Nature in the City

A City Comparison of Nature-based Solutions for Urban Water Management

Master's in Governing the Large Metropolis

Ebou Ceesay
Maxwell Garcia
Maxwell Kilman
Sallyrose Savage

SciencesPo
URBAN SCHOOL

PREFACE

From the project referent, Dr. Francesca Ferlicca, Rachel L. Mellon Postdoctoral Fellow

This capstone project, titled “A City Comparison of Nature-Based Solutions for Urban Water Management: Experiences from Mexico City, Cape Town, and Paris,” is funded by the Rachel L. Mellon Foundation and commissioned by Dr. Francesca Ferlicca, Rachel L. Mellon postdoctoral fellow and principal investigator of the “Nature in the City” project. The project aims to provide critical evidence and policy guidance for urban water management through a comprehensive comparative analysis of nature-based solutions (NBS) across three strategically selected cities: Paris, Cape Town, and Mexico City. As cities worldwide face escalating water-related challenges due to climate change—from prolonged droughts to devastating floods, this research seeks to bridge the knowledge gap between successful NBS pilot projects and their systematic implementation at scale. Through rigorous field research, stakeholder engagement, and cross-contextual analysis the research addresses critical questions of governance, equity, and effectiveness for policymakers, urban planners, and practitioners working to build more resilient and inclusive urban water management systems through nature-based approaches.

From the project tutor, Mr. Joffrey Lapilus, Advocacy Lead, French Water Partnership

Cities are often built near or around water bodies, but water was not always a priority for city planners over time. Today, water-related challenges in the urban half of the world are more acute than ever, often exacerbated by the effects of climate change. This comparative analysis of Nature-based Solutions (NbS) for urban water management in Paris, Cape Town and Mexico City is very timely as NbS in urban contexts have the potential to address those challenges bridging social, economical and ecological concerns. Drawing from diverse historical, social, political and ecological contexts, this research examines how those cities are implementing NbS to answer their own urban water issues. Through an impressive array of methodological approaches, including policy analysis, fielwork observation, stakeholder interviews, GIS mapping, the study not only identifies implementation gaps but also highlights opportunities for NbS to allow for inclusive and resilient water strategies in cities. The international scope and diversity of the sites studied make a compelling contribution to the field of climate adaptation and nature-based urban planning. Findings are particularly relevant for policymakers and practitioners engaged in the financing or implementation of NbS for water resilience. Last but not least, this project shows how student research can meaningfully inform current real-world transformational policies.

THE PARTNER

We would like to give our thanks to Gerard B. Lambert Foundation for its generous support of this program "the Nature in the City project" and the Rachel L. Lambert Post-Doctoral Fellowship.

In 1976, Rachel Lambert 'Bunny' Mellon (1910-2014) established a foundation intended to honor her father, Gerard Barnes Lambert (1886-1967), for his lifetime achievements in business and the arts. The Gerard B. Lambert Foundation was central in the development of the Oak Spring Garden Library and its contents. The Gérard B Lambert Foundation supported the transformation of the Saint Thomas campus by financing the hanging garden. The garden is now called Rachel Lambert Mellon Garden, in honor of the American philanthropist, patron of the gardens of Georgetown University and the White House.

ISSUES

Nature-based Solutions (NBS) are increasingly recognized as promising approaches for urban water management, offering potential solutions for both water scarcity and flood control. These solutions range from constructed wetlands and bioswales to water-sensitive urban design and watershed restoration. However, the implementation of water-focused NBS faces significant challenges, of which there is little research on. This is the gap our study intends to fill. Our work in the Urban School, studying resilient cities, has made this project a natural transition from theoretical to applied practice.

The overarching goal of this research project was to examine the facets of NBS in their current forms and the impacts they have on water management. To do this, it was important to first set a baseline of why these solutions are employed and how they fit into the greater scheme of water management practices. The 'why' is difficult to trace, as water management practices have long been recorded in history; however, recent years have seen the intensifying impacts of climate change manifesting in extreme events involving water, most notably, droughts and floods. Vigerstol et al. (2024) note that weather, climate, and water hazards have resulted in over two million deaths and US $3.6 trillion in economic losses occurred globally between 1970-2019. During this period of the most intense disasters, drought resulted in the most lives lost (650,000) while floods were the most prevalent (Vigerstol et al., 2024). In 2024, weather, climate, and water hazards impacted more than 167 million people and led to losses of approximately US $2.42 billion (Emergency Events Database, 2025).

The correlation between climate change and an increase in global floods and droughts lies in the increasing global temperatures. Rising temperatures increase the amount of moisture held in the air, leading to more storms, but also more intense dry spells as the water that falls must then evaporate from the land. This contributes to pendulum swings in the hydrological cycle, leading to extremes of both ends: stronger, longer droughts and floods (World Bank, 2021).

Drought refers to "periods of time with substantially below-average moisture conditions, usually over large areas, where limited water availability leads to hydrological imbalance and negative impacts on natural systems" (Vigerstol et al., 2023, p. 15). Water levels and subsequent drought are connected to both atmospheric and terrestrial components of the water cycle, thus heavily influenced by anthropogenic climate change as well as human land and water management activities. Droughts are categorized based on where in the water cycle a lack of moisture produces a drought. For instance, there are meteorological droughts due to a lack of rain, soil moisture drought caused by a lack of moisture in the soil, and hydrological drought connected to anomalies in surface water levels (Vigerstol et al., 2023). The United Nations Convention to Combat Desertification (2023) reports that these drastic changes to the hydrological cycle have led to droughts impacting over

1.84 billion people worldwide, with 85% of these people living in low and middle-income countries. Drought has a number of impacts, including food shortages via crop failures, decreases in water availability, and increased vulnerability to major heat events–all of which can culminate in the loss of human life (UNCCD, 2023). Approximately one-third of disaster-related deaths can be attributed to drought (1970-2019), and the economic loss from 1998-2017 totals over US $124 billion (Vigerstol et al., 2023).

Figure 1. *People collecting water as Cape Town approached Day Zero (Source: Shepard, 2018).*

Floods are defined as the “inundation of normally dry land, triggered by meteorological pressures including precipitation, temperature, evaporation, and snowmelt” (Vigerstol et al., 2023, p. 20). The primary types of floods are fluvial (river) floods, which occur when water levels rise and overflow, and pluvial floods, which result from intense precipitation that drainage systems are unable to handle. An increase in flooding events can be connected to earlier snow melts in some regions, increasing river flows due to melting glaciers, and decreased amounts of water infiltrating the soil as a result of anthropogenic activities. For example, urbanization, deforestation, and poor agricultural practices limit water infiltration and lead to more runoff, which can culminate in flooding (Vigerstol et al., 2023). This also creates another concern, as floodwaters can be contaminated with pollution from a number of sources, such as industrial discharge, residential/commercial wastewater, and stormwater runoff from urban areas. The risks of flooding, then, are not limited to the moment of disaster and immediate life and economic loss, but also longer-term effects such as lower water quality for drinking and enjoying (Haase, 2015).

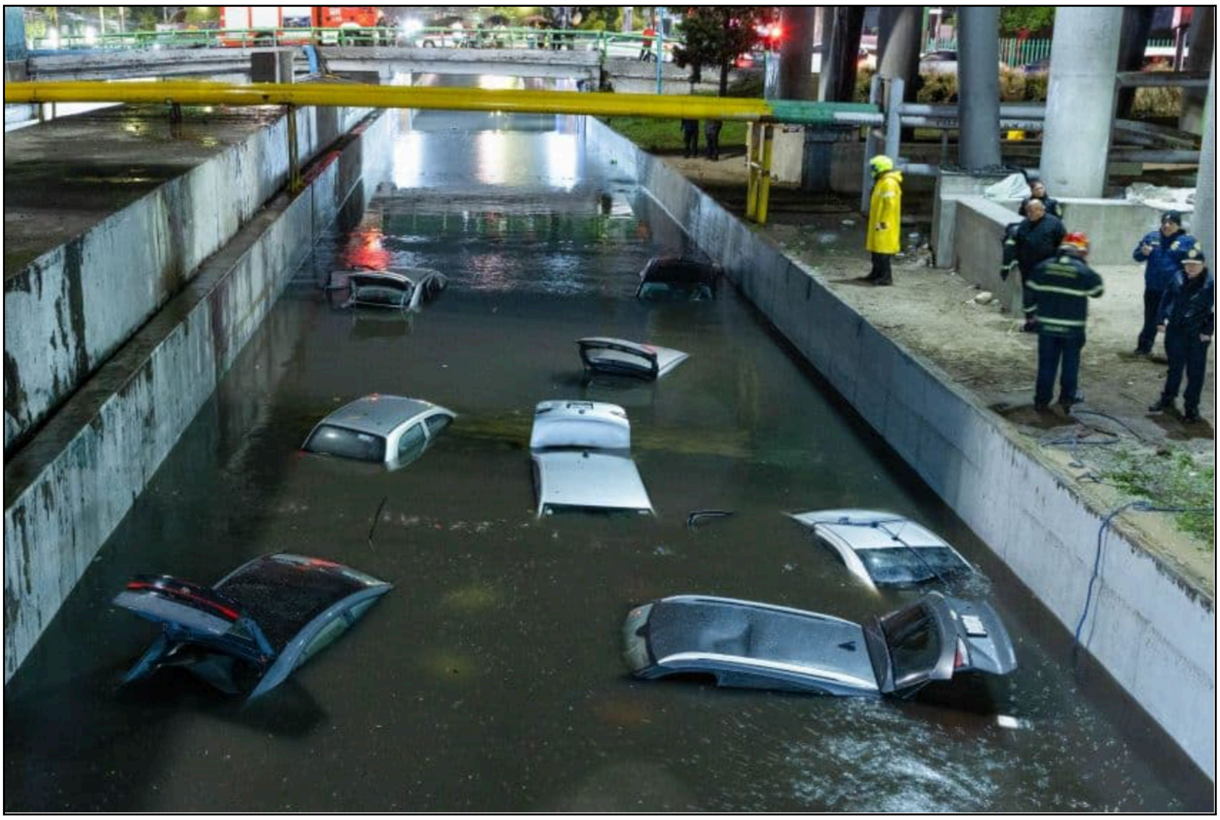

Figure 2. *Torrential rains in Mexico City trapped cars in floodwater (Source: Mexico News Daily, 2025).*

In terms of exposure levels to flooding, more than 1.6 billion people globally are estimated to be affected by floods, including 250 million people who are directly impacted by floodwater inundation. As human settlement patterns inevitably evolve and expand into more flood-prone areas, this number is bound to continue to grow. Between 1985-2015, the spatial extent of human settlements grew by 85%, and exposure to high flood hazard increased by 120%, representing the migration of people into flood-prone areas (Vigerstol et al., 2023).

FIELDS STUDIED

Our project involves studying three cities that are employing NBS as part of their water management strategies to mitigate flooding and drought. The three cities: Paris, France; Cape Town, South Africa; and Mexico City, Mexico, face a range of water-related challenges that the following paragraphs will describe, which will illuminate why they were selected as the case-study cities.

In the late spring of 2016, France's Ile-de-France region experienced a record-breaking rainfall event, fueling severe flooding, including within Paris' city center (Daniela Peredo et al., 2018). Just eight years later, the city experienced two years of low rainfall and higher-than-average temperatures, resulting in record-setting water deficits (Bureau de recherches géologiques et minières, 2024). While similar floods and droughts have occurred in the region throughout the last century (most notably the 1910 floods), the severity of these most recent hydrological events exemplifies global trends toward more extreme and frequent climate change-induced water management challenges (Julien Boé & Milka Radojevic, 2018; Ville de Paris, 2021). Indeed, the City of Paris forecasts that extreme hydrological events—an increased frequency of both flooding and periods of drought—will impact the city over the next century (*Agence de l'eau Seine-Normandie*, 2016; *Ville de Paris*, 2021). The impacts of a severe flood or drought event on Paris, France's administrative and economic center, as well as its most populous city, could impact the lives of at least five million citizens and wreak damage costing anywhere from three to thirty billion euros per OECD (2016, 2025) estimates. The cascading effects could have negative consequences for housing and food security, public health, transportation, energy access, and cultural heritage sites, as well as critical ecosystems that act as a buffer to the effects of climate change (*Institut d'aménagement et d'urbanisme* (IAU), 2010; OECD, 2014, 2025). Paris' continued urbanization within the context of the Seine-Normandy River basin has and could continue to contribute to the severity of these impacts, but may play a key role in the city's capacity to adapt to and mitigate against the effects of these challenges.

The City of Cape Town, with a legislative area spanning over 2,461 km², boasts unique geomorphological features. It is surrounded by several mountains, including Table Mountain, Lion's Head, and Signal Hill, and is home to an extensive coastline stretching over 300 km along the Indian and Atlantic Oceans (CoCT, 2017). Its more than 2,000 kilometers of rivers, which originate from various catchment areas and flow into numerous wetlands, natural reserves, and semi-natural open spaces, highlight the interweaving of the urban fabric with natural landscapes. However, Cape Town is highly exposed to a variety of water-related risks, particularly drought and flooding hazards. Despite the presence of large bodies of water, the city received international attention during its severe drought crisis near the "Day Zero" event in 2018, when nearly 4 million residents faced the risk of having their household taps shut off. This occurred after years of drought, during which time the water levels in the six dams that provide most of Cape Town's water supply dropped drastically (Enqvist et al., 2019). In addition to water scarcity, large parts of Cape Town are at risk of flooding, as indicated by the Western Cape Disaster Management Center's flood hazard index (2016). This includes extreme events such as the 2004 floods and more localized, seasonal flooding during the winter months (Enqvist et al., 2019). Annual winter storms and heavy rains, combined with steep, mountainous slopes that lead to rapid runoff, as well as extensive low-lying coastal areas, further contribute to flood risks (Ziervogel et al., 2016).

Greater Mexico City (CDMX) is in the throes of a water crisis. Called *Tenochtitlán* by its Aztec founders, the city was built at 2,240 meters on an island in the middle of Lake Texcoco, in the Valley of Mexico (UNESCO, n.d.). Since its inception, this strategic location for trade between the arid north and tropical south, as well as the coasts of the Gulf of Mexico (east) and the Pacific Ocean (west), has been attractive to many throughout history. From acting as the seat of power in the Aztec Empire to being the “city of palaces” while part of New Spain, CDMX’s long history has made it one of the most important political, cultural, educational, and financial centers in the Western Hemisphere (*Ciudad de México*, 2025). Despite its successes, this status has sparked a wicked problem. Already home to nearly 23 million people (Acuña & Sands, 2024), the metropolitan area’s population is expected to grow by almost two million in the next 25 years (Hoorweg & Pope, 2014). As the threat of climate change looms, this rapid growth fuels CDMX’s dual water crisis of excess and scarcity. Although incorporated on a lake, historic growth of the city has led to its total drainage and, as a result, artificially exposed the city to an impermeable basin that is prone to flooding during the rainy season (Maqueda Rojo, 2023). Meanwhile, the region faces the lowest per capita water availability in all of Mexico at 74.32 m^3 per inhabitant per year (Ramos-Bueno et al., 2024, p.3182). Although many attempts have been made to reconcile this issue–including constructing complex infrastructure that both diverts flood water out of the city and brings potable water into its boundaries–both local and national authorities have failed to adequately address widespread efficiency, equity, and sustainability challenges of the water supply.

METHODOLOGY

This project seeks to examine the barriers to the implementation of water-focused nature-based solutions (NBS) in three urban contexts (Figure 3): Paris, Cape Town, and Mexico City. To better understand and mitigate the effects of the overarching barriers to NBS implementation, this project seeks to answer three research questions:

(a) *What typologies and approaches of water-focused Nature-Based Solutions (NBS) have been implemented in Paris, Mexico City, and Cape Town?*

(b) *How do governance structures, institutional drivers, and stakeholder participation affect the effectiveness and inclusivity of these solutions?*

(c) *What are the social and ecological impacts of urban NBS implementations for water management, particularly in terms of social justice and equity, and how can lessons from diverse global contexts be leveraged to create more transformative and inclusive NBS governance approaches?*

We respond to these questions using a mixed-methods approach, drawing on the affordances of both quantitative and qualitative methods. To structure our analysis, we have linked each of our three research questions with a general aim and specific objectives that inform the methods we will employ (see Figure 4). We begin with a macro-scale comparison of NBS implementation across our three distinct urban contexts of interest to derive a comprehensive typology. From this macro-scale analysis, we pinpoint three to six projects in each urban context to examine in more detail with a focus on governance structures and stakeholder participation. These two levels of analysis allowed us to evaluate the social and ecological impacts of NBS initiatives and the potential for scaling them up. As the figure describes, our methods included literature reviews, creating and utilizing a GIS web mapping tool, stakeholder interviews and analysis, and field observations.

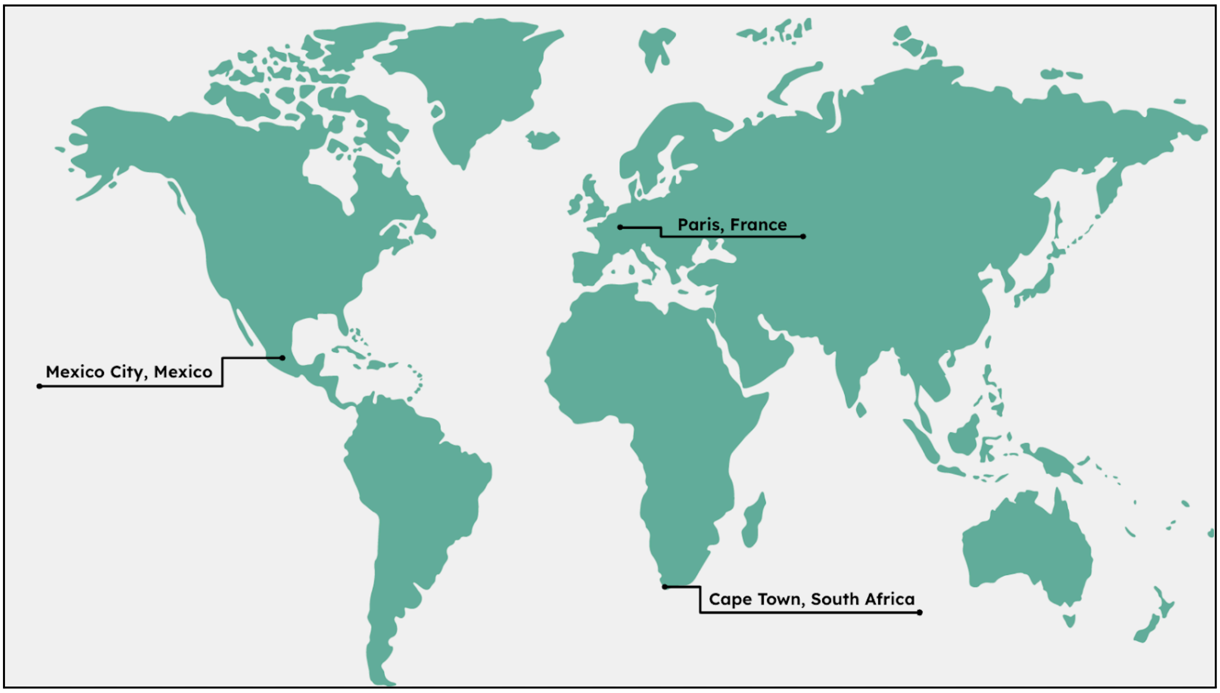

Figure 3. *The three case cities (Source: Our own mapping).*

Pillar	A) Typologies of NBS in Case Cities (Macro Comparison)	B) Governance Structure of NBS (Micro Comparison)	C) Impacts of Urban NBS (Micro Comparison)
R. Question	*What **typologies** and approaches of water-focused NBS **have been implemented** in Paris, Cape Town, and Mexico City?*	*How do **governance structures, institutional drivers, and stakeholder participation** affect the effectiveness and inclusivity of these solutions?*	*What are the **social and ecological impacts** of urban NBS implementations for water management, particularly in terms of social justice and equity, and how can lessons from diverse global contexts be leveraged to create more **transformative and inclusive NBS governance approaches**?*
Objectives	**(i)** evidence on NBS implementation across three distinct urban contexts **(ii)** identifying and documenting best practices **(iii)** analyzing different intervention approaches, spatial distribution, organizational types, and social uses of NBS	**(i)** analyzing how power relations and institutional arrangements influence the implementation and outcomes of water-focused NBS initiatives **(ii)** documenting and analyzing different governance models for water-focused NBS	**(i)** evaluating the effectiveness of various NBS approaches in addressing water scarcity and flooding
Methods	**i)** Identification and categorization of NBS projects (Literature and Data Analysis) **ii)** GIS-based Interactive Web Mapping Tool of NBS	**i)** Preliminary Identification of Multi-Level Drivers (Literature and Data Analysis) **ii)** Stakeholder Interviews	**i** Field observations **ii)** Art Exhibition

Figure 4. Our methodological approach.

City	NBS Projects Identified	Interviews Conducted	Site Visits
Cape Town	41	16	20
Mexico City	119	14	13
Paris	104	10	5
Grand Total	**264**	**40**	**38**

Table 1. Our project in numbers.

MAIN RESULTS

Throughout this project, our team has had the opportunity to learn about and, often visit a variety of nature-based solutions across three cities: Paris, France; Cape Town, South Africa; and Mexico City, Mexico. Based on our initial literature review on the topic of nature-based solutions (NBS), as well as the context we gathered about each city, we gained a general idea of what themes and points of comparison might arise. This section is dedicated to laying out our findings that we see as interesting to discuss among the two or all three of the cities. We have split up our discussion into three sections: realities of implementation, incentivizing nature-based solutions, and public sector and community relations.

Realities of Implementation

Within each of the cities, the on-the-ground reality when implementing nature-based solutions looks different due to the varying governance structures and cultural contexts. One of these differences lies in what projects are even considered to be NBS and what the intended purpose of these projects is.

Figure 5. *Liesbeek River in Cape Town cared for by the Friends of the Liesbeek (Source: Maxwell Kilman, 2025).*

In Cape Town, the NBS projects fell into the “traditional” definition that we found most commonly in our literature review (see Figure 5 for an example). The local government has explicitly researched NBS and made it an established program with various projects in direct response to the flooding and water scarcity issues in the city. For instance, recall the approximately 890 stormwater detention ponds that the municipality of Cape Town implemented with the clear goal of flood mitigation.

In Paris, the concept of NBS was well known amongst our interviewees and clearly familiar to those involved in government programs involving water. While our interviewees flagged flooding as an enduring concern and noted that periods of water scarcity would likely increase with climate change, few mentioned urban NBS primarily targeting these challenges. We found that NBS in the city most often addressed biodiversity, urban heat islands, and pluvial flooding. Consider the *Cours Oasis* project (Figure 6); the project was modeled as a way to tackle the urban heat island effect on school playgrounds, meaning that any water benefits are additional. Within the City of Paris itself, managing fluvial flooding was a secondary benefit. As you move into more peri-urban areas (for instance, near the *Bièvre*), we observed more “traditional” NBS that targeted this form of flooding, specifically.

Figure 6. *A traditional* chinampa *in Xochimilco (Source: Maxwell Garcia, 2025).*

In Mexico City, in the throes of a water crisis like Cape Town, a majority of our site visits were projects that emphasized improving water quality, either to replenish the aquifer, more commonly, to restore biodiversity to an area (*Canal Nacional*, *chinampas* of Xochimilco; Figure 7). Sometimes, through restoring biodiversity, an area would be more resilient to flooding or replenishing the aquifer could theoretically diminish water scarcity, but those were described to us as co-benefits to projects. The government employees we spoke to often knew of the concept of NBS, but did not employ it to explain their programs. For the NGO-led projects, the term NBS was not regularly mentioned at all, despite that many of the projects would very clearly be categorized as such. This can be attributed to the historical and ancestral roots of NBS that extend far further than its recent prevalence in academic literature.

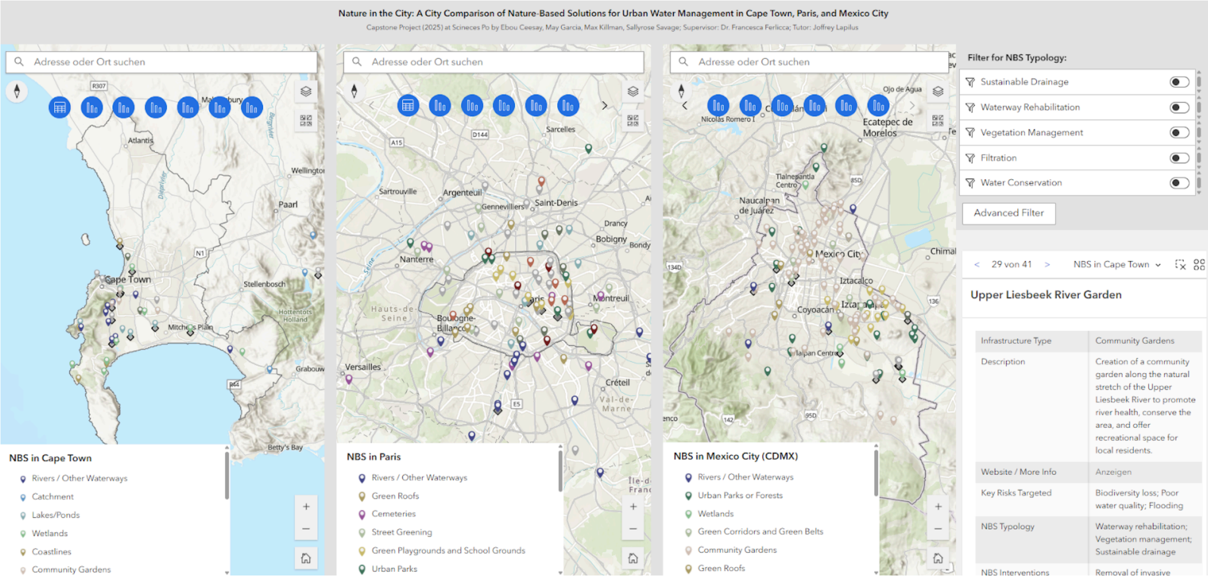

Figure 7. *Our map of NBS projects across the three cities (Source: ArcGIS).*

Our mapping of NBS typologies (Figure 7) also revealed how the different cities implement projects and what interventions are most commonly used. One glaring difference between the cities surrounds what type of infrastructure their NBS projects involve. In Cape Town, a large majority of the projects interact with rivers, streams, canals, and estuaries, as well as inland wetlands, peatlands, swamps, and moors. In Mexico City, we see that NBS infrastructure largely consists of community gardens (over 50% of the 119 projects we mapped), with the next majority being large urban parks or forests at around 15%. In Paris, we observed the widest variety of infrastructure being utilized, with the top three by close margins being rivers, streams, canals, and estuaries, institutional green spaces, and green roofs. Across the board, biodiversity loss was the key targeted risk, with flooding and drought mitigation being secondary or tertiary, or even the least targeted in the case of drought in Cape Town. Of the projects we mapped, in Cape Town, the most common NBS intervention was the removal of invasive species, in Paris it was tree planting, and in Mexico City it was the reintroduction of native species. In both Paris and Cape Town, the social uses of the NBS we mapped were primarily educational and recreational, but in Mexico City, the uses were most notably agricultural and sometimes recreational. Lastly, in all three cities, a majority of the projects we mapped were initiated by public agencies. In Cape Town and Mexico City, this was followed by community-based organizations, but in Paris, the secondary initiator was the private sector. All of these similarities and differences between the cities revealed through our mapping of NBS typology speak to the larger trends of on-the-ground implementation discussed in the remainder of this section.

Another aspect is how projects are actually implemented, meaning what strategy is employed when handling such large-scale water issues. The City of Cape Town designs its projects to focus sectionally on large water catchment areas and systems. For instance, they aim for a systematic approach with the Livable Urban Waterways program. The logic behind this is that a set of "healthy" water areas that are directly connected is more productive in restoring the ecosystem than clean water flowing into dirty water, which would flow back into supposedly clean water in a restored area further away (an oversimplified explanation). This is in contrast to Mexico City, where restoration projects are occurring, where it is feasible considering informal housing, security, and funding mechanisms. Therefore, the projects may not address the issues of the whole water system at once. In Paris, we did not observe many NBS that were related to the water systems, and those that were seemed to be handled with a similar approach as Mexico City, more fragmented, however, for different reasons. Both approaches have their own positives and negatives. Implementation of NBS cannot disregard the interconnectedness of water systems, and varying NBS tools need to be used at different levels to acquire overall water "health," which is quite a difficult feat. However, Paris and Mexico City have found success and benefits in the work they have been able to do within fragmented parts of their water systems.

A final comment on the implementation of NBS is about the scalability of the projects within the cities. As touched on briefly within the last paragraph, it is rare that governments can just come in and implement a project with no issues. There is often a public participation process, and NBS often require community support to be maintained in the long term. This ultimately has had an impact on where within the cities their NBS projects have been established. In Cape Town, an interviewee from the City noted that the Livable Urban Waterways restoration program was initiated in an area with sufficient water quality standards, well-functioning grey infrastructure, and strong community support because they knew it would be an easier success and a better pilot project to encourage the scaling of the program in other parts of the city. This may be related to the private partnerships we observed in Cape Town, where private companies were providing funding to NBS projects. In Mexico City, we found that NGOs led a large majority of NBS projects and conducted their work based on community benefit rather than meeting a predetermined idea of success. While we find that NBS implementation is largely driven by top-down action in Paris, we do note that NGOs and nonprofits do play an enabling role, especially when it comes to project management and capacity-building. Nonetheless, within all three cities, there was a wide range of bottom-up and top-down-led projects.

Another challenge of scalability we heard about within our interviews in Mexico City and Paris involves the capacity of public actors. NBS are often long-term projects, at least when it comes to maintenance, so there is a level of training that employees need to have to keep them active. This can be difficult when considering the many other responsibilities government employees often have. In addition, political will may impact where staff energies are directed, or lead to a change in the staff themselves. Another difficulty of this is the lack of clear evaluation techniques of implemented NBS projects. In Cape Town, there is a formal and technical evaluation process of their NBS projects that includes clear markers for success. In Paris and Mexico City, however, we spoke to numerous stakeholders who could not provide a clear answer on how projects were evaluated on the macro level. Rather, evaluations were based on experiential observations that could not be quantified, nor formulated into a greater evaluation that would determine whether project goals were met. This may be due to the youth of some of these projects, but if the prospect of long-term evaluation has not been considered, that would make it difficult to replicate and expand the project successfully in the future.

Public Sector & Community Relations

As briefly mentioned in the last section, nature-based solutions (NBS) projects are multi-sectoral and often invite collaboration between the public sector and the community. The governance of NBS within the three cities lent itself to being either fragmented or more transparent and cohesive. Mexico City lent itself to the side of fragmented governance, where there was less clarity around who was responsible or who was to be held accountable for the NBS. In Cape Town, NBS governance remains relatively fragmented and uncoordinated due to South Africa's broader water governance regime heavily dictated by a multi-scalar and cross-sectoral institutional arrangement. In Paris, responsibilities surrounding NBS were clearly distinguished, and the various government organizations had set responsibilities. However, our interviewees noted that there was a lack of knowledge sharing between organizations and that such distinctions between organizations could make transversal collaboration difficult at times.

The work of the public sector is either substituted for or supplemented by the work of community organizations. Many of the projects we studied in Cape Town and Mexico City were successfully led by NGOs or CBOs. In Cape Town, organizations in wealthier areas often have a fairly positive relationship with the local government, to the extent that they have regular meetings and know each other by name, whereas in the townships, CBOs have a more complex relationship with government agencies. In Mexico City, government relations with the community varied quite widely from very positive (related to favor towards the current administration) to more contentious (often based on historic and current inaction of the government). This is also related to the high rate of turnover within the government, which often leads to previously forged connections between the government and CBOs being lost. However, it is important to consider that we were only in each city for a short amount of time and thus only able to speak to a small number of the many organizations working with water, so this may not be representative of all organizational experiences with the government.

These public sector-community relationships, in all three cities, were often connected to the concept of informality or land tenure, where NBS projects were meant to, or were taking place. In all three cities, there are issues with housing, which in Mexico City and Cape Town have manifested into informal settlements scattered throughout the city, often in areas considered to be or bordering on conservation land. In Mexico City, there have been many changes over the years regarding what is viewed as “illegal” land for people to settle on, which often conflicts with governmental conservation efforts, including NBS. In Cape Town, there is a colonial and apartheid history of native, Black, and Colored South Africans being dispossessed of land, often in the name of creating green spaces for privileged groups. In the dense urban context of Paris, the city, lacking sole management power over the land on which some projects sit, faces challenges in securing the long-term sustainability of projects even in the face of shifts in land ownership and land use priorities.

In addition to managing competing interests over scarce urban land, the city must establish agreements or concessions with all relevant landowners, requiring careful management and upkeep. The City of Paris, however, has come up with creative solutions, like *Cours Oasis,* whereby city-owned land beneath elementary schools is targeted for NBS implementation. In all these cases, the blurriness surrounding land ownership and tenure, and who has the right to certain land has or may lead to conflicts in implementing and successfully maintaining NBS. It also calls into question the equity of NBS and the importance of educating ourselves on the history of the land and water, and how to ensure NBS is not perpetuating harmful patterns. As a way to mitigate this, interviewees from both Paris and Mexico City asserted that the most effective NBS are those designed at the local level by communities and associated organizations that are in touch with the on-the-ground reality, and then these NBS are bolstered, funded, and potentially scaled by governments. However, maintaining strong community relationships through all steps of this process may reduce the stress on the capacity of local governments and also ensure the community’s involvement in keeping the goal of the project centered around community well-being through mitigating water scarcity and flooding.

Figure 8. *The* Cours Oasis *at* L'École Élementaire Daniel Cordier *(Source: Maxwell Garcia, 2025).*

Incentivizing Nature-Based Solutions

Our last point of comparison encompasses our general findings from each city regarding how to incentivize nature-based solutions (NBS) moving forward. On the whole, all three cities emphasized the importance of educating the population on the water crisis and the steps that can be taken as individuals and communities to minimize the impacts of water scarcity and flooding. For example, in Mexico City, one household we spoke to from the *Cosecha de Lluvia* program explained that the rainwater harvesting system in their home encouraged conversations with the intergenerational household about water and led to conversations with their neighbors they wouldn't normally have had. In Paris, the *Cours Oasis* program showed the integrated nature of NBS projects as places for co-design and teaching, with many schools integrating environmental education into their curricula after involving their students in the consultation of schoolyard plans. Also in Cape Town, local officials emphasized the importance of having clear programming through the catchment management forums, enabling local stakeholders and citizens to understand ongoing projects and proactively participate in decision-making.

This contributes to the greater theme of the need to encourage community-wide "care" of water, as this correlates with a trend of greater success of NBS projects. In Cape Town, projects place an emphasis on tracing the water system upstream and downstream and connecting with communities along the waterway and explaining how the project impacts them. In some instances, for better or for worse, community care for water is linked to greater societal challenges. Within this Cape Town example, one community was motivated to care for the water system because their water was linked to a lower-income community that notably had lower-quality water. In Mexico City, the *Canal Nacional* project invoked the idea of educating children about the Canal and having them play around it to induce their parents to care and stop throwing trash in the waterway. Lastly, in Paris, co-designing schoolyards and participating in the demolition and reconstruction of places like *Place de la Nation* effectively fostered environmental stewardship in local communities.

NBS have proven co-benefits for the environment, as well as for the people who live around them. Given the historic inequalities of access to nature and natural resources, dispossession of land, and continuing socioeconomic disparities, NBS may also be an opportunity to change the narrative through economic empowerment. In Cape Town, for instance, the Khayelitsha Community Hub removes water hyacinth from the wetlands and produces biochar from it, which is then sold as fertilizer in local markets. In Mexico City, both *Huerto Roma Verde* (Figure 9) and UCSMT utilize NBS as a way to directly or indirectly economically support local communities, even if that just means restoring environmental justice and autonomy. Specifically, when we are thinking about the universal necessity for water and the implications of having too little or too much of it, empowerment as an individual and as a community enables more time and care to be dedicated to continued growth and development, which for many, historically involves environmental preservation measures like NBS.

Figure 9. *One of the community gardens in* Huerto Roma Verde *selling food to be sold (Source: Maxwell Garcia, 2025).*

LEARNINGS

Within the span of five months, our group of student researchers has aimed to answer research questions framed around discovering more about nature-based solutions (NBS) in three global cities: Paris, Mexico City, and Cape Town. Our three research questions (identified as A, B, and C, respectively) led to an investigation of the typologies of NBS, the governance structures of NBS, and the impacts of NBS in our case study cities.

Examining the typologies of NBS revealed a wide range of interventions being successfully implemented in all three cities. The interventions would often include a mix of grey and green infrastructure for a well-rounded project. Each city seemed to have a "primary" type of intervention that we believe could be a way for the cities to learn from one another. Paris, for instance, is strong in many small-scale vegetative management interventions in a highly dense built environment (green buildings, green roofs, rain trees), as well as a systematic approach that includes schools through Cours Oasis. Cape Town has a strong presence in large-scale waterway rehabilitation interventions along wetlands, riverbanks, and coastlines, as well as stormwater detention ponds. Mexico City is experienced in water quality improvement through biodiversity restoration projects, as well as rainwater harvesting.

All three of our case study cities have shown us that NBS, as was reflected in the literature, operate at peak capacity when managed through a form of hybrid governance, meaning a mix of both public sector and local actors' involvement. Within the three cities, this operated at different levels; in Paris, more control was in the hands of the local government, as compared to Mexico City, where many projects were managed by CBOs, with Cape Town lying somewhere in between. The varying power of the stakeholders may change based on who is funding the project, who has designed the project, and who has the will and or capacity to maintain the project in the long term. Our interviews reflected that balancing government and community implementation and management of NBS is a challenge, but that success is more likely when these processes are conducted according to local contexts.

Lastly, and perhaps most difficult to formulate, are our conclusions about the social and ecological impacts of NBS. NBS can be used as a tool that aids in dismantling historic systems of dispossession of land and excluding groups from nature and ecological resources, but it can just as easily contribute to exacerbating that harm as well. The projects we observed often centered on social justice and equity in an attempt to recreate a narrative around NBS that involves community empowerment. Ecologically, few technical approaches have been taken within our case cities to examine the long-term impacts that NBS have had on reducing water scarcity or excess, however, many of these projects are rather young. Nonetheless, all three case cities consisted of both government and community actors, as well as displayed a commitment to utilizing and improving NBS with the hope of bettering the capacities of water management systems.

FIND OUT MORE

Our Interactive Online Mapping Tool:
https://experience.arcgis.com/experience/7e4587e940fa4f52b8cec2115d21d654/

IUCN Global Standard for Nature-based Solutions Report:
https://portals.iucn.org/library/sites/library/files/documents/2020-020-En.pdf

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