A thesis submitted to the Department of Environmental Sciences and Policy of Central European University in part fulfilment of the Degree of Master of Science

Exploring the role of collaboration in creating social benefits in Nature-based Solutions. A case study of streams ecosystem restoration in Bogotá, Colombia.

Michela BONDANDINI

June, 2022

Vienna

Erasmus Mundus Masters Course in Environmental Sciences, Policy and Management

MESPOM

This thesis is submitted in fulfillment of the Master of Science degree awarded as a result of successful completion of the Erasmus Mundus Masters course in Environmental Sciences, Policy and Management (MESPOM) jointly operated by the University of the Aegean (Greece), Central European University (Hungary), Lund University (Sweden) and the University of Manchester (United Kingdom).

Notes on copyright and the ownership of intellectual property rights:

(3) For bibliographic and reference purposes this thesis should be referred to as:

Bondandini, M. 2022. *Exploring the role of collaboration in creating social benefits in Nature-based Solutions. A case study of streams ecosystem restoration in Bogotá, Colombia.* Master of Science thesis, Central European University, Vienna.

Further information on the conditions under which disclosures and exploitation may take place is available from the Head of the Department of Environmental Sciences and Policy, Central European University.

Author's declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Michela BONDANDINI

CENTRAL EUROPEAN UNIVERSITY

ABSTRACT OF THESIS submitted by:
Michela BONDANDINI for the degree of Master of Science and entitled: *Exploring the role of collaboration in creating social benefits in Nature-based Solutions. A case study of streams ecosystem restoration in Bogotá, Colombia.*

Month and Year of submission: June, 2022.

Nature-based solutions (NbS) are proven to be a valuable approach to enhance resilience in cities through the restoration and rehabilitation of urban ecosystems that support many ecosystem services vital for the population's well-being. Despite the specific aim to address all facets of sustainability, guidelines and frameworks for the assessment of social co-benefits of NbS are limited, especially in the Latin America and the Caribbean (LAC) area, where social issues play an important role in the dynamics and development of the region. The need for tailor-made interventions supporting the creation of environmental and social benefits can be met by promoting co-design and co-implementation processes with stakeholders. Identifying and including stakeholders through co-governance processes allows for better dealing with possible issues and limitations, empowering local civic actors, and creating solid partnerships, and a sense of ownership and acceptance. With the collaboration and support of Conservation International (CI) Colombia, the research investigated the ecosystem restoration of the water streams of four neighbourhoods of Bogotá, in Colombia. In the context of the selected case study, the research looked at the engagement of stakeholders in the development of the selected urban NbS and how the collaborative approach supported the creation of positive social outcomes. The research aimed to address two main gaps: firstly, the scarce evaluation of the social impacts of NbS, especially in the LAC context, and, secondly, the added value of including stakeholders in the design and development of nature-based solutions in terms of social benefits.

Keywords: nature-based solutions, stream ecosystem restoration, collaborative governance, social benefits, Latin America, Colombia, Bogotá

Alla mia amata famiglia

Acknowledgements

I would like to express my gratitude to those who made this thesis possible and that have supported and guided me throughout my master's studies. I would first like to thank Laszlo Pinter, for his kind guidance and supervision during this investigation and for having inspired my journey into urban sustainability in the last two years. I also would like to express my biggest gratitude to Conservation International Colombia and especially Patricia Bejarano, who has believed in my research, kindly supported me in all the stages of my thesis and welcomed me into the inspiring conservation world of Bogotá. A special thanks goes to all the people I met during my fieldwork and that have introduced me into their lives and personal stories with open arms. A thank you also to CEU Foundation of Budapest for sponsoring my fieldwork in Colombia.

This thesis is the emblem of an incredible journey that has challenged and amazed me in every possible way. For this reason, I would like to thank the MESPOM programme for having offered me the chance to learn, experience and share so much. To Maricruz, who has been my biggest support and source of sunshine since the first day I met her. To Miri, Dori and Wasu for being the warmest and most joyful gifts this programme could have offered me. To Su for her kind heart and most amazing friendship. To my MESPOM and MESP colleagues, for being my little international family.

To Canelle, who is my personal and brightest form of light. To Laura and Carlos, for introducing me to the wonders of Colombia and welcoming me into their lives with kindness and warmth. To Ponne, for being the most precious supporter and companion.

The biggest and most felt gratitude goes to my parents and brother, for believing in all of my dreams and ambitions and supporting me with love and laughter in every part of the world and time zone. This achievement belongs to you entirely. Thank you.

"Allá donde las preocupaciones humanas nos afligen el alma, protegida por el abrazo del árbol y el arrullo de las aguas me di cuenta que podía construir mi ser a partir de mis hábitos. Subir a la montaña me constituye un poquito más cada día. Tengo la certeza de encontrar más verdades en esas hojas olorosas y en el fresco del aire que en cualquier otro lugar Bogotano."

(Bejarano *et al.* 2014)

Table of Contents

List of Figures

List of Tables

List of Abbreviations

CAR	Corporación Autónoma Regional de Cundinamarca
CBD	Convention on Biological Diversity
CI	Conservation International
EbA	Ecosystem-based Adaptation
EC	European Commission
GI	Green Infrastructure
IUCN	International Union for Conservation of Nature
LAC	Latin America and the Caribbean
NbS	Nature-based Solutions
SDG	Sustainable Development Goal
SER	Society for Ecological Restoration

Spanish glossary

Bosque altoandino

Cerros Orientales

Corporación Autónoma Regional de Cundinamarca (CAR)

Distrito Capital

Estructura Ecológica Principal

Franja de adecuación

Localidades

Muiscas

Páramo

Reserva Forestal Protectora Bosque Oriental de Bogotá

Sabana

1. Introduction

More than half of the world's population lives in cities (UNEP 2021), with Latin America being the region that experienced the fastest urbanisation, with 81 per cent of the population living in urban centres in 2021 (World Bank 2021b). This phenomenon started in the second half of the 20th century when a substantial displacement from rural to urban areas influenced urban centres' rapid and disproportionate growth. Although urbanisation is now consolidated in the region (United Nations 2017), estimates predict that the population living in cities will increase to 87.8 per cent by 2050 (United Nations 2018). In this context, the challenge of the Latin America and the Caribbean (LAC) region shifted from dealing with increasing demographic pressure to ensuring a good quality of life and sustainability in cities (United Nations 2017).

The disproportionate demographic increase of cities contributed to growing pressure on ecosystems and their ability to provide services (Pauchard and Barbosa 2013). The convergence of these phenomena with challenges such as changes in land use, loss of agricultural land and biodiversity (Barbosa and Pradilla 2021), climate hazards, social and economic inequalities (World Bank 2021a), socioeconomic segregation, informal planning, problems of security and lack of adequate urban, environmental and land-use policies (United Nations 2017), represent a risk for urban sustainability. Given the strong interdependency between urban centres and their natural environment, it is necessary to consider them as a unique ecosystem to manage and protect to guarantee urban sustainability and citizens' well-being (United Nations 2017). Therefore, these challenges have long-term and wide-reaching effects that extend over the mere urban boundaries (Barbosa and Pradilla 2021).

Water resources management represents a critical challenge (DeVincentis *et al.* 2021). Cities face the complex problem of ensuring equitable access to water (United Nations 2017), sanitation services, efficient treatment of wastewater, and mitigation of urban floods. All of this is in a region where water scarcity is seen as a significant economic threat, especially for the areas depending heavily on agriculture (Oliver *et al*. 2021).

Nature-based solutions (NbS) are proven to be a valuable approach to enhance resilience in cities through the restoration and rehabilitation of urban ecosystems that support many ecosystem services vital for the population's well-being. They are solutions "inspired and

supported by nature" which aim at providing "environmental, social and economic benefits." (European Commission 2015). Despite their specific aim to address all facets of sustainability, guidelines and frameworks that enable assessing the different benefits of NbS, primarily related to the socioeconomic context, are recent and limited in their use. This limitation is particularly evident for medium and low-income regions like Latin America. As the implementation of NbS is increasing in the whole area, context-dependent information about their efficacy is needed (Portugal *et al.* 2020), especially in a context characterised by such unique socioeconomic and political dynamics (Dobbs *et al.* 2019). In LAC cities, NbS are well-positioned to serve development objectives common to different sectors, including water security and sanitation, flood and landslide risk reduction, climate change mitigation, biodiversity protection, public health improvements, jobs creation, and alleviation of poverty (Ozment *et al.* 2021). The type of NbS considered in this thesis – referred to as Nature-based Solutions for ecosystem restoration - wants to contribute to: "*the conservation and sustainable use of biodiversity as well as create social, economic and environmental benefits, whereby healthy and connected ecosystems should contribute to improve food and water security, people's livelihoods and to mitigate and adapt to climate change*" (CBD 2019).

Considering the social benefits created in the implementation of urban NbS can play an essential role in addressing the significant issues characterising a particular community, neighbourhood, or metropolitan area. Hence, the importance of studies outlining the potential of NbS in addressing societal challenges and how they can be implemented in local, urban, and national policies. The need for tailor-made interventions can be met by including the stakeholders of a particular context in the design and implementation process. Indeed, stakeholder engagement and participative processes have the potential to address the socioeconomic features and issues characterising these contexts and consequently produce and distribute positive social benefits (Richerzhagen *et al.* 2019). Including a wide range of actors in the design process is an efficient way of finding innovative tools to solve complex challenges. Identifying and including stakeholders through co-design allows for better dealing with possible issues and limitations (Zingraff-Hamed *et al.* 2020), empowering local civic actors, creating strong partnerships (Mahmoud and Morello 2021) and a sense of ownership and acceptance. However, research on the impacts of stakeholder engagement in NbS is still limited (Lupp *et al.* 2021).

In order to investigate the role of collaborative processes in the design and implementation of urban NbS in Latin America, this thesis is developed in collaboration with the Colombian office of Conservation International (CI). More specifically, the research wants to look at how collaborative and participatory approaches enhance the creation of social benefits for stakeholders and local communities.

Conservation International is an international conservation organisation whose central vision is to empower local societies to manage nature responsibly and sustainably, to promote global biodiversity and the well-being of human society. Their adaptation objectives are achieved by implementing NbS for adaptation or Ecosystem-based Adaptation actions. Examples of their interventions include wetland protection and rehabilitation to increase water storage potential, coral reef protection, mangrove protection and restoration, and implementation of sustainable farm management. This research is based on the project promoted by CI within four boroughs (*localidades*)[1] of Bogotá (*Usaquén*, *Chapinero*, *Usme* and *Sumapaz*), Colombia. The main objective of the interventions was to restore the rivers and streams of these territories through the enhancement of a social participation strategy.

1.1. **Problem definition**

Colombia is one of the most biodiverse countries globally (Instituto Alexander von Humboldt 2014), where urban landscapes are characterised by an intertwinement between biophysical and human-led processes (Quimbayo Ruiz 2020). Unlike other Latin American countries, Colombia has experienced a long and turbulent period of political violence and a national armed conflict that played a significant role in the urban processes of its main cities (Valencia 2016). The Colombian economic, financial, and administrative centre is Bogotá, which is the fifth biggest city in the LAC region, with a total urban agglomeration of 10,5 million inhabitants (United Nations 2019). Immerged into a unique ecosystem of hills, wetlands, rivers, and *páramos*, Bogotá has experienced an unsustainable growth model where urbanisation, housing projects, land-use speculation, and high-impact activities (Quimbayo Ruiz 2021) played a crucial part in shaping the landscape and the socio-spatial dynamics of the city (Valencia 2016). It is a city where political, social, and economic dynamics have influenced substantial socio-ecological inequalities, social exclusion patterns, poverty, insecurity, and

[1] Localidades are administrative subdivisions of the municipality of Bogotá.

informal settlements (Quimbayo Ruiz 2018). These dynamics are particularly evident in spaces with high environmental and biological value like the *Cerros Orientales* (Eastern Hills), which are part of the *Chingaza-Sumapaz-Guerrero* conservation corridor. In this corridor, the rivers and streams located in the *Cerros Orientales* constitute the principal natural components of the city's urban drainage network and tributaries of wetlands. These aquatic ecosystems hold great importance for the city of Bogotá and its citizens since, other than having a critical natural role, they represent means of social, economic, touristic, and agroecological development (Bejarano *et al.* 2014).

The socioeconomic and environmental context of Bogotá reinforces the need for local governments to incorporate Nature-based Solutions in the city's territorial planning (Figueroa Arango 2020). Implementing NbS can support the inclusion of nature as one of the main determinants in supporting livelihoods, which can help tackle the challenges imposed by poverty and inequality, amongst others. They could also support the creation of social fabric and networks promoting the conservation of nature and allowing the development of adaptation and mitigation strategies against the effects of climate change (Rinaudo Mannucci 2019).

Given the strong relationship of humans with their natural environment and ecosystems, promoting participatory processes that can create ownership and empowerment of communities is fundamental to guarantee the sustainability of any environmental strategy, especially when focusing on ecological restoration practices. The inclusion of various actors that can offer different values, points of view and knowledge can support the design of interventions tackling the complexity of urban challenges (Zingraff-Hamed *et al.* 2020). Furthermore, collaborative approaches have the power to include marginalized voices and ensure the creation of interventions aligned to the local needs and concerns (Favretto *et al.* 2021). This explains the need to investigate stakeholder engagement processes in NbS and how their implementation can enhance benefits for the actors included in such mechanisms.

Building on the capacity of Nature-based Solutions to address multiple challenges across different sectors, this thesis aims at investigating the participatory mechanisms developed within the project promoted by Conservation International Colombia and their role in addressing the territories' socioeconomic issues and creating social benefits for the targeted stakeholders.

1.2. **Research question – aim and objectives**

The overall objective of this thesis research is to investigate the role of collaborative processes and stakeholder engagement in creating social benefits through ecosystem restoration interventions that can be classified as Nature-based Solutions in Bogotá, Colombia.

The specific research questions guiding this thesis are the following:

I. How are stakeholders involved in the restoration of the areas associated with streams and rivers in Bogotá?
II. What are the social benefits created by the implementation of the project?
III. How and to which degree the collaborative approach affected the realisation of social benefits?

1.3. **Thesis structure**

The thesis is organised as follows. Chapter 1 presents the context and challenges of the research, introducing the main notions and topics investigated by this research as well as exploring its main objectives. Chapter 2 introduces the literature review related to the main concepts and approaches chosen to conduct this investigation. Chapter 3 describes the methods used to develop the research and collect the results, as well as presenting the analytical framework guiding the analysis section. Chapter 4 will give an overview of the case study and the specific details of the ecosystem restoration interventions. Chapter 5 details and analyses the research findings according to the main objectives of the investigation and to the analytical framework. Chapter 6 provides a discussion of the findings and their implications. Finally, Chapter 7 offers the investigation's conclusions and outlines the thesis's contribution to covering knowledge gaps related to implementing collaborative Nature-based Solutions and their social impacts on LAC cities.

2. Literature review

This chapter presents a review of the existing literature regarding the main topics of the thesis: the development and evaluation of Nature-based Solutions and the adoption of collaborative practices in NbS. Additionally, this section will focus on the application of NbS and the promotion of collaborative governance in the Colombian context. The literature review aims at giving an overview regarding the concept of Nature-based Solutions, its evaluation and how the application of collaborative approaches can enhance the creation of societal benefits.

2.1. Roots of the concept of NbS

Historically, communities have been dealing with the effects of natural events and climatic changes through interventions promoting the restoration of ecosystems and the preservation of biodiversity (Seddon *et al.* 2021). Guided by a conception in which nature and humans are considered profoundly interconnected and mutually dependent (Welden *et al.* 2021), Indigenous cultures have been working with and for nature for millennia. Therefore, what has recently been framed under the term of Nature-based Solution, in reality, has always existed and constituted a common practice amongst Indigenous, non-Western and local communities worldwide (Maller 2021). The merit of the concept of Nature-based Solutions and their related approaches has been to formalise and introduce these relationships and practices into the international research and policy panorama (Welden *et al*. 2021).

The need to document and conceptualise the interconnection between nature and human well-being started to grow only in the 1970s when concepts like ecosystem services began to spread in the academic world. However, it was not until the early 2000s, with the 2005 Millennium Ecosystem Assessment, that ecosystem services were considered in the first policies supporting conservation, restoration, and sustainable management of ecosystems (Cohen-Shacham *et al.* 2016).

Nature-based Solutions can be conceived as an umbrella concept that encompasses various conservation and environmental management approaches working with nature, such as ecosystem services, ecological restoration, Green Infrastructure (GI), Ecosystem-based Adaptation (EbA), eco-engineering (Dorst *et al*. 2019), agroecology, forest, and landscape restoration (FLR), ecosystem-based disaster risk reduction (Seddon *et al.* 2021). NbS is usually associated with the GI and EbA approaches in the urban context. However, GI focuses on

infrastructure, while EbA is considered an approach to manage ecosystems with a specific inclusive focus. The concept of Nature-based Solutions builds on them but presents more specific and identified objectives related to sustainability challenges, especially to positive benefits for society (Dorst *et al*. 2019). The concept first emerged in the European context. It was initially developed by the International Union for Conservation of Nature (IUCN) in 2009 to deal with climate change adaptation and biodiversity conservation. As it is not yet agreed upon, its definition may vary and offer different interpretations (Dorst *et al.* 2019). However, the definitions most referred to have been the ones of the European Commission (2015) and the IUCN (Cohen-Shacham *et al.* 2016).

The European Commission (2015) defines NbS as

"*solutions aim to help societies address a variety of environmental, social and economic challenges in sustainable ways. They are actions inspired by, supported by or copied from nature; both using and enhancing existing solutions to challenges, as well as exploring more novel solutions, for example, mimicking how non-human organisms and communities cope with environmental extremes.* (...)"

On the other hand, IUCN defines them as

"*Actions to 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).

NbS can address multiple urban challenges, offering primary (or direct) benefits and co-benefits or secondary benefits simultaneously. Therefore, co-benefits are described as "*added benefits we get when we act to control climate change, above and beyond the direct benefits of a more stable climate (…). They do not include the direct benefits of climate policy* (Fisher *et al*. 2009). Their ability to simultaneously address social, economic, and environmental challenges makes them particularly suitable for innovatively addressing multifaceted societal challenges (Dorst *et al*. 2019).

Eggermont *et al*. (2015) offer a classification of NbS according to the level of engineering involved in the specific measures and the number of ecosystem services and stakeholder groups targeted. Therefore, three types of NbS are recognized:

- **Type 1** sees a minimal intervention in ecosystems and aims at better using natural resources and ecosystems. Some examples include the creation of protected areas for conservation or the protection of mangroves to limit extreme weather conditions and improve local livelihoods;
- **Type 2** includes management approaches developing "*sustainable and multifunctional ecosystems and landscapes, which improve the delivery of selected ES* (…)". Examples are related to agroforestry approaches with societal objectives;
- **Type 3** considers intrusive ways of managing ecosystems and can also concern the creation of entirely new artificial ecosystems. Some examples can be green and blue infrastructures and approaches that aim at recovering heavily degraded areas.

Depending on the literature considered, the societal challenges addressed by NbS can vary. For example, IUCN identifies six main challenges that NbS help tackle: *Climate Change, Food Security, Water Security, Disaster Risk, Human Health, and Economic and Social Development* (Cohen-Shacham *et al*. 2016). On the other hand, the latest handbook of the European Commission (Dumitru and Wendling 2021) developed to evaluate the impacts of NbS identifies twelve main challenges addressed by NbS:

1. *Climate Resilience*
2. *Water Management*
3. *Natural and Climate Hazards*
4. *Green Space Management*
5. *Biodiversity Enhancement*
6. *Air Quality*
7. *Place Regeneration*
8. *Knowledge and Social Capacity Building for Sustainable Urban Transformation*
9. *Participatory Planning and Governance*
10. *Social Justice and Social Cohesion*
11. *Health and Wellbeing*
12. *New Economic Opportunities and Green Jobs.*

As the concept was mostly explored in the European context, several projects have been funded within the EU Horizon 2020 and other European funding programmes to develop a European evidence base on the performance and impact of NbS. Some examples include BiodivERsA, CLEVER cities, CONNECTING Nature, EKLIPSE, Naturvation, UNaLab, and Urban GreenUP. The Urban Nature Atlas – developed within the NATURVATION project – represents one of the most comprehensive databases of urban Nature-based Solutions in Europe and globally. The Atlas identifies eight main types of NbS in urban and peri-urban areas: 1) *allotments and community gardens*; 2) *blue infrastructure*; 3) *intentionally unmanaged or "derelict" areas*; 4) *nature on buildings*; 5) *green areas for water management*; 6) *green indoor areas*; 7) *grey infrastructure with green features*; 8) *parks or semi-natural urban green areas*.

2.2. **The social focus of Nature-based Solutions**

The definition of NbS offered by the European Commission (2015) stresses how Nature-based Solutions aim at providing social benefits other than economic and environmental ones. However, although social benefits are often mentioned as an outcome of Nature-based Solutions, it is still uncertain and poorly researched how these solutions affect human well-being, livelihoods, and the living conditions of marginalised communities of cities in the longer term (Haase *et al*. 2017).

The concept of ecosystem service can constitute a relevant starting point in the evaluation of NbS social benefits as it focuses on the existing linkages between ecosystems and human well-being (therapeutic, recreational, cultural, spiritual, economic etc.). Therefore, the literature related to ecosystem services' benefits can represents an interesting basis in the classification and evaluation of social benefits related to NbS (Schmidt *et al*. 2016).

Although this research wants to investigate the social benefits of NbS, potential disbenefits and costs can also be caused by the implementation of NbS. However, the focus will be put on the positive outcomes. For this analysis, it was first considered necessary to define a *social benefit*. Although the definition may vary, benefits are considered "*positive change in well-being from the fulfilment of needs and wants*." (Maes *et al*. 2016). Alternatively, Bateman *et al*. (2014)

define a benefit as "*the change in human well-being generated by a good (use-value and non). The same good can generate different values, depending on the context*.".

After analysing the available literature, the social benefits deriving from the implementation of interventions that can fall under the term of Nature-based Solution were classified into six categories in Table 1. The studies conducted by Albert *et al.* (2019), Colléony and Shwartz (2019), da Rocha *et al.* (2017), Dumitru *et al.* (2020), Haase *et al.* (2017), Jennings and Bamkole (2019), Martin and Lyons (2018), Richerzhagen *et al.* (2019), Sekulova *et al.* (2021); Toxopeus *et al.* (2020) and Zhou and Rana (2012) helped identify some of the leading social benefits deriving from the implementation of NbS. Eleven articles were selected. More specifically, 6 out of 11 recognised the importance of NbS in creating physical, psychological and community well-being, related mainly to the better availability of recreational spaces and the positive impacts that being in contact with nature has on people's mental health (Jennings and Bamkole 2019). Furthermore, 5 out of 11 identified their importance in creating benefits related to social justice, social cohesion, and inclusiveness, like the examples of Barcelona's community-driven urban garden demonstrated (Toxopeus *et al.* 2020). An essential role of NbS was also highlighted for the creation of benefits related to education and the production of knowledge (4 out of 11 articles), followed by livelihoods improvement (2 out of 11 articles) and the creation of new economic opportunities and safety benefits.

Categories of social benefits	Specific benefits encountered in the literature review
Physical, psychological, and community well-being	Public health/ Physical well-being/ Psychological well-being
Social justice and social cohesion	Social cohesion/ Social relations/ Social inclusion/ Social fabric/ Social interaction/ Participative processes
Knowledge enrichment and education	Education/ Knowledge
Livelihoods improvement	Socio-spatial inequalities/ Living conditions/ Food security
Safety	
New economic opportunities	

Table 1: Categorisation of social benefits generated through NbS implementation.

However, the general lack of focus on the social benefits of Nature-based Solutions causes a need for a more precise conceptualisation of the relationship between NbS and social outcomes as well as methodologies able to monitor and evaluate them (Dumitru *et al*. 2020) (Martin and Lyons 2018). In the context of LAC cities, context-dependent research needs to investigate the socioeconomic and political dynamics of urban centres and how NbS can efficiently address their main challenges (Dobbs *et al.* 2019).

2.3. **Ecosystem restoration**

Ecosystem restoration is considered an efficient and cost-effective way to promote water and biodiversity conservation, food security, poverty eradication and adaptation to climate change. The importance of ecosystem restoration in achieving sustainable development objectives was recognised by the UN General Assembly and the declaration of the UN Decade on Ecosystem Restoration 2021-2030. The goal of the declaration is to highlight the importance of ecosystem restoration to "*prevent, halt and reverse the degradation of ecosystems worldwide*" and simultaneously "*build resilience, reduce vulnerability and increase the ability of systems to adapt to daily threats and extreme events*." (UNEP 2019).

The field of ecological restoration has been characterized by terminology confusion, which makes it hard for policymakers and practitioners to use literature efficiently. Terms like "ecological restoration", "ecological rehabilitation", "ecological reclamation", and "ecosystem recovery" have often been improperly used (Gerwing *et al.* 2021). For the purpose of this research and its focus, the terms "ecological restoration", "ecosystem restoration", and "stream ecosystem restoration" will be used.

Ecological restoration includes practices that can be considered Nature-based Solutions as they help conserve biodiversity and create benefits for human well-being and society. The Society for Ecological Restoration (SER) defines ecological restoration as "*the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed*." It is an intervention that aims at reaching the recovery of the ecosystem according to a reference model often based on the native natural and cultural characteristics of an area or territory. According to the SER principles, an ecosystem is fully restored when its features match the ones established by the reference model. Restoration requires the control or elimination of the pressures exerted by the different uses to which the ecosystem is subjected. However, proper restoration is rarely

possible, so alternative terms have been suggested to suggest lower degrees of restoration, such as rehabilitation, remediation, recreation, etc. (Comín 2002). One of the main objectives behind these practices is the achievement of cultural, socioeconomic, and ecological objectives that can support socio-ecological resilience (Gann *et al.* 2019).

The restoration of freshwater ecosystems, applicable to the case study of Bogotá, seeks to improve the ecosystem status of rivers and streams, recover their natural conditions, increasing the heterogeneity of habitats and their connectivity. In the case of freshwater streams, it is fundamental to accelerate the natural regeneration process through the revegetation of the water body. For the revegetation to be successful, the ideal would be to carry it out after restoring the morphology of the channel and with the certainty that the round where the planting or seeding is going to be carried out is hydrologically connected with the channel (García de Jalón Lastra and Gonzalez del Tanago del Rio 2008).

The SER Standards (Gann *et al*. 2019) also underline how these interventions have the potential to create social and development objectives, both in high and low-income countries. The social benefits are related mainly to community well-being, stakeholder engagement, benefits distribution, knowledge enrichment, restoration of natural capital, and enhancement of sustainable economies. Given the importance of human actions for ecosystems, considering these impacts can help a restoration project gain the support needed to deliver ecological and social benefits. Hence, the need to include the interests of a multitude of stakeholders (Bhatt *et al*. 2020) – both human and natural - that can allow addressing multiple issues and needs (Network Nature 2021) and the importance of the inclusion of ecological knowledge drawn from the experiences of stakeholders, traditional and indigenous knowledge and scientific discovery (Gann *et al.* 2019).

2.4. **Evaluation of co-benefits**

Given the diversity of NbS, their outcomes can change according to the context and benefit various actors. However, most evaluation frameworks are limited to single indicators or objectives, without real consideration of the complexity existing between NbS and their co-benefits (Raymond *et al*. 2017b). They lack the ability to assess the outcomes across and within societal challenges. Hence, there is a growing need to consider the overall benefits of NbS according to the different actors and challenges it reaches. If considered independently, the

single benefits do not justify the overall costs of a specific intervention. However, if the benefits are evaluated across a variety of actors and challenges, the cost of the NbS will result reduced compared to the overall benefits (Figure 1).

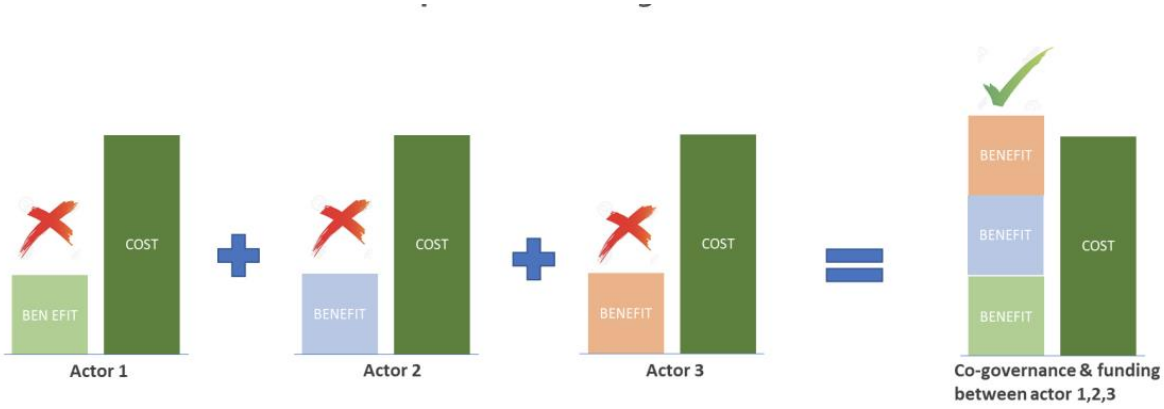

Figure 1: Added value of NbS benefits (Toxopeus et al. 2020).

The limited research on the relationship between Nature-based Solutions and their social impacts, as well as the problematic conceptualisation of the nature of the latter, influences the consideration of social outcomes as indirect impacts. Therefore, research on the benefits provided by NbS is somewhat still limited to the delivery of environmental results (Dumitru *et al*. 2020).

The importance of creating evaluation and assessment frameworks lies in the possibility of determining the strengths and weaknesses of some interventions in achieving strategic goals for urban contexts (Dumitru *et al*. 2020). Hence, the role of evaluation frameworks in investigating the causal effects of NbS practices in the natural or urban environment. By focusing on the results of NbS, impact evaluation helps provide helpful tools to determine the quality and effectiveness of the approaches taken. Assessing the impacts of NbS interventions is fundamental in creating and spreading knowledge about their effectiveness and helping policymakers and planners replicate the positive outcomes (Dumitru *et al.* 2021).

In order to conduct an efficient evaluation of what is working or not, the assessment process needs additional information regarding the features of the stages of a particular NbS intervention. Hence, the importance of complementing evaluation plans with monitoring practices can provide more information on the performance of the NbS and how it can be replicated. Unlike evaluation, monitoring constitutes the continuous tracking of how a specific

intervention is conducted to see its performance as it develops. (Raymond *et al.* 2017a). Given the dynamic and evolving nature of NbS, constant evaluation and monitoring are essential to allow more comprehensive application and transferability of the benefits achieved (Chrysoulakis *et al*. 2021).

The framework developed by Raymond *et al.* (2017b) in the EKLIPSE project was selected as the guiding framework to support the development of this research (Figure 2). The framework's objective is "*to help build up an evidence and knowledge base on the benefits and challenges of applying NBS*." (Raymond *et al*. 2017a)the assessment of NbS co-benefits through a circular design composed of seven stages founded on the concept of participatory governance. The stages are the following: 1) *identify problem or opportunity*; 2) *select NbS and related actions*; 3) *design NbS implementation processes*; 4) *implementation of NbS*; 5) *frequently engage stakeholders and communicate co-benefits*; 6) *transfer and upscale NbS*, and finally, 7) *monitor and evaluate co-benefits*.

The evaluation process starts with identifying the criticalities and opportunities of an area. Once the limitations and opportunities are highlighted, it is necessary to select the most suitable NbS that can address them and develop an action plan which can connect the objectives of the project with the specific actions and indicators used to measure the efficacy of each activity. It is already in this stage that the inclusion of different types of knowledge must constitute a fundamental element in creating social acceptance from stakeholders. The implementation process of the selected NbS has to be developed according to the knowledge obtained from citizens, practitioners, and policymakers and to promote transparency and openness. This stage also has to create a space that can allow knowledge and best-practices sharing, communication, and the enhancement of adaptive co-management. Once the primary interventions are developed, it is essential to assess their costs and benefits and manage the most conflictive elements through the use of "*transdisciplinary working methods, co-production of knowledge and adaptive management, the co-creation and design of the NBS, as well as education and greater effort on monitoring and assessing the multiple benefits of the NBS*." (Raymond *et al.* 2017b). The engagement of stakeholders through collaborative approaches and the constant communication of the results and impacts of each action constitute essential elements across all the stages of the process. Consequently, the intervention outcomes need to be upscaled through multilevel and multi-actor interactions to foster the confidence of governments, stakeholders, and investors in the successful creation of co-benefits. Finally, the evaluation of

a specific NbS intervention results continues with monitoring and evaluating practices, which must be performed across all the seven stages to create sustainable solutions with long-reaching outcomes.

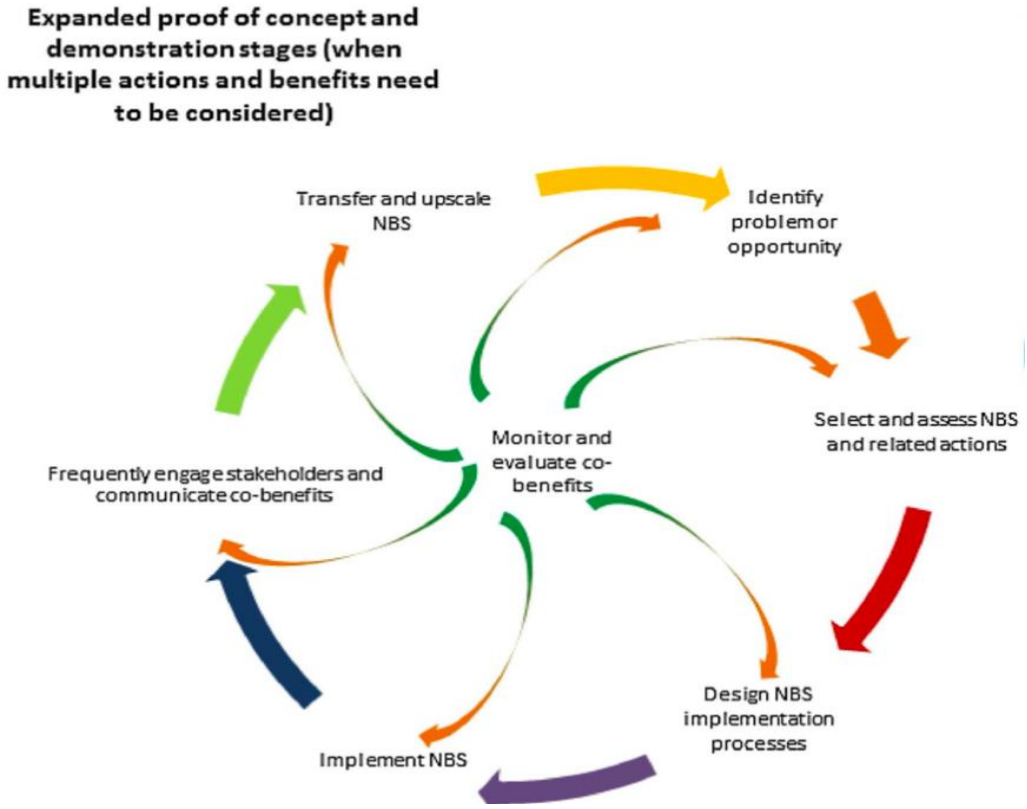

Figure 2: NBS Implementation process including phases of social innovations (Raymond et al. 2017b).

2.5. **Participation and collaborative governance**

The environmental governance models influencing the planning and implementation of NbS interventions can be various. For example, Driessen *et al.* (2012) identify four models: *government actor-led model*, *co-management*, *co-governance*, and *nongovernment actor-led model*. These approaches influence the creation, planning, implementation, and monitoring of an NbS project. However, models that include the engagement and participation of a wide range of stakeholders are more effective in managing public goods (like nature), especially if compared to top-down approaches (Zingraff-Hamed et al. 2020).

One of the most influential models regarding citizen participation in public and democratic processes is Arnstein's (1969) *Ladder of Citizen Participation* (Figure 3). The author states that participation can be considered valid if it involves the redistribution of power. The 8 types of participation are represented by a metaphorical ladder describing the different levels of citizen control and power, going from manipulative practices to complete control of citizens over the decision-making process. The eight "rungs" are divided into three groups which distinguish non-participative, tokenism and participative practices. The framework shows how participative practices can take different forms and it helps consider the value of participation within different challenges and contexts.

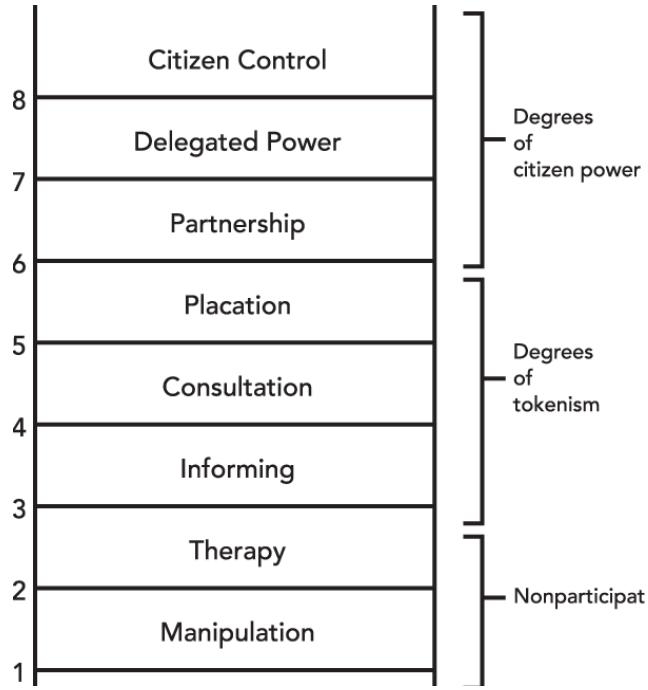

Figure 3: Ladder of Citizen Participation (Arnstein 1969).

Collaborative governance, also referred to as *participatory governance* or *network governance*, helps bring together various actors and stakeholders to tackle a common problem (Dickey and Bush 2021). Collaborative planning and decision-making relies on the sharing power of stakeholders with authorities to deliver benefits to the widest number of actors as well as promoting effective environmental management (Cradock-Henry *et al.* 2017). As highlighted by the framework proposed by Raymond *et al*. (2017b), collaborative approaches are considered to benefit NbS projects as they promote interventions able to address a variety of needs (Wilk *et al*. 2021) as well as create common goals able to bring together disconnected actors (Favretto *et al.* 2021). Furthermore, the multi-dimensionality of the issues addressed by

NbS calls for practices that include the widest variety of actors and multidisciplinary policymakers. Agbodzakey (2021) points out that some of the main societal benefits of collaborative governance include increased legitimacy, communication, trust, ownership, and shared commitment, among others. Nevertheless, participatory approaches are still rarely adopted as they are perceived to be slowing down urban planning and the development of policies due to conflicting interests between different stakeholders (Raymond *et al.* 2017b).

2.5.1. Ansell and Gash's (2008) model

The analytical framework guiding this research is based on the model of collaborative governance proposed by Ansell and Gash (2008), which provides for some of the main elements used to analyse the relationship between the collaborative approaches implemented in the case study and the social benefits created by it (Figure 4).

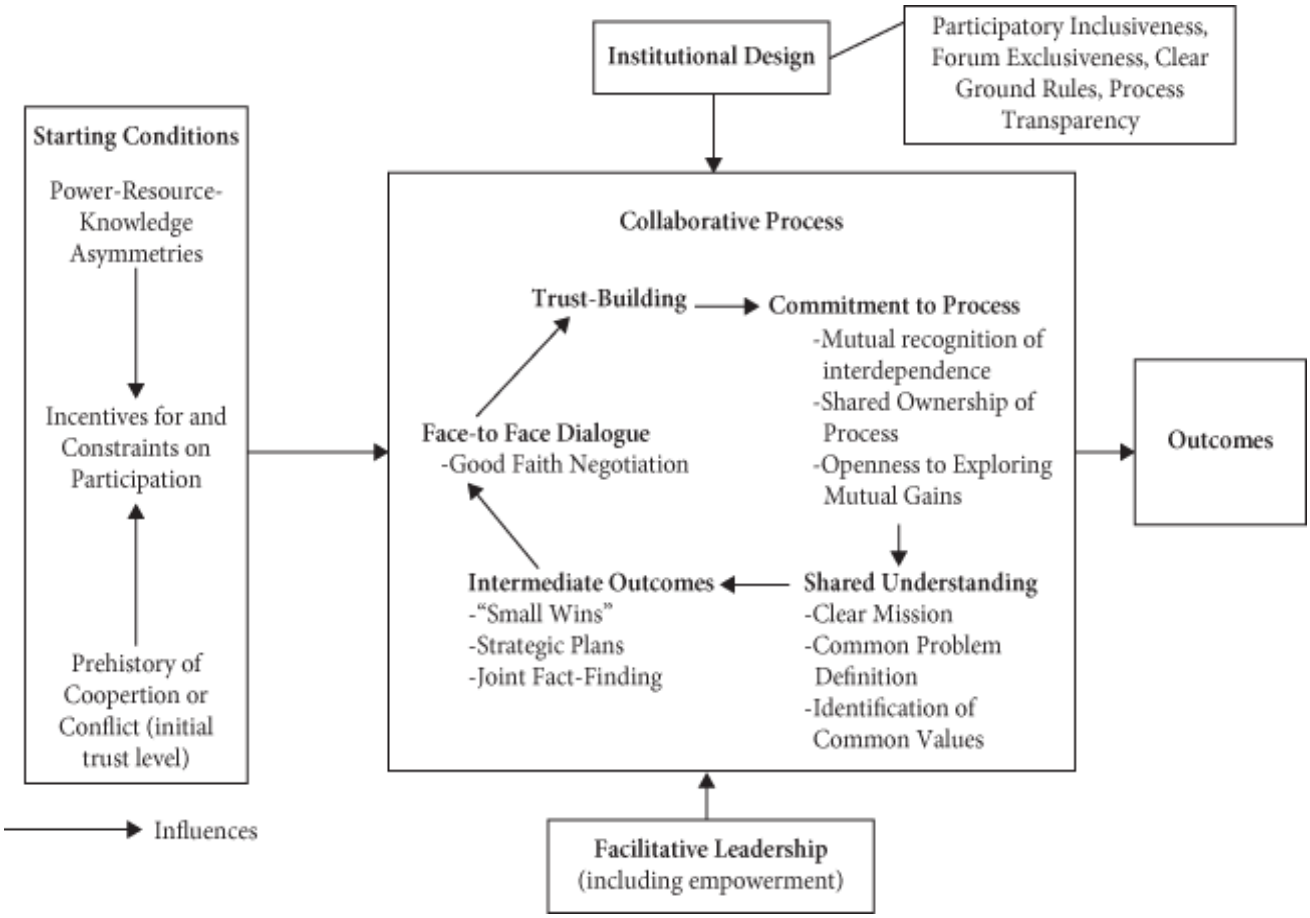

Figure 4: Ansell and Gash model of collaborative governance (Ansell and Gash 2008).

The model defines collaborative governance as a method that "*brings multiple stakeholders together in common forums with public agencies to engage in consensus-oriented decision making."*. In this case, the term stakeholder can refer to individuals like citizens, organised groups, public agencies, and non-state stakeholders. The model includes four variables that can be disaggregated into more detailed variables – Starting Conditions, Institutional Design, Facilitative Leadership and Collaborative Processes. However, the variable constituting the Collaborative Processes represents the core part of the model, while the others work as constitutive elements that can influence the collaborative process.

The starting conditions represent the foundation upon which the collaboration is developed as they can influence positively or negatively the initial efficiency of the relationships between different stakeholders. Favretto *et al.* (2021) reinforce the importance of this element by affirming that the socioeconomic context of the area is essential to establish the roles of power and the possible disparities that can influence the participation of actors. Focusing on these elements enhances the identification and inclusion of the stakeholders' values, interests, and knowledge. Hence, the importance of focusing on the power dynamics (*Power/Resources Imbalances*) that can influence manipulative practices. Another element to consider is why stakeholders decide to participate in a collaborative process (*Incentives to Participate*), which can depend upon their expectations of reaching essential outcomes, especially regarding implementing new policies. Finally, analysing the relationships that historically have characterised the main actors (*Prehistory of Antagonism and Cooperation*) is helpful to understand the factors facilitating or slowing down collaboration.

Ansell and Gash (2008) conceive Leadership as a critical element to engage various parties in the collaboration process as it represents the element that facilitates constructive dialogue and exchange of different perspectives. The leader itself is framed more like a catalyst (Agbodzakey 2021) that enables processes to reflect all participants' interests and points of view. Within its function, the leader also has a crucial position in dealing with the power imbalances that may arise and empower the weaker stakeholders. Most of all, a leader has to: *"1) promote broad and active participation, 2) ensure broad-based influence and control, 3 (facilitate productive group dynamics, and 4) extend the scope of the process."* (Ansell and Gash 2008). This role is associated by Zingraff-Hamed *et al.* (2020) with the figure of the coordinator, which is mainly seen as part of the decision-makers or public authorities.

Another fundamental element influencing the success or failure of a collaborative approach is the *Institutional Design*, described as the "*basic protocols and ground rules for collaboration, which are critical for the procedural legitimacy of the collaborative process*.". According to the proposed model, the design must emphasise an open and inclusive process with clear rules that can guarantee transparency and, therefore, trust from participants. Nunes *et al.* (2021) highlight the importance of elements like trust, clarity, transparency and openness in the co-creation and co-design of NbS.

Finally, the central part of the model is constituted by the collaborative process itself, which is specific from case to case and therefore can vary. However, the model identifies some features that are essential in the process, such as:

- *Face to Face Dialogue*: it covers a vital role in promoting communication and in obtaining consensus as well as in creating trust, respect, shared understanding, and commitment.
- *Trust-Buildin*g: it is one of the earliest cooperation mechanisms, and it ensures the sustainability and durability of the collaborative process and helps avoid manipulative actions.
- *Commitment to process*: it determines the success or failure of collaboration and it is closely related to the motivation that influences participation. Commitment is closely associated with the ownership of the process, which implies a joint responsibility from actors.
- *Shared understanding* of the process and the shared objectives it wants to achieve.
- *Intermediate Outcomes* help stakeholders to see the initial tangible outcomes of the process they have gone through. They encourage collaboration by facilitating trust and commitment in the process achieved until a certain point.

2.5.2. Wickenberg *et al.* (2021) integration

Inside the analytical framework of this research, the model presented is integrated with a few elements proposed by Wickenberg *et al.* (2021), which describes what influences the capacity for implementation of NbS (Figure 5) (Figure 6). The features underlined by the author point out the significance of co-design and co-creation to face the limitations concerning land ownership, financing and creation of knowledge. In this case, a collaborative process for NbS implementation has three fundamental requirements: spaces and platforms for collaboration, a

specific outline of the different parties involved and the type of knowledge they can offer and a joint formulation of the limitations of challenges and their consequent shared understanding.

Co-creation – conceived as an "*active engagement of stakeholders who hold different types of knowledge and resources intending to collaboratively generate outcomes.*" - is considered to support the creation of benefits such as a sense of ownership, empowerment of local communities, active citizenship and sense of belonging as well as social cohesion (Wilk *et al.* 2021). Its primary role is to produce knowledge that can help analyse the NbS and its benefits, identify the policies and stakeholders that can support NbS and, finally, explore the financial options available. The integration of collaboration and co-creation in NbS implementation has a significant role in the development of a shared understanding of the challenges as well as in the spread of actionable knowledge that can influence informed and more effective decision-making.

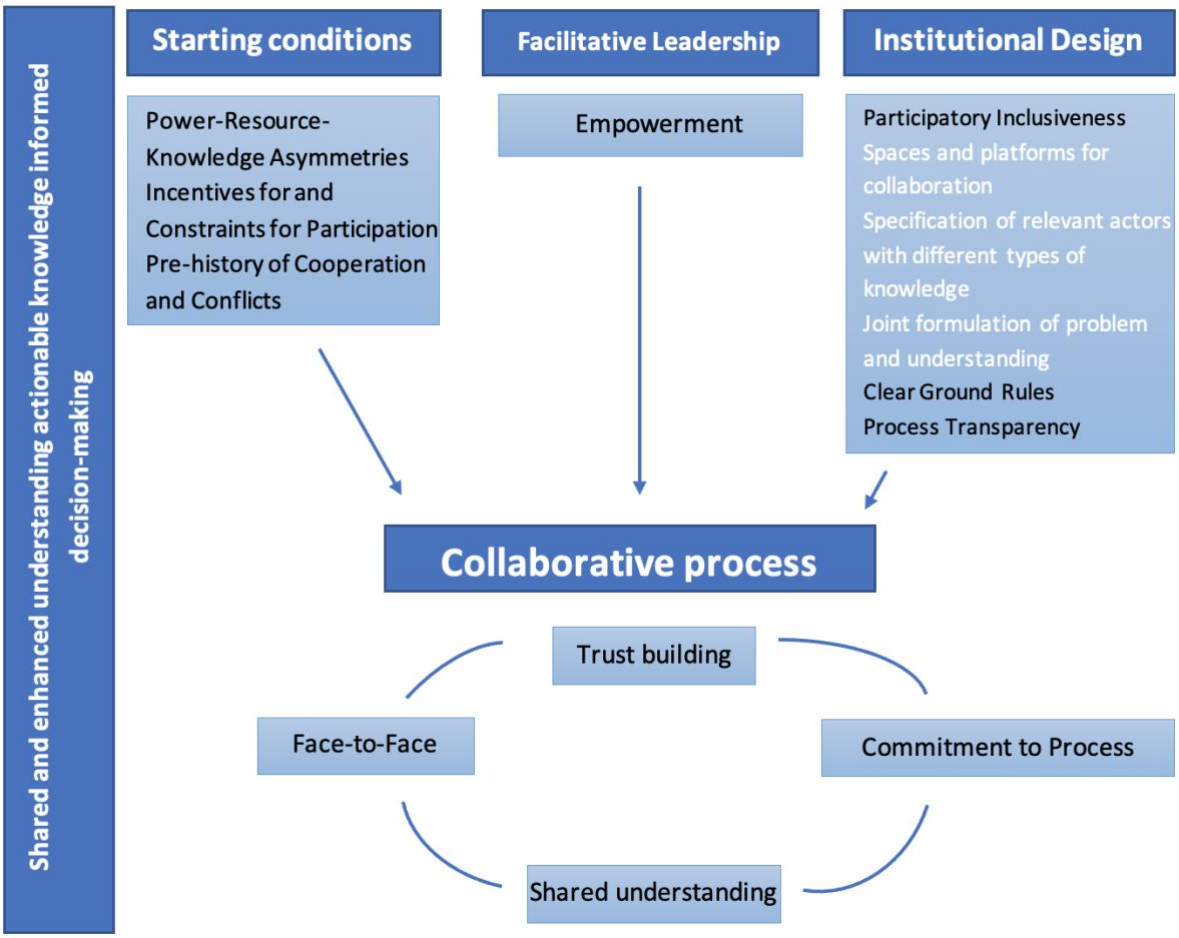

Figure 5: Key elements and steps that can influence the outputs to build capacity for implementation of NbS according to Wickenberg et al. (2021).

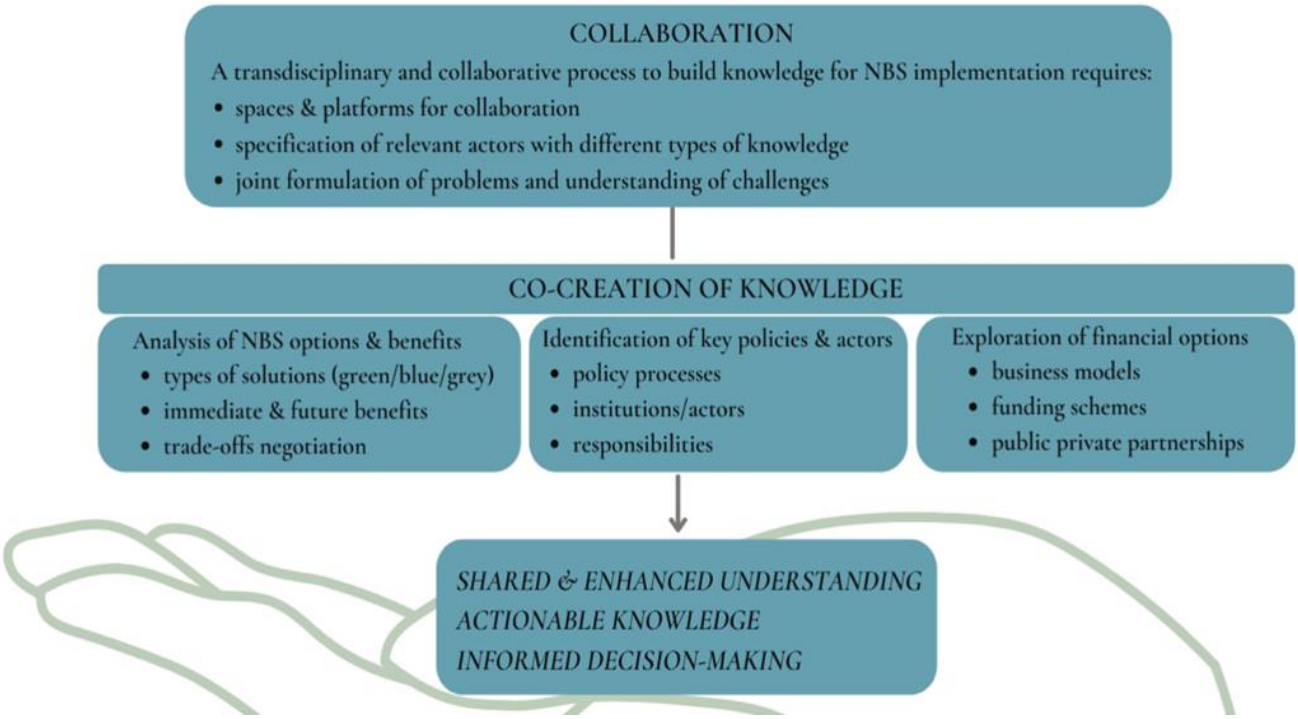

Figure 6: Adapted collaborative governance framework from Ansell and Gash (2008) and Wickenberg et al. (2021).

As it was done with the implementation of NbS, the social benefits of collaborative and participatory approaches are being explored. The studies conducted by Coghlan and Brydon-Miller (2014), Dumitru and Wendling (2021), Frantzeskaki and Kabisch (2016), Gann *et al.* (2019), and Raymond *et al.* (2017a) helped identify 4 categories of social benefits related to collaborative approaches (Table 2). These categories present similarities with the ones identified in Table 1 but with some differences in what concern the specific benefits encountered. The most-mentioned benefits are related to knowledge enrichment, education and capacity building, together with improved empowerment of the actors involved in collaboration and a more robust sense of ownership. The other outcomes encountered related to social justice and social cohesion and the improvement of livelihoods.

Categories of social benefits	Specific benefits encountered in the literature review related to collaborative approaches
Knowledge enrichment, education, capacity building	Legitimation of different types of knowledge/ Knowledge exchange/ Social learning/ Policy learning / Social engagement/ Mindfulness

Empowerment and ownership	Empowerment/ Ownership by local communities/ Consciousness/ Confidence/ Responsiveness and accountability/ Perceived control
Social justice and social cohesion	Openness/ Trust
Livelihoods improvement	Improved livelihoods

Table 2: Categorisation of social benefits generated through collaborative approaches.

2.6. **Nature-based Solutions in Latin America and Colombia**

As the concept of NbS was first developed and implemented in high-income regions (mainly Europe and North America), its operationalisation and study in middle or low-income areas like Latin America are somewhat still limited (Portugal Del Pino *et al.* 2020). Given the uniqueness of Latin America from a socio-ecological perspective, approaches, tools, or policies created and developed specifically for the Global North's reality would limit the efficacy of NbS. The region is currently transitioning from an experimentation phase to the actual adoption of these solutions on a broader scale (Ozment *et al.* 2021). For this reason, further investigation of these strategies in this geopolitical area would translate into more effective and context-adapted approaches that can address a wide range of socioeconomic and environmental issues (Dobbs *et al.* 2019). The strong relationship that ties together socioeconomic inequalities, poverty, and the progressive deterioration of the environment calls for solutions that should be deep-rooted into the dynamics of each city (Portugal Del Pino *et al.* 2020). Inostroza *et al.* (2020) underline how NbS can play a crucial role in urban planning and contribute to poverty issues and inequality by addressing the problems related to unequal access and distribution of green space among the local population. NbS are considered vital elements to achieve the development objectives of the area, provide benefits to society and, at the same time, align countries' actions to the Sustainable Development Goals (SDGs) (Ozmen *et al.* 2021).

Many urban centres in Colombia are already applying Nature-based Solutions to mitigate and adapt to climate change, improve social and human well-being and protect biodiversity. The study of Rinaudo Mannucci (2019) about the implementation of NbS in Colombia highlights how the main areas of intervention in the country are the Andean, Amazonic, and Pacific regions. In this context, research institutes and non-governmental organisations' role in

promoting NbS is fundamental, as they are the major promoters of these solutions. However, there is still a considerable gap to fill at the national level between governmental commitments and reality. In the Colombian context, many terms and concepts can be related to NbS, such as protected areas, green areas, parks, and sustainable urban drainage systems, among others. However, the country still does not have a unified vision regarding the role that NbS can play in the design of urban spaces as well as it does not have any tool or policy to promote them (Figueroa Arango 2020). The main limitations are the lack of knowledge about the concept, especially among policymakers, and the limited funding dedicated to its implementation. Hence, the need to develop methodologies and standardised tools that can allow the inclusion of NbS in the planning and development of projects (Ayazo Toscano 2019).

2.7. **Collaborative governance in Colombia and Bogotá**

In the Colombian context, collaborative approaches are referred to under the term *participatory governance* and *participatory processes*, as the Colombian Constitution of 1991 mentions. The terms *participatory governance* and *collaborative governance* have many features in common and they can refer one to the other without the risk of losing essential elements of both concepts (Newig *et al.* 2018).

In Colombia, participatory processes regarding environmental matters find their foundation in the law n. 99 of 1993 (República de Colombia), which promotes the first participation mechanisms through which actors belonging to civil society can intervene in environmental issues. Since the 1990s, independent participatory social movements for the recovery and management of Bogota's natural elements, such as wetlands, streams and some basins have started developing. Especially in the 2000s, freshwater resources turned into a determinant factor in the territorial planning of the capital city and the role of local communities in the management of these ecosystems started being recognised (Vargas and Moreno 2016).

In the period when Gustavo Petro – current candidate for the 2022 presidential elections of Colombia - was mayor of the city (2012-2015), participative practices became an essential element characterising urban policies. The mayor's objective was to motivate and actively include the citizens of Bogotá in the construction, implementation and development of projects for the city. Participation represented the critical element of an urban social strategy with three main goals: overcoming social segregation, adapting the city to climate change and defending

what is considered "public" (Ruiz Bulla 2017). In this context, in 2012, community participation in water governance was recognised by creating some strategies called *Cabildos Gobernanza del Agua* (Vargas and Moreno 2016). The main objective of the *Cabildos* is to include citizens, communities and practitioners in the decision-making process related to water governance by giving them more power for what concerns the allocation of financial resources (Ruiz Bulla 2017).

Despite the examples of successful participation of civil society movements, scholars and practitioners in various participatory processes that influenced the establishment of some environmental public policies in Bogotá, a few criticalities have been noted. For instance, a general tendency of manipulative political practices has interfered into these participatory mechanisms by favouring specific groups or few actors belonging to the local status quo. In these cases, the financial and political power of a few took advantage of the weaker socioeconomic status of some local groups and communities to restrict their participation in public decisions. This happened when there was a chance that local communities could interfere in the approval of environmental policies or regulations of specific urban projects belonging to the building sector. Hence, promoting community restoration and monitoring projects or inclusive planning practices still represents an exception (Quimbayo Ruiz 2021).

3. Methodology

This chapter will provide information on the analytical and methodological approach used in this research. This thesis wants to assess how stakeholder engagement contributes to the creation of social benefits in a selected NbS intervention (Table 3). The Bogotá case study implemented by CI Colombia served as an exploratory case to pursue the aim and objectives of this research. The three research questions will be answered with the support of the literature review conducted as well as the information obtained through the desk research, the interviews and questionnaires conducted with relevant stakeholders.

Aim	
Assessing how stakeholder engagement in the Bogotá case study contributed to the creation of social benefits.	
Objectives	**Methodology**
To investigate: • The role of stakeholders' engagement in NbS design and implementation • The creation of social benefits through collaborative governance	• Literature review • Desk research • Semi-structured and non-structured interviews with key stakeholders from the region/country studied
To investigate the co-design process of a targeted NBS project in Latin America	Semi-structured and non-structured interviews with key stakeholders in the project.
To investigate how and to which degree the collaborative approach created social benefits among the targeted audience	• Semi-structured and non-structured interviews with local communities, users, groups or associations involved in the project. • Questionnaires

Table 3: Aim and objectives of the thesis.

Given the primary aim of this thesis, it is essential to gain insight into the perceptions of the actors directly involved in the Bogotá case study. As the creation of social benefits is highly dependent on the context considered, it was deemed crucial to adopt a qualitative method

involving a case study approach that could allow obtaining the opinions and points of view of the stakeholders involved.

The qualitative methodology enables to gain insight into the targeted audience's perspective while still focusing on the context and the various steps characterising the design and implementation of the selected interventions. Additionally, the case study approach helps investigate a particular intervention in depth and within its real-life context, offering a way to evaluate specific topics in a descriptive way, even when it is impossible to obtain a clear and fixed set of outcomes. Therefore, this methodology aims at outlining the reasons behind a set of decisions, how they were implemented and with which outcomes (Yin 2009). To achieve these objectives, the research included the conduction of fieldwork research in Bogotá, where field trips, interviews and questionnaires were conducted.

3.1. **Analytical framework**

The analytical framework used to define and guide the research builds upon three frameworks: the Ansell and Gash (2008) model of collaborative governance, the key elements and steps that can influence the outputs to build capacity for implementation of NbS developed by Wickenberg *et al.* (2021) and the Raymond *et al.* (2017b) NbS co-benefits assessment framework developed by the EKLIPSE Working Group (Figure 7). The first two frameworks concern the engagement of stakeholders within collaborative approaches in NbS, while the latter relates to the evaluation and monitoring of co-benefits of NbS.

As the research focuses on the social benefits created by the participation promoted within the Bogotá case study, an assessment framework that evaluates the co-benefits of Nature-based Solutions was chosen. However, as also highlighted by Wickenberg et al. (2021), in the Raymond *et al.* (2017b) framework, collaboration with stakeholders is only seen as a later step in the implementation process (after identifying opportunities and problems to design the NbS). The literature reviewed up to this point highlighted the role that multi-stakeholder collaboration can have in planning and implementing efficient Nature-based-Solutions. For this reason, the assessment framework of Raymond *et al.* (2017b) was adapted by making stakeholder engagement a constant and continuous strategy that should be incorporated into each stage of the design and implementation process. Given the specific aim of assessing the role of stakeholder engagement in creating social benefits, the three frameworks mentioned above

were integrated to focus specifically on the results of the collaborative approach promoted within the implementation of the selected NbS.

The framework will be used in the analysis and discussion section to guide the assessment of the collaborative approaches implemented in the various steps of the interventions. The outer circle (including *Facilitative Leadership*, *Starting Conditions* and *Institutional Design*) gathers the background elements influencing collaboration. The inner circle, which includes the key elements for collaboration, wants to emphasize the importance of participation in all the stages of the NbS evolution.

Figure 7: Analytical framework adapted from Raymond *et al.* (2017b), Ansell and Gash (2008) and Wickenberg *et al.* (2021).

3.2. **Research design**

The research design was created to fulfil the aim and objectives of the thesis using adequate methods (Figure 8). The process started with an initial literature review that helped identify the scope of the research and guided the research for the case study. After having chosen the case study, the objectives of the thesis were established. Consequently, an analytical framework was created.

Secondary data collection was performed through desk-based research, in which relevant grey literature and published studies regarding the topic of this thesis were analysed. Additionally, informative documents and technical reports were provided by CI Colombia and analysed.

Primary data consisted of non-structured, semi-structured interviews and questionnaires. For this purpose, a fieldwork in Bogotá was conducted from March 8th to April 9th, 2022. 12 semi-structured and non-structured interviews were conducted on-site and online with 14 stakeholders (Table 10), mainly decision-makers, experts, community members, and community and environmental leaders of the four *localidades* of the study. Although a stakeholders analysis was independently conducted, the interviewees were suggested by the coordinator of the projects according to their role in the design and implementation stages. The overall objectives of the interviews were to gather information about the collaborative approaches taken in the design and implementation phases and collect information helpful in assessing the social benefits created within the projects. The questions were drafted according to the three research questions guiding this investigation and included references to the analytical framework presented in Figure 7 (See Appendices for the drafts of the interview guides). All interviews were recorded prior consent of each participant and had an average duration of one hour. In addition, to assess the perspective of a higher number of participants, questionnaires were sent to around 100 persons related to the projects. However, the questionnaires received poor feedback as only three people answered. The interviews and questionnaires were conducted and provided in Spanish, and the results were translated into English. Finally, a field trip was completed with CI Colombia in the context of one of their ongoing projects to gain insight into the working methodology of the organisation with communities.

Once primary and secondary data collection were collected, the data collected was analysed. In this case, the analytical framework guided the interpretation of the information gathered and structured the results and analysis section. It allowed assessing the participatory approaches taken by CI Colombia within the context of the projects and their role in creating social benefits amongst the various stakeholders.

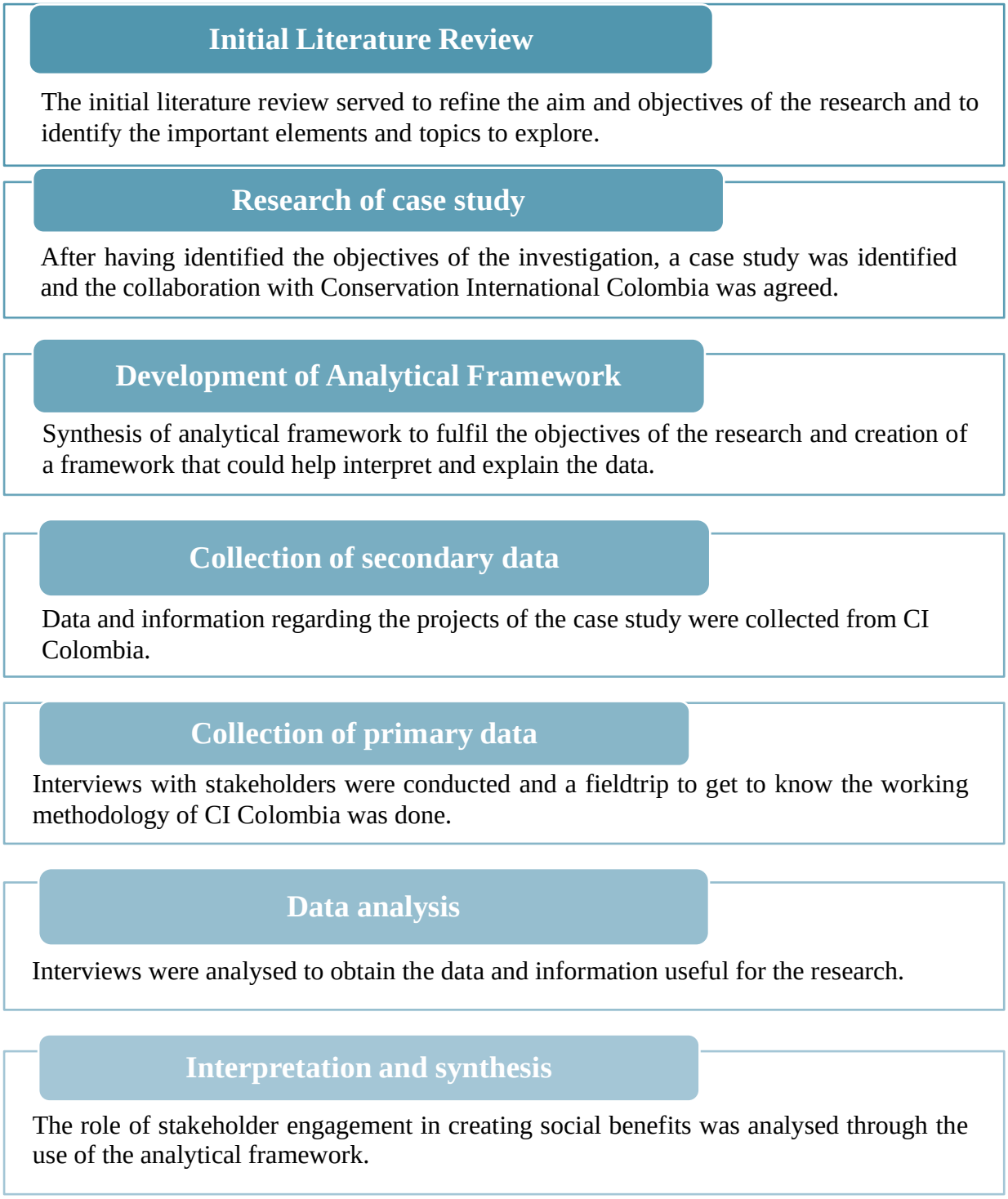

Figure 8: Research Design (Author)

3.3. **Validation and conceptual limitations**

The research came across both practical and conceptual limitations.

The first conceptual limitation relates to the evaluation of social benefits. Since there is no clear definition of what constitutes a social benefit, its categorization turns out to be arbitrary and prone to different interpretations. Similarly, a second limitation encountered in the investigation concerns the difficulty of differentiating whether social benefits were a direct benefit of the participatory process or of the NbS as a whole.

Regarding the practical limitations, the first and most evident one was that of security. The Eastern Hills and isolated natural territories represent risky areas where security cannot be guaranteed. Since the majority of the locations of the projects were located in these areas, the exploration of the results of the projects was limited to the few group activities where the presence of police could guarantee security. Hence, the impossibility of visiting all the intervention areas. The second main limitation related to the ending date of the projects. As the projects ended in 2014, 2016 and 2018, a few years had passed at the time of the research since the implementation of the activities. Therefore, it was challenging to reach out to some stakeholders: firstly, because a few actors involved in the city's governmental roles were not in charge anymore and secondly, because, after the pandemic, a few actors belonging to communities and civic sector lost contact with CI Colombia and the activities developed within the restoration process. The third limitation concerned the number of participants involved in the research. Due to limited time, the total sample size was consistently smaller related to the number of actors and stakeholders involved in all the interventions. To make up for this issue, the selection of participants, both in interviews and questionnaires, was thought to represent fairly stakeholders' categories and roles.

4. Case study

4.1. Introduction to the area

Bogotá is the capital of Colombia and it is an autonomous municipality (called *Distrito Capital*) with a total urban agglomeration of 10,5 million inhabitants (United Nations 2019). The city is composed of 20 political-administrative units called *localidades*. The majority of them have a merely urban nature while some others are primarily composed of rural areas (Quimbayo Ruiz 2021). With an average height of 2640 meters above sea level, Bogotá is located in the Eastern Colombian Andes, on a plateau called *Sabana* of Bogotá (Osorio Ardila 2020). Its Eastern part is constituted by the Eastern Hills (*Cerros Orientales*) mountain range, which has great importance in the hydrological and climatic regulation of the *Sabana* as well as holding a cultural and symbolic value (Figure 9).

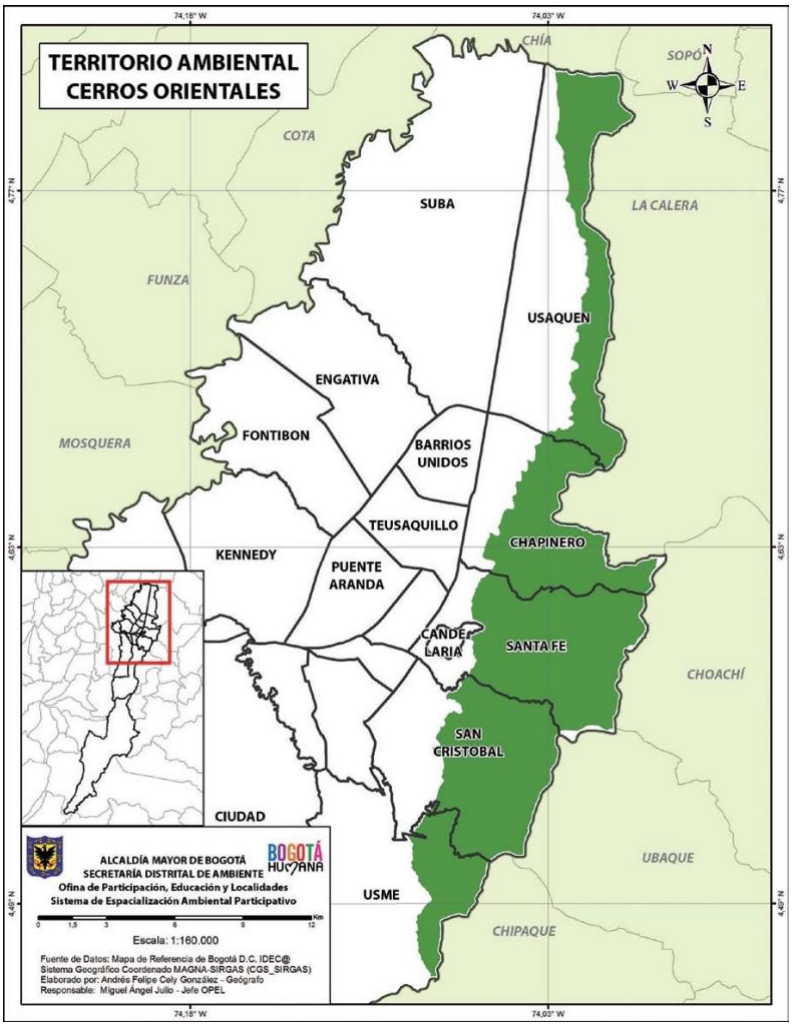

Figure 9: Territorial division of Bogotá, with a focus on the Eastern Hills (Cerros Orientales) (Julio and Quiñones 2014).

The *Cerros Orientales* take part in the Bosque Oriental de Bogotá Protective Forest Reserve (*Reserva Forestal Protectora Bosque Oriental de Bogotá)* and the *Franja de adecuación* (buffer zone between the city and the forest reserve). The Forest Reserve is a national protected area.

Aquifers recharge precipitation and streams are essential for the water supply to the city and the maintenance of its different ecosystems. Within the Eastern Hills, two types of water sources are born: a set of 33 streams, which flow to the city and discharge their waters into the Bogotá River. On the other hand, a group of 12 streams and 15 runoffs in the upper area of the Teusacá river stream also discharge to the Bogotá river (Figure 10).

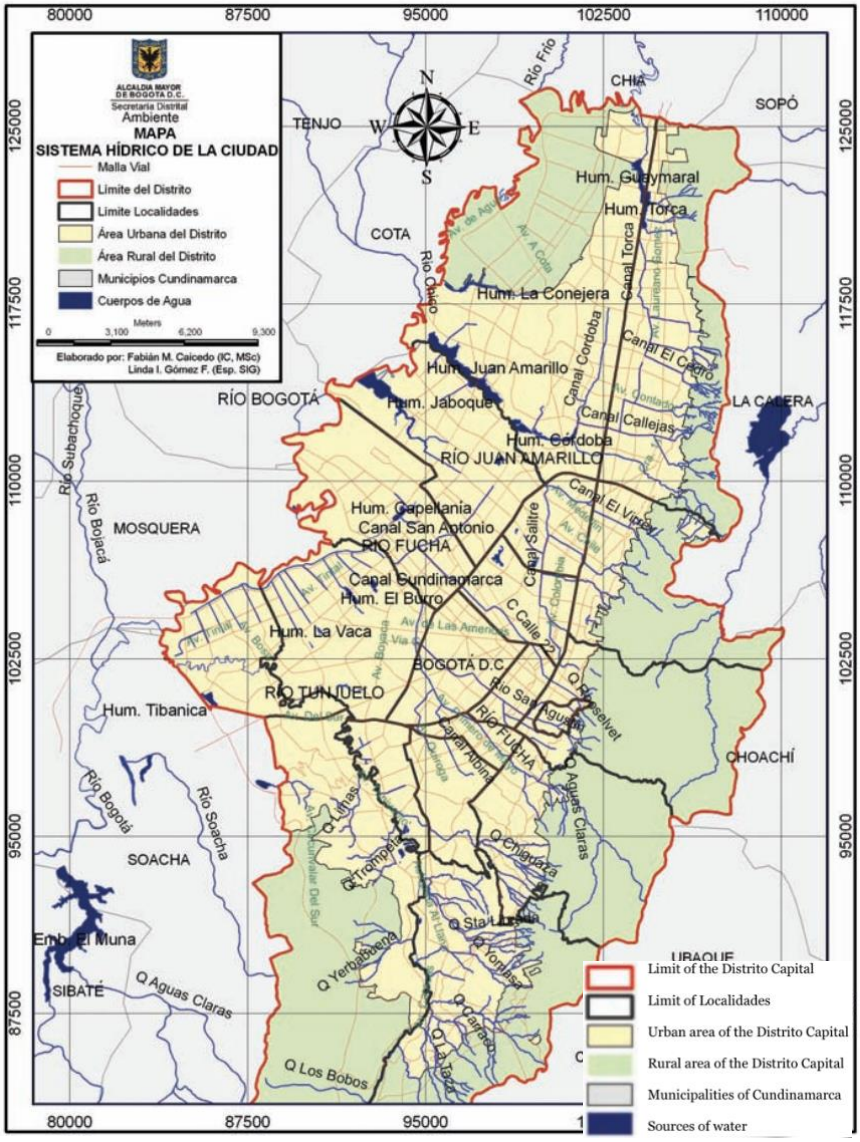

Figure 10: Hydrological system of Bogotá (Empresa de Acueducto y Alcantarillado de Bogotá and Secretaría Distrital de Ambiente 2008).

The city has a subtropical highland climate according to the Köppen classification systems, with an average temperature of 14°C and two rainy periods in April – June and September - November. The privileged position of the city translates into diverse and rich vegetation, influenced by the presence of the Andean forests (*bosque altoandino*), *páramos* and *sub-páramos*, but also by being part of the ecological corridor that connects the biggest *páramo* in the world – Sumapaz – with the Chingaza *paramo*, where most of the city's water supply originates (Escobedo *et al*. 2015) (Escobedo *et al.* 2018)(Miguel and Quiñones 2014).

All the natural elements that maintain and sustain the region's biodiversity are integrated into an urban planning strategy called Main Ecological Structure (*Estructura Ecológica Principal* EEP). The natural resources of the territory are critical to generate connectivity between various ecosystems (Andrade *et al*. 2013). The structure includes areas such as wetlands, high mountain ecosystems, moors, the Eastern Hills and forest reserves that provide ecosystem services. The public urban vegetation is managed by the regional environmental entity (*Corporación Autónoma Regional de Cundinamarca* – CAR) and by the municipal environmental secretariats (Escobedo *et al*. 2015). These environmental authorities are responsible for the creation of local environmental policies and their execution. The jurisdiction of the CAR relates to the whole region of Cundinamarca (*Departamento de Cundinamarca*) while the one of the environmental secretariats to the city of Bogotá.

Bogotá is strongly segregated in both spatial and social terms, with the wealthiest neighbourhoods located in the North and Northeast parts of the city and the lowest income areas in the South and West (Escobedo *et al*. 2018). As the city experienced a robust urbanisation process, it is estimated that 23% of the urban area is composed of informal settlements. In this context, 90% of settlements located in the West and South parts of the city started informally, mainly due to the solid rural displacement caused by the national conflict and the years of violence (Valencia 2016).

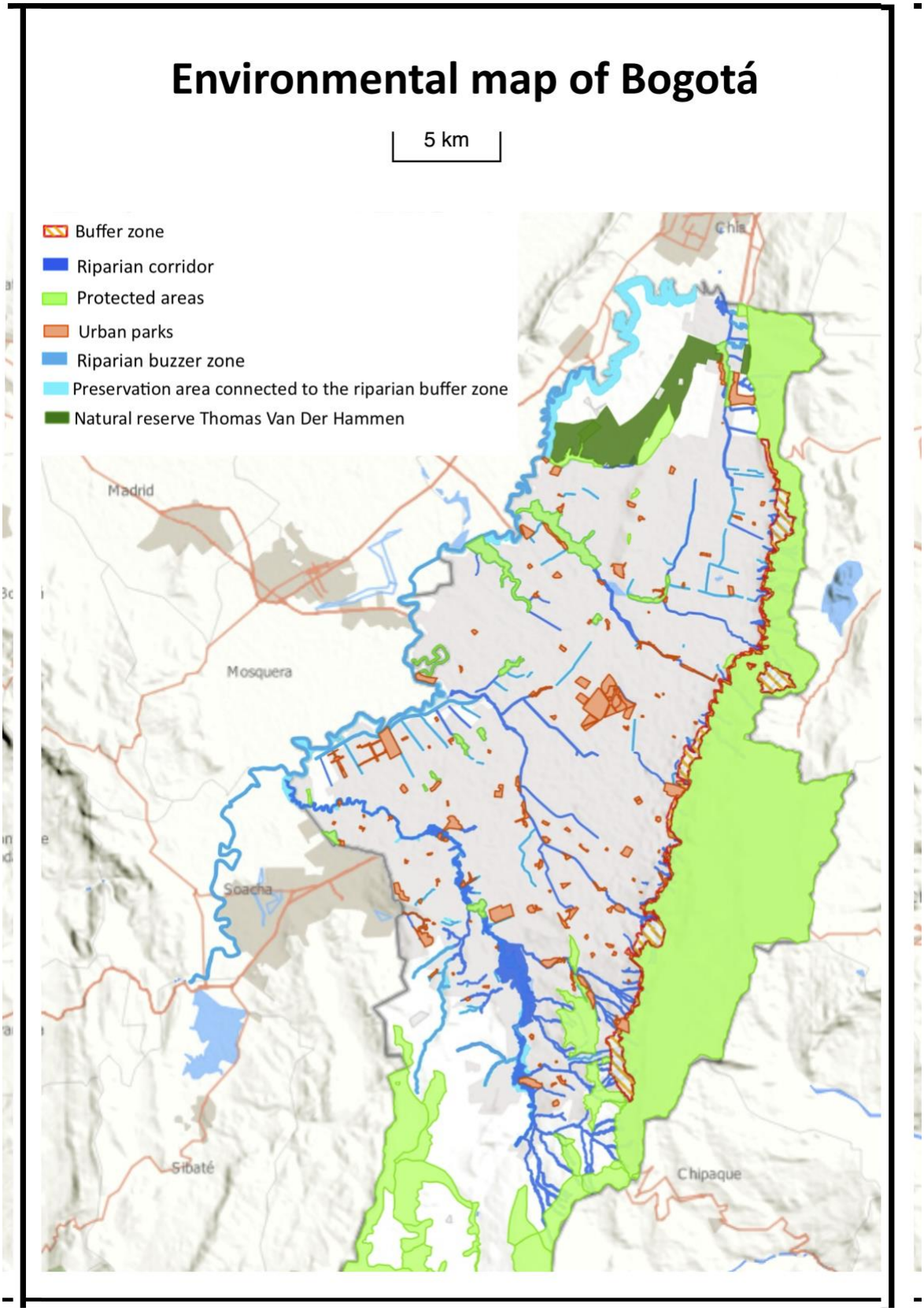

Figure 11: Principal elements of the Main Ecological Structure (Secretaría Distrital de Ambiente 2022)

4.2. **Restoration of the territories associated with streams and rivers in Bogotá**

In 2008, Blanca Inés Duran became the mayor of the *Localidad* of Chapinero. During her 5 years term, she created a social and environmental diversity political strategy for the *Distrito* of Chapinero. This political strategy focused also on the prioritisation of biodiversity, aquatic ecosystems and the importance they have on citizens' well-being (Bejarano Mora pers.comm.). The start of the Conservation International Colombia process that will conduct the comprehensive restoration of streams and rivers in Bogotá finds its roots in the strategy implemented by Blanca Inés Duran. The Chapinero interventions in 2009 represented the first successful examples of ecological restoration of rivers and streams. For this reason, the Secretary of Environment of the District took that particular experience as a reference to apply in other locations in Bogotá, adapted to the context and conditions of each stream (Bejarano *et al.* 2014). The Chapinero's interventions in 2009 were followed by others in the *localidades* of Usaquén (in the Northern part of the Eastern Hills) and Usme and Sumapaz (in the Southern part of the city).

The strategy followed by Conservation International Colombia involved the integration of natural, sociocultural and institutional elements with the local and regional dynamics of the streams considered. In order to ensure the sustainability and durability of the interventions, they used a process of "collective design" with the participation of interested social and institutional actors, as well as the entities responsible for environmental and water issues. The engagement of communities and different regulatory bodies ensured social legitimacy, political continuity and sustainable management (Bejarano *et al.* 2014). In this way, the restoration process promoted also the restoration of functions, both ecological and social.

The model for the comprehensive restoration of the rivers and streams was first developed within the Chapinero experience and it includes four stages that must be implemented continuously and consecutively and integrated by a strategy of horizontal and incidental social participation.

4.3. **Chapinero**

Stream restoration in Chapinero started in 2009 as part of the "Comprehensive restoration of the territories associated with streams and rivers in Bogotá" were developed with the incorporation of three components: landscape restoration, urban trees and ecological

restoration (Figure 14). In general terms, included the establishment and the planting of trees, environmental education, scientific resource, the development of eco-urban infrastructures (pedestrian paths, kiosks, bridges and viewpoints), the installation of green walls and the consolidation, the creation of passive recreation points, the conservation and restoration of existing ecosystem services and the promotion of various forms of artistic and cultural expression by residents and volunteer artists. These actions were developed in the case of three main streams: the *Quebrada Las Delicias* (Figure 12), the *Quebrada Morací* (Figure 13) and the *Quebrada El Chulo*.

A fundamental component, which characterized the entire diagnosis, design and implementation process, has been the community's participation throughout the process (Bejarano *et al.* 2014). During this process, a community committee was formed and met regularly to discuss and provide feedback on each intervention. This committee was crucial for achieving the assistance and participation of the communities.

Figure 12: Location of the stream Las Delicias (Alcaldía Mayor Bogotá and Secretaría Distrital de Ambiente 2015).

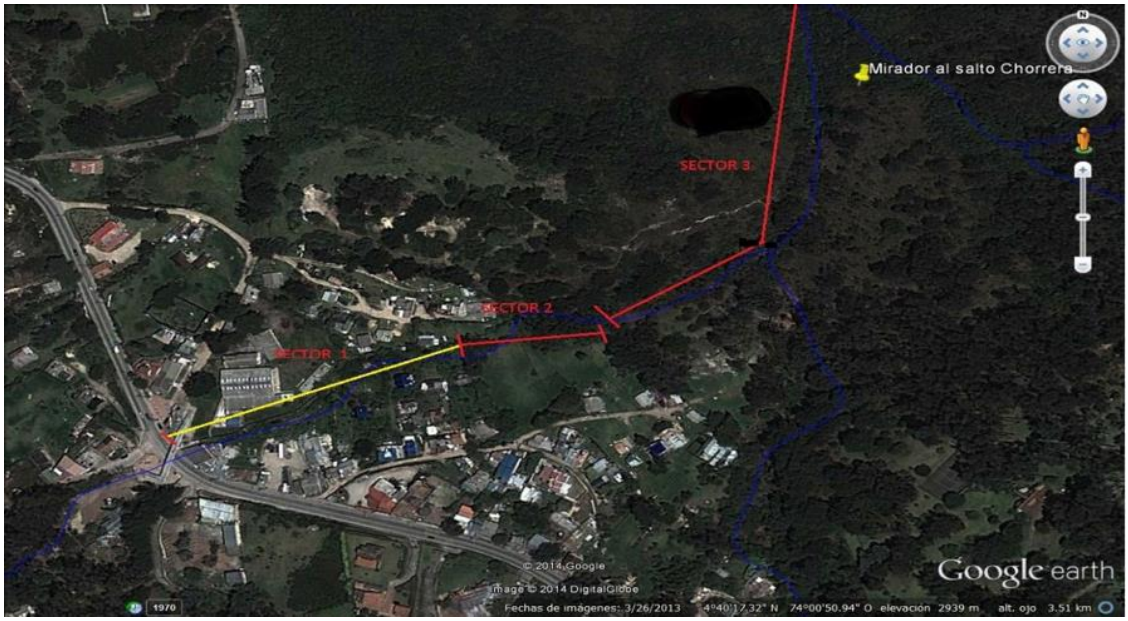

Figure 13: Location of the stream Morací (Secretaría Distrital de Ambiente et al. 2014).

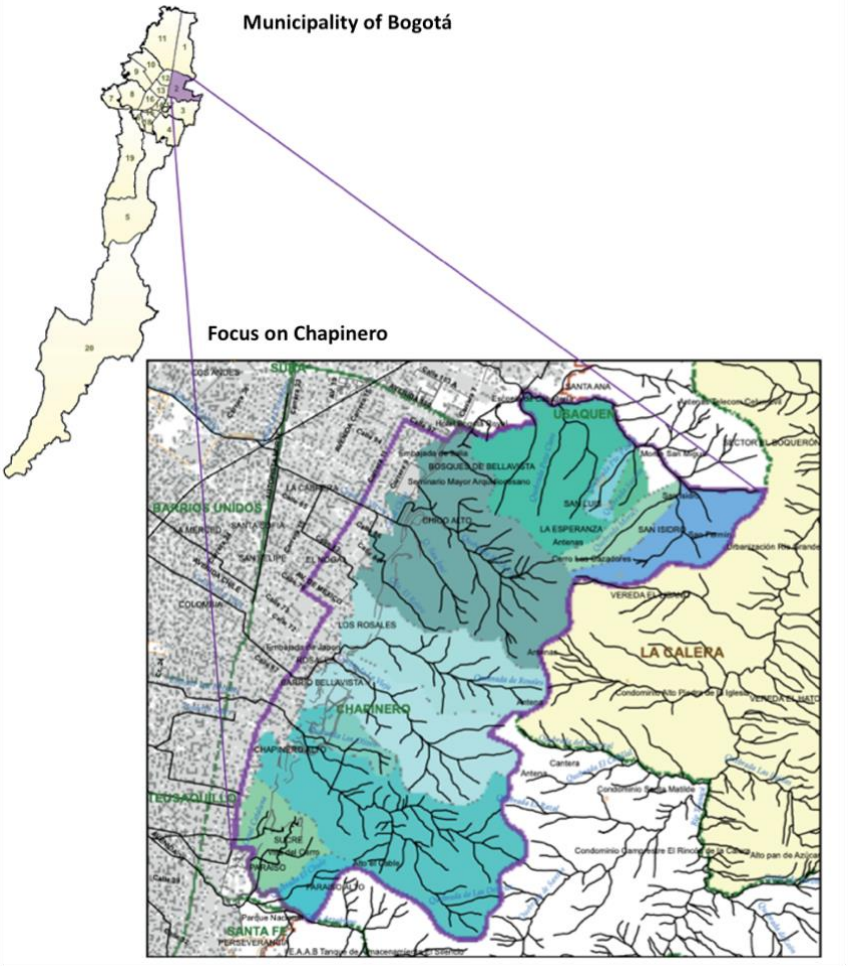

Figure 14: Location of the study area in Chapinero (Bejarano et al. 2014).

4.4. **Usaquén**

The project's success in Chapinero inspired its replication in the *Localidad* of Usaquén, in the North of Bogotá (Figure 15). In 2013, the Local Mayor's Office of Usaquén, the Secretary of Environment of Usaquén and Conservation International Colombia came together to restore 4 streams (*San Antonio*, *Quebradita*, *Morací* – shared with Chapinero – and *Puente Piedra*). Additionally, the *Santa Bárbara* stream and 4 other streams of the *Torca* river (*La Floresta*, *San Juan*, Patiño and *Aguas Calientes*) were included in order to improve the connectivity with the Torca wetland (Las Quebradas de Usaquén 2014) (
Figure 16).

Figure 15: Location study area in Usaquén

Based on previous examples, restoration measures involved landscape restoration, urban tree planting and ecological restoration through the re-establishment of exotic vegetation and revegetation. The main objectives were the following (Secretaría Distrital de Ambiente *et al*. 2014a); (Secretaría Distrital de Ambiente *et al*. 2014b); (Secretaría Distrital de Ambiente *et al*. 2014c); (Secretaría Distrital de Ambiente *et al*. 2014d):

- Restoration of the connectivity of the Eastern Hills by allowing the transit of fauna and enhancing the flow of seeds;
- Harmonisation of environmental and landscape elements through revegetation activities with native species to support food, mobility and niche for birds and the recovery of soils in degraded areas.
- Recovery of water quality by eliminating discharges (not included in this phase).
- Motivate and support soil restoration in degraded areas near the streams.

These activities involved stakeholder participation, community meetings, exchanges of experiences, activities involving schools, volunteer work, environmental education, environmental festivals, artistic activities, workshops, photographic exhibitions, socialization of the projects, participation in Local Administrative Boards and Local Environmental Council sessions focused on wetlands (Las Quebradas de Usaquén 2014).

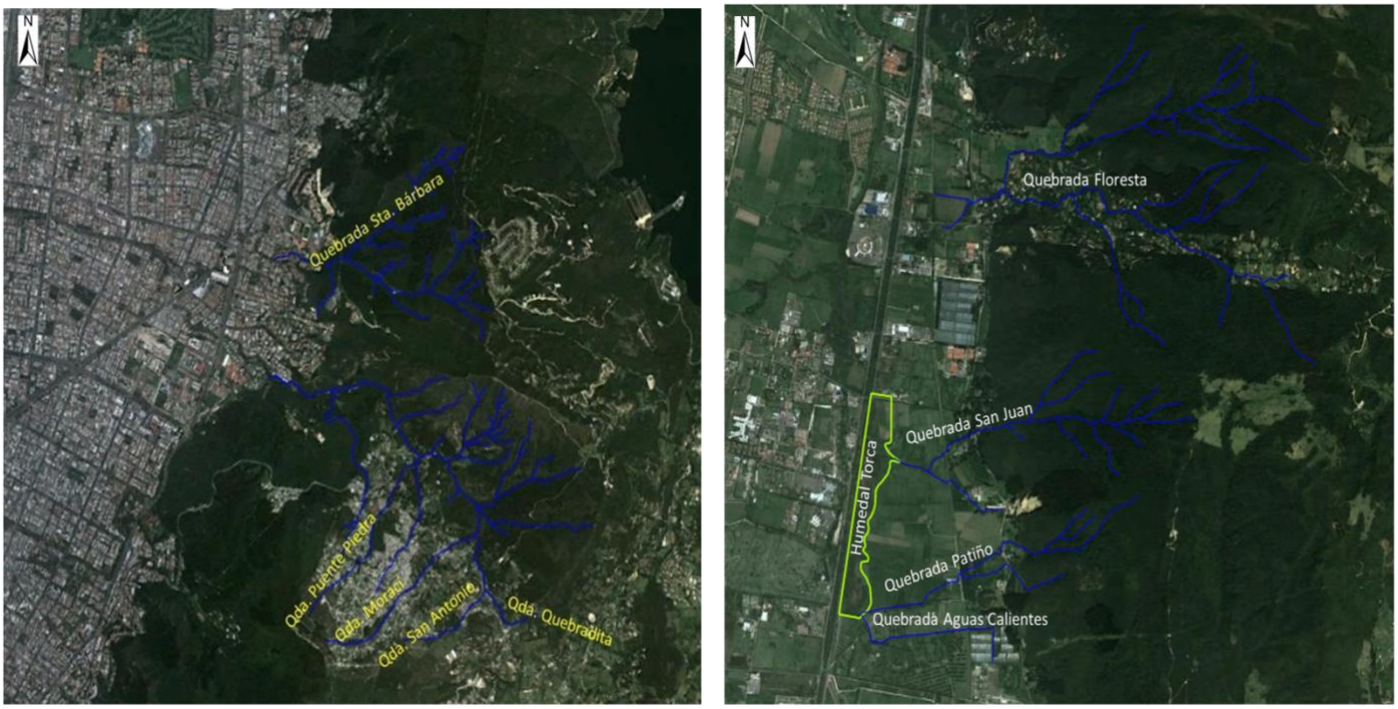

Figure 16: Location of the streams considered in the Usaquén restoration process (Secretaría de Ambiente et al. 2014e).

4.5. **Usme and Sumapaz**

In 2016, the CAR, the Secretary of Environment of Bogotá and Conservation International Colombia further amplified these processes just mentioned by promoting new participatory ecological restoration projects in the rural landscape of the towns of Usme (Figure 17) and Sumapaz (Figure 18). Usme and Sumapaz are located in the Southern part of Bogotá, and they represent the biggest *localidades* of the city. They are constituted mainly by rural land – 86% in Usme (Narváez 2019) and 100% in Sumapaz. Although Sumapaz is part of the Capital District of Bogotá, it identifies fully as a rural area, both environmentally and socially. Moreover, it is an ecosystem of great importance as it is the largest *páramo* globally and the primary source of water supply for the city, together with *Chingaza* (Miguel and Quiñones 2014).

The interventions aimed at contributing to:

- Landscape enrichment;
- Habitat improvement;

- Environmental planning;
- Ecological connectivity between protected areas;
- Conservation of species of local or national and environmental interest.

The interventions included different actions, such as the protection and enrichment of forests, springs, wetlands and water rounds, the management of invasive plant species, the enrichment of forest cover, living barriers, and the management of trails. As the majority of the intervention areas were private, the process included permanent contact and interaction with the owners and administrators of the properties to co-create the interventions. As a result of this social strategy, training sessions, workshops, awareness sessions, and participation sessions were carried out. At the same time, conservation agreements were signed with the owners of the lands to agree on the actions that had to be carried out, and mutual commitments to the sustainability of the measures were guaranteed (CAR *et al.* 2018).

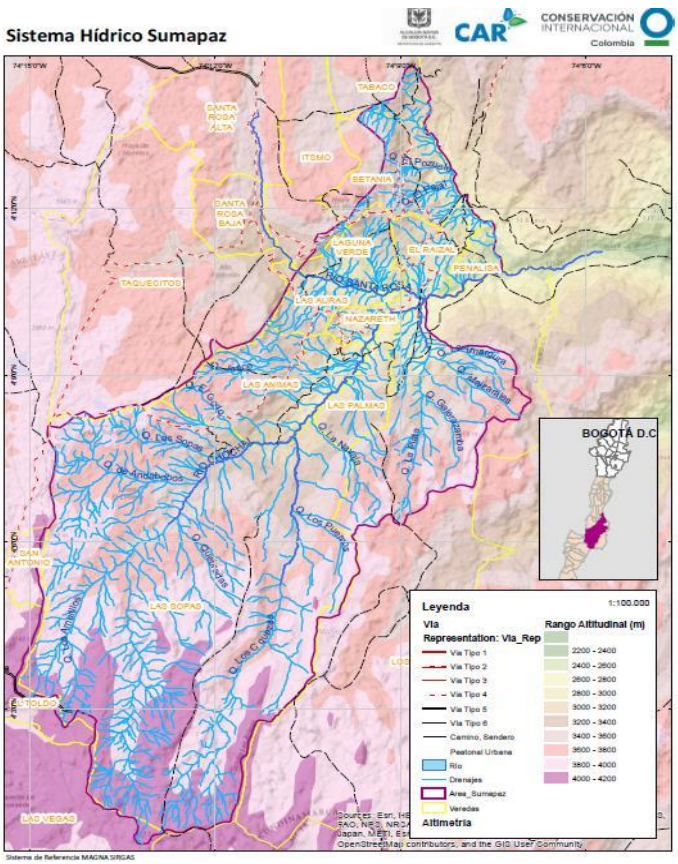

Figure 18: Area of intervention in Sumapaz (Bejarano et al. 2014).

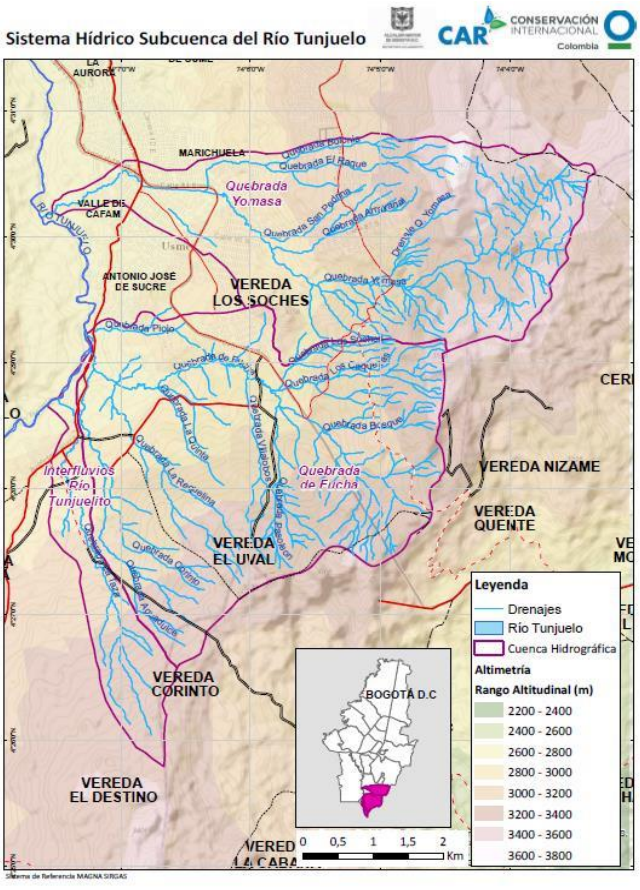

Figure 17: Area of intervention in Usme (Bejarano et al. 2014).

5. Results and analysis

This section will provide the results of this investigation and their analysis according to the research questions established at the beginning of the thesis. In order to fully understand the dynamics of the collaborative approaches of the case study, information regarding Bogotá's most relevant dynamics will be given. Consequently, the engagement of stakeholders in the different stages of the NbS development will be explored. Lastly, the social benefits of the NbS and the implementation of the collaborative approach will be evaluated.

5.1. Context of the projects' territories

Investigating the context of the projects is crucial within the scope of this research. Therefore, the main characteristics, challenges and dynamics of the four *localidades* considered by the stream ecosystem restoration process will be explored. These dynamics are considered to be part of the *Starting Conditions* mentioned in the framework as they influence the development of the NbS and the collaborative practices. The elements presented are a result of the literature review, the interviews conducted, the questionnaires and the personal observations developed during the fieldwork in Colombia.

5.1.1. Rural-urban dichotomy and geographical differences

The *Distrito Capital* of Bogotá, which includes 20 *localidades*, comprises urban and rural areas. Although its urban part hosts the highest concentration of inhabitants, most of its territory is rural, with 122.258 hectares against the 38.431 hectares of the urban land (Figure 19).

The interventions promoted by CI Colombia are located in territories with different percentages of urban and rural land that influence their dynamics, characteristics and identities. Consequently, the configuration of each *localidad* influenced different approaches and strategies developed explicitly according to the environmental, socio-economic and territorial features. The four different areas of the restoration process are configurated as a mix of urban and rural areas. Nevertheless, the dichotomy between urban and rural played and still plays an essential role in the dynamics of these areas and the planning and implementation of the projects of CI Colombia.

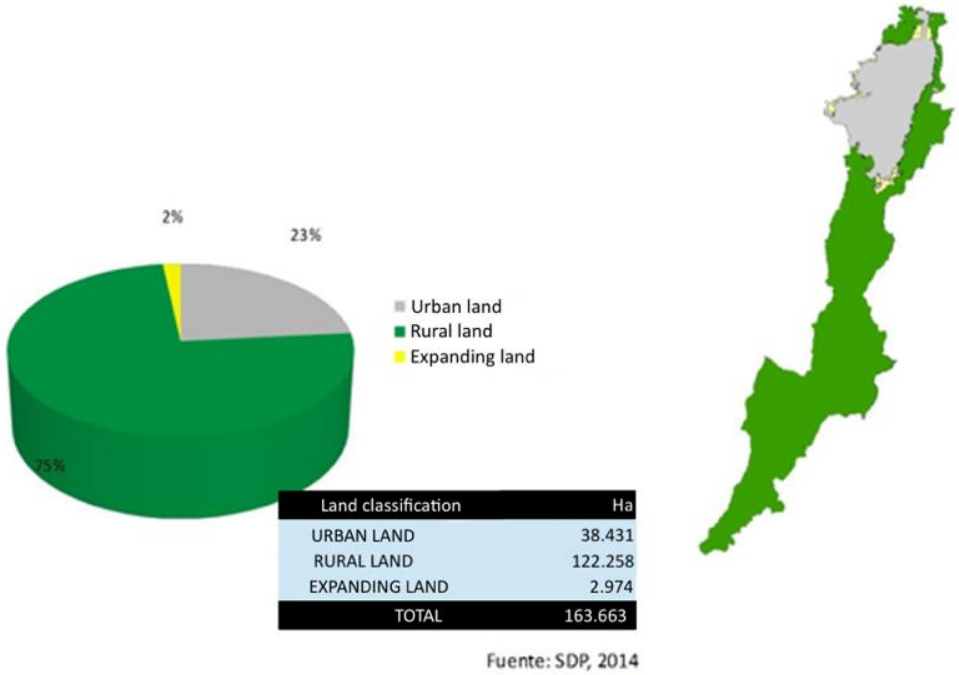

Figure 19: Distribution of rural and urban areas in the Distrito Capital of Bogotá (Lurduy Jiménez 2016).

Since Usaquén and Chapinero belong to an important commercial and financial part of Bogotá, they are mainly identified as urban boroughs. However, as Table 4 demonstrates, a significant percentage of both consists of rural land (41 per cent in Usaquén and 68 per cent in Chapinero). The rural part of Usaquén and Chapinero is constituted by the *Cerros Orientales* (Figure 8), which cross the Eastern side of the city from North to South, where they reach a tiny portion of Usme. On the other hand, Usme and Sumapaz are purely rural boroughs as they have high percentages of rural land (87 per cent and 100 per cent, respectively).

Localidad	Rural area	Urban area
Usaquén	41%	59%
Chapinero	68%	32%
Usme	87%	13%
Sumapaz	100%	0%

Table 4: Urban-rural distribution in the localidades considered by the projects.

Although all four own rural areas, their identities are different. Usaquén and Chapinero recognise themselves as urban sections, even though they own significant portions of forests

and natural reserves. On the other hand, Usme and Sumapaz have strong identities related to peasantry and rurality. Historically they have experienced solid social movements related to the land and the conservation of the *Cerros Orientales* and the *páramo* of Sumapaz. The strong attachment to the land has played an essential role in fighting the interests of big construction companies that wanted to build in strategic points – for example, the archaeological remains of *muiscas*[2]*'* cemeteries – or the ones of the local municipality that wanted to incorporate some lands into the urban development of Usme. Usaquén and Chapinero, on the contrary, do not have any type of attachment to the land. Their population have a prominent urban and city culture, and social movements are scarce. Therefore, the conservation of the environment and the *Cerros Orientales* are relegated to the few existing social movements, often linked to youngsters of lower-income neighbourhoods.

Several interviewees stressed the critical role that women have played in the success and sound development of the interventions. Especially in the rural context, women held an essential space in the social fight for the ownership of the land and the conservation of water resources, the *páramos* and, in general, peasant culture. In this context, since they usually do not have the opportunity to study or work, they develop an essential function in taking care of the territory, their family and, consequently, the community.

Another difference characterising these territories relates to their legal protection. While the rural area of Usaquén and Chapinero (constituted by the *Cerros* Orientales) forms part of protected areas, only part of rural Usme is protected (only the part included in the *Cerros Orientales*). What is not protected in the Northern *localidades* is urban, while what is not protected in Usme is farmland. Hence, the communities of Usme in the unprotected areas and with livelihoods related to agriculture and the productivity of their lands are constantly exposed to the risk of urbanisation.

According to decision-makers and leaders related to the interventions implemented, the different dynamics characterizing urban and rural areas influenced greatly the approaches taken during the planning and implementation of the various restoration practices. Given the diversity in dealing and work with urban and rural communities, each territory required different methods and ways of relating to people and communities.

[2] Indigenous communities populating the Cundinamarca-Boyacá region in Colombia.

5.1.2. Urbanisation, socio-spatial segregation and insecurity

Robust urbanisation has marked the history of Bogotá in the last 50 years. This phenomenon has resulted in the creation of territories lacking urban planning, influencing dynamics of social exclusion, poverty, and violence. Furthermore, the urban sprawl of the capital city has been linked to rural migratory flows caused by the national armed conflicts and by centuries of violence (Quimbayo Ruiz 2018). These factors have influenced the development of informal settlements and low-income housing in marginalised hilly areas prone to floods or landslides. Specifically, 70 per cent of the city's housing growth between 1950 and 2010 was illegal, and only afterwards the state regularised it. In the city's recent history, the pressure for urban sprawl and housing projects still constitutes a significant problem, particularly in environmentally affluent areas like the *Cerros Orientales* or the rural areas of the Southern *localidades*. In these territories, land-use speculation and illegal land ownership caused by corrupt political practices have caused significant injustices towards local communities and damaged important ecological areas (Quimbayo Ruiz 2021). Given the factors mentioned, Bogotá has developed as a socially fragmented city characterised by solid inequalities and socio-spatial segregation. It is characterised by high-income neighbourhoods, primarily localised in the Northern part of the city, an essential extension of areas with mixed socio-economic features, and illegal low-income settlements in the marginal parts of the city (Quimbayo Ruiz 2020). The majority of the *localidades* of Bogotá are identified by the socioeconomic strata[3] of their inhabitants, with the highest strata (5 and 6) located in the Northern areas and the lowest (1, 2 and 3) in the Southern and Western areas. These dynamics are represented in Figure 20, where the number of inhabitants, the density and the socioeconomic status of each neighbourhood is described. The projects implemented by CI Colombia are located in *localidades* and neighbourhoods which present different socio-economic statuses, with Usaquén and Chapinero being characterised by the highest or mixed socioeconomic strata and Usme and Sumapaz by the lowest socioeconomic strata (mainly 1-2).

In this context, the *Cerros Orientales* have an important particularity as they host the most vulnerable and the wealthiest neighbourhoods of the whole city. Chapinero represents the perfect example as it sees the presence of informal settlements created in the hills and highly well-off areas like the *neighbourhood of Rosales*. This contrast has often caused social conflicts

[3] Colombia has a stratification system, which divides citizens according to their home's characteristics. It is used to classify urban population.

as the lower-income communities have repeatedly been exposed to the risk of displacement due to the growing gentrification process.

The urban sprawl characterizing the city's Northern areas has also been threatening the *localidades* of Usme and Sumapaz. However, differently from Chapinero and Usaquén, the communities of Usme and Sumapaz actively depend on their land as it constitutes their primary source of income and living. Therefore, they have been experiencing solid pressure from big construction companies interested in buying their lands and amplifying the urban neighbourhoods, especially in Usme. This context explains the development of strong rural movements, which have been fighting to stop these phenomena for the last 20 years.

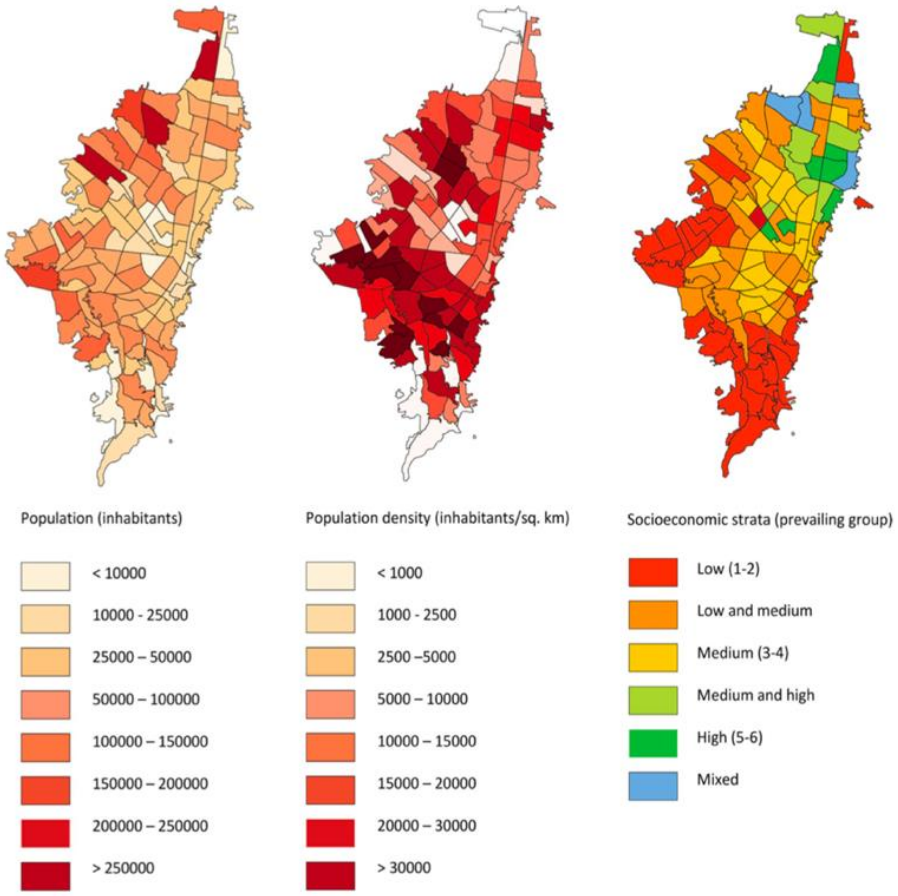

Figure 20: Population in Bogotá: inhabitants, density and socioeconomic status (Vecchio 2017).

As already mentioned, Colombia has a long history of violence, war and insecurity. The historical and political events of the country have had a considerable influence on the development of Colombian society and the relationship of its population with both urban and rural areas. As the effects of the armed conflict were more prominent in the rural territories of

the country, the Colombian society, especially in cities, started developing a fear of whatever was not located within the city border. Hence, natural environments like the *Cerros Orientales* are seen as risky areas where armed groups could be hiding or where robberies and violent episodes could be happening. In recent years, especially after the signing of the *Acuerdo de Paz*[4], the feelings of fear associated with the natural spaces, especially the Hills, are more related to interpersonal violence. Therefore, the insecurity of the *Cerros* and the fear of the population has constituted a critical issue to address in the projects implemented by CI. Hence, the goal was to both create the conditions to have safer spaces and, at the same time, help people lose their fear of the forests.

5.1.3. Short-term vision of local governments

Lack of good environmental governance and political failures influence to a large extent the increase of environmental degradation and climatic crises. Therefore, lack of political will, short-termism and the vulnerability of policies to electoral cycles have a massive influence on the environmental status (Averchenkova *et al.* 2022). Portugal Del Pino *et al.* (2020) highlight how it is widespread for local governments to set short-term objectives to comply with electoral promises and not promote policies and interventions with far-reaching goals in the LAC region. This is the case with Bogotá's environmental governance, characterised by political fragmentation and the lack of long-term vision from one local government to the other (Quimbayo Ruiz 2021).

In the context of the projects implemented, the lack of continuity between different local administrations and the competition between the various authorities in charge of the projects was recognised as the main limitation to the successful sustainability of the interventions. One of the community leaders interviewed in Usme underlined this problem as an essential element to consider when evaluating whether the positive outcomes of the interventions also continued after the closure of the projects. This is due mainly to the intense competition between the authorities of the city and the administrations governing Bogotá. Additionally, the same community leader highlighted how these dynamics strongly influence the local administrations' lack of investments in environmental projects. Working with ecological

[4] The 2016 *Acuerdo de Paz* (Peace agreement) is a peace agreement signed between the Colombian government and the FARC-EC (a Colombian guerrilla group).

restoration projects "*does not give votes politically since it is a long process that lasts more than one administration"* (Interviewee 3).

Hence, the importance of the political objectives of the 2009 mayor Blanca Inés Duran, who promoted a political agenda based on the enhancement of all types of diversity, including biodiversity. Her political bet of supporting the ecological restoration of the streams of Chapinero triggered a concatenation of events that supported the successful recuperation of the biodiversity of her territory, other than influencing the expansion of those processes to three more *localidades*.

5.2. **Assessment of the engagement of stakeholders**

The assessment of the collaborative approaches of the case study concerns its entire development, from design to implementation and transfer phase. Therefore, the analytical framework will guide the evaluation of the collaborative approach in each of the NbS phases (Figure 7). Thus, the various stages of then NbS will be analysed according to the main drivers guiding collaborative governance (Starting conditions, Institutional design, Facilitative leadership, Trust building, Face-to-face dialogue, Shared understanding and Commitment to process). The integration of these elements allows analysing the evolution of the NbS and assessing the participatory factors characterising its development.

5.2.1. Identification of the problem or the opportunity

The evaluation process starts with identifying the challenges and needs of a specific area and how the selected solution can address them. Given the frequent multidisciplinary of the. problems addressed by NbS, it is necessary to establish criteria and actions that range across economic, social, ecological and governance areas (Raymond *et al.* 2017). The starting conditions need to be considered to assess the intervention area's intrinsic characteristics. Other than having a pivotal role in identifying the main problems to address, the background elements also serve to distinguish what influences the quality of the relationships between stakeholders.

The ecological restoration process started from a previous strategy that CI Colombia and the Aqueduct of Bogotá initiated in 2007. The goal was to protect the unique ecosystems of the region (*páramos* and high mountain ecosystems) by creating the *Chingaza-Sumapaz-Guerrero*

corridor, which covers 600.000 hectares and includes the biggest *paramo* in the world. The director of the selected interventions of CI points out (Interviewee 13):

> *"A fundamental challenge for us is to conserve the páramos and high mountain ecosystems, which are the ones that provide one of the primary ecosystem services, which is the supply and regulation of the water that we Bogota citizens consume. The highest productivity of the country and largest human population (more or less 20% of Colombia) is concentrated in this area. The páramos are highly vulnerable to climate change, and since very few countries in the world have them, they are strategic. Therefore, we include natural ecosystems and ecosystems with urban interaction within this strategy. In this significant corridor, we find Bogotá, the capital and one of the most populated cities in Latin America*.
>
> *Bogotá has a forest reserve to the East: the Cerros Orientales. From there most of the streams and rivers that cross the entire city of Bogotá and flow into the Bogotá River in the West are born. These streams along their route begin to have multiple issues due to human occupation. Therefore, we saw the urgent need to delve into working on concrete actions for the restoration of these urban streams."*

After having identified the main challenges through detailed research on the socio-economic and biogeographical background and the status of biodiversity, the critical elements to address in each intervention were established. Firstly, due to the limited funding available, a cost-benefit analysis (CBA) was undertaken to identify which streams were more feasible to restore from technical and financial point of view. Additionally, given the strong connection between the natural environment and the socioeconomic features of the territory, the inclusion of local communities and critical stakeholders constituted one of the pillars of the whole process. Hence, the need to implement a social participation strategy.

> *"It is essential to include social issues in these types of projects. Otherwise, the sustainability of the process is not guaranteed. If you do not consider the people who inhabit the streams and ecosystems, then when the intervention is withdrawn its results disappear. In this way, the restored places can return to their initial state of degradation in just a few years. One of the ways to make this process sustainable is for the communities to change their behaviour and the way they relate to the restored space. It is important that they find a way to establish a relationship with that recovered space. By doing so, they take care of the place and link it to their everyday lives. That is why the communities must*

participate in the execution and design of how they will recover that space." (Interviewee 13).

The NbS *Starting Conditions* had a great influence in the evaluation of the challenges and issues to be addressed (Table 5). Amongst the elements identified by the framework, *Power/Resources Imbalances* are essential to consider as they influence manipulative practices. A recurrent power imbalance, which can be found in all four *localidades*, relates to the strong influence that big construction companies have in political decisions related to the city's territorial planning. Community leaders belonging to both Chapinero and Usme highlighted how this issue has caused frequent social conflicts and has contributed to a process of gentrification and displacement of lower-income communities, especially in the case of Chapinero. Additionally, given the mixed socioeconomic strata, Chapinero and Usaquén also experience power imbalances as wealthier strata are prone to perform political pressure on local decision-makers. A general limited public interest accentuates this phenomenon as natural areas, and the benefits of their ecosystem services are not valued.

5.2.2. Selection and assessment of the NbS

The selection and assessment of the NbS objectives depended on the issues identified in the first stage and on the challenges encountered in the consultations with communities. Therefore, it is important to consider the collaborative elements that helped shaping the NbS objectives.

In this phase, CI tried to find a way to connect with the communities, explain the benefits of a possible intervention in their territories and ask for beneficial inputs to better define the projects' actions. This first strategy supported a positive environment of exchange and cooperation where people found an incentive to participate with the perspective that they would receive favourable outcomes. As a result, the majority of families targeted by the actions of CI collaborated actively with the decision-makers and the experts. Creating spaces for sharing, where trust and closeness can be created, helps knowledge and capacity building and further strengthens the implementation process.

As Ansell and Gash (2008) explain, stakeholders are less willing to participate when they perceive they can achieve their goals unilaterally or through alternative methods. This was the case for the Chapinero and Usaquén contexts, where wealthier strata demonstrated to be less

interested in collaborating and exchanging as they could reach more favourable results by counting on their political influences. Despite the prehistory of antagonism between local authorities and communities, mainly due to the displacement caused by the pressuring urbanization and the process of gentrification, local communities collaborated quite willingly. The initial prejudices that citizens and farmers had against organizations or authorities wanting to work in their territories did not constitute an obstacle. One of the participants (Interviewee 7) stressed that the way CI approached communities – by communicating and listening to them – helped create an environment of trust. These processes helped shaping on of the major objectives for the projects, which was to restore the biodiversity of the areas and "*restore the human connection existing around the streams*".

Starting Conditions	Description	Evaluation
Power/Resources Imbalances	Power dynamics that can influence manipulative practices	Big construction companies Private interests of institutions Political solid influences, especially from the wealthiest neighbourhoods
Incentives to Participate	The reason behind the participation of stakeholders	From communities – security, more green spaces, jobs creations
Prehistory of Antagonism and Cooperation	Quality of the relationships between stakeholders that can facilitate or limit collaboration	Conflicts with big construction companies – wealthiest neighbourhoods

Table 5: Starting Conditions influencing collaborative approaches.

5.2.3. Design of the NbS implementation processes

The implementation of the interventions was anticipated by an institutional and technical design phase. The strategy adopted by CI Colombia consisted in designing solutions according to the environmental and socio-economic background of each river and stream, with some common strategies such as the three components mentioned earlier (landscape restoration, urban trees and ecological restoration) and social participation. This strategy is based on the methodology of "*aprender a aprender, aprender haciendo y aprender sintiendo" (learning to learn, learning by doing and learning by feeling)*, which finds its theoretical roots in the field of social pedagogy. Furthermore, the social participation strategy aims at generating a sense of commitment by the entities, communities and local organizations that can influence the

sustainability of the process. According to CI representatives, one of the ways to generate commitment is to create social and environmental networks with a clear plan of action with principles, objectives and goals (Bejarano *et al.* 2014). Given the socio-economic and ecological condition of the streams and rivers, the director of the projects highlighted how the whole process was not just an ecosystem restoration but a "*comprehensive restoration"* effort.

In this regard, the expert responsible of the development of the social strategy (Interviewee 3) states:

> *"The strategy includes actions that focus on the individual (including nature, who is considered a social subject) and issues related to social inclusion, human rights, and accepting difference. This focus allowed rich and poor people to come together and break some previous dynamics typical of neighbourhoods like Chapinero.*
>
> *It was possible to demonstrate that the issues related to the environment and biodiversity do not make any social difference. This was achieved through social pedagogy. Pedagogical mediation has some principles – learn by learning, learn by doing, learn by feeling. It has a lot to do with the fact that learning is a matter of relationships, not of education. Without social content, a project has difficulty continuing. On the other hand, by implementing this strategy, we have seen that in 5-6 years, the ideas of a project remain in the territory."*

Rules and protocols supporting collaborative processes need to be included in this phase of the NbS development. For this reason, it is necessary to consider the institutional design and the elements influencing the collaborative approach (Table 6). The institutional design elements proposed by the analytical framework proved to be closely connected as the performance of one influenced the development of the other. Thus, they will be discussed jointly.

The social participation strategy strongly Influenced the design of how the NbS had to be implemented and promoted. Therefore, key stakeholders and communities were central pillar in creating the actions to be undertaken. Given the interdependence of natural ecosystems and communities, the main goal of CI was to support participatory processes, where people could make direct suggestions and influence the actions to be taken. Thanks to the inputs of local communities and the regular involvement, the methodology was locally adapted to each area. One of the community leaders of Usme (Interviewee 7) reflects:

> *"CI has a model on how stream ecosystems should be restored. However, in each intervention they first listen to people and adapt that model according to the challenges and problems of each location. They work a lot on communicating with people. The language they use when they come here is adapted to the context. Because it is an inclusive language. Inclusion is the key."*

Promoting inclusive and open processes arose from the conviction that inclusiveness helps develop a sense of commitment toward the projects. Inclusivity was actively sought by CI as they assumed that the more the actors are engaged, the better acceptance and outcomes could be expected. During the planning phase, the group of experts focusing on the social participation strategy mapped the relevant stakeholders and came up with a directory of about 200 social actors that could be involved in the projects. The identification of key stakeholders was followed by introductory meetings where the restoration intentions for the various areas were introduced and discusses with people. This phase consisted of creating spaces for collaboration, such as formal or informal meetings, workshops and educational activities. The initial socio-economic diagnosis helped ensure the participation of stakeholders that could represent and protect the needs and rights of the groups living near the streams. It also enhanced the inclusion of different types of knowledge (traditional, indigenous and scientific) that resulted important for a just, inclusive and comprehensive restoration.

In all interventions, citizens and communities were free to participate. Particularly, in Usme and Sumapaz the implementation of the activities depended on the consent and the will to participate of local families as the lands to be restored were private. For instance, out of the 23 lands identified for intervention, only 21 could be restored as not everyone wanted to participate.

Institutional Design	Evaluation
Participatory Inclusiveness	The specific objective of the restoration
Spaces and platforms for collaboration	Institutional meetings with stakeholders, informal reunions with communities, workshops, and educational activities
Specification of relevant actors with different types of knowledge	Stakeholders analysis that could include a wide range of visions, knowledge and points of view

Joint formulation of problem and understanding	Through constant communication and exchange
Clear Ground Rules	Formalized, known and accepted by all
Process Transparency	Enhanced by constant dialogue and communication

Table 6: Elements of the Institutional Design influencing collaboration.

One of the main assumptions of this thesis is that collaborative and participatory practices should form part of all stages of the design and implementation of an NbS. Thus, it is crucial to look at: *face-to-face dialogue*, *trust-building*, *commitment to the process* and *shared understanding.* These elements appeared to be preconditions useful to promote participative and collaborative processes. Furthermore, communication, especially face-to-face communication through events, meetings, activities and workshops, provided an opportunity to decision-makers, local authorities and communities to create a shared understanding of what were the main challenges of the study areas, and it supported a process of co-creation and co-design where different opinions, knowledge and necessities were taken into consideration.

> *"The whole strategy started with communication, listening to people, to what they needed. Initially, we identified the intervention areas, which belonged to local families. When we identified those areas, we talked to people, we told them about the project, what we wanted to do and if they wanted to collaborate. Afterwards, we visited the territory with them to better identify the area, the territory and what it meant for them*." (Interviewee 8)

5.2.4. Implementation of the NbS

The implementation phase saw the development of the interventions' actions according to the already planned strategies. The implementation process focused simultaneously on restoring the damaged natural spaces as well as working with communities.

Considering the aim of the thesis, the focus will be on the social part of the ecosystem restoration process. From the point of view of implementation, participation strategy made use of the following approaches that contributed to social outcomes: The main elements of the strategy included:

1. Connecting with communities through community leaders. The aim was to work with leaders close to the people who could serve as a bridge between CI, experts, and residents of each area. This method is aimed at creating a sense of trust and a more genuine acceptance of the projects. In this case, the role of their facilitative leadership enhanced collaboration and engagement.
2. Including communities and educational centres or schools in the activities related to streams' restoration. CI organized formal meetings with stakeholders, community fora with the population, workshops, activities where people could exchange their knowledge and opinions, and educational events. Participation of broader public was achieved by organizing cultural and educational activities in collaboration with local organizations that could reach young people, kids, older people and women. Many activities were organized with youngsters and local artists to create a connection between art, music and biodiversity. This event helped to connect people to nature and feel a sense of commitment toward the restored area. Moreover, several events were also organized during the night for people to lose their fear of those spaces. The goal was to break the barriers of fear that limited people from getting closer to their territory. In this case, the natural appropriation of the territory was promoted through cultural appropriation.

   For instance, according to the internal archives of CI, the activities promoted in Chapinero registered the participation of around 1700 people, distributed in the activities promoted in the three streams restored (*Las Delicias*, *Morací* and *El Chulo*). The majority of activities included micro-workshops and community tours of the streams, knowledge exchange activities, co-design meetings, capacity-building courses for communities, educational events with schools, cultural events, courses for ecotourism guides and many more.
3. Fostering local employment. CI supported the qualification and training of local community member and involved them in technical interventions in the streams.
4. Awareness raising of the projects by engaging with media– journals, newspapers, and television. The goal was to reach the wider population of Bogotá and Colombia and provide visibility to the streams and the restoration process.

These activities fostered face-to-face dialogue and exchange and trust-building. Moreover, the more robust sense of ownership strengthened communities' commitment to the restoration processes. Throughout the interview processes, community leaders, experts, and citizens highlighted the importance of having leaders who could guide the development of the entire

process and connect stakeholders from different socioeconomic strata, institutions, and backgrounds. In particular, the facilitative role of the main projects' director was identified as essential for achieving the objectives set for each action. She was given credit for connecting key actors, supporting dialogue and exchange, enhancing an inclusive approach to the design and implementation phase of the NbS and giving people space to express themselves and thus enhance their feeling of empowerment.

5.2.5. Transfer and upscale

The projects ended either because funding was missing or because decision-makers felt that communities were empowered enough to continue river restoration and management on their own. The strategy of Chapinero represented the "pilot" case strategy for others to follow. The outcomes of the Chapinero case helped provide visibility to the strategies – both ecological and social – implemented by CI Colombia. Transferring the Chapinero experience was possible through and by sharing the outcomes with the population of Bogotá. This strategy included the promotion of the outcomes through media such as newspapers, television programmes and social media. At the same time, other activities were implemented to share the results of the restoration process. For example, a photographic exposition showing the history of the streams and their restoration processes was organized in the largest shopping malls in the Northern part of the city. Although this investigation could not gather much information about the role of participation in this stage, the interviewees highlighted the role of some of the participants (mainly community leaders and experts) in transferring the results of the processes.

These actions influenced the transfer of the lessons learnt in Chapinero to the other *localidades*, firstly Usaquén and then jointly Usme and Sumapaz. The methodology developed thanks to the Chapinero case became a model to follow by other *localidades* and municipalities when dealing with the restoration of rivers and streams. The model has been recognized as the most successful in terms of stream restoration in Bogotá. The Secretary of the Environment has taken this particular experience as a reference to apply in other locations in Bogotá, bearing in mind that each stream and location have particular dynamics, so the model must be adapted to context (Bejarano *et al.* 2014). Similarly, representatives of other cities such as Rio de Janeiro (Brazil), Lima (Peru) and the Federal District of Mexico (Mexico) have visited the sites in order to learn about the conceptual, methodological and strategic aspects of this community-driven stream ecosystem restoration.

The upscaling and transfer phase of the project helped give visibility to the vulnerability of the streams' ecosystems and the risk they face in a scenario of climate change. Furthermore, acknowledging the vulnerability of the ecosystems of Bogotá supported the development of regional and national policies for the protection and management of these territories and recognised ecosystem restoration as a successful method to address environmental and social challenges.

> *"The project contributed to understanding that we are in a climate change scenario and that Bogotá is highly vulnerable. As a result, the Bogotá council has a resolution saying that Bogotá is in a climatic emergency and that ecosystems are vital in helping us mitigate this emergency. In addition, the city of Bogotá has a climate action plan that links the hills, the streams, and the rivers to the actions we must undertake for their restoration due to its importance for adaptation to climate change." (Interviewee 13).*

The main decision-makers outlined the importance of creating sustainable interventions. Sustainability, in this case, meant that the communities could continue the processes started under the supervision of CI on their own. This was achieved by empowering local people and supporting their sense of ownership of the restored streams.

> *One of the ways to make this process sustainable is for communities to change their behaviour and how they relate to the restored space. It is important for them to establish a relationship with the restored space and link it to their daily lives.* (Interviewee 13)

5.3. **Evaluation of the social outcomes**

As a starting point to answering RQ2, I used the social benefit categories related to the implementation of NbS identified in Table 1. However, the data analysis highlighted the importance of additional elements (one additional category and a few specific benefits), which will be integrated into the updated table of social benefits (Table 7).

	Categories of social benefits	Specific benefits
1	Knowledge enrichment, education and capacities (**14**)	Education/ Knowledge/ Pro-environmental behaviour

2	Social justice and social cohesion (**9**)	Social cohesion/ Social relations/ Social inclusion/ Social fabric/ Participative processes
3	Empowerment and ownership (**9**)	Empowerment/ Creation of consciousness/ Cultural appropriation of the territory
4	New economic opportunities (**7**)	
5	Livelihoods improvement (**7**)	Socio-spatial inequalities/ Living conditions/ Food security
6	Physical, psychological, and community well-being (**5**)	Public health/ Physical well-being/ Psychological well-being
7	Safety (**3**)	Safety/ Perceived safety

Table 7: Updated categorisation of social benefits related to the implementation of NbS.

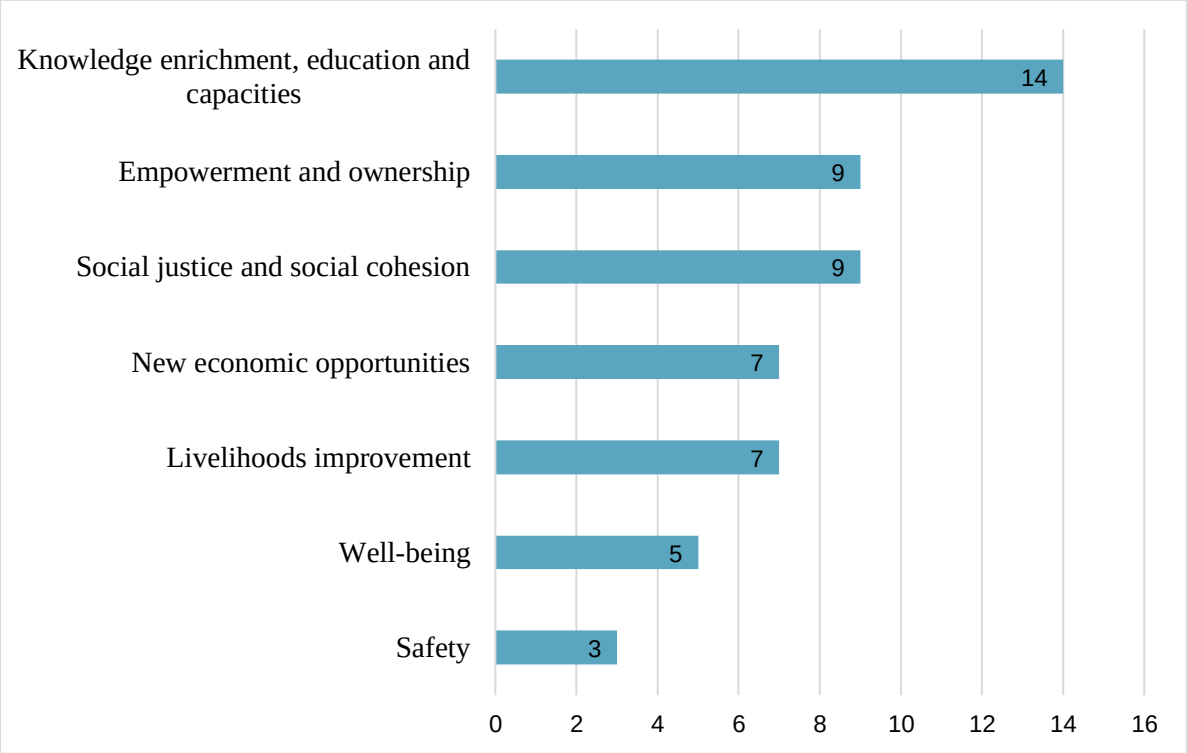

Figure 21: References to social benefits in the Bogotá case study (own representation).

The results in terms of social benefits derive from the analysis of primary and secondary data; that is, 16 interviews, questionnaires and a document provided by CI Colombia exploring the Chapinero experience (Table 10). The measured benefits are presented on the basis of the perceptions of the stakeholders involved in the projects. Overall, all the respondents highlighted the efficacy of the project(s) in generating a variety of positive social outcomes.

The benefits identified through the literature review were confirmed through the primary data collection, with the addition of a few elements that were also relevant in the Bogotá context.

14 out of 16 respondents mentioned creating and ***exchanging knowledge, promoting education, and supporting capacity building*** as a significant social benefit. Firstly and foremost, the activities of the project(s) allowed people to learn, especially about the environment and the territory, but also regarding their political and social context. They also provided members of the communities the opportunity to attend professional training and courses that could help them improve their living conditions and provide them with new skills and abilities. In addition, environmental education and awareness were enhanced by the promotion of activities focused on recycling and on the importance of the ecosystems in providing services to the community. As a result, people became more aware of the importance of nature and started modifying their environmental behaviour towards the restored spaces. For instance, citizens started taking care of the streams and stopped using them as a place to throw away trash and dangerous substances. Finally, the exchange of knowledge between the various projects promoted the replication of the interventions in other *localidades* and cities. In this case, the lessons learnt within the Chapinero project served as a basis to develop the interventions in the other three *localidades*. At the same time, the practices used in the case study served as an example for other Latin American cities as Ciudad de México, Rio de Janeiro and Lima.

The second most mentioned social benefit (9 out 16) relates to the ***empowerment*** of people, especially women, and the creation of a ***sense of ownership*** amongst communities. The director and the main expert concerning the social focus of the project(s) highlighted how the sense of ownership that people developed towards the streams ecosystems was fundamental in enhancing the whole process's sustainability. The implementation of the interventions helped people recognise rivers and streams as part of their own identity. As a result, they started more consciously connecting their livelihoods to the territory, developing practices that could empower them and, at the same time, value the richness of the environment. For instance, thanks to the increased sense of ownership and belonging, various community members in Usaquén created groups to safeguard and protect the restored places and are now recognised as key actors in the management and protection of the Hills.

> *"The issue of territorial empowerment is very important. If you restore the streams but the population is not empowered, the work will eventually be lost and the money will be poorly invested and badly spent. We thought it was necessary to seek the people's sense of belonging and to make them feel that the streams is also theirs."* (Interviewee 3).

The sense of ownership was often related to the empowerment of communities. This was the most evident in the case of women, particularly in the *localidades* of Usme and Sumapaz, where they were identified as key actors in conserving, taking care of the *páramos* and the land, besides playing a central role in the community and their families.

> *"The exchange promoted in the process allowed us to see the essence of these women. They also began to see themselves as women. This partly allowed many of them to break their dependence on their husbands and end that dynamic that convinced them that there was no other way to live. As a result, many of them have now taken many important decisions, breaking those stereotypes that they have always had."* (Interviewee 7, 8, 9).

Like the previous category, 9 out of 16 respondents indicated ***social justice and social cohesion*** as major benefits. Firstly, the interventions promoted spaces and moments where people from different socioeconomic strata could meet and connect. As a result, the quality of interactions between these groups improved and became less conflictive thanks to a renewed sense of community and closeness between "neighbours".

> "*Wealthier strata began to connect with people with fewer resources. These processes brought us together in many causes, including with people from other streams, wetlands and so on. The stream restoration projects constituted a bridge to begin to meet with others, which generated social fabric. It strengthened our identity and the confidence that we could find a solution to our common problems as a united community.*" (Interviewee 6).

The methodology used by CI helped create or strengthen the social fabric of all four boroughs, and it allowed people to take part in the decision making processes.

The creation of ***new economic opportunities*** for the population involved in the restoration process was another significant socioeconomic outcome. 7 participants highlighted the role of the interventions in job creation. The director of the projects (interviewee 13) explained that

enhancing local employment was one of the main objectives besides improving the living conditions of people. It also represented a way for people to feel more attached to restored spaces and increase the likelihood that they would take care of them once the project was over. Throughout the entire process, local and external actors were hired: community leaders, experts, and members of communities who received specific training to restore the natural spaces. Moreover, social participation also facilitated the creation of new businesses or initiatives. For example, various tourism initiatives focusing on the natural and historical value of the Chapinero and Usaquén areas were born and now represent examples of community tourism. One of the community leaders interviewed (Interviewee 2) highlighted the role of the projects in giving her skills and motivation to create an eco-tourism business (called *Tissus Turismo* Comunitario) which now constitutes her main source of income.

The ***improvement of livelihoods*** was referred to as a valuable outcome. In this context, living conditions refer to creating new employment, building spaces where people could meet for recreation, organising activities related to urban gardening and food security, and engaging in positive environmental behaviours. Through the implementation of thematical activities, people learned how to grow food and compost. Moreover, they engaged in recycling projects and activities to take care of the streams. For instance, the restoration of the streams of Chapinero included the creation of recreational spaces where people could meet, exchange and organise activities. In addition, the interventions strengthened the adaptive capacity of communities to climate change, especially in the Usme and Sumapaz areas, where the fragility of the ecosystem represents a threat to the economies of families that survive on their crops and livestock. Therefore, communities had the chance to learn how to adapt to extreme or disturbing events that can damage the natural environment they survive.

5 out of 16 people outlined the enhancement of ***physical, psychological, and community well-being***. Respondents mentioned a sense of happiness, joy and relaxation with being able to re-connect with their spaces and the forests, especially in Chapinero and Usaquén, where people generally have less contact with natural spaces. This influenced a better lifestyle and health as well as psychological well-being.

Finally, the least mentioned benefit (3 out of 16) relates to the improved ***safety*** as a result of the project(s). Although safety and insecurity problems represent one of the main concerns related to the natural spaces of Bogotá, the restoration process had a limited impact on this.

Nevertheless, some participants highlighted that the initiatives slightly improved the safety problems by organising police patrols in specific spaces in the *Cerros*. Additionally, some events also tried to deal with the fear of people of natural spaces. For example, a few artistic and educational activities were done at night, in order to help people lose the fear of the *Cerros* and natural spaces. However, the current situation regarding the safety of these spaces is still critical, also depending on other social and political issues which are beyond the scope of ecosystem restoration.

5.4. **The benefits of engaging stakeholders**

In order to answer RQ3 - which is "How and to which degree the collaborative approach affected the realisation of social benefits? - it was first deemed necessary to reflect on the benefits created by the collaborative approach used in the Bogotá case study. The benefits of collaboration retrieved from the literature review will guide the analysis of the data collected (Table 2). The data collection process focused on the value of collaboration, the inclusion of different stakeholders, and the engagement of citizens. Hence, the interviews and questionnaires inquired about the added value of the collaborative approaches. More specifically, it was asked what benefits resulted from the engagement of stakeholders in stream ecosystem restoration, for them personally and for the other participants (stakeholders, citizens, and communities).

Establishing a direct causal link between "participation" in stream ecosystem restoration and social benefits is challenging. Therefore, the basis for this analysis build upon the overall social benefits of NbS. The objective of this section is to consider what part of these benefits may be due to participation, why and through which specific mechanism could participation influence the. However, despite this limitation, it seemed relevant to explore the specific social benefits encountered while reflecting on the participatory processes (Figure 22).

For the purpose of this section, the contribution of 14 interviewees, questionnaires and literature provided by CI Colombia regarding the Chapinero example were relevant. In this case, the data analysis focused on the references made regarding collaboration and its benefits. The results generally align with the benefits shown on Figure 21, but with a stronger focus on three categories: knowledge enrichment, education and capacity building, empowerment and

ownership and social justice and social cohesion. These results confirmed the relevance of benefits found in the literature review, including a few elements specific to the case study.

	Categories of social benefits	Specific benefits
1	Knowledge enrichment, education, capacity building (**12**)	Legitimation of different types of knowledge/ Knowledge exchange/ Social learning/ Policy learning / Social engagement/ Eco-mindfulness /Pro-environmental behaviour or identity
2	Empowerment and ownership (**8**)	Empowerment/Ownership by local communities/Consciousness/Confidence/Responsiveness and accountability/ Sense of belonging
3	Social justice and social cohesion (**6**)	Openness/ Trust/ Citizens involvement/ Tolerance and respect

Table 8: Updated categorisation of social benefits related to collaborative approaches in the Bogotá case study.

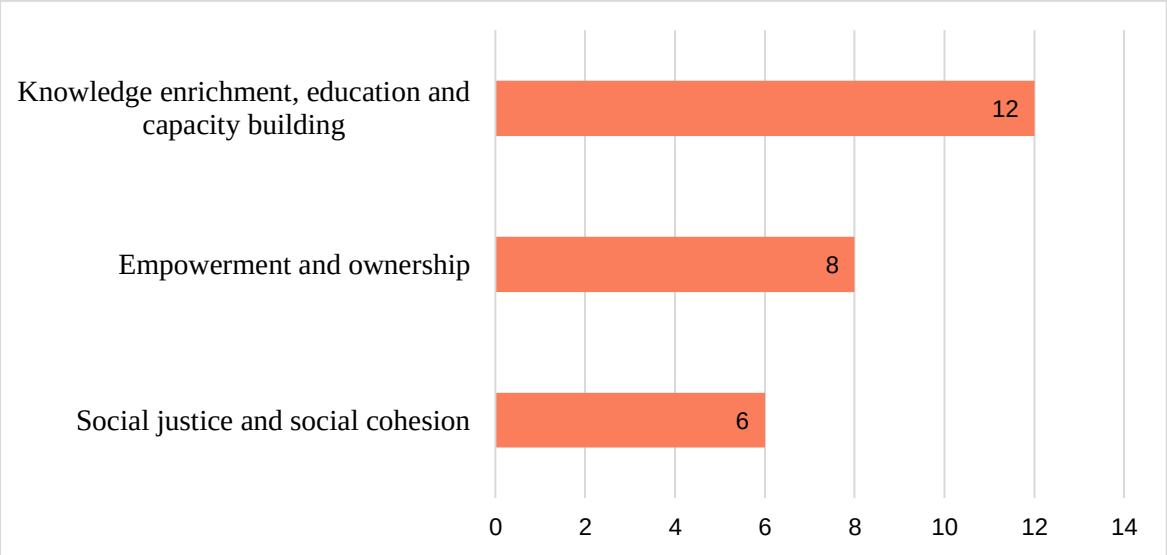

Figure 22: References to social benefits related to collaboration in the Bogotá case study (own representation).

12 out of 14 respondents highlighted how the collaborative approach fostered the ***creation and exchange of new knowledge*** and the legitimation of different types of it. The spaces for collaboration where people could exchange their knowledge and experience helped community

members and experts to learn new things. At the same time, they attributed relevance to the traditional practices and historical values related to the study areas.

> *"There are women who saw our project as an opportunity to learn different things. I learned different things. It was a two-way learning. There was an exchange of knowledge, in which we all learned and it was a win-win situation.*" (Interviewee 10).

Moreover, the activities organized by CI enhanced the use of social learning, which constitutes a relevant approach to environmental education. By enhancing social learning, the participants could learn through communication, exchange and cooperation. The cooperative and inclusive environment influenced the strengthening of pro-environmental behaviours and identities amongst youngsters and families, especially in the urban communities, which are generally more detached from nature. In this regard, Interviewee 10 stated:

> *"People are starting to take more care of the environment. They are more aware of the importance of the paramos and their actions in natural spaces. It is because of the lack of knowledge. Once you gain knowledge, you change your environmental behaviour.*

Other than strengthening environmental behaviours and identities, the activities motivated people to engage in society and participate in local environmental commissions and public spaces to give voice to the opinions and needs of locals.

8 respondents highlighted an increased sense of ***ownership and empowerment***, especially among women. These elements are closely related to the development of a sense of belonging to the territory, which made people feel responsible for the outcomes reached jointly and inspired them to engage more in institutional spaces. Additionally, by providing knowledge and skills as well as by creating consciousness regarding their role in society and for the conservation of ecosystems, the projects supported the empowerment of women. It helped them gain more independence, both financially and socially, and it made them more visible and recognized in their own families.

6 respondents stressed the relevance of working together to create connections and closeness between different communities and socioeconomic strata. Furthermore, the constant communication and exchange promoted an inclusive environment for people with different

socioeconomic and cultural backgrounds. Therefore, ***social cohesion*** and solidarity were strengthened.

After categorising the benefits, the analysis will now explore how the participants think their involvement impacted the project, their lives and other stakeholders'. Given the stakeholders' different roles (decision-makers, experts, community leaders and citizens), the perceptions regarding the added value of the engagement might vary.

Decision-makers and experts pointed out how the participation provided crucial inputs and elements to make the interventions more effective. From their point of view, the collaborative approach enhanced a sense of belonging, ownership and empowerment that allowed people to participate actively, take the lead in their communities and care for the environment. Furthermore, helping communities to create that connection with the restored place guaranteed the sustainability of the projects. In this case, sustainability meant that communities, through their behaviours, activities and new initiatives, kept taking care of the streams even when they did not have the support of a guiding institution like CI.

On the other side, the community members highlighted how their participation allowed contributing knowledge about the natural spaces surrounding them because they have site-specific, in-depth knowledge. The local population ascribes cultural, historical and spiritual value to the *Cerros*, the *páramos* or the lands located in the South. Therefore, they have unique knowledge about the environmental and social issues characterizing the study area. That is why they represent the past, present and future of the rivers and streams of Bogotá.

Additionally, interviewees reflected on the added value of participation in their personal lives. Also in this case, the creation and exchange of knowledge, as well as the development of new skills, played a relevant role. People gained more knowledge about topics related to ecosystems while also acquiring new skills that could qualify them professionally and gave them the impulse to search for or create better economic opportunities. Furthermore, new skills and social recognition played a role in empowerment them and influencing stakeholders' engagement in society.

> *"It was not only about the economic benefits. I learnt. A lot of women received participation certificates which resulted really positive for the CV. New abilities and skills were created. This helped qualifying people."* (Interviewee 11).

> "*The project brought us many things, especially to generate a sense of community, awakening the sense of belonging, appropriate and getting much more involved with our communities, enriching our ancestral knowledge, and loving the territory, among many other positive things."* (Questionnaire respondent)

Finally, participants thought their engagement was helpful for others in offering and exchanging knowledge and practices. The various phases of communication, exchange and cooperation created a stronger sense of connection, fostering a sense of community where people felt supported in their daily issues and challenges. In the specific case of women, the activities aiming at recognizing their role in society and for the ecosystem resulted essential in giving them support and recognition and helping them empower themselves. Generally talking, all participants felt like they had a role in improving the city's living conditions, especially of the communities living near the mountains or the farming lands in the South.

6. **Discussion**

This chapter discusses the relevant elements that have arisen from the results and analysis section. The discussion will first examine how the context of the case study shaped collaboration. Secondly, the relationship between collaboration and the creation of social benefits will be discussed, and lastly, the mainstreaming of the outcomes of the interventions will be considered.

6.1. **The role of the context in shaping collaboration**

Designing multifunctional NbS requires a system perspective that can consider how the various elements of the system interact with each other. The framework guiding this research (Figure 7) tried to adopt this approach by focusing on the evaluation of NbS in their entirety, taking into account all of its contextual elements. Consequently, assessing the role of collaboration in implementing NbS needs to be also done by looking at the factors facilitating or constraining collaboration within the dynamics of the considered system (Malekpour *et al.* 2021). The inclusion of dynamics influencing collaboration can be facilitated by co-creation and co-design, which allow for the joint formulation of actions that can address the vulnerabilities and strategically use the potential of the context's dynamics. In the case study, participation is shaped by a combination of political, institutional and socioeconomic elements. Therefore, before investigating any type of impact arising from collaboration, it is first necessary to reflect on how the context of Bogotá influences the overall design process.

Political dynamics

In the Bogotá context, the local political dynamics was found to influence the set-up and effectiveness of collaborative approaches. The political environment in which they were developed had involve some inherently manipulative practices, weak of political will, limited public interest, short-termism, the influence of private interests, and weak policies. Therefore, the development of collaborative practices within the various interventions had to deal with the complexity arising from these factors.

These political elements can strongly limit the setup of collaborative approaches as they interfere with the creation of effective institutional designs which can create spaces for collaboration, establish clear ground rules and guarantee transparency. The limited interest and

political will to protect the city's ecosystems and strengthen participatory approaches have a crucial influence on the development of collaborative environmental interventions. Following the findings of Portugal Del Pino *et al.* (2020), this research showed how the short-termism of regional governments represents a constraining factor for collaboration as there is a risk of superficial actions are more attuned to complying with electoral promises than creating positive outcomes. Interviewees indicated that this "institutional egocentrism" influences the loss of trust in authorities and a reluctance to participate.

Besides contributing to weak environmental policies, these factors ensure it is the wealthiest strata and/or big construction companies that benefit. In the context of the interventions, manipulative practices interfered with the set-up and efficient development of the restoration projects. Although the local mayor promoted and supported the Chapinero project, political pressures by construction companies aiming at building in the intervention areas constituted a limiting factor for collaboration that could have failed. In Arnstein's ladder of citizen participation, these practices fall under the lowest rug as they do not promote any type of participation and distort governance (Arnstein 1969). In the broader context of the entire Bogotá, these practices negatively affect the capacity of weaker or more disadvantaged stakeholders to participate effectively. Therefore, power imbalances collaborative approaches constitutes a risk factor as broad and inclusive participation is not supported.

Institutional dynamics

Although some political and legal efforts to institutionalise participatory practices were made, the administrative and bureaucratic structures of the city have limited the development of bottom-up or community-driven restoration processes (Quimbayo Ruiz 2021). The difficulties in setting up collaborative processes are rooted in the more structural and institutional levels of Bogotá and Colombia in general. This is manifested for instance in fragmented competencies of environmental authorities that diminish the efficiency of participatory mechanisms, as pointed out by some interviewees. The fragmentation undermines planning and implementation of ecological interventions and causes a general lack of coordination, leading to competition between institutions and authorities. In Usme, this elements affected the effectiveness of the collaboration between CI and other local authorities as competitive behaviours and insufficient coordination initially slowed down the planning process. From a community perspective, these dynamics led to inefficiency and loss of trust in authorities and

institutions. Finally, the fragmentation between different local administrations influences the loss of the achievements and benefits gained during the implementation of projects. This is due to the often contrasting approaches taken by the different institutions responsible for environmental projects' development. Consequently, the institutional "confusion" tends to affect the effectiveness of collaboration and, at the same time, the interests of actors to participate.

Socioeconomic dynamics

Internal socio-economic processes and characteristics played a crucial role in determining the participatory processes and their outcomes in each area. For this reason, the attention was put on the urban-rural dichotomy, the socio-spatial dynamics and the elements characterising the different communities. The literature review explored how socioeconomic dynamics (Favretto *et al.* 2021), as well as pre-existing histories of tensions and conflict can limit collaboration (Ansell and Gash 2008) (Malekpour *et al.* 2021). For instance, power and disparities had a considerable role in influencing the trust of citizens in institutions as well as their intentions to participate. Since the political and institutional context has a role in accentuating power imbalances and interfering with collaboration, considering social features is necessary to deal with these issues already in the design process. It can help prevent manipulative practices and identify and address stakeholders' challenges, values and contributions.

Due to the lack of trust in institutions, participation was also affected by the limited interest of Bogotá citizens in environmental and/or collaborative activities and projects. This explains the need for Conservation International to organise events that could "socialise" the projects and increase the interest of communities in taking care of and restoring the streams and their ecosystems.

6.2. **Relationship between social benefits and collaboration: focus and limitations**

The literature review outlined the role of collaborative governance in enhancing elements like legitimacy, communication, trust, ownership and shared commitment (Agbodzakey 2021) and generating knowledge, empowering communities and supporting social cohesion. The case study analysis confirmed these trends after the evaluation of the social benefits created both from the NbS and the collaborative approach taken in the ecological restoration projects.

The main limitation this research encountered relates to the difficulty of clearly establishing what represents a direct outcome of collaboration. In this regard, the analysis found a relationship between the social benefits of NbS implementation and collaborative approaches associated with the NbS. The line between which benefits result from the NbS and which from collaborative processes remains fairly blurred. For this reason, attributing specific benefits to the engagement of stakeholders does not imply that the same benefits are not affected by other internal processes related to the NbS planning and implementation. The investigation proved that collaborative approaches are more linked to the creation of three categories of social benefits. However, in my understanding, the entirety of social outcomes generated by the NbS are interconnected with the collaborative approach, even if in less direct ways.

The framework elements, which also served to guide data collection and analysis, proved to be the main drivers in creating social benefits. In accordance with the findings in the literature review, *Facilitative Leadership*, *Trust building*, *Face-to-face dialogue and communication*, *Commitment to process*, and *Shared understanding* influenced impacts results on communities. From the perspective of the life-cycle of each project, even if these elements were more prominent in certain phases rather than others, they still had an influential role in the evolution of the whole NbS.

Figure 23 summarises the benefits encountered according to the relevance they had in either the design (D), implementation (I) or transfer (T) stage. However, it was also considered pertinent for the purposes of this research to outline the significant social benefits created by each driver in the various phases of the projects' evolution. For this purpose, Table 9 investigates the relevance of each collaborative element mentioned in the analytical framework in creating social outcomes in the various stages of the NbS development (Design, Implementation and Transfer). The table wants to give an outlook of the role that each driver had in fostering the social outcomes created by the case study. However, the analysis section suggests that drivers and outcomes should not be considered within a linear relationship in which one causes the other. On the other hand, it demonstrated that certain social outcomes have a role in further supporting collaborative elements that can foster additional social benefits. Therefore, each driver and outcome should be looked at as part of a cycle where one reinforces the other. The results pointed out how closely relevant social benefits are for each other and how their role further strengthens collaboration and participation. For instance, this

is how trust building in the design stage, allowing broader and more inclusive participation and creating a sense of cohesion between the stakeholders, also reinforces the effectiveness of the participatory approaches in the implementation stage. Hence, there is a need to implement and support participatory practices on an ongoing basis to guarantee continuous engagement of the drivers and outcomes. The circularity of the framework used to guide this research focuses on the potential for synergies through the continuous and constant reinforcement of engagement.

Drivers of collaboration	Outcomes	D	I	T
Facilitative Leadership	Knowledge exchange	•	•	
	Mediation of conflictive dynamics	•	•	
	Broad and wide participation	•	•	
	Social relations and social cohesion	•	•	•
	Inclusiveness	•	•	
Trust building	Sense of ownership		•	•
	Broad participation	•	•	
	Knowledge exchange	•	•	•
	Social cohesion	•	•	•
Face-to-face dialogue, communication and exchange	Inclusive design process that could address the widest issues	•		
	Capacity-building and increase of knowledge		•	•
	Legitimation of different types of knowledge	•	•	•
	Empowerment		•	•
	Sense of ownership		•	•
	Mediation of conflictive dynamics	•	•	
	Strengthening of social relations and social cohesion	•	•	
Commitment to process	Pro-environmental behaviours and identities		•	•
	Social engagement			•
	Inclusive design and implementation process	•		
	Informed co-creation and co-design	•		

Shared understanding	Pro-environmental behaviours and identities		•	•
	Sense of ownership		•	•
	Social cohesion		•	•

Table 9: Categorization of social outcomes according to collaborative drivers.

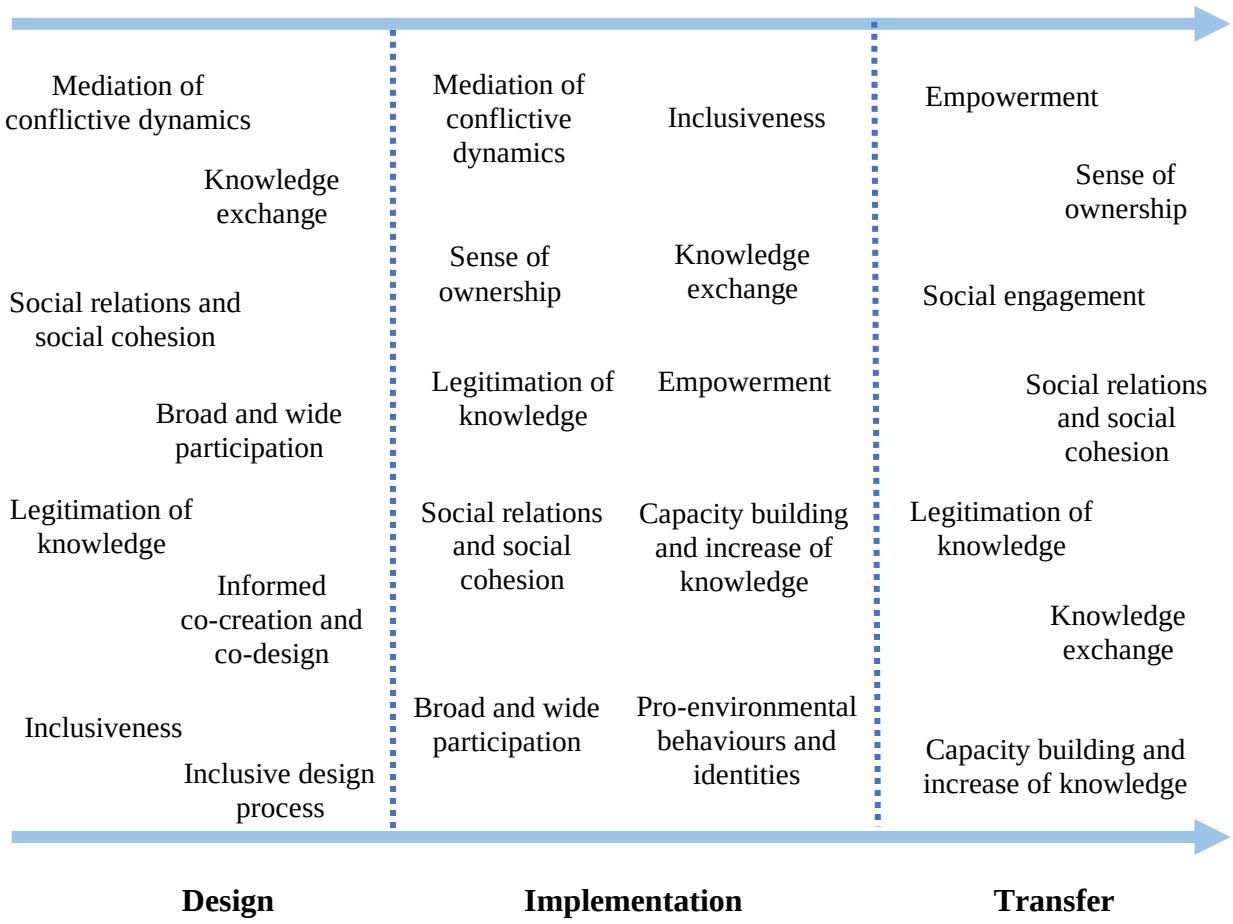

Figure 23: Major social benefits created by collaboration in the various stages of the interventions.

6.3. Mainstreaming the outcomes of the restoration process

The dynamic and evolving nature of NbS requires constant evaluation and monitoring to guarantee efficient implementation and transferability. Therefore, evaluation plans should include monitoring practices able to inform about the performance of the interventions and how they can be replicated and mainstreamed. In this regard, community-based monitoring represents an efficient practice to assess the results of NbS throughout and after the implementation of the projects by making community members played a lead role. It could be

achieved by either creating collaborative monitoring efforts with community members or by contracting local people to develop monitoring projects (Fernandez-Gimenez *et al.* 2008). In this way, community members directly affected by the degradation of ecosystems can take leading roles and take an interest in the success of a long-term restoration (Mazón *et al.* 2019).

In the case study, the lack of monitoring that could assess the projects' results was affected by the lack of funding. Therefore, the outcomes achieved and described resulted only from the perceptions of decision-makers and stakeholders and not of proven evidence. Hence, this limitation does not allow to give a clear and objective report of the current status of the restored ecosystems and their communities. Without monitoring, the ability to provide changes and advices as the project develops is compromised. The lack of feedback between the restoration actions and its outcomes might cause uncertainty regarding the efficacy of the measures. According to a brief analysis of the Urban Nature Atlas, the absence of adequate monitoring mechanisms represents a frequent limitation in NbS. For this reason, I conclude that there is an urgent need to include monitoring practices in the design phase of the ecological restoration NbS and make them an integrative part of the financial planning and capacity building of the whole process.

The importance of monitoring relates to the possibility of having a concrete proof of the lessons learnt from the collaborative experiences and, therefore, can influence broader governance levels (Raymond *et al.* 2017a). Providing evidence of the environmental and socioeconomic benefits of river ecosystem restoration can support the standardisation and mainstreaming of these approaches. The creation and exchange of knowledge, in particular, proved to be extremely influential in strengthening policy learning and further reinforcing the design and implementation processes. Thus, it is necessary to integrate the lessons learnt from collaborative approaches to NbS in urban planning and governance (Wamsler 2015) and influence cultural values and policy governance mechanisms. This could be achieved, for instance, by including them in guidelines and briefs that can impact further policy design and institutional reform programs (Brink and Wamsler 2018). In the case of Bogotá, and more generally Colombia, mainstreaming the outcomes of the streams ecosystem restoration process would mean integrating the approaches and lessons learnt into sectoral and cross-sectoral policies, strategies and practices. Therefore, the environmental and socioeconomic outcomes underlined throughout this investigation could serve as informative elements to shape regional and national policies and accelerate urban centres' sustainable and just transition.

7. **Conclusion**

The high percentage of people living in urban areas in the Latin American and Caribbean region makes urban adaptation a high societal priority for sustainable development (Tuhkanen 2021). Urban policies need to support the creation of safe, inclusive and resilient spaces that can improve the living conditions of its inhabitants. Hence, the need to address the main issues characterising LAC cities, such as inequalities, poverty, insecurity, and biodiversity loss. Sustainable urban transitions cannot be achieved without first tackling the root causes of the various socioeconomic and political challenges the region is facing.

In this context, Nature-based Solutions hold a great potential to address the challenges and necessities of the region while also supporting the sustainable transition of urban centres. Given the progressive introduction of NbS into LAC cities' policies and practices, context-dependent knowledge is necessary to adapt the concept to regional objectives. It is necessary to understand how and to what degree NbS can serve to achieve the region's development goals. In this way, they can simultaneously help adapt to climate change and tackle cities' most urgent socioeconomic challenges. These needs and opportunities were explored in this research, which showed how river ecosystem restoration has contributed to addressing some critical challenges of the city of Bogotá while also generating knowledge, empowering communities and supporting the strengthening of the social fabric.

Other than analysing the social outcomes of the selected NbS, this research took into consideration the importance of collaborative solutions that can further enhance the potential of NbS to address multi-dimensional societal challenges. This thesis demonstrated that NbS do not constitute a one-size-fits-all solution. On the contrary, they have to respond to the contextually unique needs of the country considered and the interests of local communities. This can be achieved by integrating opportunities for participation into the planning, implementation and governance mechanisms of ecosystem restoration initiatives. Therefore, the inputs of local stakeholders are essential to set up tailor-made solutions. The focus on collaborative governance wanted to investigate how and whether the engagement of local actors contributes to ecosystems restoration and socioeconomic benefits that can tackle the challenges of LAC urban centres, and in particular of Colombia.

Based on this research, governments and societies in Latin American and Caribbean countries must pay more attention to citizen participation in environmental management processes. In this regard, the ratification of the 2018 Escazú Agreement – which promotes stakeholders participation and the improvement of legitimacy, equity, justice and trust in environmental governance – is crucial. Stakeholders engagement constitutes a key element to support sustainable development for Colombia (Rodríguez 2021). It allows to face environmental problems, contribute to the alleviation of communities' burdens while also promoting sustainable development objectives and supporting the construction of a stable and lasting peace in Colombia.

Bibliography

Agbodzakey, J.K. 2021. Leadership in Collaborative Governance: The Case of HIV/AIDS Health Services Planning Council in South Florida. *International Journal of Public Administration* 44 (13): 1051-1064.

Alcaldía Mayor Bogotá and Secretaría Distrital de Ambiente. 2015. *Zuna. Pasos que nos develan Bogotá*. Bogotá: La Alcaldía.

Albert, C., Schröter, B., Haase, D., Brillinger, M., Henze, J., Herrmann, S., Gottwald, S., Guerrero, P., Nicolas, C. and Matzdorf, B. 2019. Addressing societal challenges through nature-based solutions: How can landscape planning and governance research contribute?. *Landscape and Urban Planning* 182: 12-21.

Andrade, G.I., Remolina, F. and Wiesner, D. 2013. Assembling the pieces: a framework for integrating multifunctional ecological main structure in the emerging urban region of Bogotá, Colombia. *Urban ecosystems* 16 (4): 723-739.

Ansell, C. and Gash, A. 2008. Collaborative governance in theory and practice. *Journal of public administration research and theory* 18 (4): 543-571.

Arnstein, S.R. 1969. A ladder of citizen participation. *Journal of the American Institute of planners*, 35 (4): 216-224.

Averchenkova, A., Plyska, O. and Wahlgren, J. 2022. *Addressing the climate and environmental crises through better governance: The Environmental Democracy approach in development cooperation*. London: Westminster Foundation for Democracy.

Ayazo Toscano, R.A., Hernández Palma, A.M. and Becerra Ramírez, M.T.C., 2019. *Portafolio de soluciones basadas en la naturaleza (SbN) como mecanismo de mitigación y adaptación al cambio climático en las áreas rurales de Colombia.*

Barbosa, V. and Pradilla, M.M.S. 2021. Identifying the Social Urban Spatial Structure of Vulnerability: Towards Climate Change Equity in Bogotá. *Urban Planning*, 6 (4): 365-379.

Bateman, I.J., Mace, G.M., Fezzi, C., Atkinson, G. and Turner, R.K. 2014. Economic analysis for ecosystem service assessments. In *Valuing Ecosystem Services*. Edward Elgar Publishing.

Bejarano, P., Gómez, C., Alvarado, Y., Esguerra, S., Aparicio, S. and Cavelier, I. 2014. Proyecto Recuperación Integral de las Quebradas de Chapinero. Historia ambiental y recuperación integral de los territorios asociados a quebradas y ríos en Bogotá (caso Chapinero).

Bejarano Mora, Patricia. Director of the projects falling under the comprehensive restoration of the territories associated with streams and rivers in Bogotá, Conservation International Colombia. Formal interview. Bogotá, 6 April 2022.

Bhatt, I.D., Negi, V.S. and Rawal, R.S. 2020. Promoting nature-based solution (NbS) through restoration of degraded landscapes in the Indian Himalayan Region. In *Nature-based Solutions for Resilient Ecosystems and Societies*. Singapore: Springer.

Brink, E. and Wamsler, C. 2018. Collaborative governance for climate change adaptation: mapping citizen–municipality interactions. *Environmental Policy and Governance 28*(2) pp.82-97.

CAR, Secretería de Ambiente, Conservación International Colombia. 2018. *Restauración Ecológica Participativa en el paisaje rural de las Localidades de Usme y Sumapaz*. *Informe final*. Bogotá D.C., Colombia.

CBD. 2019. 'Decision XIII/5. Ecosystem restoration: short-term action plan', in, p. 10. URL: https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-05-en.pdf

Chrysoulakis, N., Somarakis, G., Stagakis, S., Mitraka, Z., Wong, M.S. and Ho, H.C. 2021. Monitoring and evaluating nature-based solutions implementation in urban areas by means of earth observation. *Remote Sensing* 13 (8): 1503.

Coghlan, D. and Brydon-Miller, M. 2014. *The SAGE encyclopedia of action research*. London: SAGE.

Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. 2016. *Nature-based solutions to address global societal challenges*. Gland: IUCN

Colléony, A. and Shwartz, A. 2019. Beyond assuming co-benefits in nature-based solutions: A human-centered approach to optimise social and ecological outcomes for advancing sustainable urban planning. *Sustainability*, 11 (18): 4924.

Comín, F.A. 2002. Restauración ecológica: teoría versus práctica. *Ecosistemas*, 11 (1).

Cradock-Henry, N.A., Greenhalgh, S., Brown, P. and Sinner, J. 2017. Factors influencing successful collaboration for freshwater management in Aotearoa, New Zealand. *Ecology and Society 22* (2).

da Rocha, S.M., Almassy, D. and Pinter, L. 2017. Social and cultural values and impacts of nature-based solutions and natural areas. *NATURVATION* Deliverable, 1.

DeVincentis, A.J., Guillon, H., Díaz Gómez, R., Patterson, N.K., van den Brandeler, F., Koehl, A., Ortiz-Partida, J.P., Garza-Díaz, L.E., Gamez-Rodríguez, J., Goharian, E. and Sandoval Solis, S. 2021. Bright and blind spots of water research in Latin America and the Caribbean. *Hydrology and Earth System Sciences* 25 (8): 4631-4650.

Dickey, A. and Bush, J. 2021. *Sustaining collaborative governance. Literature review and case studies*. University of Melbourne.

Dobbs, C., Escobedo, F.J., Clerici, N., de la Barrera, F., Eleuterio, A.A., MacGregor-Fors, I., Reyes-Paecke, S., Vásquez, A., Zea Camaño, J.D. and Hernández, H.J. 2019. Urban

ecosystem Services in Latin America: mismatch between global concepts and regional realities?. *Urban ecosystems 22* (1): 173-187.

Dorst, H., Van der Jagt, A., Raven, R. and Runhaar, H. 2019. Urban greening through nature-based solutions–Key characteristics of an emerging concept. *Sustainable Cities and Society 49*: 101620.

Dumitru, A. and Wendling, L. 2021. *Evaluating the impact of nature-based solutions: A handbook for practitioners*. Brussels: European Commission.

Dumitru, A., Frantzeskaki, N. and Collier, M. 2020. Identifying principles for the design of robust impact evaluation frameworks for nature-based solutions in cities. *Environmental Science & Policy* 112: 107-116.

Driessen, P.P., Dieperink, C., Van Laerhoven, F., Runhaar, H.A. and Vermeulen, W.J. 2012. Towards a conceptual framework for the study of shifts in modes of environmental governance–experiences from the Netherlands. *Environmental policy and governance 22* (3): 143-160.

Eggermont, H., Balian, E., Azevedo, J.M.N., Beumer, V., Brodin, T., Claudet, J., Fady, B., Grube, M., Keune, H., Lamarque, P. and Reuter, K. 2015. Nature-based solutions: new influence for environmental management and research in Europe. *GAIA-Ecological Perspectives for Science and Society 24* (4): 243-248.

Empresa de Acueducto y Alcantarillado de Bogotá and Secretaría Distrital de Ambiente. 2008. *Calidad del sistema hídrico de Bogotá*. Bogotá, D.C.: Editorial Pontificia Universidad Javeriana.

Escobedo, F.J., Clerici, N., Staudhammer, C.L. and Corzo, G.T. 2015. Socio-ecological dynamics and inequality in Bogotá, Colombia's public urban forests and their ecosystem services. *Urban Forestry & Urban Greening 14* (4): 1040-1053.

Escobedo, F.J., Clerici, N., Staudhammer, C.L., Feged-Rivadeneira, A., Bohorquez, J.C. and Tovar, G. 2018. Trees and Crime in Bogota, Colombia: Is the link an ecosystem disservice or service?. *Land use policy 78*: 583-592.

European Commission. 2015. *Nature-based solutions & re-naturing cities*. Brussels: European Commission Report No B1049. URL: www.ec.europa.eu/newsroom/horizon2020/document.cfm?doc_id=10195

Favretto, N., Shackleton, S., Sallu, S.M., Gordon, C., Methner, N., Outa, G., Sola, P., Sikutshwa, L. and Williams, P.A. 2021. Collaboration and Multi-Stakeholder Engagement in Landscape Governance and Management in Africa: Lessons from Practice. *Land* 10: 285.

Fernandez-Gimenez, M.E., Ballard, H.L. and Sturtevant, V.E. 2008. Adaptive management and social learning in collaborative and community-based monitoring: a study of five community-based forestry organizations in the western USA. *Ecology and Society 13*(2).

Figueroa Arango, C. 2020. Guía para la integración de las Soluciones Basadas en la Naturaleza en la planificación urbana. Primera aproximación para Colombia. Berlin: Alezander von Humboldt Stiftung, Ecologic Institute, Instituto de Investigación de Recursos Biológicos Alexander von Humboldt.

Fisher, B., Turner, R.K. and Morling, P. 2009. Defining and classifying ecosystem services for decision making. *Ecological economics*, *68*(3): 643-653.

Frantzeskaki, N. and Kabisch, N. 2016. Designing a knowledge co-production operating space for urban environmental governance—Lessons from Rotterdam, Netherlands and Berlin, Germany. *Environmental Science & Policy*, *62*: 90-98.

Frantzeskaki, N. and Rok, A. 2018. Co-producing urban sustainability transitions knowledge with community, policy and science. *Environmental Innovation and Societal Transitions 29*: pp.47-51

Gann, G.D., McDonald, T., Walder, B., Aronson, J., Nelson, C.R., Jonson, J., Hallett, J.G., Eisenberg, C., Guariguata, M.R., Liu, J. and Hua, F. 2019. International principles and standards for the practice of ecological restoration. *Restoration Ecology. 27 (S1): S1-S46.*

García de Jalón Lastra, D. and Gonzalez del Tanago del Rio, M. 2008. Current Practices on the Water Frame Directive implementation in Spain: Problems and Perspectives. *GI-hidrobiologia*, *1*(1): 1-15.

Gerwing, T.G., Hawkes, V.C., Gann, G.D. and Murphy, S.D. 2021. Restoration, reclamation, and rehabilitation: on the need for, and positing a definition of, ecological reclamation. *Restoration Ecology* pp. 13461.

Haase, D., Kabisch, S., Haase, A., Andersson, E., Banzhaf, E., Baró, F., Brenck, M., Fischer, L.K., Frantzeskaki, N., Kabisch, N. and Krellenberg, K. 2017. Greening cities–To be socially inclusive? About the alleged paradox of society and ecology in cities. *Habitat International*, *64*: 41-48.

Inostroza, L., Garay, H., Andrade, G. 2020. *Servicios Ecosistémicos Urbanos en Latinoamérica, Oportunidades Para el Desarrollo Urbano Sostenible, la Acción Climática y la Gestión de la Biodiversidad Urbana*. Bogotá: CODS, Universidad de los Andes.

Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. 2014 ¿Qué es la biodiversidad? URL: http://www.humboldt.org.co/es/biodiversidad/que-es-la-biodiversidad (Accessed March 21).

Jennings, V. and Bamkole, O. 2019. The relationship between social cohesion and urban green space: An avenue for health promotion. *International journal of environmental research and public health 16*(3): 452.

Las Quebradas de Usaquén. 2014. *Proyecto Quebradas*. Accessed April 18. URL: https://quebradasusaquen.wordpress.com/proyecto-quebradas/

Lupp, G., Huang, J.J., Zingraff-Hamed, A., Oen, A., Del Sepia, N., Martinelli, A., Lucchesi, M., Wulff Knutsen, T., Olsen, M., Fjøsne, T.F. and Balaguer, E.M. 2021. Stakeholder

Perceptions of Nature-Based Solutions and Their Collaborative Co-Design and Implementation Processes in Rural Mountain Areas—A Case Study From PHUSICOS. *Frontiers in Environmental Science* p.593.

Lurduy Jiménez, M. 2016. En Bogotá 4.353 hogares están en la ruralidad. *Alcaldía Mayor de Bogotá* (Bogotá), March 17. URL: https://bogota.gov.co/mi-ciudad/desarrollo-economico/en-bogota-4353-hogares-estan-en-la-ruralidad.

Maes, J., Liquete, C., Teller, A., Erhard, M., Paracchini, M.L., Barredo, J.I., Grizzetti, B., Cardoso, A., Somma, F., Petersen, J.E. and Meiner, A. 2016. An indicator framework for assessing ecosystem services in support of the EU Biodiversity Strategy to 2020. *Ecosystem services 17*: 14-23.

Mahmoud, I. and Morello, E. 2021. Co-creation pathway for urban Nature-based Solutions: Testing a shared governance approach in three cities and nine action labs. *Smart and Sustainable Planning for Cities and Regions: Results of SSPCR 2019* pp. 259-276

Malekpour, S., Tawfik, S. and Chesterfield, C. 2021. Designing collaborative governance for nature-based solutions. *Urban Forestry & Urban Greening 62*: 127177.

Maller, C. 2021. Re-orienting nature-based solutions with more-than-human thinking. *Cities 113*: 103155.

Marlier, E. and Atkinson, A.B. 2010. Analysing and measuring social inclusion in a global context. *Journal of Policy analysis and Management 29*: 285-304.

Martin, D.M. and Lyons, J.E. 2018. Monitoring the social benefits of ecological restoration. *Restoration Ecology 26* (6): 1045-1050.

Mazón, M., Aguirre, N., Echeverría, C. and Aronson, J. 2019. Monitoring attributes for ecological restoration in Latin America and the Caribbean region. Restoration Ecology 27(5): 992-999.

Miguel, A. and Quiñones, H. 2014. *Territorios ambientales de Bogotá: historias de acciones colectivas.* Bogotá: CODS, Universidad de los Andes.

Narváez, A.M.A. 2019. *Heterogeneous Waters in the City: Power and Concerned Interactions in the History of Community Aqueducts in Usme, Bogotá (1980-2015)* (Doctoral dissertation, Technische Universität Berlin).

Network Nature. 2021. *Nature-based solutions for ecosystem restoration: concept.* URL: https://networknature.eu/sites/default/files/networknature/images/NN%20S2%20Concept%20Brief.pdf

Newig, J., Challies, E., Jager, N.W., Kochskaemper, E. and Adzersen, A. 2018. The environmental performance of participatory and collaborative governance: a framework of causal mechanisms. *Policy Studies Journal 46* (2): 269-297.

Nunes, N., Björner, E. and Hilding-Hamann, K.E. 2021. Guidelines for Citizen Engagement and the Co-Creation of Nature-Based Solutions: Living Knowledge in the URBiNAT Project. *Sustainability 13* (23): 13378.

Oliver, E., S. Ozment, M. Silva, G. Watson, and A. Grünwaldt. 2021. *Nature-Based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank*. Washington, DC: Inter-American Development Bank and World Resources Institute.

Osorio Ardila, G. 2020. What do Claims for Participation Tell Us About City Planning?: The experience of defenders of an environmental protected area in Bogotá, Colombia. *Doing Tolerance: Urban Interventions and Forms of Participation* pp. 211-231.

Ozment, S., Gonzalez, M., Schumacher, A., Oliver, E., Morales, A.G., Gartner, T., Zuniga, M.S., Watson, G. and Grünwaldt, A. 2021. *Nature-Based Solutions in Latin America and The Caribbean: Regional Status and Priorities for Growth*. Washington, DC: Inter-American Development Bank and World Resources Institute.

Pauchard, A. and Barbosa, O. 2013. Regional assessment of Latin America: rapid urban development and social economic inequity threaten biodiversity hotspots. In *urbanisation, biodiversity and ecosystem services: challenges and opportunities* pp. 589-608

Portugal Del Pino, D., Borelli, S. and Pauleit, S. 2020. Nature-based solutions in Latin American cities: A stakeholder perspective. *The Palgrave Handbook of Climate Resilient Societies* pp.1-28.

Quimbayo Ruiz, G. A. 2018 People and urban nature: the environmentalization of social movements in Bogotá, *Journal of Political Ecology* 25 (1): 525-547.

Quimbayo Ruiz, G.A. 2020. Territory, sustainability, and beyond: Latin American urbanisation through a political ecology. *Environment and Planning E: Nature and Space 3* (3): 786-809.

Quimbayo Ruiz, G.A. 2021. Reterritorialising conflicting urban natures: socio-ecological inequalities and the politics of spatial planning in Bogotá. (Doctoral dissertation, Itä-Suomen yliopisto).

Raymond, C.M., Breil, M., Nita, M.R., Kabisch, N., de Bel, M., Enzi, V., Frantzeskaki, N., Geneletti, G., Lovinger, L., Cardinaletti, M. and Basnou, C. 2017a. *An impact evaluation framework to support planning and evaluation of nature-based solutions projects. Report prepared by the EKLIPSE Expert Working Group on Nature-Based Solutions to Promote Climate Resilience in Urban Areas*. Centre for Ecology and Hydrology.

Raymond, C.M., Frantzeskaki, N., Kabisch, N., Berry, P., Breil, M., Nita, M.R., Geneletti, D. and Calfapietra, C. 2017b. A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environmental Science & Policy* 77: 15-24.

República de Colombia 1993. *Ley 99. Ley general ambiental de Colombia*. Bogotá: Congreso de la República.

Richerzhagen, C., Rodríguez de Francisco, J.C., Weinsheimer, F., Döhnert, A., Kleiner, L., Mayer, M., Morawietz, J. and Philipp, E. 2019. Ecosystem-based adaptation projects, more than just adaptation: analysis of social benefits and costs in Colombia. *International Journal of Environmental Research and Public Health 16* (21): 4248.

Rinaudo Mannucci, M.E. 2019. Diseño de un portafolio de soluciones basadas en la naturaleza y gestión del cambio climático en un contexto de transiciones socioecológicas hacia la sostenibilidad en Colombia (Doctoral dissertation, Bogotá: Universidad Externado de Colombia, 2019).

Ruiz Bulla, J.J. 2017. *Los cabildos de gobernanza del agua: ¿ciudadanía empoderada en la localidad de San Cristóbal?* Pontificia Universidad Javeriana: Bogotá.

Rodríguez, G. 2021. *Yo participo, tú participas, otros deciden: la participación ambiental en Colombia*. Bogotá: Fondo Nacional Ambiental y Fiedrich Ebert Stiftung.

Schmidt, K., Sachse, R. and Walz, A. 2016. Current role of social benefits in ecosystem service assessments. *Landscape and Urban Planning* 149: 49-64.

Secretaría Distrital de Ambiente, Fondo Desarrollo Local Usaquén and Conservación Internacional Colombia. 2014a. *Diseños restauración ecológica. Quebrada Morací*. Bogotá, Colombia.

Secretaría Distrital de Ambiente, Fondo Desarrollo Local Usaquén and Conservación Internacional Colombia. 2014b. *Diseños para la restauración ecológica de la Quebrada Aguas Calientes.* Bogotá, Colombia.

Secretaría Distrital de Ambiente, Fondo Desarrollo Local Usaquén and Conservación Internacional Colombia. 2014c. *Diseños para la restauración ecológica Quebrada San Juan.* Bogotá, Colombia.

Secretaría Distrital de Ambiente, Fondo Desarrollo Local Usaquén and Conservación Internacional Colombia. 2014d. *Diseños para la restauración ecológica quebrada. La Floresta.* Bogotá, Colombia.

Secretaría Distrital de Ambiente, Fondo Desarrollo Local Usaquén and Conservación Internacional Colombia. 2014e. *Diagnóstico biofísico y socioeconómico de las quebradas, zonificación y focalización de la intervención.* Bogotá, Colombia.

Seddon, N., Smith, A., Smith, P., Key, I., Chausson, A., Girardin, C., House, J., Srivastava, S. and Turner, B. 2021. Getting the message right on nature-based solutions to climate change. *Global Change Biology* 27 (8): 1518-1546.

Sekulova, F., Anguelovski, I., Kiss, B., Kotsila, P., Baró, F., Palgan, Y.V. and Connolly, J. 2021. The governance of nature-based solutions in the city at the intersection of justice and equity. *Cities 112*: 103136.

Toxopeus, H. López Gunn, E. Vos, P. and McQuaid, S. 2020. *Financing sustainable Nature-Based Solutions*. Covenant of Mayors investment Forum, 19th of February, 2020.

Toxopeus, H., Kotsila, P., Conde, M., Katona, A., van der Jagt, A.P. and Polzin, F. 2020. How 'just'is hybrid governance of urban nature-based solutions?. *Cities 105*: 102839.

Tuhkanen, H., 2021. Climate justice for people and nature through urban Ecosystem-based Adaptation (EbA): a focus on the Global South.

UNEP. 2019. *New UN Decade on Ecosystem Restoration offers unparalleled opportunity for job creation, food security and addressing climate change opportunity*. URL: https://www.unep.org/news-and-stories/press-release/new-un-decade-ecosystem-restoration-offers-unparalleled-opportunity (Accessed 28th of May, 2022).

UNEP. 2021. *Smart, Sustainable and Resilient cities: the power of Nature-based Solutions.* URL: https://www.g20.org/wp-content/uploads/2021/07/G20_NbS- Cities_06.pdf

United Nations. 2017. *Habitat III Regional Report. Latin America and the Caribbean. Sustainable Cities with Equality*. Nairobi: UN-HABITAT.

United Nations. 2018. *World Urbanisation Prospects: The 2018 Revision*. Department of Economic and Social Affairs, Population Division. URL: https://population.un.org/wup/Country-Profiles/.

United Nations. 2019. *World Urbanisation Prospects: The 2018 Revision.* Department of Economic and Social Affairs. Population Division. New York: United Nations. URL: https://bit.ly/36hajfl.

Valencia, S. 2016. Caught between spaces: socio-environmental vulnerability in formal and informal peri-urban Bogotá and Soacha, Colombia (No. 13). Lund University.

Vargas, R.M. and Moreno, N.R.R. 2016. La gobernanza del agua y la participación ciudadana en Bogotá. *Revista republicana* (21).

Vecchio, G. 2017. Democracy on the move? Bogotá's urban transport strategies and the access to the city. *City, Territory and Architecture* 4 (1): 1-15.

Wamsler, C. 2015. Mainstreaming ecosystem-based adaptation: transformation toward sustainability in urban governance and planning. *Ecology and society 20* (2).

Welden, E.A., Chausson, A. and Melanidis, M.S. 2021. Leveraging Nature-based Solutions for transformation: Reconnecting people and nature. *People and Nature 3*(5) 966-977.

Wickenberg, B., McCormick, K. and Olsson, J.A. 2021. Advancing the implementation of nature-based solutions in cities: A review of frameworks. *Environmental Science & Policy* 125: 44-53.

Wilk, B., Säumel, I. and Rizzi, D. 2021. Collaborative Governance Arrangements for Co-creation of NBS. In *Nature-Based Solutions for More Sustainable Cities–A Framework Approach for Planning and Evaluation*. Emerald Publishing Limited.

World Bank. 2021a. *A Catalogue of Nature-Based Solutions for Urban Resilience*. Washington, D.C.: World Bank.

World Bank. 2021b. Urban population (% of total population). *World Development Indicators.* URL: https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=ZJ (Accessed 10th of December, 2021).

Yin, R.K. 2009. *Case study research: Design and methods* (Vol. 5). London: SAGE Inc.

Zhou, X. and Rana, M.P. 2012. Social benefits of urban green space: A conceptual framework of valuation and accessibility measurements. *Management of Environmental Quality: An International Journal*.

Zingraff-Hamed, A., Hüesker, F., Lupp, G., Begg, C., Huang, J., Oen, A., Vojinovic, Z., Kuhlicke, C. and Pauleit, S. 2020. Stakeholder mapping to co-create nature-based solutions: who is on board?. *Sustainability* 12 (20): 8625.

Appendix 1

Table 10: List of stakeholders interviewed

	Organisation	Interviewee's role	Intervention area	Date of interview	Type
1	WWF Colombia	Specialist in sustainable cities	Bogotá	7th of December, 2021	Non structured
2		Community leader Chapinero	Chapinero	15th of March, 2022	Semi structured
3	Universidad Nacional de Colombia	Expert sociologist	All four	16th of March, 2022	Semi structured
4	*Distrito* of Santa Fe	Urban decision maker	Chapinero	16th of March, 2022	Non structured
5		Community leader Usaquén	Usaquén	21st of March, 2022	Semi structured
6	Amigos de la Montaña	Community leader Usaquén and Chapinero	Usaquén and Chapinero	22nd of March, 2022	Non structured
7	Sabias montañeras	Educator 1	Sumapaz	23rd of March, 2022	Semi structured
8	Sabias montañeras	Educator 2	Sumapaz	23rd of March, 2022	Semi structured
9	Sabias montañeras	Educator 3	Sumapaz	23rd of March, 2022	Semi structured
10		Community leader Usme and Sumapaz	Usme and Sumapaz	24th of March, 2022	Semi structured
11		Community leader Usme	Usme	1st of April, 2022	Semi structured
12		Citizen	Chapinero	1st of April, 2022	Non structured
13	Conservation International Colombia	Director of the projects	All	6th of April, 2022	Semi structured
14	Conservation International Colombia	Project manager	Bogotá	2nd of May, 2022	Non structured

Appendix 2

INTERVIEW COMMUNITIES/CITIZENS	
Date_____	Interviewee_____
Role _____	Place _____

1. Can you describe me briefly the project?
2. Can you tell me a bit about your role or the role of the community/organization you represent in the project?
3. What was your interest in participating to the project?

4. How were you engaged in the planning and implementation of the project?
5. Do you think that the necessities and points of view of your community/organization were efficiently integrated in the project?
6. How did you become aware of this project? Who was the entity that involved you?
7. How was communication promoted in the design and implementation of the process? Did you have space to have face-to-face communication?
8. Did you trust the decision-makers and local authorities of the project? And the other participants?

9. Do you think that the project promoted any social benefit for you, your organization and the people being able to enjoy the area?
10. Do you think that the project promoted bonding and sense of community? Trust? Solidarity?
11. Do you think that this project promoted social inclusion? Especially of less advantaged communities?
12. Has this restoration improved the area? Do you feel safer?
13. Do you think anyone has been affect negatively from the outcomes of this project?

14. How did your engagement affect the results of the project?
15. How did your engagement affected you personally?
16. How did your engagement affected others (locals, residents and visitors of the areas)?

INTERVIEW DECISION MAKERS	
Date_____	Interviewee_____
Role _____	Place _____

1. Can you describe me briefly the project?
2. Can you tell me a bit about your role or the entity you represent in the project?
3. What was your interest in participating in the project?

4. How was the socio-economic context of the project area considered in the planning of the project?
5. Was there one or more particular actors that helped bringing together stakeholders and supported a collaborative approach?
6. Would you reckon that the project promoted a successful engagement of all key stakeholders, both in the planning and implementation phase?
7. Could you describe me how they were engaged?
8. Were there power imbalances between stakeholders? If so, how were the weaker stakeholders included?
9. Have any conflicts risen? How were they mediated?
10. How was communication with stakeholders promoted?

11. One of the main approach of the project relates to a social participation strategy. What is the added value of implementing this strategy?
12. Did any social benefits arise from the project? If so, which ones?
13. Are these social benefits already perceived amongst the citizens, communities and stakeholders included in the project?
14. How did this project specifically benefit local communities?
15. Were the social benefits mentioned above more evident for certain stakeholders than others? Has anyone been affected negatively from the outcomes of the project?

16. What do you think are the main benefits of engaging different stakeholders?
17. Do you think that promoting a collaborative approach supported the creation of any of the social outcomes you mentioned? If so, which ones?
18. Do you think that actively engaging under-represented social groups helped building or strengthening their adaptive capacity?

Appendix 3

Examples of the interventions in the stream Morací, in Chapinero, before and after the restoration.

Appendix 4

Activities with communities. 1) sowing activities and 2) cultural activities.