet and Purpose-driven innovation.

MORE EXAMPLES FROM URBINAT CITIES

In the co-creation participatory processes of URBiNAT cities, culture has played a diverse role and with diverse expressions, as exemplified in the following boxes: subjective mapping and observation mediated by arts (Box 9. Brussels and Box 15. Siena); promoting a culture of participation around ludic activities (Box 10. Khorramabad); memorial collection to accompany urban renewal (Box 11. Nantes); local media for residents to share information, experiences and thoughts (Box 12. Nantes); public participatory events and exhibitions (Box 13. Porto and Box 17. Høje-Taastrup); social and solidarity economy initiatives to foster cooperation and collective experience across cultures, professions, and ages (Box 14. Sofia); and green cultural projects (Box 16. Nova Gorica).

Box 9. Brussels - Artistic synthesis of the local diagnostic



Image: Bruxelles - Artistic synthesis of the local diagnostic

Credits: Claire Allard (Klar Graphics)

→ At the outset of the local diagnostic phase of the URBiNAT project in Brussels, it became self-evident that a synthesis of the full report was necessary in order to be able to restore the knowledge gained about the neighbourhood to the community.

→ Inspired by subjective mapping exercises done in Neder-Over-Heembeek, but also in partner cities such as Nantes, a colouring map was designed to synthesise the field-based and experiential knowledge of the neighbourhood.

→ This complemented well the more technical and cartographic knowledge(s) with which the municipality is used to work, and serves nowadays as an additional subjective entry point for those new to the neighbourhood to get a glimpse of elements that characterise it, and of the everyday ways in which people live in and experience Neder-Over-Heembeek.

Contributor: *Laetitia Boon*

Box 10. Khorramabad - Game centre



→ One of the nature-based solutions developed in Khorramabad city was the implementation of a play centre, which was opened with the participation of active local children and teenagers.

→ This initiative promoted a culture of participation among local activists.

→ Deciding on the location of the game centre was one of the challenges that was decided by holding several meetings among the members of a focus group. The choice of game items, the type of their arrangement and the hours of use of the centre were all done by participating children and teenagers who were members of the focus group.

→ One of the most important things was the maintenance of the game centre, which can be called the cultural heritage of URBiNAT for the neighbourhood, because due to the high sense of belonging of the participants, the maintenance of the game centre is also done by the users.

Images: Opening ceremony of the game centre for children and adolescents (15th Sep. 2022)

Credits: ICCIMA -URBiNAT team in Iran / Amin Azadbakht & Aida Dodangeh

Contributors : *Aida Dodangeh, Mohsen Ameri*

Box 11. Nantes - Memorial collection of the life and development of the district

1.



→ “Je me souviens” (I remember) is an artistic and cultural project aimed at collecting the memories of the inhabitants of the micro-districts that compose Nantes Nord.

→ It aims to complement the transformations taking place in the district as part of the urban renewal project by collecting the memories of residents and local stakeholders through written, audio, video and visual contributions.

→ This material will be used in artistic projects taking place in the district (design of a fresco on the palisades of the Champlain tower, etc.) and in digital contents. The collected material will also be added to the collections held by the Nantes municipal archives.

→ The project was initiated by the City of Nantes, in particular the Nantes Nord district team and the Department of Culture and Heritage. It is also supported by the State (Préfecture de Loire-Atlantique), the Accord association that manages the neighbourhood's socio-cultural centres, and several cultural associations: PaQ'la Lun, L'EclectiC and Vlippi.

2.



3.



Images: Event of the 15th October 2022 to collect memorial materials before the destruction of one the tower in Nantes Nord (Champlain tower)

Credits:

1. © Jean-Félix Fayolle for Nantes Métropole

2. *Mosaïque journal*, N°88 (December 2022)

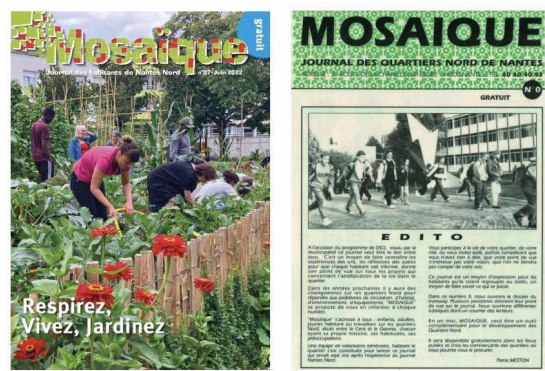
3. © Nantes Métropole

→ Several campaigns will be organised to collect materials. The first event, organised on 15 October 2022, brought together more than 20 associations and 400 people.

→ Even if the area is sometimes criticised, residents have an attachment to the place (where they grew up, where they raise their children). This memorial collection is necessary to accompany the radical transformations that are occurring in the area, such as the demolition of a tower block.

Contributor: *Philippe Bodéan*

Box 12. Nantes - *Mosaïque Journal* – written for and by the inhabitants



Images: *Mosaïque* journal, written by and for the inhabitants. Front pages of N°87 (2022) and N°0 (1992)

Credits: *Mosaïque*

→ *Mosaïque*, “the newspaper for the residents of Nantes Nord” (translation), has three issues a year (around 30 pages), with a print run of 4500 to 5000 copies. It is distributed free of charge in several places in the neighbourhood. It is funded and piloted by the municipality (district team).

→ “The aim of the magazine is to act as a link between everyone. It’s a way of sharing people’s experiences and thoughts, so that everyone can be informed and give their point of view on all the projects aimed at improving life in the neighbourhood” Meston Pierre, 1992, Editorial, *Mosaïque* N°0.

→ *Mosaïque* is produced entirely by residents of the Nantes Nord neighbourhood, which makes it different from *Nantes Passion*, the journal published by the Nantes municipality, or the *Journal de Projet*, published throughout the period of an urban renewal project by the municipality as well. In *Mosaïque*, the residents themselves decide on the subjects to be covered and write the articles. The topics are varied, and recently included culture, local life, youth and health.

→ *Mosaïque* celebrated its 30th anniversary in 2022.

Contributor: *Philippe Bodéan*

Box 13. Porto - *Let’s Create Together!*



Image: Calling the local community for co-creation

Credits: URBINAT / GUDA

■ This 1-day public event in October 2019 launched the →rticipatory process to plan the inclusive and innovative urban regeneration of Campanhã, in the framework of the URBINAT project, which was introduced to the residents.

■ The event was organised with the active participation of →al organisations and initiatives to involve local forces, resources and talents in the process of co-creating healthy corridors with citizens.

■ It also kicked off the processes of identifying facilitators →d ambassadors to connect with the broader local population, collecting preliminary data for the local diagnostic, and refining and adjusting methodologies and protocols to support participatory activities based on the experience of the public event.

■ The activities involved lots of interaction and creation →ere participants could experiment and share their desires for improvements of their city and, in particular, for the area of Campanhã.

■ Activities were organised as a route with several →eractive activities aimed at exploring: How to know and value the people and places that make up Campanhã? What do we want and what can be improved? How can we create solutions together in the public space that improve citizens’ quality of life? What solutions can be inspired and taught by Nature? What can we share about our experiences?

■ At the end of the journey, citizens were invited to join the →BINAT project and participate in follow-on events to take place at the different stages of the co-creation process.

Contributor: *Susana Leonor*

Box 14. Sofia - Bread House



Image: Workshop at the Bread Houses Network in Sofia, on 26 January 2019

Credits: Picture by Rune Strunge

→ Bread House is part of URBiNAT's catalogue as a social and solidarity economy nature-based solution, since bread-making fosters cooperation and collective experience across cultures, professions, and ages.

→ The [Bread Houses Network](#) is an initiative of the International Council for Cultural Centres Association, which creates and unites centres for community-building, creativity, and social entrepreneurship.

→ The mission of the Bread Houses Network is to inspire individuals and communities to develop their creative potential and cooperate across all ages, professions, genders, special needs, and ethnic backgrounds through collective bread-making, accompanying art forms and education in ecological sustainability.

→ Currently, the network unites 8 Bread Houses in Bulgaria and has trained people and organisations in more than 20 countries on 6 continents.

→ The Bread Houses Network is supported by other actors and stakeholders to co-deliver the benefits of participation to citizens in the district of Nadezhda.

→ The model and methods of the Bread Houses Network have been awarded and recognized as good practices by various international organisations. As an example, the Sofia Bread House cooperation with the Health and Social Development Foundation was dedicated to educational bread-making for children of Roma origin between 4 and 8 years old.

Contributor: *Milena Tasheva*

Box 15. Siena - Graphic Novel about the activities



Image: Pag. 5 from graphic Novel of Polito (Politecnico di Torino)

Credits: Politecnico di Torino

→ A group of students from the Turin Polytechnic came to visit Siena together with their teacher Daniela Ciaffi (an urban sociologist) to analyse the URBiNAT participation process in Ravacciano from their perspective.

→ They independently visited the neighbourhood, talked to citizens and took part in some activities.

→ Once back home, each student graphically elaborated what they had learnt and made comic strips, which became part of their examination work.

→ The perspectives of young people, who are experts in these subjects but not involved in URBiNAT, were very interesting because they revealed new or little considered aspects of the process.

Contributor: *Mariapiera Forgione*

Box 16. Nova Gorica - Interaction with culture capital / Culture heritage as a central point



Image: URBiNAT meets EPK, GoI2025

Credits: Municipality of Nova Gorica

→ The candidature for the European Cultural Capital designation was delivered in 2020 through the official Bid Book, which focused on three axes, including nature.

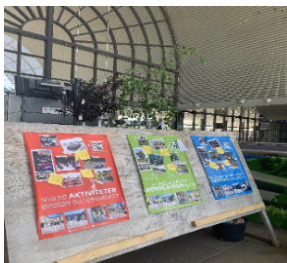
→ In the Bid Book, the project URBiNAT was mentioned explicitly as a reference for the implementation of Green Cultural projects, so much that later, after the awarding of the designation in 18 December 2020, the University itself started to have a central role in the implementation of some green, culture-oriented activities flourishing from URBiNAT (and other minor projects).

→ Both URBiNAT and GoI2025 met in Biennale Architettura in November 2021 as a mutual international moment of synergy, and again opened a space jointly during the URBiNAT partners meeting in Nova Gorica in March 2023.

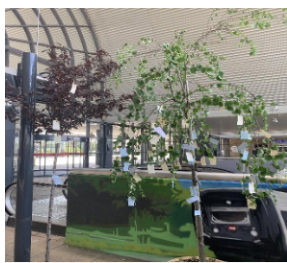
→ On that occasion, the first saplings of forgotten trees were planted, right in the margin of the future Green-blue theatre along the Koren stream in the NBS Koren park designed within URBiNAT.

Contributor: *Marco Aciri*

Box 17. Høje-Taastrup - Exhibition and kick-off event



Exhibition and survey at Høje-Taastrup Station



"Wish trees" with ideas for the area



Kick off workshop in the community park



Construction of planting boxes

Credits: Laura Bøndergaard (Healthy corridor urban plan of Høje-Taastrup)

■ Between 14 and 18 June, 2020, a series of outdoor public consultations were also held with representatives of the URBiNAT project during the kick-off event, and residents to start to map out the future healthy corridor. Dozens of residents took part in the discussions, then rolled up their sleeves to build a series of plant boxes. The URBiNAT local task force arranged the event to inform about the project and co-design a nature-based solution for the neighbourhood, to display an example of what URBiNAT is.

■ The urban garden was built on the ground for the future community house. It is a temporary NBS and test for what can be implemented in the park after the construction of the house.

→

Contributors: *Laura Bøndergaard Andreassen, Knud Erik Hilding-Hamann*

■ Together with the architects hired to develop the urban plan for The Yellow City, URBiNAT's local task force in Høje-Taastrup arranged a four-week exhibition in the station hall to gather citizens' ideas for the plan.

■ Four different types of posters were displayed and people passing through were invited to answer a survey about the area through a QR-code. People could also hang their ideas for the area in three large "wish trees."

■ The objective was to gather inputs from people using the area and passing by using public transportation. These inputs would become a basis for further work on the urban plan for The Yellow City.

■ This initiative reached many people living in the area and commuters, but had little effect with shoppers in the area who were directly contacted and received the code to the survey.

■ The main inputs were that people wanted more green spaces, more biodiversity, places to sit, markets (events), less traffic, and safer zones for pedestrians and bikes.

3. CULTURE AS A RESULT OF NBS CO-CREATION

Authors: Laetitia Boon, Mariapiera Forgione, Marco Acri, Nathalie Nunes, Nancy Duxbury

Contributors: Aida Dodangeh, Mohsen Ameri, Charlie Brazo, Philippe Bodéan, Susana Leonor, Laura Bøndergaard Andreasen, Knud Erik Hilding-Hamann, Ribal Aman Eddine, Vitório Leite

As we have seen, culture has been at the core of an inclusive and innovative urban regeneration with NBS in the framework of the URBiNAT project, considering it first as central to sustainable urban development and, consequently, as part of participatory processes of URBiNAT cities with diverse roles and expressions. In terms of results, it is noteworthy that culture has also constituted an end in itself, by emerging from the co-creation of NBS.

In fact, if cultural mapping, community-based arts and communication and interaction with local populations and stakeholders in general have been key as participatory means and tools, that is in methodological terms, they have also constituted activities, synergies, venues or artefacts which are solutions of urban regeneration themselves, namely by establishing platforms for the expression, empowerment and social cohesion of communities.

These results and consequent impacts need to be further explored based on monitoring and evaluation, expanding room and time for a reflexive process in relation to URBiNAT's actions and knowledge production. This last subsection is also intended to outline possible routes for deepening research and assessment of the cultural dimension in, for, and as inclusive urban regeneration as possible.

CULTURE AS A PLATFORM

Cultural venues and activities can be considered real platforms for meeting and discussion. In Brussels, culture becomes a platform for engagement and dialogue and community-building when mobilised in conscious ways for these objectives. For example, an initiative called “Clap!Femmes” (collaboration between *Projets Versailles* and the *Maison de la Création NOH*) enable women to meet and watch movies relevant to their everyday lived experiences, and to invite discussants to deepen the topics broached in the movie, such as parenting, migration and its impacts on everyday life, or the gendered relationship and tension between parenting and working.

In Siena, a recreational centre (CIRCOLO ARCI), a historic meeting place in the Ravacciano district, was fundamental as a reference point for UR-BiNAT. In recent years, activities have increased and there has been a real generational change that has brought new energy.

Beyond URBiNAT, during the Venice Biennale di Arte 2022 and Architettura 2021 and 2023, URBiNAT partners witnessed nature and environment become actors and performers in community-based arts projects.

On several occasions, URBiNAT has also experimented with ways in which NBS could offer suitable locations for artistic performances. The set of NBS, either from the URBiNAT catalogue or from other successful, sustainable stories, often applies nature into cultural environments, for example, to create green theatres and amphitheatres (Sofia and Nova Gorica), multifunctional spaces such as greenhouses (Sofia), and open-air platforms for citizens' gatherings. These NBS solutions in URBiNAT cities propose hybrid solutions for a more resilient enjoyment of culture by citizens.

MONITORING AND EVALUATION OF CULTURE IN THE CO-CREATION PROCESS

Demonstrations of the relevance of the cultural dimension within urban sustainable development, and more specifically in inclusive and innovative urban regeneration in the case of the URBiNAT project, was further advanced in the framework of monitoring and evaluation and corresponding operationalization strategies. These strategies aimed to adapt the collection and analysis of data to the challenges that emerged from the

previous stages of the co-creation process, including in the application of cultural mapping, and to make the most of methods and tools being tested and accessible to cities.

To this effect, a series of questions were formulated to be included in the scripts of the methods of monitoring and evaluation to be applied, as detailed in Table 3. These questions cover dimensions envisioned in the 2020 *Rome Charter on Culture* (www.2020romecharter.org/pagine/charter), which imagines a more inclusive, democratic and sustainable city - discover, create, share, enjoy and protect. They are also connected to the research/evaluation questions of URBiNAT's analytical framework in relation to the dimension of "culture at the heart of sustainable urban development / inclusive urban regeneration":

- I. How does understanding the local cultural ecosystem inform and influence the neighbourhood's cohesion, vitality and well-being?
- II. How are cultural components produced and reproduced in the context of the territory's urban regeneration?
- III. How does cultural mapping function as a communication, conversational and knowledge production platform?

Moreover, introducing reflexivity in analysing the co-creation process in terms of cultural mapping and cultural dimension within urban sustainable development may also emphasise the interdisciplinary, transdisciplinary and intercultural nature of this field of research (Nunes et al., 2017). It may, for example, address cross-cutting dimensions of human rights and gender, or even enter the field of sociology of law, in order to more closely examine how inclusive and innovative urban regeneration projects handle a complex combination of societal challenges aiming at contributing to the right to the city. Thus, it can illuminate intertwined complexities – social, cultural, economic, ecological, legal and political dimensions – of living in and understanding a place. These dimensions are also unveiled in the collective efforts required to co-design, co-develop and co-implement NBS in an interdisciplinary, multi-stakeholder, participatory context. That is to meaningfully and inclusively catalyse processes that can regenerate a neighbourhood to improve the quality of life and opportunities of its residents (Duxbury et al., 2024).

Dimensions /Themes	Questions for inclusion in the monitoring and evaluation scripts (of interviews, focus groups and observations)
Discover	<p>→ What did you become aware of through this project? e.g., in terms of new knowledge, histories and stories, people and organisations, new connections and relationships, activities and initiatives, and specific places in your neighbourhood</p>
Enjoy & Protect	<p>→ What aspects are you most proud of in your neighbourhood and why? e.g., specific sites, traditions and events, artistic/cultural work that has been done, etc.</p> <p>→ Do you participate in these local cultural activities or others (activities/organisations)? (what, how, in what roles, how are you connected with them)</p>
Create & Share (specific conversations with local creators, e.g people who do things, connect with others, and express themselves through artistic means in different ways of personal and collective expression)	<p>→ What inspires you here?</p> <p>→ Resources – tangible and intangible – that are important to you?</p> <p>→ Challenges? What is missing or could be reinforced to show and promote the local talents and assets?</p> <p>→ Aspirations? What would you like to see next? What are your aspirations for this place and for people from here?</p>
Transversal (asked to all, not only with local creators)	<p>→ What would you like to <u>do</u> next? (i.e., actions following up from this discussion, culture-related participation, aspirations)</p>

Table 3: Monitoring and evaluation of culture in the co-creation process

However, monitoring and evaluation is a challenging process in terms of expanding room and time for reflection. That is, a step further towards a reflexive process based on a critical stance in relation to the project’s actions and knowledge production, namely as an ex post process. In fact, by the end of the funding period of the URBiNAT project, in March 2024, it was not possible to get early findings relating to the cultural dimension, since healthy corridors were in a final stage of implementation in the case of front-runner cities, and still to be co-implemented in follower cities. It is expected that the series of questions formulated to be included in the scripts of the methods of monitoring and evaluation will support URBiNAT cities in following up with their co-creation processes and, most importantly, as a channel and tool for engagement, as well as paving the way to future research.

Nevertheless, as detailed in Table 4 below, the authors of the present section were able to map and share some testimonies within the URBiNAT Community of Practice stressing the cultural dimension in, for, as inclusive urban regeneration, namely in terms of: culture embedded within the idea of healthy corridor; culture as a key dimension of participation for urban regeneration processes; arts and culture to unify, reconnect, and aiming at social cohesion.

TESTIMONIES STRESSING THE CULTURAL DIMENSION <i>IN, FOR, AS</i> INCLUSIVE URBAN REGENERATION
<i>IN</i> - Culture embedded within the idea of healthy corridor
<p>“The idea of the corridor is something that is rooted in the history of humanity. We have always thought about the corridor as a shortcut, a space, a line that is connecting two points. We have humanitarian corridors, green corridors that allow animals to cross a barrier like a highway. We have the corridor also in architecture. If you have a house, somebody is implementing the corridor to enable you to go faster to your room or to go to the closet. But it is also the space where you meet other people of the house and maybe conversations can also start in that specific, not expected space. It is a place also, where culture is produced. In itself, somehow, the history of humankind, which is also the history of culture, has been included in the idea of the corridor”.</p> <p>Marco Acri - UNG, Slovenia</p> <p>Excerpt of interview for the URBiNAT Open Education Programme</p> <p>Module 1 - Key Concepts: Urban Inclusive & Innovative Nature / Lesson 5 - Co-creating urban corridors of inclusion</p>
<i>FOR</i> - Culture as a key dimension of participation for urban regeneration processes
<p>“Culture is a key piece in three main ways.</p> <p>The first one is related to a substantive understanding of the culture that we have in each URBiNAT city. It is really important to understand how people are used to interacting with each other, what are the festivities, what are the rituals that we have in each city that somehow frame the way people interact, the way people dialogue. How much open or less open is the discussion in the public space.</p> <p>The second one is also related to this aspect, but really focuses on the participatory culture of each city. How are citizens, how are public representatives, how are public officers, and how are researchers used to participate in matters of urban governance, in matters of urban regeneration processes. We need to understand how they are used to do this public dialogue, how they are used to interact regarding public issues.</p> <p>The third aspect why culture is a key dimension of the urban regeneration processes is related to the other way around. How do we integrate all these aspects of the local participatory culture within the community-driven processes that we want to design? We want to design the participatory processes within the local participatory cultures and with the participants of that living lab. In that sense, it is really important that we keep ourselves very attentive to what is the most respectful and the most meaningful way of having a dialogue and interacting with these people. How we can introduce innovation, but in a respectful way, in a way that really contributes to a meaningful decision-making process. In a way that it is not only the participatory process of URBiNAT, but that we leave some meaningful seeds, practices, and a deep collective reflection with the local actors on what is a democratic and fair participatory process that contributes with opportunities for negotiation, for deliberation, for dialogue in the local context of decision-making processes”.</p> <p>Isabel Ferreira - CES-UC, Portugal</p> <p>Excerpt of interview for the URBiNAT Open Education Programme</p> <p>Module 1 - Key Concepts: Urban Inclusive & Innovative Nature / Lesson 4 - Devising people-centred projects</p>
<i>AS</i> - Arts and culture to unify, reconnect, and aiming at social cohesion
<p>“I approached the CIRCOLO ARCI with the intention of revitalising an environment that had died out with events, social activities, involvement of voluntary associations, and entertainment for children and the elderly. So I turned the environment upside down, recreating a family atmosphere that had been lost”.</p> <p>Miranda Ballini - President of Ravacciano's Circolo Arci, Siena, Italy</p> <p>Excerpt of interview for local diagnostic conducted in 2021</p>

"It was a team effort [...] Everything has been done with our own resources: self-taxing and with the collaboration of people from the neighbourhood [...]. Many of us are contradaoli (people of the Contrada). It's in our DNA to go out of the buildings and work with people in the neighbourhood [...]. Simply to share".

Alessandro Paciotti - President of Ravacciano's Committee, Siena, Italy

Excerpt of interview for local diagnostic conducted in 2021

"There was a lack of interaction, information, synergies, recognition of the hard work of the many people of Campanhã. Often, this work has been done for years, it is presented and, then, quickly forgotten. That is where the idea of the Campanh'Up community platform comes from, to try to unite all of this.

URBiNAT is helping with this, which is to bring people together, to bring associations together. Let's talk about what you think, about the area, what we could improve there. Projects: are you working with children? Are you working with the elderly? If we got together, we could have more human resources and financial resources. We could work other types of skills in the younger ones. We could work on active ageing, because there are many people who don't leave their houses. Sometimes they don't know the importance they have of telling us what was there before, what is the memory they have of it.

This also helps such projects to think about the area in a better way, because there are things that are not for nothing.

There are buildings that are built in an area that were not for nothing, there are things that were destroyed in an area that were not for nothing.

Campanh'Up will take all of this and try to gain synergies and bridges between institutions, entities, the community itself, and at the same time, the institutions themselves may have more children to work with, there will be more connections.

In my opinion, this is also social cohesion. Campanh'Up will be able to elevate the Campanhã area".

Ricardo Lopes - URBiNAT participant / Porto, Portugal

Excerpt of interview for the URBiNAT Open Education Programme

Module 1 - Key Concepts: Urban Inclusive & Innovative Nature / Lesson 2 - Inspiring solutions for urban regeneration

"It is about how we manage to get information out of people, and working with younger people. I use hip hop music, going to that cultural side. If we want to have younger people to sit down and we tell them let's work here, maybe they will not participate as much.

I also consider as an NBS to be working with children, exploring what music they like or don't like. Telling me this and that, then words linked to the area, new words stand out automatically, whether it is about a safer place or another which is not".

Ricardo Lopes - URBiNAT participant / Porto, Portugal

Excerpt of interview for the URBiNAT Open Education Programme

Module 1 - Key Concepts: Urban Inclusive & Innovative Nature / Lesson 4 - Devising people-centred projects

"A lot of studies have been developed, a lot of work has been done in using arts and culture to unify and reconnect not only communities and people, but also different institutions. Using the arts and the culture to express the feelings, the experience, the sensitive parts that are behind what we say, is a way for giving space to everyone to express in the way they can.

Every time I go to a neighbourhood or to a community, even if I really want to go deep and understand, I don't live there. I always take my mind and my background with me, and I am always in an analysis point of view, even if I can train myself, etc. But I don't know, actually, well. I could go there and live, but I had to live there for years so stop being a foreigner.

Not only do we have different cities, but also inside of each community we have different backgrounds, different languages. Art can be a way of connecting people by a language that is not from one person, one place, one culture, it is from all. It is a way of breaking all the barriers that can be inside of any other language".

Sofia Martins - GUDA, Portugal

Excerpt of interview for the URBiNAT Open Education Programme

Module 1 - Key Concepts: Urban Inclusive & Innovative Nature / Lesson 4 - Devising people-centred projects

Table 4: Testimonies stressing the cultural dimension in, for, as inclusive urban regeneration

MORE EXAMPLES FROM URBINAT CITIES

URBiNAT cities have integrated culture as a means and as an end in the co-creation of nature-based solutions, as exemplified in the following boxes: showcasing local culture and heritage through street art and murals (Box 18. Brussels); art house to increase interaction among different segments of the population and foster inclusion and social cohesion (Box 19. Khorramabad); green loop to connect and support cultural activities (Box 20. Nantes); platform for the dissemination of information co-dynamized with the community, through diversified channels and actions (Box 21. Porto); urban trekking, combining sport, art, taste and revealing the many faces of a city (Box 22. Siena); natural amphitheatres as new multi-use landmarks of the city (Box 23. Nova Gorica and Box 24. Sofia); art projects paying tribute to the area's history, and communal dining initiatives as unifying events to (re)connect people and the territory (Box 25. Høje-Taastrup); and new people's places within abandoned cultural heritage sites (Box 26. Porto).

Box 18. Brussels - Street art and murals to showcase local culture and heritage



Image: Bruxelles - Street art and murals to showcase local culture and heritage - "Arbre"

Credits: Picture by Chavez-Villanueva Ana-Maria

→ Since the 1990s, the City of Brussels has been developing a comic strip exploration route that connects dozens of murals honouring the rich Belgian comic book history. In recent years, the route has been expanded to the peripheral neighbourhoods of Brussels, including Neder-Over-Heembeek.

→ Three new murals have recently been inaugurated in Neder-Over-Heembeek, the URBiNAT study area in Brussels, showcasing the heritage and local particularities of the neighbourhood, identified and elaborated through a participatory process between the artist(s) and inhabitants.

→ These municipal-led initiatives join a tapestry-in-the-making of murals showcasing the identity of the different neighbourhoods of the Brussels territory, some of which were painted at the direct initiative of inhabitants to honour their community (in Versailles), others which were elaborated to promote social cohesion (on Place Saint Nicolas).

→ These murals become landmarks in place, change the landscape of the neighbourhood, and thus necessarily need to be co-constructed with inhabitants in order to ensure that they are coherent with local narratives of place.

Contributor: *Laetitia Boon*

Box 19. Khorramabad - House of Art



→ Excluded social groups, in addition to social problems, generally have a low quality of life due to a lack of attention from the city management to their place of residence. This is the case of people from Roma origin who have been rejected and isolated by other citizens in Khorramabad. However, because of their talent in music, they were always busy playing in the celebrations of the people.

→ The URBiNAT team learned from the traditional practices and intangible heritage of the 'Luti people', a long marginalised segment of the society, in order to integrate their traditional practices and arts, namely music.

→ Building on this existing foundation, one of the NBS carried out was to open the art house to be used by local 'Luti' musicians to practise music, which is an effective measure to increase the interactions of this group with other residents of deprived neighbourhoods.

→ Additionally, several artists were issued health insurance cards that allow them to benefit from free healthcare services, thus regularising their status in the medical system. These solutions represent a step forward towards integrating them into the broader society.

Image: Art House

Credits: ICCIMA - URBiNAT team in Iran

Contributors : Aida Dodangeh, Mohsen Ameri

Box 20. Nantes - Parcours de l'Amande / Nantes Patrimonia: green loop as a support for cultural activities



→ The green loop is a walkway of nearly 2 kilometres built in partnership with local residents and professionals. Besides being a ballad, it connects green spaces and points of interest in the URBiNAT project, and provides relaxation while accentuating the social role of the loop. It is designed to bring people together, sharing public space to encourage encounters and to improve the physical and mental health of local residents. The loop's logo, for example, was created in partnership with local teenagers, and the name "Promenade de l'Amande" was chosen from a number of proposals put forward by the neighbourhood team and local residents. The goal is to make the loop become a tool easily used for all kinds of activities that enhances a sense of the well-being and the social life of the inhabitants. It is ready to initiate a multitude of projects.

→ From a project aiming for healthy issues (physical exercise, environmental health, etc.) the green loop became a support for cultural activities. For instance, while straightening the public's knowledge of the biodiversity that the environment has to offer within animations, it was also possible to value the patrimonial history of the district thanks to the "Nantes Patrimonia" program developed by the Cultural Direction of Nantes municipality. It is a project that aims to preserve and enhance both the cultural and historical heritage of the city of Nantes, and encourages residents to share their memories and experiences in order to capture the collective memory of the neighbourhood. The project has been adapted to suit the green loop district.

→ As lessons learned, URBiNAT's local task force stressed: the importance of the discussions within the process of co-creation leading to this kind of initiative; and that stakeholders who took part in the discussions for the green loop became valuable resources for additional projects like Nantes Patrimonia. The local task force also assessed, as potential barriers and challenges, the need for another stakeholder in an already very complex project, as well as the uncertainty of accessibility to digital tools for all inhabitants.

Image: The Green Loop map

Credits: Nantes Métropole

Contributors: Charlie Brazo, Philippe Bodénan

Box 21. Porto - Campanh'Up - Cultural platform



Image: Website Campanh'Up

Credits: <https://campanhup.org/>

→ Campanh'Up aims to create a cultural platform that allows the dissemination, creation of information, training and entertainment through various initiatives and mechanisms.

→ Its objective is to streamline the process of creating a platform for disseminating information co-dynamized with the community, with content that is of collective interest, through diversified channels and actions, such as joint dynamization actions; experiments with different activities; workshops/training; content production; website development and social networks; and other diversified products and channels of communication and interaction.

→ One of the featured activities is CampMarket, which aims to establish a solidarity market with local producers and craftsmen, thus helping to reduce unemployment and to support cultural activities, as well as promoting a circular economy.

→ The market has been organised in two spaces: one more related with fresh products (vegetables, fruits) and another with materials (books, crafts, clothes).

→ These spaces can also be complemented with a market for children, and the organisation of cultural activities during the day.

Contributor: *Susana Leonor*

Box 22. Siena - Urban trekking



Image: Urban Trekking in Siena - From Orto de' Pecci to Piazza del Campo

Credits: <https://www.sienanews.it/toscana/siena/giornata-del-trekking-urbano-giovedi-la-presentazione-del-percorso-senese/>

→ Urban Trekking was born in Siena in 2003 as a new way of making "slow tourism" with the purpose of diversifying visitors away from the most popular circuits. An activity that combines sport, art, taste and the will to discover the most untrodden and interesting corners of the city, through itineraries characterised by steep rises and drops of terrain along with stairways.

→ It is a form of "vagabond" tourism, free and full of surprises, suitable for all ages, without prior training. With comfortable clothing and shoes, the whole family can practise urban trekking with children and also persons who are less trained.

→ In addition to being an activity that is good for body and mind, Urban Trekking is a sustainable 'tool' for cities because it relieves the pressure of the areas crossed by traditional tourist flows, diversifying the flow in less known and peripheral areas of the City, as well as motivating tourists to prolong their stay. A sustainable kind of tourism respectful of the residents' quality of life and, at the same time, an opportunity for the tourist to actively live the travel experience. A city walk becomes a way for visitors to discover the local tourist attractions by realising a moment of cultural and spiritual growth.

→ In 2022, some URBINAT cities joined the initiative by involving the study areas in the activities.

Contributor: *Mariapiera Forgione*

Box 23. Nova Gorica - Water theatre



Image1: Open theatre on the riverbank

Image2: The Green belt in front of the EpicCenter, Railway Station

Credits: Marco Acri, Saša Dobričić, University of Nova Gorica

→ The establishment of the healthy corridor in Nova Gorica has included several spaces devoted to the cultural and artistic life of citizens, and benefiting from the upcoming European Capital of Culture year in 2025.

→ The corridor, based on the establishment of the Koren NBS Park, will include several tangible facilities such as the Water Theatre, a space to perform art in an immersive experience in nature and water; the creation of several terraced loops for social gathering; the construction of Greenhouses meant to be tree nurseries as well as places for social recreation and public discussions; new sport facilities, including the terraced arena mostly devoted to soccer playing, but not only, regenerating an existing pitch converted into a green, multifunctional sport ground; and the phytodepuration swimming pool, a water facility freely accessible by citizens.

→ The corridor connects to numerous existing initiatives promoted by the GOI2025 (European Capital of Culture) and extends, thanks to URBiNAT, in several other areas such as the Transalpina, Europe Square cultural EpiCenter (<https://www.go2025.eu/en>). In fact, the extension of the URBiNAT project has permitted the University of Nova Gorica, through the design of Saša Dobričić, to imagine the entire area in front of the railway station in Nova Gorica, where the core of the Culture Capital will happen, hosting also the new Museum of interpretation of the Border. Repeating the NBS corridor model, a long green belt was imagined, incorporating many of the innovative ideas of the Culture Capital Bid Book, such as the Tree-Houses, the Basket in the Jungle, the SuperOsmica Restaurant, and the Interpretation wall – all characterised by a green, wild green park turned into pedestrian area.

Contributor: Marco Acri

Box 24. Sofia - Green amphitheatre



Image: Green amphitheatre

Credits: Sofia municipality

→ The idea of the green amphitheatre is to create a flexible outdoor space that will function as an informal social area; an event venue for performances such as concerts and performances, dance and music events, exhibitions, and literary readings; and a gathering spot for the citizens of Nadezhda.

→ The amphitheatre will act as a landmark and provide a distinctive character to the intervention zone, increasing its attractiveness for new users. The green amphitheatre is a shared open space skilfully inscribed in the urban landscape. The creation of such a place clearly indicates the intention to hold larger community events and initiatives, including the URBiNAT participatory nature-based solutions. Discussing issues important to communities and citizens through forum theatre, world café, focus groups in situ, and community workshops will help the green amphitheatre to establish itself as the corridor landmark and a hospitable place for residents of the study area.

→ The URBiNAT local task force has highlighted several important benefits of this solution, namely: bringing together communities; sharing common problems and make decisions together; integrating culture into urban environment; having new community space to play; creation of a local landmark suitable for a multitude of different users; providing a much-needed comfortable outdoor event venue to Nadezhda; and using natural materials to increase local citizens' awareness of alternative construction techniques and their beneficial impact on the environment.

→ Challenges include: keeping place safe and to ensure its protection against potential vandalism; proper maintenance; ensuring that the amphitheatre serves both informal social purposes and more formal events by setting up a model for its future operation in accordance with the needs of the local community; and finding a business model for the post-URBiNAT future.

Contributor: Milena Tasheva

Box 25. Høje-Taastrup - Art project and Communal dining



■ The art project is a nature-based solution that should help in the transition phase. Its function is to tell about the history and value of the area, while also pointing ahead and giving directions for the future joint society. The residents who live here should see their lives reflected in it, while at the same time it should give hope for the future and bring in new perspectives. On top of that, it is a wish that this work of art also contributes to the urban space by, for example, letting people be able to use it as seating furniture. The challenge is to involve the residents so that they feel ownership and recognition through the art project, so this art piece gets the desired functions.

Images: Reference photos for the development of the art project and the communal dining. Inspiration for the URBiNAT activities in relation to these solutions (not taken at URBiNAT arrangements)

Credits: Laura Bøndergaard (Healthy corridor urban plan of Høje-Taastrup)

■ Communal dining (*fællesspisning*) is a way for people to get to know each other and to feel more connected to the territory, since the consumption of food has always been a unifying event. It forms a platform for more inclusive and committed communities, which in turn make the inhabitants feel a greater connection to the areas where they live or work. It could also evoke new stories about the neighbourhood and thereby help give areas like the Quarter Park or the Yellow City a new reputation. These kinds of events could lead to new friendships and prevent loneliness. However, the challenge is who should arrange these bigger events - could this be facilitated within a BID-network or something similar? As best practices and references, URBiNAT's local task force has been inspired by [Folkhuset Absalon](#) and other [communal dining initiatives](#) in Denmark.

Contributors: Laura Bøndergaard Andreassen, Knud Erik Hilding-Hamann

Box 26. Porto- Logar do Falcão



Image: Ruins of the Quinta do Falcão

Credits: BIOPOLIS



Image: Proposal of the new Logar do Falcão

Credit: Vitório Leite

→ In Porto, the participatory co-creation process at 'Quinta do Falcão' offers insights into the intersection of cultural heritage and contemporary needs. An agricultural 'leftover' amidst an urban landscape transformed by modern housing developments and intermittent pastoral patches, the ruins of the old farm stand in the middle of URBiNAT's Healthy Corridor, between the Oliveira urban garden and the municipal pool (D4.2 Healthy Corridor Concept). The former farmhouse was set upon a slope, terraced with stone walls to create level platforms for cultivation. The site lost its pastoral activities in the 1980s and was purchased by the municipality (Leite et al., 2023), but left abandoned, allowing it to become a locus for illicit activities and casting a shadow of insecurity over the residents.

→ In the co-diagnostic phase, the task force involved the local community in various activities, including walkthroughs with citizens of different age groups, workshops, and interviews. This stage allowed the community to map the existing cultural features and collect stories and ideas that resonate with the local memory. Early ideas for the space have included an artistic hangar proposed by some citizens for the building, preserved as a cultural facility, although budgetary and political constraints rendered the idea infeasible. The co-design phase took these inputs further, with physical models and digital tools like Miro software enabling a dynamic exchange of ideas between adults and children. A co-design workshop with students from the University of Coimbra developed the citizen's ideas in integrating the ruins with NBS proposals, namely by developing a proposal for the CampMarket community marker within the space (Urban Plan for Porto, Nantes, Sofia).

→ The resulting solution will preserve the memory of the old Quinta do Falcão through the selective recovery of structural fragments of the walls of the ruins of the existing farmhouse, which will surround a new paved public space - the 'Logar do Falcão' - open to social and solidarity economy practices and community events.

→ The co-design of the Logar do Falcão shows how new cultural 'people's places' could be born in abandoned sites of heritage value, making culture not only the starting point but also the result of the co-creation process.

Contributors: Ribal Aman Eddine, Vitório Leite

CONCLUSION

TOWARDS CULTURE AND NATURE-BASED SOLUTIONS

This chapter is the culmination of insights into the intersections of Culture and Nature-Based Solutions. The integration of culture into inclusive urban regeneration, as detailed in this chapter, underscores its important role as a means and an end.

Culture and Ecological Sustainability could seem, at first glance, to belong to separate disciplines. Yet in a world grappling with environmental degradation and heritage at risk, the role of culture is not only about safeguarding the past but also about its vital contribution to promoting social and environmental justice.

Starting from this premise and recognizing the role of culture in fostering human collaborative dynamics, the chapter articulated URBiNAT's exploration of culture's role as an underpinning foundation (discussed in section 4.1), a methodological process (section 4.2), and an outcome of inclusive urban regeneration (section 4.3).

The first section showed us how culture, encompassing both its tangible and intangible aspects, is increasingly recognized as a community's identity fabric - the collective "we" (c.f. UNESCO, 2003; UNESCO, 2011 in Aman Eddine, 2024) - and framed as a cross-cutting resource capable of activating models of territorial regeneration that hold sustainability as their main objective (de León et al., 2020). At the heart of sustainable urban regeneration, culture emerges not just as a fourth pillar but as a central, unifying theme that intersects with the social, economic, and environmental dimensions of sustainability. Already in the Faro convention of 2005, people were placed at the centre of cultural action, and the urgent need to emphasise the value of culture and cultural heritage as a resource for sustainable development in Europe was highlighted (CoE, 2005).

Afterward, culture was discussed as a methodological resource in the co-creation process. Through cultural mapping, community-based arts, and participatory communication, this section illustrates how URBiNAT cities have woven culture into the fabric of NBS co-creation. The method-

ologies deployed not only creatively engage communities but also ensure their heritage and intangible assets are integral to resulting regeneration strategies.

Finally, culture was recognized as a result of NBS co-creation, seen in the emergence of new cultural activities and spaces, and the reinforcement and promotion of local culture, including aspects of self-reflexivity. Integrating cultural dimensions in the co-monitoring stage validates URBiNAT's approach and its replicability across different urban contexts, namely by evidencing: i) how understanding the local cultural ecosystem inform and influence the neighbourhood's cohesion, vitality and well-being; ii) how cultural components are produced and reproduced in the context of the territory's urban regeneration; iii) how cultural mapping functions as a communication, conversational and knowledge production platform.

ADDRESSING THE TRANSFORMATIVE POTENTIAL FOR COMMUNITIES POST-URBINAT

The journey through URBiNAT's eight cities has illustrated the diversity of approaches to integrating culture into NBS. Moving forward post-URBiNAT, the challenge —and opportunity— lies in sustaining and expanding the integration of cultural methodologies in future urban regeneration efforts, both top-down and bottom-up. In light of this, a set of conclusions can be drawn.

URBiNAT has demonstrated that when cultural elements are thoughtfully incorporated from the start, the outcomes are more profound and authentic. In the same vein, when people are actively and meaningfully engaged throughout the project, the NBS not only enhance natural ecosystems but also ensure that they are inclusive and resonate with the daily lives of the community.

The importance of such interdisciplinarity cannot be overstated: merging the scientific insights of architects and heritage conservators with the anthropological perspectives of social scientists, along with the political and economic viewpoints of policymakers and municipal technicians, proves crucial for a holistic, inclusive, and marketable approach.

Cities, while prioritising cultural heritage and leveraging local traditions, should also consider innovation. Often interesting elements can be found

in the city's tradition in terms of sustainability: in the cultural processes of the past it is possible to find inspiration for new solutions. This must consider local diversity, taking an integrally plural perspective to uncovering and understanding the cultural dimensions of a place, considering the long-term outcomes of development actions, and fostering an inclusive approach and attentiveness in engaging the community.

Cultural mapping not only has the potential to catalyse processes for actively connecting people and deepening knowledge of a locality, but it also offers the possibility to be applied in different ways, combined with different approaches, or informed by other approaches (Duxbury et al., 2024). Its flexibility is of great methodological relevance, since participatory methods need to be adapted according to the local context and participatory specificities of each city. Indeed, cultural mapping is flexible according to the objectives, purpose and what one wants to map, for example, facilities, organisations, stories of places, historical sites, other aspects oriented towards the past (memories and landmarks) or aspects oriented towards the future (aspirational mapping), intended for the community or for outsiders.

Therefore, cultural mapping emerges as a vital tool which could be upscaled and integrated. However, cultural mapping extends beyond its role in identifying and leveraging cultural assets for urban regeneration. Extensively used in URBiNAT in view of action, this methodology also embodies a significant educational dimension that is important to explore. It prompts communities to reflect on their collective identity, values, and the intricacies of their living environment. Integrating cultural mapping into community initiatives, even if it is not with a view to intervention, can cultivate reflective communities that are not only aware of their cultural wealth but are also equipped to proactively participate in its preservation and regeneration.

In this sense, while cultural mapping is primarily seen as a methodology, it could also be thought of as a valuable outcome and output in the context of these projects. That is the reason why cultural mapping has been proposed as a means and as an end, or as a participatory NBS, which can be associated with all NBS, giving support to the co-creation process as a whole and providing platforms for discussion, engagement and empowerment through participation in the process.

Monitoring and evaluation can be integrated into this empowering process, fostering improvement and self-determination (c.f. ‘empowerment evaluation’). This holistic approach – in line with the 2020 Rome Charter on Culture – supports the aim of imagining a more inclusive, democratic and sustainable city, motivating further integration of culture and nature-based solutions for an inclusive urban regeneration (refer to Figure 7).

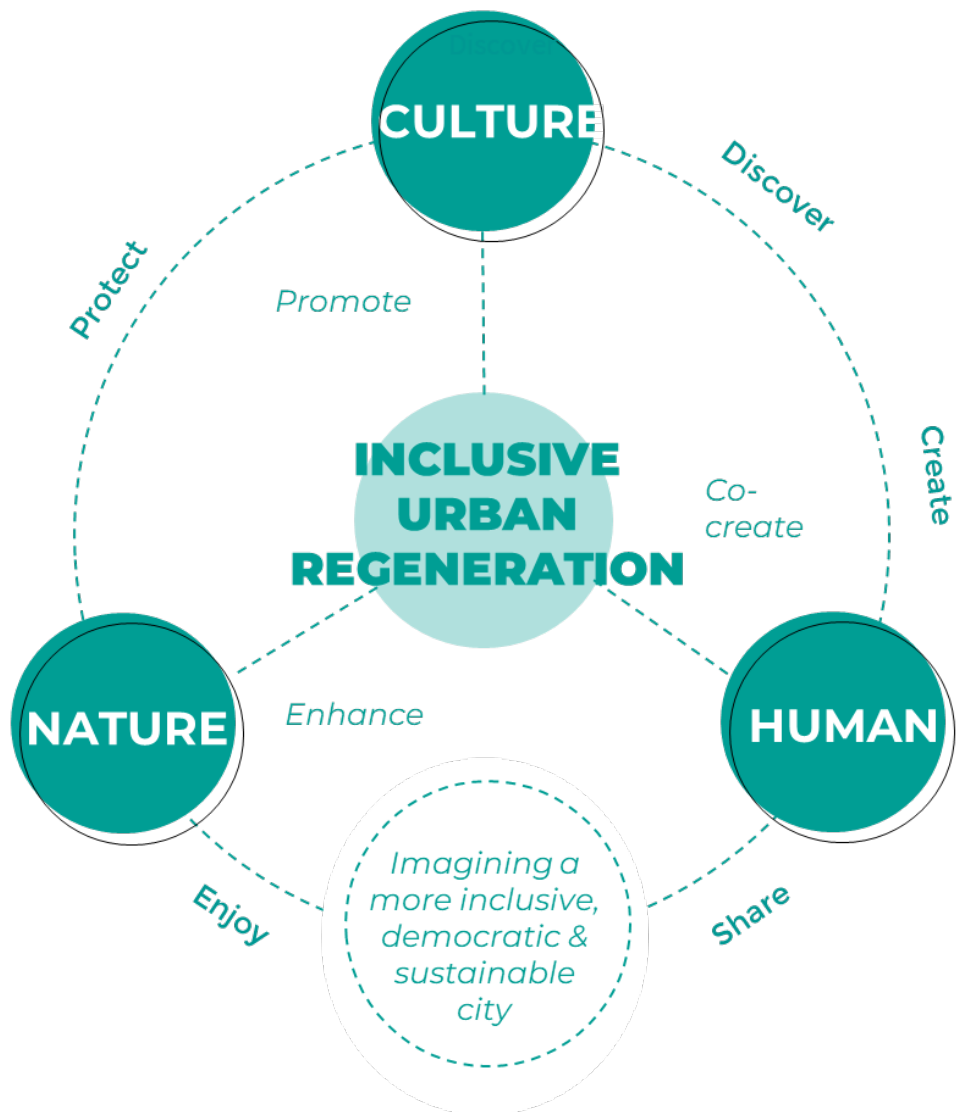


Figure 7: Intersecting culture, people, and nature-based solutions for inclusive urban regeneration.
Graph created by Ribal Aman Eddine and Nathalie Nunes.

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CHAPTER 5.

THE PLURALITY OF ECONOMIC LENSES IN THE DESIGN AND IMPLEMENTATION OF NBS' HEALTHY CORRIDOR

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Keywords: Social and solidarity economy, Nature-based Organizations, Business models, Value creation, Roadmap, Social Return on Investment (SROI) instrument, Socio-economic impact, Co-governance

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1. INTRODUCTION

Beatriz Caitana¹ & Emma Björner²

In the present chapter 5, we view nature-based solutions (NBS) as interlinked with plural economic perspectives, and in particular perspectives connected with social and solidarity economy (SSE). We also address and highlight that nature-based organisations (NBOs) can be valuable in dealing with societal and environmental challenges, not least in deprived city areas. The empirical context of URBiNAT cities, nature-based solutions and healthy corridors bring together a variety of community-led economic initiatives, SSE actors and NBOs, providing interesting and insightful examples elaborated on in this chapter.

In Porto, the solidarity market is associated with a popular economic context. As observed in section 3, the social and environmental relevance of the solidarity market is emphasized, since the market constitutes an immediate solution to implement skills that could contribute to raising employability on the one hand, and associating social cohesion to environmental goals in the territory, on the other. As observed in section 4, a number of nature-based organisations were identified in Nantes, such as a La Cocotte Solidaire, a combined restaurant/café and community kitchen; Phytolab, connecting urban planning with nature; and Moneko, a local currency used in Nantes and its surrounding urban area. In the same section, ambitions and contributions of NBOs in URBiNAT cities are outlined. In Sofia, ambitions of NBOs included to fight homelessness and food scarcity, locally and globally (The Bread House Network), to improve air pollution and positively impact mental health (Mr. Green Walls), and to educate society about the urgency of effects of climate change, such as food scarcity and increased levels of poverty (Food, not Bombs).

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The commodification of nature is still at work, even today. Already in the 19th Century, industrialization and the rise of an industry-driven economy and society led to an outspoken interest in different economic logics to exploit nature in favour of the overall idea of economic progress and societal welfare. Nature and its richness offered attractive, new avenues for capital valuation, investments and accumulation (Remme & Haarstad, 2022; Gomes-Baggethun & Ruiz-Perez, 2011). Soon, and in accordance with the dominant (mainly western), economic logic of the 19th, but also largely the 20th, Century, nature became the object of a neo-liberal free-market economy. Alternatives to respond to the consequences of this process emerged through concepts such as nature-based solutions.

Nature-based solutions were first used and conceptualized in the early 2000s, as part of designed solutions for agriculture (Potschin et al., 2016; Eggermont et al., 2015). New concepts and approaches emerge, transcending the economic logic and incorporating also ambited societal benefits and overall nature resilience. The NBS concept has been used and explored by prominent global organisations such as the World Bank, the International Union for Conservation of Nature (IUCN) and the European Commission (EC) since 2008, 2013 and 2015 respectively.

In 2015, the EC defined NBS as solutions “[...] inspired and supported by nature, which are cost-effective, and simultaneously provide environmental, social and economic benefits and help building resilience” (Faivre, et al., 2017; European Environment Agency et al., 2021). Since then, funds, resolutions, policies, initiatives and research have been adopted to strengthen and disseminate the NBS concept, in Europe and worldwide. At times other concepts have been associated, and even closely intertwined, with NBS, such as nature-based organizations, nature-positive economy, ecosystem services, nature-based infrastructure. As a consequence, Faivre et al. (2017) hold that NBS ‘operationalize’ the concept of ‘ecosystem services’ in real-world situations to promote sustainability by means of innovative governance and adequate (cost-effective) investments.

In the URBiNAT project, diverse lenses have been proposed to understand the economic dynamics in the context of Healthy Corridors (HC). One such lens has consisted of the SSE economic paradigm for the evaluation of the socio-economic impact of NBS, considering the definitions and features of NBS matching fairly well with the SSE lens. The difference between neo-liberal perspectives and SSE is highlighted by Vallet and Stoffels in section 2. While a neo-classical approach tends to focus on realizing maximum profit in order to reward economic actors that bring capital, the SSE approach seeks to harmonize economic power distortions

based on past accumulations and focus explicitly on social justice and economic inclusion, realizing benefits for all economic actors. In the same section, the role of intermediate stakeholders in creating socio-economic impacts and synergies are demonstrated. The advantages of the use of SROI methods combined with an SSE lens is moreover underlined, above all to capture NBS impacts.

In section 3, “The roadmap for nature-based solutions and urban regeneration powered by the social and solidarity economy”, Caitana and Santos outline the innovative choice of the URBiNAT project in refocused their NBS practices in the light of more emancipating and transforming perspectives. The proposition for a participatory and social and solidarity economy as NBS typologies was one of the measures adopted within the Healthy Corridor implementation, based on an ‘inclusive’ urban regeneration. Section 3 focuses on a roadmap to subsidize the practical experience of future NBS in the context of Healthy corridors, including recommendations for social organisations and local governments.

In section 4 on “Business models and value-creation of nature-based organisations”, Björner and Andersson claim that the rise of nature-based organisations (NBOs) have potential in improving NBS value-creation and thus contribute to societal and environmental challenges. Business models and value-creation of NBOs are proposed as fruitful tools in the arsenal of NBS project promoters, and identified as an area of research worthy of further investigation. Section 4 delves into how nature-based organisations create, deliver and capture value, presenting findings from Sofia, Nantes and Porto.

2.

THE SOCIO-ECONOMIC IMPACT OF NBS: EXPLORING THE USE AND ADDED VALUE OF THE SROI-INSTRUMENT AND THE ASSOCIATED SSE ECONOMIC PARADIGM

Nathalie Vallet³ & Sara Stoffels⁴

ABSTRACT

There exist many ways to judge upon the socio-economic impact of NBS throughout the rich tradition of behavioural sciences (e.g. political sciences, sociology, anthropology, economy, organizational behaviour or management). When gradually (i) elaborating the theoretical framework, (ii) realizing the research efforts and (iii) evaluating the numerous practical outcomes of the URBiNAT project, this colourful kaleidoscope also became apparent. In this contribution we describe and illustrate how the socio-economic impact of a NBS can be assessed by using the concept of the Social Return on Investment (SROI), a concept that also ‘fits’ the underlying Social and Solidarity Economy (SSE) lens within the discipline of Economics and Organizational Behaviour. After having developed ourselves a first version of a SROI-procedure for NBS, we implemented it in 3 case-studies, being the three URBiNAT front-runner cities Nantes, So-

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fia and Porto. Based on the results, we have identified some interesting lessons learned that enable us to further improve and fine-tune our SROI procedure for NBS in a well-considered and reality-based manner.

INTRODUCTION

It is often assumed that the realization of NBS conflicts with the thoughts of economics and management. This is however not automatically and always true. Creating and experiencing a conflict mainly depends on the economic and management ‘lens’ used. Such a lens is often directly related to underlying political and ideological convictions in our society.

A well-fitting – and *not* conflicting – economic and management lens for NBS is for instance the so-called Social and Solidarist Economy lens (SSE) (Defourni and Develtere, 2009; Calvo, Morales and Zikidis, 2019). It is an economic lens that already exists for more than 2 centuries. As such, it has also been implemented by various entrepreneurs throughout the world. It is important to emphasize that SSE is not focused on a particular sector or economic activity, but rather on a shared set of *fundamental economic values* functioning as a kind of joint *DNA* over many sectors (e.g. transportation, agriculture, commerce, housing, care-taking, creative industries and even banking). As will be further explained below (see 2), the SSE lens is for instance based on the fundamental conviction that economy and the management of economic organizations should explicitly support the entire society including its human and natural resources (i.e. fundamental value), and not the other way round. This also implies for instance that SSE organizations strive for and protect an *equal* economic power distribution throughout our society (i.e. fundamental value). By means of these fundamental values, SSE organizations clearly present themselves as an *alternative* and even an *opponent* lens for the presently dominant neoliberal ideology and ditto the economic lens.

Admittedly, given the SSE-lens, evaluating the economic impact of initiatives like NBS is quite challenging. A first challenge concerns the lack up until now of a fully-fledged and ready-made SSE method or procedure to evaluate an economic impact. Nonetheless, there do exist SSE suggestions to use the concept of the so-called Social Return on Investment (SROI) (Arvidson et al., 2013; Purwohedi and Gurd, 2019). Based on the existing, more general literature on the SROI, we have therefore developed a kind of first version of a SROI procedure applicable for NBS ourselves. To further try-out, fine-tune and develop our first version, we have realized a case-study research involving 3 real-life URBiNAT case-studies (Nantes,

Sofia and Porto). In line with the principles of qualitative research, these ‘inductive’ research efforts are based on interviews (e.g. citizens, policy makers, field experts, academic experts), site visits, action participations, observations of NBS events and document analysis (e.g. URBiNAT reports, websites, brochures, info guides)⁵ (Maxwell, 2012; Denzin, Lincoln, Giardina and Canlella, 2023). A second, but quite important additional challenge is the *timing* of our economic impact research. On the one hand there is the URBiNAT project planning. As we were part of the last work-package on NBS monitoring in URBiNAT, we had to realize our case-study research *after* intense prior data-collection activities of our fellow URBiNAT researchers. So, involving ‘again’ already intensively engaged NBS end-users (e.g. adults, children, inhabitants) was unfortunately no option anymore. As will be described later (see 3), this however opened an interesting window of opportunity, being engaging especially *intermediate* and *facilitating* actors (e.g. the local governments, civic organizations and SSE entrepreneurs). On the other hand there was also the considerable delay of the NBS *implementation* phase in all URBiNAT cities involved. Due to COVID-19 and to the sometimes ‘unpredictable’ course of public decision making, most NBS projects of URBiNAT were not finished when the monitoring phase started and the entire URBiNAT project finally ended. This complicates self-evidently the in-depth analysis and ‘rich’ set of *inductive* lessons-learned of our own research.

Finally, the structure of this contribution is as follows. First, both central concepts of the SSE lens and the NBS SROI will be described. As far as the SROI is concerned we will describe the features of the overall SROI concept as well as its tailor made use in URBiNAT. Taken together, both conceptual descriptions form the *conceptual backbone* of our contribution. Secondly, we will summarize the major results of the try-out of our SROI procedure in the 3 front-runner cities of URBiNAT (i.e. Nantes, Porto and Sofia). Given the qualitative nature of the research methodology (see before) and the encountered challenges (see also before), the results have to be considered explicitly as *intermediate* lessons learned. Finally, we will also highlight in a final conclusion the major consequences and advice for future researchers and policy makers.

⁵ More information on the research methodology can be found in the URBiNAT Report of WP 5.4

2.1 THE SOCIAL AND SOLIDARIST ECONOMY (SSE) LENS

As indicated in the introduction, the fundamental economic values of the SSE lens are quite opposite to the presently dominant neoclassical or neo-liberal lens. Let us focus in this paragraph on some main differences between both economic lenses. This is useful as this will simultaneously facilitate a better understanding of the SROI itself (see 3) and of our arguments for choosing the SROI as an *appropriate* and *useful* concept to evaluate the economic impact of NBS.

We will start with the lens that many people, including various politicians, captains of industry and even journalists, often associate with the one and only (true) economic lens, being that of the *neoliberal economic ideology* or the *neoclassical economic lens*. According to this lens, the emphasis of a 'good' economic practice and policy is on (Harvey, 2005; Cahill, Edwards and Stilwell, 2012; Mazzucato, 2021):

- Realizing *maximum profit* on the *offer-side* of economics, in order to mainly/exclusively reward economic actors that bring in 'capital' when generating products and services (i.e. profit is the reward for capital). Consequently, minimize all costs and thus also labour and 'reward' costs for actors that bring in 'labour' when generating the same products and services (i.e. wages and work condition investments are the reward for labour). Additionally, it is key to focus (only) on the *best* performing organizations, this means the ones that have survived a highly competitive free market system (i.e. survival of the *economic* fittest and elimination of the *economic* weakest);
- Serving mainly/exclusively consumers on the *consumption-side* of economics that guarantee high profits. This can be done by their willingness and capability to buy a lot of products and services, or to pay high prices (i.e. with a considerable profit margin). These consumers often have a *prosperous* and *powerful social and economic position* in society;
- Considering *nature 'not'* as a resource supplier with *economic rights* (e.g. respect and reward for its delivery of raw materials, energy and favourable production or logistic conditions). Additionally, nature is considered to be a resource supplier with *unlimited obligations* towards the providers of capital. As such, the natural resource supply must also follow the free market logic: the more (cheap) exploitation, the higher

the production capacity, the higher the consumption potential and the higher the (remaining) profit potential;

- Judging on ‘good’ *management* by means of (only) particular impact indicators amongst which ‘*efficiency*’ (i.e. minimal costs and max. profit), *growth* and *upscaling* (i.e. by reducing average costs increase the overall profit) are the most important ones. The reason is clear: they stimulate high profit rewards for actors delivering ‘capital’;

When depicting the essential features of the SSE lens, it is interesting to mention that it has various *ideological* fathers and mothers. Most often they come from left (e.g. socialist) and left *wing* parties (e.g. left wing liberals, left wing christian democrats and the green left) as well as activist movements (e.g. anti-globalists, climate change movements). In contrast to the neoclassical or neoliberal lens, the emphasis of ‘good’ economic practice and policy is on (Defourny and Develtere, 2009; Calvo, Morales and Zikidis, 2019; Estevez, Henfrey, Lucas dos Santos and Leal, 2023):

- Realizing benefits for *all economic actors* on the *offer-side* of economics generating together products and services. As such, the SSE lens does not only appreciate and reward those who provide capital but also labour. Thus this lens wants explicitly (i) to harmonize economic power distortions based on past accumulations of capital/power (i.e. social and economic inclusion, social justice), (ii) to value explicitly all human input, efforts and engagements (i.e. whether big or limited), (iii) to guarantee the fundamental and universal right to work and participate in economic activities (i.e. social and economic *inclusion*). Additionally, not only the best performing organizations that have survived the highly competitive free market system are appreciated, but equally and also the small and less powerful local entrepreneurs fulfilling mainly local needs (i.e. economic *inclusion*). Additionally, not only the powerful and appreciated labour forces on the highly competitive free labor market are appreciated (i.e. high skilled, marketable competences), but equally those with (very) limited or even absent physical, mental and socio-economic competences that do not win nor survive in a highly competitive free labor market (i.e. economic inclusion). And finally, also *volunteers* are considered as highly valuable labour forces that deserve equally safe and good working conditions like the paid labour force;
- Serving *equally* and certainly also consumers on the *consumption-side* of economics that have a *restricted, less powerful* and less *prosperous* social and economic position in our society (i.e. economic inclusion);

- Considering *nature* as a vital resource supplier *with* economic rights (e.g. preservation, bio-diversity, well-being) that should be *guaranteed* and explicitly *protected* by all other economic actors. This is for instance obtained by less (mass) consumption, less (mass) production, less economy-related pollution and more circular economy (i.e. sustainability);
- Judging on ‘good’ *management* by means of a combined set of indicators emphasizing mainly *effectiveness* (i.e. efficiency stops when effectiveness or the realization of important values and goals are jeopardized), *sustainability*, *inclusiveness*, *social justice* and *equal socio-economic power positions*. Consequently, low and even absent or negative profits of organizations are accepted as long as the previously mentioned indicators have a positive score. Moreover, such economic performance (i.e. negative efficiency, financial shortage) will be willingly compensated with extra public financial support, as this financial support is considered to be a kind of collective price paid by society (i.e. collective consumer) to an organization that has contributed explicitly to the realization of collective socio-economic goals (e.g. sustainability, inclusiveness, equal socio-economic power positions). Finally, continuous growth and up-scaling is not an economic ‘must’, on the contrary, *small* is equally beautiful, viable and even perhaps more sustainable.

When considering the definition and features of NBS in the URBiNAT project (see other chapters), it is clear that they match quite well with the definition and features of the SSE lens. Evaluating the socio-economic impact of NBS by embedding it explicitly in the SSE economic lens is therefore certainly possible and perhaps even recommendable.

2.2 THE SROI CONCEPT

When we evaluate the socio-economic impact of NBS in view of the SSE-lens, this clearly differs from a neo-liberal lens. According to the latter, economic impact measurements should be entirely focused on (only) evaluating types of financial *revenues* and financial costs, as well as calculating various *monetary* metrics with these revenues and costs (e.g. liquidity, solvability, cash flow and profit). An important neo-liberal metric or indicator for the socio-economic impact evaluation is the so-called Return on Investments (ROI). This metric evaluates the efficiency or profitability of an investment or project (e.g. NBS project) by calculating the *relative* amount of all its *financial* revenues to all its *financial* costs.

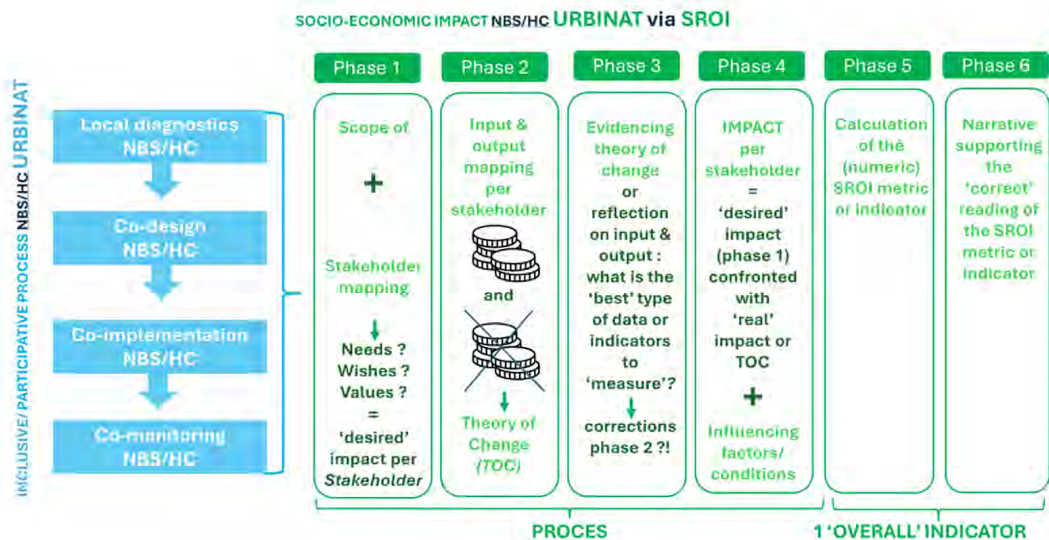


Figure 1: The SROI for NBS/HC as developed and applied in URBINAT.

At the beginning of the 21th century, mainly social profit and SSE organizations looked for an appropriate *alternative* of the ROI metric that 'fitted' better their typical SSE profile or identity (i.e see 2) (Carnochan, et al., 2014; Manetti, 2014). This quest was often urged by the forced legitimization of their existence and received public financial support by neo-liberal (inspired) policy makers. Thus, they introduced the concept of the so-called *Social Return on Investments* (SROI) (Arvidson et al., 2013; Purwohedi and Gurd, 2019). In contrast to the traditional ROI, the SROI consists of 2 evaluation activities (Lingane and Olsen, 2004; Krlev, Münscher, R. and Mülbert, 2013):

- On the one hand there is the SROI *process analysis*. This activity consists of 6 subsequent phases in which particular features of the project like the scope, the stakeholder mapping, the input-output flows per stakeholder are systematically inventoried, described and evaluated by the project stakeholders involved. Taken together this creates insights into the so-called *Theory of Change* (TOC) that represents the total and ever-changing socio-economic impact during the entire life cycle of a project. To realize each of these 6 phases, special techniques like interviews, focus group debates and observations are used. As such, the SROI process analysis resembles closely the process of doing qualitative research in behavioural sciences (Whitley and Kite, 2012; Gravetter and Forzano, 2018). It is important to emphasize that input and output flows replace the limited monetary approach of the ROI. Besides financial costs and revenues of each stakeholder, *output flows* also consist

of non-financial efforts and losses (e.g. time and energy spent to participate and solve conflicts, alienation of the changed neighbourhood) and *input flows* also of non-financial gains and benefits (e.g. personal growth, social contacts, the feeling of belonging, a better mental and physical health);

- On the other hand there is the second activity, namely the gradual calculation of a so-called SROI *metric*. This consists of generating in a creative manner financial ‘proxies’ for non-monetary costs and benefits (e.g. medical savings in the family budget because of a better health, free on-the-job communication training in projects that improves job perspectives and higher wages on the local labour market).

Based on a brief SROI literature study, we finally elaborated a tailor-made SROI analysis process or rather a procedure for NBS in the URBiNAT project. Subsequently we realized an inductive try-out of this tailor-made procedure in a set of 6 NBS in 3 cases (i.e. Nantes, Sofia and Porto)⁶. Due to the unforeseen challenges mentioned in the introduction (see 1), the try-out could only be partially realized. In particular we had (i) to stop after the SROI phase of the input-output flows, and (ii) to limit our stakeholder involvement to intermediate actors (i.e. local governments, civic organizations and SSE entrepreneurs). Irrespective of this only partially realized try-out, we still are able to detect some interesting, inspiring and useful lessons-learned.

2.3 SOME INSPIRING LESSONS LEARNED

When comparing our gained insights throughout the 3 URBiNAT case-studies involved, we are inclined to identify the following major lessons-learned. As mentioned before, these are clearly *intermediate* lessons-learned, resulting from a first overarching analytical reflection on all collected data up until the phase of SROI input-output flows for mainly three types of *interacting* stakeholder (see before):

- First, it is interesting to experience as a researcher how **dynamic, organic** and **long** the entire **life-cycle** of a single **NBS** is in reality. In view of measuring the socio-economic impact, this implies that it does not

⁶ The NBS *Paysages Nourriciers & Le Petit Lieu* in Nantes, the *NBS Green Classroom & Green Amphitheater* in Sofia and the *NBS Redevelopment of the X square & Campmarket* in Porto.

only take a *long time* before we can measure the actual or *final* socio-economic impact of a NBS, but it also suggests that there does not really exist *one final 'end' moment* in time but rather a continuous, ever-changing socio-economic impact *process*. Accordingly, it is advisable not to use **one overarching indicator** to represent a *realistic* socio-economic evaluation measurement at the 'end' of a NBS (i.e. when the construction is finished, when the NBS project 'formally' ends), but construct rather a **(changing) pattern** of subsequent partial socio-economic impact evaluations over time. In fact the NBS is never ending, and so is its socio-economic impact. In addition, the long life-cycle increases also the occurrence of unexpected incidents that radically can change the experienced socio-economic impact up until that particular moment in time (e.g. COVID-19).

Finally, this first lesson-learned supports also the *usefulness* of the SROI procedure or analysis in which the calculation of a metric on a certain moment in time is only a part of the overall socio-economic impact measurement. Additionally, the SROI procedure also facilitates the visualization (i.e. impact patterns) and follow-up of various items (e.g. changes in the stakeholder mapping) that determine and influence together the perceived socio-economic impact. Therefore it fits the complex nature of NBS quite well;

- Another lesson-learned is less or more related to the first one. After our inductive case-study research we realized that *the* socio-economic impact of a NBS actually does not exist. According to other **stakeholders** involved, as well as their mutually different *aims* and *frames of references* used to evaluate the socio-economic impact (e.g. desires, ambitions, values), the evaluation or result is different. On the bases of our three cases this is clearly not a matter of *right* or *wrong*, but of **other socio-economic angles** and **expectations**. Some may suggest to calculate some kind of 'average' of all stakeholders involved, but that is quite difficult and useless as the first lesson-learned suggests that even for one stakeholder the experienced socio-economic impact may change over time. From that point of view it makes more sense to reconstruct patterns per stakeholder over time, as we suggested earlier. Thus, at certain moments we can detect whose perceived socio-economic impact pattern rises, declines or does something else.

In view of this second lesson learned, it is also interesting to realize how **subjective** socio-economic impact evaluations are ... and will unavoidably remain. Even when 'objective/quantitative' data are used

to for instance evaluate the investment cost, correctly assessing this cost is influenced by *how* this cost *is* and *can* objectively and quantitatively be *measured*: does and can it for instance also include your invested personal *worries*, your time to *negotiate* and clear out *frictions* informally, your personal *efforts* to build trust? This *subjective* feature of socio-economic impact evaluations we have frequently experienced when constructing the stakeholder mapping and the input output flow per stakeholder. When really talking in-depth with stakeholders on all costs and returns, it soon became clear that certain costs and income cannot precisely be assessed, even not by means of a proxy. Therefore, forcing this kind of objective and quantitative discussions or dialogues risks to lead to artificial reasoning/facts and figures that actually are far removed from reality and actual practice. Why then should we still continue to persist to do so?

Finally, once again this second lesson learned convinces us of the usefulness and appropriateness of the SROI procedure to evaluate the socio-economic impact of NBS;

- A third lesson learned concerns the identity and role of the NBS **stakeholders**. When identifying (important) stakeholders of NBS in URBiNAT, the concepts of ‘participation’ and ‘co-creation’ tended to (over)emphasize **citizens**, albeit different types of citizens (e.g. adults, children, men, woman, migrants). From an outspoken political point of view in a democratic society, this is understandable. After all, it are mainly these citizens that elect the political representatives based on the extent in which the latter (i.e. politicians) have met the needs and desires of the former (i.e. voters). It is also the *electoral gain* that eventually will influence the *financial profits* of politicians (i.e. opportunities for money spending, extra income to fulfil political party ambitions). According to the network and stakeholder literature this is however a very – too – narrow focus (Freeman et al., 2010; Borgatti, Everett and Johnson, 2018). Without going too much into detail, the stakeholder literature emphasizes the role of *all* stakeholders involved in a societal network like for instance NBS, not only the end-users.

Rather by coincidence (see also introduction) we have focused our research on the role of **intermediate stakeholders**, being local governments, civic organizations and SSE entrepreneurs. Thanks to this unfortunate incident, we discovered in our cases how important their role in NBS are for boosting *learning* competences and experiences as an important socio-economic impact. After all, this enables the entire NBS social network to change and fulfil *future* societal needs. We our-

selves are inclined to talk about the *empowerment* or *resilience* of the NBS social network they are involved in. As such, these intermediate stakeholders have a really a considerable socio-economic impact on the long run as well as on a larger part of society than only the limited action radius of a particular NBS. When embedding the NBS in a bigger set of other initiatives and projects in other places of the city, this stimulates socio-economic *synergies* that presumably will result in an ever-increasing overall socio-economic impact... also when the NBS is formally already 'finished'. Unfortunately, there was not enough time left in the URBiNAT project to explore this supposed synergetic effects thoroughly;

- In the reconstruction of the **socio-economic input-output flows per stakeholder**, we discovered that what actually mattered most for them in our cases were the **non-financial output flows**. That was the topic that most of them spontaneously addressed when asked for their specific desired and/or expected added value of a NBS. In particular, they nearly all emphasized independently of each other the major importance of what they called themselves the *learning and experimenting opportunities* experienced in NBS.

When we further analysed the exact meaning of 'learning' and 'experimenting' they often referred to *gained insights in how their own organization tries to coop with long term but also incident-like organizational change management issues like a new strategy or structure*" (e.g. what do we actually do and do not? What are the consequences? How are our actions perceived by our own personnel involved and by various 'outsiders'? Do we and they consider these actions to be helpful and why?).

Further in-depth analysis showed that specific features of '*change management issues*' varied across the case-studies and consisted of organization *internal* and *external* issues. Some examples: (i) a changing of the 'guards' (i.e. a new political coalition after elections or new administrative employees and leaders, new directors and coordinators), (ii) the installation of a co-creative and 'more' democratic or participative policy-making culture, (iii) (forced) financial rationalizations and budget-cuttings, (iv) a dominant ideological 'wind' through society influencing also the management 'demands' in public and social profit organizations (e.g. neoliberalism), (v) considerable and fundamental changes of urban neighbourhoods (e.g. demography, social and economic positions, housing accommodations), (v) pandemics and crises (e.g. COVID19, energy crises). In some cases also opportunities or seren-

dipities were associated with change management (e.g. the ownership of the city of vast public green spaces to be used for offering healthy food, the presence of vast infrastructural education investments from the past to have infrastructural interaction facilities with families for participation, the geological morphology of the city facilitating certain NBS solutions focusing on clean healthy water and flood management).

When further analysing their experienced '*gained insights*' in depth, a variety of specific alternatives were mentioned. Insights that were most frequently emphasized were: (i) how can we coop with *complex* policy concepts (i.e. wicked problems) like sustainability (i.e. What does it mean? What are different point of views? How to realize this? What are alternative actions and practices?);(ii) how can members of our organization grow (unexpectedly) when participating in the NBS change process and leave their functional and personal comfort zone behind?; (iii) how can we build networks, develop network competences and reinforce the 'glue' (e.g. appreciation, trust) of these NBS social networks? Finally, it is interesting to mention that the nature of these gained insights had an outspoken operational or 'activity-based' character. It was not so much by 'talking' but rather by 'doing' that the insights really became clear and apparent for the intermediate organizations involved.

As such, many NBS of URBiNAT were seen as 'nurseries' and 'laboratories' or even 'play grounds' for present and future organizational change. This was not only the case for the SSE entrepreneurs and civic organizations, but also for the employees and staff of the local governments. Consequently, it was not so much the final result, or the actual effectiveness and efficiency 'output' (measured with a financial or quantitative indicator) that was important to evaluate the socio-economic success of a NBS, but rather the experimental *socio-economic journey and discoveries along this journey* themselves. Admittedly, we have to emphasize that this might have been different or more nuanced in local governments when more political instead of mainly administrative representatives would have been involved in the URBiNAT interviews and observations. Their underlying *electoral logic* (i.e. to 'win', to be considered as 'good' by voters) might have emphasized the importance of financial outputs more (i.e. more and/or cheaper public services). Unfortunately we have had no opportunity to investigate and question political representatives in the 3 case-studies;

Finally, this particular lesson learned was interesting as it *inductively* confirmed that the intermediate actors that we had involved, did not approach the socio-economic impact and appreciation of a NBS automatically from a neoliberal lens. This coincides with our argumentation to use also another economic lens in order to get a realistic view on how reality and all stakeholders involved actually perceive the socio-economic impact or added-value of NBS. Admittedly, neoliberal inspired stakeholders will question this and presumably judge the attitude of these intermediate stakeholders as ‘not good’, ‘not professional’ or even ‘not economic’. This however tells us more about their particular attitude, than about the economic truth itself.

- An additional overall lesson-learned when constructing the **socio-economic input output flows**, was that most stakeholders did **not** use nor even prefer **quantitative data** and **actual ‘results’** to evaluate the socio-economic impact of a NBS (e.g. expressed in *kilos* of harvested fruit and vegetables, *kilometres* of bicycle pathways, *amount* of participating citizens or inhabitants). In the in-depth discussions that we as researchers had with them, quantitative data did not really seem to express their previously mentioned goals and ambitions of learning and experimenting. Instead, the observed and experienced *quality* of the NBS (e.g. shared enthusiasm, intensity, surprise effect, originality, autonomy, well-being) clearly seemed to be more important for them than quantity. Consequently, they were not really fixed on generating quantitative socio-economic indicators such as magnitude, frequency, volume and vastness to evaluate the socio-economic impact.

For us as URBiNAT researchers it was again interesting to discover that this overall lesson-learned was confirmed by most SSE entrepreneurs, civic organizations and administrative staff of local governments involved. Thus, evaluating the socio-economic impact of NBS by a non-quantifying method or indicator is quite alright and even recommendable. It does not jeopardize the impact evaluation itself in view of what the stakeholders themselves really find relevant and important. We as researchers assume that an additional argument for this finding is related to the outspoken, complex local embeddedness of NBS (e.g. interaction with other projects, local enablers and disablers). Translating or ‘catching’ the influence of this complex embeddedness with only ‘numbers’ seems to be quite difficult if not impossible. Admittedly, once again we must be careful in generalizing this finding already as political representatives in local governments were under-represent-

ed in our qualitative interview activities and might have had another perception on this. Unfortunately, the URBiNAT project was too short to investigate more in-depth these nonetheless important contextual interaction effects. We tried to do it in each case-study, but the total information gathered was not enough to come to specific additional conclusions on that item.

- Taken together, the **overall lessons learned** seem to indicate that a **neo-liberal lens** emphasizing only -solely - financial and quantitative indicators directly related to the NBS to measure the socio-economic impact of NBS is not really suited let alone desirable by most intermediate actors involved. After all, the respective stakeholders in our URBiNAT case-studies themselves certainly did not use them when expressing and describing their proper socio-economic impact and added-value experiences of NBS;

CONCLUSION

In this contribution we have paid attention to the conceptual backbone and the major empirical research findings in our socio-economic impact evaluation of NBS in URBiNAT. In line with the explorative nature of our research efforts as well as some unpredicted challenges, we developed in URBiNAT a first version of an SROI procedure that was tried out in 3 empirical case-studies (i.e. Nantes, Sofia and Porto).

On the basis of our research findings we can identify the following major lessons learned as well as some associated (policy) advice:

- Due to a dynamic, organic and long NBS life-cycle, it is advisable to focus on socio-economic impact *patterns* rather than a single-moment metric at the assumed NBS 'end';
- It is advisable to realize that the measurement of the socio-economic impact of NBS unavoidably differs according to the socio-economic angles and expectations of different stakeholders (i.e. many stakeholders = many faces and values of the socio-economic impact);
- It is advisable to consider explicitly the long term and contextual embedded socio-economic impact *synergies* created by intermediate stakeholders, rather than only the short term and isolated impact appreciations of only citizens;

- It is advisable to recognize explicitly that the most important socio-economic impact measurements are non-financial outputs in terms of long-life learning effects that facilitate the overall resilience of the NBS social network in relation to unavoidable and complex challenges of societal change (i.e. NBS as ‘nurseries’);
- It is advisable to be aware that (only) quantitative indicators or metrics are according to intermediate stakeholders not really suited. These indicators can only reflect limited and isolated results, no synergetic effects that are however vital to obtain a realistic view of the socio-economic impact of NBS;
- It is advisable and appropriate to use the SSE economic lens and the fitting SROI method when evaluating the socio-economic input of NBS, as they both capture the actual socio-economic impact as inductively experienced by many intermediate actors involved;

In view of future research, we advise to focus the socio-economic impact research on items that could not yet be investigated in-depth in our URBiNAT research, due to unforeseen research circumstances. In particular it concerns (i) the influence and synergetic effects of the *contextual* NBS embeddedness, (ii) the input output flow of also various types of citizens and (iii) the political point of view within local governments.

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3.

THE ROADMAP FOR NATURE-BASED SOLUTIONS AND URBAN REGENERATION POWERED BY THE SOCIAL AND SOLIDARITY ECONOMY

Beatriz Caitana⁷ & Luciane Lucas dos Santos⁸

ABSTRACT

URBiNAT has refocused its NBS practices in the light of more emancipating and transforming perspectives. The proposition for a participatory and social and solidarity economy as an NBS typology was one of the measures adopted (see URBiNAT, 2021a) within the implementation of the Healthy Corridor (HC), based on ‘inclusive’ urban regeneration. In addition, the adverse effects of NBS are still under-explored, as is the equal distribution of economic benefits arising from NBS. Stijnen (2021) points out the failure to prioritise equity and social inclusion issues in implementing NBS, despite them being considered contributors to urban regeneration (Andreucci, 2022). Within the Social and Solidarity Economy (SSE) perspective, solidarity is seen as the equitable redistribution of opportunities, goods and results (Hespanha and Lucas dos Santos, 2016) between equals, people and groups that share the same problems and aspirations, involving cooperation based on relationships of proximity and trust. It is increasingly consolidated as an alternative to capitalist economies and proposes common interest instead of individual ambitions, cooperation instead of competitiveness and reciprocity instead of accumulation. SSE is an opportunity to improve living conditions and to move emancipation forward in deprived urban neighbourhoods.

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Figure 1. CampMarket. Photo: Carlos Barradas.



Figure 2: Germinário. Photo: GT2 Porto.

INTRODUCTION

This roadmap is the result of the implementation process of solidarity NBS. It is inspired by the various discussions that took place in the context of the design and implementation of the URBiNAT Healthy Corridor. In practical terms, the activities involved local residents and associations, practitioners, researchers and local government actors, creating a co-production atmosphere that gathered diverse forms of knowledge. Despite the sharing of information in training workshops, webinars and other events, the qualitative research process *in situ* with solidarity market and SSE local initiatives in Porto, Nantes and Sofia played a pivotal role in the establishment of the outlines of the present roadmap. This roadmap provides evidence that conceptual frameworks can also be grounded in community experiences and practices – the latter contributing to making science respond to concrete societal needs and supporting evidence-based policymaking.

The solidarity economy is historically rooted in communities that face the lack of rights and adequate living conditions, among others. The starting point of this roadmap falls back on the notion that inclusive urban regeneration models based on SSE can produce sustainable social transformation in any urban area. The political commitment with this agenda in metropolitan cities – such as the cases of Barcelona and Montreal – has also proven the social and environmental relevance of SSE for urban transformation (UCLG, 2017). Additionally, some research projects have also demonstrated this, confirming the social economy (SE) as a “distinctive approach to urban regeneration and community-based planning” (Murtagh, 2020).

A set of transnational efforts to reinforce SSE contributions to ecological transition should also be stressed. An example is the adoption of the resolution “Promoting the Social and Solidarity Economy for Sustainable Development” as part of the efforts by the UN Inter-Agency Task Force on Social and Solidarity Economy. It is also worth recalling the role played by the Intercontinental Network for the Promotion of Social Solidarity Economy (RIPESS) as a transnational mechanism committed to a regenerative agenda, stimulating the debate on the relation between the solidarity economy, resilient cities and urban sustainability. Other European projects and initiatives include the case of Euroregen (a FCT-funded project) focused on ecological regeneration of transnational networks, and the Transformative Cities initiative, centred on promoting integrative solutions for social, economic and ecological crises.



Figure 3: Jardin du Canada, 2023. Source: Gonalo Canto Moniz

Although the recent literature about the relation between NBS and SSE or urban regeneration and SSE is still scarce (Murtagh, 2020; Caitana, Tasheva-Petrova and Vallet, 2024; Lucas dos Santos, 2024), URBiNAT demonstrated that solidarity-based practices might be of help in rethinking a) the way urban spaces have been shaped in cities, b) the role that the participation of citizens may play with regard to regenerative practices in the neighbourhoods, and c) the relevance of equitable distribution of benefits and resources in the nature-based transformation of urban neighbourhoods.

In this way, inspired by the question “How can SSE practices support urban regeneration and make it more inclusive?”, this roadmap is based on the analysis of the perception of the community engaged in solidarity-based practices and results of diverse scientific activities. The proximity to citizens brought about by SSE practices allowed us to be more aware of the communities’ perceptions, expectations and concerns. This systematisation has also the ambition of supporting municipal governments in their efforts to strengthen their urban regeneration models. For this reason, the report provides recommendations related to the community engagement in solidarity-based practices, pointing out its benefits and the best ways of achieving it.

3.1 MAKING THE PLURALITY OF ECONOMIC CONFIGURATIONS VISIBLE WITHIN THE COMMUNITY URBAN SPACE

Economics as a discipline and societal dimension is not only composed by plural theories and doctrines, but by plural objects as well (Louçã and Caldas, 2009). Additionally, it is not an isolated scientific area, but, as a social science, results from the intersection with other areas of knowledge, such as moral philosophy, ethical issues or political sciences (URBiNAT, 2018). Contrary to what is claimed, territories of communities in outlying areas are made up of a diverse and thriving popular economic fabric that empirically illustrates this plural character of the economic rationality and principles. It means that non-market economic values – such as reciprocity, redistribution and householding (Polanyi, 1957) – are as important for guaranteeing the economic vitality of neighbourhoods as the market itself (Hillenkamp, 2013; Hillemkamp and Lucas dos Santos, 2019). In this sense, recognizing the existence of other economic rationalities in the local community initiatives is the first step towards designing more inclusive and assertive policies.

URBiNAT project promptly identified the association of SSE and the popular economy with self-management and cooperation practices, as well as mutual help and solidarity activities⁹. Although charitable actions are the first ones to be recognised under the label of solidarity, due to their contribution to ameliorate the material conditions of disadvantaged groups, it is worth recalling that solidarity in the sense pursued by Urbinat encompasses much more than charity and other voluntary sector organisations' goals. In this sense, URBiNAT aims to reinforce the relevance of SSE for the resilience of the communities and their self-empowerment and recommends that local bodies take this into account when thinking of social and environmental goals.

The solidarity economy can be vital for territories because of its characteristics of shared management/horizontal solidarity/collective forms of producing, consuming or distributing resources. However, its absence as a regular and formally recognised practice does not mean that the community cannot make use of its economic model to boost creative ways of urban regeneration, such as demonstrated by the case of the Porto HC. Forms of popular economy, in fact, provide relevant adaptations

⁹ Such as loans of goods or cross-trading – participants buying from each other, among others.

and concerns with regard to the domestic domain, revealing a certain correspondence to communities' life rhythms. Working mothers who work as small retailers or in street markets, for example, might adapt their work schedule to fit into the children's school schedule, demonstrating that the market focus, in popular economy, is not rarely blended with domestic concerns. The popular economy usually brings aspects and concerns related to the domestic domain to the market field, producing a kind of hybrid result, in which issues of care are taken into account. Similar to popular economy and community-led economic initiatives, tacit knowledge is prized, and its validation by organisations and local bodies constitutes a cornerstone for co-creation processes towards urban regeneration. Both the popular economy and SSE can create different means of conviviality, reinforce the social cohesion in the community, promote public uses of urban space and improve socio-economic conditions.

The three front-runner cities in URBiNAT brought together a variety of community-led economic initiatives and SSE actors in the context of the HC. SSE and popular economy practices were identified and mapped in different cities of the project. In the case of Porto, although several cases might be associated with a popular economy scope rather than SSE, their social and environmental relevance are to be stressed, as they constitute an immediate solution to situations of unemployment and for implementing skills that could contribute to raising employability, on one side, and associating social cohesion to environmental goals in the territory, on the other. The Germinário in Porto illustrates this latter goal as it has promoted forms of community management of urban gardens, fostering social cohesion and environmental awareness.

In Nantes, Le Petit Lieu - a SSE organisation that works as a second-hand store - diversified and broadened the scope of its project by forging an intergenerational co-living space through the redevelopment work of the building that hosts them. In Sofia, in turn, community-based Bread Houses not only gathered disadvantaged people around a way of guaranteeing their own provisioning but also stimulated them to critically think about challenges in the community. As such, bread houses became much more than economic arrangements, having boosted dwellers' agency and stimulated a more active participation in the neighbourhood.

How can social organisations and local governments take advantage of this recommendation?

- By **identifying, through diagnosis, the existence and the relevance of different economic principles within the community** – that is, reciprocity, redistribution, provisioning (householding) and trading mechanisms (market). Municipalities should not be so singularly focused on market arrangements as if they were the only forms of local development. Non-market and community-led economic initiatives forms of goods and services should be evaluated as part of the local economy inasmuch as they contribute to everyday neighbourhood provisioning.
- By **building the capacity of social organisations and staff of local bodies with regard to SSE principles and activities**. This broader perception of the economic, social and environmental role of SSE can foster more effective community engagement and also stimulate co-governance processes regarding transition goals. For this purpose, training activities on the plurality of economic principles, rationalities and practices as well as on the straight connections between SSE initiatives and urban regeneration are expected.
- By **using new measurements (and methods) to capture the particularities of SSE and community-led cases**. It means to give attention to the economic relevance of reciprocity or redistribution within the community as much as to the trading activities. It also means to recognise the importance for a community, in terms of collective resilience, to develop community financing models (eg. community banking models, ethical banking, solidarity revolving funds), bet on forms of solidarity cooperativism and boost a more participatory attitude towards issues of public interest. The evidence that can be produced through diagnostics can contribute to greater visibility of the transformative potential of the initiatives and their sustainability, anchored beyond profit and business goals.

3.2 RECOGNISING THE DIVERSE MOTIVATIONS BEHIND SSE INITIATIVES UNDER THE HC

Understanding the motivations behind the SSE initiatives helps understand the drivers for the emergence of SSE initiatives in outlying neighbourhoods as beneficiaries of the project. According to the results identified within the URBiNAT task 7.6, several reasons were brought to the scene during the co-implementation of the HC. These motivations were grouped into three categories: (1) those related to situations of social and economic vulnerability, (2) those resulting from emotional trauma, and (3)

those related to knowledge sharing linked to intergenerational learning in the context of families and neighbourly ties. As the project could verify and witness as drivers of community innovation, certain situations and living conditions have transformed problems into opportunities for inclusion through people's creative impulse and willingness to change.

Some of the causes underlying the social and economic vulnerability are the lack of formal employment opportunities, the precarious living conditions aggravated by the pandemic situation (which however already existed, being attached to previous structural inequalities), and a weak support network to help communities to deal with scarce resources, among others. This situation demonstrated the extent to which community economies might be useful in providing answers to the immediate intrafamily absence of resources. Similarly, the occupation of free time and the use of popular economy practices to overcome personal difficulties and emotionally traumatic situations highlights the relevance of SSE as a way of promoting quality of life, confirming their non-monetary value associated with conditions of health and well-being.

Many popular and SSE cases reported emerged under circumstances of sharing knowledge. Small entrepreneurs within the community told us that they have learned how to produce a specific product or service with immediate family members (grandmothers or mothers, among others) and in other cases with community members, based on close relationships between friends and/or neighbours. These cases gained prominence in the community. It can be thus stated that the learning experiences in a family and community context can be determinant in the trajectories within the popular economy. Intrafamily challenges and constraints served as levers for interest in starting up an economic initiative as an alternative to facing multiple challenges. The intergenerational practices of knowledge sharing proved to stimulate SSE practices as well. As a learning lesson, it could be said that.

How can social organisations and local governments take advantage of this recommendation?

- By paying attention not only to the specificities that shape social and environmental inequalities in the territory but also to **the way in which residents might gather to deal with individual scarcities.**
- By **recognising the way in which social markers of gender, race, class, ethnicity, nationality, age, among others, might define opportunities**

and challenges in the place and imply different needs and expectations when participating in community-led initiatives. With regard to that, the solidarity economy can contribute to promoting spatial justice (in social and environmental terms), bringing minority perspectives to the scene that may be under-represented.

- By **preparing local agents and institutions to refine their own understanding of loopholes with regard to representativeness, inclusiveness and social cohesion** and the contributions which might be brought by SSE initiatives.

3.3 CHANGING THE URBAN SPACE MONOPOLY

SE reinforces the relationship with pre-existing urban space¹⁰, which is the creation of a differentiated space (Lefebvre, 1993) through several sociocultural practices that stimulate new forms of sociability, place-based approaches and spaces of resistance. Following the concept of identity of resistance, in the urban space we identify a group of actors who are excluded and frequently stigmatised and who produce a force of resistance to prevalent patriarchal, colonialist and neo-liberal perspectives that might animate institutions (Castells, 1999 apud Resgala, 2017). As in SE, differential space seeks to promote social emancipation by stimulating the use value of urban spaces and not their exchange value (Resgala, 2017). Breaking with the capitalist mode of space production, this perspective of prioritising use value in space production challenges the ongoing risk of homogenisation (Resgala, 2017).

The case of solidarity markets (e.g. the CampMarket in Porto) illustrates how they combine resistance to the prevalent capitalist logic of exchange – through direct exchange between neighbours, use of social/transition currencies or, still, redistribution of scant resources in the neighbourhood (Lucas dos Santos and Silva, 2014) with a heterogeneous use of urban spaces and community-building in cities (place-based approach). Being grounded on territoriality, SE stimulates the connection with the infrastructure of public space. This connection between solidarity economic arrangements on one hand, and a more encompassing and fair use of the public spaces on the other, with the aim of achieving a

¹⁰ The UN-Habitat guidelines, published in 2018, advocate that policies, plans, designs and implementation processes should be reviewed and improved for more compact, socially inclusive, better integrated and connected cities and territories, so they can foster sustainable urban development and be resilient to climate change.

just representativeness of the different social groups in the production of the space, can be seen in the way the circulation of goods and forms of self-supply testify to different logics of gathering, sense-making and belonging to the social fabric. It happens, for example, when neighbours can fix their bikes by going to community-based shops, in a DIY format, where tools are collectively shared, or through public fairs. In this way, instead of urban areas being managed mainly by public administrative bodies, the functionality of public space is expanded, reducing the usual monopoly and diversifying the way in which citizens make use of this space (Caitana, Tasheva-Petrova and Vallet, 2024).

SSE actors not only amplify the uses of these urban areas, but they also co-produce them with municipal governments in order to guarantee their design, construction and maintenance, and to reduce technical uncertainty. With their socially oriented economic activities, SE initiatives engender a high degree of respect for the quality and added value of public space (Caitana, Tasheva-Petrova, Vallet, 2023). The public space becomes an obvious place to host collective dynamics with an orientation towards public interest. Its meanings multiply and it becomes a place of encounter, struggle, resistance and spatial transformation.

Within the HC, several economic activities focused on respect for natural resources and public nature regeneration, such as the case of the urban gardens in Nantes. The urban agriculture strategy of the HC in Nantes Nord aims to create a diversity of solutions around the theme of healthy food, from already existing family gardens whose production is dedicated to personal use to solidarity gardens, whose production is dedicated to the most vulnerable groups. This action creates a virtuous circle of abundance that transforms the logic of production and the territory where it is produced.

How can organisations and municipal governments take advantage of this recommendation?

- By adopting the **co-production model, understood as active involvement of the citizens in the provision and governance of social services** (Pe-stoff, 2011; Vooberg et al., 2015). The SE actors are **relevant agents in the co-production of urban public spaces**. Co-production is defined by Ostrom (1996, p. 1073) as “the process through which inputs used to provide a good or service are contributed by individuals who are not the same organisations”. Several opportunities emerge from the co-production model for **sharing the responsibilities and services related to the public urban area, such as design, construction and maintenance**.

- By **adapting administrative procedures and rules to accommodate heterogeneous uses of the urban space and their requirements.** The diverse forms of SE activities, in a general collective format, require public management models of the urban space to be reviewed in order to include their specificities and the right to the city. In many cases, the mastery of technical concepts and regulations, almost always attributed to technicians and experts, makes it impossible for communities to exercise full participation and collective use of public spaces.
- By **providing adequate infrastructure to include SSE economic activities in urban areas.** In the case of CampMarket, e.g. the availability of public toilets was fundamental to the functioning of the market. For the second stage of the initiative, the resources allocated to the storage of the furniture structures to be used in the markets also contributes to the efficient implementation of this initiative.

3.4 FACILITATING THE LOCAL PROXIMITY ECONOMY AND SOCIAL COHESION

One of the lessons learned from the recent pandemic crisis was the importance of local scale. The dynamics of globalisation, so greatly explored by capitalist domination, have had their undesirable effects revealed. During the pandemic, limitations on human circulation made the local dimension of the communities a place to overcome negative effects and reduce risks of contamination. Even before the pandemic, the notion of urban regeneration centred on local communities, closer economic relations and strengthening the local economy were already part of the SE agenda. The greater the purchase of local goods and services, the greater the chances of better distributing the economic benefits to the local communities, beyond the countless benefits to biodiversity conservation, local cultural assets and improvements of the economic status. In addition, the proximity economy effectively responds to the relentless expansion of the neo-capitalist logic of online marketing. Despite its benefits, online marketing has transformed producer-consumer relations, with a huge impact on small producers in particular. In the online marketing context, social relations and cohesion are considered secondary and the small producers are losing ground to initiatives with better e-commerce resources.

Several advantages of proximity relationships can be underlined. Interviews with those involved in SE cases in Porto revealed that based on

dialogue, products can be customised to attend to consumers' preferences, inspired by the co-production logic. Many relationships which start within SE markets and fairs are deeply constituted, with the capacity to transform into close friendships in the future. Advances in the local economy are enhanced and existing bonds are also strengthened through SE activities, to mention just some of these advantages. Despite the multiple challenges highlighted during the HC co-implementation, the common problem among these cases is the sale of product and services.

The production and marketing dynamics of the cases in URBiNAT refer to practices of mutual help between SE initiatives and community members, especially in the context of markets and fairs. This space facilitated proximity among participants and gave rise to spontaneous solidarity networks. Beyond the profits, the solidarity environment in the context of markets was the most significant motivation to keep participating for several cases. Communities appreciate when their sociability processes are properly recognised and validated. These processes not only contribute to strengthening social bonds in urban areas but also to propelling the natural resilience of the communities by stimulating internal forms of provisioning and redistributing resources (Lucas dos Santos, 2019).

These unseen community processes can be boosted through SSE practices. It is thus advisable for the economic role underlying some non-market activities – as is the case of edible community gardens, which provided the neighbourhood with fruit, vegetables, PANCs and medicinal plants – to be recognised and boosted as much as the small businesses in the surrounding area. Proximity relationships impact economic initiatives, such as the feeling of belonging to the community, the bonds of conviviality and the perception of security. Moreover, since the proximity economy favours the local level, the wealth generated by the community remains in the community, beyond the social bonds reactivated.

How can social organisations and municipal governments take advantage of this recommendation?

- By **including tax benefits to stimulate the local economy**. Several global movements, such as slow food, seek to bring producers and consumers closer together in order to improve the local economy. Usually, big companies receive several tax benefits, but still commodify natural resources, even adopting strategies of greenwashing.
- By **creating local social currencies** with the potential to facilitate and intermediate the marketing relationship.

- By **amplifying measures to support the transition ecological** for SE initiatives.
- By **adopting measures for boosting the local economy**, such as hiring professional residents in the community and capacity building programmes for community members.
- By the use of **solidarity-based NBS financing solutions** to amplify NBS financing opportunities with inclusion of this kind of modality as part of local policies, funds and programmes.

3.5 TAKING THE GENDER AND INTERGENERATIONAL ISSUES INTO ACCOUNT

The recognition of the role of women as economic agents and the constraints to which they are subject has been a challenge throughout social history. The economic value of care has been recognised through the large set of institutions focused on older citizens, children and persons with disabilities, to name but a few, as well. In doing so, the usual burden of women due to prevalent social roles is brought to the scene, with this matter becoming an issue of public interest instead of a private one. The economic value of care, however, remains a challenging issue, not only because of the over-representation of women in care work but also due to the low-paid jobs in the EU care economy.

SE arrangements identified in HCs are primarily led by women. Exchange fairs with social currencies, community kitchens and canteens, solidarity rotating funds, etc. constitute good examples. Middle-aged and elderly women have played a pivotal role in community-led initiatives all over the world and similar condition can be identified within HCs. In this sense, gender issues must be carefully observed. The initiatives pointed out that the conciliation of domestic tasks with the time needed makes the production process difficult. Initiatives such as kindergartens, cooperative schools and collaborative means of children care can help women that need to dedicate themselves to economic activities. Beyond gender issues, the condition of being elderly is another crucial factor to take into consideration for policy design and social interventions. Several co-implemented initiatives are led by senior citizens that seek supplementary income in economic initiatives or better conditions of well-being and quality of life.

How can social organisations and municipal governments take advantage of this recommendation?

- By **amplifying the public services to support social reproduction** in communities, guaranteeing adequate conditions for women to be engaged in economic activities. As underlined, the SE is directly interconnected with gender issues, and gender inequalities affect the equitable distribution of economic benefits to women as well. **Public policies for co-production of services (kindergartens, cooperative schools**, among others) can be relevant in order to reduce the structural gender asymmetries.
- By **offering financial support for economic initiatives led by women** to reduce the asymmetries in access to resources. For example, public or private funding measures geared towards economic initiatives.
- By **offering programmes to support the elderly population** in getting involved in economic initiatives.

3.6 PROMOTING THE ENVIRONMENTAL BALANCE THROUGH SUSTAINABLE CONSUMPTION AND PRODUCTION

Despite advances in human well-being, healthy living conditions and environmental sustainability, there still exists the risk of promotion of nature only due to its “attractive new avenues for capital valuation, investments and accumulation” (Remme & Haarstad, 2022; Gomes-Baggethun and Ruiz-Perez, 2011). The commodification of nature as a means for economic progress and societal welfare remains part of the overall idea of developed societies. In the economic logic of the 19th and most of the 20th century, nature became a neo-liberal free market economy. This statement confirms the fact that the economy cannot exist as an isolated sphere and should take environmental issues into account (Laville, 2018; Simlesu, 2023). It is no coincidence that concepts such as ecological economics and circular economics have gained prominence. The circular economy (Kirchherr et al., 2017) seeks to respect ecological balance through strategies of reuse, recycling and reducing, recovering, with the aim of protecting present and future generations.

Beyond the circular economy, the SSE has also focused on combining an inclusive economy with a just and ecological transition as a core part of its practice. Some SSE examples include agroecology models, recycling

cooperatives, and the production of organic cotton for clothes, among many others. What these initiatives have in common is the capacity to address the environmental agenda through fair economic practices.

The most significant contribution from SSE in HCs was conscious consumption and sustainable production. From the producers' side, diverse sustainable practices were adopted, such as reuse initiatives, biological raw materials, composting and organic foods, as well as the inclusion of environmental issues in the local community agenda. From the consumer's perspective, this involved choices of what to consume, being more oriented towards products and services with a low environmental impact (sustainable use of the resources) and health benefits. The urban vegetable gardens in Nantes, for example, go beyond personal use of gardens to solidarity gardens whose production is dedicated to the most vulnerable. In Porto, the collective management of the community garden introduced the production of seeds for solidarity distribution and cooperation.

There is no one specific productive sector associated with the SSE, but several. SSE sectors range from agriculture and food production, reuse, arts and craft production to clothing and energy, to name but a few. There is a strong interconnection between what is produced and consumed, and between those who consume and produce. During the HC solidarity market, the producers consumed diverse productions during the events, and this proximity relationship creates opportunities for everyone to produce and consume in the same space. Within the SE there is an attempt to overcome individual dynamics, to demonstrate that the production and consumption should not be understood separately.

The exchange process does not necessarily need to be intermediated by conventional money in such a way that non-monetary means can be adopted – e.g. time, social currencies, direct exchanges. It is also worth recalling that SE adopts a particular logic of production for agriculture, paying attention to food cycles, and stimulating the sharing of seeds.

How can social organisations and municipal governments take advantage of this recommendation?

→ By holding solidarity markets, whether for adults or children, in which **the meaning of consumption is profoundly changed**. Promoting such initiatives lays the foundations for a pedagogical transformation of consumption and its impact on society.

- By sustainable production, which aims to optimise scarce natural resources in the production process. **Sustainability-oriented production contributes to economic progress while not impacting biodiversity.**

3.7 VALUING LOCAL KNOWLEDGE AND NON-HIERARCHICAL RELATIONS

It is evident that the intergenerational learning process is the base for many cases of community-led economic initiatives identified within the HC. In a more practical way, it means that the knowledge circulates into families, but also into the community, creating a virtuous circle of learning. The results achieved within URBiNAT demonstrate products and services, for example, that emerge because the grandmother or mother taught their children and grandchildren how to manufacture them. Other products and services are initiated by the creativity of entrepreneurs who participate in training courses to improve and transform personal wishes into reality. There are initiatives activated due the socio-economic conditions of families, associated with the challenges of living conditions as well. In this last illustrative case, SSE initiatives have the function of supplementing family income or the social subsidies received by the families.

Despite the collective engagement of the community, which is crucial to improve the economic solutions researched, many challenges associated with the technical performance were mentioned, for example the domain of management issues, the design of the products and marketing strategies, among others. This lack of technical knowledge reflects the absence of access by outlying communities to certain expertise. When accessible, these knowledge resources are concentrated in the centre of the city and have high costs. The emergence of the social technology (ST) concept has been understood as the alternative to this scenario, promoting technologies which are oriented towards solving social problems. The aim of ST is also to assume a critical position over the models of knowledge produced in the universities and distributed to the communities. In turn, the solidarity incubators are academic arrangements committed to support local solidarity economy sharing solutions which can improve the performance of the initiatives. Inside the incubators, several social technologies and solutions are tested and implemented combining empirical knowledge with techno-scientific expertise. Many of the NBS solutions implemented in cities, for example, were improved through inputs from municipal government staff. Otherwise, making accessible specific expertise without the URBiNAT project could be hard. Within incubators, the

conventional hierarchy of knowledge is replaced by opening opportunities for co-production and valuing diversity of knowledge, assuming the principle that empirical knowledge from communities can reduce the uncertainties from technical solutions.

How can social organisations and municipal governments take advantage of this recommendation?

- By **activating local social incubators to subsidise the initiatives with technical assistance, knowledge sharing and improvements in case performance.** The social incubators consist of micro-production processes in which practises and resources are put into circulation within the relation between academics, local communities and public agents. A deeper learning process is activated to build capacities for community members, professors, students and researchers. Hybrid knowledge can emerge, based on diverse typologies of information.
- By **adopting a horizontal relation in terms of knowledge production,** considering that the URBiNAT project is anchored on three fundamental principles, mentioned in Deliverable 4.5. First, technical and scientific knowledge should not be considered the only type of knowledge that is viable and legitimate, especially since the residents of the neighbourhoods have a thorough understanding of their needs and can better contribute to the design of the respective solutions. Second, scientific knowledge produced within universities should not only serve the purposes of the market, but should expand the possibilities of democratisation by being better distributed among different societal agents. Third, mono-disciplinary scientific knowledge is not sufficient to explain and to solve complex problems; in fact, the gains from a transdisciplinary approach include the variety of actors and open perception of the relevance of different forms of information.

3.8 STRENGTHENING OF DEMOCRATIC PARTICIPATION AND LOCAL GOVERNANCE

One of the most significant contributions of the SE is the strengthening of democratic participation in the community and the decision-making process. It occurs at two levels: locally, within the communities' diverse small collective activities for making decisions inside the community-led economic initiatives; and at the governance level, in which community-led economic practices strengthen the capacities of their members to ac-

tively participate in the municipal governance and political sphere. What these two levels of participation have in common is the principle of collective and public interest. These non-capitalist activities are grounded in the democratic management and the autonomy of individuals expressed in forms of collective self-organisation. Instead of a perspective of solidarity based on a benevolent attitude, the viewpoint of democratic solidarity is considered to be the principle of the democratisation of society, from which collective actions of social reproduction emerge in an attempt to effectively reduce inequalities (Laville, 2018).

A robust participatory frame of democracy and collective decision-making are envisioned. In practice, the democratic transformation generated by the SE approach can be seen in the sharing rules of the collective initiative, adopting a collaborative perspective on decision-making and conflict resolution. It includes sharing information and transparency between different stakeholders, citizens, municipalities and researchers, joint decision-making and politics of co-governance.

The focus of the SE on democratic management and co-governance reinforces and triggers the democratic skills (listening, communicating, negotiating) of stakeholders, as well as cooperation within self-managed dynamics (Caitana, Tasheva-Petrova and Vallet, 2024). As such, the SE also alters power relationships towards more equal partnerships both inside and outside organisations. When SE entrepreneurs are involved in local governance of nature, they may provide extra support to the co-realization or ambition of NBS for public space (Caitana, Tasheva-Petrova and Vallet, 2024). These are concrete proposals for a different type of economy, promoting both the economic and political dimensions. Changes in power relationships are incorporated through the reinvigoration of the notion of community, the creation of different forms of self-organisation and solidarity among social groups (URBiNATb, 2021).

In the case of solidarity market in Porto, for example, as well as being a place of commercialisation, there are other associated benefits. Collaborative management, from the outset, has strengthened social cohesion in the territory through practices of mutual help and shared solidarity among all those involved. There is mutual concern about the well-being of group members and attitudes of caring and affection are adopted as part of the process of co-design and co-implementation. Collaborative management is the principle adopted by the organising committee, inspired by the co-management practices in which decisions are taken jointly and based on cooperative actions. In this model, the members of the committee favour mutual assistance and solidarity relationships among them.

A collaborative atmosphere is also understood as a pillar of community economies (Gibson-Graham et al., 2020).

How can social organisations and municipal governments take advantage of this recommendation?

- By **spotlighting the relevance of the associative approaches to strengthen skills such as listening, communicating, negotiating, among others fundamental to democratic participation.** In the arena of participation, it is necessary to mobilise individual resources and capacities that help the participatory process of the different groups. On the community side, associative practices help to mitigate social and historical asymmetries in the dynamics of participation involving different stakeholders. With the involvement and leadership in SSE initiatives, abilities and skills are strengthened, given the democratic nature of SSE as mentioned.
- By **inviting the members of SSE initiatives to participate in local co-governance.** Better cooperation between community and public bodies for the resolution of problems amplifies the active role of communities. There is the possibility of segregation and manipulation, and in this way the associative sphere can once again mitigate it.
- By **supporting community-led economic initiatives.** All the initiatives under the URBiNAT project agree that there should be greater state intervention to support SSE initiatives. They recommend that the state and institutions should participate more in communities and get to know their real needs in order to develop more assertive public policies – the co-implementation of local programmes, for example, combining different actions. Examples include (1) focusing on supplying public services through local agro-ecological production; (2) providing incentives for individuals in a socio-economically vulnerable situation to start their own business; (3) making fairs accessible and reducing the tax; and (4) activating public social incubators or public support structures of social or solidarity economy initiatives.

FINAL CONSIDERATION

Although SSE might hold different meanings for community members – e.g. constitution of a support network, access to scarce resources due to a better community redistribution, belonging – three aspects empha-

sise the social and environmental contribution of SSE arrangements within regenerative goals: 1. the reinforcement of communities' resilience, 2. the possibility of bringing knowledge and community technologies to the surface as useful assets to face environmental issues in the neighbourhood, and 3. the capacity for fostering social cohesion and, as such, of creating active citizenship for co-governance processes. Social economy organisations can play a pivotal role here, by prizing the local knowledge in the territories and by fostering the community autonomy, that is, their capacity for constituting a network of support and fighting for their rights.

Solidarity incubators and partnerships with universities are some of possible alternatives to the lack of technical knowledge to improve the community-led economic initiatives. Second, marketing strategies, in most cases, referred to difficulties in disseminating their products and customer acquisition. Options for exhibition of products, permanent selling points and markets/fairs are some solutions which may help, in particular for products that sometimes encounter difficulties selling in public spaces and gaining legal permission from local authorities. Digital marketing also could support these improvements.

Third, the conciliation of domestic tasks with the time needed for the production process. Considering that most initiatives are led by women, gender issues must be carefully observed. Initiatives such as kindergartens, cooperative schools and collaborative means of child care can help women that need to dedicate time to SSE activities. Fourth, how can the effect of conventional economy and the commercial competition be overcome? One solution is to communicate better the non-monetary and social values inherent in the SSE products and services and establish local partnerships. Fifth, finding raw materials can be hard, and in this sense, partnership between producers is an alternative. Sixth, several cases mentioned the lack of notions about business characteristics, value propositions, marketing, etc., for which training and monitoring of tutors are some of the solutions. The lack of spaces for production beyond the sales phase is also underlined. Finally, in addition to gender issues, age is a central point to take into consideration, and specific measures are required to include those of advanced age in particular.

Recognising the contributions of SSE initiatives to achieving just NBS, this section demonstrated the context and different actions that can strengthen urban regeneration to a more inclusive level. This leads us to conclude that the SSE is more than a concept, it is a way of life and a means for community-driven political action.

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4. BUSINESS MODELS AND VALUE-CREATION OF NATURE- BASED ORGANISATIONS

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ABSTRACT

Governments increasingly recognize the viability of nature-based solutions (NBS) to deal with societal and environmental challenges. However, noteworthy hurdles, including immature market development, hinder realising NBS potential for value-creation. Innovation and the rise of nature-based organisations (NBOs) have been observed to improve the situation. Business models have moreover been proposed as a vital tool in the arsenal of NBS project promoters. Nevertheless, business models and value-creation of nature-based organisations, especially in socio-economically weak areas, remains to be explored. This study investigates how nature-based organisations create, deliver and capture value. Methods include field research in three cities: Sofia, Nantes and Porto, featuring in-depth interviews with NBOs. Based on a comparative analysis, conclusions are drawn on what business models characterise NBOs. Finally, policy implications and recommendations are presented.

INTRODUCTION

The demand for nature-based solutions (NBS) has seen a steady increase over the past decade. While there are various definitions of NBS in circulation, a common applied description refers to nature-based solutions as inspired and supported by nature, while providing generous envi-

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ronmental, social, cultural and economic benefits (European Commission, 2016).

Companies and organisations with NBS at the core are often termed Nature-Based Enterprises (NBE) or Nature-Based Organisations (NBO) (Kooijman et al., 2021). Related phenomena include green, environmental and ecological enterprises, eco-enterprises, as well as sustainable and nature entrepreneurship (Dean & McMullen, 2007; Gast et al., 2017; Gliedt & Parker, 2007; Schaltegger, 2002).

Nature-Based Enterprises use nature to grow, harness, harvest or restore natural resources in a sustainable way, or by contributing to the planning, delivery or stewardship of nature-based solutions (Kooijman, 2021). NBEs also benefit from and contribute to the value-generation around NBS (McQuaid et al., 2022). Depending on the definition and scope of NBS, NBEs can also involve a focus on social and solidarity economy or participatory solutions, which is the case in the URBiNAT project and the present study. Furthermore, compared to NBE, nature-based organisation, or NBO, is a somewhat broader concept, also incorporating social community initiatives of informal nature. It is also the concept used in this study.

Governments increasingly recognize the viability of NBS to deal with societal and environmental challenges. Various challenges, including immature market development, however, hinders the potential for value-creation in the context of NBS. Furthermore, investments in NBS continues to rely on public funding. To enhance investments in NBS, the private sector also needs to engage. The rise of nature-based organisations has improved the situation (Kooijman et al., 2021). Yet, to date little effort has been made to arrive at guidance on what conditions or measures are necessary to stimulate the development of NBOs (McQuaid et al., 2021). Business models has been proposed as a vital tool in the arsenal of NBS project promoters (Mayor et al., 2021). Nevertheless, business models and impacts of nature-based organisations, especially in the context of socio-economically weak areas, remains to be explored (Peredo & Chrisman, 2006; Anyonge-Bashir & Udoto, 2012).

The present study and chapter investigate how nature-based organisations create, deliver and capture value. As such, we assess what business models characterise NBOs, with a focus on socio-economically weak city areas. The methods involve field research in three cities, namely Sofia, Nantes and Porto, featuring in-depth interviews with NBOs.

4.1 KEY CONCEPTS: NBS, NBO AND BUSINESS MODELS

NATURE-BASED SOLUTIONS

Nature-based solutions is a concept currently under development. In the recent decade, much research and innovation in the EU has been steered to the development and use of NBS to promote sustainable urban development. The Horizon 2020 programme include, among other things, the implementation of innovative NBS in cities for inclusive urban regeneration, and particularly the regeneration of deprived urban districts. Such districts are often characterised by the presence of derelict infrastructure, environmental pollution, low employment rates, and high levels of urban poverty (Nunes et al, 2021; Seddon et al, 2020).

Nature-based solutions has been defined as solutions that make use of nature and ecosystem services to provide economic, environmental and social benefits (Maes & Jacobs, 2017). NBS are associated with benefits for biodiversity and human well-being (IUCN, n.d.). In URBiNAT (n.d.), a somewhat broader definition of NBS has been employed, classifying nature-based solutions into four categories, namely territorial, technological, participatory, and social and solidarity economy.

NATURE-BASED ORGANISATIONS

Mobilising and leveraging value-creation in relation to NBS is intrinsically related to innovation along with entrepreneurship, business development, or other organisations and networks enabling value-creation. Entrepreneurship has long been recognised as imperative for boosting innovation and for risk-taking, testing, and experimentation of new solutions (Hall et al, 2010). There are several conceptualisations of entrepreneurship in relation to sustainable development. Examples include green enterprises and eco-enterprises, ecological and environmental enterprises, sustainable entrepreneurship and nature entrepreneurship (Dean & McMullen, 2007; Gast et al., 2017; Gliedt and Parker, 2007; Schaltegger, 2002). Nature-based enterprises (NBE) refer to the full range of formal organisations that operate in this space, covering various business models, while the broader concept of nature-based organisations (NBO) in addition also incorporates social community initiatives of informal nature.

Empirical work pursued by Connecting Nature (n.d.) has made progress in mapping and examining the nature of NBEs. The findings thus far indicate that NBEs tend to be of limited size, often nascent start-ups,

and limited to certain sectors. Of high importance is the degree to which entrepreneurs, business owners and enterprises are able to innovate in packaging the benefits of NBS to mobilise latent demand and thereby attain first-mover advantages in developing new market niches (Barney, 2018). Success in this respect typically requires aligning shareholder and stakeholder interests, agreeing to prioritise investments and returns for the long-term rather than grabbing short term profits (Freeman et al., 2020). NBEs are commonly viewed as propelled by internal convictions, notably in start-ups and SMEs (Kooijman et al., 2021). In practice, companies and organisations' internal motivations and external conditions interact in shaping what is possible.

Nature-based solutions and nature-based organisations are often context-specific and should thus ideally evolve in resonance with local needs and preferences. Institutional and regulatory conditions influence what organisational models are preferable and able to work under different conditions. Political and regulatory factors are often viewed by NBOs as associated with significant obstacles, although they are also on other occasions identified as important enablers. Policy induced measures tend to be viewed as high on the priority list of NBOs looking for means to raise investments in NBS or build enhanced demand for their services. Economic incentives, by way of taxes and market-based instruments, are generally viewed as more effective in underpinning demand and market growth, compared to regulatory measures (Tarui & Polasky, 2005).

NBOS AND BUSINESS MODELS

The adaptation and application of business models in the context of NBS emerged around 2014-2016 in connection to the EU Commissions launch of a call within the Horizon 2020 programme for research and innovation steered at NBS. The necessity to advance knowledge of business models for NBS has been acknowledged as a critical area of research, especially in an urban context (Mayor et al., 2021).

At the core of the business model concept is how an organisation creates, delivers and captures value (Díaz-Díaz et al., 2017). Traditionally, value has often been associated with financial performance, yet the concept is evolving as companies increasingly are expected to contribute to the creation of shared value (Schaltegger, et al., 2016). Business models for sustainability (BMfS) and 'sustainable business model archetypes' have emerged as concepts, proposing value propositions that limit negative impacts on sustainable development (Kooijman et al., 2021; Mayor et al., 2021).

From previous research on business models, we have detected three main models that we use as inspiration in the present study. In the first, ‘traditional’ model, owners are viewed as addressing sustainability considerations while carrying out conventional profit maximisation, put forth by, for example, Garrod and Chadwick (1996) in their work on environmental management and business strategy. In the second model, business owners are strongly motivated by fulfilling social objectives, as outlined by, for example, Laville (2014) in the context of democratic solidarity and the social and solidarity economy. The third model incorporates a combination of the first two (Freeman et al., 2007; Gupta, 2011).

4.2 METHODOLOGY: FIELD RESEARCH AND INTERVIEWS

The present study draws on field research in Porto in Portugal, Nantes in France, and Sofia in Bulgaria, all three frontrunner cities in URBiNAT. The field research in Sofia was carried out in March and June 2019, while the fieldwork in Porto and Nantes was conducted in April 2022. The selection of NBOs to include in the study was managed in close collaboration between the authors of this chapter and representatives in the cities.

In order to select a range of different nature-based organisations in the three cities, a number of criteria guided the search, namely connection with NBS (territorial, technological, participatory, and/or social and solidarity economy) business achievement, core operation (e.g. computer recycling, community kitchen, compost toilet), diversity (e.g. gender, ethnicity), type of organisation (e.g. start-up, SME, NGO), as well as reach and scope (e.g. local, national or internationally operation).

For the shortlisted NBOs, semi-structured interviews were conducted with company owners, managers, or other key personnel. Interviews lasted between 45 and 60 minutes. Table 1 contains information about the names of the selected NBOs, brief information about their core operations and the date of the interview. The interviews first touched upon key information about the organisation, followed by questions about the business model. Questions about ambitions and target groups were then addressed, followed by contribution to sustainable development, and opportunities for knowledge-sharing. Finally, the local policy landscape was discussed.

Name of NBO	Core operation	Interview date
Porto, Portugal		
Noocity Urban Ecology	Selling self-watering vegetable boxes and provides educational services and team building exercises.	2022-04-05
Good Food Hubs	Food network and pop-up meeting spaces to connect producers and consumers sustainable food.	2022-04-04
Reboot	Computer recycling and sharing programme; 'repair club' targeting families in vulnerable socio-economic situations.	2022-04-04
Cidade+	Annual, free festival dedicated to sustainability and social transformation.	2022-04-05
Nantes, France		
La Cocotte Solidaire	Combined restaurant/cafe and community kitchen.	2022-04-06
Phytolab	Connects urban planning and nature with a focus on landscaping.	2022-04-06
Moneko	Provision of a local currency covering Nantes and the surroundings of the urban area.	2022-04-07
Le Solilab	Association of entrepreneurs.	2022-04-07
Sofia, Bulgaria		
Shit and Blossoms	Manufactures and sells non-plastic compost toilets.	2019-03-19
Mr. Green Walls	Produce and sell vertical gardens to improve the interior microclimate, acoustics, and visual environment.	2019-03-06
Food, not Bombs	Educate people on food scarcity and offer solutions to combat poverty.	2019-06-26
The Bread House Network	Supplies homeless people with bread. Bread-making as an experience for team building activities or celebrations.	2019-06-20

Table 1: Selected NBOs, their core operations and interview dates.

4.3 RESULTS: VALUE CREATION, DELIVERY AND CAPTURE

AMBITIONS, TARGET GROUPS AND SUSTAINABILITY

The ambitions addressed by the NBOs studied were often tied to environmental and social aspects of sustainability and contributing to a better society in different ways. For example, Solilab's objective is to create value for society, the planet and its people. Ambitions also include to improve air pollution and positively impact mental health (Mr. Green Walls), to fight homelessness and food scarcity, locally and globally (The Bread House Network), to establish a healthier food system (Good Food Hubs), and to reconnect urban citizens with nature through the experience of growing

their own healthy and tasty vegetables (Noocity Urban Ecology). Some of the NBOs also focus on influencing collective behaviours to more sustainable ways of living (Cidade+) and on educating society on the urgency of effects of climate change, such as food scarcity and increased levels of poverty (Food, not Bombs).

Target groups of the NBOs include students in the neighbourhood (Good food hubs), citizens with a common interest in sustainable food (La Cocotte Solidaire), single households, families, community buildings, offices and public buildings (Shit and Blossoms), companies, private households and schools (Noocity), homeless people (The Bread House Network), and people in need, for example of a nutritious meal, a warm shelter, mental health advice or social contact (Food, not Bombs). The festival Cidade+ arranged in Porto, Portugal, is open and accessible to all. While the main event is arranged in the city centre, promotional activities and smaller 'pre-events' prior to the festival, are arranged in different parts of the city, including socio-economically weak city areas.

The challenges related to the environment and the social and solidarity economy that the NBOs researched focus on include environmental aspects more broadly (Phytolab), and more specifically, such as water scarcity (Shit and Blossoms), air quality and noise (Mr. Green Walls). Disconnection between nature and people living in urban areas (Noocity) as well as unsustainable ways of living (Cidade+) are also at the core of some NBOs missions. Sustainability challenges addressed by the NBOs also include unhealthy food systems (Good food hubs), food waste, and unsustainable production and consumption of food (La Cocotte Solidaire). Social sustainability aspects such as inequality (Reboot) and homelessness (The Bread House Network) are also important topics addressed by the NBOs.

The NBOs studied do not operate in isolation, but depend on fruitful links and knowledge-sharing with other actors. They also demonstrate openness and interest in capacity-building and strengthening relationships with other NBOs and other kinds of partners, and thus raising the relevance of the NBS agenda through collective efforts. The results also indicate that viable paths for establishing NBOs are not open to one kind of entrepreneur only. However, the most thriving NBO entrepreneurs are not only profit-oriented, but genuinely care about social and environmental values. At the same time, they also demonstrate talent and ability to manage resources and generate sustainable value streams. They also tend to surround themselves with trusted colleagues and teams that offer capabilities that are complementary to their own.

NBO BUSINESS MODELS

Three main business models were identified in the NBOs researched, namely: 1) Traditional For-Profit Model, 2) Social Economy Model, and 3) Hybrid Model. In the *Traditional For-Profit Model*, value is generated for owners, stakeholders and shareholders, and measured by the company's economic performance, while sustainability is also at the core of the NBO. The traditional for-profit model has similarities with business models proposed by, for example, Garrod and Chadwick (1996), Dillon and Baram (1993) as well as Irwin and Hooper (1992).

In the *Social Economy Model*, positive sustainability impact is the primary performance measure and mission of the organisation. No cost-revenue structure is applied, which means that all costs are being covered through public and/or private support, donations, and/or volunteer work. The social economy model has similarities with business models proposed by, for example, Laville (2014) and Defourny and Nyssens (2014).

The Hybrid model is based on shared value principles, meaning that owners and employees are mission driven with a shared value system that targets sustainability or circularity. The organisation has paying customers and is self-financed, but the owners have no profit interest for their own sake, and all surplus of the operation goes into maintenance and improvements of the NBO or for social purposes, for example helping homeless people. Examples of work championing the hybrid model include Freeman et al. (2007) and Gupta (2011).

Various overlapping or coinciding characteristics may in practice partially align or unite the three models. The traditional model and the hybrid model share the trait that both are self-sustainable and not reliant on third party contributions or subsidies. The traditional model and the social economy model each have their own track records of viability, despite different cost-revenue structures and performance measures. The social economy model and the hybrid model both draws on community-driven approaches that are ingrained in the local context. Furthermore, it is important to mention that the three models may not be entirely separable, since many NBOs carry features that belong to more than one business model. Moreover, changes in the societal and economic context, as well as changes in relationships between the organisation and its stakeholders, can change sentiments on the part of the owner and influence the business model of the NBO.

All three models discussed here are similar in that they contribute to the creation of shared value (Schaltegger et al, 2016) and to sustainable development (Mayor et al., 2021). Regardless of the NBOs' shareholders, cost-revenue structure, customers, suppliers, users, or distributors, at the core of all NBOs stands the principle of producing, accelerating and/or promoting nature-based solutions (Koijman et al., 2021). The NBOs' ability to achieve wider positive impacts on sustainable development, where business performance as well as social prosperity and community development go together, is emphasized. Viable business models in the case of NBOs are far from only about internal organisation and profitability in a narrow sense, particularly not for organisations that emanate from and succeed in traditionally deprived areas with socio-economic weak populations.

CONCLUSION

This study and chapter advance knowledge on business models associated with NBS, identified by Mayor et al. (2021) as a critical area of research. By exploring how nature-based organisations create, deliver and capture value, the present study also adds a deepened understanding of business models and nature-based organisations, with a focus on socio-economically weak populations, an area of research that has been highlighted as in need of further understanding (Peredo & Chrisman, 2006; Anyonge-Bashir & Udoto, 2012).

Nature-based organisations is still a rather new concept and phenomenon. Consequently, there is a need to amass more knowledge and to build operational skills in city administrations with the aim to foster favourable conditions for NBOs. Policymakers are called upon to shift from a passive or neutral stance to one of positive encouragement of NBOs, including removal of bureaucratic hurdles and red tape in various forms.

NBS present themselves as a set of new products or services with the potential to attract individuals, teams or communities with entrepreneurial mindsets and ambitions to contribute to sustainable development and better societies. The provision of small and medium-sized grants for communities, NGOs and other local actors could enhance NBS piloting and help disseminate adoption efforts as well as raise the interest of entrepreneurs and local companies to develop business models around nature-based solutions.

Small-scale funding can also increase awareness of and engagement in NBOs. This is important since success of NBOs hinges strongly on the realisation of models of engagement. Furthermore, increased efforts to co-create with citizens and other stakeholders can add to and internalise the value of NBS and the success of NBOs. Innovative environments, such as innovation hubs, also play an important role in mobilising engagement as well as spurring critical innovation, and to establish an expanded scope for exchange of experience, joint learning and underpinning mindsets for pioneering progress.

As argued here, NBOs are not merely about business growth and profitability, but also need to be plugged into and promote local community development. This creates the scope for win-win with NGOs. New methods and initiatives should be promoted and tested, in search for ways forward to shape favourable local ecosystems able to breed innovative NBOs, while at the same time building demand, generating resources and thereby leveraging and realising enhanced NBO business models as well as social benefits from NBS.

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CHAPTER 6.

HOW NATURE-BASED SOLUTIONS PROMOTE HEALTH & WELLBEING

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Keywords: Nature-based Solutions; Public health; Air pollution; Thermal comfort; Social cohesion; Physical activity

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1. HOW NATURE AND HUMAN HEALTH ARE CONNECTED

Marcel Cardinali, Philippe Bodénan

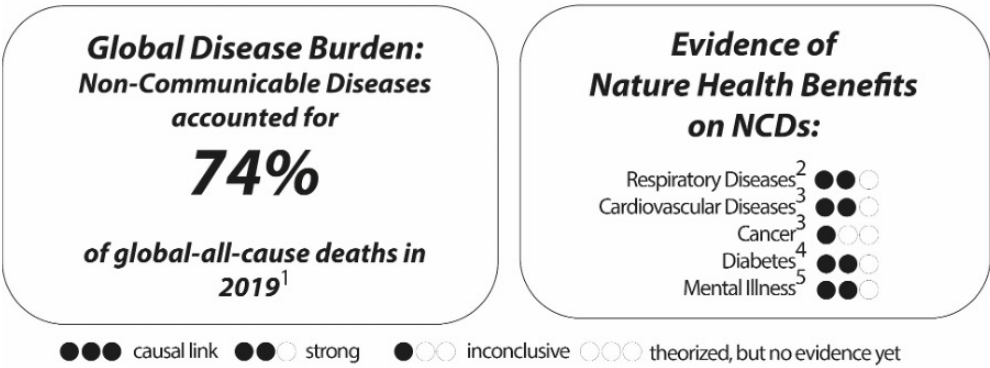
Currently, our global disease burden is dominated by lifestyle diseases. The latest global disease burden Report 2019 attributed 74% of global deaths to these non-communicable diseases (NCDs, Bai et al., 2023). The United Nations recognises five main categories diabetes, obesity, cardiovascular problems, chronic respiratory diseases, cancer and mental disorders and associates its prevalence with five main risk factors which are inactivity, loneliness, eating and drinking habits, smoking and air pollution (UN General Assembly, 2018). Since these lifestyle diseases and their associated risks are at least partly due to the way our cities are designed, current urban planning is tasked with reducing these risk factors (Frumkin et al., 2004; Giles-Corti et al., 2016; Nieuwenhuijsen, 2021; WHO Regional Office for Europe, 2012).

Nature-based Solutions (NBS) are considered to be one of the key strategies to achieve this. They are also considered a key strategy in combating other societal challenges, like climate change and biodiversity loss (United Nations Environment Assembly of the United Nations Environment Programme, 2022, European Commission Directorate-General for Research and Innovation., 2021). Globally, the qualitative (re)design of the human habitat has become a central and concrete field of action for important political agendas at national and international levels with the United Nations Sustainable Development Goals (SDGs) as its frontrunner. NBS are increasingly gaining momentum as a holistic approach to tackle all the challenges from climate resilience of urban environments to the health and wellbeing of their citizens (IUCN, 2022).

This focus on nature has also led to a sharp increase in studies on their health effects in the past decade, which have recently been put into the perspective of the five main disease categories of cardiovascular diseases, respiratory diseases, cancer, diabetes and mental illnesses (Cardinali, 2024).

As can be seen in Figure 1, there is convincing evidence for four of the five categories. Researchers were able to repeatedly demonstrate a decrease in respiratory disease, cardiovascular disease, diabetes and mental illness when study participants were in contact with or surrounded by nature. Only the connection between nature and the various types of cancer is unclear. However, a positive correlation is also suspected here, as green spaces are able to reduce the risk factors.

The current state of research assumes several different mechanisms responsible for these positive effects (Markevych et al., 2017), which can be categorised as *Mitigation* (reduction of environmental stressors), *Restoration* (stress reduction and attention restoration) and *Instoration* (inviting to adopt a healthier lifestyle). Mitigation refers to reducing environmental stressors such as air pollution, noise pollution, and heat island effects through the presence of vegetation, which are especially prevalent in urban environments. Restoration, on the other hand, refers to the restorative effects of contact with nature, particularly in terms of restoring attention and reducing stress. Spending time in green spaces can help individuals feel refreshed and rejuvenated, improving their mental and emotional wellbeing. Instoration refers to the inviting character of green spaces that has been shown to encourage individuals to engage in more physical or social activities, and consequently foster social cohesion in the neighbourhood.



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Figure 1: Evidence of the benefits of nature in reducing main NCD diseases (Cardinali, 2024)

Although these positive mechanisms are widely agreed upon, some researchers have criticised the distorted view of the purely positive aspects of nature and proposed to include harmful effects, like vector-borne diseases and pollen (Marselle et al., 2021). Indeed, it is important to keep in mind that nature in urban environments can both mitigate and induce environmental stressors. Accessible urban green spaces are associated with promoting physical activity, socializing, and healthy eating. Conversely, there is also some evidence that those spaces might increase injuries and elevate crime levels (WHO 2016). Direct contact with nature is very beneficial for children and their brain development and can build and restore capacities also for adults (Bratman et al 2019). On the other hand, it is important to recognize that being in nature increases the risk of harmful exposures related to disease vectors, wildlife, and ultraviolet radiation (Marselle et al 2021). So, while the overall research results show us a clearly positive effect –especially in reducing the global disease burden of non-communicable diseases – it is important not to lose sight of these negative aspects, especially as they pose very different risks in different regions of the world.

This also means that NBS can (and should) differ significantly depending on the original context and problem situation. While a lot of connected greenery seems most promising for reducing air pollution (*Mitigation*), community gardens are more suitable for increasing social cohesion (*Restoration*) and public green space network for inviting physical activity (*Ins-toration*). Use cases and their mechanisms are explained in more detail in the next sections to demonstrate how to make use of NBS for a healthier society.

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2. MITIGATION OF AIR POLLUTION WITH NATURE-BASED SOLUTIONS

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2.1 AIR QUALITY, HEALTH AND NATURE

Air pollution is one of the major environmental risk factors for health in urban areas, globally, in European cities and especially in Central or Eastern and parts of Southern Europe (WHO, 2022). In these geographical areas, the continental climate and cold winter or dry summer conditions can exacerbate the concentration of pollutants from the emissions related to energy uses such as heating of buildings (based on biomass, wood, coal), combustion in transportation (relying on fossil fuels), as well as industrial production (related to mechanical activities and chemical by-products). Furthermore, the primary natural determinants in space such as climate, topography and native land cover can be positively, neutrally, or negatively linked to the structure and infrastructure built in cities, towns, and suburbs in terms of episodes of pollution concentration. On top of those natural and urban environmental determinants come cultural, economic, and political drivers and pressures which can worsen the status of an area by the intensive or extensive cumulative contribution of activities that make use of polluting technologies or thanks to tailor-made policies and suitable urban planning and design solutions these can be well regulated and mitigated.

In order to make informed and wise planning decisions, the overview of the main and more specific pollution sources from industrial production, building heating and means of transportation, the set of various pollutants, and the characteristics of the places of exposure can serve as an initial scoping for the air pollution mitigation approach towards any specific setting, e.g. by urban regeneration with the help of Healthy Corridors and NBS. The growing availability of measured (EEA, 2022) and modelled (HEI,

2020; McDuffie et al., 2021; HEI, 2023a) air pollution data gives very good ground for better informed local decisions for planned regenerative adaptation of NBSs by authorities and communities across the Globe. Often such information is more reliable in countries and regions with higher societal development level so in some cases additional experiences, observations, measurements, and sensing may be needed for informed urban planning, design and decision making. Finally, understanding better some of the major diseases and the global to urban level burden of disease (GBDCN, 2020; ISGlobal, 2023), associated more closely with air pollution is an important point of departure of mitigation of the negative effects of air pollution but also the restoration pathways with the help of NBS.

2.2 APPROACHES AND CATALOGUES OF NBS FOR AIR POLLUTION MITIGATION

The format of the NBS for mitigating the unfavourable current status of the environment can involve different scales – from large regeneration of degraded landscapes through reforestation in urban areas to urban acupuncture redrawing the patterns of harmful air flows and everyday habits towards active way of living. Communities, specialists, and decision-makers can make choices of the approach, the scales, and the specific solutions by inspiration from:

- Good practice in place (Oppla, 2023)
- Sets of NBS catalogues and types of technological and territorial ones among other groups of solutions (URBiNAT, 2023; N4C, 2023)
- Evaluation criteria for the needed and appropriate ecosystem, social and economic services of the solutions (Raymond et al., 2017; Connecting Nature, 2020; Cardinali et al. (Eds.), 2021)
- As well as their adaptation and co-creative elaboration thanks to a unique process of collaboration in planning, design, and implementation as demonstrated in the current URBiNAT green Healthy Corridor development process and related research (Moniz et al, 2022).

2.3 RESEARCH ON NATURE-BASED GREEN INFRASTRUCTURE MITIGATION OF AIR POLLUTION

The comparison of contexts from the global pollution and health models to the local data, experiences, and expertise, show diverse pictures of drivers, pressures, statuses, impacts and responses. Those different pre-conditions turn into various significance of air pollution as a risk causing death and disabilities.

The health risks associated with air pollution are not homogenous in the macro-regions and vary among countries and cities, towns, suburbs and villages. Still, there are few reliable studies at the regional and city scales with plenty of cities' statistics blurred in the broader regional and national averaged indicators and probabilistic models. Many cities in Central and Eastern Europe experience a disproportionately high burden of disease from fine dust (particulate matter) with a particle size of up to 2.5 µm in diameter (PM2.5 exposures (HEI, 2023b) from the rest of the continent, especially in countries like Italy (northern), Poland (southern) and the South-Eastern European, Balkan peninsula ones (HEI, 2022a,b). Western European cities with their different climatic conditions and configuration of urban activities can experience a higher burden from nitrogen dioxide (NO₂) exposures.

There are significant research results on the topic of NBSs for mitigation of air pollution in urban areas which provide valuable insights, though still far from being cost-efficient for in-depth practical monitoring and evaluation. Diener and Mudu have proposed practical implications for urban planning from a public health perspective as part of their critical review of green spaces' mitigation abilities for air-borne particles (Diener & Mudu, 2021). The implications are in the form of logical steps with considerations of exposure risk and choices related to the design of green interventions to be gradually tailored to pollution sources and context.

Among policy interventions summarised to dedicate to the more appropriate use of green infrastructure for the improvement of urban air quality (Hewitt et al., 2020) are a) the modelling of ventilation in streets with closed tree canopies and the modification of them; b) the introduction of hedges and other linear barriers between traffic and pedestrians with suitable barrier height, porosity, and length; c) the long-term management of green infrastructure for enhanced pollutant deposition; d) the maximisation of green walls surface in street canyons; e) the creation of "green

oases” with slowly ventilated zones containing or surrounded by green infrastructure of varying possible size; f) the evaluation of ground-level ozone influenced by the tree population increase.

A systematic review of pathways to respiratory health in relation to exposure to urban greenspace (Mueller et al., 2022) has found that the major significant positive associations or better health in terms of dose-response are related to respiratory mortality. This conclusion comes in comparison to several other more specific respiratory diseases or health measurements (Asthma, Lung function, Rhinitis, Lung cancer as well as Symptoms and Hospital admissions) for which the authors state that more evidence of effects (not that well studied, less significant or controversial) or control of factors (e.g. species presence, more specific metrics of vegetation/green infrastructure) is needed in future research.

Shen and Lung studied the mediation pathways and effects of green structures on respiratory mortality via the reduction of air pollution (Shen & Lung, 2017). Their model based on data from Taipei, Taiwan reveals that the largest patch percentage reduced the mortality of pneumonia and chronic lower respiratory diseases by altering the levels of primary and secondary air pollutants, while fragmentation of green space was indicative of rising respiratory mortality. The authors discussed the beneficial effects of minimising fragmentation and maximising the largest patch percentage of green structures, also highlighting the crucial importance of these green structure indicators in greening policy for enhancing public health, beyond total green area and coverage ratio.

Another review bridging air pollution, green infrastructure, and human health in urban areas stresses the need for clear design guidelines for balancing between possible reduction in mortality, morbidity, and the links with improved wellbeing by dry deposition and other benefits from vegetation versus the possible increase in aeroallergens, biogenic volatile organic compounds (VOCs) and ozone as ecosystem disservices (Kumar et al. 2019). Beyond policies and towards site-specific NBSs and green infrastructure, there is proof of the effectiveness of urban green against PM and the controversial role of it in terms of VOC emissions and abatement, which are associated with the need for careful species selection (Ferrini et al., 2020). This review stresses also knowledge gaps and challenges in front of the practice which are widely and deeply discussed in the points considering the particulate matter and gaseous pollutants thanks to in-depth studies found in the scientific literature.

A valuable numerical experiment (Xing & Brimblecombe, 2019) was directed towards studying hypothetical scenarios for various types of open space layouts - with a vegetation barrier of trees, with a green belt of trees, or with completely filled area with trees and shrubs along with the leaf area density profiles of the trees and shrubs used in the simulations. Its implications for park design and policy include better accounting for pollution micrometeorology and the aerodynamic effects. That means that dense stands may lead to higher pollutant concentrations than expected, and vegetation barriers like hedges or green belts are not that likely to be effective in reducing air pollutants within the green area. The non-popular solid walls can be effective at the downwind side and can become more attractive with the help of climbers as green walls. The denser and variable in height greenery can provide better air quality in the core of the green areas, where seats, exercise areas and childrens' playgrounds are recommended to be placed, which is intuitively practised by planners and designers, also due to other factors such as noise. Considerations of accessibility when discouraging long-term occupancy in zones closest to the road should be taken carefully, as concluded by the authors Xing and Brimblecombe.

Further research on the appropriate indicators, metrics and data has come up with a list of mechanisms by which NBS can affect local and regional air quality (ConnectingNature, 2020). The list includes the more direct effects of the removal of pollutants and the emitting of chemicals, the intermediate impacts on microclimate like the lowering of urban temperatures and changing wind patterns, and the more indirect influences on the modification of the atmospheric boundary layer height and the reduction of building energy use that can save emissions from fossil and waste burning power plants or domestic smokestacks from solid fuel heating. For the cost-efficient study of O₃ and NO₂ in proximity to NBSs there are also measurement protocols available (proGInreg, 2020) along other PM and NO₂ Crowdsourced (Sensor Community, 2023; DUH, 2022). Such citizen science initiatives are extending the role of official stationary and mobile measurement methods as they reveal more air pollution 'hot spots' that are often blurred by inconsistent measurement and modelling approaches by public institutions and procured private consultancies. More thorough measurement and evaluation of the impact of NBSs on air pollution mitigation is hardly accessible for the purpose of smaller-scale urban regeneration interventions, though. In the case of larger or more dispersed regeneration projects and programs, there is a greater need for capacity in advanced measurements and modelling as part of wise planning, design, and decision support systems.

2.4 SOFIA HEALTHY CORRIDOR IN NADEZHDA AS A CASE STUDY

The broader estimates for Bulgaria show a higher burden from the air pollution risk factor to all causes (8.9%), including communicable (9.9%) and non-communicable (9.1%) diseases, than the average for Central and Eastern Europe (GBDCN, 2020) (Figure 2). Based on these figures, there were more than 11 000 premature deaths in the country in 2019 and an important part of them are expected to be in the capital city of Sofia with its 1/5 share of the Bulgarian population and relatively poor air quality. The city doesn't yet have its own integrated in-depth model for local estimation of the burden of diseases linked to air pollution. Thanks to wider comparative studies, there are calculations for Sofia by the year 2015 of around 1500 premature Years of Life Lost (YLL) only from PM_{2.5} (Khomenko et al., 2023).

The preliminary results from the research in URBiNAT during the co-diagnosis, co-selection, and co-design phases (Tasheva et al, 2021) show that the self-rated inconvenience concerning air pollution is higher in Sofia-Nadezhda (Bulgaria), in comparison to three other studied cities in Europe - Porto (Portugal), Nantes (France), and Høje-Taastrup (Denmark)

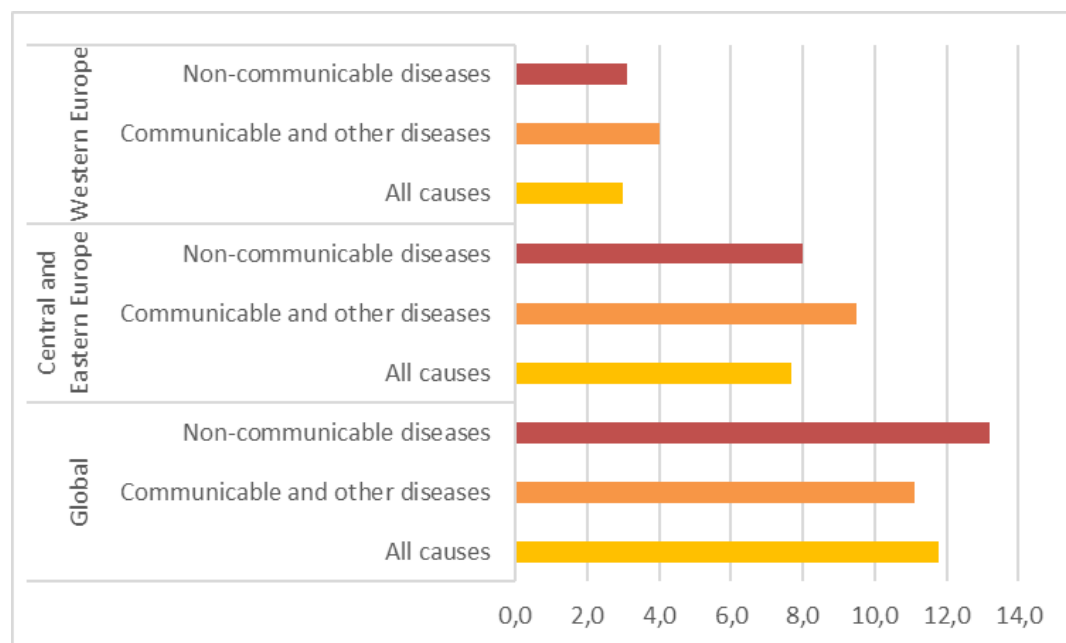


Figure 2: Comparison of the burden of disease from the air pollution risk factor (GBDCN, 2020)

(Cardinali et al., 2024). This evidence is even though Sofia and especially Nadezhda district and the URBiNAT area which is part of the district are associated with high availability of green infrastructure and moderate to high satisfaction with urban green areas and parks (Moniz (Eds.), 2019). This relation has been additionally and more broadly studied for Sofia as part of other research efforts to reveal the contribution of different air pollution sources seasonally (Dimitrova & Velizarova, 2021), as well as research on the joint associations between self-reported health, access to green, air pollution, and noise (Dzhambov et al., 2023a). The peculiar combination of air pollution sources in the case of Nadezhda district, especially during the colder parts of the year, unfortunately, cannot be mitigated by vegetation all year round. The constraint is due to the regional background pollution and the additional city-wide contribution from cars, smokestacks, and resuspension, altogether dispersed towards the low-lying district in times of low atmospheric boundary layer, temperature inversion, lack of wind and other unfavourable meteorological conditions. This is most often coupled with the usual fall of the leaves after the autumn (Todorova et al, 2021) which overlaps with the major episodes of exceedances of the national, and EU norms, as well as WHO guidelines (WHO, 2021). The dispersed pollutants accumulate for several days and even weeks with high concentrations of fine and ultrafine particulate matter and nitrogen oxides, combining in a toxic cocktail that has certain immediate effects on public health (Dzhambov et al., 2023b). The biomass of falling leaves takes part in the mix of pollutants during the process of their dissolution over the various urban surfaces, especially when falling over non-maintained 'muddy spots' where informal car parking takes place. This can be attributed to the general resuspension of dust in the city that makes up $\frac{1}{4}$ of the background pollution with PM_{10} (NIMH, 2020). The current monitoring and the final evaluation of the urban plan for the Healthy Corridor (Moniz (Eds.), 2021) and the related landscape design and placement of vegetation, as well as the provision of conditions for active mobility and parking address the choices of green and grey infrastructure in the wider context and discourse for the air pollution and health measures in Sofia and beyond.

We need to answer the question of how the geographic setting, urban development, mobility and heating are interplaying with the air quality in Sofia and Nadezhda. The geographic preconditions of the enclosed valley, where Sofia is located, with its specific geomorphology and temperate continental climate, have been imposing certain spatial and environmental limits to the urban growth and to the broader circulation of air in and around the core city. The changing urban development model from

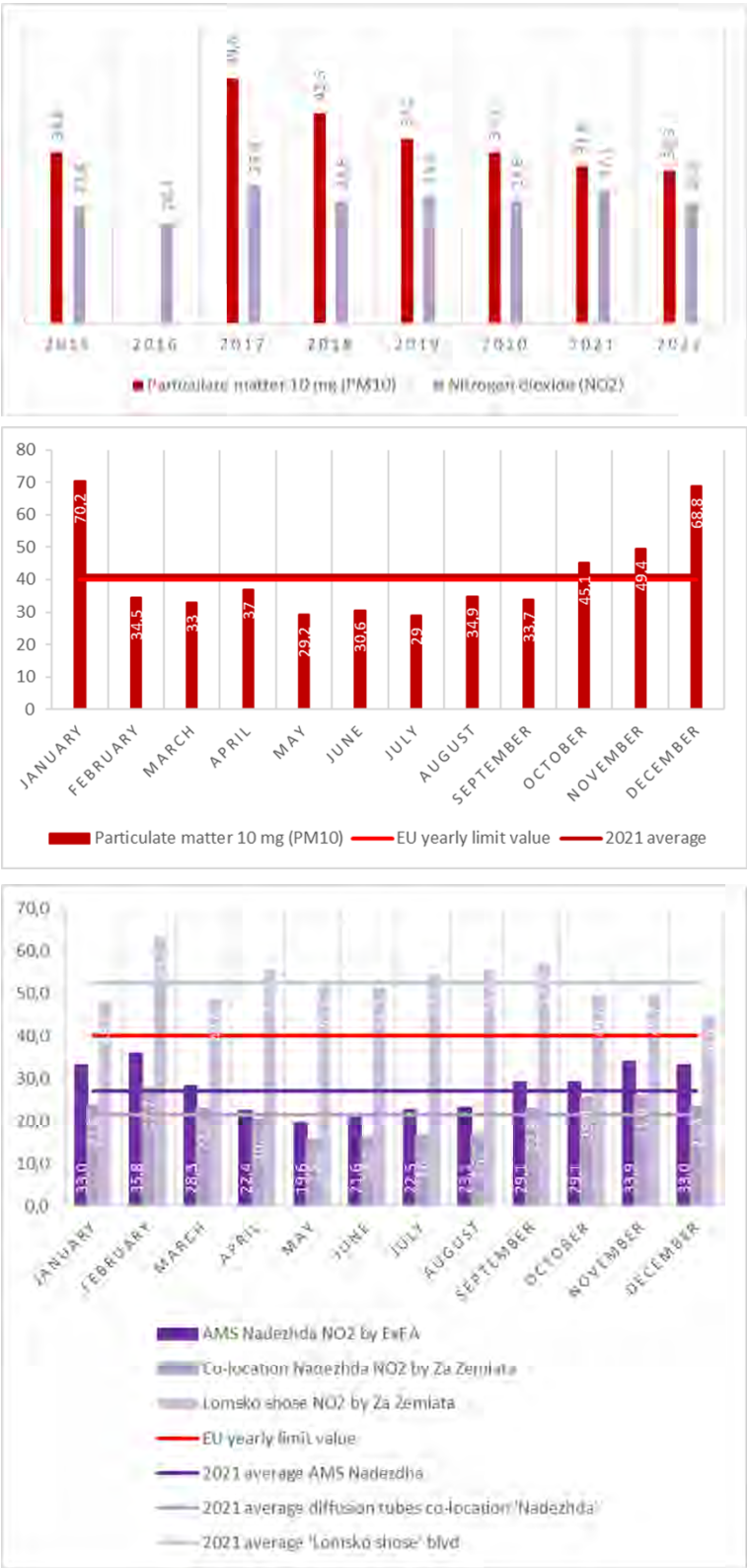


capitalist, through socialist and again back to capitalist city has led to an amalgam of ownership, building morphology types and street network patterns with varying degrees of roughness and porosity of the urban tissue as is the case of Nadezhda (Tasheva et al., 2021). Furthermore, the temporally dynamic mobility modes with growing car dependence and the regime shifts in the seasonal domestic heating choices have persistently been leading to high concentrations of air pollution and exceedances of limits throughout the last decade. This combination of factors didn't provide good ground for a more decisive shift in the state of the post-industrial metropolitan environment to definitely cleaner air although some minor improvements in the quality have been observed in the last five years (ExEA, 2023). Some of them can be attributed to a more favourable climate and, in 2020-21, to the pandemic effects that led to a lower volume of transportation activity.

Nadezhda has often been in the news amongst polluted areas in Sofia city as a point on the map being one of the five urban background monitoring stations where measurements of PM_{10} , O_3 , NO , NO_2 and SO_2 take place (ExEA, 2023), (figures 4-6). In recent years, levels of PM_{10} , NO_2 , and other monitored pollutants have generally remained below the limits set by the EU (EU, 2024) and national legislation, currently under review, with only occasional exceedances, yet above the recent WHO recommendations (WHO, 2021). A crucial pollutant not being measured here is $PM_{2.5}$, available at only one official measurement location in the city of Sofia – Pavlovo. There are additional measurements of $PM_{2.5}$ next to the URBiNAT Healthy Corridor thanks to an INTERREG project with the participation of Sofia municipality (AIRTHINGS, 2023), as well as the AirBG.info civic initiative in Bulgaria and Sofia, associated with Sensor Community (initially Luftdaten) (Fondatsia Kod: Bulgaria, 2023). The last one performed screening for NO_2 throughout the city between mid-2019-2020 ($22.6 \mu g/m^3$) with one point next to the official station in Nadezhda showing approximate results with it ($25.6 \mu g/m^3$ for 2019 and 24.8 for 2020).

The ecological association Za Zemiata also performed monthly measurements of NO_2 with diffusion tubes at bul. 'Lomsko shose' and 'Republika' street (co-located to the official monitoring station 'Nadezhda') during 2021 (Za Zemiata, 2022). The year 2021 was partially characterised by less traffic but the average value for bul. 'Lomsko shose' of $52,4 \mu g/m^3$ and within the $40-60 \mu g/m^3$ range during the months is well above the yearly limit value of $40 \mu g/m^3$. This was in sharp contrast with the co-located measurements next to the official background station 'Nadezhda', around 200 metres away, where the average value for the same period was $21,4 \mu g/m^3$.

Figure 4-6: Yearly PM10 and NO2 values (a) and monthly PM10 (b) and NO2 (c) values of PM10 and NO2 for selected time periods at 'Nadezhda' official automatic measurement station (ExEA, 2023) and two NO2 diffusion tubes (Za Zemiata, 2022)



and the monthly ranges were between 15-25 $\mu\text{g}/\text{m}^3$. That is even around 5 $\mu\text{g}/\text{m}^3$ less than the official measurements, typical underestimation by the diffusion tubes method. The gradient of pollution concentration between the internal background station and the major junctions is expected to vary in more direct relation to the traffic intensity. The routes along and across the corridor are aside from the heavy traffic and only the axe along the 4th class 'Republika' street as well as the crossing of 3rd class 'Nikola Zhekov' boulevard that continues with a short strip along the 4th class 'Narodni buditeli' street are areas with intermediate traffic load.

Generally, the concept for the location of the Healthy Corridor is towards the more internal parts of the neighbourhoods with enough distance from the traffic sources of pollution thus providing a healthier environment for outdoor activities, even in the colder months. That is when domestic heating raises the burden of disease but if coupled with a lack of physical activities the combination of environmental quality and unhealthy behaviour can have even more harmful effects.

The Healthy Corridor in Nadezhda bridges the two major city and district levels of significance parks – Severen and Nadezhda. The corridor goes primarily through or by inter-block green and quiet spaces, avoiding boulevards and streets with heavy traffic, thus air and noise exposure, as well as traffic accidents and injuries. The places of intervention are well protected and distant from arteries and other major streets, except the Green Assembly and the section along Republika Street where specific recommendations for the landscaping and greenery are yet to be considered. Just next to the Assembly is the place of the small-scale Autochthonous urban forest (less than 1 ha in size) which is going to be filled with more sizable trees and foliage surface. In between the places of intervention, there is abundant and relatively well-connected green infrastructure, a high average natural difference vegetation index (0,46 for the quarters where the corridor passes) and a variety of tree species (38 among 368 evaluated and mapped single trees (Ednodarvo, 2023) and 14 among 274 being or up to be planted by the procured company and or the community). Thus, URBiNAT will contribute to the enhancement of the tree and shrub vegetation for the mitigation of deposition and dispersion of pollutants along the corridor and during the vegetative season. This will also make more favourable conditions for active mobility and physical exercises, socialisation, passive recreation and restoration along the corridor, especially thanks to the location of most of the interventions. The three areas of intervention - Aqua Vita, Health-Energy, and Co-Place are aside from the major boulevards and streets, while the fourth one (Green As-

sembly) borders main streets. The Green Assembly is surrounded by lines of linden trees and shrubs along the nearby streets, as well as the sizable patch of autochthonous forest to be further enriched with appropriate vegetation. Further evolving landscaping next and out of the intervention zones, as well as along other crossing pedestrian paths, envisaged in the concept of the corridor can be a next step that should take into account the context of open roads and street canyons when shaping the vegetation (Barwise & Kumar, 2020).

In order to maximise this effect specific trees and shrubs were selected. Among the various trees and shrubs in place or to be planted along the corridor, the ones that are evaluated highly by the tool Specifind when applying priority criteria for pollutant removal (PM_{10} – 10, NO_2 – 8, SO_3 – 6, O_3 – 4, CO – 2), low VOC emissions, and Sofia as climatic locality, in the resulting list, there are species like *Tilia tomentosa* (rank 93 from 100), *Acer campestre* (rank 81), *Fraxinus excelsior* (rank 62), *Robinia pseudoacacia* (rank 56), *Betula pendula* (rank 50) and *Fraxinus ornus* (rank 47) (GreenInUrbs, 2023). The first three species and the last are included in the landscape design as some of the most predominant trees to be introduced in proximity to the places dedicated to longer and intensive activities. The next two from this shortlist are already present, either as pioneer and invasive trees or planted in the past after the construction of the housing estates. A brief assessment of the rate of removal of PM_{10} by this list of trees (except the missing data for *Fraxinus excelsior*) and their specific number (63 out of the 642 planted or up to be) is estimated at 12,78 kg per year considering the amounts taken from the scientific literature mentioned in the Specifind tool. This is 45,6 % of the PM_{10} exhaust and non-exhaust emissions generated by the volume of traffic (around 7500 light vehicles/day) along the 1.365 km long sections of streets next to the Healthy Corridor (Republika, Traen mir and General Nikola Zhekov) estimated by a recent transport model (Brezov and Burov, 2023). This rate of removal is achieved by only 10% of the existing trees along the corridor. The resuspension is not calculated here and it can diminish the role of the local vegetation. The dispersed pollution from anywhere else, when entering the area of the corridor leads to strong transportation of particles and substances. This process is most intensive during the winter inversions when the atmospheric boundary layer becomes very thick in separate episodes of no or slight wind from several hours to a week or even more. The remaining 90% of the trees, bushes, grass and soil, as well as other surfaces with pollution removal characteristics along the corridor, are expected to contribute enormously, especially during the vegetative period

of around 200 days in the year. The district is generally rich in vegetation which also influences the air quality positively. The URBiNAT Healthy Corridor is not a panacea for all of the negative impacts to the air quality of Nadezhda district and Sofia city but it will certainly contribute directly to more deposition and less dispersion of pollutants, especially during the vegetative season. There are reasonable solutions for planting trees and other vegetation along the corridor to filter pollution and provide plenty of other ecosystem benefits. Further evaluation through modelling and following review of the design and management of the corridor for more in-depth mitigation of air pollution and other impacts can make the synergy with city-wide (e.g. low emission zone, cycling infrastructure provision) and even higher-level policies (combined energy, climate and air related) even stronger. There will be stronger synergy if WHO guidelines are taken more seriously by political bodies in the EU, member states and city authorities and if local citizens and businesses continue to advocate more strongly for city wide reforms around cleaner mobility and heating.

2.5 LESSONS LEARNED AND GUIDELINES ON THE POSSIBLE ROLE OF NBS FOR HEALTHY URBAN REGENERATION

The wider context offers a great variety of local specifics and the choice of plants that can provide the appropriate ecosystem services and benefits is altogether science, craft and art.

When addressing air pollution in the cases of urban regeneration with the help of NBS, several general aspects need to be considered in first place amongst others, as shown in the case study of Sofia:

- Regional relief and local topography;
- Wind patterns and other local climate phenomena;
- Urban form and compactly built up and density profile of the city;
- Street and morphology types, open space, urban street canyons;
- Vegetation cover and species with their canopy density, leaf area, height, porosity and disservices
- Social-technical systems performance or infrastructure provision and collective behaviours – supply and demand management in terms of

heating, moving, active mobility opportunities and physical activity time windows.

In the domain of air pollution mitigation, the partial application of a narrower set of measures can hardly become successful as well as the formalistic, non-integrated, and controversial application of numerous measures. The consecutive long-term air pollution abatement is related to an array of locally, regionally, and nationally adopted and well-matched measures, many of which may have been applied somewhere in a similar or more different context. Studying cases like Sofia's can be helpful in uncovering the complexity of intertwined factors. Nature-based solutions are amongst the possible measures for the mitigation of air pollution. Their beneficial application is also a matter of well-diagnosed conditions and prescribed landing of the solutions - appropriately selected, planned, designed, and monitored for the foreseen purposes.

Hypotheses like the environmental Kuznets curve suggest that pollution initially rises during early economic growth but decreases as income levels increase further, leading to environmental improvement. Evidence from the burden of disease studies and others related to the external effects of simplistic economic growth shows that we need to go beyond that way of thinking. So changing the development paradigm for cities from short-term profit first towards regenerative material culture can be seen as a longer-term opportunity to design and build with nature a more viable ecological and environmentally sound global civilisation (Mauroner et al., 2021).

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3.

INCREASING THERMAL COMFORT THROUGH NBS: HOW DO PSYCHOLOGICAL AND METEOROLOGICAL FACTORS IMPACT OUTDOOR THERMAL COMFORT?

Jude Le Roy-Lisneuf, Sophie Herpin, Katia Chancibault, Ghazlane Fleury-Bahi

Urban populations are subject to increasingly hot conditions in summer, due to the Urban Heat Island phenomenon, which intensifies with urbanisation (see environment chapter), and climate change, causing more frequent extreme events, like heat waves (IPCC AR6 2021). This exposure to heat causes sanitary issues. For instance, 15000 deaths were attributed to the 2003 heat-wave, in France. Since then, health monitoring and alert systems have improved, but a recent report from Santé Publique France (2023) indicates that, over the 2014-2022 period, between 1000 and 7000 deaths per year in France are still due to heat. It is of interest to note that a maximum of 7000 deaths/year have been reached in 2022, owing to the harsh meteorological conditions during this summer. Hot conditions can also impact people's psychological health, reducing subjective wellbeing and quality of life. In this context, it is particularly important to study and understand the factors influencing residents' thermal comfort.

3.1 THERMAL COMFORT: BEYOND THE PHYSICAL FACTORS

Thermal comfort corresponds to an individual's state of satisfaction with his or her climatic environment and is linked to the individual's thermal perception. This perception is the result of the human body's thermal balance and the thermoregulatory mechanisms that enable it to be balanced. The heat balance can be determined from knowledge of meteorological variables (air temperature and humidity, wind, radiation), which

determines heat transfers between the human body and its environment (see environment chapter). Objective thermal comfort indices can then be calculated from these meteorological variables, in order to predict the average thermal perception of a group (Predicted Mean Vote or PMV, ISO 7730) or the thermal stress of an average individual (Universal Thermal Climate Index or UTCI, Bröde et al. 2013). The use of vegetated NBS, especially trees providing shade, has been shown to improve the local microclimate and thermal comfort indices (Armson et al. 2012, Coutts et al. 2016, Klemm et al. 2015).

However, thermal comfort is not only determined by the physical environment and the physiological characteristics of the individuals, it is also the result of psychological adaptation. Only 50% of the variance between the objective assessment of thermal conditions, and the subjective assessment by individuals, can be explained by physical or physiological factors. This suggests that other factors, particularly psychological ones, are involved in the process (Eliasson et al., 2007; Nikolopoulou and Steemers, 2003). This has led to the emergence of an architectural approach that focuses on the holistic person-environment system (de Dear, 2004). An adaptive model of thermal comfort has emerged from this architectural school, in which two processes in particular are expressed: firstly, context influences environmental perception, and secondly, past experience modulates the evaluation of environmental stimuli (de Dear, 2004). This adaptive point of view implies that the same environmental stimulus can induce different responses in individuals. Following on from this architectural approach, environmental psychology has turned its attention to thermal comfort. We know that psychological dimensions underpin subjects' adaptation to the environment and influence thermal comfort. These include, first and foremost, the individual's experience (Eliasson et al., 2007), the climate they have experienced in their life, i.e. their recent and past "thermal history", and also their cultural origins (Lenzholzer et al., 2015; Nikolopoulou et al., 2001). Also noteworthy in many articles is the mention of perceived control over the situation as an influencing variable on individuals' thermal perception (Schweiker et al., 2017; Keeling et al., 2016). Even outdoors, this factor can play a role, as individuals prefer places exposed to both sun and shade: the simple fact of having choice and therefore control over the situation modulates subjects' behaviour (Nikolopoulou and Steemers, 2003). Another psychological factor is very important to take into account: the subject's expectations (de Dear and Brager, 1998; Nikolopoulou et al., 2001), which imply that the subject is psychologically prepared for certain thermal conditions and that this influences their thermal perception.

As the psychological aspects are not taken into account in the thermal comfort indices at our disposal, it could be interesting to identify any discrepancies between the (calculated) PMV derived from meteorological measurements and the subjective perception of the participants. In case of any discrepancies, to what extent can they be explained on the basis of the identified psychological factors?

3.2 HOW TO CHARACTERISE THERMAL COMFORT? A CASE STUDY IN NANTES.

Thermal comfort was studied at 6 sites in the Nantes Nord district, (Figure 7), made up of various NBSs as an urban forest, a wading pool, a tasty garden and shared gardens. At each of these locations, two tools were used simultaneously to characterise thermal comfort: meteorological measurements to calculate thermal comfort indices (PMV, UTCI) for an average individual, and a questionnaire for participants present in the



Figure 7. The six studied sites in the Nantes Nord district around the Green Loop, with the positions of fixed and mobile weather stations.”



Figure 8. Wading pool at the Quebec residential complex, with the group of users surveyed that day (9th of June, 2022) and the mobile weather station used (visible in the middle of the group of participants). During that day, the participants chose to stay in the shade of the trees, and the mobile weather station was placed accordingly, also in the shade of the trees (credit photo : Sophie Herpin 2022).

investigated spaces (Figure 8). Meteorological measurements were carried out using two stations: a fixed station for Stendhal Middle School and a mobile station (LSI-Latsem Heat Shield model) at the other locations studied (Figure 8), measuring air temperature, air relative humidity, wind, and radiation. The stations were placed in sun exposure conditions similar to those of the participants surveyed: in the sun for the fixed station at Stendhal Middle School, and in variable conditions for the mobile stations, depending on the majority position of the participant group (exposed to the sun or in the shade).

The questionnaire is designed for quick questioning of participants present in the public space. It is about their perception of temperature and

thermal comfort at the precise moment they answer (Table 1). Psychological, socio-demographic and contextual variables were also investigated. Individuals’ perceived sense of control is also investigated through several questions, on the free choice to be where they are, and the subjective feeling of choice of temperature in the place studied. A two-month survey (14 days over June and July 2022) was needed to collect 125 responses to the questionnaire and the associated meteorological data. During these surveys, the average air temperature was 24.8°C, with a minimum temperature of 19.1°C and a maximum temperature of 35.5°C.

How do you feel at this moment? I am...						
-3	-2	-1	0	1	2	3
Cold	Cool	Slightly cool	Neutral	Slightly warm	Warm	Hot

Table 1. Correspondence between thermal perception scale and thermal comfort index PMV

3.3 DIFFERENCES BETWEEN THE OBJECTIVE AND SUBJECTIVE EVALUATION OF THERMAL PERCEPTION

The distributions of PMV (objective) and subjective thermal perception within the total sample (N=125) are compared graphically (Figure 9). They are similar, with a very close median for both quantities: 0.85 for PMV and 1 for thermal perception. This average score of thermal perception of the participants over the 14 days investigated corresponds to “slightly warm” (Figure 9), which indicates that the thermal environment during this summer remained acceptable. This is probably due to the NBS present on the green loop, which provided either shade (urban forest, individual trees) or freshness and water (wading pool) to the participants. Indeed, vegetation is recognised as a mitigation strategy to reduce thermal stress in urban areas (Wong et al. 2021, Klemm et al. 2015).

Some differences between PMV and thermal perception can also be observed but with a larger variability of PMV (Figure 9). To characterise these differences, an indicator is calculated as the difference between the reported thermal perception and PMV. The mean difference is very low (0.17), indicating that PMV is a good indicator of thermal perception.

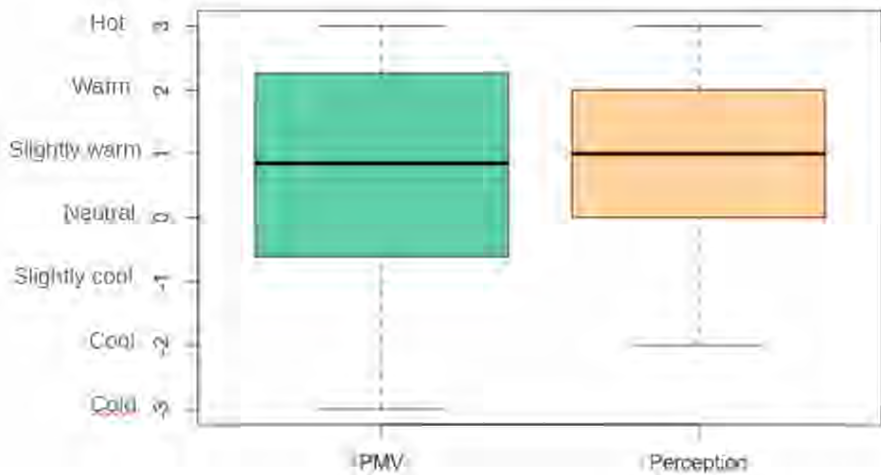


Figure 9. Compared distribution of measured PMV (Predicted Mean Vote) values and thermal perception indicated by respondents (125 participants). The black thick line indicates the median value (half of values are higher and half of values are lower than the median value) (left) and frequency of the difference between thermal perception and PMV within the sample (right).

3.4 EXPLANATORY VARIABLES OF THERMAL PERCEPTION

The first significant result to be noted is the strong positive correlation between thermal perception and the two thermal comfort indices, PMV and UTCI. On the other hand, we note that frequentation and recent thermal history are also positively correlated with thermal perception, but with lower values.

There was a negative correlation between thermal perception and age, suggesting that younger individuals report higher thermal perception. One explanation for this result may lie in the fact that the youngest participants (the minors) were all interviewed in the garden of Stendhal Middle School. In contrast to the other study sites, where participants were mostly in the shade, here they were all, without exception, exposed to the sun. However, this negative correlation was maintained even when the participants from Stendhal Middle School were excluded (91 participants over 18 years old). This suggests that it was the elderly who had a lower thermal perception. Older people are known to have a lower metabolism (body heat production), and therefore have a preference for warmer environments (Hoof and Hensen 2006; Wang et al. 2018), which could explain their lower thermal perception in summer. The perceived temperature control (subjective

feeling of temperature choice in a place) has been analysed in order to see if it could partly explain this result, but the results show it does not impact perception when all weather conditions are considered.

Analyses conducted only on warm and sunny days (59 participants, with an average UTCI value per participant equal to or greater than 26°C, as well as an average PMV value per participant equal to or greater than 0.5) reveal the same results, with positive correlations between PMV and thermal perception and between age and perception. On the other hand, there was a significant difference in perception according to perceived temperature control: participants who said they could choose the temperature in the location under study (for example, by choosing between a sunny and a shaded spot) declared a lower thermal perception (they were feeling less warm) than participants who considered they had no choice. They also reported higher thermal comfort, which is in line with the findings of Nikolopoulou and Steemers (2003).

The statistical analyses reveal that PMV contributes significantly to the prediction of thermal perception. The higher the PMV score, the higher the thermal perception. Age and recent thermal experience also contribute significantly to explaining thermal perception. It means that the older the respondents, the lower the thermal perception. And that the higher the recent thermal history, the higher the thermal perception.

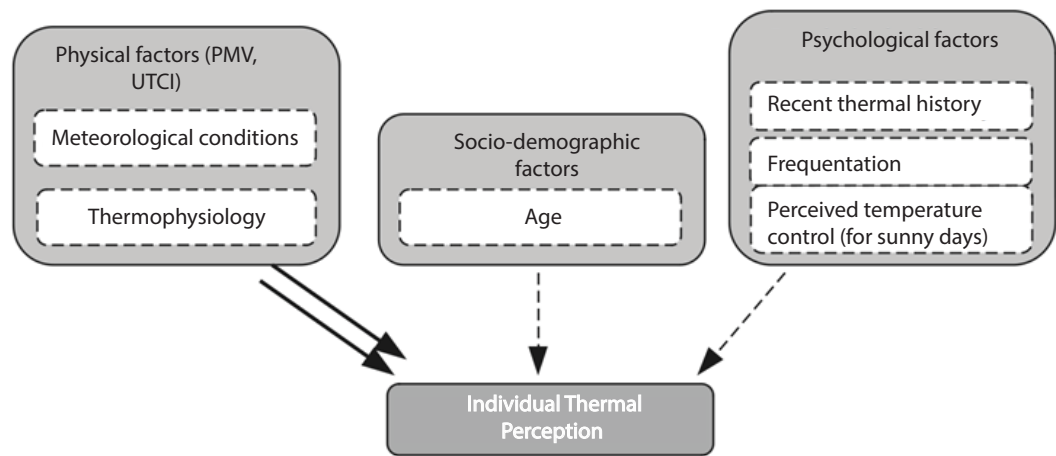


Figure 10: Factors explaining individual thermal perception, as found in the URBiNAT case study in Nantes during summer 2022.

3.5 CONCLUSION

Taken together, the analyses reveal one main result: thermal perception, and to a lesser extent thermal comfort, are strongly correlated with thermal comfort indices, and therefore strongly related to weather conditions. In exploring how people's perception of temperature is influenced by various psychological and demographic factors, it's found that a person's age and their recent experiences with temperature play a notable role in shaping how they perceive thermal conditions. This relationship holds true across different days. Interestingly, when focusing specifically on hotter days, there's an additional factor that affects how people perceive temperature: their sense of control over their thermal environment. In simpler terms, on hot days, if people feel they can manage or control the temperature around them, it alters their perception of the heat. The other variables studied (gender, socio-professional category, housing conditions) do not appear to have any significant effect on reported perception or thermal comfort.

Considering the studied sites, the NBS effect on thermal comfort is highlighted, because, although summer 2022 was very hot (see environment chapter for more details), the participants mostly stood in vegetated shadow places and felt slightly warm, which is acceptable considering the weather conditions.

A final recommendation for practitioners to improve thermal comfort in outdoor public spaces is to include both shaded and unshaded (sunny) places, to accommodate different weather conditions and different individual preferences and sensibilities to heat and cold conditions.

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4. INCREASING WELLBEING AND SOCIAL COHESION THROUGH ALLOTMENT GARDENS: BENEFITS, OBSTACLES AND CHALLENGES

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nan and Ghazlane Fleury- Bahi*

In a context of increasing climate and health crises (Carlson et al., 2022; IPCC, 2021, 2022), urban natural areas are especially valuable in that they contribute to the adaptability of environments to natural disasters and to the economic development of cities (Cohen-Shacham et al., 2016) and can bring wellbeing, social ties and health. Urban nature can exist in many forms, including allotments, a category that is particularly relevant to look at.

CONTACT WITH NATURE AND WELLBEING

Studies in the field of environmental and health psychology have provided a better knowledge of how natural spaces benefit the quality of life. In its integrative conception, quality of life refers to the physical and psychological condition of an individual and how this brings them satisfaction in regard to their expectations and the context in which they evolve (Fleury-Bahi et al., 2017). Quality of life can be considered through four fundamental components (World Health Organization, 1998): the physical condition (the individual's somatic health and functional capacities); the psychological component related to wellbeing; the quality of social relations and social activities; and finally, the relationship with their material and environmental condition. Hence, nature has several characteristics that contribute to a better psychological quality of life. Research on hedonic wellbeing: (positive emotion experienced at a specific moment, Diener, 2009) has notably identified two processes triggered by contact with

nature: attentional restoration (Kaplan, 1995) and stress recovery process (Ulrich et al., 1991). The first process suggests that nature's characteristics are propitious for a relaxation of focused attention and thus for cognitive restoration while the second assumes these features generate positive emotions and reduce internal tensions. More recent work also highlights the fact that the restorative character of natural environments also applies to social resources. Hence, Hartig (2021) points out that the characteristics of natural spaces provide a context in which social relationships can flourish, both at the level of a small group and at the level of an entire community. Because gardening is an activity that involves contact with nature, studies on gardening also emphasize its health benefits. Thus, the scientific literature has identified the benefits of gardening on physical health (Draper & Freedman, 2010; Kirby et al., 2021), life satisfaction (Soga et al., 2017; Sommerfeld et al., 2010; Waliczek et al., 2005; Wang et al., 2014), stress reduction (Genter et al., 2015; Kirby et al., 2021; Koay & Dillon, 2020; Van Den Berg & Custers, 2011) or attentional restoration (Gonzalez et al., 2010; Kim et al., 2012). According to Kirby et al. (2021) meta-analysis, gardening is also an opportunity to learn and build skills while doing a fun and money-saving activity.

ALLOTMENT GARDENS ARE SOCIAL SPACES

Yet, allotment gardens are places where people interact with each other and meet. The collective and social dimension of these spaces must therefore be considered in an urban gardening project. Hence, many studies have highlighted the propensity of allotment gardens to meet the social needs of individuals: the garden helps to develop social relationships, to intensify the feeling of belonging to a community and it contributes to social, cultural and generational mixing (Dobson et al., 2021; Genter et al., 2015; Kingsley et al., 2019, 2020; Kirby et al., 2021; Koay & Dillon, 2020; Soga et al., 2017). The garden is also a place of expression where individuals can value their social identity, their culture and their practices (Clayton, 2007; Draper & Freedman, 2010; Freeman et al., 2012; Mazumdar & Mazumdar, 2012).

The aim of this case study was therefore to identify, in Nantes, the contribution of gardens to quality of life and the psychosocial benefits linked to allotment gardens. Two allotment gardens in Nantes (318,000 inhabitants), more specifically in the "Nantes Nord" district, were selected for the data collection: "Les Eglantiers" and "Angle Chaillou". The sample of gardeners is finally made up of 28 participants. In addition, 8 non-gardeners who live in the Nantes Nord district were interviewed.



Figure 11: Photo of a plot in the Eglantiers allotment garden

The data was collected through semi-structured interviews conducted in June 2021. The objective was to identify the main psychosocial aspects (social cohesion, wellbeing, difficulties encountered, anchoring in the neighbourhood, etc) of the allotment gardens from gardeners' and non-gardeners points of view. The data was then analysed to identify and group key themes and ideas.

4.1 ALLOTMENT GARDEN'S BENEFITS

The content analysis of the 24 interviews with the gardeners revealed four main dimensions, each divided into several sub-themes.

THE ACTIVITY ITSELF

The first theme refers to the benefits resulting from the specific features of the gardening activity. Sixteen participants mentioned the intrinsic pleasure linked to the activity, particularly regarding the importance of the sensory aspect and contact with the soil (*"And then to work the soil, it's... It's really a virtuous thing, to see things growing and everything...it's very exciting"*). The desire to have products that are considered to be of good quality and whose production conditions are known is also an important aspect of gardening. Finally, a small group of 7 participants also mentioned the essential supporting role of the garden in the food budget.

HEALTH AND WELLBEING

In 21 out of the 24 interviews, the benefits for wellbeing and quality of life have been identified: "The garden is good for people who live in apartment buildings. It takes your mind off things...For those who like to garden too...[...] And here we're in a place where it's quiet...". For ten gardeners, gardening has a therapeutic dimension, it is a way to get rid of negative emotions and to fight loneliness. "I realised that there is a therapeutic side to gardening... At some times in my life, I wasn't doing too well.... At those times, it was utterly obvious to go gardening...I felt better". The analysis also highlights, in 6 interviews, discourses that refer to the notion of flow proposed by Csikszentmihalyi (1990), i.e. a state of intense concentration where our attentional resources are fully mobilised in an activity that we are passionate about ("We think about nothing, we think about what we're doing. It's one of the only moments when my mind doesn't wander because I'm concentrated on what I'm doing [. ...] That's how I stay focused without thinking about unpleasant things, as long as I'm here I enjoy it."). Nine gardeners also underline that gardening is a good way to keep fit and healthy.

SELF-DEVELOPMENT

For fourteen participants, the garden also provides an opportunity for personal development. Thus, half of the gardeners emphasise that the experience of gardening is made up of regular discoveries and learning; of

a feeling of gaining skills that grows with the years. (*"It makes us read - there are magazines on gardening - to see a little bit how to do this, to see why I failed that [...] Well, there's always something to learn, to see."*). For some others, the pleasure of having a plot is due to the feeling of personal accomplishment or the pleasure of committing to a long-term project.

THE POSITIVE SOCIAL ASPECTS OF GARDENS

Since allotments are collective spaces, numerous gardeners evoke the social life brought by the garden. Hence, we identified several social practices that contribute to establishing social links and conviviality in the gardens. Found in 20 out of the 24 interviews, the first practice refers to exchanges between peers (lending tools, giving plants, offering help). There is also a lot of interaction and discussion about the growing practices: *"We all have something in common - even if we don't necessarily have any particular affinities or connections, we are all able to talk about plants"*. Moreover, fifteen participants expressed their joy at being able to develop friendships and to experience moments of conviviality (*"I have friends who also garden, so as soon as we've finished gardening at around midday, we stay together...We have a chat and a drink and there you have it, that's also one of life's good moments"*).

4.2 IS THE ALLOTMENT GARDEN AN OPPORTUNITY FOR TOMORROW'S CITY?

The allotment garden is considered to be an added value for the city in 22 of the 31 interviews conducted (15/24 for gardeners and 7/7 for non-gardeners). This point of view is mainly supported by 3 arguments. The most mentioned aspect (19 interviews) refers to the garden being a space for meeting, social cohesion and cultural diversity; an opportunity to bring different populations together: *« I think there is quite a cultural diversity, you see. And I think that's really cool. I think we can learn other stuff and we also learn to live together even if sometimes we don't have the same habits, the same reflexes. »*. Secondly, the garden is also described in 16 interviews as a place that contributes to environmental education, to the evolution of the mindsets of young and older people: *"If we bring our children, they will also develop habits. And then it will be knowledge that they will have and that they can continue to multiply when they are older"*. Finally, in line with the benefits of exposure to nature mentioned earlier, 8 participants emphasised that the garden constitutes a preserved and relaxing place in the urban environment where local residents can "re-

charge their batteries”. 9 participants, however, consider that an allotment garden doesn’t necessarily contribute to the neighbourhood dynamism, since it’s not necessarily a “neighbourhood place”. Since it is relatively far out of town, and since the gardeners may be residents from the other end of the city, some participants consider that they are spaces that exist in the neighbourhood without really taking their place there. There’s also the fact that the garden, although a place of social life, is also a setting where interpersonal conflicts occur - an aspect we’ve gone into in greater detail in the scientific article resulting from this survey (Sapin et al., 2022).

OBSTACLES AND EXPECTATIONS OF THE LOCAL RESIDENTS

Although identifying the contributions of NBS is crucial to the success of their implementation, it is also necessary to explore the perceived obstacles and expectations of the beneficiaries to better understand the levers we need to work on in order to stimulate support.

Thus, our analysis of the interviews reveals that many of the various obstacles identified refer in one way or another to the crucial question of accessibility. Indeed, six interviews mentioned the issue of distance and travel time which can discourage potential residents who would like to take up the project. Six other participants also described growing difficulties in gardening because of their age or disability. In addition to these difficulties, there is a considerable waiting time for access to a plot: five years on average (Métropole de Nantes, 2021)). Finally, two other obstacles are cited only by local residents and are therefore particularly interesting to identify actions that could be implemented. The first relates to local residents’ lack of knowledge of existing schemes: where to get information about the gardens, how to register, how it works, etc. On the same topic, some residents also express a certain fear and apprehension about the complexity of gardening and the amount of knowledge they have to absorb in order to start: « And you have to know your stuff: when to sow, when to harvest... that scares me about !»

Putting perceived obstacles and expectations side by side enables us to draw up some recommendations. To offer practical guidance, we’ve synthesized key insights from our study into actionable recommendations for practitioners. These include:

- **Enhancing Garden Accessibility and Appeal:** Many gardeners (nine in total) stressed the need to further develop gardens, making them more accessible, attractive, and social spaces. Suggestions include adding new parking areas and expanding shared gardening spaces.

- **Supporting New Gardeners:** A common theme, highlighted by six participants, is the importance of providing better support and information for new gardeners. One idea is to meet with individuals on waiting lists beforehand to give them a clearer idea of what to expect.
- **Addressing Safety Concerns:** Safety emerged as a significant issue, with nine interviews mentioning experiences of theft, damage, threats, or drug-related activities in the gardens.
- **Improving Institutional Engagement and Follow-up:** Several participants (six) called for better institutional follow-up and stronger relationships between allotment garden associations and public institutions. They advocate for more local representation in decision-making roles and a more participatory approach from institutional actors.
- **Make Gardens as Close to Home as Possible:** nine residents mentioned that allotments don't contribute to the vitality of the neighbourhood, since the gardeners come from every neighbourhood of the city. This underlines the importance of these spaces being accessible to people who live nearby so that they can better integrate into the neighbourhood's "eco-system".

4.3 CONCLUSION

This case study highlights some original results. In particular, this work has emphasised the importance of "flow" in urban gardening, that state of total immersion in an activity that the person enjoys and which brings him or her a feeling of intense satisfaction. This work has also enabled us to describe the main benefits of allotment gardens while formulating prospects for improvement.

On an operational level, some recommendations can be drawn from these results. The psychological and social benefits identified can be mobilised on several levels. The aspects of wellbeing and social cohesion to which allotment gardens contribute have been described, which can help decision-makers determine whether or not it's an interesting solution depending on their objectives. These benefits can also be used as arguments to communicate with the population and to make the gardens more attractive to local residents. Finally, our analysis has also highlighted several aspects on which to work to improve the existing systems. Thus, the issue of support and accessibility appears to be particularly essential

to bring new people into gardening; facilitation could make the allotment garden resolutely more attractive. The participants also rightly pointed out that the participatory aspect is an essential condition for the success of a garden project. This last remark is, in our opinion, essential: There's a need to strengthen dialogue, to establish more horizontal communication between local residents and public institutions, and projects such as URBINAT must contribute to meeting these needs.

In conclusion, the results of this survey confirm the benefits of allotment gardens on wellbeing and social ties. Indeed, it has been shown that gardening is a fulfilling activity, enabling some people to reconnect with nature. Contact with nature is good for mental health: it drives away negative emotions and allows you to relax. Last but not least, the allotment garden has a strong social aspect: it's a place where people can meet, socialize and experience cultural diversity. It's not the only NBS with a social component, but it's one of the real assets of this solution for improving the quality of urban life.¹

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¹ The writing of this chapter relied, among other things, on the scientific publication resulting from this survey; the reader may wish to consult it for certain additions not covered here (Sapin et al., 2022).

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5. INVITE FOR HEALTHY BEHAVIOUR THROUGH NBS

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5.1. HOW NATURE AFFECTS HUMAN BEHAVIOUR

Urban green spaces allow for health-promoting activities, such as physical activity or rest and relaxation, to take place. Greenery as a public good, can also have positive impacts on social determinants of health, such as recreation and physical activity, social capital, and crime prevention. The condition of public open spaces and their facilities influence people's behaviour, thus reflecting their perceptions, feelings, and needs. Based on qualitative studies, the relationships between outdoor behaviour, user feelings, space image, and other related issues have been described since the mid 20 century (Sitte, C., 1945; Whyte, W. 1957; Gehl, J. 1987; Cullen G., 1961; Bacon, E., 1967). After 2000 many studies based on quantitative research methods explored the relationship between outdoor behaviour and thermal comfort optimisation, environmental perception investigation, and health promotion (S. Thorsson et al, 2004; Burton, M. et al, 2009; T. Sugiyama, 2015; J. Zacharias et al., 2016. Martinelli, L. et al, 2015; Kabisch, N. et al,2021) Many international organisations and projects are focused on physical activity (WHO,2020a) and sedentary behaviour (WHO,2020b) in order to formulate guidelines that enhance knowledge and enable the design of comfortable, usable, and healthy public space.

Nowadays there is an established consensus that public green in cities generates adequate spaces and creates conditions for a) mobility activities through paths, paved or covered by vegetation; b) immobility activities, like stay/resting, contemplation, sun and shade exposition; c) nature observation and conservation activities d) biodiversity stimulating activities, habitats, and ecological niches creation; e) farming activities and agricultural production (Lencastre and Farinha-Marques, 2021, Han S. et

al, 2022). Access to green spaces usually encourages physical activity and people's engagement in jogging, walking, cycling, or playing sports in these areas. The presence of well-maintained paths, sports facilities, and open spaces influences the type and intensity of physical activities undertaken by individuals.

By providing a contrast to the hectic urban environment, contact with green spaces allows individuals to engage in activities that promote cognitive wellbeing (Han S. et al, 2022). Attractive and accessible greenspace with the appropriate amenities can improve community identity and sense of place, improve aesthetics, facilitate recovery from stress and attention fatigue, and provide a place for gathering and social interaction. Bigger green space areas might be better able to support social cohesion through more visitors and different activities (Wan et al., 2021), which might reflect the strong associations with green space corridors and their theorised relation to physical activity (Cardinali et al, 2024). Green spaces in cities can also invite individual or group passive recreation and sedentary activities that might influence stress levels (Thompson et al., 2012) and lead to the reduction of stress-linked conditions (WHO, 2023).

Some studies prove that the quality of the space is more important than quantity in the likelihood of impact on psychological distress. Quality is described as the availability of walking paths, shade, water features, irrigated lawns, birdlife, lighting, sporting facilities, playgrounds, type of roads in the vicinity and the presence of water nearby (WHO,2016, Zhang et al, 2021). These characteristics bring diverse associations to different types of user groups that occupy public open spaces (Burton et al, 2009; Močnik et al, 2022). In addition to the qualities and characteristics of urban green system elements, social factors also play an important role in determining their accessibility and use. Indeed, the accessibility of green spaces influences not just the likelihood of physical activity being undertaken but also its frequency and therefore may facilitate active lifestyles in the urban setting (Han, S. et al, 2022; WHO, 2017). Green spaces provide an opportunity for interaction with nature, and further result in exposure to fresh air, development of healthier behaviours (e.g., physical activity and better sleep), attention restoration and stress recovery (Markevych I et al., 2017). Green spaces enhance socialisation and social wellbeing by improving social interaction by enabling residents to get social recognition and build ties within the community (Cohen DA,2008; Kim J, Kaplan R., 2004; Kemperman A, Timmermans H, 2014; Maas J, 2009).

5.2 STUDYING USERS' BEHAVIOUR IN URBAN GREEN SPACES

Studying users' behaviour in urban green spaces is vital to improving their quality as they are usually perceived as arenas where users can interact with each other and with nature. Major factors that influence behavioural patterns of citizenship are social belonging, way of perception and conventional understanding, sense of citizenship, sense of place, mechanical conditions, and quantity of the components of the environment. (Saidi, M., Behzadfar, M., Kheyroddin, R. et al., 2023) The condition of public open spaces and their facilities influence people's behaviour, thus reflecting their perceptions, feelings, and needs. The built and natural environment with its space structure, elements, available equipment and furniture predetermine users' behaviour. The opposite is sometimes also true – people/end users change the built and natural environment according to their needs.

Emerged as an environmental psychology data collection technique developed by Ittelson et al. (1970) to capture the behaviour in a specific setting, Behavioural Mapping (BM) initially focused on understanding the undisturbed interaction between people and space, which can be useful to identify patterns of human behaviour. Later, BM was commonly used in environmental psychology (Klein et al., 2018), usually applying a person-centred approach to explore how outdoor environmental characteristics are associated with human physical activity levels and to study children's behaviours in outdoor spaces to promote informed natural play spaces (Cosco et al. 2010, Cox et al., 2018). The place-centred approach of BM is associated with microclimate conditions and space design, when the aim is to study people's locations in a particular setting, at a specific time, engaging in various activities (Zacharias et al., 2004).

As an observation method, BM can avoid exaggerations and underestimations of actions and situations fuelled by the bias of social desirability. BM relies on an empirical document (data set), whose graphical representation of use and occupation of space allows the association between attributes of the environment, the occurrence of observable behaviours and the time when they occur (Cosco, Moore, & Islam, 2010; Goličnik & Thompson, 2010; Marušić & Marušić, 2012; Pinheiro et al., 2008). Developed as a specific technique with environment-behaviour studies to register, analyse and present data about the behaviour of people in direct relation to their physical environment (Van Andel, Joost, 1994), BM usually informs and contributes to spatial planning, place design and decision-making on

changes in the urban environment. Therefore, it is an appropriate instrument to gather evidence about behavioural changes in the course and after implementing interventions in public spaces. Depending on the design stage, in which behavioural maps are elaborated, they could be used as a check-list for the quality of places, as a check-list of tacit knowledge of designers, and as the key input data for comprehensive spatial simulations (Marušić & Marušić, 2012). BM is valuable for evidence-based design as it combines and explores a variety of environmental factors (e.g. sun exposition, shade, leisure zoning) with users' socio-demographic profiles. (Ward Thompson, 2013, Vidal, D. et al, 2022).

5.3 NATURE-BASED SOLUTIONS AND THEIR POTENTIAL TO INITIATE BEHAVIOURAL CHANGES

NBSs are characterised by an integrated approach and provide multiple benefits to complex adaptive systems, connecting ecological, social, and economic spheres (Eggermont, H et al. 2015; Roggema, R et al. 2020). They provide outcomes that are transformative for nature, places and people. The transformative change through NBS can be assessed through a 'three spheres of transformation' framework including three dimensions on which a transformation process is based: personal (with elements including knowledge, values, and worldviews), political (rules, economic and legal instruments, governance), and practical (behaviours, management, and technical responses) (Palomo et al, 2021, O'Brien, K. and Sygna, L.,2013). According to the leverage points concept, transformations based on the personal sphere have greater systemic impacts than those based on other dimensions. (Meadows, D., 2008).

Through these transformation processes, different transformative pathways on human behaviour could be outlined as follows:

- ***NBSs as drivers of behavioural change through infrastructure, equipment and built environment components.*** Nature-based programs are particularly important in driving behavioural change as NBSs can initiate behavioural change, invite healthy behaviour and improve mental health (Kopsieker L. et al., 2021). Previous research defines outdoor physical activity in many ways: enjoying nature, getting exercise or improving fitness, releasing stress or reducing tension, enjoying tranquillity or avoiding crowds, spending time with friends, observing or studying nature, being around good people, doing something creative, connecting with family, thinking and reflecting, resting and relaxing, and spending

time outside. (Brown, G. et al, 2014, Wagner et al., 2019, Han, S. et al., 2022). Most of these activities and behaviours could further affect people's health situations including physical health, mental health, and even ageing processes (Wagner et al., 2019).

- **NBSs as channels for environmental stewardship and sustainable practices.** Contact with and use of nature-based interventions can develop greater awareness of the importance of nature and environmental stewardship, and lead to increased community involvement in conservation efforts and sustainable practices (Šorytė D et al, 2023). It can also involve in resilience practices focused directly and specifically on the protection, management, and restoration of natural ecosystems (Pérez, S., Becerril, H. (2023); addressing climate change and environmental natural resource cycles, including biodiversity and natural habitat improvement (Colucci, A. 2023
- **NBSs as promoters of change through natural materials and closeness to nature.** Nature-based interventions play an important role in promoting environmental behaviours and could serve as a basis for further development of interventions that are based on natural materials and in natural settings (Han, S. et al, 2022), thus systematically changing attitudes, preferences, choices, and hence behaviours;
- **NBSs as factors and climate change mitigation measures** are mainly associated to reducing exposure to the immediate impacts of climate change (Seddon N. et al., 2020). Changed environmental and micro-climatic conditions such as improved thermal comfort or quality of air due to NBSs' implementation can offer options for choice to individuals and groups for spending more time outdoors, walking, jogging, sitting, and dog walking thus indirectly inviting behaviour change.
- **NBSs as an integral part of the educational processes.** The potential of some NBSs to be integrated into formal and informal educational settings (botanical gardens, edible gardens of learning, permaculture gardens, greenhouses) offer opportunities for learning about nature, ecology, and biodiversity and thus change the behaviour of individuals and groups (Han, S. et al, 2022);
- **NBSs as catalysts for Resilient Communities.** NBSs as a means for community building by preserving cultural traditions and as an agent for change in social and inter-generational relations.

The different transformative pathways on human behaviour will be discussed in section 4.2 which will be related to the findings of the conducted BM and survey during the URBiNAT local diagnostics.

5.4 UNDERSTANDING BEHAVIOURAL PATTERNS IN SUPPORT OF MAKING INFORMED DECISIONS AND ASSESSING THE IMPACT OF THE URBINAT HEALTHY CORRIDOR

METHODOLOGY

The results from the implemented BM in the URBiNAT cities obtained in-depth knowledge of the users' dynamics at specified places in the study area that was further taken into consideration for the design of URBiNAT's Healthy Corridor (HC) and the implementation of selected NBSs. It was expected that the data sets collected via BM and integrated with the data from the URBiNAT "Neighbourhood Survey – Assessing health and wellbeing of the local population" and other quantitative techniques would contribute to the process of comparing changes in terms of users' preference, changed behavioural patterns and liveability of the observed sites after the HC implementation.

During the co-diagnostic phase, BM outlined the distribution and concentration of people and activities in the open space thus identifying the "empty places" and the existing competing uses and conflicts. It also opened the process of evaluation of the interconnections between the existing/missing inventory, the previous public works and the activities/absence of activities. The latter was included as a criterion in the territorial analysis during the identification of the potential plots for the co-design of the HC. BM in Nadezhda district, Sofia was intended to support the co-design process of NBS and serve as a baseline for monitoring and future studies of the changes in the behavioural modes after the implementation of the HC. The territorial analysis (inventory) was integrated with on-site observations focused on: the activities performed – stationary or dynamic; the overall characteristics of people(users); and the overall characteristics of people and activities in the separate time intervals.

The BM was implemented in Nadezhda during two working and two nonworking days in May/June 2019 in 19 public spaces simultaneously across the URBiNAT study area. Once the construction works were finalised and after the official opening of the Healthy Corridor in March 2024, BM was implemented only in the areas of intervention and several control places. Sets of two observation sessions per four one-hour periods of the day: in the morning, at lunchtime, in the afternoon, and in the evening. The methods are adapted and slightly modified for the purposes of URBiNAT from a combination of tools or survey protocols previously structured and published (Gel and Gehl Institute; RAND Health Care). The observed main characteristics of people were focused on: approximate age, gender group, general pattern of stationary occupation, major areas and types of play, and key directions of non-motorized flows of movement through or along the sites. The main categories of the observed behaviour included: activities related to moving, staying and playing (physical and intellectual activities) as well as other activities and habits (gambling, smoking, drinking, taking drugs, fast food eating), usage of media and communication devices, socialisation, play activities and game.

The responses to three groups of questions, though a 5-point Likert scale, part of the URBiNAT "Neighbourhood Survey – Assessing health and wellbeing of the local population" (URBiNAT, D2.1, 2019), were considered and further related to the a) inventory in the evaluation of the amenities (satisfaction with the ability to walk on sidewalks in the neighbourhood; with the upkeep of the streets; with leisure facilities available on site); b) the share of time spent outdoors and the intensity of outdoor activities (walking, socialising, moderate physical activities; c) the level and intensity of social contacts within the neighbourhood, and d) motivation to contribute to society. Crossing the results from the BM in Sofia, along with the results obtained through the mixed-method approach (observation, interviews, walkthrough), contributed to better understanding of the differences/similarities before and after in terms of a) interrelations between the behavioural patterns and the user dynamics of preferred spaces, b) links between limitations, built environment and behaviour patterns in public space, c) links between climate conditions and use of open public space, and d) gender and age specifics in users' behaviour. Besides the short-term changes, an expert estimation of the expected mid-term and long-term impact on human behaviour of the URBiNAT intervention (after the introduction in Section 6.5.3), and specifically the NBS clusters by area of intervention is presented.

THE BEHAVIOURAL PATTERNS IN THE URBINAT STUDY AREA IN NADEZHDA, SOFIA

Pedestrians walking and socialising were found in most of the analysed public places. The most intensive activities were ascribed to places enabling encounters. Although intensive and multi-layered, with established rhythms, and meeting points, the public life in the LHEs was rather fragmented into numerous places due to the dispersed location and discontinuity of the public lots, the poor amenities, and the existing barriers such as abandoned and non-maintained private lots. (Tasheva et al, 2021) The main routes and places usually or intensively used were paved paths and equipped playgrounds. Others, although confined spaces or bottlenecks as the bridge overarching the river and providing an essential link to Nadezhda Park, were crowded and used as the only option for a functional connection. People crossing the river most often stopped and waited as the one-way movement was only possible due to the narrowness of the bridge - about a meter width. Spaces currently out of use were usually plagued by public perceptions of danger and criminal activities. The abandoned buildings and playgrounds with pavements in bad condition at the intervention area "Health and energy" were empty; a limited number of people were crossing or walking in a wider perimeter of these spots, places impassable due to ruderal vegetation were avoided but crossed in cases when unpaved shortcuts went through or near them.

Despite the significant share of the survey respondents generally satisfied with the possibility of walking on sidewalks in their neighbourhood (around 75%), many of the respondents did not appreciate the condition and the upkeep - around 38% were dissatisfied and 54% were moderately satisfied. The general level of outdoor physical activity in the neighbourhood was low. Around 29 % of the respondents to the survey had not walked even 10 minutes during the last 7 days (at the time the survey was taken) and around 41% of respondents had not performed moderate physical activities like carrying light loads or cycling at a regular pace. Around 22% of the respondents were not satisfied with the leisure facilities available on site. A marginal share of the survey respondents performed activities with friends that took place outdoors (merely 2%), and a marginal share performed personal relaxing activities outside in the neighbourhood.

There were outdoor activities observed in the warmer season (mid-April - mid-October) mostly related to socialisation and passive recreation among elders, as well as active recreation and play as socialisation among youngsters and children. The majority of the places of socialisation

were organised just in front of the high-rise prefabricated blocks of flats. (Tasheva et al, 2021) During hot summer days, the children who attended the childcare services provided by the schools played indoor games in the gym, where it was cooler and the floor was more convenient than the rough asphalt pavements in the yard. Only one drinking water fountain was available in the URBiNAT study area. Fountains in the schoolyards, the wide inter-block spaces, and the sports and children's playgrounds were not available or were out of order.

Children were playing at equipped playgrounds in the interblock spaces, parks and schoolyards. As the schoolyards were directly exposed to the sun, most of the outdoor activities were registered in the time span before noon. Cycling and/or playing football by toddlers and children accompanied by their parents were the most represented dynamic activities at the schoolyards. Regardless of the poor condition of the pavements and sports facilities in two of the schools, active and continuous use was observed in some of the freely accessed schoolyards.

During the working day, peculiar spots preferred only by women and only by men were identified, while during the non-working day, the children clustered and occupied specific spots, mainly in the schoolyard and near the playgrounds. The cool hours in the evening and the shaded areas at noon attracted families with children. The kids were playing with ball and cycling, while the parents were talking and drinking beer. There were few conditions for creative activities in the neighbourhoods' open space and the opportunities for adults and children to play together in public space were limited.

There was no public place explicitly intended for teenagers in the housing estates, the places for public gatherings and entertainment were insufficient, and few cultural activities were organised in the open space. (Tasheva et al, 2021) Few youngsters were biking over or crossing unpaved and unattended spaces. Sports dancing courses for children and teenagers were organised indoors, at the school gyms in the evenings of the working days. There, similarly, to in the yard of the Centre for Art and Education and the square in front of Nadezhda Cultural Institute, parents (mostly mothers) usually waited (sitting or standing) for their children until the end of non-formal educational activities (dance classes, rehearsals, etc.).

Around 47% of the respondents were satisfied with the neighbourhood relations (conviviality, mutual aid, solidarity), and a quarter said they knew the names of more than 30 people in the neighbourhood. Almost 50% of

the respondents demonstrated their strong feeling of belonging to a community, and around 36% declared belief in the significance of their own contributions to societal development.

Satisfaction with the neighbourhood's reputation has slightly increased by eight percentage points in 2024 (46 %) compared to the level of satisfaction in 2019 (36%). There is a remarkable growth in the number of people who are satisfied with the ability to walk on sidewalks in the neighbourhood, from 23% in 2019 up to 53%. The share of people who have not walked for at least 10 minutes at a time during the last 7 days has decreased almost twofold - from 29% in 2019 to 14% in 2024. There is also an increase in the number of days respondents spend more than 10 minutes walking in a week.

Most of the respondents (more than 41%) claimed that the COVID-19 pandemic positively changed their relationship with their neighbourhood. According to the survey, the level of physical activity of 34% of respondents has increased during the pandemic, while and for 25,3% this level went down. There is not significant change in the share of respondents that rate their health status as very good, good or fair. Unfortunately, significant share (39%), of respondents shared that COVID-19 affected their social activity negatively and for only 24% the time with friends has increased. About 22,5 % of respondents pointed out that their health got worse and almost the same share reported the opposite. According to the survey results, the level of physical activity has increased for 34 % of the respondents in 2024.

However, a global overview and comparison of the data gathered through Behavioural Mapping before and after the implementation of the URBiNAT Healthy Corridor shows less active mobility flows, mostly due to different seasons compared - late spring in 2019 and late winter in 2024. The choice of season for ex-post evaluation of the impact of the corridor was limited to the sole end of its construction, although the best option would have been to compare the same seasons and if possible, to control for choice of days with similar weather conditions. This was due to the overall delay of the implementation because of the COVID-19 pandemic, as well as the energy crisis, inflation and rising prices of materials and labour which affected the construction of the Healthy Corridor. Nevertheless, the stationary activities mapped during the late winter season, show promising pictures of plenty of new magnets that provoke people to stay at the URBiNAT intervention areas and to perform various physical and social activities, not present at these sites in 2019.

Several considerations are important when comparing and discussing the presence of actively moving people in the case of Nadezhda, and in general. First, the amount of the total population in the city, the district and the single housing estates, as well as their age and employment status distribution as a baseline for the quantities and qualities of the flows that can be observed. There is neither publicly available data from the 2021 census at the sub-city level nor for the Covid-19 mortality. Nevertheless, one hypothesis might be based on the assumption that the decrease of the population in Nadezhda is in line with the general trends in Bulgaria. Second, the crisis of public transportation during and after the COVID-19 pandemic has its mid-term effects on active mobility as part of it is related to various intermodality options with the different public transportation means. Third, the different seasons and weather conditions could have further affected the numbers. So, another observation more distant from the final touch over the Corridor as well as closer to the baseline conditions and with the help of the actual micro-demographic statistics altogether with the survey results can give more overall clarity to the direct impact of the Corridor on mobility and recreational behaviour.

EXPECTED IMPACTS OF THE HEALTHY CORRIDOR IN NADEZHDA ON HUMAN BEHAVIOUR

The concept of a URBiNAT Healthy Corridor represents a cluster of diverse typologies of NBS in an integrated manner, which covers several conditions that impact health. (URBiNAT, D4.1). In this sense, it integrates **health in urban and territorial planning for sustainable urban development**, as: “The way we plan and build our cities defines our quality of life. It affects not only the quality of our living spaces and transport, but also the air we breathe, the water we drink, and our access to nutritious food, education, health care services and employment” (UN-Habitat & WHO, 2020), and visual amenities (M.J. Koohsari et al, 2015, Zhu, W., 2021) thus playing an important role in providing supportive environments for health and wellbeing (M. Knöll, J.J. Roe, 2017).

The expected impact of the NBSs, integrated into the Healthy Corridor in Nadezhda is foreseen to have multiple and complementary impacts on human behaviour through the single or multiple transformative pathways, thus grounding on the observed trends and peculiarities, and addressing the existing challenges (outlined through BM, see Table 2).

NBSs Expected impact on human behaviour						
Area of intervention	drivers of behavioural change	promoters of behaviour change	channels for behaviour change	mitigation measures inviting behavioural change	integral part of the educational processes	catalysts for resilient communities' development
Co-place						
An eco-parking for different kinds of vehicles	+++	+++	+	+++		
Two areas for open-air family games			+++		+++	+++
A space for leisure with a flower garden	++	++			++	+++
A picnic and social zone		++				+++
Health-Energy						
A playground facility made of natural materials	+++	+++				++
Restoration of a multipurpose sports playground	+++	++		+++		
Removal of the existing private garages on municipal land	+++	++				
Aqua Vita						
A public swimming pool with mineral water	++	+++	+++		+++	
A school greenhouse, supplied by mineral water for heating		+++	+++		+++	++
An outdoor fitness	+++	++				++
Social place and a square		+++			+++	+++
Green Assembly						
An open-air green amphitheatre	++	+++			+++	+++
A flexible recreation area	++					+++
A workshop/cafe/infopoint the URBiNAT pavilion		++	++			+++
Urban forest		+++		+++		
Other locations						
Tasty garden of learning in the yard of kindergarten N90	++	+++	++		+++	+++
Bridge overarching Suhodolska river	+++					
Dogs' garden	++	++				+++
The Healthy Corridor linking the two existing parks	+++	+++	++	++	++	+++

Table 2. Expected impact on health and wellbeing of the proposed regenerating open public space in the 4 intervention areas integrated into the adopted Healthy Corridor Concept, Nadezhda, Sofia

- **NBSs as drivers of behavioural change through infrastructure, equipment and built environment components.** Territorial NBSs, like urban forests, different types of gardens, and tree planting along the Corridor axis can promote healthier lifestyles by encouraging physical activity and can improve mental health (ten Brink et al., 2016). Despite accommodating recreational activities, the co-designed public spaces provide opportunities for recreational activities, an outdoor gym, and a social meeting point. The playgrounds and the facilities there, the restoration of the multipurpose sports playgrounds, and the swimming pool invite for active sport. The solutions co-designed with citizens to improve non-motorized mobility, sport, leisure, recreation and education will also act as drivers for active movement, as well as individual or group choices that change behavioural patterns and foster healthy lifestyles. The place for leisure with a flower garden, picnic and social area (Zone Co-place) will create opportunities for Involving adults, together with children in the games and the dynamic activities. The multipurpose sports field (Zone Health and Energy) in the place of the pre-existing footprint of playgrounds previously plagued by public perceptions of danger and criminal activities and their reintegration in the urban fabric will benefit mostly the young people in the vicinity and will enrich the spectrum of local users of the space via the addition of communal activities around healthy outdoor pursuits. The outdoor gym (Zone Aqua Vita) will provide more possibilities for sport thus promoting active and healthy lifestyles, while the renovation of an abandoned space there and at Zone Health and Energy may turn upside down the trend “walk through but don’t occupy”.
- **NBSs as channels for environmental stewardship and sustainable practices.** The URBiNAT Living Lab Pavilion (Zone Green Assembly) as a combination of indoor and outdoor space will contribute to raising citizens’ awareness of the role of nature in the urban environment and its importance for human health. Apart from providing a new accessible educational, recreational and sports facility for the communities, the swimming pool (Zone Aqua vita) offers cost-efficient solutions by using the existing thermal water as the main resource and for heating. Children and adults will be able to develop and demonstrate their skills in making various games and/or other items out of recycled materials at zone Co-place. Campaign events for the collection and recovery of recyclable items can also be held at this location. Information board with suggestions for various family games that people can make out of the materials at hand thus providing the missing conditions and places for creative activities in the neighbourhood’s open space.

- **NBSs as promoters of change through natural materials, demonstration projects and closeness to nature.** The thermal mineral water swimming pool (Zone Aqua Vita) relies on the use of a local geothermal resource to provide a healthy environment for physical education and training as well as recreational activities for school children. It also aims at the revival of the millennia-long regional cultural tradition of living in close contact with mineral water. (D4.1.) The territory provided for the swimming pool is empty and not a well-maintained place. During the project development (and after 2024) this area will be promoted and used for exhibitions and information on the qualities and composition of the mineral water and its benefits for human health. The school greenhouse (Zone Health Energy) is to provide an open space classroom for the pupils where they can attend classes in a natural environment. Pupils' awareness of processes in nature, botanic, and food production will be increased. The greenhouse itself was co-designed following the parametric design principles and made of innovative materials. Thus, this NBS as a demonstration project could change perceptions, attitudes and maybe motivations for action and choices. The upgrading of the existing playground (Zone Health Energy) focuses on creative spatial solutions to inspire children to develop environmental responsibility through interaction with natural materials. By growing plants, the "Tasty Gardens of learning" will develop lasting skills and attitudes for healthy living in harmony with oneself, other people around and Nature as a whole. Perceived as a living ecosystem, the tasty garden meets all challenges arising from the need for constant care - watering, weeding and plant care, lawn mowing, and the purely environmental challenges of pests and climate disasters. Similarly, the amphitheatre (Zone Green Assembly) employs natural materials to increase local citizens' awareness of alternative construction techniques and their beneficial impact on the environment. Modelled as a green amphitheatre, such open space is not in itself an innovation. Still, the functions it can perform and community events to be sheltered can bring innovation to community interactions and links to nature and open space in Nadezhda thus changing lifestyles, culture, and public life.
- **NBSs as factors and climate change mitigation measures.** The URBi-NAT Healthy corridor, and especially the newly added green elements will contribute to mitigation of deposition and dispersion of pollutants along the corridor during the vegetative season. This will also make more favourable conditions for active mobility and physical exercises, socialisation, recreation and restoration along the corridor. The urban forest (Zone Green assembly), the tree-lined paths and hedges divi-

ding playgrounds from abandoned spaces (Zone Health and Energy) will contribute to improving the microclimatic conditions in the vast open spaces by bringing additional canopy (in the long run) and increase melioration and air purification. The hedges that surround the parking (Zone Co-place) will contribute to improving the aesthetical quality of the public space and will act as a screen dividing the parking (where pollutants such as PM, NO₂ and others are released by automobiles). The Green parking (Zone Co-place) will to some extent eliminate the brown spot effect (and the dust during the dry periods). These improvements due to the implemented NBSs are more likely to increase options for choice to individuals and groups for spending more time outdoors, walking, jogging, sitting, and dog walking thus indirectly inviting behaviour change.

- **NBSs as an integral part of the educational processes.** The swimming pool, the tasty gardens of learning and the school greenhouse as new accessible educational, recreational and sports facilities for the communities would have a serious impact on the modes of formal and nonformal education and their delivery. The Tasty Garden of Learning is a green “growing classroom” situated in the yard of the kindergarten or the school where children, teachers and parents unite their efforts and vision to grow together herbs, vegetables and fruits and they all receive valuable lessons and inspiration directly from their own experience with Nature. As a rich multi-dimensional educational tool with a great potential to unite school subjects to real-life challenges and provide inclusive educational activities, the “Tasty Gardens of Learning” may have a positive impact on the community and social cohesion, and could influence human health and wellbeing by encouraging physical activity, providing healthy eating lifestyle and encouraging children and families to spend more time outdoor while working in the garden and in contact to the living Nature.
- **NBSs as catalysts for resilient communities.** The green amphitheatre and some other subzones at the intervention zones fill the identified gap of small public space for events and informal cultural activities. The flexible outdoor space of the Green Amphitheatre (Zone Green Assembly) will function as an informal social area, an event venue for performances (concerts, dance and music events), exhibitions, book promotions, URBiNAT participatory NBSs, as well as a meeting spot for the citizens of Nadezhda. Discussing issues important to communities and citizens through the Forum Theatre, Word Café, Focus Groups in Situ, and Community workshops will help the Green Amphitheatre to

establish itself as the Corridor landmark that integrates cultural events into the urban environment and a forum where common issues are discussed and joint decisions are made. The place for leisure with a flower garden, picnic and social area for making various games and/or other items out of recycled materials (Zone Co-place) will create settings for spending leisure time and will create opportunities for social contacts and joint community activities for both children and adults. The restored multipurpose sports field (Zone Health Energy) can motivate citizens to develop a connection with the site and challenge the public perceptions of danger on the one hand, and on the other – enrich the spectrum of citizen involvement through proactive participation in local sports events. In a natural way, the Tasty Garden of Learning brings together children, teachers, parents and local community friends in a life-enriching relationship and leads them to a deeply creative process of learning by experiencing thus supporting the development of the physical, intellectual, emotional and social intelligence of the pupils and further enhances the sustainable behavioural patterns of their local communities.

5.5 CONCLUSION

The use of urban green spaces and the related benefits need to be evaluated to inform future planning and to ensure that existing green spaces are reviewed and adapted to meet the community's needs. For this purpose, quantitative data and qualitative data provide different types of information on the impact of an intervention and are equally important in the course of planning, regeneration and design.

Individuals' contact with nature and NBSs could potentially contribute to fulfilling several crucial goals at once and lead to multiple behavioural transformation pathways. People's choices could also be strongly influenced by specific climate conditions linked with weather, season, and regional differences. Studying beliefs, attitudes and socio-cultural traditions is also important when studying behaviour and the factors influencing behavioural change.

Studying the behavioural patterns and the potential behaviour change that will result from the implementation of the NBSs that constitute Sofia Healthy Corridor (HC) is only one of the dimensions in the complex co-creation process. Grounding on the local context, the implemented mixed-method approach for the co-design of the HC combines traditional methods for information gathering and synthesis, and inclusive partici-

patory methods for gathering specific information about the area and its inhabitants. All these, along with the intensive consultations and validation procedures were gradually integrated into the established statutory planning process. In this sense, and from the monitoring and evaluation perspective, it is important to be aware that health outcomes as well as behaviour transformations are affected by many determinants and therefore, NBS and any green space intervention may benefit health, wellbeing (WHO, 2017) and behavioural change, but not automatically lead to significant improvement of health status indicators or behavioural patterns. Therefore, evaluation efforts should be realistic and proportionate to the scale of the intervention - be practical, and fit-for-purpose when designing the interventions' evaluation, and respect the existing modes of use when upgrading open public space.

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6. RECOMMENDATIONS FOR PRACTITIONERS

In this chapter, wellbeing and health are addressed by researchers with approaches rooted in different disciplines. From both an operational and theoretical point of view, these contributions help to highlight aspects of physical and mental health that are usually not addressed by clinical health approaches, and which are linked to environmental quality and the quality of urban spaces. The researchers who contributed to this chapter largely use cross-disciplinary approaches, sharing the need to integrate a diversity of environmental, social, perceptive and urban factors. This highlights the need for interdisciplinarity. The NBS concept appears to be a key concept for addressing and managing the complexity that comes from taking into account multiple factors and interconnections between scales (the notion of co-benefits). The concept also makes it easier to link concepts and operationalisation by building bridges between all the different actors: practitioners, academics and citizens.

In this conclusion, we would like to highlight some recommendations for practitioners, namely considering a cluster of NBS instead of individual NBS, the necessity to monitor and evaluate the impact of NBS, and the awareness of the multiple changes NBS can address simultaneously in times of climate change.

A CLUSTER OF NBS RATHER THAN INDIVIDUAL NBS- NOTION OF HEALTHY CORRIDOR

NBS are usually referred to as single solutions like allotment gardens, green walls or bee hives addressing specific problems. However, as outlined in this chapter, there is a great potential to go beyond this perspective and consider on a broader scale, clusters of NBS. Depending on the theory of change (Skodra et al 2021), a cluster of NBS can address a variety of challenges simultaneously. The wide availability of different NBS makes it possible to develop a bundle of measures depending on the local challenges. The different NBS can support each other in their effect and even develop complementarities with other types of solutions. All these coherent solutions create a 'Healthy Corridor'. Examples include a green corridor for increased physical activity, a higher rate of air exchange, a

reduced heat island effect and a protection layer for extreme weather events that might be combined with allotment gardens to further increase social cohesion and foster healthy dietary habits. The possibilities are countless, and that is why the chapter should be seen as frequent examples rather than an exhaustive list of possible applications.

THE NECESSITY OF MONITORING & EVALUATION

There is growing awareness that NBS can have positive impacts on several societal challenges, but the specific evidence for NBS is still scarce. This missing return on investment (social, environmental, economic) is a key leverage point for the widespread use of NBS. The valuation is a frequent question from both operational actors and decision-makers. There are concerns over NBS reliability, their cost-effectiveness and possible trade-off (Seddon et al., 2020). Therefore, to get access to the specific conditions and costs of implementation and maintenance, costs-benefit ratio (economic dimensions but also non-monetary ones), return on investment and comparing effectiveness with alternative engineering solutions is key. Implementing NBS monitoring and assessment raises several methodological issues.

NBS are related to a systemic approach which implies an interdisciplinary approach to integrate all the dimensions (environmental, socio-cultural, economic) which is now well recognised and regularly claimed. However, efforts have to be continued to develop interdisciplinarity and go over silos because persistent resistances remain (Ledford 2015). As complex and multifunctional systems, NBS can rarely be grasped intuitively. Therefore, the development of assessment tools, both scientifically and empirically based, seems to be essential for an informed decision. A specific methodology is needed to provide a holistic assessment grid integrating environmental and socio-economic criteria (Raymond, Frantzeskaki, et al. 2017). As shown by Bouzoudja et al. (2021), multi-factorial approaches can quickly become very complex (accumulation of indicators) and are sometimes difficult to synthesise and investigate the relationship between the various factors. Therefore, it is recommended to think of a monitoring strategy from the beginning of a NBS project.

The concepts of urban quality or quality of life seem to be interesting guidelines for evaluation, because they express a global view of the city and life in the city, and set projects in pre-existing contexts. However, it is often more difficult to provide quantitative indicators for these concepts, even though they are needed to complement qualitative indicators. A good

example can be found on the economic side. There is a challenge in valuing urban NBS in monetary terms. Although their value is increasingly recognised (climate benefits, wellbeing) many of NBS benefits are unmeasurable or without direct monetary value attached (Bockarjova, Botzen, 2017). Therefore, to obtain a quantitative valuation of these NBS, there is a need for estimating values through non-monetary methods which are particularly cumbersome (Hein et al. 2006). This method was already developed in the framework of the Ecosystem Services (ES) Assessment (de Groot et al. 2010; Häyhä & Franzese 2014).

Choosing the right space and temporal scales is a rather complicated endeavour, especially if multiple NBS and multiple key outcomes should be evaluated. The effect range of NBS as well as its manifestations differ widely depending on the indicator of interest. For health and wellbeing, a classic example would be short-term effects on physical activity, with potential mid-to long-term changes in average obesity, which might, in the long run, turn into a lower mortality rate. There is also some evidence that these effects might only occur for people living within a 10-minute walk of these interventions (Cardinali et al 2024) and are different when we look at other green space health pathways like social cohesion (Cardinali et al 2024b).

The back and forth between scales is also very important to understand how the aggregation (and vice versa the split) of one type or different NBS can eventually lead to the formation of other NBS addressing other challenges at wider scales (Andersson et al. 2014). For example, urban street trees, when considered as singular NBS, may provide cooling and quality of life benefits. But when connected at the city scale, they lead to a green network that can have biodiversity benefits participating in the ecological continuity.

For further information on how to set it up and what strategies are available, we refer to the NBS Handbook of Impact Evaluation, published by the European Commission (EC 2021a), and its summary for policymakers (EC 2021b).

THE BIGGER PICTURE

While the focus of this chapter was to provide insights into the nature health mechanisms, the chapter is not exhaustive. Some aspects of environmental health have not been addressed in detail, such as the impact of noise and light pollution mitigation on health as well as a range of mental

health benefits that occur from direct contact with nature. Furthermore, the negative effects of nature on health were not discussed in detail. For example, concerning climate change and rising temperatures, an increased risk of infectious diseases is also to be expected, such as the documented northward migration of the tiger mosquito (Cardi, 2022). Accordingly, the risk of forest fires is also expected to increase further. Both aspects are also linked to the issue of rainwater management which NBS can tackle. In addition, positive effects beyond human health can also be expected through more biodiversity corridors and in the area of environmental health. The ability to increase soil quality, particularly when soil is used to grow food in cities will then indirectly affect human health, in summary contributing to the One Health perspective (Chapter 2). Last but not least, participation itself is also able to increase wellbeing (Chapter 3) and also ensures that the urban intervention is accepted and maintenance costs are reduced. This leads to an important reframing of how we should cope with all the challenges ahead. Instead of fighting against multiple challenges, we should frame the necessary urban green transformation in the 21st century as increasing the quality of life for all.

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