

Unlocking Strategies for Co-Financing Urban Nature-based Solutions

A balancing act between the scaling up and justice

Ismat Fatema Fathi

Supervisor

Yuliya Voytenko Palgan

Thesis for the fulfilment of the
Master of Science in Environmental Management and Policy
Lund, Sweden, May 2022



© You may use the contents of the IIIIEE publications for informational purposes only. You may not copy, lend, hire, transmit or redistribute these materials for commercial purposes or for compensation of any kind without written permission from IIIIEE. When using IIIIEE material you must include the following copyright notice: 'Copyright © Ismat Fatema Fathi, IIIIEE, Lund University. All rights reserved' in any copy that you make in a clearly visible position. You may not modify the materials without the permission of the author.

Published in 2022 by IIIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiiee@iiiiee.lu.se.

ISSN 1401-9191

Acknowledgements

My deepest gratitude goes to my supervisor, Yuliya Voytenko, for her incredible and constant support throughout the thesis. Thank you for giving me your invaluable time to listen to my ideas with patience. Thank you for your care and generosity. Thank you for being both soft and straightforward when required. I truly valued your critical feedback, and the thesis would not have been the same without your guidance.

I would also like to thank Bernadette Kiss for her generous support in the lost phases of my thesis. Josie, Chris and Nicolo, thank you for providing with your meaningful comments at crucial milestones. It was great to be able to share our hardships and learn from each other. A big shout out to all the staff at IIIIEE staff for helping me to grow and learn both as a sustainability professional and as a person. Without your support, I couldn't have imagined producing a master thesis. Thank you for being so understanding and putting in the effort and hard work during these two years, especially during the Covid time.

Outside of the institute, I would like to extend my gratitude to Heidi Tuhkanen and Jennifer Lenhart whose professional mentorship has helped shape my work ethic and skills to produce a well-moulded thesis. The researchers and practitioners interviewed for this study were an extremely critical part of this study. Thank you for all your time to share your knowledge and experiences with me. Without any of you, this thesis would not have been possible.

Thank you, my lovely lovely batch, each of you, for your honesty, humility and love. I feel blessed to have been surrounded by a group of such dedicated and passionate people. There was always so much to learn from every one of you. You guys are all stars! Student Council, PPC, you guys rock! All the meals in the lunchroom, joys and frustration we shared, games we played, hikes we enjoyed, parties, singing and dancing will always be precious to me. Thank you, Elaine, for listening to my ideas even when they did not really make sense. Nahla, our late-night meals at the institute were the best. Lina and Isha, you have no idea how much our laughs meant to me in those stressful times!

I also want to take this opportunity to express profound gratitude to my family. Thank you for making me the person I am today and for letting my ideas float. Ammi, Baba, your endless support, encouragement, and love are things I could not live without. Thank you for always believing in me, even when I didn't. My brother and my sisters, Munni, Malli, Bhai, Mui our phone calls was exactly what I needed after a day of research, thank you for always being there for me and being my constant support.

Abstract

The current reality is that cities are losing green spaces rather than creating more of them, leading to many urban challenges. Urban nature-based solutions (NbS), through renaturing urban landscapes, are seen as a promising solution to help cities deal with climate change and build a better future for communities worldwide. In Europe, specifically, NbS is also seen as a way of boosting green innovation and resilience in cities by delivering many benefits. However, securing long-term investments is a recurrent barrier to its mainstreaming. Co-financing NbS, which brings together multiple entities (across sectors, departments or actor groups) to finance the project encompassing one or more financing mechanisms, can overcome this challenge. However, there is growing evidence of research which shows that depending on how NbS is implemented, it may have potential implications on justice. This is exacerbated by the profit-driven nature of private actors involved in co-financing urban NbS. Elements of justice are often in contestations with scaling up of finance, and the balancing act between them can be quite tricky for cities to achieve. Through a comprehensive literature analysis and 20 interviews (10 expert and 10 case study interviews). The qualitative research develops a conceptual framework which elaborates on the relationship between the scaling up of co-finance and social justice. The framework provides an understanding of the roles of different public, private and community actors. It establishes five building blocks for scaling up and justice, each used as a basis to examine four case studies in Europe. The analysis reveals that implementing a scaled up and just co-financing of urban NbS requires looking beyond the project, entering into the structural domains of governance and urban development. Further, the research brings to light seven strategic possibilities which offer promising pathways for urban actors and should be considered when formulating policies and planning to ensure that the co-financing of urban NbS is upscaled and just. As such, this research makes significant contributions to academic knowledge and practice.

Keywords: nature-based solutions, co-finance, scaling up finance, social justice

Executive Summary

Introduction. Cities in Europe and globally are grappling with the effects of climate change, biodiversity loss and rapid urbanization. Urban nature-based solutions (NbS) are seen as a promising solutions to help cities deal with climate change and build a better future for communities worldwide. Through renaturing urban landscapes, they can advance urban sustainability goals by providing solutions to climate change (mitigation and adaptation), bad air quality, loss of biodiversity, vulnerable coastlines and other threatened ecosystems, food insecurity and health, social injustice and economic deterioration (Kabisch et al., 2016). Owing to the diversity of the benefits to nature and humans, NbS are considered as an innovative and cost-effective approach to development. In Europe, specifically, NbS are also seen to boost green innovation and resilience in cities, representing a feasible transition path to sustainable development (EC, 2015). Although multiple trade-offs and synergies exist within the discourse of NbS, the social, economic and environmental sustainability agenda often clashes. While the uses and advantages of NbS are known in principle, the actual implementation and subsequent maintenance is often regarded as problematic. Aspects related to financing (both public and private finance) are highlighted as one of major deterrents to achieving mainstreaming of NbS (Toxopeus and Polzin, 2021).

Public funding is often not sufficient to meet the urgency in investments. For large-scale projects, it often lacks high operation costs and requires capital injection from the private funds. Co-financing, thus, overcomes the barrier of NbS finance by bringing together multiple entities (across sectors, departments or actor groups) to finance the project encompassing one or more financing mechanisms. However, there is growing evidence of research which shows that depending on the way NbS is implemented, it may have potential implications on justice. This stems from the so-called ‘growth-obsession’, exacerbated by the involvement of private actors. The equation between social justice and the scaling up of co-finance is complex. On the one hand, there is an urgent need to amplify the investments in NbS and diversifying funding through the involvement of private actors hold potential, and on the other hand, it reinforces social exclusion and inequitable distribution of risks and benefits (Sekulova et al., 2021). While the recent literature has started looking at systematic barriers to financing, they tend to overlook the sensitivity to the social, cultural, geographical and policy context, hindering a tailored and effective approach to a financial solution (Dorst et al., 2022). To demonstrate the full potential of NbS finance, future research needs to conceptualize better and integrate the trade-offs and synergies of NbS across multiple scales and systems (Schröter et al., 2022). This calls for unpacking and unravelling the potential of NbS co-finance for a just and scaled up outcome of it. This leads to the aim of the thesis research to *explore the potential of co-financing urban NbS through the lens of scaling up and justice*. Based on the research problem and aim the following research questions (RQ) are proposed.

RQ1: *How do scaling up and social justice concepts relate to co-financing urban NbS?*

RQ2: *What strategic possibilities can urban actors adopt to ensure scaled up and just co-financing of urban NbS?*

Methodology. To achieve the aim of the thesis, the researcher carried a systematic exploratory qualitative approach. A multiple case study approach which included four pilot projects in Europe, was adopted where the qualitative case data was analyzed using the conceptual framework (developed by the researcher). An iterative research design of research gap, forming research questions, and the primary outcomes through tailored methods of data collection and analysis was used. Given the newness of the concept of NbS co-finance having a complex actor arrangement, a flexible semi-structured process of collecting and analyzing the data was adopted, which allowed the identification of new patterns. Main sources of data

collection included 20 interviews (10 expert and 10 case study interviews), several academic literature and grey literature. Thematic analysis was the main form of data analysis. Moreover, qualitative validity and reliability were ensured through different procedures like triangulation, reflexivity and providing a detailed and accurate account of the research methodology.

Findings. The study looks at NbS co-financing from the lens of scaling up and justice, where each public, private and community actor cluster plays a pivotal role. From the perspective of scaling up finance, mobilization of private sector funds is considered inevitable, especially for large-scale projects. Further, the continuity of the project largely depended on covering maintenance costs. However, the inflow of private finance often contradicts the environmental justice outcomes, raising concerns on the neoliberal green growth agenda where social inclusion and equity concerns are often neglected. Here, contestations by community actors can be seen as a counter measure to the issue mentioned above. Public actors can be seen as the balancing force in the room to ensure scalable co-finance of just NbS. Drawing from multiple sources of literature and expert opinion, the author explains the relationship between the scaling up of finance and justice by developing the Conceptual Framework, illustrated in Figure 0-1, answering RQ1. This encapsulates five building blocks of scalability of co-financing urban NbS – Innovative Partnerships (S1), Multi-scalar Action (S2), Strategic Political Vision (S3), Incentive-based Mechanism (S4), Evidence-based Investments (S5) as well as the social justice perspective of co-financing urban NbS - Inclusive and Local Governance (J1), Incentives for Public Participation (J2), Social Co - benefits (J3), Distribution of Benefits and Power (J4), Quality Green Jobs (J5).

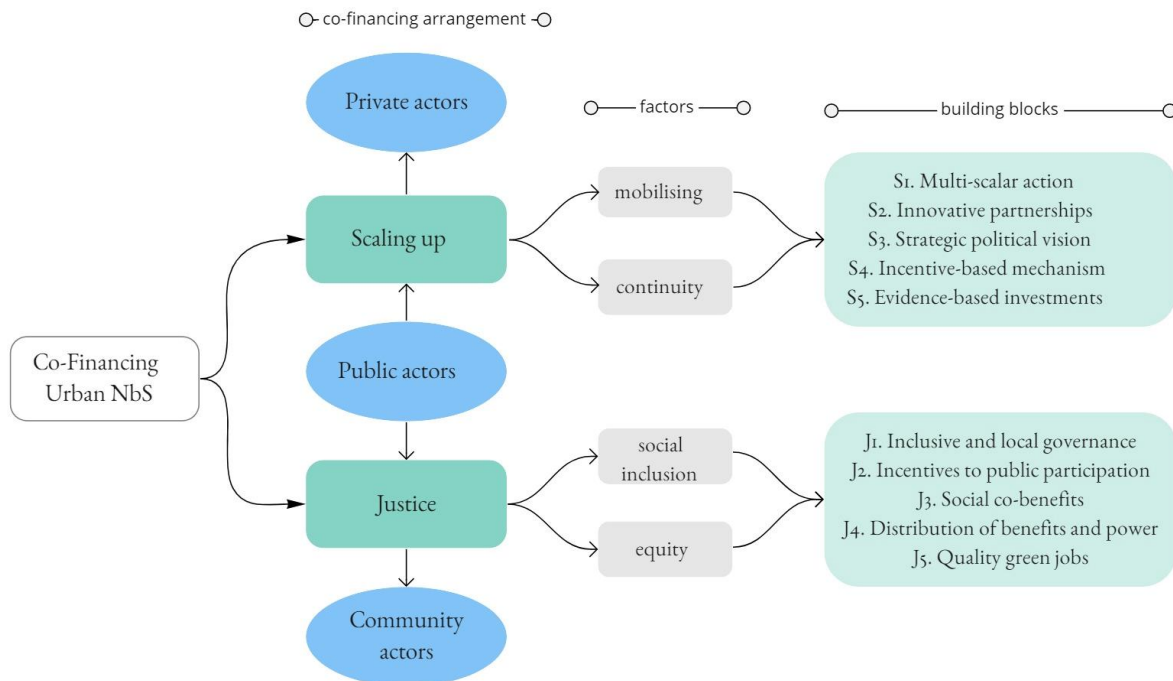


Figure 0-1: Conceptual Framework

Four European case studies which adopted innovative co-financing solutions for urban NbS supported. The case studies offered insights into the relationship between the concepts of justice and scaling up through testing the framework developed by the author. Both trade-offs and synergies were observed in the case studies and the balancing act between them can be quite tricky for cities to achieve. The complexity is increased when a range of diverse actors are involved in improving the share of funding. The analysis led to the parting of traditional role of the three actor groups where boundaries became open and blurry. On the flipside, it

became clear that a critical interrogation on the visions around renaturing cities, and how it is redefined, reimagined, exported and rearticulated is required. While co-financing NbS did create green jobs in the analyzed cases and most managed to achieve distributional justice, it remains unambiguous both in the literature and case studies if recognition and procedural justice were considered with or without the private sector involvement. Further, in different capacities, all three actors, including aggregators and NbE, can contribute to both the scaling up and social justice aspect of co-finance. To ensure a holistic approach to just and scaled up co-financing of urban NbS requires looking beyond the project, entering into the structural domains of governance and urban development. Overall, the analysis further brings to light seven strategic possibilities - Collective Leadership, Integrative Business Case, Rethinking Value, Building Narratives, Use of Technology and Data, Experimentalist approach and Feedback Loops, to overcome the contractions of scalability of finance and justice and realizes their synergies. The analysis led to a revision of the Conceptual Framework, depicted in Figure 0-2. These possibilities, answering RQ2, offer promising pathways for urban actors and should be considered when formulating policies and planning to ensure that the co-financing of urban NbS is scaled up and just.

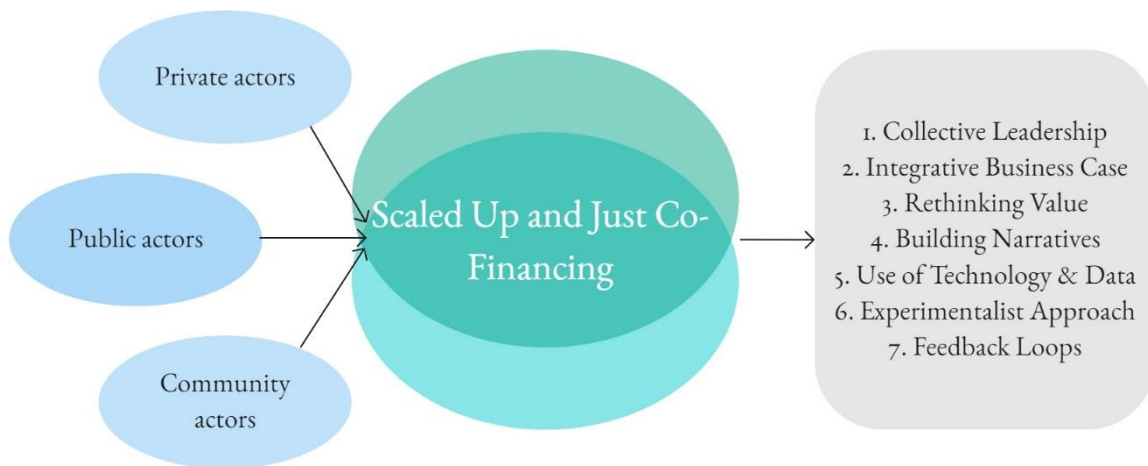


Figure 0-2: Revised Conceptual Framework

Conclusion. An essential finding of the study was that finance is a systematic barrier. The conceptual framework unpacks the concept of co-financing by looking at it from a holistic lens of justice and scaling up. The recommendations (provided in the form of strategic possibilities) act upon this information and open the door for endless prospects. It urges the urban actors to take a collective leadership approach that encompasses political will, collaborative multi-scalar governance, and internal and external co-creation. An integrated business case should be developed which considers the characteristics of different types of NbS where funds are allocated throughout the project's lifecycle. Yet, a fundamental shift in how we think about our relationship with nature is required to realize its potential fully. Further, using technology and data in different phases of the project is extremely beneficial for distribution of benefits and risks, transparency, and monitoring and assessment. Lastly, the author prescribes an experimentalist approach that encompasses bold and creative thinking, followed by incorporating feedback loops to maximize the synergies throughout different phases of the project.

The newness of NbS co-financing implies there is also a lack of knowledge to understand and operationalize this concept. Crucially, before this concept is mainstreamed in practice, the author recognizes the critical need to investigate the topic in an integrated manner. In this regard, the research has practical implications for urban actors and academia. The study

provides guidance to several urban actors to navigate the challenging task of balancing the trade-offs of increasing the share of finance with the social justice outcomes and capitalizing on their synergies. It advises the urban actors –policy makers, government officials, NGOs, businesses, and researchers who directly or indirectly help the public officials and other private and community actors to take an intentional approach to scaled up and just co-financing solutions. Moreover, the four case studies further provide demonstratable examples for the same (although through varying degrees), emphasizing bold and creative thinking. These successful case studies demonstrated a holistic and long-term approach to finance, featuring several innovative financing mechanisms and arrangements for the municipalities and cities to take inspiration.

Currently, research in developing pathways to mainstream NbS in cities is happening at a fast pace. While the research thesis has provided a systematic outlook on co-financing urban NbS, it opens doors for further efforts to assist cities and municipalities in catalyzing investment into the same with high socioeconomic benefits and social justice outcomes.

Table of Contents

ACKNOWLEDGEMENTS	I
ABSTRACT	II
EXECUTIVE SUMMARY	III
LIST OF FIGURES	IX
LIST OF TABLES	IX
ABBREVIATIONS	X
1 INTRODUCTION	1
1.1 SETTING THE SCENE.....	1
1.2 RESEARCH PROBLEM.....	3
1.3 AIM AND RESEARCH QUESTIONS	4
1.4 SCOPE.....	4
1.5 ETHICAL CONSIDERATIONS	5
1.6 AUDIENCE.....	5
1.7 DISPOSITION.....	6
2 LITERATURE REVIEW	7
2.1 URBAN NATURE-BASED SOLUTIONS.....	7
2.1.1 <i>Multiform of NbS</i>	8
2.1.2 <i>Nature-based Solutions and its Trade-offs</i>	9
2.2 FINANCING NATURE-BASED SOLUTIONS	10
2.2.1 <i>Phases of Financing</i>	11
2.2.2 <i>Scales of Financing</i>	12
2.2.3 <i>Sources and Types of Funding</i>	13
2.2.4 <i>(Co) Financing Mechanisms and Arrangements</i>	14
2.3 SUMMARY	17
3 METHODOLOGY	19
3.1 RESEARCH PHILOSOPHY.....	19
3.2 RESEARCH DESIGN.....	19
3.2.1 <i>Case Study Research Design</i>	20
3.3 METHODS.....	21
3.3.1 <i>Methods for Data Collection</i>	22
3.3.2 <i>Data Analysis</i>	23
3.4 RESEARCH VALIDITY, RELIABILITY AND GENERALIZABILITY	24
4 CONCEPTUAL FRAMEWORK	25
4.1 CO-FINANCING OF NATURE-BASED SOLUTIONS	25
4.2 SCALING UP OF CO-FINANCING	26
4.2.1 <i>Building Blocks for Scaling up of Co-Finance</i>	28
4.3 SOCIAL JUSTICE OF CO-FINANCING	31
4.3.1 <i>Building Blocks for Social Justice of Co-Finance</i>	33
4.4 UNDERSTANDING CO-FINANCING IN RELATION TO SCALING UP AND JUSTICE.....	37
5 CASE STUDY ANALYSIS	40
5.1 CASE 1: INTERPOLIS	40
5.1.1 <i>Co-Financing Arrangement</i>	40
5.1.2 <i>Scaling up Perspective</i>	41
5.1.3 <i>Justice Perspective</i>	42
5.2 CASE 2: ADOPT A PARK	43

5.2.1	<i>Co-Financing Arrangement</i>	44
5.2.2	<i>Scaling up Perspective</i>	45
5.3	CASE 3: TREES AI.....	46
5.3.1	<i>Co-Financing Arrangement</i>	47
5.3.2	<i>Scaling up Perspectives</i>	48
5.3.3	<i>Justice Perspectives</i>	49
5.4	CASE 4: BIODIVERCITY, MALMÖ.....	50
5.4.1	<i>Co-Financing Arrangement</i>	51
5.4.2	<i>Scaling up Perspectives</i>	51
5.4.3	<i>Justice Perspectives</i>	52
5.5	ENABLING AND CONSTRAINING FACTORS.....	53
6	ADVANCING THE CONCEPTUAL FRAMEWORK	55
6.1	SCALING UP AND SOCIAL JUSTICE OF CO-FINANCE.....	55
6.1.1	<i>Actor Arrangements</i>	57
6.2	STRATEGIC POSSIBILITIES.....	58
6.2.1	<i>Collective Leadership</i>	59
6.2.2	<i>Integrative Business Case</i>	59
6.2.3	<i>Rethinking Value</i>	60
6.2.4	<i>Building Narratives</i>	61
6.2.5	<i>Use of Technology and Data</i>	62
6.2.6	<i>Experimentalist approach</i>	63
6.2.7	<i>Feedback Loops</i>	64
6.3	REVISED FRAMEWORK.....	64
7	CONCLUSION	66
7.1	KEY FINDINGS.....	66
7.2	IMPLICATIONS FOR URBAN ACTORS AND ACADEMIA.....	67
7.3	AREAS FOR FUTURE RESEARCH.....	68
7.4	LIMITATIONS.....	69
7.5	PERSONAL REFLECTIONS.....	69
	BIBLIOGRAPHY	71
	APPENDIX A – DEFINITIONS OF NATURE-BASED SOLUTIONS	84
	APPENDIX B – INFORMATION FORM	85
	APPENDIX C – CONSENT FORM	86
	APPENDIX D – INTERVIEW GUIDE	87
	APPENDIX E – LIST OF INTERVIEWEES	88
	APPENDIX F – LIST OF CODES	89

List of Figures

Figure 0-1: Conceptual Framework.....	IV
Figure 0-2: Revised Conceptual Framework.....	V
Figure 2-1: Heartbeat diagram for Nbs financing.	12
Figure 2-2: Conceptual matrix for Scale of Nbs Finance	13
Figure 2-3: Synthesis of Nbs Financial Mechanisms According to Actor Clusters.....	14
Figure 3-1: Iterative Research Design.....	19
Figure 4-1: Conceptual Framework.....	39
Figure 6-1: Revised Conceptual Framework.....	65

List of Tables

Table 3-1: Case Study Selection	21
Table 3-2: Methods for Data Collection & Analysis	21
Table 3-3: Search Strategy.....	23
Table 5-1: Enabling and Constraining Factors of Case Studies.....	53

Abbreviations

BM - Business Models

CCS - Comparative case study

EbA - Ecosystem-based adaptation

EC – European Commission

GBI - Green blue infrastructure

GCC – Glasgow City Council

GIS – Geographic Information Systems

ICLEI - International Council for Local Environmental Initiatives

IDB - Inter-American Development Bank

IUCN - International Union for Conservation of Nature

NAIAD - NAture Insurance value: Assessment and Demonstration

NbE - Nature-based entrepreneurs

NbS - Nature-based Solutions

OECD - Organisation for Economic Co-operation and Development

PES - Payments for ecosystem services

SUDs - Sustainable urban drainage schemes

TNC - The Nature Conservancy

UN DESA - United Nations Department of Economic and Social Affairs

UNEP - United Nations Environment Programme

UNTCAD - United Nations Conference on Trade and Development

1 Introduction

The introduction sets the scene (*Section 1.1*) for the research thesis by introducing the concept of Nature-based Solutions (NbS) and the barriers to financing them. *Section 1.2* emphasizes the need for diverse financing streams and potential implications for social justice outcomes. It further highlights the gap in the literature which informs the aim and research questions in *Section 1.3*. The scope, ethical considerations, audience and disposition of the thesis is presented in *Section 1.4, 1.5, 1.6 and 1.7* respectively.

1.1 Setting the Scene

Cities are considered economic growth engines. At the same time, urbanization and subsequent rapid development have been carving out a place meant for humans, leaving nature behind (*UN-Habitat, 2016*). Global urbanization is on a rising curve. By 2050, an estimated 66% of the world's population will reside in cities (*UN DESA, 2018*). The global impact of this unfettered economic growth and urban sprawl has resulted in both driving and intensifying climate change, biodiversity loss, resource scarcity, socio-economic inequality, and livelihood vulnerability (*Cohen-Shacham et al., 2019*). In 2018, 85% of the cities reported major climate change disruption events such as extreme heat waves, floods, rains, droughts, and increased spread of vector-borne diseases. These will only become more frequent and intense in the future (*European Commission, 2020; IPCC, 2022*). These urban challenges are further exposed to unequal distribution of environmental risks, disproportionately affecting the most vulnerable groups (*Anguelovski et al., 2018*). Thus, cities in Europe and worldwide are increasingly facing pressure to tackle multiple and complex societal challenges of climate change (adaptation and mitigation) and biodiversity loss while building the resilience¹ of vital infrastructures (*Bush & Doyon, 2019; IPCC, 2022*). One of the promising effective solutions to buffer these challenges and progress towards sustainable urban development is nature-based solutions (*Nesshöver et al., 2017; Cohen-Shacham et al., 2019; Seddon et al., 2020*).

Nature-based solution (NbS) are solutions inspired or supported by nature and offer an alternative to grey fossil-based or hard infrastructure solutions (*EC, 2015; Cohen-Shacham et al., 2016; Barquet et al., 2021*). They create a strong business case by holding great promise to a multitude of benefits and synergies ranging from reduced climate risks (heat, flooding), enhanced biodiversity and their ability to promote socially inclusive green growth (*EC, 2015; Bazrkar et al., 2015; Kabisch et al., 2016, Depietri & McPhearson 2017; Toxopeus & Polzin, 2021*). They are novel, based on the innovative solutions, e.g., green roofs and sustainable urban drainage systems or in the way they are used, e.g., urban parks and community gardens where nature is re-oriented towards solving complex societal challenges (*Toxopeus & Polzin, 2021*). NbS builds on and unites several concepts of green-blue infrastructure (GBI), ecosystem-based adaptation (EbA), ecosystem services, ecological engineering, and disaster risk reduction (*Kabisch et al., 2016; Nesshöver et al., 2017; Depietri & McPhearson 2017; Cohen-Shacham et al., 2019; Dorst et al., 2019; Toxopeus & Polzin, 2021*). It advances these concepts to renature the urban landscapes by providing multiple (co) benefits to biodiversity and humans. These include but not limited to social value, recreational value, green jobs, green innovation, increased air quality, improved human well-being, enhanced biodiversity, water and food security, if planned well, rendering it a cost-effective approach to development (*EC, 2015; Nesshöver et al., 2017; Raymond et al., 2017; Kabisch et al., 2017a; Kabisch et al., 2017b; Wickenberg et al., 2021*). Although there is no standard definition in

¹“The ability of an urban system to adapt, respond and recover from adversity” (*Meerow et al. 2016*).

the literature, for this research, the European Commission (2020) defines it as “solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions”.

A study by European Commission (2015) reports that by 2050, over 80% of the population in Europe will be living in cities, arising both challenges to sustainable development as well as business opportunities for the planning and construction sector. NbS are expected to address both these challenges and have led to increased attention to upscale these solutions in cities (Sekulova et al., 2021; EC, 2021). In recognition of these various functions and (co) benefits, the integration of NbS into conventional urban development practices is being advocated by urban policy-makers, practitioners and researchers (Faivre et al., 2017, Frantzeskaki, 2019, Kotsila et al., 2020; Dorst et al., 2022). Moreover, cities in Europe and globally are increasingly adopting strategies, climate actions and targets to either develop new NbS, extend or link existing ones (Enzi et al., 2017; van der Jagt et al., 2021). Further, urban NbS often represent local public goods and benefit those citizens primarily in their location (Anguelovski et al., 2018). Here, how the benefits are distributed can play an essential role in the social and environmental justice² outcomes of NbS. The recent pandemic has highlighted the societal disparity in access to green spaces and re-emphasized people’s basic requirement to be connected to nature for mental, physical, and social health and wellbeing (Mell, 2021; Schröter et al., 2022). The more cities can adhere to principles of equity and inclusion, the more likely they are to also enhance social and environmental justice in cities (Kotsila et al., 2020; Toxopeus et al., 2021). Since 2013, NbS has been widely adopted as a term and pushed forward in the European Union (EU) Research and Innovation Policy agenda and are increasingly promoted across EU funding schemes and projects (Maes & Jacob, 2017; CohenShacham, 2019). Progressively, future research is being steered to encourage synergies between nature, society, and the economy, focusing on the social justice outcomes (European Commission, 2021).

Although the uses and advantages of these solutions are known in principle, the uptake of NbS has been relatively slow, facing several challenges relating to financial, institutional, and governance barriers linked to characteristics of NbS compared to grey solutions (Sarabi et al., 2020, Seddon et al., 2020, Mayor et al., 2021; Toxopeus & Polzin, 2021). Aspects related to the financing of NbS are highlighted as significant deterrents, slowing down its mainstreaming³ (Droste et al., 2017; Nesshöver et al., 2017, Toxopeus & Polzin, 2021). While investments in NbS cannot substitute the decarbonization of the global economy, they can contribute to reach the given scale of climate change mitigation and adaptation. According to the new State of Finance for Nature report by the United Nations Environment Programme (UNEP), the world needs to triple the annual investment in NbS by 2030 to tackle climate change successfully, biodiversity loss and land degradation and close a gap of USD 4.1 trillion by 2050. Public and private finance seems to be a recurring theme when discussing barriers (Droste et al., 2017; Nesshöver et al., 2017; Frantzeskaki et al., 2019; Toxopeus et al., 2020; van der Jagt et al., 2021).

² Social justice aims to ensure fair treatment of individuals and groups. The concept of social justice is that every group or individual receives a fair share of economic, as well as environmental benefits. As such, environmental justice is an integral part of social justice.

³ The approach of mainstreaming is “intended to signify processes, through which new ideas, instruments or interventions come to be a part of or integrated into established traditions, fields of activity and conventions” (Xie et al., 2022).

Both public and private investments face several challenges in implementing NbS (Toxopeus & Polzin, 2021). The barriers to municipal funding are many and concern budget constraints, lack of the competing funding for other priorities issues, short-term decision-making cycle, limited expertise, and silo working nature of various governmental departments (Droste et al., 2017; Seddon et al., 2020; Toxopeus & Polzin, 2021). The private sector also faces similar challenges due to the innovative nature of green infrastructure planning relating to the long-term nature of NbS investments, general lack of awareness, and nascent framework stage to monitor and evaluate NbS projects (Toxopeus et al., 2020; Toxopeus & Polzin, 2021). Owing to the public good nature of NbS, the investments are currently mainly coming from the public sector. The potential of private sector financing is still yet to be unlocked and scale drastically (UNEP, 2021). However, many authors have confirmed that there is no lack of financial resources for implementation, rather, catalyzing investment from various actor groups is a challenge (Sarabi et al., 2020, Seddon et al., 2020; Mayor et al., 2021; Toxopeus & Polzin, 2021). There are many economic opportunities, but knowledge of the systems to enable the creation of long-term financial support and securing investment for an emerging and less understood sector is fragmented in the traditional financial system (Somarakis et al., 2019; Toxopeus & Polzin, 2021; Beatriz et al., 2021).

1.2 Research Problem

In the literature, questions on long-term and robust financing schemes for NbS remain unanswered (Wickenberg et al., 2021; McQuaid et al., 2021; van der Jagt et al., 2021). Well-designed, innovative funding mechanisms could be instrumental for mainstreaming NbS (Austin et al., 2021; Toxopeus & Polzin, 2021). Co-financing solutions, where a combination of two or more actors from different departments in public sectors, private actors and community groups, pool and fund a project, are emerging as a hot research topic in Europe. This arrangement employs innovative business models (Sarabi et al., 2019; Toxopeus et al., 2020; Beatriz et al., 2021). Co-financing NbS not only increase the scaling up⁴ of financing but also allows better risk-sharing of costs and benefits. However, the cooperation between public and private actors can be impeded by complex actor arrangements, institutional factors and conflict in strategic decisions between the actor groups (Swann et al., 2021; Toxopeus & Polzin, 2021).

Several factors impede the willingness of the private sector to invest. These conditions concern the economic growth paradigm where the short terminism nature of the current financial system hampers the longer-term planning required for reaping the benefits of NbS (Seddon et al., 2020; Sekulova et al., 2021). Moreover, both public and private actor groups might feel uncertainty in the knowledge and performance of NbS, hindering long-term investments. In addition, the strategies for accessing public-private finance for NbS will inevitably affect decision-making on where and how to develop urban NbS, which in turn will influence how ‘socially just’ this green urban development is (Anguelovski et al., 2018; Toxopeus et al., 2020; Sekulova et al., 2021). There is a trade-off involving private actors where the benefits from nature can be unequally distributed, resulting in winners and losers (Kotsila et al., 2020). Market-driven greening strategies involving private capital aimed at regeneration and economic development usually target middle- and high-income citizens, increasing concerns about the green gentrification of neighbourhoods (Bäckstrand, 2003; Haase et al., 2017; Anguelovski et al., 2018). Hence, while additional financing can ‘increase the pie’ or scaling up finance of urban NbS, how the ‘pie is sliced’ will define its justice

⁴ Scaling up in this thesis refers to its ability to increase in size and scale.

outcomes and therefore requires careful planning and governance decisions (Toxopeus et al., 2020). This exploration of tradeoffs is not articulated enough in the NbS finance literature (Bush & Doyon, 2019; Toxopeus et al., 2020; Hanson et al., 2020; Barquet et al., 2021). There is a void in the literature which scrutinizes the equity, and justice dimension of NbS critically and adequately engage in discussions that pins down how their costs and benefits are distributed across scales (Cousin, 2021).

Current literature outlines these challenges but fails to provide a comprehensive and systematic responses to address them. There is little empirical research done in identifying successful co-financing solutions for urban NbS which are both just and can be upscaled (Sekulova & Anguelovski, 2017, Seddon et al., 2020; Toxopeus & Polzin, 2021). There is a need for an aggregated research to support for the amplification of NbS financing across levels and scales in cooperation with policy and governance in the urban development domain (EC, 2020; Toxopeus et al., Schröter et al., 2022). This calls for unpacking and unravelling the potential of NbS co-finance for a just and upscaled uptake.

1.3 Aim and Research Questions

The thesis research explores *the potential of co-financing urban NbS through the lens of scaling up and justice*. To achieve this aim, investments need to be looked both co-operatively (involving different actors) and holistically (involving different domains of governance, policy and urban development). The thesis contributes to empirical and conceptual research by studying pilot projects in Europe across a geographical range of diverse NbS typologies and scales. The following research questions (RQ) are proposed based on the research problem and aim.

RQ1: *How do scaling up and social justice concepts relate to co-financing urban NbS?*

RQ2: *What strategic possibilities can urban actors adopt to ensure scaled up and just co-financing of urban NbS?*

1.4 Scope

To answer the RQs identified, four case studies in different cities in Europe were chosen. The rationale for choosing four case studies over a single case study design was to provide diversity in co-financing mechanisms, financing actors, scales and type of NbS, etc., yet bounded by a similar socio-political context of Europe. It was the intention to the author to capture and systematically analyze different co-financing configurations appropriate in the given time. The geographical scope was further limited to Europe for data availability and accessibility.

For the context of this research, a municipality was defined as the urban administrative authority with corporate status and self-government powers over an area. In contrast, a city is used to describe an area of a large physical human settlement (Dijkstra et al., 2019). Further, owing to the fuzziness of the concept of NbS, several definitions of NbS exist in both academic literature and policy documents (a review of NbS definitions can be seen in Appendix A). For this research, the definition by EC (2020) is used, which emphasizes local adaptation and resilience approach with equal reliance upon social, environmental and economic aspects.

An intended broad scope was purposefully chosen to get a systematic understanding of the topic and to find gaps that negate an in-depth analysis of a particular sub-topic or a concept. Saying this, the research study focused more on co-financing arrangements with the private

and community actors as both the aspects of scaling up finance and justice become more pronounced. Further, the study acknowledges that the justice and equity are never homogenous entities, and details on recognition and procedural justice (explained in Section 2.1.1), such as gender distribution, were left out of the scope purely based on the time factor and the loosened connection with finance. And while valuation tools and different business models for NbS are considered to be essential concepts to scale up finance were not focused for the benefit of understanding a broader picture.

The temporal scope of this research was a fixed period; interviews were performed between February 2022 and April 2022. It is acknowledged that this research captures attitudes and views of this time, which may evolve and change later. The secondary data collected to answer both the RQ's were taken from up-to-date sources, mainly ranging between 2017-2022.

1.5 Ethical Considerations

Considerations were given to identifying and addressing potential risks during the research process extending beyond the publications of findings.

Financing NbS implies that nature and its services is assigned a monetary value, the research acknowledges this hard truth and tries to sensibly tackle this issue by highlighting the importance of social, cultural, environmental, and inherent values of nature. Additionally, since the research considers the viewpoints of the vulnerable and marginalized communities, the issues around social equity and justice were addressed with the required sensitivity while conducting proxy interviews, and while writing about it.

Further, several procedures were followed during the interviews in terms of consent, confidentiality, and courtesy towards the participants. Their participation in the interviews was on voluntary basis under an informed consent form. The respondents were informed of their right to withdraw from the study at any given point in the research process. Prior to the interviews, the participants were accurately notified in the email through an information document which contained research background and how the outcome would be used in the future. Anonymity was the default mode of referencing, instead each interviewee was assigned a reference number. Permission to record the interview was asked in advance and the recordings was stored on the author's password protected computer and were used only for scientific purpose.

Although different pilot projects were used as case studies the thesis was written and developed by the author independent of any external organisation. Thus, the conclusions drawn from the research are exclusively the result of the authors own interpretation. Moreover, the researcher acknowledges that their own background and experience have shaped the outcomes and results of the study. Lastly, this study has been reviewed against the Lund University research ethics guidelines and has been found to not require a statement from the ethics committee.

1.6 Audience

Nature-based solutions are increasingly being adopted in the urban context; however, finance is a major roadblock to increasing its uptake. Owing to the recent emergence of various co-financing schemes, the topic remains vastly unexplored. In response to RQ1, the author developed a conceptual framework that would be a theoretical contribution to the academic

field and can be further matured into a tool for societal actors and used by practitioners to mainstream the co-funding of NbS. The answer to RQ2 provides a pragmatic lens to practitioners and researchers alike where strategic possibilities are provided for just and scaled up co-financing solutions. The research will also be relevant to the multiple urban actors ranging from different levels of government, policymakers, urban planners, investors, businesses, local communities, and NGOs to name a few. The research thus, through unpacking and unlocking the potential of co-financing contributes to increase in uptake of NbS for its benefits to be reaped by both people and nature.

1.7 Disposition

The thesis follows a logical structure which is outlined below:

Chapter 1: The introduction presents the reader with the background of the topic and nature of the problem, further outlining the aim, research questions, scope, audience and ethical considerations.

Chapter 2: Literature Review provides a thorough, up-to-date analysis of the existing literature on different aspects of NbS. Further, a synthesis of various (co) financing mechanisms and arrangements forms the basis for creating the conceptual framework.

Chapter 3: Methodology explains the research strategy used by the author to collect and analyze the data. The chapter describes research design and methods used for conducting a systematic literature review and interviews, along with research validity, reliability and generalizability.

Chapter 4: Conceptual framework which connects the scaling up of co-finance and social justice outcomes of urban NbS is presented, answering RQ1.

Chapter 5: Case Study *Analysis* presents the findings from the four case studies and analysis against the conceptual framework developed in the previous chapter.

Chapter 6: Advancing Conceptual Framework discusses the lessons drawn from the case studies to the conceptual framework and seeks to advance it. This chapter then provides strategic insights for urban actors for a scaled up and just co-financing of urban NbS, answering RQ2.

Chapter 7: Conclusion summarizes the main conclusions of the thesis concerning the two RQs. It further highlights the implication of the study along with its limitations. The chapter also outlines suggestions for future research and ends with the author's reflections on the research thesis.

2 Literature Review

This chapter aims to do a comprehensive background study and synthesize up-to-date literature on the concepts of Urban Nature-based Solutions and their different aspects, along with (co) Financing Nature-based Solutions in an urban context. This knowledge is then used to develop the Conceptual Framework. Gaps in literature are further identified and elaborated in this Chapter 4.

2.1 Urban Nature-based Solutions

NbS has been realized as an innovative strategy to achieve sustainability goals while simultaneously delivering multiple benefits such as biodiversity protection, climate change mitigation and adaptation, sustainable living, and social wellbeing (Kabisch et al., 2016; Cohen-Shacham et al., 2016; Kabisch et al., 2017b). It promotes nature as a means for solutions to several urban challenges such as bad air quality, loss of biodiversity, food insecurity and health, social injustice and economic deterioration (Kabisch et al., 2016; Nesshöver et al., 2017). It encompasses concepts like EbA and GBI, which are commonly understood by several municipalities due to departments working on these concepts for a longer time (Nesshöver et al., 2017; Droste et al., 2017). One of the distinct characteristics of NbS is the emphasis on the integrated use of nature to support human well-being cost-effectively. The term was first mentioned by a financial institution, World Bank in 2008 and later promoted by scientifically oriented NGOs; International Union for Conservation of Nature (IUCN) and The Nature Conservancy (TNC) as a policy tool for several societal benefits across various scales and functions (Eggermont et al. 2015; Cohen-Shacham et al., 2016; Faivre et al., 2017; Barquet et al., 2021). Although there is a lack of operational clarity in the concept, several authors have highlighted the recurring two key elements, 1)the diversity of NbS typologies brings forth its multifunctionality nature (Albert et al., 2017), 2)there is a need for it to be adapted to place-based conditions⁵, requiring stakeholder involvement or collaborative governance and planning (Nesshöver et al., 2017; Dorst et al., 2019, Toxopeus et al., 2021; Sekulova et al., 2021).

Urban areas are seen as important target locations for NbS implementation. Indeed, cities are more than their physical form where the performance of NbS is embedded in complex dynamics of concentration between the different socio-ecological systems and institutional contexts (Kabisch et al., 2016; Nesshöver et al., 2017; Raymond et al., 2017; Frantzeskaki, 2019). It offers a solution-oriented approach (again, to specific contextual challenges) to address the complex challenges faced in cities. It helps cities tap into the transformative potential by offering social benefits, citizen involvement, and opportunities for replication and up-scaling of local ecosystem-based adaptation (Dorst et al., 2019; Toxopeus et al., 2020; Toxopeus & Polzin, 2021). In addition, the IUCN global standard on NbS governance launched in 2020 sets explicit operational criteria, outlining the inclusivity, transparency and empowering objective of NbS interventions (IUCN, 2020). Further, several assessment frameworks demonstrate the so-called co-benefits of NbS (Raymond et al., 2017; IUCN, 2020; Sekulova et al., 2021).

In Europe, specifically, urban NbS are seen not only as an alternative means to address social needs and enhance natural environments but also as a way of boosting green innovation, green jobs and resilience in cities (EC, 2020). It has the potential to achieve green economic

⁵ Adapted and designed specifically for the place or location.

development by transforming and diversifying the local business (Seddon et al., 2020). It fits well with the broader discourse on innovation and green growth as a response to rapid urbanization, climate adaptation and mitigation while holding a promise to achieve the triple bottom line and promote 'a resource-efficient and inclusive model of economic growth (Raymond et al., 2017; Faivre et al., 2017; Dorst et al., 2019; Toxopeus et al., 2020). However, the review reveals that it is relatively understudied how NbS can be operationalized in a dense urban environment, matching the interest of high diversity of stakeholders and interests (Faivre et al., 2017; Frantzeskaki, 2019; Dorst et al., 2019).

2.1.1 Multiform of NbS

NbS adopts a multiform approach which involves tackling complex challenges of biodiversity loss, climate change, frequent natural disasters, and rapid urbanization. The solutions take place through varied, interconnected scales with multi-thematic typologies offering diverse functions and involving various actors.

Multifunctionality

Multifunctionality is more than delivering two (or more) functions together but rather searching for synergies between these while minimizing potential trade-offs (Pauleit et al., 2017). Conventional grey or technological solutions usually provide single benefits (e.g., less carbon emissions). In contrast, urban NbS can provide multiple goals, benefits, values and synergies, making it a cost-effective approach to development (van der Jagt et al., 2021). It provides a strong business case for nature as a multifunctional sustainability solution delivering value for sustainable and just cities (EC, 2015; Maes and 4Es, 2017; Dorst et al., 2019). This is becoming part of an emerging policy discourse within the EU. For example, urban forest, community gardens, or a neighbourhood park includes benefits ranging from biodiversity and habitat provision; mitigating urban heat; increased mental and physical health benefits; address stormwater runoff quality and quantity, prevent flooding and damage to infrastructure through water-sensitive urban design.

Multi-stakeholder engagement

To deliver on the range of benefits NbS requires engagement and collaboration with multiple actors to make it a cost-effective solution. Stakeholders from different municipal administrations include town planning, public open space management, traffic engineering, climate change adaptation and mitigation, urban landscape design, water and waterway management, public health, and social policy. Local communities, policymakers, practitioners, and scientists are also considered essential stakeholders (Fastenrath et al., 2020). The diversity of benefits can also interest private actors such as developers, utility and insurance companies, healthcare organizations, and municipalities. Further, depending on the problem, NbS implementation might need city-level or international collaboration (Somarakis et al., 2019). Subsequently, NbS are multi and transdisciplinary and serve as a common language for different stakeholders (Dorst et al., 2019; Toxopeus et al., 2020). Consequently, the interactions between several urban actors and institutional settings involved in providing societal functions play a critical role in delivering urban NbS (Dorst et al., 2022).

Multi-scalar

Multi-scalar actions for NbS include working across spatial scales, socio-political boundaries and structures where the temporality aspect relates to the time taken for NbS to be fully effective (Nelson et al., 2020).

Three spatial scales that are used by urban planners that correspond to the economic factors are; a) city scale or the meso-scale refers to several hundreds of kilometres which include an agglomeration of a large, dense and populated area consisting of a city and its suburbs (e.g., river restoration, urban forests), b) neighbourhood scale or the local scale is an area of several square kilometres and defined based on its administrative division consisting of a district or neighbourhood of buildings (e.g., city parks or sustainable urban drainage systems) and c) object scale or the micro-scale includes several thousand of square meters and refers to urban block, street, place, building (e.g., green roofs, pervious pavements) (Ramirez-Agudelo et al., 2020). In addition, one can also implement NbS over a landscape scale which emphasizes the heterogeneity between different spatial scales and focuses on large-scale processes ranging from regional, national or global (Chang, 2019).

NbS is further embedded in the social and institutional scale (Nesshöver et al., 2017; Dorst et al., 2019). Depending on the problem and typology being implemented, relevant policies and stakeholders are needed at different levels of governance, ranging from municipality to international level of collaboration (Banwart et al., 2019). Further, the spatio-temporal aspects of NbS are complex, dynamic and challenging to assess in the short-run as it takes years, or even decades, to realize the effectiveness of NbS interventions (Powell et al., 2019; Barquet et al., 2021). The benefits often materialize over medium to long-term horizons (depending on the typology of NbS), making investments in other interventions more attractive (Xie et al., 2020). Compared to engineered solutions, NbS does not have a 'one size fits all' approach, given the spatial, ecological, social and political variations that are often poorly understood (Frantzeskaki et al., 2019; Banwart et al., 2019).

Multi-dimensions of Environmental Justice

NbS must work to address social and systemic inequities and may frequently engage with environmental justice (Nelson et al., 2020). To capture environmental justice in green infrastructure, urban scholars have conceptualized three interconnected pillars: recognition justice, distribution justice and procedural justice (Sekulova & Anguelovski, 2017). More NbS planning takes these principles mentioned below into account, the more likely they are also to enhance social benefits for the citizens (Kotsila et al., 2020; Toxopeus et al., 2020).

Recognition justice is about acknowledging and including people from different races, gender, and ethnicity, for example, the elderly, migrants, women and people with disabilities, in the inclusive urban regeneration processes (Fraser, 2009; van der Jagt et al., 2021).

Distributional justice refers to the providing equal allocations of cost and benefits of environmental qualities across cities and between different social strata of the societies (Barquet et al., 2021; Toxopeus et al., 2020).

Procedural justice concerns with who is involved and the outcome of the participation (Anguelovski et al., 2018; van der Jagt et al., 2021). It is about providing a fair and inclusive chance for residents to put forth their needs during green infrastructure planning and decision process (Kabisch & Haase 2014). This type of justice concerns itself with the quality and level of participation, which relates more to the power play and the socio-cultural hierarchies (Sekulova & Anguelovski, 2017; Barquet et al., 2021).

2.1.2 Nature-based Solutions and its Trade-offs

Generating co-benefits like stormwater control, reduced social vulnerability and heat island effects, improvement in air quality, habitat connectivity and (green) space accessibility are widely touted NbS features in policy discourses. Yet, several authors in the literature have

confirmed that NbS are often planned and implemented based on a single criterion and in an opportunistic fashion (Sekulova et al., 2021). Additionally, NbS faces multi-scalar challenges over spatial, social and political scales to the delayed delivery of some of the benefits generates temporal mismatches regarding the timing of actions and outcomes for NbS investments (Nelson et al., 2020).

Further, the multifunctionality aspect of NbS can create challenges for framing and focus (Fastenrath et al., 2020), often marked by explicit pursuit of economic growth and unequal power relations (Sekulova & Anguelovski, 2017; Sekulova et al., 2021). Currently, the framing of NbS is tied directly to the development and growth agendas whilst also meeting the meeting social imperatives. This makes NbS fall under a weak sustainability approach where economic, social and environmental are given equal importance (Sekulova & Anguelovski, 2017). Despite the clear links between NbS and equity, there is a gap in the research when it comes to social sustainability (Hanson et al. 2020). Today, little is known about how the benefits of NbS are delivered to more marginalized communities and how decisions affect the historic distribution of negative or positive impacts across space. Where are NbS most needed and for whom? What measures can be taken to ensure access to their benefits? And are there costs or trade-offs associated with NbS delivery that impact particular groups? For instance, urban greening may result in ‘green gentrification’ as neighbourhood improvements bring about rising property values, social exclusion and displacement (Sekulova et al., 2021). On the other hand, local transformative green actions through volunteering and stewardship go beyond market logic and produce social capital (Wolch et al., 2014; Nelson et al., 2017; Kotsila et al., 2020). The relations between these benefits and challenges are complex and can potentially be contradictory. Trade-offs while delivering multiple services are therefore likely to occur (Eggermont et al., 2015; Haase et al., 2018). Many authors are advocating for an integrative and holistic evaluation of its consequences which promotes the involvement of a variety of stakeholders, cross-disciplinary collaboration and a shift to a socially inclusive approach (Kotsila et al., 2020; Toxopeus et al., 2020; Nelson et al., 2020; Sekulova et al., 2021).

2.2 Financing Nature-based Solutions

NbS are often more cost-effective than traditional grey infrastructure alternatives. Despite this, there are numerous complex barriers to its implementation (Kabisch et al., 2016; Seddon et al., 2020). Urban densification strategies in cities are exacerbated by long-term financing opportunities (Toxopeus et al., 2021; Mayor et al., 2021; Hagedoorn et al., 2021). There is a siloed understanding of finance in the literature where this domain is looked at separately from other structural fields of urban development and regulatory functions (Dorst et al., 2022). These can be linked to partnership working, management change, securing investment for an emerging and less understood sector, monitoring and evaluation, lack of ecological knowledge and awareness in planning and development, and government austerity hindering urban greening initiatives (Somarakis et al., 2019; van der Jagt et al., 2021; Mayor et al., 2021).

For cities, NbS offer environmental benefits for the people and economy, investments can be deployed to implement and maintain old or new NbS and they often struggle with both (Ershad Sarabi et al., 2019; Toxopeus et al., 2021). Economic opportunities from implementing NbS are slowly being recognized, but the system to enable the creation of financial support is lacking in the traditional financial structure. Through several EU-funded

projects, cities are partnering with research institutions and intermediate organizations where knowledge related to long-term financing options and new funding⁶ options through pilot projects are being explored (Wilk et al., 2020). The research in the field is advancing considerably, and the funds made available for delivering NbS are constantly evolving (Mell, 2018).

2.2.1 Phases of Financing

Implementing NbS is complex and requires detailed consideration of investments through various stages (Somarakis et al., 2019; Mayor et al., 2021). Financing of NbS includes securing the funds to implement and maintain the NbS intervention in the long term (Cohen-Shacham et al., 2019, Toxopeus & Polzin, 2020; Mayor et al., 2021). ‘Nature-based Solution Business Model Guidebook’ by McQuaid (2019), a collaborative output from the Connecting Nature⁷ Horizon 2020 Project, identifies three main phases of financing NbS, known as the heartbeat diagram, as shown in Figure 2-1. These phases occur multiple times over the lifecycle of an NbS. A lifecycle cost perspective is critical for long-term investment security and subsequently successful delivery of the NbS (Mayor et al., 2021; Koojiman et al., 2021).

1. *The planning and design phases*: This phase can take a long time and involve multiple actors, especially for large-scale interventions like the sustainable urban drainage schemes (SUDs) compared to the small-scale interventions like community gardens. Beyond economic analysis, this phase should also take a detailed business case into account where questions around partnerships (engaging other actors), the distribution of benefits and what additional resources are required to realize the project (Somarakis et al., 2019; Mayor et al., 2021).

2. *The capital investment or build phase*: Financing the capital investment phase for NbS usually incurs the highest cost over a short period. This phase includes direct and indirect investments to deliver assets⁸ (Nature4Cities, 2018; Somarakis et al., 2019).

3. *Operational costs or stewardship phase*: Financing this phase involves considerable costs of minor and significant maintenance expenditure and asset renewal, replacement and rehabilitation over a long period and are recurrent over time. It also includes indirect activities that spread out during this phase (Nature4Cities, 2018; Somarakis et al., 2019).

NbS have a different financial structure than a typical infrastructure project, where the latter is structured upon the construction and operating revenues. NbS are living and growing interventions and thus require more significant investments in the operational and maintenance phase, and most often, little consideration is given to them (Sarabi et al., 2020; McQuaid, 2021, Kampelmann, 2021, Mayor et al., 2021; Dorst et al., 2022). Projects implemented through research and innovation funds still experience a challenge in securing

⁶ While funding is about transferring resources from a financial contributor to a recipient, financing is about the act of obtaining the capital or structuring financial flows to achieve a common result (UNESCAP, n.d).

⁷ Connecting Nature is a Horizon 2020 project which aims at large scale demonstration of NbS relating to its benefits in renaturing cities and to provide EU wide evidence base of a range of tested, scalable and easy-to-promote NbS. The framework is being used as living document that is continually being updated and revised according to the city’s changing needs.

⁸ An asset is a resource with economic value that an individual, corporation, or country owns or controls with the expectation that it will provide future benefits, e.g., property, structures, or investments such as stocks or bonds (Barone, 2022).

long-term investments needed for post-implementation efforts (Schröter et al., 2022), undermining its functionality (Wickenberg et al., 2022).

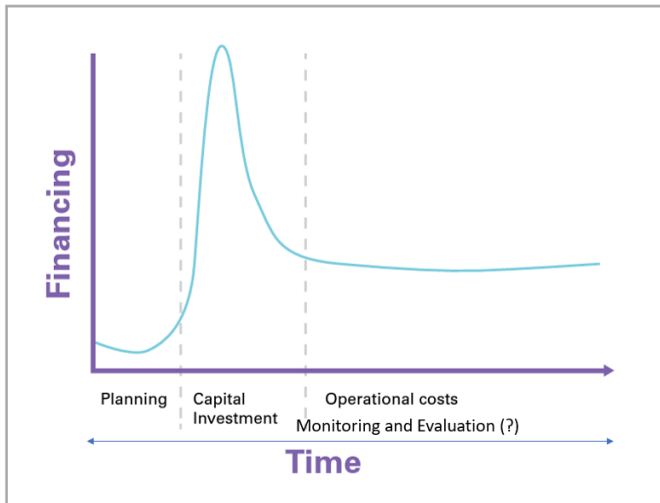


Figure 2-1: Heartbeat diagram for NbS financing.

Source: Adapted from McQuaid, 2019.

Monitoring and feedback are also crucial steps, ideally occurring throughout the three phases (as shown in Figure 2-1) that reflect the dynamics of NbS and the need for adaptive management (Somarakis et al., 2019). Leaving these steps out have recognised as one of the major challenges for long-term financing opportunities (van der Jagt et al., 2021). Thus, financing of NbS doesn't stop at the operational costs. Funds are required to assess and monitor NbS projects. As much emphasis is placed on the monitoring and evaluation phases to prove the worth of NbS, there is little said on funding mechanisms for measuring the impact.

2.2.2 Scales of Financing

Financing NbS is mainly dependent on the type, typology and scale of NbS. Projects of large scale, require massive investments in cities are usually a coastal defense, flood defence, mangrove restoration and so on where the implementation is spread across an extended timeframe. Small scale NbS are common in dense urban cities; green roofs, green walls, neighborhood parks, permeable surfaces, etc., require a considerably small investment (Banwart et al., 2019; Schröter et al., 2022). Here, the benefits compared to the large-scale NbS are observed in a shorter timeframe. Importantly, small-scale NbS requires a low level of stakeholder engagement. In contrast, at the larger scale or at the landscape scale beyond single cities, requires tackling much more complex multi-level governance structures, as shown in (Dorst et al., 2022). The simple high-level matrix depicted in **Error! Reference source not found.** summarizes this multi-scale temporal functionality concerning the scale of investment required. It provides a preliminary framework for any project (Banwart et al., 2019).

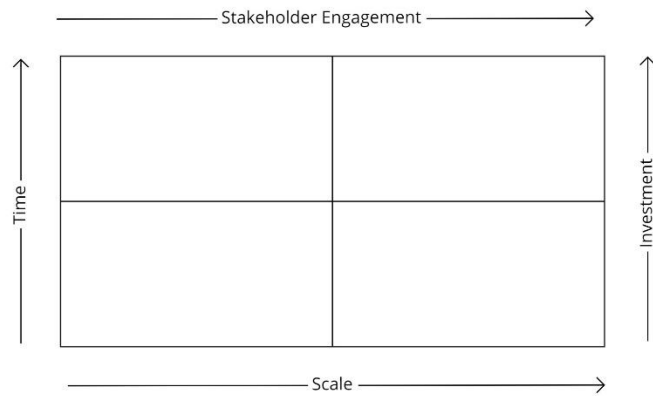


Figure 2-2: Conceptual matrix for Scale of NbS Finance

Source: Adapted from Banwart et al., 2019

2.2.3 Sources and Types of Funding

NbS are usually financed by public actors, municipalities, regional authorities and national governments or private companies and philanthropic organizations. The process of securing finances varies significantly across states and regions and public and private entities (Chen & Bartle, 2022). Globally and in the EU, most of the funds to implement NbS flows from the public sector, and the potential of private sector financing is still yet to be unlocked (UNEP, 2021). According to Urban Nature Atlas⁹, almost 75% of NbS are funded from public sources comprising of local authority budget (public budget/direct funding or subsidies).

NbS in urban contexts is still recognized as a burden borne by the public sector, not fitting in with the revenue-generating model of the private sector (Toxopeus and Polzin, 2021; Mayor et al., 2021). However, a diverse and growing range of hybrid financing solutions has emerged over the last few decades in response to the growing ambitions of the cities (Wilk et al., 2020). This diversity of funding mechanisms reflects the various types and scales of NbS. There has been a high incidence of non-governmental or private actors being involved in governing public goods as green infrastructures (Mell, 2018; Toxopeus & Polzin, 2020; Mayor et al., 2021). Likewise, the financing solutions that have evolved to meet the funding needs have involved a range of funders and used a spectrum of sources and types of finance (Mayor et al., 2021).

Two main funding types include a) repayable investments, e.g., investments related to debt¹⁰ and equity¹¹, and b) non-repayable ones, e.g., grants, direct payment, and earned income. Business models can then be either based on revenue or other incentive-based mechanism. These funding types are used independently or in combination to create financing mechanisms such as crowdfunding, social impact investment, loans, subsidies, etc. (Wilk et al., 2020; Chen & Bartle, 2022). Along with the source, how NbS is financed becomes a key

⁹ Urban Nature Atlas is a database of over 1000 NbS in 100 cities in Europe, which was developed within the EU Horizon 2020 NATURVATION project (GA#730243). See: <https://naturvation.eu/atlas>

¹⁰ Funder invests into NbS and takes a percentage of ownership; repayment depends on the value of NbS.

¹¹ Funder lends the private capital to pay for NbS and the recipient repays the funds over time with additional interest charges.

consideration (Mell, 2018) and depends on the local context and the willingness of the stakeholders to collaborate (Toxopeus & Polzin, 2021). Further, the economic risk from an NbS project will vary with the type of solution, targeted resilience outcome, the level of investment, and the scale of the actions (Ershad Sarabi et al., 2019; Mayor et al., 2021).

2.2.4 (Co) Financing Mechanisms and Arrangements

Financing of NbS in urban areas can take many different forms. Various ‘innovative’ mechanisms (excludes municipal budgets) and arrangements (involve two or more actors) have emerged in recent years. One classical way of characterizing arrangements is according to the main actor (s), namely, private (or referred to as market by some authors), public and community (Ershad Sarabi et al., 2021). The section details the financial mechanisms according to the actor clusters and is synthesized in Figure 2-3. Further, each cluster's main barriers and drivers for the implementation of their financial mechanism and arrangement are articulated below. Many of the mechanisms can be used for multiple actor arrangements; often, there is no clear distinction between them. Depending on the context and the NbS typology, they can further be mixed and matched.

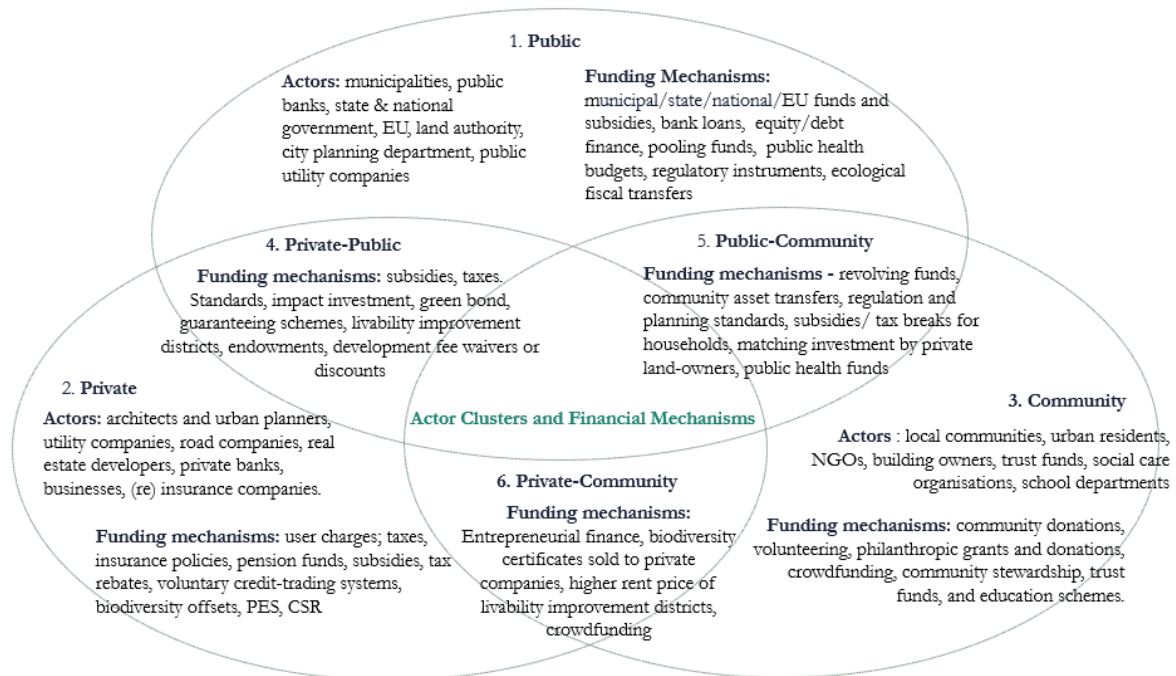


Figure 2-3: Synthesis of NbS Financial Mechanisms According to Actor Clusters

Source: Author’s elaboration informed by literature in Section 2.2

Public Cluster

The benefits of NbS fall under the public goods and are often seen as a responsibility borne by the public sector (Toxopeus et al., 2021). Public source of funding usually deals with direct or non-repayable types of funding. City budgets for green development and maintenance often face budget constraints. Municipalities suffer from short-term political cycles, whereas NbS requires long-term thinking and budgeting (Toxopeus et al., 2021; Kabisch et al., 2016). Decreasing public budgets translate into lower capital investments required in short term and maintenance costs in the medium and long term (Toxopeus & Polzin, 2021). Unless earmarked, NbS funding is made to compete with other development priorities like social housing (Toxopeus and Polzin, 2021). Further, there is a lack of

coordination between different departments to realize a joint funding scheme. A strong political agenda and streamlined public procurement processes can be highly operational for urgent problems and may initially provide considerable step-change improvements (Grow Green, 2019; Egusquiza et al., 2021). A few emerging innovative public financing schemes are pooling funds from different governmental departments with cross-sectoral benefits, or using untapped sources such as public health, educational budgets or public security, and overcoming departmental silos with each having their own budgets and objectives. For example, the urban forest fund can pool funds from environmental departments, healthcare, education, cultural and social, public security, climate resilience, recreational, agroforestry, tree planting, etc, creating an opportunity for joint investment (Droste et al., 2017, Toxopeus et al., 2021). Grant funding and donations include EU funding and grants from regional and national public bodies. Public sources also include the incentive-oriented design of existing charges (e.g., municipal fees for water services) or levying new ones (e.g., water charges). They can utilize previously untapped sources such as the public health budget and ecological fiscal transfers, where municipalities receive tax revenue for hosting protected areas (Dorste et al., 2017; Xie et al., 2020; Green Surge, 2021).

Private Cluster

Private sector funding is a crucial piece to narrow the nature finance gap materially. The private sector usually considers repayable funding, i.e. equity or debt. Sometimes, concessional funding as part of direct funding where the funder expects a lower or nil return on investment is also considered (Wilk et al., 2020). Private actors such as real estate firms, businesses, investors, developers, and insurance companies can create a market where NbS develops access to new sources of revenue, increases the resilience of commercial activities and contribute to reputation and purpose (EC, 2015; Kabisch et al., 2016; UNEP, 2021). Considering the innovative character of many urban NbS, many barriers need to be overcome for private investments to become a significant part of the equation. Lack of awareness and understanding of urban NbS, including their benefits and values and investor's attitude on no foreseeable tangible return on investment, are outlined as main barriers by several authors (Kabisch et al., 2017; Beatriz et al., 2021; Toxopeus et al., 2021, IUCN, n.d). They are often perceived as high-risk ventures due to lack of information on metrics and tools for evaluating the performance of NbS assets (DNB, 2020; McQuaid et al., 2021; IDB, 2021). Green roofs and SUDs take a while to reap benefits. These long-term, infrastructural investments are traditionally seen as a public policy domain into which private investors do not enter naturally. In addition, owing to the ecological public good that is delivered through NbS, investors often find it difficult to internalize the benefits (Toxopeus & Polzin, 2021). Here the investors and other private contributors need to be motivated differently, possibly touching upon their reputation, and sustainability commitments, exploring their financial, reputational and physical risks linked to nature (World Bank, 2020; IDB, 2021). The insurance sector is a vast potential source of risk financing schemes for climate change mitigation and adaptation (Swiss Re, 2020; World Bank, 2020). The private sector can benefit through market-based instruments: user charges, taxes (as incentives rather than a cost-recovery mechanism), credit-trading systems, urban biodiversity/GBI offsets and payments for ecosystem services (PES). On the other hand, NbS-economy can create new, often socio-entrepreneurial businesses and foster business opportunities by guiding customer movement, building 'green jobs'. There is an emergence of NbS entrepreneurial finance, such as crowdfunding (which can also be led by communities or municipalities) which involves raising funds through the donation of small amounts from many individuals (Grow Green, 2019; Ershad Sarabi et al., 2019; Koojiman et al., 2021).

Community Cluster

Bottom-up approaches are one of the most cost-effective for funding urban green space maintenance and improvements. This cluster includes range of funders: philanthropy and charity, citizens, and other societal groups (Egusquiza et al., 2019). Volunteering, education budgets and programmes are potential alternative funding sources for NbS (Nature4Cities, 2018; Wilk et al., 2020). Community-led projects have a high legitimacy and acceptance of the projects as they reflect the local context (Egusquiza et al., 2019; McQuaid et., 2021). They can play a significant role in providing on-the-ground evidence e.g volunteer bee health monitoring. However, grassroots movements are inherently unpredictable and require a certain level of environmental awareness and commitment (Egusquiza et al., 2019; Toxopeus & Polzin, 2021). Funding in this cluster is often minimal and consists of in-kind donations or grants and philanthropic or trust funds. Opportunities to overcome a lack of municipal financing through bottom-up community crowdfunding strategies have also been highlighted in the literature (Toxopeus et al., 2021). Although, community-owned and led projects remain predominantly random and at a pilot stage (Schröter et al., 2022).

Public-Private Cluster

An effective public-private partnership is considered to be an answer to both government and market failures (Mayor et al., 2021; Toxopeus & Polzin, 2021). It combines the private sector's access to finance (especially for large scale projects which require high capital investment), innovation, knowledge of technologies, managerial efficiency and entrepreneurial spirit with expertise and local knowledge of public sector to solve urban challenges, environmental awareness, and social responsibility (Koppenjan & Enserink, 2009; McQuaid et., 2021). Insecurities in general revenues and risk-averse nature of the private sectors can be overcome by public loan guarantee schemes, public subsidies, and so-called blended finance, which describes a mix of funding types (Wilk et al., 2020; Toxopeus and Polzin, 2021). Several funding mechanisms are being piloted in the EU, such as social/environmental impact bond schemes that shift the risk of reaching social or environmental milestones from taxpayers to private bondholders. Moreover, public actors can leverage private investment through development fee waivers, building permit fee discounts, and land taxation funds from real estate companies (Green Surge, 2017; Green Growth, 2019; Wilk et al., 2020; Toxopeus and Polzin, 2021).

Investments in this nexus are highly complex due to the diverse composition of actors where strategic calculations could lead to the divergence of interests (Egusquiza et al., 2019). Besides, the lack of experience of the public actors in collaborating with non-public actors for financing is compounded in some municipalities by the absence of a suitable regulatory framework to support such partnerships (Connecting Nature, n.d; Wickenberg et al., 2021; Toxopeus & Polzin, 2021). Further, shifting from public grant-based funding to these new forms of financing raises important concerns. While this arrangement of actors increases the 'size of pie' for financing NbS, private funds' mobilization often raises social justice questions (Toxopeus et al., 2020). Market-driven strategies usually target middle- and high-income citizens, increasing risks for green gentrification of neighbourhoods (Haase et al., 2017; Anguelovski et al., 2018). In addition, often the success of these financial mechanisms is measured in terms of profitability and rate of return rather than in the ability to protect or enhance nature. This could for instance foster controversial policy tools such as carbon and biodiversity offsetting, which would only worsen the issue (Somarakis et al., 2019).

Public – Community Cluster

This arrangement of actors works effectively for small-scale projects (Schröter et al., 2022). For example, to finance community gardens, concessional funding (non-repayable finance from public institutions such as EU grants and philanthropic donations) along with crowdfunding can be used to implement and maintain an NbS project. Other innovative funding mechanisms include community asset transfers where the local authorities lease lands to the community to implement NbS or revolving funds which are operated by NGOs or trusts but established by the state governments where the profits generated from the project are circled back for maintenance purposes. The NbS implemented within this cluster are usually not meant for commercial purposes, but the emphasis is on other benefits; building relationships, relaxation and education as outcomes of urban gardening activities (Vogl et al., 2004; Toxopeus et al., 2021). The authors also found that urban green space (including urban agriculture) that allows for recreation and leisure for the general public are valued higher by citizens than urban green spaces that cannot be accessed. For functional NbS, e.g., stormwater management systems, taxes or subsidies could be one potential funding source. Although the benefits from the projects may not be in line with the time invested and willingness to pay (when the citizens are the payers). Here, raising awareness among the citizens may help overcome this challenge (Grow Green, 2019; Egusquiza et al., 2019). In addition, this cluster of actors often falls short in coordinating multi-scalar governance and often depends on the local socio-political and cultural context (Nature4Cities, 2018; Dorst et al., 2022).

Private - Community Cluster

The short-term utilitarian investments from the private sector can be balanced by environmentally aware citizens, capturing the holistic value of NbS (Wickenberg et al., 2021, Egusquiza et al., 2019). The motivations of companies and NGOs to collaborate are very diverse. They can range from searching for legitimacy and resources, the need for competence in solving complex problems, or society-oriented motivations (Nature4Cities, 2018). Since the municipality is directly or indirectly involved, not many financial mechanisms are seen in practice which involve private and community actors. Private green spaces can be charged with an entrance fee and/or combined with a stewardship model. Developers can charge higher rents for green roofs and have special tax districts for added customer value (Grow Green, 2019; Xie et al., 2020). Private actors can purchase carbon or biodiversity offset credits that can be sourced from rural or peri-urban communities, including economic and environmental benefits delivered due to their urban location (Toxopeus & Polzin 2021). Further, industries and NGOs can work together to develop voluntary sustainability standards for green buildings (Egusquiza et al., 2019). Although these instruments are very innovative, they usually require high transaction costs. Moreover, differences in organizational cultures between business and community need building trust and strengthening collaboration paths (Egusquiza et al., 2019).

2.3 Summary

To critically evaluate all the intended and unintended consequences of NbS, the concept must explore holistically at different scales, temporal, spatial, and social. The delayed delivery of some benefits generates temporal mismatches regarding the timing of actions and outcomes for NbS investments. While the co-benefits of NbS are emphasized in the literature and are part of policy discourses, they are planned and implemented opportunistically, missing out on tapping the full potential of NbS. NbS placed in a market-driven economy often results in marginalized communities being deprived of green spaces due to displacement and gentrification. Many authors are advocating for an integrative and

holistic approach that promotes the involvement of various stakeholders, advocating cross-disciplinary collaboration and a shift to a socially inclusive approach.

Moreover, public funding is often insufficient to meet the urgency in investments. For large-scale projects, it often lacks high operation costs and requires capital injection from the private funds. There are new and emerging sources of financial mechanism that use different actor arrangements, each having its own weaknesses and strengths.

The chapter highlights the need to consider these interdependencies between co-creation, governance, financing, and business model design choices that were found to be crucial within the H2020 projects (Mayor et al., 2021). To demonstrate the full potential of NbS finance, future research needs to conceptualize better and integrate the trade-offs and synergies of NbS across multiple scales and systems (Egusquiza et al., 2019, Frantzeskaki, 2021, Dorst et al., 2022, Schröter et al., 2022). Yet, despite the importance of taking account of synergies and trade-offs between these goals, there is little evidence that this is happening in practice (Seddon et al., 2020).

3 Methodology

To achieve the aim of the thesis to explore the potential of co-financing urban NbS through the lens of scaling up and justice, the researcher aims to adopt an exploratory qualitative approach. The research questions are answered by following a systematic approach to unravel the various explanations and possibilities regarding the scaling up and justice of co-financing. This was done by adopting a case study approach where the qualitative case data is analyzed using the conceptual framework. Furthermore, a crucial criterion for a quality research project is to trace the knowledge produced during the research process, contributing to the research's replicability (Walliman, 2016). For this purpose, the research philosophy (Section 3.1), research design (Section 3.2), methods of data collection and analysis (Section 3.3) and ending with presenting research validity, reliability and generalizability (Section 3.4).

3.1 Research Philosophy

This research adopts a combination of interpretivism and pragmatism research philosophy answering RQ 1 and RQ 2 sequentially. Interpretative researchers study a particular topic to gain a richer and deeper understanding of the phenomena and its complexities in its unique context (Brynman, 2012). This is primarily explored through respondents' opinions and the casual relationships of their actions and reactions shaping the evolving reality (Stake, 2010; Wickenberg et al., 2022). Hence, this philosophy assisted in exploring the relationship between environmental justice outcomes and the scaling up of co-financing urban NbS. Moreover, a pragmatist, instead of favouring a philosophy, concerns themselves with application and finding solutions to problems (Creswell & Creswell, 2018). They adopt a pluralist approach to methods, techniques and procedures to suit their purpose. Thus, a pragmatist approach was favoured in deriving strategic possibilities for upscaled and just co-finance. Further, as a qualitative researcher, the author's own experiences and background affected data gathering and analysis and shaped the results and findings.

3.2 Research Design

Owing to the limited research done in the field of co-financing urban NbS and the investigative approach of the research questions, an exploratory qualitative design approach is merited (Creswell and Creswell, 2018). Further case studies were selected to provide a practical and holistic understanding of the topic. The iterative research design has been demonstrated in Figure 3-1. It includes a cyclic process of research gap, forming research questions, and their main outcomes through tailored data collection and analysis methods.

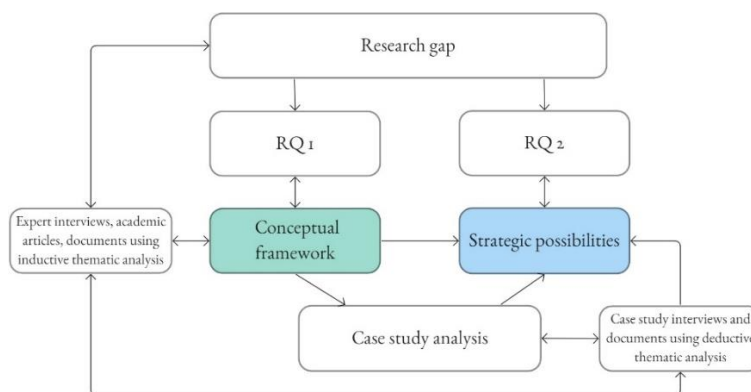


Figure 3-1: Iterative Research Design

Source: Author's own elaboration

3.2.1 Case Study Research Design

The specific qualitative approach used to achieve the exploratory aim of this study will be a case study design since this commonly is seen as an appropriate strategy to explore processes, activities or events (Creswell & Creswell, 2018). A case study design supports using various data sources, allowing for multiple perspectives and potential explanations to emerge (Yin, 2018). Case studies can help generate a holistic ‘real-world’ understanding of a complex issue (Creswell & Creswell, 2018). Moreover, case studies allow the researcher to remain flexible regarding the research design as new findings emerge, and the design structure can be adapted accordingly (Perri & Bellamy, 2012).

As noted by Yin (2014), the use of multiple cases can provide a greater spectrum of representation of social phenomena as findings and conclusions are based in a broader number of studies. The objective of this study was not to conduct a comprehensive analysis of the case projects in different cities but instead to focus on specific objectives of the research, providing a succinct yet relevant information within the research time frame. A tracing across comparative case study (CCS) design was adopted as the study was not bounded by the key notions of culture, context, place and scale but conceptualized and compared by spatial and relational aspects. The tracing approach of CCS sees it from a process orientation where the connections and explanations are based on analyzing how some situations and processes influence each other and what connects the two (Bartlett & Vavrus, 2017). Therefore, the CCS approach helps understand how the process of scaling up and justice of co-financing unfolds, which were often influenced by actors and events over time in different locations and at different scales, rather than sticking to a unit of analysis. This tracing logic helps to reveal significant and surprising results by allowing for an informal flow of information. It follows an emergent design approach, a hallmark of qualitative research (Bartlett & Vavrus, 2017).

Case study selection

In qualitative research, purposeful sampling is carried out to extend constructs and reveal new relationships to fill in the gaps and holes in the study (Ridder, 2017). This study adopts an indirect method of difference for case study selection where both similarities and differences between cases are seen (Perry and Bellamy, 2011). The contextual differences and similarities offer a rich basis for comparison and allow for a deeper understanding of how structural conditions influence the potential of collaborative financing for urban NbS. These are summarized below.

Accessibility. The first round of interviews with expert practice-based researchers was crucial in selecting case studies. They were either directly or indirectly researched on these projects and had contacts in the city, making it easier to gain first-hand information on the projects. Preference was given to projects involving private actors as financers, setting a scene to study justice and scaling up. Further, the geographical location was diverse yet bounded within the socio-political context of Europe. Europe was also selected as it has been advancing the research and innovation since over a decade, resulting in a greater level of awareness on this topic within the research and practice of NbS.

Diversity. An intentional approach was adopted to select different groups of private actors involved in different co-financing mechanisms. Site, scale, type and phases of NbS implementation were other distinct characteristics of these pilot projects. This was done with the hope of bringing different factors and conditions, highlighting contradictions and synergies of varying co-financing solutions in diverse contexts.

Table 3-1: Case Study Selection

Case	Type of NbS	Scale	Geography	Funding actors
Interpolis	Green roofs	Local-meso	Tilburg, Netherlands	Municipality, insurers
Trees AI	Urban forests, open spaces, SUDs, street trees, etc	Meso-landscape	Glasgow, UK	City, EU funds, private innovation funds, and other private actors
Adopt a Park	Neighbourhood and medium-sized parks	Meso	Nicosia, Cyprus	City comprising of nine municipalities, corporates, EU funds
BiodiverCity	Green walls, green roofs, SUDs, urban forests, etc.	Local-micro	Malmö, Sweden	Municipality, developers, real estate. National innovation agency

Source: Author's elaboration

3.3 Methods

Given the newness of the concept of NbS co-finance having a complex actor arrangement, a flexible semi-structured process of collecting and analyzing the data was adopted, which allowed the identification of new patterns. Triangulation of data sources and methods was appropriated, which is seen as suitable for case study research (Yin 2014). Based on the research questions, data collection and analysis broadly took place in two phases, a) methods for the conceptual framework (which answered RQ1) and b) methods for case study analysis. The main sources of data collection included interviews, academic literature and grey literature. Thematic analysis was the primary form of data analysis and is argued as a valuable method for examining the highlighting patterns and, themes, perspectives of different research participants and generating unexpected findings (Nowell et al., 2017), aligning well with the aim. These two phases overlapped with each other and together formed the answer for RQ2. An overview of the methods is provided in Table 3-2.

Table 3-2: Methods for Data Collection & Analysis

Phases of Research	Type of Information	Data Collection and Sources	Data Analysis
Phase 1: Developing the conceptual framework	Understanding of different aspects of urban NbS; co-financing (mechanisms, actor arrangements, business models); elements of scaling up and justice related to co-financing NbS.	Primary data – 10 expert interviews comprising of researchers and practitioners working in finance, governance, justice of NbS/GI/EbA or broader urban climate field. Secondary data - academic literature, grey literature (EU	Thematic analysis using NVivo.

		Horizon 2020 Projects ¹² , reports and policy papers from various organizations).	
Phase 2: Case study analysis	Case data from four pilot projects provided information on identifying practices, strategies and processes related to different aspects of co-financing urban NbS.	<p>Primary data – 10 case interviews comprising researchers who were directly or indirectly involved in the case study and practitioners working in the municipality (usually project leads) or a relevant stakeholder from the private sector.</p> <p>Secondary data – case policy documents, project reports, white papers, academic articles and news articles.</p>	Thematic analysis based on the conceptual framework using NVivo.

Source: Author’s elaboration

3.3.1 Methods for Data Collection

Two main sources of secondary data were academic literature and grey literature, used in phase 1: developing the conceptual framework and phase 2: case study analysis. Further, semi-structured interviews are the central element of qualitative empirical research (Yin, 2014). The questions were kept broad and general so that the participants could construct the meaning of a situation and answers were typically forged in discussions (Creswell and Creswell, 2018). An interview guide (see Appendix D) of open-ended questions was created to allow participants to freely share their views, which could further provide additional insight into new themes mentioned by the participants. To ensure anonymity, the names of interviewees were coded. A detailed list of coded interviews can be found in Appendix E.

Literature Review was performed to provide context and insights into various concepts relevant to the research topic, identify the research gap and lay a base to develop the Conceptual Framework. The data for the first phase was scattered among the literature and interviewees and collected from different governance, finance, business models, and environmental justice fields. A total of 10 expert interviews were conducted, consisting of researchers and practitioners to understand processes, informalities, vested interests, enablers and constraining factors in developing a co-financing strategy related to scaling up and justice. A search strategy using a combination of terminology, concepts, mechanisms and factors, as illustrated in Table 3-3 was adopted using one or more search engines; Google, Google Scholar and LUBsearch. An initial pre-filtering of the articles was followed by a snowballing method, ending with about 15-20 highly relevant literature pieces. This phase emphasized the research gaps and supported identifying patterns and relationships between these different concepts.

¹² European Union through EU Horizon 2020 projects is investing in nature-based solutions as a transitional pathway to a sustainable economy. Thus, information produced as an outcome of these projects such as Naturvation, Grow Green and Clever Cities, Connecting Nature, Green Surge, Nature4Cities and Think Nature were used to extract grey literature and academic publications (Maes & 4Es, 2017).

Table 3-3: Search Strategy

Terminology	Concept(s)	Factor(s)	Actor Group(s)
nature-based Solutions, ecosystem service, green blue infrastructure, ecosystem-based adaptation, disaster risk reduction, urban climate	finance, funding, business models, investments, governance	Scaling up, scalable, mainstreaming, effective, just, (social and environmental) justice, social equity, social inclusion	Communities/citizens, public/government/cities, private/market

Source: Author's elaboration

For the second phase, secondary data from project reports, white papers and even academic articles were collected to contribute general information on the case and strategic insights into scaling up and justice of co-financing solutions. To gain wider and more nuanced perspectives on the different co-financing strategies, 10 interviews with representatives from public, private sector along with researchers. Sampling was purposeful and saturation driven, done through a snowballing approach was adopted to gain further contacts for the case studies. The questions asked related to different aspects of the RQs can be viewed in the Interview Guide (as seen in Appendix D). Some questions were edited or added depending on the stakeholder being interviewed. The questions related to the governance processes of co-financing, motivation and the value that the project captured, the interaction between public and private actors (e.g., terms & conditions; contracts; sharing of responsibilities, risk & return), citizen engagement, long term financing solutions, concerns on equity and enablers and constraining factors in implementing the co-financing strategy concerning its scaling up and implications on justice. The main goal of the interviews was to identify learnings that aided in the strategy's development process as well as challenges in establishing the strategic possibilities for implementing just and upscaled co-finance of urban NbS.

3.3.2 Data Analysis

The research uses thematic analysis due to its flexibility and ease of understanding in analysing the qualitative data (Creswell & Creswell, 2018). This process involved "identification, segmentation, categorization, and summarization of the data" to capture important concepts for implementing upscaled and just co-finance of urban NbS (Creswell, 2018). Interviews were audio recorded (agreed upon by the participants) and transcribed using the software HappyScribe. The thematic analysis process involved using a computer-assisted qualitative data analysis software program called NVivo. Using this software, data was manually coded, sub-coded, and categorised in several iterative rounds both in phases 1 and 2.

In the first phase, the information from academic articles and documents was categorized and rationalized and, potential stakeholders to contact were logged into an excel spreadsheet (based on actor groups). A set of open pre-set themes were used following a broad three concepts of finance, scaling up and justice. New codes within these broad themes were allowed to emerge, making it an iterative process with data collection. A comprehensive set of analyzed data was used to produce the conceptual framework consisting of two factors and five building blocks each for scaling up and justice. The final list of codes and sub codes (or keywords) for the same can be found in Appendix F.

In phase 2, empirical data from the four case studies was examined by a 'pattern matching logic' with the codes and codes derived from the Building Blocks of scaling up and justice. The Conceptual Framework and the codes provided a structure and guidance to

systematically analyse the case studies. A conceptual framework has strengths in testing, revising and expanding by exploring constructs and relationships within distinct settings (Yin, 2014). After being compared with the empirical results, the framework was advanced through modification and extension of the previous one, where new emerging patterns and associations were inductively generated, adding to the set of existing codes and leading to a refined framework.

3.4 Research Validity, Reliability and Generalizability

Qualitative validity refers to the accuracy of the findings, while research reliability indicates the consistency in the results and the extent to which it can be reproduced under similar conditions (Creswell & Creswell, 2018). To achieve validity, specific protocols for collecting and analysing data through multiple steps was followed. In addition, triangulation through numerous data collection, which utilized interviews from different sources (practitioners working within municipalities and researchers) and the collection of academic and grey literature, was done to achieve internal validity. Further reflexivity, i.e., self-reflection on any potential bias, was observed throughout the research process. For an outsider, transparency about methods, assumptions, and the way a researcher arrives at conclusions is crucial to assess the reliability of the study. A primary strategy to attain reliability and validity was a detailed and accurate account of the methodology to achieve transferability and frequently checked for errors in the gathered data (Creswell & Creswell, 2018). In addition, codes were associated with keywords to avoid drifting in their meanings (Yin, 2018).

Moreover, the intent of this qualitative case study is not to generalize but rather to generate explanatory answers to the research questions, expanding on the conceptual framework developed by the researcher rather than gaining scientific knowledge of a specific phenomenon (Flyvberg, 2006). However, Flyvberg also argues that a strategic choice in case studies may significantly add to the generalisability of the research study. This is partly reflected while answering RQ2, where strategic possibilities for a just and upscaled co-financing of urban NbS are outlined based on the literature, case study analysis, and interviews.

4 Conceptual Framework

This chapter elaborates on the relationship between scaling up of co-finance and justice. The three key concepts - Co-Financing of Nature-based Solutions Scaling up of Co-Financing and Social Justice of Co-Financing explained in sections 4.1, 4.2, 4.3, respectively. Building blocks for scaling up and social justice related to co-finance are integrated in these sections. The chapter ends by linking all three concepts in the form of a conceptual framework, answering RQ1 (Section 4.4). The framework is based on data from academic and grey literature scattered across different disciplines and expert interviews with scholars researching NbS finance, justice, citizen engagement and business models and practitioners working in NGOs in the field of finance.

4.1 Co-Financing of Nature-based Solutions

Co-financing implies blasting through the silo thinking and looking more holistically at the various opportunities and challenges of urban NbS (Toxopeus & Polzin, 2021). Co-financing mechanisms use numerous beneficiaries of NbS to develop innovative financing mechanisms that take the plurality into account. A strong co-financing plan (in-kind or in-cash) has a diversity of relevant actors and forms an essential component and a success factor of an NbS project. It explores a variety of governance options by the diverse stakeholder groups - municipalities, developers, project managers and planners which determine what strategies, resources, and networks will be required to move the project forward financially and logistically (ICLEI, n.d). As showcased in Section 2.2.4, combining different actors' groups with other mechanisms builds on their strengths. However, the negative consequences of the partnerships must be given heed (Toxopeus & Polzin, 2021). In this research, co-financing is an approach to financing NbS in which multiple entities (across sectors, departments or actor groups) finance the same project and encompasses one or more financing mechanisms.

Synergies with NbS can be tied to transport, water, sewage, education, health services, and recreation, etc. These challenges are multi-level, multi-scale, multi-stakeholder, and multi-disciplinary. Co-financing relies strongly on the principles of adaptive and collaborative governance. They entail a flexible and learning-based collaborative approach to decision-making through the involvement of state and non-state actors, often at multiple levels, intending to adaptively negotiate and coordinate the management of social-ecological systems across different levels and scales (Schultz et al., 2015; Newton et al., 2018; Dorst et al., 2022). Subsequently, co-financing with a hybrid governance model builds resilience, facilitates learning and experimentation, enables cross scalarity and, increases participation and accountability. Multiple actors possessing different types and degrees of knowledge could engage in a reflective way to update their planning, governance, and knowledge production practice over time to address arising risks and uncertainties continuously (Toxopeus et al., 2020, Toxopeus & Polzin, 2021). However, after reviewing substantial case studies involving multi-actor arrangements to finance NbS, Toxopeus et al. (2020) observed limited collaborative and adaptive governance. This resulted mainly from a complex stakeholder landscape and silos in project management and the governmental organization, with responsibilities and budgets divided over various government agencies and departments. Moreover, it often overlooks the sensitivity to geographical and policy context, hampering tailored and possibly more effective approaches to co-financing solutions (Dorst et al., 2022).

There is a need for different approaches that provide financial and other institutionalized incentives, which support actors at many different scales and places to favour NbS (Schröter et al., 2022). An integrated approach to co-financing tries to overcome the barrier of looking

at financing as a separate domain and takes a systematic approach across organizational and jurisdictional boundaries.

Business Models

Financing in a collaborative governance arrangement requires considering the engagement of multiple stakeholders in creating, delivering and capturing the value of different benefits of NbS. However, there is a significant gap between articulating nature's value and finding stakeholders willing to pay for it, particularly in the private sector (Beatriz et al., 2021). For NbS to be cost-effective, the benefits (both in monetary and non-monetary terms) must be mapped and bundled to be captured between different stakeholders, and their contributions should be coordinated (Frantzeskaki, 2014; Kremer et al., 2015). To achieve the aforementioned remains an ongoing challenge (Beatriz et al., 2021). Business models (BM) provide an opportunity to pool and package these benefits with shared responsibilities and investments (time, resources and labour) among various government agencies, departments and other actor groups who have a stake in urban NbS development (Toxopeus et al., 2021; 1E).

The business model innovation literature distinguishes three main elements 1. value proposition (what the customer wants in the form of a marketed product or service), 2. value creation and delivery (who is required to create and deliver the value proposition, notably resources, partners, network) 3. value capture (how much it costs and how to make money, revenues and costs) (Toxopeus & Polzin, 2017; Beatriz et al., 2021). NbS business models consider the economic, social, and environmental value proposition.

“And I often tell people you might say that you have the best project for the most impactful climate action, but if you do not have the business model behind it, you're not going to get any private investors to get out of bed for it if it's not at the scale that they need” (6EC).

However, while business models solve the primary challenge surrounding the uptake of finance by matching commitment from heterogeneous urban constituents to different benefits of NbS, there are several challenges yet to be resolved (Toxopeus & Polzin, 2017). Business models in the literature have not yet advanced to a stage where it can cover the long-term financing NbS demands (Mayor et al., 2021). *“We need better financial models to support the long-term maintenance of this nature. This has been a key issue for us” (11E).* There is a challenge in quantifying the widely accepted (co) benefits in economic terms and a lack of coordinated knowledge transfer (Toxopeus & Polzin, 2021; 1E; 3E; 5E). On the other hand, they currently lack an understanding of the power struggles that are likely to occur in a cooperative financial arrangement. Furthermore, a lack of widely accepted social and environmental impact indicators to measure their performance is currently missing (3E, 11E; 15E). These factors can hinder the development of a well-defined business model (Toxopeus & Polzin, 2017; Beatriz et al., 2021).

4.2 Scaling up of Co-Financing

While co-finance increases the share of investments, there is a gap in issues concerning mobilization and continuity of the flow of investments. Various authoritative sources, including IUCN, have identified the gap. There is a further need to move from a small-scale random act of kindness of financing NbS to prioritizing scales for which NbS has measurable impacts (Nelson et al., 2022).

“Experience to date with private finance for nature suggests that, while there have been successes, the overall investment volumes have been small, adequate returns have not always been achieved, and the knowledge required to build scalable investment products is dispersed” – Elmedina Krilasevic, Programme Manager, IUCN (IUCN, n.d).

The term scaling up of finance has been used by organizations such as OECD (Organisation for Economic Co-operation and Development), IDB (Inter-American Development Bank) and UNCTAD (United Nations Conference on Trade and Development) for broader adaptation finance. IDB (2021) uses the term ‘scaling up’ of NbS investment where larger-scale investments are made and point out that over half the NbS projects in Latin America are still in their preparation stage and are seeking funds to scale up operations. As mentioned, some of the critical barriers relating to scaling or amplifying NbS financing and business models are sustained pressure on public sector funding and competing funds with other public services such as health or education. There is low level of interest from financial institutions due to either lack of awareness or lack of suitable projects where the scale is too small. Additionally, there is a lack of knowledge of co-benefits of NbS in other departments, lack of planning for long term costs (as NbS appreciates rather than depreciates over time) and lastly maintenance and monitoring of NbS more complex than grey infrastructure (2E; 4E; 6EC). Achieving scaling up of co-finance may entail mainstreaming them at different spatial, temporal, jurisdictional, institutional, and management levels, whilst simultaneously expanding networks and knowledge (Fastenrath et al., 2020; 4E). This requires acting on external factors such as regulatory frameworks, standards, political strategies, creating evidence, business models, and the societal acceptance of these solutions (Frantzeskaki et al., 2019; Cortinovis et al., 2022; 6EC). Based on the literature review and talking to different experts the author came up with her interpretation of scaling NbS co-finance, which is presented by formulating it into two factors - mobilization of funds and continuity of financing.

Mobilization. To attain the scaling up of co-finance, funding needs to be mobilized. Similar to scaling up NbS does not require ‘a one-size-fits-all’ approach (Cash et al, 2006, Dorst et al., 2019). The idea here is to increase the share of funding in a given economic, socio-political and cultural context. Most NbS are financed through grants, therefore, missing out the potential of private investments and lacking financial security. Infrastructure service providers and investors need to demonstrate more strategic support for NbS investments to mobilize funding and unlock investments at all governments. These stakeholders can leverage a wealth of existing knowledge and develop processes to integrate NbS within policies to create a long-term flow of investments (IDB, 2021).

Continuity. Co-financing greening initiatives involves experimenting with different forms of governance where the discussion often revolves around continuity issues (16EC). There is a perceived discontinuity arising due to the conflict between the short-term actions of the municipality not matching the long-term requirements or goals of the whole life-cycle of the project (planning, implementation, maintenance processes) (Kabisch et al., 2016; Sekulova & Anguelovski, 2017). *“In terms of acquiring finance for NbS, the capital cost is not difficult to cover. The most tricky part is how to cover the operation and maintenance cost so the project is self-sufficient in terms of finance” (15E).* Cities often lack the budget and capacity for green development and subsequent maintenance. *“I would say in the majority of the cities, the number one inhibiting factor is that they don't have the budget for maintenance” (6EC).* This is not given enough thought and attention (Kabisch et al., 2016; Toxopeus & Polzin, 2021; Mayor et al., 2021; Dorst et al., 2022, Schröter et al., 2022).

4.2.1 Building Blocks for Scaling up of Co-Finance

Building upon the two factors, the author has identified five key building blocks to realize the scaling up of NbS co-finance. These building blocks - are innovative partnerships, multi-scalar action, strategic political vision, incentive-based mechanism and evidence-based investments. For each of the building blocks a set of keywords which are later used as sub codes for data analysis of the case studies are derived.

Innovative Partnerships (S1)

Partnerships are recognized as one of the most frequent enablers in the literature to increase the share of finance and play a key role in conceiving the multiple co-benefits of NbS (Nesshöver et al., 2017). Partnerships among stakeholders and organizations occur at various levels (vertical cooperation) as well as from the same level (horizontal cooperation) (Ershad Sarabi et al., 2019; Mayor et al., 2021).

Private sector partnerships are undoubtedly considered a viable investment and are seen as an essential element for scaling financing for urban NbS. Innovation finance talks about the strategic interplay between public-private actors to share the risks and gains of innovation (Toxopeus & Polzin, 2021). Although for this partnership to be effective, drivers and barriers related to procurement should be addressed and explicit attention must be given to the transaction costs (7E; 11E; 15E). Moreover, actors such as real estate firms, businesses, investors, developers, and insurance companies can create a market and increase the resilience of commercial activities (6EC; 15E; 3E). Further investments can also be in the form of labour, time, land and other resources. Here, educational institutions, churches, and communities can create access to new revenue sources where these green interventions contribute to reputation and purpose (UNEP, 2022; 5E). Moreover, NbS maintenance is especially problematic given that NbS are 'living' and growing interventions, which implies they rely on a different maintenance and management approach than grey urban infrastructure solutions (Dorst et al., 2022; 1E). This can involve local companies from various sectors like construction or gardening (3E; 15E).

In addition, governance architecture between national and city levels is crucial to get access to finance (3E; 11E). The lack of municipal resources for urban NbS implementation, maintenance and management sometimes results from austerity measures at the national level (Toxopeus & Polzin, 2021). Many interviewees expressed that the cities (especially smaller cities) have trouble accessing funding from multilateral development banks such as World Bank, ADB, etc., since they need to go through the national government. On the other hand, if the federal government collaborates well with their cities, they can play a crucial role in supporting the local governments to acquire access to funds (11E, 3E). Thus, horizontal and vertical innovative partnerships allow for mobilizing and continuous flow of funds and is essential for systematic scaling of investments in NbS.

Key words: horizontal and vertical levels of partnerships, procurement, tendering process, transaction costs, governance architecture.

Multi-scalar Action (S2)

Municipality budgets represent a lion's share in the investment of NbS. One of the main challenges of private sector is the small scale of the projects in terms of budget. Private investors, international organizations, and other institutions are looking for massive landscape-level projects based on return on investments (Egusquiza et al., 2019; Seddon et al., 2020; Toxopeus & Polzin, 2021; Mayor et al., 2021; Cortinovis et al., 2022). However,

NbS projects, such as street trees, small parks, in a dense urban environment do not have the scale in terms of size and investment (7E). *“One of the controversial things when it comes to urban NbS financing is scale”* (6EC). Big donors such as insurance companies, pension funds, and multinational companies want to invest in large scale projects involving an investment of 50-100 million EUR (1E; 6EC; 7E; 8E; 9EC). Individual NbS projects (often less than 5 million EUR) is too small for private sector investors (Mayor et al., 2021). Many expert interviews suggest that a portfolio of bundled projects of multiple NbS interventions might be needed to secure huge investments. This can increase the size of the projects and lead to economies of scale to make it financially and operationally feasible. Pooling of projects would then require a multi-level governance structure at a landscape level among diverse actors (Schröter et al., 2022).

The private sector is only a part of the answer. There is a strong need for financial models to prioritize national and global investments to implement NbS (Nelson et al., 2020, Barquet et al., 2021; 15E). *“Whether it is the city, the national government or any other entity implementing NbS, there has to be more commitment towards building scale into their projects”* (15E). Multi-scalar action extends beyond spatial scales and includes social, temporal, political and ecological scales. There seems to be a mismatch in the delivery of some of the NbS (co)benefits, with the temporality aspect negatively affecting mobilizing and continuity of funds. Decision-making through the involvement of state and non-state actors aims to negotiate and coordinate the management of social-ecological systems across multiple levels and scales (Schultz et al., 2015; Newton et al., 2018; Dorst et al., 2022). This is especially true in a dense urban city where the social scale of impact outweighs impact's economic and environmental sale (7E). Thus, to critically evaluate all the intended and unintended consequences of NbS, the concept must explore holistically at different scales, temporal, spatial, social, etc. (Dorst et al., 2019; EC, 2021).

Key words: *economies of scale, multi-level governance structure, matching scale.*

Strategic Political Vision (S3)

This concept concerns itself with the visions, strategies, and policy guides to urban regeneration among a broad range of stakeholders. Deliberate strategic approaches provide as an essential prerequisite to set the scene and ensure the scaling up of NbS investments. For example, policy ambitions around climate mitigation and adaptation, circular economy, sustainable housing and mobility agendas have economic regeneration properties and are likely to receive significant investment. *“These solutions have the potential to solve multi-faceted urban sustainability challenges. It's not just about biodiversity, climate change, or green jobs, it's about all of that together. This understanding how a NbS can meet economic, social and environmental values is very new for the cities”* (6EC).

By highlighting the synergies of these urban agendas with NbS, additional investment could be unlocked (Xie et al., 2020; 4E; 3E; 6EC). Interviewee (6EC) discussed the importance of internal and external co-creation¹³ and alignment to seek strategic decisions and to ensure long term success. *“And to capitalise on these synergistic opportunities, you bring different actors representing these different domains together to talk about solutions. There is a big opportunity there and this shouldn't happen at city scale but also at larger institutional scale. One of the first things that we did during the workshop was mapped the (co) benefits of NbS to match it with the goals of the city. The long winded*

¹³ Co-creation is a the practice of collaborating with other stakeholders to guide the design process.

internal co creation process helps in identifying how NbS can fit not only within the strategic goals of the city but even beyond, UN SDGs and other major international, European and national strategies” (6EC).

Further through strategic and creative thinking, total project cost can be reduced through increased overall project efficiency by taking a lifecycle approach that integrates design and construction with operations and maintenance (6EC, 2E, 4E). This can be achieved by reducing resource consumption and using or leveraging existing assets, such as by leasing or selling them to the private/community sector. For example, brownfield recycling or areas of low land value (usually located in low-income neighbourhoods) are fragmented and can provide an opportunity for pocket garden, community gardens, etc. Paired with the right set of regulations such as rent controls or measures to maintain housing prices (to prevent gentrification), this approach provides as close to free, unencumbered funding as possible with no repayment obligations and offer multiple co-benefits for the local communities (Kim, 2016; Xie et al., 2020; 4E; 2E).

Key words: *strategic visions, strategies, and policy guides, synergies, internal and external co-creation*

Incentive-based Mechanism (S4)

Incentive-based mechanism can be a successful way for municipal level government to leverage funding. A lot of companies (and cities) are putting net zero targets. This money instead of being used for planting forests remotely can be invested closer to the cities. From a reputation and publicity point of view, it could be more attractive and have a wider level of impact (2E; 4E). In places such as Sweden where market demand was identified to be high, companies in particular construction companies, valued ‘green reputations’ as a reason to engage with NbS implementation (Dorst et al., 2022; 4E). The use of social impact bonds can also present an opportunity to unlock a large pool of funds from philanthropic organizations, foundations, and other non-profit entities. They can also help to tap into the large cash reserve held by major corporations currently sitting on the sidelines. Further, green bonds issued by municipalities, are often bought by big investors who are seeking to include green criteria in their portfolio are another great approach finance NbS (9EC). Many countries have passed a legislation which requires large companies to spend a small percentage of their annual profits on corporate social responsibility (Kim, 2016). Significant investments can be unleashed from these socially responsible investors, using CSR as a financial incentive (Egusquiza et al., 2019; 6EC; 4E). Moreover, for the cities, an incentive to brand themselves as green and stand out against their peers is huge (2E). NbS can increase the attractiveness of the city and incentivize investments by businesses, therefore creating a market demand. The municipality government can set incentives ranging from labels, standards, tax reforms, certification schemes should be incorporated into both public procurement and corporate procurement practices which cover the three phases (Dorst et al., 2022; 2E, 11E; 6EC). Standardization of these incentives are recommended to make it easier for actors such as real estate owners and developers to make use of public incentives for their investment decisions (Toxopeus & Polzin, 2021). For example, to drive wetland protection, municipality can develop a policy standard which required developers to replace lost wetland to a new site. Further building codes can play an essential role in green building construction in new construction as well activities involving their retrofitting.

Key words: *branding, reputation, legal, standards, codes*

Evidence-based Investments (S5)

A precondition for an efficient provision of any type of NbS finance is that benefits exceed costs. Evidence of the performance of NbS requires an understanding of ecological

production functions and their uncertainties and include benefits that typically accrue over longer time horizons over conventional solutions (Nelson et al., 2020). *“For private investors, there’s a variety of funding mechanisms that they can be involved in, but they need a certainty about the performance. The projects need to be bankable”* (5E).

While there is growing research being carried out in this field it can be surpassed by giving the co-benefits of NbS more publicity through advertising and more visualization on this information (1E). Collecting and communicating evidence on the (co) benefits and return on investments is critical to build credibility for NbS and gain the necessary financial and political support (IDB, 2021). The development and analysis of evidence, data sets and valuation tools are crucial to improve the social and environmental assessment of urban NbS and subsequently encourage investment especially in a dense city with high opportunity costs (Nelson et al., 2020; Xie et al., 2020; 7E). Recently, plenty of business models tools have been developed in different EU projects which can be used to map the (co) benefits and subsequently the actors that can be engaged in the process of measuring performance. Insurance sector could act as a key stakeholder in this setting in developing and applying valuation metrics and evidence for the benefits of urban nature in creating climate resilience value. In doing so, they could better protect their portfolio against the risks of climate change (Kaiser, 2019; Xie et al., 2020). Another important actor are utility companies. In the UK, for example, there have been a lot of progress and push from the water companies to adopt constructive wetlands to decrease their overall operational costs (1E).

Key words: performance, bankable projects, communication, credibility, valuation

4.3 Social Justice of Co-Financing

While urban NbS aim to tackle several sustainability goals, questions around how ‘just’ NbS¹⁴ planning, implementing and maintenance lacks attention (Toxopeus et al., 2020; Cousins et al., 2021). Nature is redefined, reimagined and re articulated through privatization and beautification without addressing the systematic inequalities (Kotsila et al., 2020; Toxopeus et al., 2020, 2E, 18E). Private businesses (such as housing associations, investors or developers with whom municipality enters a contractual agreement or a partnership to co-finance a greening intervention can act as a potential barrier to implement a just and effective NbS (Kabisch et al 2016; Kotsila et al., 2020). Most often than not projects around green urban renewal and revitalization are intended as market driven strategies of increased real estate prices catering to high-income residents (Anguelovski, 2015; Toxopeus et al, 2020). Typical examples of these inequitable strategies can be found in waterfront developments in former harbour or industrial areas in many European and US cities (Haase et al., 2017). Lower-income and homeless people in these instances are threatened by displacement, exacerbating social exclusion (Anguelovski et al. 2018). Privately developed urban green spaces, with controlled access and high entry fees, are now becoming commonplace (EC 2021). The operationalization of these NbS is driven by a neo liberal agenda since the beginning, stemming from so called growth obsession (Sekulova & Anguelovski, 2017) and do not have do not have inclusiveness as a core component (Haase et al., 2017). The distribution of benefits and power (between gender, ethnic and cultural groups) and citizen participation in urban greening initiatives have thus far received little attention in the literature (Brink et al.

¹⁴ Just NbS is defined as “harnessing nature to social, political, and economic drivers of spatial inequality and environmental degradation into opportunities to create progressive, cohesive, antiracist, and socio-ecological sustainable communities” (Cousins, 2021, p.6).

2016; Sekulova & Anguelovski, 2017). On the other hand, there are plenty of examples in the literature where NbS financing through the involvement of different actors, more specifically the private sector has led to wider societal benefits and generated a positive socio-economic impact. Depending on the financing mechanism and consequently the multistakeholder arrangement, the community and neighbourhoods might either welcome or contest the greening intervention (Sekulova & Anguelovski, 2017; Toxopeus et al., 2020). However, it becomes critical to explore the possible tradeoffs as there might be a mismatch between immediate effects of co-financing and the long-term social justice outcomes (Cash et al., 2006; Toxopeus et al., 2020).

Based on the issues described above, the author has pinned two main factors – equity and social inclusion, which are essential elements to ensure social justice (Nelson et al., 2020). These two factors are closely inter-related to each other. An understanding of equity and social inclusion for NbS requires exploration of both intended and unintended consequences relating to how impacts are distributed, experienced, understood and negotiated (Anguelovski et al., 2018; Barquet et al., 2021).

Equity. Equity is a systematic issue (15E) which requires an understanding why and how such interventions came about, including the negotiation processes taking place prior and during the implementation (15E). The risk of potential urban injustices due to greening interventions is connected to conflicting interests of different actors (Toxopeus et al., 2020). Certainly, increasing climate resilience and environmental quality, while also providing opportunities for relaxation, cultural enrichment and social cohesion, are all potential benefits of NbS. The more those adhere to principles of equity and justice (outlined in *Section 1.1.1*), the more likely they are to also enhance social and environmental justice in cities (Kotsila et al., 2020; Toxopeus et al., 2020; 15E). This becomes relevant for NbS financing as different benefits maybe reaped by different actors favouring the neoliberal mentality and has received very little attention the literature. An understanding and explicitly recognizing of these tradeoffs of who will be the winners and losers and how will they be affected is crucial early in the process of co-financing. Further, NbS initiatives in cities need to ask critical questions by whom and for whom this is being realized (Anguelovski et al., 2018; Kotsila et al., 2020; van der Jagt et al., 2021). *“Explicit recognition of these trade-offs empowers cities to then further plan for processes to protect vulnerable and low-income people’s interests and enhance their well-being, as they are often the one’s at most risk” (6EC).* The end goal is to achieve equitable benefits for the disadvantaged and marginalized people within efforts to mainstream NbS in cities (Xie et al., 2020).

Social inclusion. A broad goal of social inclusion and participation to build social resilience (Nelson et al., 2020). For participative modes of governance, the varying wants and needs of the population are considered (Raworth et al., 2014; Kabisch et al. 2016; Raymond et al., 2017; 7E; 5E). Critically, vulnerable and marginalized communities are the ones in greatest need of health and social well-being offered by these spaces. Unfortunately, their voices are least heard in the decision-making process and/or lacking resources to access these spaces (Seddon et al., 2020). Power issues and contestations have to be addressed with a pro-active, conflict resolution approach (Schröter et al., 2022) which becomes more critical in co-financing schemes. This can be achieved through equitable co-designing process requiring the active engagement and participation of communities (Barquet et al., 2021). However, there needs to be a genuine policy and political commitment to realize the goals of social inclusion (15E).

4.3.1 Building Blocks for Social Justice of Co-Finance

Delineating from the two factors of equity and social inclusion, the author has identified five building blocks to achieve positive social justice outcomes for co-financing NbS - inclusive and local governance, incentives for public participation, social co-benefits, distribution of benefits and power and quality green jobs. For each of the building blocks a set of keywords which are later used as sub codes for data analysis of the case studies are derived.

Inclusive and Local Governance (J1)

Inclusive and local governance increase the participatory space and promotes ownership of these decision-making processes. However, processes to better embed NbS to political and power systems for a deliberate inclusive process are experienced as difficult, contested, or insufficiently prioritized and comes with its own challenges (Eggermont et al., 2015; Kabisch et al., 2016; Nesshover et al., 2017; Hasse et al., 2017, 6EC).

Cities, especially in South Europe find it difficult to engage citizens, owing to the relatively limited experience with citizen engagement as part of urban NbS development (although variations between cities and city districts were observed). One of the explanations for this is the lack of environmental awareness leading to unrealistic expectations (Raworth et al., 2014; Toxopeus & Polzin, 2021). In addition, there is limited funding availability to support these processes, limited incentives for the public to participate and few assurances that doing so will lead to tangible results (Toxopeus & Polzin, 2021; Dorst et al., 2022). In the context of new buildings there are no residents to engage with in the development stage which makes it even more challenging (Wickenberg et al., 2022; 16EC). These critiques are important to address, else there is a risk that policy makers will try to avoid participatory processes (Armstrong, 2020). Developing participatory methodologies, investing in capacity building and education about greening initiative can help fighting these challenges (Raworth et al., 2014).

Furthermore, there needs to a political commitment to social inclusion within NbS where policy priorities are aligned for the two to ensure that existing inequalities are understood, and a meaningful attempt is made to address (Xie et al., 2020). An effective local and inclusive governance a strategy needs to link participation with the required formal decision-making processes and instruments at an early stage (Dorst et al., 2022). Carefully designed and implemented laws, policies, processes, planning documents and guidance can facilitate community action and address context specific inequities such as based on gender, ethnicity, disability, age, location and income (Xie et al., 2020, IPCC, 2022, 18E). Interestingly, inclusive and local governance by supporting activities related to raising awareness of the local community as well as creation of multifunctional space is considered one of the key strategies to increase the investments (Toxopeus & Polzin 2021).

Keywords: *participation, stakeholder engagement, awareness, political and policy commitment*

Incentives for Public Participation (J2)

Participation is a central element to ensure social justice (Nelson et al., 2020). A broad goal of participation is essential to build social resilience and to increase public acceptance. Community participation in relation to NbS can involve local-level environmental stewardship and volunteering generating overall public acceptance (Jerome et al., 2017; 7E; 12EC). Furthermore, involving the communities is not just about balancing interest but considering them a possible source of investment to fund investment in a resource-deplete

public sector (Toxopeus & Polzin, 2021; 2E, 4E). Examples of different sources of community finance is detailed out in Section 2.2.4.

A series of push and pull factors can be identified to engage communities and understand the motivating factors to do so. These activities can enhance the experience of living in a particular location by contributing to perceived benefits e.g., better quality of life psychological and spiritual benefits, improved health and wellbeing and, economic benefits from environmental stewardship. In addition, there is an increase in social values between the volunteers which results in in the production of social capital and pride (Wolch et al., 2014; Nelson et al., 2017; Jerome et al., 2017). Another driver is the role played by design and aesthetics in how green infrastructure is perceived¹⁵. Interestingly, the proximity of the space rather than the size and the ways in which a space responded to communal needs played an important role in incentivizing participation. Smaller NbS sites implemented in proximity to where people live/work play an important role in reducing levels of stress in individuals than larger sites increasing the overall acceptance of the project (Jerome et al., 2017). Besides, volunteering activities can contribute to support state or private funding for NbS is becoming increasingly significant.

Exploration of financial and other institutionalized incentives and strategies for integrated participation processes could be an interesting way forward by harnessing the dynamics and reinforcing the benefits of local change. Raworth et al (2014) stresses on understanding the stranded assets, job creation and losses, induced migration and their associated opportunities and threats. This requires firstly understanding the land use plan of the city to facilitate community-based actions. Maps, survey that identify the presence or absence of green and open spaces are produced by municipal governments but not acted upon due to lack of funding. These when shared with the communities and local groups can provide incentives to raise funds and act upon it by using this evidence to improve their own localities (Xie et al., 2020; 6EC). *“It's not just communities but also entrepreneurs that could do generate funds by applying for grants or through crowdfunding schemes to create and maintain a community garden”* (2E). The design of locally-led business models, together with suitable governance models, could be a step towards this goal but knowledge on the actual implementation in this respect is still in its early stages (Raworth et al., 2014; Schröter et al., 2022).

Keywords: *acceptance, ownership, perceptions, volunteering, financial and other institutionalized incentives, stewardship, socially led business models.*

Social Co - benefits (J3)

NbS in densely packed high concentrated cities tend to have more societal goals than environmental (6EC, 11E, 3E). *“NbS has the potential to advance social justice just because it brings so many societal benefits that go beyond the infrastructure services of flood protection or carbon sequestration and provide advantage communities with other health and social benefits”* (5E). They have strong co-benefits with development goals such as mental and physical health and well-being, education, poverty alleviation, gender inclusion and food security. These interventions when combined with physical activities such as walking and cycling in urban parks, growing food in allotments and community gardens or enjoying the birds, insects become ‘effective, accessible and affordabale’ (Vujcic et al. 2017). They provide an opportunity to align with

¹⁵ Mårtensson et al. (2014) found that ‘settings with a mix of green and built elements in proximity to buildings are well-used’

social justice outcomes by addressing underlying inequalities through social inclusion (Anguelovski et al. 2018; 5E; 11E). For example, higher air quality will have a higher positive impact on vulnerable people as they are more likely to be exposed to them (3E).

Even though public health and social benefits are recognised and acknowledged as one of many co-benefits of urban nature-based solutions, yet these solutions are rarely implemented for this purpose. *“There needs to be a strategic perspective from the beginning to map out the societal goals being achieved from the intervention”* (5E). Introducing visions, strategies and authoritative guides can increase awareness and create partnership among a broad range of stakeholders (Xie et al., 2020). As benefits from nature regarding physical and mental health are studied and understood better, funding from the public health budget, public security/police budgets can be generated. *The social domain of the municipality has the potential and opportunity to invest some money in supporting green space initiatives with a particular focus on health and crime and supporting vulnerable communities* (2E). However, not all possible forms of co-benefits can be assessed and measured straightforwardly. Aspects such as quality of life or reduced stress levels are much harder to measure. Another barrier, for instance, for health care providers is the idea of causality and having a strong evidence base for it (8E).

The value of NbS can be rethought from a cultural perspective as well. *“So, it all depends on if, let's say the Ministry of Culture and Education figure out that these are the places where you could create more social cohesion and collaborative culture or if you figure out frequent exposure to urban garden and green areas contributes strongly to public health or lowering or spiritual diseases. In that sense, scaling up NbS finance can be just and could take place through reorienting and rethinking public budgets from grey infrastructure expansion”* (18E).

Keywords: *multiple social and health benefits, targeted investments, strategic perspective*

Distribution of Benefits and Power (J4)

Just distribution of benefits and power to avoid economic and non-economic losses can be a key to achieving transformational change (Barquet et al., 2021). To enact social transformations, NbS financiers must acknowledge nature as a site of power which, depending on how it is financed and governed, can produce uneven distribution of opportunities and risk (Pelling et al., 2015). These realities stem from ensuring an investment alignment with the distributional outcome in space and time (Toxopeus & Polzin, 2021). The alignment calls for increased participation to capture the multi-dimensionality of values and distributional considerations for a just and green transition (Nelson et al., 2020; Seddon et al., 2020). From the beginning, it should be clear and transparent how the distribution is taking place regarding who gains, who pays, which areas benefit concerning space and time, and what the trade-offs from NbS interventions might be (Hanson et al. 2020). However, it should be read with an overarching assumption that even the ones with good intentions can lead to unexpected tradeoffs and thereby hinder a just transformation (15E, 6EC).

Policy mechanisms such as mixed social housing to prevent segregation or rent controls/ceilings for home and land prices are vital to avoid the financialization of assets, prevent gentrification where the land prices become expensive and anti-displacement measures in turn protect the local community (4E, 5E). A distinct and effective strategy could be to introduce small green spaces everywhere, and there is potential to do this as part of regularization or urban revival in different areas (18E). This is easier to implement in the post-socialist cities as there is quite a lot of vacant unused land. In the densely built-up cities, there is quite a resource of vacant land, e.g., near the railways tracks, which can be used to recreate green spaces and green and blue infrastructure (4E). Stockholm is a good example of

a city which ensures that green and blue spaces or improve the attractiveness of green spaces in residential areas are everywhere in the city equally distributed even to those who may not have enough financial or social any kind of means to demand green spaces for themselves (4E). Another area to explore is to target low land values such as brownfield development. Hybrid NbS, small pocket gardens, can be created in areas with little or no green space, thus increasing the associated health and well-being benefits of being close or with nature (Xie et al., 2020). Therefore, a tactical spatial distribution promotes a patchwork of green spaces in the city with the logic that if green spaces are equally available and distributed to everyone, then there is no such incentive for gentrification to occur¹⁶ (4E, 5E, 18E).

To address the unjust distributional effects of NbS, working across scales and domains beyond traditional actors is required. This further provides an opportunity to for capacity building to improve coordination across silos (Schröter et al., 2022). Here the expertise of scientists, practitioners, civic society activists and NGOs is required (Hasse et al., 2017). This multi-scalar stakeholder engagement approach balances the differing interests and reconciles at governance levels through enhanced consideration of actors' interests, discourses, resources and perceptions. NbS initiatives sometimes work with intermediaries or gatekeepers to build capacity and engagement on the local scale by bringing different actors together (Armstrong, 2020; Xie et al, 2020; 6EC). It is essential to be aware that gatekeepers can also be selective and contribute to a pattern of exclusion (Toxopeus et al., 2020). These new strategic system level partnerships should be mobilized early on to ensure social inclusion (Xie et al., 2020).

Key words: *exploration of trade-offs, investor alignment, policy measures, spatial distribution, stakeholder engagement*

Quality Green Jobs (J5)

NbS can provide opportunities for local jobs and practical skills development, particularly for citizens who are long-term unemployed, low skilled and/or suffer mental health problems (Xie et al., 2020). Urban renewal can increase the confidence of businesses to invest in such an area, leading to new economic opportunities and entrepreneurial activity e.g., from tourism. *"If you can attract more business, more highly skilled workers, more tourists, that also has ripple effect to other parts of the city"* (2E). On a meso level, cities can become attractive places to live and work. At the micro-level, economic regeneration is about the improvement of the socio-economic situations of individual citizens through 'creating places in which people want to live and work' (Forest Research, 2020).

This principle is relevant to justice and securing more finance as *"it is often sexier to say that the project is creating jobs rather it is reducing emissions, it is an easier sell it to a politician and to secure public funds"* (15E). It also helps to helps to bring in the community buy-in and makes it easier to engage the locals which is crucial to maintain long-term projects (3E). Further, opportunities can be identified throughout lifecycles to optimize job creation, such as in maintenance jobs (Raworth et al., 2014). *"This financial buffer of creating and accessing better and higher paying jobs helps citizens to improve their quality of life and in turn, be involved and committed to maintaining green interventions"* (15E). Cities can promote and dedicate programs for skills upgrading and decent work to increase the likelihood of opportunities in the informal sector and, as such co-

¹⁶ Although this is not possible on a macro scale. If there is a large forest on one side of the city, it's impossible to ensure that everyone else will have a similar large forest

benefits jobs (Raworth et al., 2014). Thus, creating an inclusive economy and green jobs leads to more employment opportunities and is critical to achieving a more equitable future.

Key words: *local jobs, economic opportunities, economic regeneration, buy-in, maintenance jobs, upskilling*

4.4 Understanding Co-financing in relation to Scaling up and Justice

The equation between justice and the scaling up NbS co-financing is complex. One of the major conflicts to attain a just and scaled up funding mechanism stem from the so-called ‘growth obsession’. There is an urgent need to amplify the investments in nature resolutions. One approach with high potential is diversifying the funding actors through co-financing. Along with the mobilization of investments, a long-term supply of funds is essential for successful delivery of these living green interventions. Attaining the scaling up of NbS co-finance through mobilizing more funds from different actor groups can lead to more comprehensive societal benefits and have a positive socio-economic impact. However, recent research has shown that municipalities are harnessing NbS through real estate developments to rejuvenate derelict areas without addressing the deeper issues associated with land use urban development, reinforcing social exclusion and inequitable distribution of risks and benefits (Sekulova et al., 2021). While the recent literature has started looking at systematic barriers to financing (Egusquiza et al., 2019, Sarabi et al., 2020), they tend to overlook the sensitivity to the social, cultural, geographical and policy context, hindering a tailored and an effective approach at a financial solution (Fastenrath et al. 2020; Dorst et al., 2022).

Private investment tends to increase the scale of finance. However, such acts were often compensated by having more leverage and power in decision-making as per NbS design, implementation, and siting. There are plenty of examples in the literature and from various case studies where co-financed NbS projects have favoured white higher-income neighbourhoods. Further, all the interviewees expressed this concern. *“NbS provides a great opportunity to battle against the climate problem, yet it worries me this promising concept is likely to be hijacked into the mainstream capitalist working of the society and then we lose the fundamental essence of it”* (3E). Although many also provided room for interesting discussions such as the use of financial mechanisms like impact investment, social bonds, green bonds and CSR funds are ways to assure a just and scaled up investment (1E; 3E; 9EC; 15E). It remains unclear if increase in the size of investments is considering the intersectional social justice perspectives and yet it has received very little attention in the literature (Nelson et al., 2020; Seddon et al., 2020; Toxopeus et al., 2020; Fastenrath et al. 2020; Toxopeus & Polzin, 2021; Sekulova et al., 2021).

Based on this premise, the author attempts to develop a tripartite model involving public, private and community actors (Toxopeus et al., 2020) for a just and upscaled co-financing of urban NbS, as presented in Figure 4-1. The strength of this model is that it captures the synergies and tries to balance the trade-offs of NbS co-finance. It presents a holistic and systematic approach to urban NbS financing, characterised by collaboration among diverse societal groups with different expertise and assigning them roles. If not done successfully, it poses the risk that no single stakeholder group feels responsible for championing NbS, which limits their uptake in urban development (Toxopeus et al., 2021). The model opens the door for creative reasoning and demands a forward-thinking approach from the urban actors.

Role of Public, Private and Community Actors

Private actors. The lack of public funding for urban NbS makes the entry of private investors attractive and sometimes even unavoidable (Koppenjan and Enserink 2009). They allow for better risk sharing and embody faster and efficient delivery of public services, creating better incentives for the customers or citizens in the case of NbS (Toxopeus & Polzin, 2021). However, private actors such as businesses, housing associations, investors or developers with whom the municipality enters into a contractual agreement or partnerships to raise funds are motivated by market-driven strategies. They may create constraints for a just and practical implementation for NbS. Researchers are questioning the appropriateness of these public partnerships for financing NbS. *“I think this is partly why financial impact analysis and modelling become decisive in private sector investment in NbS. They need to be motivated differently. For example, financial institutions need to start looking at the resilience impact of NbS, assessing several risks arising from it” (15E).*

Community actors. Involvement and engagement with community actors can balance the interest of market players through representatives of disadvantaged groups. Here the expertise of scientists, practitioners, and civic society activists and NGOs is required (Hasse et al., 2017). Collaboration with civil society (NGOs, citizen groups), increases participation and democracy in urban nature and sustainability politics (Haase et al., 2017; Anguelovski, 2018) through formulating dialogues with the local and marginalized communities. Actively involving the community in the governance of financing NbS allows for a more equitable allocation of benefits resulting in a just NbS (Egusquiza et al., 2019; Toxopeus et al., 2020; Cousins, 2021). They can be potentially considered a financier, but more importantly, civic contestations become key to providing new sources of knowledge (Sekulova et al., 2021). Even if public funding is potentially available, NbS often represent local public goods, involving citizens increasing the willingness to pay e.g through taxation (Toxopeus & Polzin, 2021). Although, practitioners from three cases reported that the process of meaningful citizen engagement is very lengthy and time-consuming. Through building awareness and communication, this twisted problem can be overcome (4E, 2E).

“As it might be unrealistic for community owners to finance NbS projects, it could be unrealistic for private actors to have their main motivation as justice. Real estate companies, banks, insurance companies, or businesses have their own agendas towards biodiversity. It's linked to their physical risk. For the real estate companies, it's an argument to build and then sell. And this again is tied to its aesthetic pleasure like having some trees around or having a beautiful view or proximity to the park or the sea. If they implement green roofs, for example, they would view it as their selling point” (4E).

Public actors. A quasi-market structure¹⁷ requires active government involvement and public control to ensure efficient delivery of public goods (Toxopeus & Polzin, 2021). In this model, the municipality government plays a crucial role and is imagined to have the last say among different actors. They can be seen as the balancing force in the room to ensure justice outcomes in a co-financing arrangement (Sekulova et al., 2021). Public administration can use different regulatory and market incentives to mobilize funds from the private sector. They are responsible to and to pay back the sunk costs to the investors and safeguarding social welfare through the involvement of community actors. Further, they are official representatives and should keep the public's best interests at heart to secure that the benefits

¹⁷ Market where the public sector opens its service production to other actors departing from a hierarchical way of production without comprising of social welfare.

are being delivered along with the improved quality of life (15E). Thus, they cooperate with multiple stakeholders to ensure a scaled up and just co-financing of NbS by adopting a collaborative decision-making approach.

“I think the leadership has been voted of a city, of a national government, voted in to represent the people. They should make the decision and have at heart the best interests of their citizens. So, they must be that balancing force in the room” (15E).

To conclude, the conceptual framework stresses on the engagement of all three actors to attain a just and scaled up outcome for co-financing NbS. The model ties the concepts of scaling up and justice to different actor groups by highlighting their strengths and weaknesses based on the literature analysis and expert interviews. It advocates for a somewhat technocratic and socially inclusive approach for scaled up and just NbS co-financing. The building blocks provide further guidance in assessing the scaling up and justice of co-financing. It is acknowledged that the model is designed to be ideological in nature to be able to test it out and see its implications in real case scenarios.

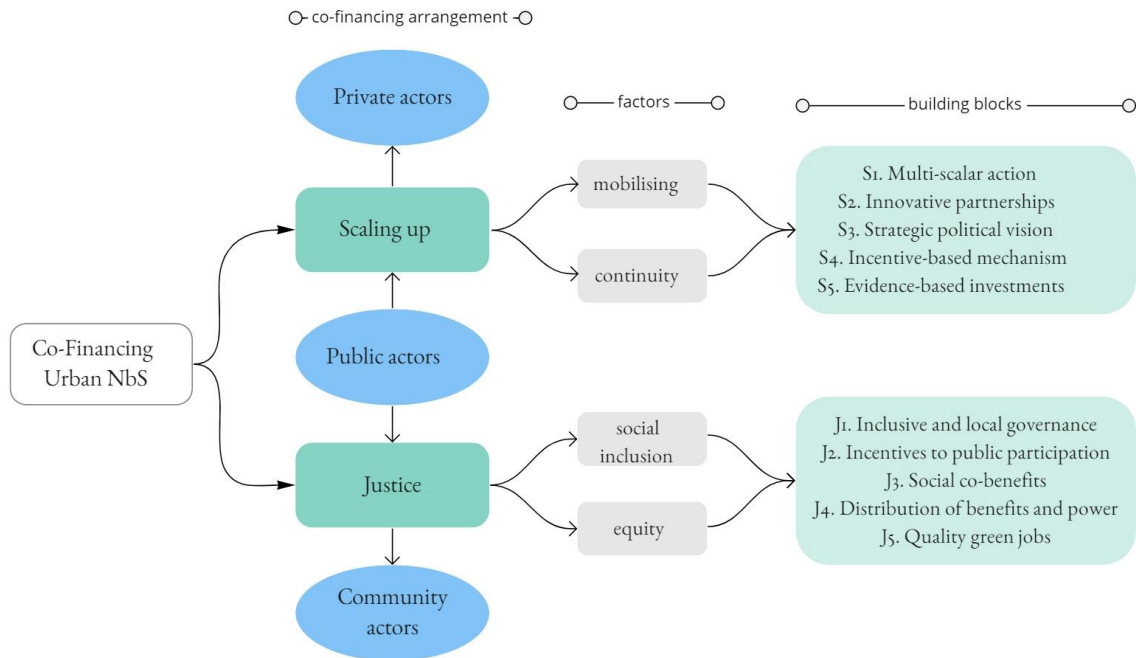


Figure 4-1: Conceptual Framework

Source: Author's elaboration

5 Case Study Analysis

This chapter highlights four case studies in Europe: Case 1: Interpolis, Case 2: Adopt a Park Case 3: Trees AI, and Case 4: BiodiverCity, Malmö. These case studies exhibit bold, visionary and out-of-the-box thinking. They range across diverse NbS types, financial arrangements, financial mechanisms, spatial scales and sites. The reporting style follows a structured approach where the analysis is based on the framework developed in Chapter 4. After a brief introduction, the co-financing arrangement where allocation of budget and responsibilities and the motivation of actors are presented for each case. Successively, a detailed description of scaling up and justice is produced, guided by the building blocks of the Conceptual Framework. New themes related to understanding these concepts are also incorporated in these sections and later discussed in Chapter 6.

5.1 Case 1: Interpolis



Information:

- *Location:* Netherlands (Tilburg)
- *Cost:* Subsidy budget 2017-2019 is €250,000
- *Duration:* 2019 – present
- *Typology:* Green roof
- *Co-financing actors and mechanisms:* Municipality – subsidies; insurance firm - market development
- *Co-financing arrangement:* Informal partnership between the Interpolis and Municipality
- *Scale:* Local-meso level

Image: Scandinavian Green Roof Institute. Credits: CC BY-NC 2.0

Tilburg, an early medieval Dutch town with about 200,000 inhabitants in the Netherlands, faced heavy rainfall and flood in the last decade. Further, impacts (such as sewage congestion and economic loss due to infrastructure damage) of climate change from flooding and urban heating are expected to be more striking and familiar. At the same time, green areas are disappearing in the city. In response, the municipality launched a subsidy for green roofs for water retention and climate adaptation supported by WUR, Wageningen University & Research (WUR, 2019). A few years later, Interpolis, a subsidiary of the Dutch Insurance Firm Archmea, spearheaded efforts to promote green roofs to lower the roof-related damage costs in their portfolio (CLICKNL, n.d.). “It is a great example of a smart investment in NbS that captures the value in terms of economic, environmental, and social to a certain extent” (9EC).

5.1.1 Co-Financing Arrangement

After suffering recently from extreme rainfall events causing floods, the municipality of Tilburg, with the support of a research institution and the residential development cooperation, a construction company, the regional government and the water board drafted a subsidy scheme¹⁸ which was put in place in 2017. Interestingly, the potential co-benefits of a

¹⁸ Applicants can get a 50% subsidy of the green roof installation costs, to a maximum of €25/m², and a maximum of €2,500 for private owners and €25,000 for housing associations, owner associations, companies, and institutions.

green roof were kept in mind and were not designed solely to tackle flood risks¹⁹ (WUR, 2019).

The city had enormous budgets for green roof subsidies, but they weren't getting utilized. Motivated by rising claims of roof damage through water leakage in its portfolio, Interpolis invested in awareness and increasing market demand for green roofs in the Netherlands to lower roof-related damage costs. They successfully stimulated market demand in the Netherlands by running a Green Roof Marketing Campaign featuring well-known media personalities (Xie et al., 2020). During this time, the municipality and the firm (acting as an intermediary) entered into an informal partnership. *"There were no coordinated funds, but both the actors are stimulating the same thing for different benefits resulting in very successful delivery of the urban NbS"* (9EC). However, they were hesitant to get into a formal alliance as they wanted to avoid a lengthy tendering process to get a private actor on board (9EC; 14C).

Interpolis systematically removed the barriers the municipality in Tilburg faced in providing information around green roof installation to its citizens and conveying the benefits to green roofs and suppliers (9EC). Interpolis offered a free roof inspection and green roof installation at a standard low price through a collaboration with a green roof installation firm that took care of the maintenance aspects. Consequently, the homeowners were getting access to low-rate installation combined with the Interpolis campaign and municipality subsidy (14C). The case is an example of the insurance industry inviting other stakeholders to co-invest and building public-private-civic partnerships.

"Interpolis in this case is playing a role of more of a market development where they are not directly investing in the green roof installation or maintenance but created a market which stimulated its uptake. They are helping in financing NbS by making it more attractive" (9EC).

5.1.2 Scaling up Perspective

From starting a pilot project in Tilburg to making it a nationwide campaign, Interpolis successfully scaled up efforts that promote green roofs, spreading in about 70 percent of municipalities in the Netherlands. *"Nice to see that something that once started as an experiment now is having such an impact"* (14C). One of the barriers to financing NbS is that the benefits are not clearly captured.

"Interpolis managed to overcome one of the financing barriers of capturing the benefits by building a hypothesis through modelling on how green roofs could better protect their portfolio against the risks of climate change and help them lower their costs. They acted as a key stakeholder in developing and applying valuation metrics and evidence for the benefits of urban nature" (9EC).

Additionally, by campaigning and sharing data (about damage costs and NbS impact for instance), they raised awareness on the value of NbS, including economic regeneration (Xie et al., 2020). Further, Interpolis acquired the economy of scale from its visionary strategy. By collaborating with local green roof operators, the firm made green roofs more affordable and accessible to homeowners (14C). The interviewee added, *"the free roof inspection and a standard low price made it very attractive for the customer. Combined with the municipal subsidies, they could now install a green roof at a low price"*. They sold over 100 green roofs in their pilot project in Tilburg,

¹⁹ from a multipurpose perspective, green roofs support climate adaptation, are effective insulation, prolong the roof's life, provide habitat for biodiversity and increase the value of the property, making them more cost-effective than other solutions. For best adaptation purposes they should be placed close to each other on a large scale (WUR, 2019).

which was ten times more than the amount. *We went on a bike with a green roof in it through the city so people could see and touch it. It was a good bug fix* (14C).

The informal partnerships between the municipality and the firm worked well. They gave several press releases on the importance of green roofs, as the water was a massive problem for the city and was fueling the fire from the Intepolis' campaign. Interpolis acted as a market maker, getting the green roof companies and citizens²⁰ together (14C). The firm meanwhile reduces their claim, and subsequently, their insurance premiums remain manageable (CLICKNL, n.d.). *It made our brand look green* (14C).

What is more interesting in this case is different parties have different benefits and motivations attached to the green roofs. While Interpolis was more interested in the protective capacity and longevity of the green roof, the municipality was interested in the holding capacity and insulative capacity of the roof (9EC). They were different incentives in the market. *"The biggest factor of success was that the benefits were understood, and different actors were interested in different benefits. The sharing of costs while capturing all the benefits and maintenance was ensured"* (9EC). The strength of the successful campaign in Tilburg was that both the municipality and Interpolis worked together. However, the very strict, long transparent tendering procedures in the Netherlands hindered any formal arrangement with other municipalities. Interpolis ended up running the project by partnering with local green roof companies. This was probably one of the project's most significant barriers and failures (14C). The interviewee reflected that one of the enabling factors in Tilburg was that the green party was in charge during the launch of their campaign, which wasn't the case in other municipalities (14C), contributing to the institutional barriers of successful scaling financing for NbS.

One of the outcomes of this campaign was the formation of Dutch green roof network, which is a coalition of green roof companies to share information (9EC). The project managed to create a feedback loop to ensure continuity. *"It is a successful case where the insurance company acted as an intermediary to encourage green roofs and shows an interest at a smaller scale"* (9EC).

5.1.3 Justice Perspective

One of the positive social benefits was that the success of the campaign opened the market for creating high quality green jobs. The demand to install green roofs in Tilburg soar high so much so that the local green roof company hiring sub-contractors for the job (14C). Along with the meagre price, visibility of green roofs, aesthetic value and the feel-good factor were strong motivators for high demand of nature (14C).

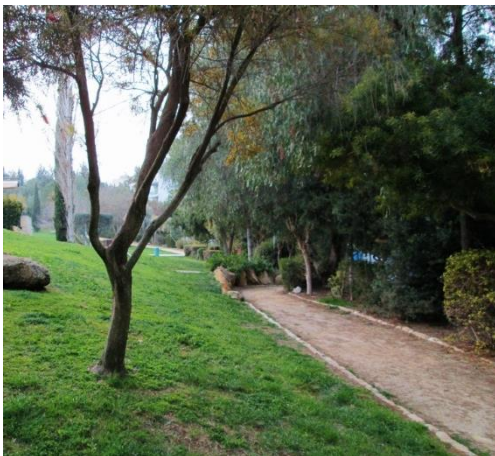
Interpolis were targeting homeowners rather than the housing corporations or people renting it out, where the latter formed the vulnerable part of the population. This targeting of functional areas was solely based on the transaction costs, which is often very time-consuming decision-making process (14C). Homeowners naturally comprise affluent parts of the population in the Netherlands, comprising on the distribution of benefits (9EC). *"We have a lot of private customers to sell. In the end it has to be profitable not just for us but also the green roof companies"* (14C). Further, developers or owners of housing cooperatives are hesitant to add green roofs as from a business case perspective, as the rent would increase considerably. However, when they decide to renovate the building, it could fit in well (9EC; 14C). Plus, it

²⁰ The citizen doesn't necessarily need to have an insurance with Interpolis to make use of this offer.

might be a stretch to think that the housing companies represents the views and always the best interest of the citizens (14C). The interviewee further commented that for inclusive governance, the public authorities should take charge on making this decision.

The value of rethinking and use of good data for a just co-financing of urban NbS was greatly stressed upon by the interviewee 9EC. The interviewee discussed that it could be beneficial for Interpolis to make special deals with the housing corporations which housed low-income citizens where energy poverty is dominant. There could be a win-win here where the housing cooperatives can double the life span by installing a green roof which could have multiple benefits for the financial vulnerable renters in terms of their health and well-being (by cooling their property, preventing costs for air conditioning, and also preventing just lower wellbeing, due to heat effects.). To further save up on transaction cost, Interpolis could identify and work with the city's five biggest housing corporations. The triad of the insurance company, municipality and the housing corporation, could then explore concrete projects and make the business case for targeting the low-income population. Further through good data, the firm could support the municipality in recognizing the areas that can receive the highest benefits. In future, the municipality in Tilburg has plans to work with residential development cooperation and construction companies to cover more neighbourhoods (WUR, 2019).

5.2 Case 2: Adopt a Park



Information

- *Location:* Nicosia, Cyprus
- *Duration:* 2021 – present
- *Cost:* Unidentified
- *Typology:* Small and medium-sized parks
- *Co-financing actors and mechanisms:* Corporates - CSR funds, municipalities - budgets, tax rebates; EU funds
- *Co-Financing arrangement:* Formal partnership between the municipality and businesses, supported by ANEL
- *Scale:* Meso level

Image: Acropolis Park, Nicosia. Credits: CC BY-SA 3.0

Nicosia is the capital city of the Republic of Cyprus with a population of around 238, 547. It is located in the centre of the island and has a subtropical semi-arid climate. Plenty of tourism-based companies and shipping companies make up for Nicosia's vibrant financial industry and has attracted many international businesses and tech companies (Oppla, n.d.). The city of Nicosia is currently grappling with urban congestion due to heavy use of private cars and lack of adequate urban green spaces in the proximity of densely built urban core. This, in turn, is leading to multiple urban challenges such as urban heat island effect, poor storm water management and desertification along with adverse mental and societal effects. Green infrastructure/NbS was recognised as suitable solution. This took form of a network of green spaces through interconnected trails, greenways, and paths to support bicycling, running and walking, (Oppla, n.d.).

The Nicosia Development Agency or ANEL (responsible for the planning activities for the city Nicosia) supported by Connecting Nature implemented a huge ambitious project entitled: "Network of Linked Open and Green Spaces" with a vision to connect, densify, and

develop an urban network of green and open spaces. The strategy was supported by Connecting Nature framework which became an exemplar in Nicosia to increase the overall health and well-being of the environment and people. However, the project focused on larger parks and a series of smaller parks were left out. Complementing to this project, ANEL proposed the “Adopt a Park” Scheme which focused on connecting smaller parks to the wider scale network (13C). The project is as an extension of the network where the municipalities wanted to create open and green spaces to improve the quality of life for their citizens. The project aimed to ‘create on a district level, an urban network of Open and Green spaces (connecting them with an integrated bicycle and pedestrian network) using as a core the National Forest Park of Athalassa and other existing successful urban NbS projects’ (*Connecting Nature*, n.d.). The intervention scheme extended in nine municipalities in the district of Nicosia (13C).

“The scheme forms an interesting case as it extends the network of green spaces to smaller parks in the city and promotes long term sponsorship and partnership between the corporates, local business enterprises and the city government” (6EC).

5.2.1 Co-Financing Arrangement

The idea for Adopt a Park scheme was aimed at involving private sector in greening initiatives. Further, larger parks in Cyprus are financed and operated by the national government (Ministry of Agriculture, Rural Development, and Environment – Department of Forest and Department of Environment) and the small and medium-sized parks are under the regional government (13C). The identified opportunity was the existence of many small green spaces, most underused or abandoned in the neighbourhoods, which had the potential for pocket parks. These spaces are owned and maintained by Local Authorities (municipalities) which are more open to private sector involvement in investing and developing these smaller green spaces. *“This led to the development of scheme to promote long term partnerships between the local government, corporates, local businesses and enterprises in order to maintain and beautify these neighbourhood products” (13C).*

Three main actors involved in this co-financing arrangement were ANEL, the municipalities of Nicosia and businesses. In this arrangement, ANEL was participating in Connecting Nature an EU Horizon 2020 project and representing the city of Nicosia. Connecting Nature as a knowledge partner helped the City of Nicosia overcome numerous challenges such as limited understanding of NbS and related concepts, lack of common language to communicate between different departments, limiting funding for the scale of the project, etc. Connecting Nature project didn’t directly fund the scheme but was their knowledge partner. The framework was used as a tool to incorporate NbS strategically in the local policies and plans and facilitate on-ground events and cooperation with different actors. Through understanding the challenges and discussion, they together devised an innovative solution of Adopt a Park involving private actors (13C).

After announcing the green and open spaces in early 2021, the businesses could choose the park for their beautification and maintenance. The business adopter is responsible for planning and maintaining the entire green space based on the guidelines ANEL developed and committing to its ongoing care for at least five years (13C). The smaller businesses or nature-based enterprises such as landscape engineers, gardeners, plan specialists, and so on, are commissioned to plan, design, implement and maintain the individual parks and are directly paid and managed by the investors (13C).

5.2.2 Scaling up Perspective

“Nicosia case is a successful example of implementing small-scale nature-based solutions over a macro scale and securing a continued financial flow and commitment” (6EC). Strategic political vision and the interplay of governance architecture played an interesting role in this case. Through Connecting Nature Framework, ANEL team aims to help deliver NbS as part of a strategic plan that places environmental objectives and healthy, attractive, and natural surroundings for the local population higher on development agendas. Another enabling factor was that the municipality had complete autonomy over the medium and smaller-sized parks, which facilitated private sector investments. The identified opportunity was the existence of many small green spaces, lands of low land value most of them underused or abandoned, which had the potential for pocket parks and neighbourhood gardens. Further, partnership with Connecting Nature and using the framework generated new sources of finance and created a feedback loop of sharing and learning with other cities. *“It gave us a more structured understanding of how to approach each project and who to involve in the process” (13C).*

One of the main incentives for corporates was the legal requirement to corporate responsibility strategy or CSR activities in Nicosia. Investment in this scheme was then a perfect match to use the CSR funds to develop and maintain green spaces which are later integrated into their annual reports. It provided a credible and effective way of optimizing these funds that would affect the company's sustainability and demonstrate honest and responsible leadership. Importantly, companies who were involved in the scheme received tax incentives on their profits (13C). In the first round the scheme managed to map and secure private sector funding for 200 small and medium-sized parks. The SME's²¹ are hired by businesses that do the planning, on-ground implementation of the project and the maintenance. Thus, the scheme creatively secures long-term maintenance of these spaces by involving local small businesses to take care of it. *“This is really interesting as both the capital investment and maintenance cost are covered by these big investors” (6EC).* After the success of the first round, the scheme intends to continue more rounds of adoption making the city greener in the process (13C). For the next round, businesses can choose to continue their plan or the park feeds into the next round of adoption, inviting new administrators to take care of it.

Justice Perspectives:

One of the goals of Connecting Nature framework was to involve and work closely with the communities in the design and maintenance process. Before, the network worked with NGOs and involved the local citizens, who were affected by the implementation of large parks. However, due to Covid, the public consultation processes for this scheme were seen as challenging (13C). The interviewee further highlighted the importance of connecting nature enterprise platform as a tool especially for the larger businesses that will participate in the scheme as a mean to involve the citizens in the design and maintenance of the parks, although that platform is still in making. From the socio-economic development perspective, the scheme engaged local businesses and succeeded in creating quality green jobs.

Nicosia includes a variety of green spaces that are intensively used by the local population. In terms of mapping and distributing these green spaces, the scheme covered different city zones such as the housing zones, industrial zones and so on. Depending on the use of the

²¹ Investors can either choose these SME's from a list that is already provided by ANEL or have the right find new ones (13C).

area, with each zone having a certain specification and guidance for the businesses. “We give them the authority to do whatever they want as long as it follows the plan that we have already agreed from the beginning” (13C). All parks were owned by the municipality and are free of charge for the citizens. Thus, even with business financing of NbS the city had full ownership and authority over the parks. Perception on the NbS type played another significant role. “So, for us, it was more beneficial it takes to have the parks being developed because we wanted the people to benefit from this. And in the case of SUDs, or green roofs, they wouldn't have a chance to enjoy it” (13C).

5.3 Case 3: Trees AI



Information

- *Location:* Glasgow, UK
- *Duration:* 2021 - ongoing
- *Typology:* Open spaces, Forests and Woodlands
- *Co-financing actors and mechanisms:* Municipalities, regional, national – pooled budgets; institutional investors – carbon offsetting, pension funds, user charges, etc; private innovation funds.
- *Governance arrangement:* Indirect formal partnership between the municipality and the corporates through Trees AI
- *Scale:* macro-level

Image: Glasgow from above. Credits: CC BY-2.0

Glasgow is a deprived post-industrial city with a population of about 626,000. It has grand buildings from the industrial era, lush green parks, woodlands spread across urban and urban areas, and numerous attractions along the waterfront (*Connecting Nature*, n.d.; 6EC). However, the city is facing many urban challenges from the effects of development, industries and climate change. The city's shipbuilding and textile industries has left the lands contaminated and Glasgow was ranked higher than London in the most polluted cities in the world. Being UK's third wettest city, extreme rainfall has been putting pressure on the old Victorian sewer, leading to its overflow in the rivers and seas in the last five years. According to the Scottish Environment Protection Agency, by 2050 the city will be facing 100 million in flood damage; by 2080, 230,000 people will be at risk from flooding (Conte, 2022). Further, the city faces immediate public and mental health issues. There are massive disparities in health, and according to the Glasgow Index there is a ten-year difference in the life expectancy between one part of the city and the other (6EC).

Glasgow is using trees, open spaces and woodlands as an infrastructure to alleviate pressure on its grey infrastructures, providing improved stormwater management and flood mitigation. issues. In early 2020, the Glasgow City Council (GCC) adopted the Open Space Strategy²² (OSS). During COP 26, the city further launched its ambitious 'Forestry and

²² The OSS is a corporate strategy that will align the work of various council services to deliver a variety of benefits for people and nature in Glasgow.

Woodland Strategy’ to boost the number of trees in Glasgow City Region by 18 million over the next 10 years. These strategies aim to positively contribute to the city’s liveability and increase the attractiveness of the city to work and live, improving the people’s health and wellbeing and biodiversity (GCC, 2015).

Trees AI, a product of Dark Matter Lab²³ is a cloud-based platform seeking to establish nature as a critical part of urban infrastructure and to support their clients in just transition (TreesAI, n.d.). We created a platform to value and invest in urban nature to establish green infrastructure and nature as a core infrastructure of urban and peri-urban setting similarly to bridges, roads and rails to enable investment in regenerative maintenance of these assets (17C). Trees AI aims to match funds to cure investments for Glasgow to help them meet their ambitious plan. It attempts to place urban forests frontline in Glasgow City Council’s attempts to fight its various challenges and provide a natural hedge against climate change (Conte, 2022).

5.3.1 Co-Financing Arrangement

Trees AI was born out of Dark Matter Lab’s ‘Nature as the Solution’ mission, which was looking at ways to support municipality to reach the targets and scale their urban forests. The interviewee from Dark Matters Lab commented that *“while working with municipalities across Europe, Korea and Canada, we realised that one of the biggest barriers to scaling was this kind of critical funding gap. On top of that, there were several other barriers, more skillset, technological enablers, and cultural barriers. Funding is a systemic problem”*. They had received funding for a proposal from Google Impact challenge to develop this product and the technology behind in treating the trees as proper infrastructure.

“During our work we found that one of the biggest challenges related to funding is that we have valued trees and green infrastructure as costs rather than assets in municipal balance sheet for too long. And therefore, this has really been one of the key stoppers, both from the point of view of the shortage of private capital investment and long-term thinking to maintain these assets” (17C).

Glasgow’s Open Space Strategy used GIS (Geographic Information System) modelling and a place-based approach. These actions, similar to Adopt a Park scheme, were supported by Connecting Nature Framework to map and coordinate the various open space responsibilities to ensure well-managed, well-located and well-connected open spaces throughout Glasgow. In June 2021, Glasgow City Region announced an ambitious plan to plant 18 million trees in the upcoming decade through an extensive urban forest stretching across derelict areas and connecting historic woodlands through its visionary Forest and Woodland Strategy. In October 2021, Glasgow hosted COP26, where the partnership between Trees AI and Glasgow City Council was announced to help fund, grow and maintain natural infrastructure (Conte, 2022). Trees AI identified Glasgow as their pilot project based on their ambitious strategies and readiness to innovate and take on private sector investments to achieve them.

“We selected Glasgow for various reasons, there was right kind of knowledge thinking within the municipality. The evidence based-GIS system provided a good steppingstone to get to the next level of data granularity. They had the essential political will and stakeholders on the ground that were really motivated to

²³ Dark Matter Labs is a global design and discovery agency which supports cities, municipalities and institutional and national partners to develop plans for a just climate transition.

take on innovation and not just do a quick win projects. On the other hand, the city had a particularly disjointed and non-streamlined infrastructure asset management system and needed support with the innovation”(17C).

Trees AI in this co-financing arrangement acts as an intermediary and aggregator, playing a match maker's role. Through the platform (will be launched in November 2022), they will acquire portfolios of projects from the public sector that can match the desires from investors from the private sector. On the stewardship side, they are curating and populating the donors by getting different investors on board along with coordinating between different departments to build a portfolio of projects (17C). This works both ways where the public sector acquires long-term funding without compromising on the outcome and the private sector can do a meaningful investment (10C).

Ecosystem services from trees can interest a wide range of actors; corporations looking to offset emissions and invest in local communities, utility companies looking to sustain water quality, insurance companies looking to better manage flooding and healthcare providers looking to improve air quality. Using technology, these services can be matched to the investor's needs in a clear, evidence-based, transparent manner to showcase benefits and share spillover values (17C, 10C). Hopefully, by 2050, some of millions of trees would have matured through this collaboration, providing a natural hedge against climate-related risks (17C).

The actor arrangement is a bit complex in the partnership. Trees AI are interfacing themselves with a wide array of across the governance system of Scotland from the national level all the way to the municipal level, including organisations such as GCC, Scottish Environmental Protection Agency, all the way to the regional level. In addition to this are the private stakeholders, the outcome buyers they interact with. *“Our multidisciplinary team helps us relate to different disciplines in different ways”* (17C). Furthermore, the role of knowledge funds both from the EU and big investors like Google through impact challenges play an essential role in supporting the required innovation.

5.3.2 Scaling up Perspectives

“Glasgow through their partnership with Trees AI is innovatively tackling the problem of scale by working through the platform which that can aggregate small urban NbS. The platform is a really powerful mechanism for channeling investments, taking place in a transparent and an equitable” (6EC).

The use of data and technology is playing a critical role in spatial finance. It is not just about understanding funding asset that are local. Here, spatial finance focuses on the geolocalization of the assets that has a huge impact on the return a particular asset can provide (17C). The interviewee went on to add,

“And therefore, it is super important from the success of this venture to be able to have a clear, transparent asset management system that enables the assets to be located in order to understand their impact. Further, we are using blockchain as a centralised ledgers to support the transparency. This can be used by not only by the municipalities but across the world, which aides in knowledge sharing”.

Using LiDAR and satellite imaging, Trees AI will improve the maintenance and monitoring and will offer investors access to outcomes most relevant to them. Through the use of technology and data, they are rethinking the value of trees and valuing them as assets, similar to roads and bridges (17C).

The city is simultaneously relying on evidence-based strategy, political commitment and impact assessment to reach the ambitious target of planting 80 million trees. Statutory documents on Open Space Strategy and Forest and Woodland Strategy which recognizes the wider benefits of nature to the city and its inhabitants establishes strategic political vision. The city has displayed a collaborative spirit and a collective sense of value through long-term strategic vision to work across different strategies and plans (*Glasgow | Connecting Nature, n.d.*). Glasgow has set a leading example to use spatial data and modelling by leveraging data sets, surveys and local knowledge to enhance the use of multifunctional open spaces throughout the city. Further, the city is using impact assessment framework (supported by Connecting Nature) to map spaces to determine locations where new or enhanced open space should be provided to support new development and also helps determine whether a financial contribution should be taken from developers (GCC, n.d).

TreesAI's natural assets portfolio also intends to support Glasgow's remediation of contaminated land. This arrangement could extend to several NbS typologies ranging from street trees, swales, and ponds. The project is now in its research and development phase and is now entering the advanced design stage. The next stage will be the detailed design, followed by the delivery and the funding stage in 2023. From here the portfolio will range for about five years. The target will be met over several years where Trees AI will be indirectly financing roughly 5000 trees per year all the way to 50 ha (17C).

5.3.3 Justice Perspectives

The social goals and socioeconomic, and environmental benefits offshoot the carbon offsetting benefits for the city (17C). A systematic inequity exists in the cities and through the platform, Trees AI attempts to address them.

"People's lives are really determined by the postcode or the places in which they were born, this has a very big impact on the type of outcome further down in their lives. And we also know that nature resolution is unequal distributed in our cities where most deprived areas are also the one where the least cannot cover. And a consequence of this inequality, it can be demonstrated in fewer years of life, having less capacity to focus, less access to good jobs, and so on. Everything is pretty much connected. When we speak about the transition, we speak about a transition where we really are not speaking of generating profits out of the current system but essentially building nature resolutions" (17C).

When asked the interviewee from Trees AI on how the power struggles are balanced and who gets the final say –

"Currently, we are in the process of building a governance system and ensuring that no one actor or actor group has more power than another, but also to have an open and transparent system where there will be mediation across different factors. However, the city will be considered as an expert in managing trees and understand what is best for the citizens. It's a combination between negotiation, mediation, and compromises across different actors. So, no actor has the final say in this. It's sort of matching different names of different actors and getting them on the same level".

The Open Space Strategy exemplar and LCAs map and prioritises open spaces according to the city and local community needs. The NbS plans to deliver an enhanced sense of place and ownership for local communities by building on the 'placemaking' policy (and processes). This is underpinned by the City Development Plan 2017. Drawing from maps, surveys, data analysis the strategy developed standards to deliver good quality multifunctional open space within 400 m from any given locality and ensure a just distribution of public open spaces throughout the city. Moreover, there is a collective sense of the value of Glasgow, on

a city scale, as a connected city. It recognizes the benefits of green jobs, health and mental well-being, local entrepreneurship, and community engagement, where actions result in scientifically proven outcomes (Glasgow | Connecting Nature, n.d).

“We know that achieving our higher climate mitigation and adaptation targets means learning to design and live in cities in radically different ways.” Says Susan Aitken, CEO of Glasgow City Council. “It will require us to rethink our human development and economic growth principles, our asset valuations and investment decisions, and the role of urban forests in our operations and lives. At its core, the Trees.AI approach is an invitation to re-evaluate our bureaucratic, financial and cultural relations with urban trees to achieve better outcomes for cities” (Conte, 2022).

5.4 Case 4: BiodiverCity, Malmö



Information

- *Location:* Malmö, Sweden
- *Duration:* 2012-2017
- *Typology:* multiple
- *Total cost:* €500,000 - €2,000,000
- *Co-financing actors and mechanisms:* Public-Private partnership between the municipality, developers & housing associations; national innovation funds.
- *Co-financing arrangement:* Formal partnership between the municipality and the private actors.
- *Scale:* Local - micro level

Image: Urban Biotope, Malmö. Credits: Ismat Fathi

Malmö, Sweden’s third largest city, is a compact and dense city, with a population of 326 645. It was once called the City of Parks. Rapid urbanization and population growth (approximately 2% per year for more than 20 consecutive years) is putting pressure on city land use. This is resulting in lack of biodiversity, urban flooding, densification, scarcity of green spaces, lack of recreational lands and social disintegration to name a few (Malmö stad, 2018). In 2009, Malmö City launched the Environmental Program with an agenda to improve the sustainability of the city and the quality of life of its citizens and, become climate-neutral city by 2020. Later in 2012, the city launched the Comprehensive Plan to “grow inwards” by densification, i.e., inside the outer ring road (Malmö stad, 2018). The strategy recognized the multi-functionality aspects of green and blue infrastructure, however knowledge and expertise to overcome the challenge of spatial planning and allocation of land/space for green and blue qualities were still missing (Stadsbyggnad.org, 2017).

The BiodiverCity project was developed to bridge this gap between the vision of a greener, healthier, and more attractive Malmö with rich biodiversity and the reality of growing population, densification and lack of green spaces. It did this by focusing heavily on integrating ecological knowledge into urban planning processes (Kiss, 2017). The project was very innovative in its nature as it planned to increase the biodiversity, incorporating local vegetation, rainwater management through open storm water management and connecting it to the sea. Constructing habitats in a dense urban environment worked to develop a green and healthy city and to further design and test new ideas, products, services, and processes to increase the conditions of urban ecosystem services (*BiodiverCity | Urban Nature Atlas*, n.d.). Over the implementation phase of two years, almost 30 different innovative multifunctional

green structures were established in different parts of the city, including urban biotopes, urban forests, green roofs, green walls, street trees, and mobile plant systems.

5.4.1 Co-Financing Arrangement

The BiodiverCity project was led by the city's Environmental department of Malmö, experimenting with NbS integration both in new urban developments and in established urban areas across the city (Wickenberg et al., 2022; 16EC). The project brought together research institutes and universities and building companies and entrepreneurs in the landscape architecture sector (*BiodiverCity | Urban Nature Atlas*, n.d.). This resulted in a multidisciplinary team working on the design, implementation and maintenance phases of 30 different NbS across Malmö.

The collaboration of many public, private, and community actors was critical for generating initial action on the ground, facilitating knowledge development and mobilizing agency and resources, while contributing to the further development of urban greening policies. The project was partly funded by the Swedish Innovation Agency, Vinnova in three different stages. In the first phase, 100% of the total costs was covered. The second and the third stages fell under 50% funding, the other 50% had to be covered by the project partners. The funding from the Vinnova was crucial, as the initial investment costs for any innovation is usually high and innovation is seen as a risky business due to lack of information linked to the actual cost and labour required for the product (16EC). Other parties involved in this co-financing scheme were participating private project partners and EU's Regional Development Fund. The first stage (2011-2012) of funding and project lifecycle included the establishment of a strong team and preliminary studies for future implementation. In Stage 2 (2012-2014) different cases were identified and were put to test. Stage 3 (2015-2018) involved compiling lessons learned from Stage 2 and spreading the learning to other sectors through seminars, education, maintenance and implementation manuals for practitioners, and exhibition activities to demonstrate how green solutions can be realized. It also included evaluating some of the individual projects and commercialization of green solutions developed in Stage 2 (Kiss, 2018; Malmö stad, 2018). Formal and informal communication channels and networks, e.g. from previous urban sustainability projects, such as the Environmental Building Program South played an essential role in the development, implementation and commercialization of these innovative solutions (Wickenberg et al., 2022).

5.4.2 Scaling up Perspectives

For developers and private market actors one of their main incentives was to experiment with innovative green development through new products, services and processes to create potential future business opportunities in an increasing market segment (19EC). *“They wanted to do something different above the ordinary simply. For example, working with the green area factor²⁴ in the district of Western Harbour”* (16EC).

Malmö has a monopoly on real estate developers (20EC). The involved private actors were already part of a dialogue/network and had experience and knowledge to work on this type of innovative structure (16EC). Stage 3 was another exciting aspect of the project where funds were kept aside for learning knowledge dissemination, evaluation and

²⁴ Green area factor is a practical tool for urban planners which ensures sufficient green infrastructure for new developments.

commercialization of innovative solutions for urban greenery. The idea with the project was to create a feedback loop where the housing and real estate companies could replicate what they had learned in this pilot project, ensuring the overall continuity of the project (16EC). Generating partnerships and fostering collaboration was a way to remedy the knowledge gaps in designing and implementing NbS by enabling mutual learning and hands-on practice. Although the evaluation was slightly touched upon and not incorporated in all projects and in, while monitoring was done, it was not communicated effectively to other audiences (16EC; 19EC; 20EC). One of the biggest challenges of the project was the lack of knowledge among the customers to prioritize urban biodiversity (Vinnova, n.d). Here an educational and informational component to the end users could have added value to the project, for instance conveying the increase in butterflies and bees in the region could potentially lead to better community buy in (16EC).

Other factors such as the leadership of the working groups, background of the project leader, cross-project management and the learning cycle placed a key role in the project lifecycle (16EC, 19 EC). The project in terms of its continuity, was not entirely successful. The project leader is an ecologist and has been the key driver behind bringing in more and more green infrastructure into the city – even several years before this project kicked off (Kiss, 2017). The project was strategically incorporated in Environmental Programme and the Comprehensive Plan. On the other hand, some other national or local requirements can increase the incentive for more investment. Ecosystem services such as water management, climate change and improved public health are important components of the city's long-term sustainability (Malmö stad, 2018). The project had a strong ecological perspective and was not exclusively open to other municipal departments, missing out on capturing other key co-benefits at of NbS. Further, experience has shown that it is difficult to make a business case based solely on biodiversity and impedes real estate investment (20EC).

One of the main outputs of this project was the novel maintenance plan, including new ways to maintain green structures at a low cost and how to pass knowledge on to staff responsible for the maintenance (Xie et al., 2020). When developed on private land, the landowners or the developers took care of the maintenance budget for it. However, for the projects implemented in the school, its maintenance wasn't ensured. One possible reason was the actor was not involved in the project design, obscuring the knowledge transferability and ownership of the project (16EC). Involving few actors saves time spent on management. On the other hand, it can also be seen as vulnerable in case of staff changes within the organisations involved, affecting the planning and finance aspects of the project (Andersson et al., n.d.). *“They did think very intensely about the maintenance, but knowledge transfer didn't actually happen the way it was supposed to happen”* (16EC). In the second and third phase, several private actors dropped out. The research collaborative project and development timelines often don't often match, and objectives need to be aligned from the beginning (16EC; 20EC). Any possible reason could be that they didn't see the market ready for biodiversity-based NbS (20EC). Overall, the project can be looked at as successful in terms of collaboration activities, networks, knowledge creation, knowledge transfer and deliverables. In terms of commercialization, the overall project might not have fulfilled the requirements set by Vinnova, i.e. creating value chains from the idea & design phase through planning, operation, all the way to maintenance and then to achieve the transference of it (Kiss, 2017;Vinnova, n.d.).

5.4.3 Justice Perspectives

Indeed, visions on sustainable urban futures include challenging goal conflicts between NbS and social inclusivity, and among different benefits offered by NbS itself which requires self-

reflection and new ways of thinking and doing. “We have a big challenge since we have shortage of housing. In the Comprehensive Plan, we say that the city should be dense and green. We have to think in new ways, to question our regulations that are self-imposed, and which are contradictory to sustainable development of cities” - Architect, City planning office, 2017 (Kiss, 2017). There was a conflict in the goal of balancing economic, environmental and equity-related priorities, i.e., whether densification or greening should come first, and if greening is prioritised, where it should be localized and whom it should benefit (Wickenberg et al., 2022). The 27-30 sites/cases were pretty dispersed throughout city. The selection was primarily based on where it was possible to take advantage of established dialogue platforms on similar questions, e.g., green roofs or new developments provide a chance for testing new solutions from scratch, mostly developed in collaboration with developers in the building sector. Many interventions were implemented on private buildings and as such not publicly accessible, raising concerns on the justification of public funding (20EC, 16EC). Although, in this selection, few projects were implemented which included vulnerable communities like elderly homes or school gardens, those were explicitly included for diversity (16EC). Furthermore, the scattered interventions challenged the negotiations among the multiple stakeholders involved and hindered the implementation of visionary ideas.

One of the key things of NbS which helps in increasing the financing share and community by conveying the co-benefits, especially the health and the social benefits (16EC). The point of departure was that the project exclusively satisfied the ecological needs (e.g., increase in biodiversity and greenery, ecosystem generation), and missed out on creating social value for local citizens (e.g., increase in aesthetics, recreation, health and well-being) and contribute to the local economy (e.g., value creation, job creation). Community involvement was also lacking in the project, it is indeed a challenge in new construction projects. The project hoped that the developers would bring the community's perspective on their needs and requirements, which was not the best way to capture the view of the local communities (16EC). One way to overcome this barrier is to establish user/resident panels (quite common within marketing) or organize focus groups, for example, in a recently developed area in another city district to discuss their attitudes and ask questions (16EC; 20EC). Another interesting approach could involve young people soon to enter the housing market (20EC).

5.5 Enabling and Constraining Factors

The four case studies were tested and analyzed by applying the Conceptual Framework using the building blocks for scaling up and social justice of co-financing. Table 5-1 summarizes the enabling and facilitating factors for each case study while highlighting the emergence of new ones.

Table 5-1: Enabling and Constraining Factors of Case Studies

Case Study	Enabling Factors	Constraining Factors
Interpolis	S1: transaction cost, informal partnerships S2: economies of scale, matching scale S3: strategic vision, synergies S4: branding, reputation S5: performance, credibility, communication, valuation, data and modelling J1: awareness, stakeholder engagement J2: acceptance, perceptions J3: multiple social and health benefits	S1: tendering process J1: participation, political commitment J4: inequitable distribution of benefits Not applicable to other NbS typology

	<p>J5: local jobs, economic regeneration, buy-in, maintenance jobs, upskilling</p> <p>Built strong narrative</p> <p>Rethinking Value</p> <p>Experimentalist approach</p>	
<p>Nicosia</p>	<p>S1: transaction cost, governance architecture</p> <p>S2: economies of scale, matching scale</p> <p>S3: strategic visions, strategies, policy guides, synergies</p> <p>S4: branding, reputation, legal, standards</p> <p>J1: stakeholder engagement, political and policy commitment</p> <p>J2: perceptions, stewardship, socially led business models.</p> <p>J3: multiple social and health benefits</p> <p>J4: investor alignment, policy measures, spatial distribution</p> <p>J5: local jobs, economic regeneration, buy-in, maintenance jobs</p> <p>Rethinking Value</p> <p>Experimentalist approach</p>	<p>J1: participation</p> <p>J2: ownership, volunteering</p> <p>Not applicable to other NbS typology</p>
<p>Trees AI</p>	<p>S1: horizontal and vertical level of partnerships, governance architecture</p> <p>S2: economies of scale, matching scale</p> <p>S3: strategic visions, strategies, policy guides, synergies, internal and external co-creation</p> <p>S4: branding, standards</p> <p>S5: performance, bankable projects, communication, credibility and valuation</p> <p>J1: stakeholder engagement, political and policy commitment</p> <p>J2: perceptions, stewardship, socially led BM</p> <p>J3: multiple social and health benefits, targeted investments, strategic perspective</p> <p>J4: exploration of trade-offs, investor alignment, policy measures, spatial distribution</p> <p>Rethinking Value</p> <p>Experimentalist approach</p> <p>Use of technology and data</p>	<p>Still in the planning stage and, therefore difficult to predict the outcome</p>
<p>BiodiverCity</p>	<p>S1: horizontal and vertical level of partnerships</p> <p>S3: strategies, policy guides</p> <p>S4: branding, standards</p> <p>S5: performance</p> <p>J1: policy commitment</p> <p>Feedback loops through learning and evaluation</p> <p>Experimentalist approach</p>	<p>S1: transaction costs</p> <p>S2: multi-level governance, matching scale</p> <p>S3: strategic visions, internal and external co-creation</p> <p>S5: bankable projects, communication, credibility and valuation</p> <p>J1: stakeholder engagement, participation, political commitment</p> <p>J2: acceptance, ownership, perceptions</p> <p>J3: strategic perspective</p> <p>J4: exploration of trade-offs, investor alignment, policy measures, spatial distribution</p> <p>J5: economic opportunities, local jobs, maintenance opportunities</p>

Source: Author's elaboration.

6 Advancing the Conceptual Framework

The case studies provided a medium to test the framework developed in Chapter 4. The framework's flexibility allowed for new understanding and intersectional themes between the three concepts of scaling up, justice and co-finance to emerge. The section is divided into two main parts where the first part (*Section 6.1*) revisits the relationship between the three concepts of co-finance, scaling up and justice, and the second part (*Section 6.2*) based on the new understanding from the case study analysis derives a set of Strategic Possibilities for an upscaled and just co-financing of urban NbS. Expert interviews and literature analysis support the issues discussed in these sections. The chapter concludes by presenting a revised framework (*Section 6.3*), tying both the sections together.

6.1 Scaling Up and Social Justice of Co-Finance

Cities in Europe are recognizing the multi-functionality of NbS, and there are more and more case examples of green roofs, urban forests, neighbourhood parks, SUDs, etc., being implemented to tackle climate change and other urban challenges. The research confirms that the municipalities and cities will require large number of investments to meet their climate goals. The urgency to scale NbS finance has never been higher and is impossible without the private sector playing a key role. However, this often comes with a cost. The ambiguity around the term, makes it easy to be reimagined and reused to serve the neoliberal agenda of market actors. The literature and the expert interviewees affirm that elements of justice often contest the scaling up of NbS finance. Unless social equity and justice are well-considered throughout the governance of co-financing, winners and losers will likely reinforce existing inequalities and injustices. This was seen across the four cities in varying degrees. Both trade-offs and synergies were observed in the case studies, and the balancing act between them can be quite tricky for cities to achieve.

Discussing the factors for scaling up, mobilization of funds was well achieved by all the case studies through innovative co-financing arrangements. They ranged from increasing the value of real estate and land, capitalizing CSR funds, improving public health and biodiversity, to reducing damage costs. While in some cases one mechanism can be clearly identified, in other cases a combination of financing mechanisms facilitated the implementation of the solution. All in all, it is clear that these mechanisms alone are not able to scale up NbS across Europe or the globe. More innovation is needed to create financial arrangements that capture the value that NbS can provide and turn it into an investable business case. Private sector investments were not only essential to acquire the initial investments but more so, owing to the living nature of NbS their involvement was crucial for long-term maintenance costs. However, continuity was not ensured in all. This was quite evident in the case of BiodiverCity where the maintenance and the project suffered due to the exit of private actors in Stage 2. However, the case study achieved transference of knowledge throughout the value chain, ensuring the project's continuity in another sense.

Analyzing the two factors related to justice, social inclusion and equity were not always incorporated from the beginning of the project and in most cases were touched upon lightly or were unintentional outcomes. It can be considered that equity is a more decisive factor than social inclusion to achieve social justice in a co-financing arrangement where the distribution of benefits is more effective than participation or rent control policies. Further, the concept of equity extends beyond intra-generational equity to inter-generational. Here, a financial mechanism such as development taxes which redirect to green infrastructure, can be questioned (6EC). Interestingly, the case study reveals that some private actors such as real estate agents and insurance companies, lead to greater distributional injustice than the others.

Moreover, while three out of four case studies did create green jobs and achieve distributional justice, it remains unambiguous in the literature and case studies if recognition and procedural justice were considered. In addition, citizen engagements were carried out as 'sustainability fixes' which has also been observed in the literature (Sekulova et al., 2021). Overall, the author supports the dominant literature and suggests a more critical interrogation on the visions around renaturing cities, especially in the land market (Sekulova et al., 2021).

On the flip side of things, it was the case studies did not explore examples of project which tried to be just by co-producing²⁵ with the communities to test whether they could be amalgamated with the scaling up of finance. While some experts agree that this actor group can form a viable part of scaling the investment, other seem to disagree. *"Citizens should play a part in the process of co-financing, but they shouldn't be considered as owners, but more as part of the solution"*. An expert interviewee took a convenient and realistic stand on involving citizens. *"They should be involved but there should also be a limit to it. They might be able to provide you with information on their needs, but in the end, the design details should fall on the experts. Otherwise, it becomes a very protracted process and costs about three times the amount it should have"* (15E). Critically the two points above are in contradiction, if they are not involved from the beginning, they will not take the role of ownership seriously, this was evident in the case of BiodiverCity. This twisted problem can be overcome through increased awareness, especially around its health benefits and communication (4E, 2E).

Few expert interviewees had an interesting opinion on the trade-offs. In their view, even though collaborative finance for urban NbS can have negative trade-offs on social justice outcomes, it should not stop the involvement of private sector finance. Usually, these solutions will add value to the land. Still, they also bring about green jobs and new opportunities, and if a social plan accompanies these investments, then these jobs can be made available to the local communities. The desire to achieve multiple benefits simultaneously must be met with a realistic acknowledgement of potential losers and winners for the project's long-term success (Nelson et al., 2020). The important thing here is to explicitly address the trade-offs by raising awareness and communicating them transparently to the relevant stakeholders (Toxopeus et al., 2020). This merit was not observed in any of the case studies, however, transparency in communicating the (co) benefits was observed in the case of Trees AI.

From a more holistic perspective, NbS should move away from a weak sustainability agenda to a strong sustainability framing which put emphasis on the extent to which such interventions can address longstanding patterns of uneven development and the inherent value of nature (Sekulova & Anguelovski, 2017; 3E). The change should be more of a systematic one to further seep into the issue of co-financing which must be understood and addressed from various dimensions (5E, 17C, 15E). To ensure the just and scaled up co-financing of NbS needs to look at from a structural lens rather than a project-based outlook (Toxopeus & Polzin, 2021). Co-financing has complexity embedded in the governance structure in urban built environments and infrastructures are planned, developed and operated (Dorst et al., 2022). Understanding how to deliver benefits across different scales, understanding of trade-offs, meaningful participation, stakeholder engagement (including nature as one of the stakeholders), transparent decision-making and accountability for

²⁵ Co-production is a novel governance method for developing NbS where many actors (individuals, groups or organisations) to collaborate and produce shared results such as policies and visions.

solutions are important components (Toxopeus et al. 2020; Sekulova et al., 2021). All the case studies in their own way captured this well, where policies, governance, scale, and impact of the project extended beyond the project itself where a multi-scalar action was seen as essential for an effective outcome. Many of the building blocks for scaling up and justice overlap and interact, opening the door for synergistic possibilities. Based on these discussion points, the author pins Strategic Possibilities in Section 6.2 for a just and scaled up co-financing.

6.1.1 Actor Arrangements

This section rethinks the role of public, private and community actors through understanding the conceptual framework developed before. It further introduces four strategic actors - researchers, nature-based entrepreneurs, aggregators and intermediaries, which can fall under private, public or community groups and are essential to achieve just and scaled up co-financing of NbS.

Role of Public, Private and Community actors

Co-financing with a hybrid governance model builds resilience, facilitates learning and experimentation, enables cross scalarity and, increases participation and accountability. Multiple actors possessing different types and degrees of knowledge could engage in a reflective way to update their planning, governance, and knowledge production practices over time to address arising risks and uncertainties continuously. Although if the responsibilities remain unspecified, coordination between the actors becomes difficult (Eguisza et al., 2019) and might lead to difficulties not previously foreseen, as noticed in the case of BiodiverCity.

Public actors, as confirmed by the case studies play a pressing role in the co-financing arrangement. Both expert interviews and authors from the literature have argued their position in safeguarding the societal welfare and as being the ultimate decision-making power through democratic accountability mechanisms and participation of affected communities (Toxopeus et al., 2020). Interestingly, Trees AI are vouching for a matching governance model, which might result in new form of governance for NbS.

Private actors' role interestingly can extend beyond just providing investment. This was witnessed in the case studies where these actors were seen agile and open to innovation, learning and experimentation. Further from a justice perspective, involving them usually has a negative connotation attached to it. If they are allowed to decide the nature and rules of the arrangement and the overall management of the intervention, it is very likely that the social justice outcomes might be compromised as seen in the case of Interpolis. However, the case of TreesAI reveals that with an ambitious and inclusive governance and proper business model, the private sector's motivation can be aligned to social justice outcomes.

Community actors play a pivotal actor group that can facilitate cross-sectoral and multi-level coordination and cooperation. Stakeholders such NGOs, researchers, and resident associations can be coined as mediators, supporting the municipalities and cities to acquire funds, provide technical expertise, balance interests of different stakeholders and carry citizen engagement. They also supported experimental approaches using pilot projects, learning alliances, or living labs engaging different types (Toxopeus et al., 2020; Schröter et al., 2022). Mediators supported the case cities to achieve societal resilience by involving communities in planning, designing and managing (Egusquiza et al., 2019). Both researchers or research associations and NGOs are strong knowledge bearers and partners and can

connect different cities to share their experience and lessons learnt for these projects, this was observed strongly in the case of Adopt a Park scheme where ANEL, through its partnership with Connecting Nature. They played an important role in setting up the governance structure and realization of the co-production processes in two cases (4E). They can also build trusts, contracts, user associations, lowering the transaction cost in public-private partnerships (Toxopeus et al., 2020). In cases 3 and 4 they laid the groundwork for the municipal governments to realize strategic intervention for NbS by identifying the key people and developing tools and methodologies to understand and measure the value and motivations of different actors (6EC).

Other actors

*Nature-based entrepreneurs*²⁶ (NbE) have recently emerged as a critical actor group in the delivery and supply chain of NbS to solve societal challenges (McQuaid et al., 2021). Globally, a recent survey of businesses specializing in reforestation and tree-planting found that some companies are seeing revenues grow as much as tenfold each year (Bennett, 2018). They can cover offer their services to phases of NbS finance and contribute to a diverse range of economic activities (Kooijman et al., 2021) with ventures ranging from eco-tourism, urban food production and supply, and ecological restoration. A strong business model would be a prerequisite to involve this actor, especially to cover the maintenance of a project, which was evidently observed in the Adopt a Park scheme case. Thus, a focus on nature-based enterprises can strategically look to overcome the barrier of long-term maintenance and create quality green jobs to benefit the local communities and reduce the burden falling on the co-financing actors.

Aggregators or ‘multipliers’ can strategically solve the challenge of small-scale urban NbS projects. They can provide a medium for aggregating different projects through creative thinking (2E, 6EC). Additionally, they play a very similar to the mediators, where they develop sustainable solutions for governing NbS (Schröter et al., 2022) and provide strong technical expertise. They can also be either public or private and seemed to have played a critical role in the Trees AI and Adopt a Park case. Trees AI platform and ANEL bundled various small NbS to provide financing opportunities at a meso or landscape scale for viable investors. They are pivotal in matching appropriate governance and management at different levels and scales to different typologies and scales of NbS to effectively achieve the application of NbS for large-scale investments. While aggregating these solutions, an essential factor is ensuring they are distributed equally across the city. Aggregators like mediators carry out due diligence, where they can facilitate a fair ‘slicing’ of the pie in a transparent and accountable way (Toxopeus et al., 2020). This leads to investors finding it easy to invest in projects through trusted aggregators having a statutory match, thus, increasing the share of finance in an equitable way (6EC), as seen in both the cases. Hence aggregators like mediators can help organize urban sustainability transitions at strategic, tactical, operational, and reflexive levels.

6.2 Strategic Possibilities

Nature-based solutions are not inherently unjust, it is not the nature of the solution itself but the way/how you implement them (1E; 2E; 4E). For example, if you distribute the benefits across the cities considering the most vulnerable groups, then it could be a balance and not have

²⁶ NbE uses engages engaged in economic activity, that uses nature sustainably as a core element of their product/service offering and contribute positively to biodiversity and ecosystem services” (McQuaid et al., 2021).

any negative impacts of gentrification. Below are seven strategic possibilities that the decision-makers and policymakers can use to ensure a just and scaled up co-financing scheme. They tie together different concepts and themes from literature, case studies and experts' and practitioners' interviews. They build on finding the synergies between the building blocks for scaling up and justice, discussed in Sections 4.2.1 & 4.3.1. The seven strategies are articulated in an orderly manner, starting from Collective Leadership, moving on to Rethinking Value, followed by developing an Integrative Business Case and Building Narratives. Next, the Use of Technology and Data Experimentalist approach is highlighted. The cycle ends with Feedback Loops. They promise to overcome the contractions of scaling up of NbS finance and justice and work on their synergies and should be considered when formulating policies and planning for co-financing solutions.

6.2.1 Collective Leadership

The author recognizes 'collective leadership' as one of the prerequisites to just and upscaled co-finance. Leadership is essential to aid in innovation and to facilitate an experimentalist approach. It links to adaptive governance such as building trust, managing conflict, linking actors, initiating partnership among actor groups, compiling and generating knowledge, and mobilizing broad support for change. A governance system must continuously learn and generate experience about ecosystem dynamics following iterative learning and action (Egusquiza et al., 2019). For example, depending on the context and the NbS typology being implemented a bottom up or a top down or a combination of the two can be adopted (1E). Leadership can come from any of the actor groups, where the actors play an important role in fostering policies for NbS which safeguards social welfare of their citizens, crucial to balance these trade-offs. This can be further mobilized through broad support from big international organizations such as the EU, which also play a role in funding NbS projects (4E; 6EC). The author's interpretation on collective leadership includes a combination of collaborative governance, internal co-creation and political will.

Collaborative governance overcomes complex stakeholder landscape and silos in project management with responsibilities, budgets, and expertise divided over various governmental departments having a stake in urban NbS development (Dorst et al., 2022). Key individuals should develop and communicate visions of ecosystem management which results in building social capital and trust among stakeholders (Nature4Cities, 2018). Case 2 and 3 embodied the principle of collaborative governance. The project should further tie to internal synergies with the existing strategies and plans through the process of internal co-creation, where no one agenda dominates the project. This helps in building a successful business case (Nature4Cities, 2018). The case studies demonstrated the adoption of NbS into the regional or district planning and policy processes, rather than developing a new one-off strategy (Raworth et al., 2014). For any policy to be developed political will is one of the non-negotiable pre-requisite. Political factors were identified as the most significant external influence, where regulations, mandates and economic instruments play an important role in market development (McQuaid et al., 2021). For example, in the case of Adopt a Park, the CSR requirement enabled the mobilization of private sector investment. Conversely, policy inconsistencies and poorly designed public procurement approach present significant challenges, as seen in the case of Interpolis.

6.2.2 Integrative Business Case

The strategic possibility of an integrative business case can be considered an extension of NbS business models. Building an integrated business case stresses on understanding NbS typologies and taking a holistic approach to different phases of NbS finance.

For any city looking to implement NbS, it is important to closely look at the NbS and find the right financing solution (NAIAD, 2021; 16EC). Evaluating NbS and its typologies provides a spatial and temporal framework whilst identifying the potential stakeholders and co-beneficiaries and pins down its co-benefits, perceptions on its functionality, and level of stakeholder engagement of uncertainty. This understanding aids in identifying the right financing options. This approach further provides strategies for long-term maintenance of NbS and determine tailored courses for each stage of financing an NbS.

Further, life-cycle thinking is required for an integrated business case (4E). Long-term review is necessary where both the direct (planning phase, the operational costs and the long-term maintenance costs) and indirect phases of funds of financing should be considered. These investments don't have to be money, they can be labor, time spent by experts, or vacant land (5E). Through case study analysis, the author has identified three phases of indirect financing, namely, knowledge and communication funds, monitoring and assessment funds and, transference which matched with experts' opinions and literature analysis. Knowledge funds consist of acquiring information on generating technical knowledge, understanding trade-offs, expertise on co-creation processes, developing business models, indicators, etc., and can be considered as a kick-starter to the project. These funds were prevalent in all four case studies. Well-planned communication and awareness activities about the project's intended benefits, gains public acceptance, and helps neutralize the intervention's trade-offs (15E, 5E). In the case of Interpolis, communication also led to market development and became even more crucial as the citizens were also the end buyers. Monitoring and assessment funds support in the monitoring uncertainty related to temporal scale) and assessing the effectiveness of the interventions and adapting accordingly (Schröter et al., 2022). This, in turn, gives credibility to the project resulting in attracting private sector investment., Monitoring relates to both uncertainty and temporal scale. From a justice perspective, these assessments should include the distribution effects of risks and benefits, who is represented there in these, who do you engage and to what extent can be seen as a strong counterbalance to the traditional economic focus on valuation and measurement (Barquet et al., 2021, 2E; 4E). While on the other end of the cycle, transference funds should be kept aside, which facilitate the transfer of knowledge where the lesson learnt are documented and shainternally andalso with other cities (15E). BiodiverCity explicitly focused on transference funds in Stage 3 of their project.

6.2.3 Rethinking Value

An intended feature of NbS is their multifunctionality and potential to address multiple sustainability challenges simultaneously. To unlock and maximize such possibility, a holistic approach to financial valuation²⁷ and moving beyond from looking at nature as a commodity is required (Nelson et al., 2020). Schröter et al. (2022) comment that this requires breaking through the current systems that overemphasize economics (4E).

One way to look at it is to make them work, fit into the dominant discourse, include the multiple co-benefits in the financial risks, and then quantify that in terms of improved air quality, reduced heat stress, reduced flood risk, etc., through data and modelling. Funding mechanisms such as impact investment, social impact bonds, environmental impact bonds,

²⁷ Although there are approaches such as biodiversity and natural capital accounting which may help bridge this gap they still don't do justice to capturing the entire essence of NbS and is within the domain to quantify the multiple values of nature as an asset.

carbon credits or crowdfunding or certain tax incentives and subsidies are examples of ways to attract investment through this lens (1E, 15E, 5E). For instance, in the case of Interpolis, the insurance company funded NbS to avoid damages from floods or disasters. Trees AI went a step further by revaluing the natural assets and matching it to the needs of different actors. *“And so we will need to build these baby steps in shifting how our economic systems, the foundations of our economic system is set out to welcome a different kind of market that is based on just a more resilient sustainability of these assets. And by understanding the benefits differently and the value it generates, I think the return on investment will be same if not more than grey infrastructure. And hopefully with this flourishing economic system, we'll also be able to live in much nicer places for everyone, not just for a few people”* (17C).

“But maybe it's not just about funding. I would say that there is limited potential to generate funding from the communities themselves and that it's mainly a matter of support and promoting an understanding of this kind of alternative solutions” (4E). A fundamental shift in how we think about our relationship to nature and our conceptions of infrastructure is required to fully achieve the high potential of NbS. This is more than just a scientific rethinking but will challenge the common cultural perceptions of separation from nature, which entails fundamental changes in the ways decisions are made. This approach furthermore implies challenging existing social inequalities and the deeply ingrained assumptions that cities, or urban space, are only for people and openly acknowledging the complexity and reciprocity of human-non-human relations at play. Here, developing ambitious inclusivity mechanisms in the governance of NbS implies tackling not only the visible part of urban (green) inequalities, the one manifested in terms of (nature) accessibility, but the deeply-nested structural divisions that create or lead to particular exclusionary practices and the production of uneven social landscapes in the first place. To that aim, using relational, multi-scalar and multi-temporal perspectives in the design and evaluation of NbS is fundamental (Toxopeus et al., 2020). These conceptual shifts will require focused communication efforts with the public and policymakers, and address not just possible benefits but also the arduous road to get there (Nelson et al., 2020).

“Now is our time to rewrite our value and starting again by creating a new understanding of the 21st century, by putting the aside the 20th century economics which is trapping us in old systems, old metrics of money, old rules and regulations, old ideas about who we are as people. Humanity is not just self-interested and competitive. We are collaborative and adaptive. We live within ecosystems, and we are part of nature. How can we redesign the goal of economic development? How can we redesign markets and the role of the state and the role of the community?” - Kate Reworth (Dark Matters Lab, 2020).

6.2.4 Building Narratives

The literature confirms that there is a significant challenge in articulating the benefits of NbS and expressing nature's value in monetary and non-monetary terms. Narrative can be a strong mechanism to bridge this gap between communicating nature's value and finding stakeholders willing to invest in it (Nature-based Initiative, n.d). Moreover, delivering a clear narrative is crucial to get buy in from different set of key stakeholders involved in the project (NbS Initiative, 2020). A change in the narrative then supports the uptake of various financial instruments and mechanisms e.g. taxes and subsidies. IPCC (2022) has emphasized the both the adaptation and mitigation values of NbS. For example, if the main benefit from the project is flood reduction, then actors benefitting from them form direct beneficiaries and are more suitable to pay for it. Supplementary, there are indirect beneficiaries from the co-benefits such as biodiversity, air quality and social well-being. Building narratives, for example, through tools such as NbS business model canvas, can help get the direct and indirect beneficiaries on board (Mayor et al., 2021; 1E). They can bridge the silos between the environmental, finance, economic, social, and health care departments, increasing the share of investments and ensuring a just outcome. Building narratives is also finding

synergies with different sectors and actors and knitting them together at various levels of strategic plans and policies, opening doors for diverse financing sources (11E). This was quite evident in all the case studies.

The insurance sector in the case of Interpolis and the aggregator platform in the case of Trees AI played an influential role in building the narrative for the end buyers. Campaigns are another powerful tool to build a strong narrative Interpolis' marketing campaign was very successful as it conveyed the benefits of green roofs in a very 'human' terms and built a relatable narrative for their audience. The marketing campaign asked consumers, 'What is your contribution to a sustainable world?' Thus, people weren't installing green roofs to reduce their claim or catching water but rather participating in making the climate better and, thus, bought it for their satisfaction (9EC).

6.2.5 Use of Technology and Data

Technology and big data play a significant role in all phases of financing, ranging from planning and design, and operational to maintenance and monitoring. They are essential in supporting collaborative commerce and spatial finance, which can contribute to scaled up and just co-financing mechanisms (6EC). This strategic possibility also facilitates the piloting of innovative projects (Eguisztal et al., 2019). Technological innovations such as fintech and blockchain are shaping existing institutions, governance and financial landscapes of green interventions (NAIAD, 2021).

Transparency is often one of the concerns in the emerging public-private governance related to co-financing and its governance (Toxopoeus et al., 2020). Further, financial decisions need to take risks and opportunities into account and as such these assessments have been difficult in the past. In the case of Trees AI, the city of Glasgow and Dark Matter heavily relies on the use of technology and data to overcome this challenge through the use of technology and data. With the advancement in geo-spatial and earth observation data (GIS, Remote Sensing) combined with artificial intelligence and machine learning, new opportunities are rapidly developing to manage risk, and transparently measure impact. This new and emerging field is called Spatial Finance. New technologies are making it increasingly possible to gain robust independent insight into not just the asset owners (companies and nations) but also insight into the extent of the initial and ongoing environmental high-level impact (WWF, n.d.).

Furthermore, blockchain has inherent characteristics such as immutability and transparency. It can act as a robust layer of assurance for investors and contribute to further unlocking private capital for NbS whilst eliminating free riders. In addition, similar to crowdfunding, tokenising assets in blockchain can assist in making the project more fundable, precisely by reaching out to those investors that can benefit the most (even from a non-monetary perspective) from the implementation of NbS project (Somarakis et al., 2019).

Moreover, existing methods of NbS assessment often do not consider individual and community capacity to adapt to climate change. Experts in municipal organisations identify major limitations to bridge the monitoring results across large-scale NbS projects. NbS technologies can support in overcoming this barrier by delivering robust and accurate data capable of quantifying the multi-scale NbS impacts (Somarakis et al., 2019). For example, estimating the climate impact of each measure (e.g., in GHG emission reductions or adaptation benefits) across the timeframes set out in the climate strategy incentivizes climate projects and actions and raise awareness on the "climate cost" of cities' strategies. Furthermore, high resolution geolocalised data (GIS layers combined with information on potential beneficiaries and their vulnerability) provides valuable information urban planners

and decision-makers. The OSS of Glasgow provided information on the location of green infrastructure improvements, where investments might be best targeted, and what kind of interventions might be most beneficial for the needs of green deficiency areas. Such methodologies facilitate the wide acceptance of NbS across a range of societal challenges and geographical scales by preventing undesired local effects and supporting a fair and equitable distribution of NBS benefits among the urban population (Somarakis et al., 2019; NAIAD, 2021). These tools provide a platform for discussion and dialogue on the topic of collaborative policy making and can be adapted to other needs. Additionally, digitization or smart technologies may provide cost-efficient solutions by reducing the maintenance costs, e.g. via automated irrigation systems, as seen in the maintenance of BiodiverCity project. Adopting new technologies like blockchain and other remote sensing-based techniques may significantly lower projects' costs and provide high-quality geolocalised data for a just and scaled up NbS finance.

6.2.6 Experimentalist approach

The case studies highlight the role of piloting and testing and endorse an experimentalist approach. The pilot projects demonstrated the creative thinking and boldness to experiment with different co-financing mechanisms and arrangements.

Testing in previous literature has been chiefly spoken about in the urban development domain of NbS. The experimentalist approach can be advantageous to amplifying NbS funding using innovative financial arrangements and mechanisms in context-specific and ambiguous conditions to deliver a just and scaled up NbS co-finance. This includes the testing of multi-scalar governance, participation culture, incentives for different actors, business models, use of innovative technologies, etc. “Urban experimentation approaches can be devised to co-create narratives, positive visions and solutions of urban sustainability and urban resilience to steer clear from these lock-ins and strengthen narratives around a good Anthropocene” (Elmqvist et al., 2019, p. 270). In this light, the experimentalist approach may allow changing “material arrangements, cultures, norms, and conventions, and in the process, create a new political and institutional space”(Schröter et al., 2022).

Experimentalist approaches moves away from top-down hierarchical style of governance, create condition to address procedural, distributive, and intersectional justice in green space by opening up new ideas and methods for urban environmental governance and transformative and adaptive co-production process (Bulkeley et al., 2016; Anguelovski et al., 2018; Cousins, 2021). Diverging interests of stakeholders have usually been negotiated before the start of the funding or are homogeneous in favor of the NbS implementation. While the case studies demonstrated openness and a considerably supportive political space by inviting or accepting the invitation from different actors to increase the financing share, the same cannot be claimed for urban environmental justice.

Experiments are not usually funded by public money as innovation activities fall outside the scope of the municipal budget, time and expertise (Schröter et al., 2022). Three out of four innovation in the case studies were partly funded by the EU funds and/or private and national funds. European Commission is currently supporting numerous research and innovation projects to advance NbS which is then promoted by researchers, activists and practitioners (4E). The aim is, this testing, comparing and learning from different approaches would start a discussion supporting the policy approach (Schröter et al., 2022). Consequently, municipalities must lead by example to initiate a broader transformative change (4E). However, these projects can experience challenges in securing the funding needed for post-

implementation efforts beyond project lifetime (i.e., maintenance and monitoring) unless supported by private funding, which most case studies managed to conquer.

6.2.7 Feedback Loops

Forming feedback is essential for experiments to get mainstreamed. Learning, capacity building, collaboration, knowledge dissemination, communication and monitoring and evaluation form strong elements of the feedback loops. The multifunctional aspects of NbS evolve and varies in space and time, thus the assessment of their benefits is strongly related to complex thinking that examines dialogic processes and loops. Ideally, these elements need to occur across all project activities (Schröter et al., 2022). These practices underpinned the investment's sustainability and secured positive outcomes (Solomon et al., 2020).

Iterative learning and capacity can be built by getting private actors, researchers, mediators and aggregators. For a complete transformation, current professionals need to be upskilled, and a new stream of professionals needs to be explicitly trained to deliver NbS. The capacity to collaborate, and coordinate across functions, agencies, sectors, and levels of government is essential for greater cohesion and maximum use of scarce resources in an efficient manner, avoiding silo approaches. Further enabling cross-sectoral partnerships is critical for NbS design implementation and maintenance, but it also supports knowledge sharing and fosters effective management in the face of uncertainty (Nature4Cities, 2018). Practices that built on people's skills, community institutions, capacity and levels of social cohesion support the multiplier effect, built relationships between the city and other groups, catalyzing wider action, impact and consequently investment (Solomon et al., 2020). For example, if you need strong citizen support to implement the solution, they will be familiar and accepting by co-developing with them. This in turn will lead to a level of trust and ownership crucial for the long-term success of the intervention (6EC).

Diffusion of knowledge and communication is considered as another of the hallmarks for a successful co-financing scheme. This is important for NbS where there is hardly any precedence, and a lot of new knowledge is created through learning-by-doing. Communication of the co-benefits to different levels of decision-makers and citizens becomes a transversal activity throughout the project's entire lifespan. Collaborative and imaginative approaches of communication not only increase the support for NbS but also through increased evaluation to also optimize the potential of attaining the co-benefits (Raymond et al., 2017). Moreover, a continuous feedback cycle of evaluating results and adjusting actions and objectives helps to improve outcomes (Wilk et al., 2020). This results in better adapting in the face of uncertainty where the choice between several alternatives must be made over different project phases (Nature4Cities, 2018).

6.3 Revised Framework

Figure 6-1 summarizes the discussion points presented in the chapter. All three actor groups – public, private and community, including aggregators and NbE have a decisive role to play in scaled up and just co-financing of urban NbS. Multi-level governance vertically and horizontally across scales and adaptive management are considered essentialities of collaborative NbS finance. There are several perspectives and opinions in literature and among experts that exist between the balancing act of scaling up of finance and justice. However, the case studies point to some of the key strategic possibilities outlined in Section 6.2, providing urban actors with guidance to operationalize an integrated approach to co-financing.

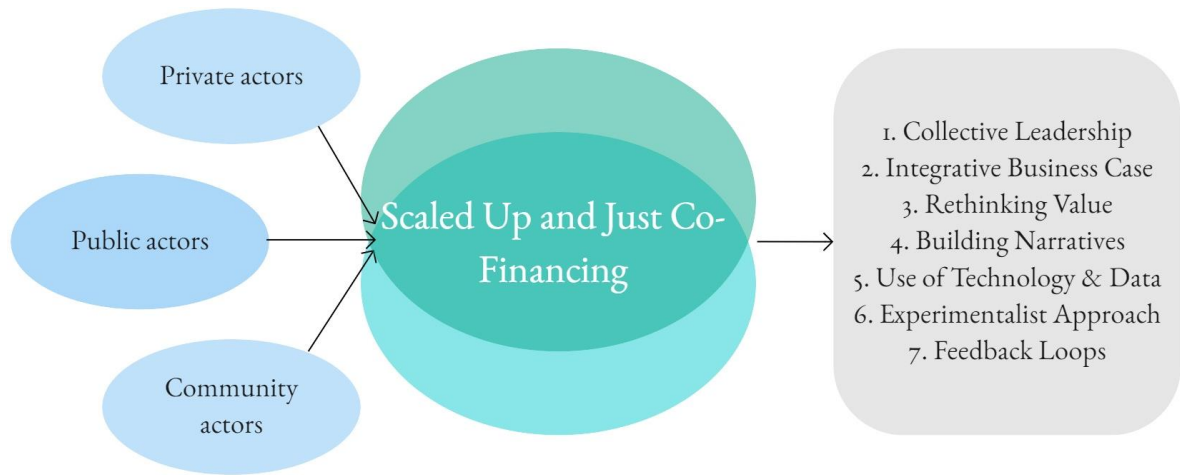


Figure 6-1: Revised Conceptual Framework

Source: Author's elaboration.

7 Conclusion

This final chapter outlines the Key Findings of this research in relation to the two RQs. Based on these findings, broader Implications for Urban Actors and Academia are highlighted, followed by Areas for Future Research. The chapter ends with Limitations and author's on Personal Reflections on the research thesis.

7.1 Key Findings

The current reality is that cities are losing green spaces rather than creating more. NbS is seen in conflict with the urban densification which is paradoxically driven by the same sustainability agenda. Further, within the discourse of NbS, multiple trade-offs and synergies exist, and the social, economic and environmental sustainability agenda are often clashing. However, if implemented correctly, NbS can play a crucial role in the long-term resilience of the cities, although one of the recurrent barriers for its mainstreaming is finance. NbS co-finance, which comprises financing solutions involving stakeholders from different departments, sectors and/or actor groups, offers a solution to overcome this hurdle. The research explored this paradigm through two research questions. RQ1: How do scaling up and social justice concepts relate to co-financing urban NbS? And RQ2: What strategic possibilities can urban actors adopt to ensure scaled up and just co-finance of urban NbS?

The study looks at co-financing through the lens of scaling up and justice, where each of the public, private and community actors play a vital role. From the perspective of scaling up finance, mobilization of private sector funds is considered inevitable especially for large-scale projects. Further, the continuity of the project largely depended on covering maintenance costs. However, inflow of private finance often contradicts the environmental justice outcomes, raising concerns on the neoliberal green growth agenda where social inclusion and equity concerns are often neglected. Here, contestations by community actor can be seen as a corrective measure to the issue above. Public actors can be seen as the balancing force in the room to ensure scalable co-finance of just NbS. Drawing from multiple sources of literature and expert opinion, the author elaborates on five building blocks for scaling up and social justice each related to the co-financing of urban NbS. The relationship between the three concepts is explained through developing the Conceptual Framework answering RQ1.

Four case studies were examined that adopted innovative co-financing solutions for urban NbS and supported answering RQ2. The case studies offered insights into the relationship between the concepts of justice and scalability and provided a comprehensive analysis of these concepts by testing out the framework. Both trade-offs and synergies were observed in the case studies and the balancing act between them can be quite tricky for cities to achieve. The complexity is increased when a range of diverse actors are reinvolved to increase the share of funding. It became clear that a critical interrogation on the visions around renaturing cities, and how it is redefined, reimagined, exported and rearticulated is required. While NbS did create green jobs in the analyzed cases and most managed to achieve distributional justice, it remains unambiguous both in the literature and case studies if recognition and procedural justice was considered with or without the private sector involvement. Further, all three actors, including aggregators and NbE, in different capacities, can contribute to both the scalability and social justice aspect of co-finance. An important finding of the study was that finance is a systematic barrier and is highly contextual. To ensure a holistic approach to just and scalable co-financing of urban NbS requires looking beyond the project and entering into the structural domains of governance and urban development. Overall, the analysis further brings to light seven strategic possibilities - Collective Leadership, Integrative Business Case, Rethinking Value, Building Narratives, Use of Technology and Data,

Experimentalist approach and Feedback Loops, to overcome the contractions of scalability of finance and justice and realizes their synergies. These possibilities offer promising pathways for urban actors and should be considered when formulating policies and planning to ensure that the co-financing of NbS is scalable and just.

7.2 Implications for Urban Actors and Academia

Many cities worldwide understand the impact of climate change in urban areas and are committed to delivering climate action. They increasingly realize the role of NbS to provide their population a safe, prosperous, and equitable future. Despite this increased focus, cities face a pressing challenge in securing long-term green investment. The newness of NbS co-financing implies there is also a lack of knowledge to understand and operationalize this concept. Crucially, before this concept is mainstreamed in practice, there is a need to investigate the topic through a holistic lens. In this light the research develops a conceptual framework to understand the relationship between the scalability of finance the social justice outcomes. It further provides practical recommendations in the form of Strategic Possibilities, which provides leverage points to implement just and scalable NbS co-finance.

The research guides the municipal and city governments through understanding how investments can be mobilized and its continuity maintained. Further, balancing the interest of diverse group of financing actors can be quite complex for the municipal officials to govern. The study recognizes the challenge for public administrators to balance the trade-offs of increasing the share of finance with the social justice outcomes and capitalize on their synergies. However, it urges the urban actors –policymakers, government officials, NGOs, business, researchers, directly or indirectly helping the public officials, and other private and community actors to take an intentional approach for just and scalable co-financing solutions. Moreover, the four case studies further provide demonstratable examples for a just and scalable co-financing solution of NbS (through varying degrees) emphasizing bold and creative thinking. These successful case studies demonstrated a holistic and long-term approach to finance, featuring several innovative financing mechanisms and arrangements for the municipalities and cities to take inspiration from.

The recommendations (provided in the form of strategic possibilities) act upon this information and open the door for endless prospects. It urges the urban actors to take a collective leadership approach that encompasses political will, collaborative multi-scalar governance, and internal and external co-creation. An integrated business case should be developed which considers the characteristics of different types of NbS where funds are allocated throughout the project's lifecycle. Yet, a fundamental shift in how we think about our relationship with nature is required to realize its potential fully. Further, the use of technology and data in different phases of the project is highly beneficial for the distribution of benefits and risks, transparency, and monitoring and assessment. Lastly, the author prescribes an experimentalist approach that encompasses bold and creative thinking, followed by incorporating feedback loops to maximize the synergies throughout different phases of the project.

The study also has implications for academia by contributing to the growing literature on NbS finance, environmental justice, business models, governance and mainstreaming. The literature on a holistic approach to co-financing is currently scattered. Furthermore, experts in different fields at times exhibited siloed thinking. It brings together up-to-date information from the literature and speaking to experts on this topic. The conceptual framework unpacks the concept of co-financing by looking at it from a holistic lens of justice and scalability. The

framework can be further be developed into a tool by the researchers to be used by societal actors and practitioners to mainstream by co-financing of NbS.

7.3 Areas for Future Research

Currently, research in developing pathways to mainstream NbS in cities is happening at a fast pace. While the research thesis has guided urban actors, it opens doors for further efforts to catalyze long-term investments with high socioeconomic benefits and social justice outcomes.

Systematic outlook. The research recognized scalability and justice as the main elements for a holistic co-finance approach. While the thesis claims to provide a holistic view of co-finance, it was impossible to cover the wide range of systematic conditions. More research is required to build on connecting finance to different domains of urban developments, governance and politics. Further other fields such as ecological and environmental sustainability, culture was vastly kept out of the scope, although it could have numerous implications on NbS finance, demanding further research.

Regarding scalability, the study calls for future research to conceptualize better and investigate the interactions across multiple urban systems and scales. Moreover, citizens were not entirely perceived as homogenous entity. Further, the research focused on distributional justice and did not explore the ties of recognitional and procedural justice with co-financing urban NbS. By explicitly considering the heterogeneity of these structural conditions, their interlinkages and how they lead to a scalable and finance more nuanced, granular, and holistic understanding of the complex challenges and then strategic possibilities can be derived.

Co-financing mechanisms. There is an array of financial mechanisms which can be applied to NbS, some presented in the thesis. Through the case studies it was clear that these mechanisms alone are not able to scale up NbS across Europe or the globe. More innovation is needed to create financial arrangements that capture the value that NbS can provide and turn it into an investable business case. The strengths and weakness of each mechanism involving different actor arrangements can be focused further to reveal new strategies. Moreover, research in business models thus far has been neglecting the justice component and more study should be directed in developing intentional business models that are both scalable and just. These models should be studied more in depth from the scales of time perspective, analyzing the differences between the different stages of the project's life cycle to operationalize more precisely.

Actor constellations. In a complex, multi-actor constellation in the urban context, it is still less clear how actor alignments and their interdependencies affect opportunities and challenges for implementing just and scaled up NbS co-financing solutions. The framework can be further developed where the nuances between different actors are captured better, to maximize on the collaborative aspect of co-financing solutions. Follow-up research could more explicitly identify alignment or lack between actors, to identify suitable governance models concerning co-financing solutions.

Strategic Possibilities. Each of the strategic possibilities defends co-financing solutions. However, it provides surface-level information. NbS co-financing can benefit from further research which looks into each of these leverage points to offer a more context-specific transition pathway.

Case Studies. The four analyzed cases uncover the first stepping stones in this ongoing journey. While co-financing solutions highlighted are across many types and scales, an in-depth study is required to pin down (co) financing solutions for different types and typologies of urban NbS. Further, the study did not explore examples of projects that tried to be just by co-producing with the communities to test whether they could be amalgamated with the scalability of finance. Additionally, it failed to capture the various co-financing mechanisms and arrangements and how they relate to these two concepts. Lastly, it is worthwhile to explore the approach in different geographies. This study has focused on European countries, where EU funds partly supported two case studies. It would be interesting to look at transnational alignment and explore this topic in rapidly developing economies and the Global South.

7.4 Limitations

The research thesis has several limitations related to methodological choices translated into the study's outcome. In a qualitative case study design, the issue's complexity is explored through participants' opinions and the way the study was conducted (Creswell & Creswell, 2018).

Relating to the philosophical approach, the author adopted a mix of interpretivism and pragmatism philosophies. The researcher's bias in framing questions, selection of literature and case studies, analysis of results may have altered the results. Further, the outcome and the result of the study were shaped by the interviewee's background and experiences and the author's interpretation of their responses. The study acknowledges how this interpretation flows from their personal, cultural, and historical background to the author's background. The author used data triangulation to address this and supported findings through various literature sources and expert opinions. The study could not capture the private sector's perspective (except for Case1) on the co-financing arrangement. However, this was compensated through researcher's or other practitioners' opinions, web articles, and strategy plans.

While a certain degree of generalizability was achieved through a multiple case study approach, the way the conceptual framework is interpreted and implemented will depend heavily on the context. The framework and the strategic possibilities can be used as a guide and should not be considered as a silver bullet. Moreover, NbS finance is an emerging hot topic in the research field. Due to the time constraint, the research thesis possibly couldn't cover all the mechanism and actor arrangements, which would have increased the research generalizability.

7.5 Personal Reflections

To begin, the process of finding a gap, deciding on a topic to research, deciding on case studies and presenting the information has been highly iterative. In the beginning, the topic idea was very abstract which developed over time. Brainstorming ideas with anyone who was interested to listen, further helped me tremendously in the process.

Some of the roadblocks I faced during my research was that the literature on co-financing NbS was very scattered, resulting in a time-consuming literature analysis process. I had to change my case studies several times before I finalized them. Finding the right balance of case studies which used diverse financial mechanisms and diverse groups of actors was challenging in the short amount of thesis duration. An adaptive approach helped me realize this thesis research's potential.

Undoubtedly, the thesis is a reflection of who I am as a person and how I bring together my own experiences, background and values to my thinking process. This has added both to the strength and weaknesses of the thesis. My passion for NbS and curiosity to learn about finance have kept me motivated during tough times. I thoroughly enjoyed researching on this topic and hearing so many multiple perspectives on it from researchers and practitioners alike. The thesis research is like a teaser, and I would like to pursue the topic and learn more about in the future through research and/or practical work.

Bibliography

- Andersson, J., Green, J., Stålhamre, J. N., & Arkitekter, W. (n.d.). *Utvärderingsrapport: Organisation och genomförande demoanläggningar BiodiverCity Fas 2 - PDF Free Download*. Retrieved May 20, 2022, from <https://docplayer.se/107446908-Utvarderingsrapport-organisation-och-genomforande-demoanlaggningar-biodivercity-fas-2.html>
- ANEL. (n.d.). *Niou Georgiou Park*. Nicosia Municipality. Retrieved May 19, 2022, from <https://www.nicosia.org.cy//en-GB/discover/parks/agioi-omologites/small/49527/>
- Angelovski, I. (2013). Beyond a Livable and Green Neighborhood: Asserting Control, Sovereignty and Transgression in the Casc Antic of Barcelona. *International Journal of Urban and Regional Research*, 37(3), 1012. https://www.academia.edu/3430697/Beyond_a_Livable_and_Green_Neighborhood_Asserting_Control_Sovereignty_and_Transgression_in_the_Casc_Antic_of_Barcelona
- Angelovski, I. (2015). From Toxic Sites to Parks as (Green) LULUs? New Challenges of Inequity, Privilege, Gentrification, and Exclusion for Urban Environmental Justice. *Journal of Planning Literature*, 31(1), 23–36. <https://doi.org/10.1177/0885412215610491>
- Angelovski, I., Connolly, J. J. T., Masip, L., & Pearsall, H. (2018). Assessing green gentrification in historically disenfranchised neighborhoods: A longitudinal and spatial analysis of Barcelona. *Urban Geography*, 39(3), 458–491. <https://doi.org/10.1080/02723638.2017.1349987>
- Armstrong, A. (2020). *Mainstreaming Nature-Based Solutions: Social Inclusion*.
- Bäckstrand, K. (2003). Civic Science for Sustainability: Reframing the Role of Experts, Policy-Makers and Citizens in Environmental Governance. *Global Environmental Politics*, 3(4), 24–41. <https://doi.org/10.1162/152638003322757916>
- Banwart, S. A., Mortimer, N., & Rabb, B. (2019). *Development of a multi-stakeholder dialogue platform and Think tank to promote innovation with Nature-based solutions*. ThinkNature. https://platform.think-nature.eu/system/files/project_deliverable/d7.1.pdf
- Barone, B. (2022). *What Is an Asset?* Investopedia. <https://www.investopedia.com/terms/a/asset.asp>

- Barquet, K., Leander, E., Green, J., Tuhkanen, H., Omondi Odongo, V., Boyland, M., Fiertz, E. K., Escobar, M., Trujillo, M., & Osano, P. (2021). *Spotlight on social equity, finance and scale: Promises and pitfalls of nature-based solutions*. Stockholm Environment Institute. <https://doi.org/10.51414/sci2021.011>
- Bartlett, L., & Vavrus, F. (2017a). Comparative Case Studies: An Innovative Approach. *Nordic Journal of Comparative and International Education (NJCIE)*, 1(1), Article 1. <https://doi.org/10.7577/njcie.1929>
- Bazrkar, M. H., Zamani, N., Eslamian, S., Eslamian, A., & Dehghan, Z. (2015). Urbanization and Climate Change. In W. Leal Filho (Ed.), *Handbook of Climate Change Adaptation* (pp. 619–655). Springer. https://doi.org/10.1007/978-3-642-38670-1_90
- BiodiverCity | Urban Nature Atlas. (n.d.). *BiodiverCity | Urban Nature Atlas*. Retrieved May 20, 2022, from <https://una.city/nbs/malmo/biodivercity>
- Brink, E., Aalders, T., Ádám, D., Feller, R., Henselek, Y., Hoffmann, A., Ibe, K., Matthey-Doret, A., Meyer, M., Negrut, N. L., Rau, A.-L., Riewerts, B., von Schuckmann, L., Törnros, S., von Wehrden, H., Abson, D. J., & Wamsler, C. (2016). Cascades of green: A review of ecosystem-based adaptation in urban areas. *Global Environmental Change*, 36, 111–123. <https://doi.org/10.1016/j.gloenvcha.2015.11.003>
- Bush, J., & Doyon, A. (2019). Building urban resilience with nature-based solutions: How can urban planning contribute? *Cities*, 95, 102483. <https://doi.org/10.1016/j.cities.2019.102483>
- Cash, D., Adger, W. N., Berkes, F., Garden, P., Lebel, L., Olsson, P., Pritchard, L., & Young, O. (2006). Scale and Cross-Scale Dynamics: Governance and Information in a Multilevel World. *Ecology and Society*, 11(2). <https://doi.org/10.5751/ES-01759-110208>
- Challenges of Scaling Up and Financing Ecosystem-Based Adaptation in Africa: The Role of Innovation*. (2021, July 8). Global Resilience Partnership. <https://www.globalresiliencepartnership.org/challenges-of-scaling-up-and-financing-ecosystem-based-adaptation-in-africa-the-role-of-innovation/>
- Chen, C., & Bartle, J. R. (2022). Innovative Mechanisms of Financing Infrastructure. In C. Chen & J. R. Bartle (Eds.), *Innovative Infrastructure Finance: A Guide for State and Local Governments* (pp. 71–132). Springer International Publishing. https://doi.org/10.1007/978-3-030-91411-0_4
- CLICKNL: *Interpolis*. (n.d.). CLICKNL. Retrieved April 1, 2022, from <https://www.clicknl.nl/>

- ICLEI. (n.d.). *Climate Finance Glossary*. <https://tap-potential.org/wp-content/uploads/2021/06/climate-finance-glossary-tap.pdf>
- Cohen-Shacham, E., Walters, G., Maginnis, S., & Janzen, C. (2016). *Nature-based Solutions to address global societal challenges*. <https://doi.org/10.2305/IUCN.CH.2016.13.en>
- Connecting Nature. (n.d.). *Connecting Nature Framework | Connecting Nature*. Retrieved May 22, 2022, from <https://connectingnature.eu/innovations/connecting-nature-framework>
- Conte, C. (2022). *Trees are infrastructure*. <https://www.domusweb.it/en/speciali/domus-air/2022/treesare-infrastructure.html>
- Cortinovis, C., Olsson, P., Boke-Olén, N., & Hedlund, K. (2022). Scaling up nature-based solutions for climate-change adaptation: Potential and benefits in three European cities. *Urban Forestry & Urban Greening*, 67, 127450. <https://doi.org/10.1016/j.ufug.2021.127450>
- Cousins, J. J. (2021). Justice in nature-based solutions: Research and pathways. *Ecological Economics*, 180, 106874. <https://doi.org/10.1016/j.ecolecon.2020.106874>
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE.
- Dark Matters Lab. (2020). *Interview with Kate Raworth at Trees as Infrastructure Workshop on Vimeo*. <https://vimeo.com/377023491>
- Davis, M., & Naumann, S. (2017). Making the Case for Sustainable Urban Drainage Systems as a Nature-Based Solution to Urban Flooding. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 123–137). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_8
- Depietri, Y., & McPhearson, T. (2017). Integrating the Grey, Green, and Blue in Cities: Nature-Based Solutions for Climate Change Adaptation and Risk Reduction. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 91–109). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_6
- European Commission, E. (2015). *Towards an EU research and innovation policy agenda for nature-based solutions & re-naturing cities*. Horizon 2020 - European Commission.

<https://ec.europa.eu/programmes/horizon2020/en/news/towards-eu-research-and-innovation-policy-agenda-nature-based-solutions-re-naturing-cities>

European Commission. (2021). *Evaluating the impact of nature-based solutions: A summary for policy makers*. Publications Office of the European Union. <https://data.europa.eu/doi/10.2777/521937>

Dorst, H., van der Jagt, A., Raven, R., & Runhaar, H. (2019). Urban greening through nature-based solutions – Key characteristics of an emerging concept. *Sustainable Cities and Society*, 49, 101620. <https://doi.org/10.1016/j.scs.2019.101620>

Dorst, H., van der Jagt, A., Toxopeus, H., Tozer, L., Raven, R., & Runhaar, H. (2022). What's behind the barriers? Uncovering structural conditions working against urban nature-based solutions. *Landscape and Urban Planning*, 220, 104335. <https://doi.org/10.1016/j.landurbplan.2021.104335>

Droste, N., Schröter-Schlaack, C., Hansjürgens, B., & Zimmermann, H. (2017). Implementing Nature-Based Solutions in Urban Areas: Financing and Governance Aspects. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 307–321). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_18

Eggermont, H., Balian, E., Azevedo, M., Beumer, V., Brodin, T., Claudet, J., Fady, B., Grube, M., Keune, H., Lamarque, P., Reuter, K., Smith, M., Ham, C., Weisser, W., & Roux, X. (2015). Nature-based Solutions: New Influence for Environmental Management and Research in Europe. *Gaia: Ökologische Perspektiven in Natur-, Geistes- Und Wirtschaftswissenschaften*, 24, 243–248. <https://doi.org/10.14512/gaia.24.4.9>

Egusquiza, A., Arana, M., Sopelana, A., & Babi Almenar, J. (2021). Conceptual and Operational Integration of Governance, Financing, and Business Models for Urban Nature-Based Solutions. *Sustainability*, 13, 11931. <https://doi.org/10.3390/su132111931>

Elmqvist, T., Andersson, E., Frantzeskaki, N., McPhearson, T., Olsson, P., Gaffney, O., Takeuchi, K., & Folke, C. (2019). Sustainability and resilience for transformation in the urban century. *Nature Sustainability*, 2(4), 267–273. <https://doi.org/10.1038/s41893-019-0250-1>

Enzi, V., Cameron, B., Dezsényi, P., Gedge, D., Mann, G., & Pitha, U. (2017). Nature-Based Solutions and Buildings – The Power of Surfaces to Help Cities Adapt to Climate Change and to Deliver Biodiversity. In N. Kabisch,

- H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 159–183). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_10
- Ershad Sarabi, S., Han, Q., L. Romme, A. G., de Vries, B., & Wendling, L. (2019). Key Enablers of and Barriers to the Uptake and Implementation of Nature-Based Solutions in Urban Settings: A Review. *Resources*, 8(3), 121. <https://doi.org/10.3390/resources8030121>
- Faivre, N., Fritz, M., Freitas, T., de Boissezon, B., & Vandewoestijne, S. (2017). Nature-Based Solutions in the EU: Innovating with nature to address social, economic and environmental challenges. *Environmental Research*, 159, 509–518. <https://doi.org/10.1016/j.envres.2017.08.032>
- Fastenrath, S., Bush, J., & Coenen, L. (2020). *Scaling-up nature-based solutions. Lessons from the Living Melbourne strategy—ScienceDirect*. <https://www.sciencedirect.com/science/article/pii/S0016718520302049>
- Flyvbjerg Bent. (2006). *Five Misunderstandings About Case-Study Research*—Retrieved May 18, 2022, from <https://journals.sagepub.com/doi/10.1177/1077800405284363>
- Frantzeskaki, N. (2019). Seven lessons for planning nature-based solutions in cities. *Environmental Science & Policy*, 93, 101–111. <https://doi.org/10.1016/j.envsci.2018.12.033>
- Frantzeskaki, N., Borgström, S., Gorissen, L., Egermann, M., & Ehnert, F. (2017). Nature-Based Solutions Accelerating Urban Sustainability Transitions in Cities: Lessons from Dresden, Genk and Stockholm Cities. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 65–88). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_5
- GCC. (2015). *Open Space Strategy* [Accounts]. 1619. <https://www.glasgow.gov.uk/openspacestrategy>
- GCC. (2021). *Woodland strategy aims to boost tree cover over Glasgow City Region* [Standard]. <https://glasgow.gov.uk/article/26755/Woodland-strategy-aims-to-boost-tree-cover-over-Glasgow-City-Region>
- Glasgow | Connecting Nature. (n.d.). *Glasgow | Connecting Nature*. Retrieved April 8, 2022, from <https://connectingnature.eu/glasgow>

- Green Surge. (2017). *Unlocking alternative ways of financing urban green infrastructure by getting a better grasp of its diverse values*. Department of Geosciences and Natural Resource Management; University of Copenhagen. <https://ign.ku.dk/english/green-surge/>
- GrowGreen. (2019). Approaches to financing nature-based solutions in cities. *GrowGreen*. <https://growgreenproject.eu/approaches-financing-nature-based-solutions-cities/>
- Haase, A. (2017). The Contribution of Nature-Based Solutions to Socially Inclusive Urban Development– Some Reflections from a Social-environmental Perspective. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 221–236). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_13
- IDB. (2021, October 13). Driving financial innovation and investment for nature-based solutions in Latin America and the Caribbean. <https://blogs.iadb.org/sostenibilidad/en/financial-innovation-investment-for-nbs-in-lac/>
- Investopedia*. (n.d.). Investopedia. Retrieved February 21, 2022, from <https://www.investopedia.com/terms/s/scalability.asp>
- IPCC (2022). Summary for Policymakers. In: *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R Shukla, J.Skea, R.Slade, A.Al Khourdajie, R.van Diemen, D. McCollum, M.Pathak, S.Some, P.Vyas, R.Fradera, M.Belkacemi, A.Hasija, G.Lisboa, S.Luz, J.Malley, (eds.)]. Cambridge University Press, Cmabridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001
- IUCN. (n.d.). *Nature+ Accelerator Fund* | IUCN. Retrieved May 19, 2022, from <https://www.iucn.org/theme/nature-based-solutions/initiatives/nbs-finance-mechanisms-and-funds/nature-accelerator-fund>
- IUCN. (2020). *IUCN Global Standard for Nature-based Solutions: First edition*. <https://doi.org/10.2305/IUCN.CH.2020.08.en>
- Jerome, G., Mell, I., & Shaw, D. (2017). Re-defining the characteristics of environmental volunteering: Creating a typology of community-scale green infrastructure. *Environmental Research*, 158, 399–408. <https://doi.org/10.1016/j.envres.2017.05.037>

- Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., Haase, D., Knapp, S., Korn, H., Stadler, J., Zaunberger, K., & Bonn, A. (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: Perspectives on indicators, knowledge gaps, barriers, and opportunities for action. *Ecology and Society*, 21(2). <https://www.jstor.org/stable/26270403>
- Kabisch, N., Korn, H., Stadler, J., & Bonn, A. (2017a). Nature-Based Solutions to Climate Change Adaptation in Urban Areas—Linkages Between Science, Policy and Practice. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 1–11). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_1
- Kabisch, N., & van den Bosch, M. A. (2017b). Urban Green Spaces and the Potential for Health Improvement and Environmental Justice in a Changing Climate. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 207–220). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_12
- Ketschau, T. J. (2015). Social Justice as a Link between Sustainability and Educational Sciences. *Sustainability*, 7(11), 15754–15771. <https://doi.org/10.3390/su71115754>
- Kim, J. (2016). *Global Report on Urban Infrastructure Financing*. News Powered by Cision. <https://news.cision.com/new-cities-foundation/r/new-cities-foundation-releases-global-report-on-urban-infrastructure-financing.c2001843>
- Kiss, B. (2017). *NATURVATION – Case Study Working Paper, MALMÖ*. https://atlas.naturvation.eu/sites/default/files/nbs/files/wp4_case_study_malmo_20171120.pdf
- Kooijman, E. D., McQuaid, S., Rhodes, M.-L., Collier, M. J., & Pilla, F. (2021). Innovating with Nature: From Nature-Based Solutions to Nature-Based Enterprises. *Sustainability*, 13(3), 1263. <https://doi.org/10.3390/su13031263>
- Koppenjan, J. F. M., & Enserink, B. (2009). Public–Private Partnerships in Urban Infrastructures: Reconciling Private Sector Participation and Sustainability. *Public Administration Review*, 69(2), 284–296. <https://doi.org/10.1111/j.1540-6210.2008.01974.x>
- Kotsila, P., Anguelovski, I., Baró, F., Langemeyer, J., Sekulova, F., & JT Connolly, J. (2020). Nature-based solutions as discursive tools and contested practices in urban nature’s neoliberalisation processes. *Environment and Planning E: Nature and Space*, 4(2), 252–274. <https://doi.org/10.1177/2514848620901437>

- Kremer, P., Hamstead, Z., Haase, D., McPhearson, T., Frantzeskaki, N., Andersson, E., Kabisch, N., Larondelle, N., Rall, E. L., Voigt, A., Baró, F., Bertram, C., Gómez-Baggethun, E., Hansen, R., Kaczorowska, A., Kain, J.-H., Kronenberg, J., Langemeyer, J., Pauleit, S., ... Elmqvist, T. (2016). Key insights for the future of urban ecosystem services research. *Ecology and Society*, 21(2). <https://www.jstor.org/stable/26270402>
- Maes, J., & Jacobs, S. (2017). Nature-Based Solutions for Europe's Sustainable Development. *Conservation Letters*, 10(1), 121–124. <https://doi.org/10.1111/conl.12216>
- Malmö stad. (2018). *Startsida Malmö stad* [Text]. <https://malmo.se/Miljo-och-klimat/Miljo--och-klimatprojekt/BiodiverCity.html>
- Mayor, B., Toxopeus, H., McQuaid, S., Croci, E., Lucchitta, B., Reddy, S., Egusquiza, A., Altamirano, M. A., Trumbic, T., Tuerk, A., García, G., Feliu, E., Malandrino, C., Schante, J., Jensen, A., & Lopez-gunn, E. (2021). State of the Art and Latest Advances in Exploring Business Models for Nature-Based Solutions. *Sustainability*, 13, 7413. <https://doi.org/10.3390/su13137413>
- McQuaid, S., Kooijman, E. D., Rhodes, M.-L., & Cannon, S. M. (2021). Innovating with Nature: Factors Influencing the Success of Nature-Based Enterprises. *Sustainability*, 13(22), 12488. <https://doi.org/10.3390/su132212488>
- McQuaid, S. (2019). *Nature-based Solutions Business Model Canvas Guidebook: A collaborative output from the Connecting Nature Horizon 2020 Project; Zenodo: Dublin*. <https://connectingnature.eu/sites/default/files/downloads/NBC-BMC-Booklet-Final-%28for-circulation%29.pdf>
- Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. *Landscape and Urban Planning*, 147, 38. https://www.academia.edu/20035413/Defining_Urban_Resilience_A_Review
- Mell, I. (2018). Financing the future of green infrastructure planning: Alternatives and opportunities in the UK. *Landscape Research*, 43(6), 751–768. <https://doi.org/10.1080/01426397.2017.1390079>
- Mell, I., & Whitten, M. (2021). Access to Nature in a Post Covid-19 World: Opportunities for Green Infrastructure Financing, Distribution and Equitability in Urban Planning. *International Journal of Environmental Research and Public Health*, 18(4), 1527. <https://doi.org/10.3390/ijerph18041527>
- Nature-based Solutions Initiative (n.d). *Mobilizing up-scaling of Nature-based Solutions for climate change throughout 2020 and beyond*. Retrieved February 25, 2022, from <https://www.naturebasedsolutionsinitiative.org/news/report->

[workshop-on-mobilizing-up-scaling-of-nature-based-solutions-for-climate-change-throughout-2020-and-beyond/](#)

NAIAD (2021). *New Handbook for Implementation of Nature-based Solutions for Water Security* | NetworkNature.

<https://networknature.eu/new-handbook-implementation-nature-based-solutions-water-security>

Nature4Cities. (2019). *Nature4Cities developed a typology of Nature Based Solutions Implementation models*. nature4cities.

<https://www.nature4cities.eu/post/nature4cities-typology-nature-based-solutions-implementation-models>

Nelson, D. R., Bledsoe, B. P., Ferreira, S., & Nibbelink, N. P. (2020). Challenges to realizing the potential of nature-based solutions. *Current Opinion in Environmental Sustainability*, 45, 49–55.

<https://doi.org/10.1016/j.cosust.2020.09.001>

Nesshöver, C., Assmuth, T., Irvine, K. N., Rusch, G. M., Waylen, K. A., Delbaere, B., Haase, D., Jones-Walters, L., Keune, H., Kovacs, E., Krauze, K., Kylvik, M., Rey, F., van Dijk, J., Vistad, O. I., Wilkinson, M. E., & Wittmer, H. (2017). The science, policy and practice of nature-based solutions: An interdisciplinary perspective. *Science of The Total Environment*, 579, 1215–1227.

<https://doi.org/10.1016/j.scitotenv.2016.11.106>

Nicosia | Connecting Nature. (n.d.). *Nicosia | Connecting Nature*. Retrieved April 5, 2022, from

<https://connectingnature.eu/nicosia>

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). *Thematic Analysis: Striving to Meet the Trustworthiness*

Criteria. <https://journals.sagepub.com/doi/full/10.1177/1609406917733847>

Open Space Strategy. (2015, November 3). *Open Space Strategy* [Accounts]. 1619.

<https://www.glasgow.gov.uk/index.aspx?articleid=17192>

Oppla. (n.d.). *Urban Green Network of Nicosia* | Oppla. Retrieved April 5, 2022, from <https://oppla.eu/casestudy/24727>

Pauleit, S., Zölch, T., Hansen, R., Randrup, T. B., & Konijnendijk van den Bosch, C. (2017). Nature-Based Solutions and Climate Change – Four Shades of Green. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 29–49).

Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_3

- Portney, K. E. (2013). *Taking Sustainable Cities Seriously: Economic Development, the Environment, and Quality of Life in American Cities* (2nd ed.). MIT Press.
- Ramirez-Agudelo, A., Porcar Anento, R., Villares, M., & Roca, E. (2020). *NBS spatial scales description*. ResearchGate. https://www.researchgate.net/figure/NBS-spatial-scales-description_tbl2_346937410
- Raworth, K., Bass, S., & Wykes, S. (2014). *Securing social justice in the green economy*. International Institute for Environment and Development. <https://www.jstor.org/stable/resrep01566>
- Raymond, C. M., Frantzeskaki, N., Kabisch, N., Berry, P., Breil, M., Nita, M. R., Geneletti, D., & Calfapietra, C. (2017). A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environmental Science & Policy*, 77, 15–24. <https://doi.org/10.1016/j.envsci.2017.07.008>
- Ridder, H.-G. (2017). The theory contribution of case study research designs. *Business Research*, 10(2), 281–305. <https://doi.org/10.1007/s40685-017-0045-z>
- Rutt, R. L., & Gulsrud, N. M. (2016). Green justice in the city: A new agenda for urban green space research in Europe. *Urban Forestry & Urban Greening*, 19, 123–127. <https://doi.org/10.1016/j.ufug.2016.07.004>
- Sarabi, S., Han, Q., Romme, A. G. L., de Vries, B., Valkenburg, R., & den Ouden, E. (2020). Uptake and implementation of Nature-Based Solutions: An analysis of barriers using Interpretive Structural Modeling. *Journal of Environmental Management*, 270, 110749. <https://doi.org/10.1016/j.jenvman.2020.110749>
- Schultz, L., Folke, C., Österblom, H., & Olsson, P. (2015). *Adaptive governance, ecosystem management, and natural capital* | PNAS. <https://www.pnas.org/doi/10.1073/pnas.1406493112>
- Seddon, N., Chausson, A., Berry, P., Girardin, C. A. J., Smith, A., & Turner, B. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375(1794), 20190120. <https://doi.org/10.1098/rstb.2019.0120>
- Sekulova, F., & Anguelovski, I. (2017). *The Governance and Politics of Nature-Based Solutions*. 39.
- Sekulova, F., Anguelovski, I., Kiss, B., Kotsila, P., Baró, F., Palgan, Y. V., & Connolly, J. (2021). The governance of nature-based solutions in the city at the intersection of justice and equity. *Cities*, 112(103136). <https://doi.org/10.1016/j.cities.2021.103136>

- Sekulova, F., Kallis, G., & Schneider, F. (2017). Climate change, happiness and income from a degrowth perspective. In *Chapters* (pp. 160–180). Edward Elgar Publishing. https://ideas.repec.org/h/elg/eechap/15720_8.html
- Solomon, S., Appavoo, J., & Brown, V. (2020). *Addressing Finance And Capacity Barriers For Nature-based Solutions Implementation At City Level*. C40 Cities Finance Facility. <https://www.c40cff.org/knowledge-library/nature-based-solutions-implementation-at-city-level>
- Somarakis, G., Stavros Stagakis, & Nektarios Chrysoulakis. (2019). *ThinkNature Nature-Based Solutions Handbook*. <https://oppla.eu/product/19999>
- Stadsbyggnad.org. (2017). Urban Grönska – från arkitektdröm till verklighet. *Stadsbyggnad | Tidskrift För Föreningen Sveriges Stadsbyggare*. <https://stadsbyggnad.org/2014/urban-gronska-fran-arkitektrom-till-verklighet/>
- Swann, S., Blandford, L., Cheng, S., Cook, J., Miller, A., & Barr, R. (2021). Public International Funding of Nature-based Solutions for Adaptation: A Landscape Assessment. *WRI Publications*. <https://doi.org/10.46830/wriwp.20.00065>
- Swiss Re. (2020). *Protecting and Enabling Nature-Based Solutions*. <https://www.swissre.com/dam/jcr:19ebcb33-03c6-41bb-9047-917c95116b43/nature-based-solutions-pss.pdf>
- Toxopeus, H., Kotsila, P., Conde, M., Katona, A., van der Jagt, A. P. N., & Polzin, F. (2020). How ‘just’ is hybrid governance of urban nature-based solutions? *Cities*, 105, 102839. <https://doi.org/10.1016/j.cities.2020.102839>
- Toxopeus, H., & Polzin, F. (2017). Characterizing nature-based solutions from a business model and financing perspective. *Undefined*. <https://www.semanticscholar.org/paper/Characterizing-nature-based-solutions-from-a-model-Toxopeus-Polzin/93fa7601930de2c944d448c13f55cb7be6945b2e>
- Toxopeus, H., & Polzin, F. (2021). *Reviewing financing barriers and strategies for urban nature-based solutions—ScienceDirect*. <https://www.sciencedirect.com/science/article/pii/S0301479721004333>
- TreesAI. (n.d.). *Trees as Infrastructure*. Retrieved May 20, 2022, from <https://treesainfrastructure.com/#/>
- UNEP (2022, January 26). *The State of Finance for Nature in the G20 report*. UNEP - UN Environment Programme. <http://www.unep.org/resources/report/state-finance-nature-g20-report>

- UN DESA. (2018). 68% of the World Population Projected to Live in Urban Areas by 2050, Says UN | UN DESA | United Nations Department of Economic and Social Affairs. <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>
- US EPA, O. (2015). *Learn About Environmental Justice* [Overviews and Factsheets]. <https://www.epa.gov/environmentaljustice/learn-about-environmental-justice>
- van der Jagt, A. P. N., Kiss, B., Hirose, S., & Takahashi, W. (2021). Nature-Based Solutions or Debacles? The Politics of Reflexive Governance for Sustainable and Just Cities. *Frontiers in Sustainable Cities*, 2. <https://www.frontiersin.org/article/10.3389/frsc.2020.583833>
- van der Jagt, A. P. N., Raven, R., Dorst, H., & Runhaar, H. (2020). Nature-based innovation systems. *Environmental Innovation and Societal Transitions*, 35, 202–216. <https://doi.org/10.1016/j.eist.2019.09.005>
- Viinanen, J. (n.d.). *Green Factor Tool | Integrated Storm Water Management*. Retrieved May 20, 2022, from <http://www.integratedstormwater.eu/material/green-factor-tool>
- Vinnova. (n.d.). *BiodiverCity steg 3 | Vinnova*. Retrieved May 20, 2022, from <https://www.vinnova.se/p/biodivercity-steg-3/>
- Vujčić, M., Tomičević-Dubljević, J., Grbic, M., Lečić-Toševski, D., Vuković, O., & Tošković, O. (2017). Nature based solution for improving mental health and well-being in urban areas. *Environmental Research*. <https://doi.org/10.1016/j.envres.2017.06.030>
- Walliman, N. (2016). *Social Research Methods The Essentials*.
- Wamsler, C., Pauleit, S., Zölch, T., Schetke, S., & Mascarenhas, A. (2017). Mainstreaming Nature-Based Solutions for Climate Change Adaptation in Urban Governance and Planning. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice* (pp. 257–273). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_15
- Wickenberg, B., Kiss, B., McCormick, K., & Palgan, Y. V. (2022). Seeds of Transformative Learning: Investigating Past Experiences From Implementing Nature-Based Solutions. *Frontiers in Sustainable Cities*, 4. <https://www.frontiersin.org/article/10.3389/frsc.2022.835511>

- Wilk, B., Shira, L., Seiler, B., & Sora, F. (2020). *D5.3 Governance, business, and finance models, Clever Cities*.
<https://clevercities.eu/resources/deliverables-and-reports/>
- Wolch, J. R., Byrne, J., & Newell, J. P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough.' *Landscape and Urban Planning*, 125, 234–244.
<https://doi.org/10.1016/j.landurbplan.2014.01.017>
- World Bank. (2020). *Mobilizing Private Finance for Nature*. World Bank.
<https://openknowledge.worldbank.org/handle/10986/35984>
- WUR. (2019). *Green roofs for liveable cities*. WUR. <https://www.wur.nl/en/article/Green-roofs-for-liveable-cities.htm>
- WWF. (n.d.). *Nature and Spatial Finance*. WWF. Retrieved May 8, 2022, from <https://www.wwf.org.uk/what-we-do/projects/nature-and-spatial-finance>
- Xie, L., Bulkeley, H., Pearl-Martinez, R., Dorst, H., & Runhaar, H. (n.d.). *PATHWAYS FOR SYSTEMIC INTEGRATION OF NATURE-BASED SOLUTIONS*. 63.
- Xie, L., Bulkeley, H., & Tozer, L. (2022). Mainstreaming sustainable innovation: Unlocking the potential of nature-based solutions for climate change and biodiversity. *Environmental Science & Policy*, 132, 119–130.
<https://doi.org/10.1016/j.envsci.2022.02.017>
- Xie, L., Bulkeley, H., van der Jagt, A., Toxopeus, H., Tozer, L., Pearl-Martinez, R., Dorst, H., & Runhaar, H. (2020). *Pathways for Systemic Integration of Nature-based Solutions*.
- Yin, R. K. (2014). *Case study research: Design and methods*. SAGE.
- Yin, R. K. (2018). *Case Study Research and Applications Design and Methods (6th ed.)*. Thousand Oaks, CA Sage. - References—
Scientific Research Publishing. (n.d.). Retrieved May 18, 2022, from <https://www.scirp.org/%28S%28351jmbntvnsjt1aadkpozje%29%29/reference/referencespapers.aspx?referenceid=2914980>

Appendix A – Definitions of Nature-based Solutions

European Commission: “Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions.”

IUCN: “protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits” (Cohen-Shacham et al., 2016). These definitions puts an emphasis on socio-ecological adaptation and resilience approach with equal reliance upon social, environmental and economic aspects.

Nature-based solutions Initiative: (NbS) involve working with nature to address societal challenges, providing benefits for both human well-being and biodiversity. Specifically they are actions that involve the protection, restoration or management of natural and semi-natural ecosystems; the sustainable management of aquatic systems and working lands such as croplands or timberlands; or the creation of novel ecosystems in and around cities. They are actions that are underpinned biodiversity and are designed and implemented with the full engagement and consent of local communities and Indigenous Peoples.

Bush & Doyan (2019): “Nature-based solutions has emerged as a concept, or umbrella term, for ecosystem-based approaches to address the societal challenges of climate change, natural disasters, food and water security, human health and well-being, and economic and social development. Nature-based solutions address these societal challenges through the delivery of ‘ecosystem services.’”

Appendix B – Information Form

Co-financing, i.e., investments involving multiple entities (across sectors, departments or actor groups) to finance the project encompassing one or more financing mechanisms. Moreover, the potential of co-financing strategy, in terms of both scaling up and social justice outcomes is rather an unexplored field of research. Thus, the aim of my thesis research is to explore the potential of synergistic investments through hybrid governance (multi-actor) structures for urban nature-based solutions.

NbS help address urban challenges such as climate change mitigation, water management, land-use and urban development. Common examples include park developments, green roof development, community gardens, green areas for water management, green corridors, and greening streets. It is realised as an innovative strategy to achieve urban sustainability goals which encompasses different concepts like ‘nature-based interventions’, ‘ecosystem-based solutions’ and ‘green blue infrastructure’. For this project, NbS is defined as “...*solutions to societal challenges that are inspired and supported by nature, which are cost-effective, provide simultaneous environmental, social and economic benefits, and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions*”. One of the distinct characteristics of NbS is the emphasis on the integrated use of nature ecosystems to support human well-being in a cost-effective way. NbS offer a transformative potential for cities through social benefits, citizen involvement, and opportunities for replication and up-scaling of local ecosystem-based adaptation.

However, finance is one of the major deterrents hindering NbS uptake and mainstreaming. NbS in urban context may still be seen as a burden borne by the public sector, where funds for meeting the demand for NbS more often than is not fulfilled. Further, the public good nature of NbS does not particularly fitting in with the revenue generating model of the private sector. Additionally, if and when the private sector is involved, tradeoffs concerning justice and equity outcomes are rarely considered. Thus, it becomes essential to capture different value perceptions in a socially just manner among various stakeholders. Thus, the project aims to develop and test knowledge on the potential of co-financing mechanisms from both scalability and justice perspectives.

Note: The collected material will be used to produce a MSc Student Thesis, which will be publicly available online.

Data Management

All the data for this project is collected and stored in accordance with the General Data Protection Regulation (GDPR) 2016/679 of the European Union. More information about GDPR implementation at Lund University can be found: lunduniversity.lu.se/gdpr. All the research materials, including the participants’ data will be securely stored during the thesis process (until 28/06/2021) at a protected shared virtual space of Lund University - LU Box, which provides password access only to the individual working on the documents. At any stage of the research project, the research participants have a right to gain access to their own personal data, request its correction or deletion or limitation to processing of data as well as they can file a complaint about how their personal data is used.

Appendix C – Consent Form

This form is to ensure that you have been given information about the research project being performed and to give you the opportunity to confirm that you are willing to take part in this research. For all activities below, please indicate which applies to you:

<input type="checkbox"/>	I have been familiarised with the thesis project, I have had the possibility to ask questions and I have received satisfactory answers to my questions
<input type="checkbox"/>	As a research participant, I am aware of my right to withdraw participation at any time
<input type="checkbox"/>	I give my consent that the interview can be audio- and video-recorded, transcribed, and analysed
<input type="checkbox"/>	I understand that the results of the research will be presented so that no information can be traced to me personally
<input type="checkbox"/>	I give my consent that a record of my interview can be safely stored for future reference

Note: Your participation is voluntary. As an interviewee, you do not have to answer all the questions that are asked; you reserve the right to refuse or cease participation in the interview process without stating your reason and may request to keep certain materials confidential.

Please, sign below to confirm your consent:

	Participant (s)	Researcher (s)
Name(s)		
Signature(s)		
Date(s)		

For any enquiries regarding this research, please contact:

Ismat Fatema Fathi

MSc Student in Environmental Management & Policy

International Institute for Industrial Environmental Economics

Lund University

Email: is7362fa-s@student.lu.se

Appendix D – Interview Guide

An interview guide was created as an aid to guiding the interview. Depending on the field and practice of the interviewee the questions were altered. Further for the case studies, few tailored questions were included for a better in-case understanding.

Interview Briefing 0-3 Minutes

1. The purpose of this research is to explore the potential of co-financing urban NbS through the lens of scalability and justice.
2. Findings from this interview will be transcribed and analysed using the software NVivo. All data collected will be stored securely on my laptop which will only be accessed and reviewed by me. Reference will be made to these findings in the final thesis. However, your name and position will not be referenced.
3. Should you have any questions at any point during the interview regarding the handling of data please do let me know at the end of the interview.
4. Please note you are welcome to withdraw at any time during the interview and from the research study, should you desire.

Participant Introduction/Background 5 Minutes

- Q1. Please could you briefly describe your role in the organisation and how your work is related to NbS?
- Q2. Do you have any strategic approaches and/or goals for NbS planning, implementing and maintaining with NbS in the city you are involved with?

Existing Mechanism and Arrangements 20 Minutes

- Q3. What kind of funding mechanism did your organisation/department been involved in delivering funding NbS?
- Q4. What actors were involved? What kind of partnerships were involved?
- governance structure, how did it work? Who took the responsibility and who took the end decision?
- Q5. Do you think this funding mechanism can be upscaled?
- Q6. Were citizens involved in the process? Why or why not?
- Q7. Was social justice outcomes considered in the process?

Future of NbS Investments 15 Minutes

- Q8. What potentially do you see from joint funding of NbS with other public/private/community actors?"
- Q9. According to you, what is needed to ensure that NbS can both grow and scale up but could also deliver just outcomes? (e.g. funding and governance strategies, policies, action plans, co-creation approaches)
- Q10. Do you think there are any other actors apart from those that we have discussed who would be relevant for investments in NbS?
- Q11. How do you see the future of NbS investments in cities?

Appendix E – List of Interviewees

No.	Participant Code	Position	Medium	Date of Interview
1.	1E	Practitioner, Consultant and former researcher	Online	21-02
2.	2E	Practice-based researcher	Online	23-02
3.	3E	Practitioner, NGO	Online	02-03
4.	4E	Practice-based researcher	Online	02-03
5.	5E	Practitioner, NGO	Online	02-03
6.	6EC	Practice-based researcher, Glasgow & Nicosia	Online	02-03
7.	7E	Practitioner, Public Official	Online	04-03
8.	8E	Practitioner, NGO	Online	08-03
9.	9EC	Practice-based researcher, Tilburg	Online	14-03
10.	10C	Urban Planner, Glasgow	Online	15-03
11.	11E	Practitioner, NGO	Online	17-03
12.	12EC	Practice-based researcher	Online	22-03
13.	13C	Urban Planner, Nicosia	Online	23-03
14.	14C	Insurer, Tilburg	Online	24-03
15.	15E	Practitioner, NGO	Online	24-03
16.	16EC	Practice-based researcher, Malmo	In-person	24-03
17.	17C	Practitioner, Glasgow	Online	12-04
18.	18E	Practice-based researcher	Online	25-04
19.	19EC	Practice-based researcher, Malmo	Email	25-04
20.	20EC	Researcher, Malmo	Online	02-05

E: expert in the research or practice

C: Case studies:

EC: researchers who were interviewed primarily due to their involvement in the case study

Appendix F – List of Codes

Code	Keywords or Subcodes
Innovative Partnerships (S1)	<i>horizontal and vertical levels of partnerships, procurement processes, transaction costs, governance architecture.</i>
Multi-scalar Actions (S2)	<i>economies of scale, multi-level governance structure, matching scale.</i>
Strategic Political Vision (S3)	<i>strategic visions, strategies, and policy guides, synergies, internal and external co-creation, creative thinking</i>
Incentive-based Mechanism (S4)	<i>branding, reputation, legal, standards, codes</i>
Evidence-based Investment (S5)	<i>performance, bankable projects, communication, credibility, valuation</i>
Inclusive and Local Governance (J1)	<i>participation, stakeholder engagement, awareness, political and policy commitment</i>
Incentives for Public Participation (J2)	<i>acceptance, ownership, perceptions, volunteering, financial and other institutionalized incentives, stewardship, socially led business models.</i>
Social Co-benefits (J3)	<i>multiple social and health benefits, targeted investments, strategic perspective</i>
Distribution of Benefits and Power (J4)	<i>exploration of trade-offs, investor alignment, policy measures, spatial distribution, stakeholder engagement</i>
Quality Green Jobs (J5)	<i>local jobs, economic opportunities, economic regeneration, buy-in, maintenance jobs, upskilling, equitable future</i>