Participatory Greening: International Experiences



المعهد العربي لإنماء المدن
Arab Urban Development Inst.

Participatory Greening: International Experiences





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Project: "Supporting Greening Activities in Some Arab Cities - Participatory Greening of Neighborhoods." The project aims to support neighborhood greening efforts by piloting and developing knowledge on greening solutions, as well as participatory and contractual models. This report also aims to present and discuss the framework and methodology for participatory neighborhood greening, which was applied in the context of a pilot project to study the Kherba area in Tunis. This approach could help address urban greening challenges not only at the neighborhood level in Tunis but also more broadly in cities across the Arab region.
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This publication reflects AUDI's commitment to fostering cross-regional dialogue and advancing evidence-based approaches to participatory urban development.

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Executive Summary

Urban greening plays a crucial role in urban planning due to its environmental, economic, and social benefits. It contributes to climate change mitigation, improves air quality, reduces urban heat island effects, and enhances biodiversity. Additionally, green spaces increase property values, attract investment, and create economic opportunities. On a social level, they improve public health, foster social cohesion, and enhance the overall quality of life.

However, despite these benefits, many cities in the Global South face persistent challenges, including limited green coverage due to rapid urbanization, constrained financial resources, and weak policy enforcement. Urban greening interventions vary in scale and impact. Large-scale initiatives include afforestation and urban forests, while smaller solutions encompass tactical interventions such as pocket parks and building-scale measures like green roofs and walls. Each intervention contributes differently to food security, sustainability, social cohesion, livability, and economic resilience. Local authorities play a significant role in fostering, implementing, and sustaining the different urban greening efforts from institutional, strategic, and operational levels.

Local authorities play a key role in enabling urban greening by creating supportive institutional frameworks, strategic plans, and operational mechanisms.

The benchmarking report "Participatory Greening: International Experiences" is part of the "Supporting Green Activities in Some Arab Cities: Participatory Greening for Neighborhoods" project, managed through the Urban Living Lab/Urban Policy Research Program and funded by the Arab Fund for Economic and Social Development.

Methodologically, the study is based on desktop research and comparative analysis. It examines 66 international case studies of urban greening initiatives, selected from a broad geographical spectrum including Africa, Asia, Europe, the Middle East, North America, and Australia. These cases were analyzed to extract key lessons and identify critical success factors relevant to cities in the Arab region.

The report distills global experiences into actionable institutional, strategic, and operational recommendations for municipalities, while also highlighting critical enablers, such as inter-sectoral coordination, participatory planning, and policy alignment. The goal is to provide local authorities and urban planners with evidence-based strategies to advance sustainable, inclusive, and climate-resilient urban environments.



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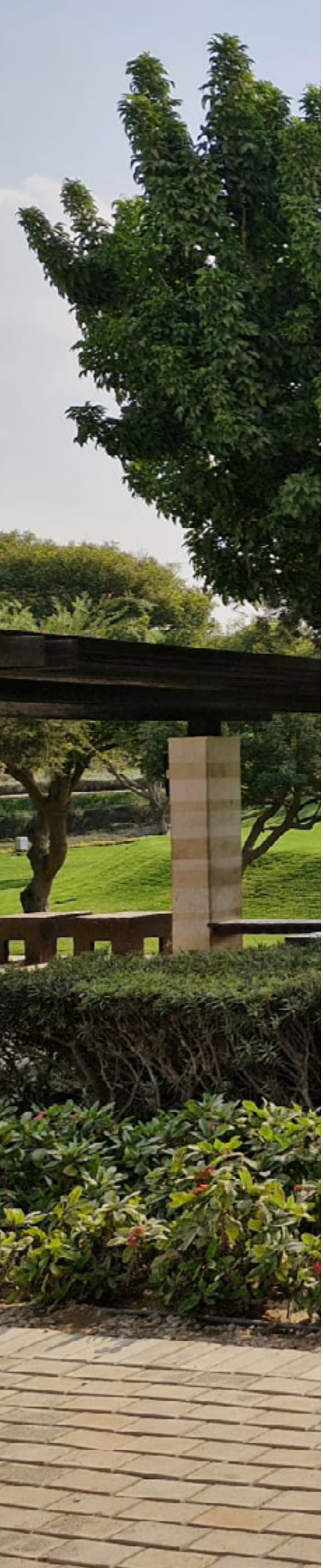

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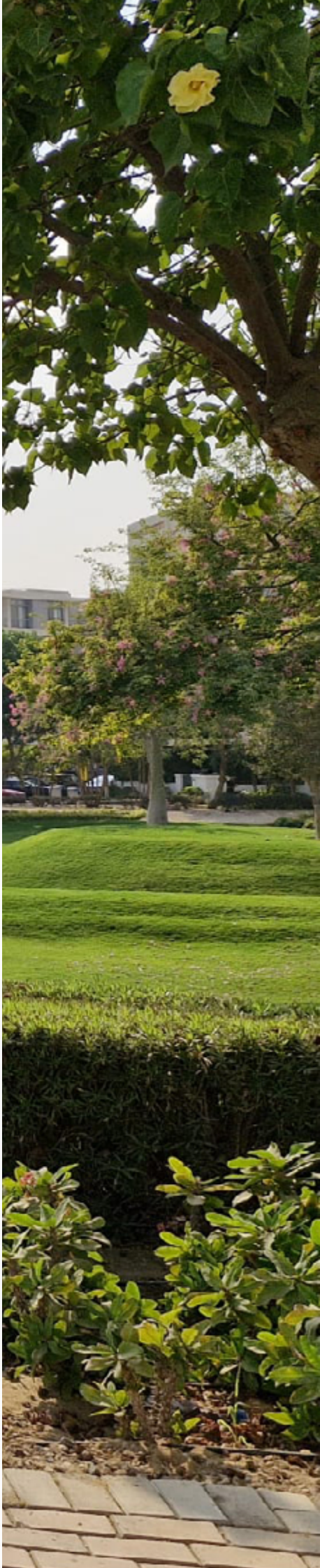





INTRODUCTION

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Background

The World Health Organization (WHO) recommends a minimum of 9 square meters of green space per capita, with an optimal urban green space value of 50 square meters per capita.[2] However, a lot of cities worldwide still struggle to reach this minimum requirement.

In the global north, for example, in Europe, urban green infrastructure makes up an average of 40% of the surface area of European cities with 18.2 square meters of publicly accessible green space per resident; 44% of the continent's urban population resides within 300 m of a public park. However, the percentage of green space per capita significantly varies in the European cities, as some cities strive to include even more green space (for instance, the Italian planning legislation mandates 18 square meters of green space per person in new constructions), while many cities find it difficult to meet this suggested minimum (Joint Research Centre, European Commission, et al. 2019).

Additionally, in the global south, for example, in the Arab countries, this percentage of green spaces in many Arab cities is considerably lower. For instance, in 2020, Cairo had only 0.74 square meters per capita (Aly and Dimitrijevic, 2022), and Beirut reported 0.8 square meters per capita in 2015 (Nazzal and Chinder, 2018). There have been some governmental efforts to enhance the availability of green spaces; notable examples include Qatar, where the per capita green space increased from less than one square meter in 2010 to 16 square meters in 2022 (The Peninsula Qatar, 2024). Additionally, the Green Riyadh project, launched in 2019, seeks to raise the per capita green space in Riyadh from 1.7 square meters to 28 square meters by 2030 (Saudi Vision 2030, 2024). Nevertheless, there is a continued need for comprehensive urban greening initiatives that address various types of green spaces, selected according to local environmental and socio-cultural conditions.

Objectives

This report aims to support municipalities in understanding limitations and benefits of urban greening interventions by showcasing a wide range of global examples of best practices, innovative strategies, and practical solutions that cities have implemented to enhance green spaces, urban forests, and ecological systems within their boundaries. These examples, drawn from various cultural, geographical, and climate contexts, provide valuable insights into the challenges, opportunities, and tangible outcomes of urban greening initiatives. The report aims to distill these Lessons Learned and identify the recommendations that can be used by municipalities. Its primary goal is to equip local authorities, policymakers, and urban planners with evidence-based strategies to foster sustainable urban environments, mitigate climate change impacts, enhance community well-being, and promote biodiversity through thoughtful urban greening practices.

Methodology

This study employs a qualitative, comparative methodology grounded in extensive desktop research and a structured review of academic literature, policy reports and project documentation.

The research approach was designed to meet the primary objective of the report: to identify replicable and context-sensitive urban greening strategies that can inform municipal practice in the Arab region.

The methodology unfolded in three main phases:

1. **Typology and Analytical Framework Development**

A typology of urban greening interventions was developed, categorizing them into three scales of action:

- **City-wide** (e.g., afforestation, green corridors)
- **Neighborhood-scale** (e.g., community gardens, pocket parks)
- **Building-level** (e.g., green roofs, facades)

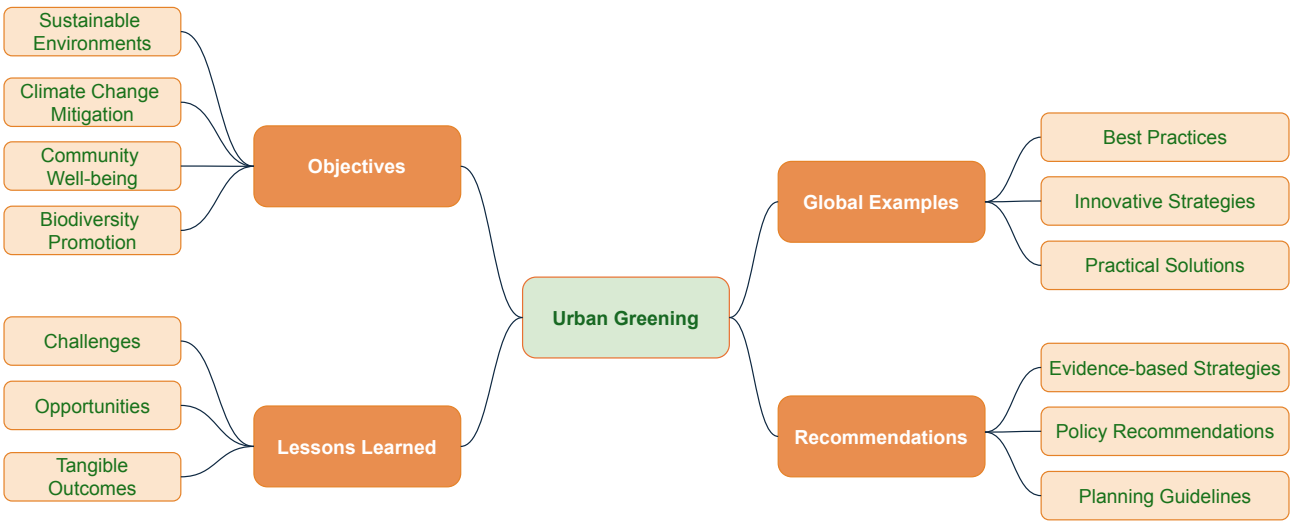

Figure 1: Framework, strategies, and benefits
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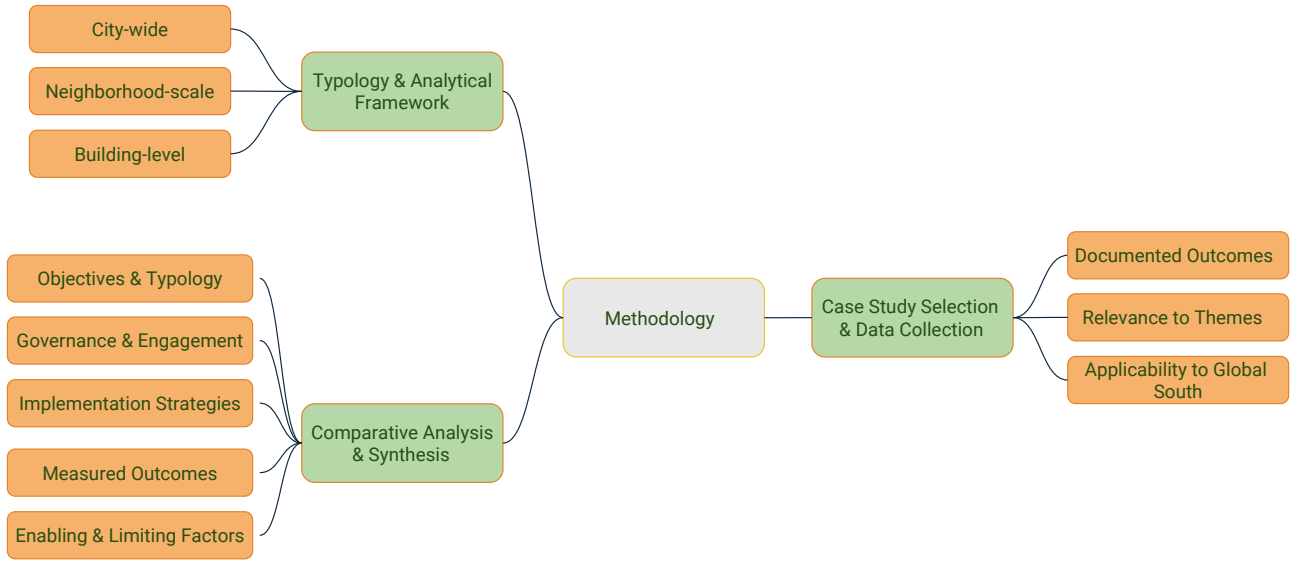

Figure 2: The methodology structure

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This framework informed the structure of the report and ensured consistent evaluation across cases.

2. **Case Study Selection and Data Collection**
   Approximately 60 international case studies were identified, aiming to represent diversity in geography, climate, urban form, and socio-economic context. The selection criteria included:
   - Documented implementation outcomes
   - Relevance to urban greening themes
   - Potential applicability to cities in the Global South

Cases were drawn from Africa, Asia, Europe, the Middle East, North America, and Australia.

3. **Comparative Analysis and Synthesis**
   Each case was analyzed in terms of:
   - Objectives and typology
   - Governance and stakeholder engagement
   - Implementation strategies
   - Measured or reported outcomes
   - Enabling and limiting factors

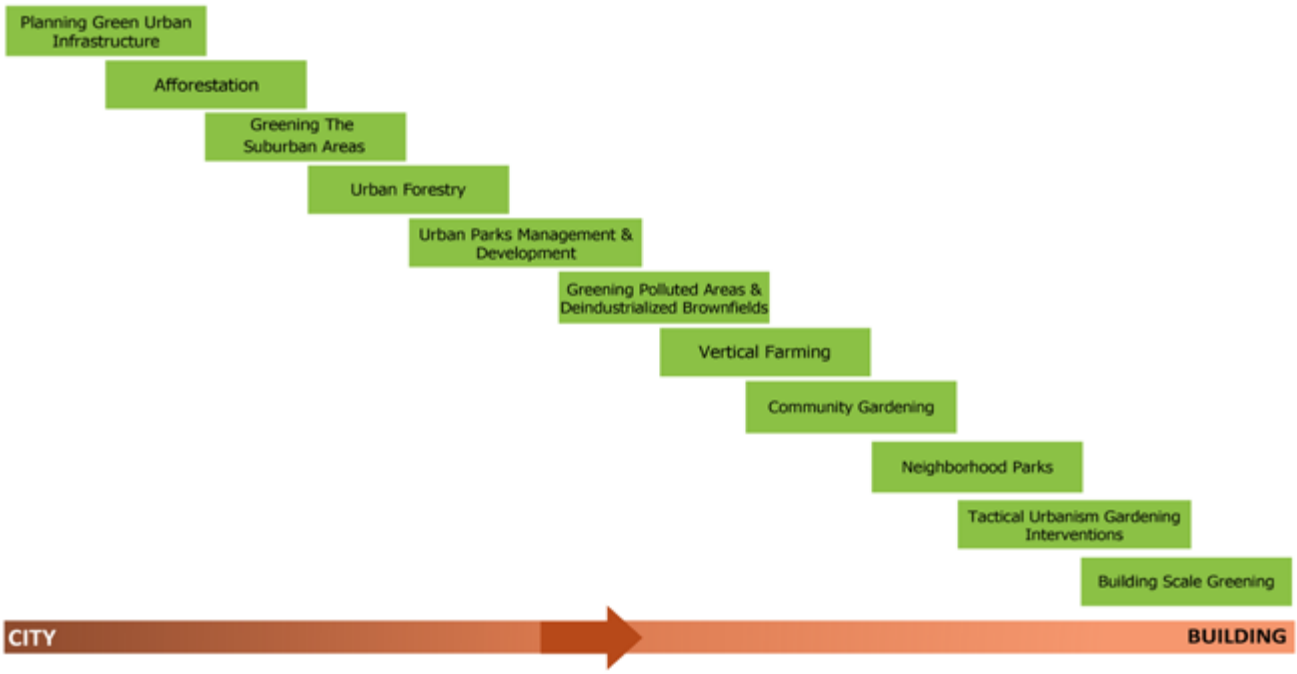

Figure 3: The different types of urban greening interventions based on their scale

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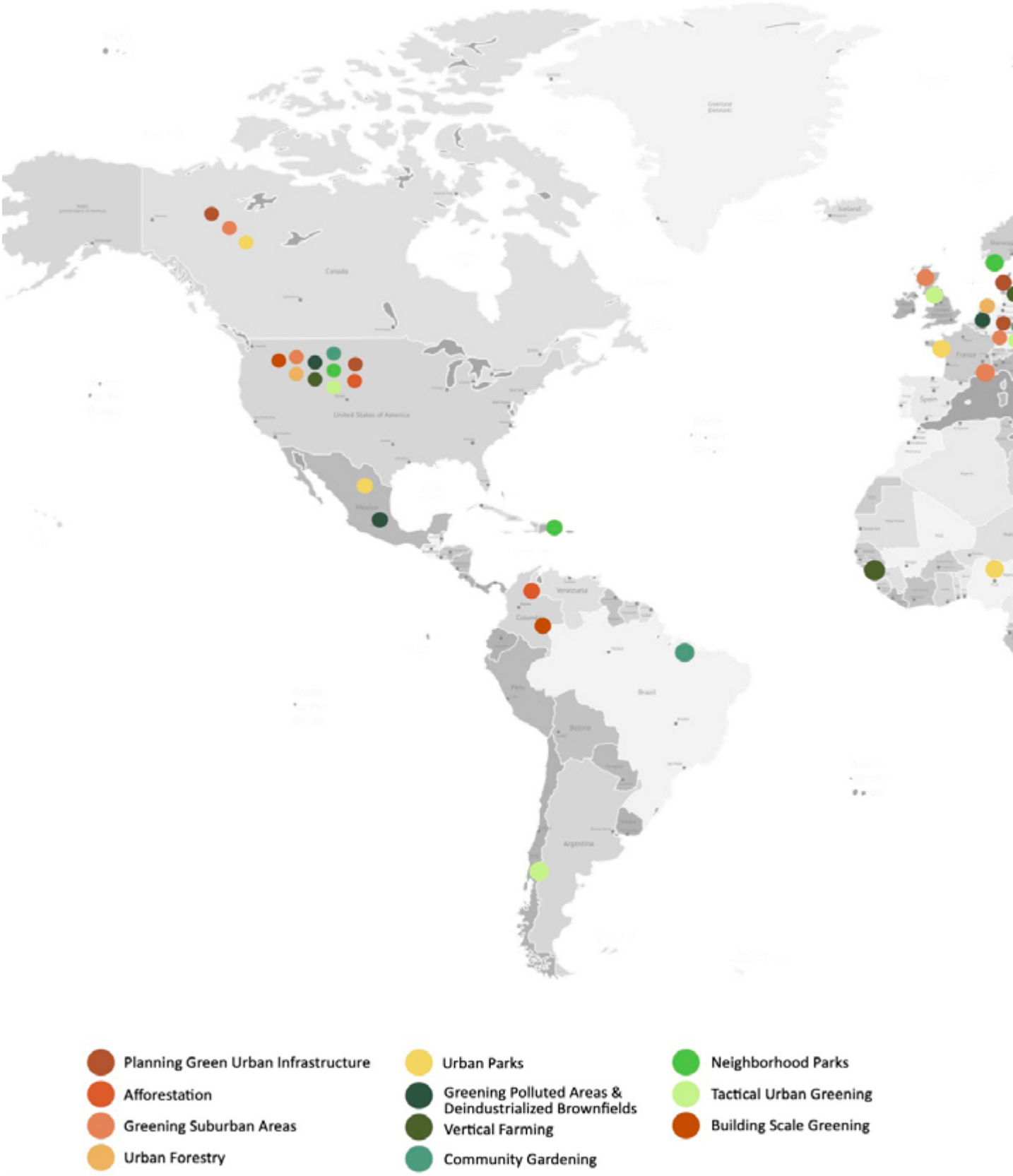

Figure 4: Map indicating the geographical location of selected urban greening types throughout the report
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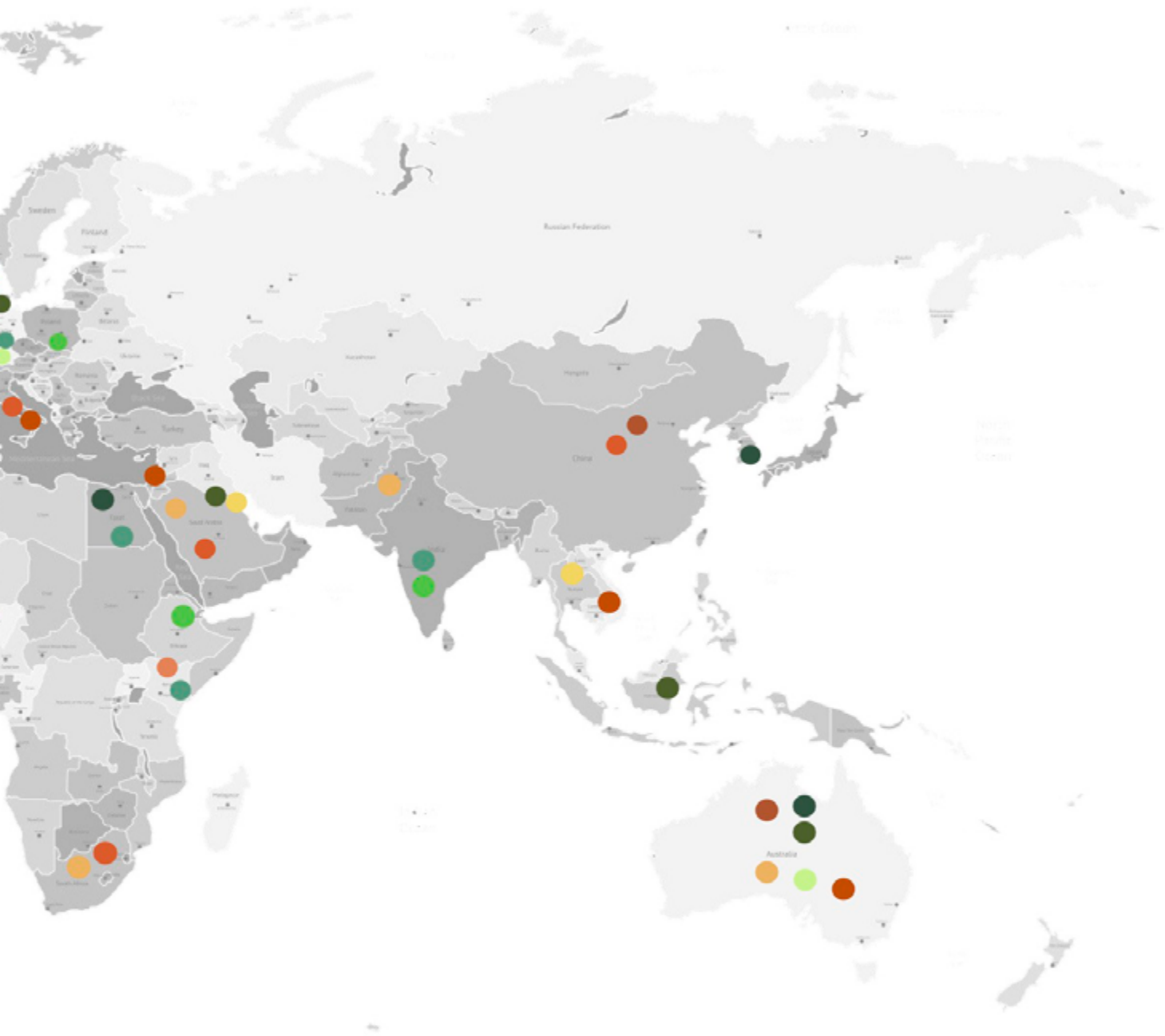

Map Source: https://gisgeography.com/high-resolution-world-map/

4. This comparative analysis was used to extract recurring patterns and lessons. The insights were distilled into institutional, strategic, and operational recommendations for municipal authorities. Key enabling factors, such as cross-sector partnerships, participatory planning, and integrated policy frameworks, were identified as critical success factors.

The methodological approach ensured both breadth (through global coverage) and depth (through structured analysis), resulting in practical guidance grounded in international experience yet adaptable to the Arab region's specific challenges.

In addition to the conceptual foundations section, this report is organized into eleven sections, each dedicated to a specific urban greening intervention or action. These are arranged by scale, from city-wide strategies to the building-level solutions, as illustrated in the diagram that follows:

- Conceptual Foundations
- Planning Green Urban Infrastructure
- Afforestation
- Greening the Suburban Areas
- Forest Within the City
- Urban Parks Management and Development
- Greening Polluted Areas and Deindustrialized Brownfields
- Vertical Farming
- Community Gardening
- Development and Management of the Neighborhood Parks
- Tactical Urbanism Greening Interventions
- Building-Scale Greening

However, these categories are not clearly delineated, and the boundaries between them are blurred, so the types are often overlapped. For example, some interventions that are a part of greening the suburban areas can also be community-based and can be considered as community gardens. Moreover, some afforestation projects are part of planning green urban infrastructure as a national program.

Structure

The report begins with Section 1, which provides a conceptual foundation by defining urban greening, illustrating its various categories, highlighting its benefits, and explaining the role of local authorities and municipalities in facilitating urban greening initiatives. This introductory section is followed by eleven subsequent sections, each focusing on a specific type of urban greening. These sections systematically present the definition, benefits, and types, supported by six illustrative case examples. From these examples, insights are drawn regarding the roles of municipalities and local authorities, with a focus on institutional, strategic, and operational aspects. The report concludes with a final section that synthesizes the Lessons Learned through a discussion and presents recommendations, evidence-based strategies and overarching conclusions.

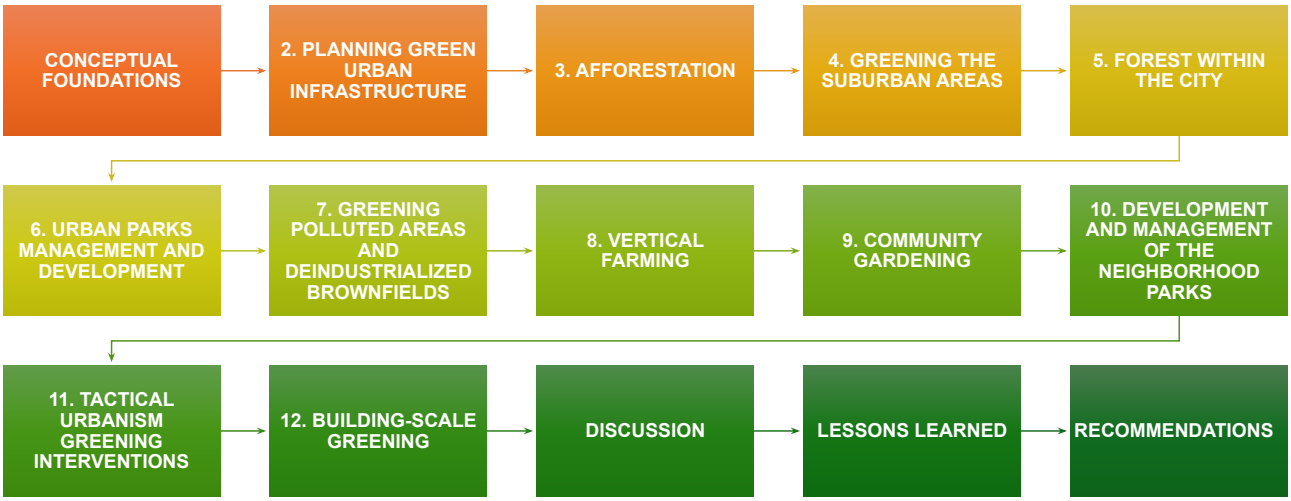

Figure 5: The structure, from conceptual foundation, to examples and then conclusions

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1



CONCEPTUAL FOUNDATIONS

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CONCEPTUAL FOUNDATIONS

Urban Greening is the process of increasing the vegetation cover and integrating green areas and features into the urban context, such as streets and roofs. Additionally, the urban greening definition also includes the maintenance of the green spaces and green infrastructure in the cities and urban contexts (UCEM, 2024). So urban greening mainly refers to interventions and actions. Moreover, urban greening is defined by the journal of Urban Forestry and Urban Greening as "the planning and management of all urban vegetation to create or add value to the local community in an urban area" (Konijnendijk & Randrup, 2002).

1.1 Why Cities Target Urban Greening?

To be able to answer this question, the coming parts will illustrate that cities target urban greening interventions for various reasons, including environmental, economic and social. Environmental concerns include climate change mitigation, pollution reduction, mitigating flood risks, and improving biodiversity. While the social concerns focus on improving physical and mental health, social cohesion and social interaction, and empowering the local community. Moreover, the economic concerns mainly include real estate added Value, supporting food security, and job opportunities, as well as saving resources.

1.2 Urban Greening: Environmental Concerns

1.2.1 Climate Change Mitigation

Many urban greening interventions are developed in order to address environmental challenges as their main goals, as they help the locals to get access to nature within the dense cities. Urban greening actions such as afforestation and urban forestry, explained in detail in Sections 3 and 5, are specifically designed with climate change mitigation as their primary objective. As they help a lot in cooling and mitigating the effects of the increasing temperature resulting from the global climate change and the urban heat island effect (UCEM, 2024; Bowler et al., 2010). Average-sized green areas (50 hectares = 500,000 square meters) can reduce temperatures by 1.5 to 3.0 °C (Huang, Cui, and He, 2018), for example, urban parks, illustrated in detail in Section 6. Additionally, strategic policies and laws regarding green infrastructure and greening the suburbs aim to preserve and expand green spaces to enhance their role in mitigating climate change, as shown in Sections 2 and 4.

1.2.2 Pollution Reduction

Urban greening interventions can be used to reduce pollution by filtering air, soil and water and help in offsetting the carbon emissions, for example, by greening the polluted areas, including former factories and landfills, as illustrated in detail in Section 7. According to the US Forest Service in the department of agriculture, over 48 pounds (about 21.8 kilograms) of carbon dioxide may be absorbed by a mature living tree in a single year (Androff, 2021). So urban greening actions such as afforestation and urban forests aim to increase the trees in the urban context, as explained in Sections 3 and 5. Studies indicate that greening 35% of the metropolitan area in the EU, which ismore than 26,000 square kilometers, might prevent greenhouse gas emissions of up to 55.8 million tons in a year. (Joint Research Centre, European Commission, et al. 2019). Additionally, green spaces can help to reduce noise pollution coming from vehicles and traffic in the urban context (UCEM 2024; Bowler et al., 2010). Sections 2 and 4 delve deeper into strategic interventions and policies encouraging green spaces for pollution reduction.

1.2.3 Mitigating Flood Risks

Moreover, urban greening interventions can also be created in order to reduce the flood risks as the main concern, such as the urban greening interventions in Asia. The green spaces can be used to intercept and slow down rainwater before it enters waterways and sewage systems (UCEM, 2024). Green infrastructure could lower urban runoff by around 17.5%, lowering the chance of floods (Quaranta, Dorati, & Pistocchi, 2021). For example, the Chulalongkorn University (CU) Centenary Park in Bangkok, Thailand, is mainly implemented to assist in minimizing urban flood risks through different ecological design components, which are illustrated in detail in Section 6.

1.2.4 Promoting Biodiversity & Preventing Desertification

Furthermore, urban greening interventions can be used to support the biodiversity in cities by creating habitats for various species, such as bees and birds. Connected green spaces, including green corridors and urban parks, illustrated in Section 6, enable species to travel and migrate more easily, which improves urban ecology (Berthon, Thomas, & Bekessy, 2021; Beumer, 2014). On the other hand, despite the small areas of the neighborhood parks of less than 0.25 acres, they also contribute to promoting biodiversity within the neighborhood, as shown in the example of the garden of butterflies in Poland, explained in detail in Section 10. Moreover, urban greening interventions such as afforestation, illustrated in Section 3, contribute to preventing desertification through improving the soil health and promoting biodiversity.

1.3 Urban Greening as Local Community Development

Some urban greening actions are created with the main goal to assist in improving the quality of life for the urban dwellers through the connection with nature, green spaces that encourage behavior change and good physical and mental health, and providing spaces for social interaction and social cohesion.

1.3.1 Physical and Mental Health

According to the World Health Organization (WHO), access to green space within 300 meters of homes is advised as a way to

support both mental and physical health outcomes (World Health Organization [WHO] et al., 2017). Safe, accessible green spaces within the city have a lot of positive influences on physical health through direct and indirect ways. As urban greening actions help to reduce air pollution, perceived noise and heat, numerous health consequences, including cancer, diabetes, cardiovascular disease, and neurodevelopmental impacts, are directly linked to these environmental factors. Additionally, the cooling effect of trees and green areas decreases the negative health effects of urban heat islands, especially mortality (WHO et al., 2023). According to recent studies, spending at least 120 minutes a week in natural settings is linked with noticeably improved health and well-being (Pearce et al., 2022).

In addition to these direct advantages, parks and other green areas promote physical exercise, which has indirect positive effects on physical health (Pearce et al., 2022; Smith et al., 2016). Participating in physical activity and spending time in natural settings are dependent on personal preference and behavior; the more active behavior that occurs via exercise, the more opportunities there are to fully use access to natural settings (WHO et al., 2023). Regarding the impact of urban greening interventions on mental health, based on many various studies, urban green and blue spaces have been shown to improve mental well-being, prevent poor mental health, and serve as venues for behavioral therapy or nature-based wellness programs (White et al., 2021; Vert et al., 2020; WHO, 2021; Britton et al., 2020).

These mental health benefits are not only for the whole population but also for specific age groups to fulfill their needs, such as children or elders (WHO et al., 2023). Childhood nature exposure has an impact on subsequent mental health and well-being (Engemann et al., 2020), for example, in playgrounds in the neighborhood gardens, as shown in Section 10. The following are many ways that urban green areas may improve psychological and mental health: reducing negative effects, like noise annoyance; facilitating the development of positive traits, like social interaction and physical activity; and restoring positive traits, like stress recovery and cognitive restoration, including enhanced working memory, focused attention, and cognitive flexibility (Dzhambov and Dimitrova, 2014; Brito et al., 2022; Mygind et al., 2021; Stevenson, Schilhab, & Bentsen, 2018).

1.3.2 Social Cohesion and Social Interaction

Urban greening interventions have a lot of social benefits that focus on enhancing the quality of life and providing spaces for social interaction and social cohesion, as they can promote a sense of community and belonging (WHO et al., 2023; Francis et al., 2012) Neighborhood parks, illustrated in Section 10, provide a communal space for all the people from different age groups, such as children and elders, through playgrounds and seating areas. The community gardens also provide an opportunity for the community to socialize and communicate through participation in the gardening activities, as explained in detail in Section 9. Additionally, community gardens and neighborhood parks

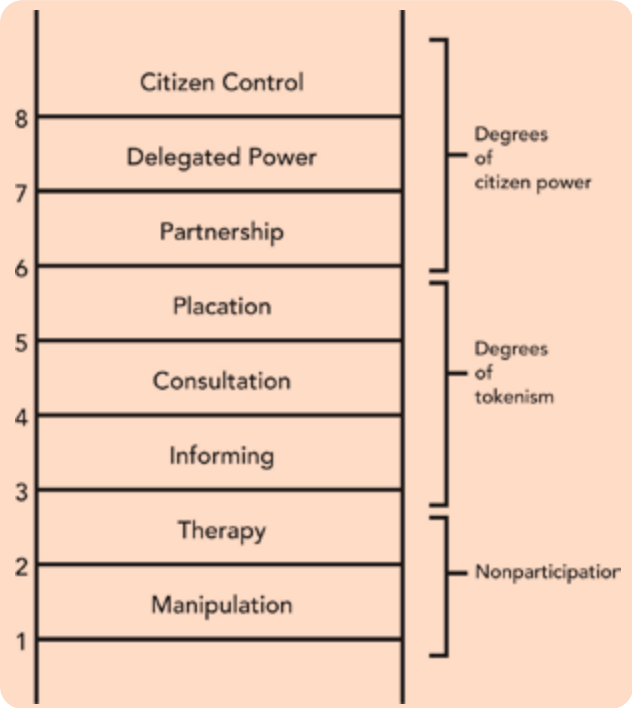


Figure 1.1: A ladder of citizen participation
© Arnstein, 2019

provide a chance for raising awareness and knowledge exchange between the people through organized educational programs or knowledge exchange between the different participants.

1.3.3 Empowering Local Community

Urban greening interventions can contribute to local community empowerment through community engagement in the decision-making process and the participatory approach through the various stages of implementation. Some types of urban greening interventions focus on community engagement and participation as their main concern; for example, community gardens and the tactical green interventions illustrated in detail in Sections 9 and 11. There are eight levels of participation, arranged in a ladder hierarchical framework, to analyze the various degrees of citizen involvement in decision-making processes within the urban greening interventions, as shown in Figure 1.1.

- The lowest stages, Manipulation and Therapy, are intended to create the illusion of involvement, so they don't include any meaningful participatory ways to involve the community in the decision-making (Arnstein, 2019). That is applied in the top-down approach that is usually adopted by the local authorities in mega projects such as afforestation and urban parks, explained in Sections 3 and 6.

- Tolerance: The intermediate rungs, Informing and Consultation, enable residents to voice their views and receive information. However, these levels lack procedures to guarantee that their advice is acted upon, allowing powerholders to retain control and sustain the status quo. Placation is a somewhat more advanced version of tokenism in which citizens can offer advice, but power holders maintain final decisions (Arnstein, 2019).

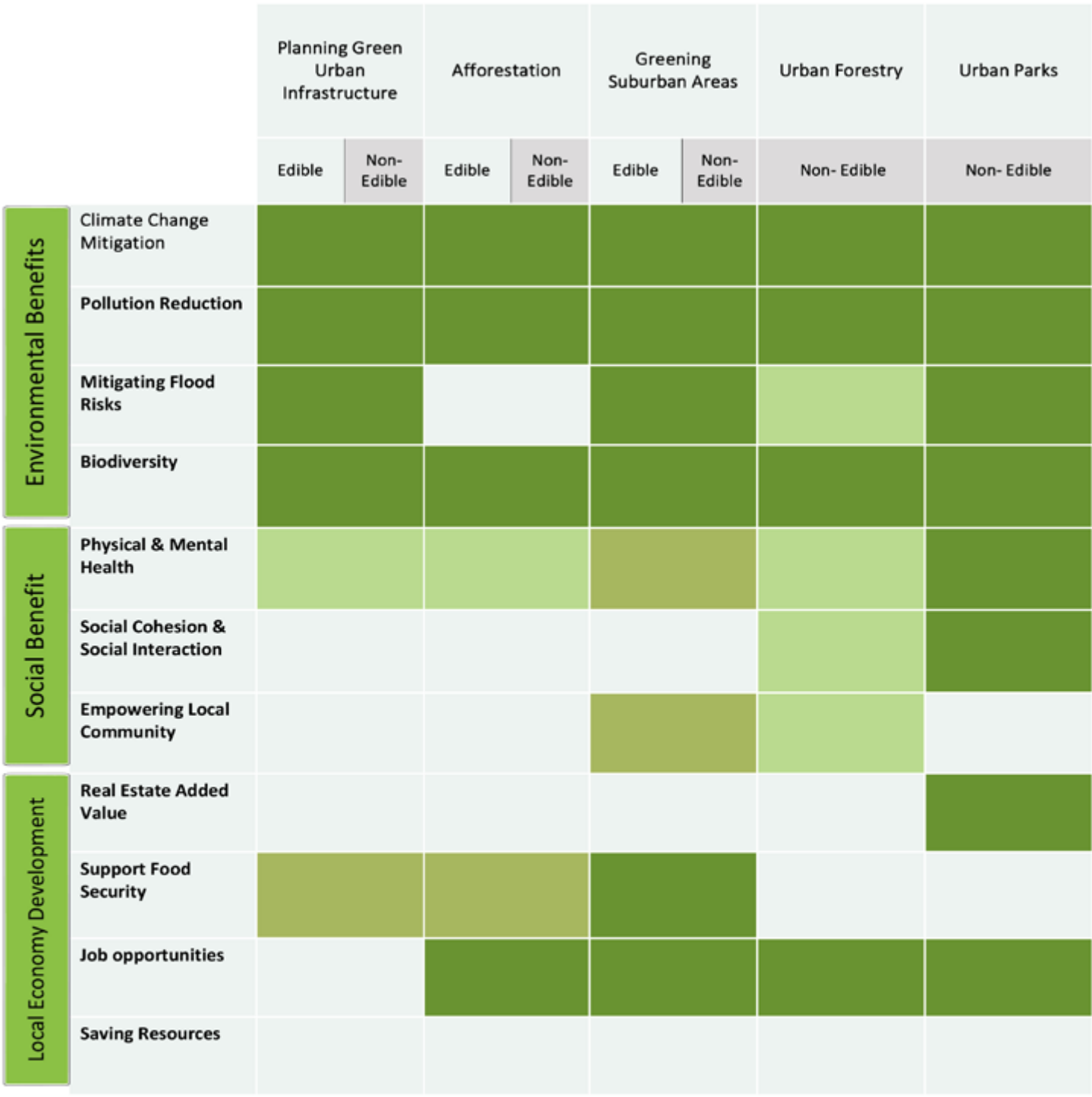
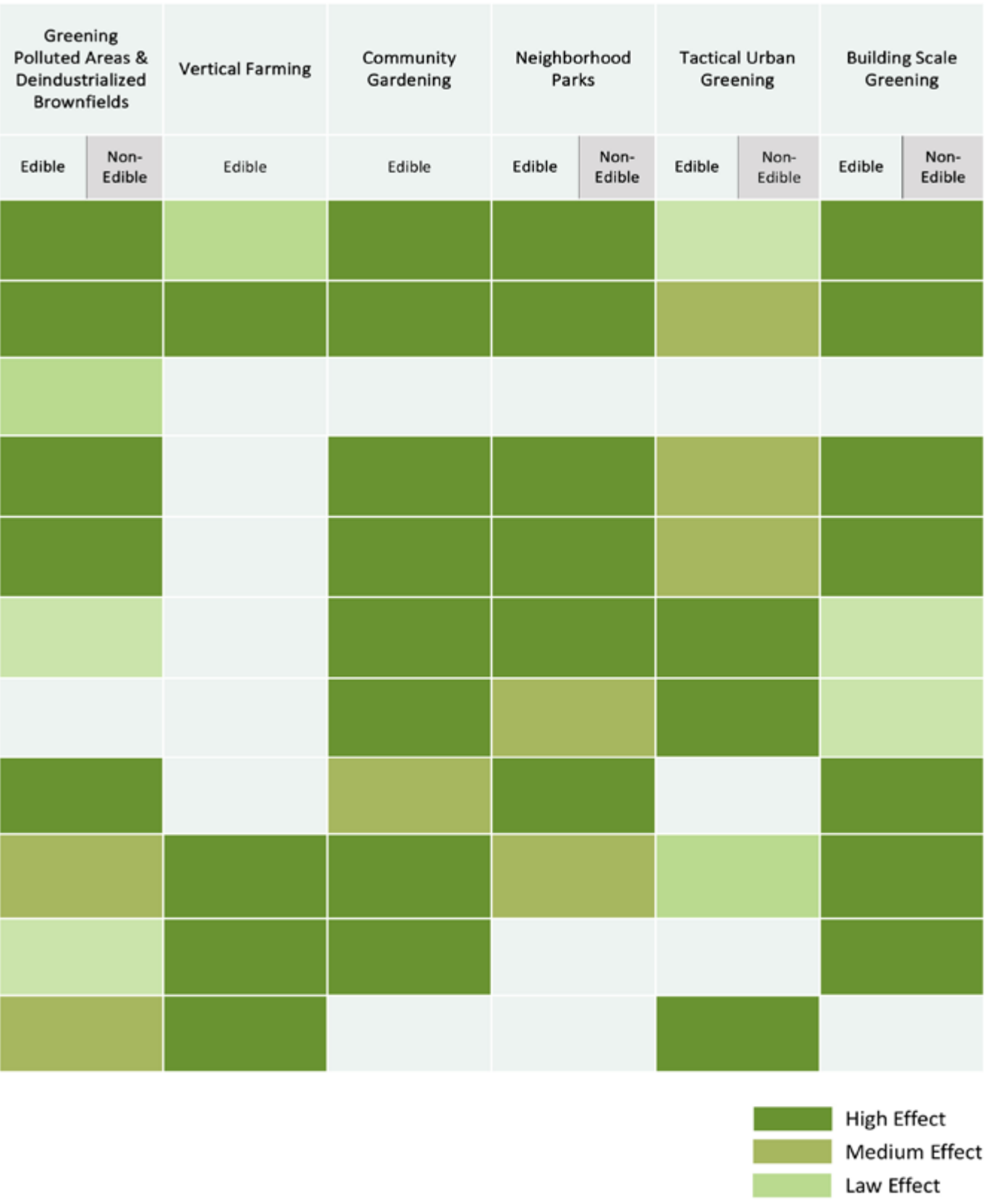


Figure 1.2: Matrix of the different urban greening types and the environmental, social and economic benefits
© Author, 2024


Greening Polluted Areas & Deindustrialized Brownfields
Vertical Farming
Community Gardening
Neighborhood Parks
Tactical Urban Greening
Building Scale Greening
Edible
Non-Edible
Edible
Edible
Edible
Non-Edible
Edible
Non-Edible
Edible
Non-Edible
High Effect
Medium Effect
Law Effect

- Citizen Power: Higher rungs represent genuine empowerment. In a partnership, individuals share decision-making authority and negotiate with conventional authorities. At the top, Delegated Power and Citizen Control provide citizens with majority decision-making ability or complete control over governance. (Arnstein, 2019) Those high levels of community involvement become the main concern of some urban greening interventions, such as community gardens and the tactical interventions as shown in Sections 9 and 11, as they are usually suggested, initiated and operated by the community members.

Additionally, the local community can also influence the decision-making process in other urban greening interventions, for example, Parque La Mexicana in Mexico, explained in detail in Section 6 of urban parks, and the community-supported agriculture examples, the Zenger Farm in the USA and the Bauerngarten in Germany, illustrated in detail in Section 4 of greening the Suburbs. Moreover, other urban greening actions could begin as a local community grassroots initiative, such as the Nanalal Mehta Garden in India, illustrated in detail in Section 10 of the neighborhood park; however, in these cases, the local community needs to get support from the local authority to be able to implement the proposed urban greening intervention.

1.4 Urban Greening as Local Economy Development

1.4.1 Real Estate Added Value

Some urban greening interventions have many social and economic benefits, includingenhancing quality of life and increasing real estate value. Urban residents, in their search for a better living environment, highly value the availability and accessibility of green spaces near their homes. Areas close to parks, urban forests, and other green spaces are more desirable because they provide recreational opportunities and environmental advantages while improving visual appeal. Additionally, numerous studies demonstrate that environmental factors can increase real estate prices, with estimates ranging from a modest 2% to a significant 62% (Szczepańska, Krzywnicka, & Lemański, 2016; Yoshida & Sugiura, 2015).

Urban parks, as discussed in Section 6, play an important role in increasing the property value of surrounding residential areas. This rise is largely attributed to the aesthetic appeal and contribution to residents' overall quality of life. Additionally, the urban parks can also be considered valuable real estate assets in their own right. Beyond serving as public amenities, they hold intrinsic economic importance by attracting visitors and supporting local businesses. Furthermore, they are becoming increasingly attractive to the private sector for management and maintenance, as they can generate revenue through event hosting, concessions, recreational services, and branding possibilities. This creates a mutually beneficial relationship in which the private sector gains financial returns while helping maintain park functionality, thereby reducing municipal financial burdens.

A similar effect may be seen with community gardens and neighborhood parks, as discussed in Sections 9 and 10 on a smaller scale. These green areas enhance property values by improving neighborhood aesthetics and fostering a sense of community. Their presence improves quality of life and neighborhood desirability, therebyattracting residents and potential buyers. However, these types of green spaces face a major challenge which is the scarcity of accessible vacant land in densely populated urban areas. The lack of suitable open land for conversion into parks or gardens necessitates innovative approaches to urban design and land use.

High real estate prices further exacerbate the problem by raising the cost of implementation and imposing additional financial pressure on local governments responsible for development and maintenance. Incorporating green architectural elements such as green roofs and living walls, as discussed in Section 12, also significantly increases the property value. This increase is due not only to the high execution cost but also to their aesthetic contribution and integration into the urban landscape. These features enhance architectural distinctiveness while reflecting evolving environmental and lifestyle preferences, making such properties more appealing to potential buyers or tenants.

1.4.2 Support Food Security

Food security is defined as "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2008). And there are different dimensions of food security, including availability, accessibility, utilization, stability, sustainability and agency (HLPE 15, 2020). Some urban greening types prioritize food production, contributing to one or more dimensions of food security.

For example, greening the suburbs aims to support and protect agricultural activities in the suburbs through local policies and government assistance, as discussed in Section 4. Meanwhile, vertical farming techniques, highlighted in Section 8, focus on high-tech, resource-efficient methods like saving water and soil to achieve massive food production, often driven by private sector investments. Additionally, community gardens emphasize smaller-scale food production, benefiting participants by providing locally grown products, as illustrated in Section 9.

1.4.3 Job Opportunities

Some urban greening interventions focus on providing job opportunities for the local communities, such as the urban parks with their facilities, explained in Section 6. Additionally, the vertical farming techniques illustrated in Section 8 also help in providing job opportunities for the local community, such as the example of AquaFarms Africa in Guinea. Moreover, the Manguinhos Garden in Rio de Janeiro in Brazil, as one of the community garden projects, aims to employ over 20 local workers, as explained in Section 9. Furthermore, some green roof projects that focus on food production, such as rooftop farming refugee camps in Lebanon, seek to create work possibilities for refugees, as illustrated in detail in Section 12.

1.4.4 Saving Resources

Certain urban greening interventions may not directly contribute to the development of the local economy; however, they play a significant role in saving resources. For instance, vertical farming techniques demonstrate efficient resource utilization by requiring significantly less water, soil, and other inputs compared to conventional agricultural practices, as discussed in detail in Section 8.

1.5 The Advantages of Urban Greening Interventions

As highlighted earlier, the advantages of urban greening interventions deeply interfered, creating a cascading impact on various aspects of urban life: environment, social life, and economic development. For instance, these interventions significantly contribute to the reduction of pollutants in the air and soil by acting as natural filters. As trees, shrubs, and green spaces absorb harmful substances such as carbon dioxide, they thereby improve overall environmental quality. This reduction in pollution directly impacts the mental and physical health of urban residents. This connection emphasizes the several benefits of incorporating green infrastructure into urban design and development.

The figure 1.2 illustrates the diverse ways in which different types of urban greening contribute to the environment as well as to the social and economic progress of local communities. However, data shows that the scale of urban greening projects has a considerable impact on their principal advantages. When urban greening projects are implemented on a citywide basis, they tend to focus on environmental benefits such as improving air quality, minimizing the urban heat island effect, and promoting biodiversity. This comprehensive strategy focuses on tackling ecological issues that affect the entire metropolitan environment, for example, the planning for urban greening interventions and the afforestation.

In contrast, when urban greening activities are focused at the neighborhood or building level, the emphasis switches to social advantages. Furthermore, these localized solutions, such as community gardens and neighborhood parks, promote greater social interaction and increase inhabitants' quality of life. They provide accessible recreational places and enhance social cohesiveness, ultimately benefiting both individual well-being and community development, while still having environmental benefits, but not as their main focus.

This distinction emphasizes the significance of customizing urban greening solutions to the unique demands and scales of implementation in order to optimize the numerous advantages. Certain urban greening projects, such as vertical farming and community gardens, have a strong emphasis on edible plant cultivation and food production. Other interventions, such as urban forestry, are entirely non-edible. Furthermore, some programs include edible and non-edible components, as seen in neighborhood parks and afforestation activities. Besides the high effects of the urban greening interventions on certain environmental, social, and economic benefits, they still have low and medium effects on other benefits as indirect effects. This matrix is based on the literature and the examples illustrated in the next sections.

1.6 Municipalities and Urban Greening

Local authorities and municipalities are pivotal in implementing urban greening interventions, serving as the government's local representatives, and they are key players in the urban development process, with the power and interest to influence urban development and shape the local context of the cities. Their capacity to impact urban greening initiatives becomes even more pronounced in systems of decentralization. Decentralization entails shifting management away from a single center and giving local governments greater power in the decision-making process (Masuanganhe, 2005). Their role in supporting the urban greening projects can be divided into three different levels: institutional, strategic, and operational.

- **Institutional level:** is the middle layer between the high level of strategic objectives and the daily operational level. It includes the structures, roles, and responsibilities assigned to various entities within the local government framework. The aim of this level is to confirm that organizational plans and policies are successfully and appropriately carried out. So their tasks include allocating resources, establishing departmental goals, and overseeing teams (Aurora Training, 2023; American Management Association, 2023). Additionally, they focus on regular communication and collaboration, and they play a significant role in training and capacity building for the employees and raising awareness campaigns for the local community.

- **Strategic level:** through setting an ambitious vision with long-term goals and objectives to achieve in the future. Urban greening actions can be implemented on a strategic level through different methods, including strategies, laws, regulations, policies, programs and plans that guarantee the inclusion of green infrastructure in the urban planning of the cities, encourage the creation of various urban greening interventions, or protect the existing urban greening interventions, especially in the suburbs. That is illustrated in detail in Sections 2 and 4: planning green urban infrastructure and greening the suburban areas. Moreover, some of those policies and programs used to be tested in the streets and with the people through tactical interventions that are illustrated in detail in Section 11.

There are different levels that can be adopted to support the urban greening interventions (bsp, 2024):

- **Strategy:** a high-level approach in order to achieve long-term goals aimed at shaping the future of the urban areas.

- **Policy:** a vision with a set of governing principles, guidelines, regulations, and traditions that govern choices and behaviors.

- **Program:** a continuous cycle of actions that accomplish strategic goals and carry out policy. They are made up of several procedures and initiatives that are coordinated to accomplish long-term objectives.

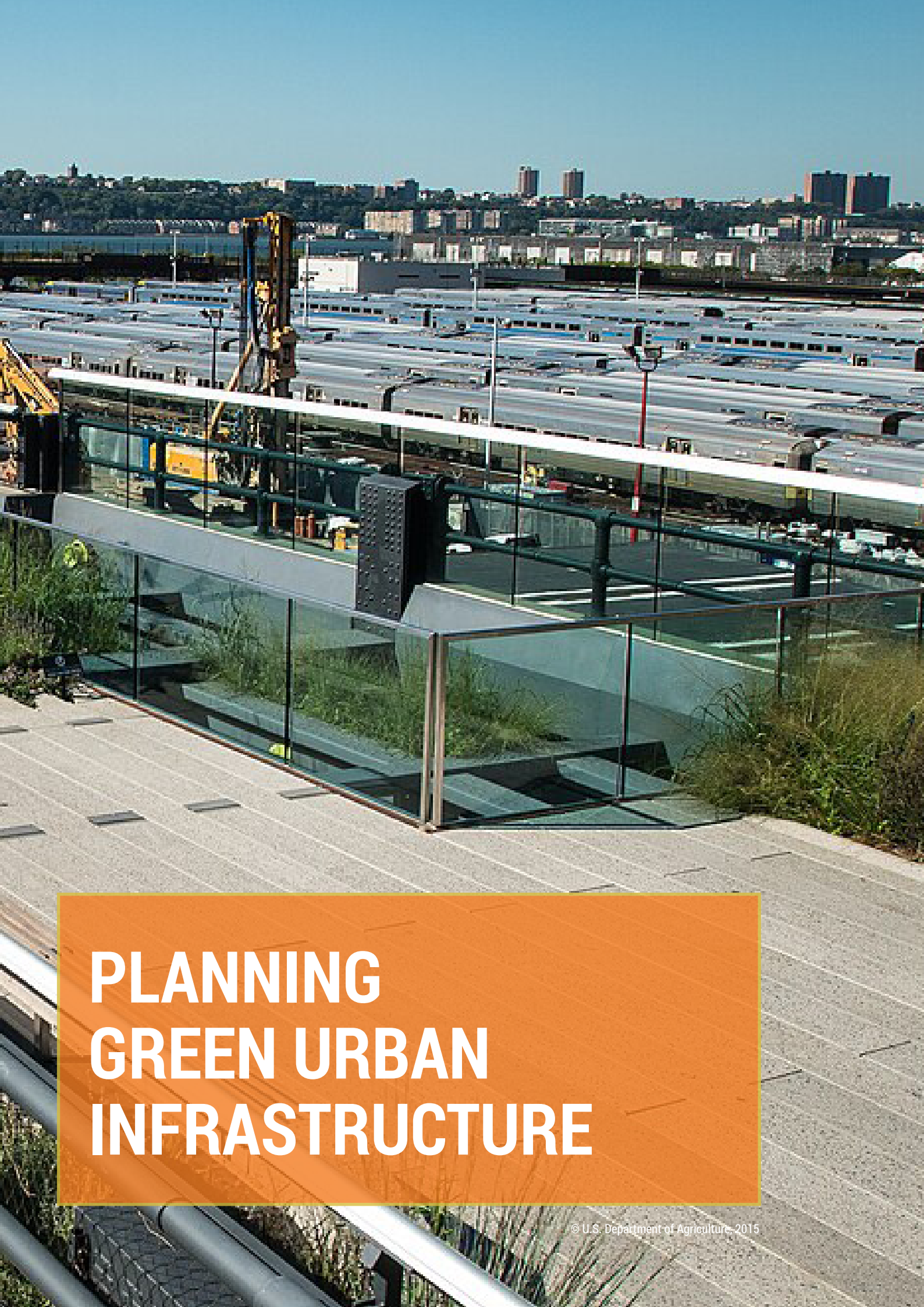
- **Plan:** a detailed proposal to reach determined goals or objectives. They outline the steps and resources required to reach a desired outcome. That can include a clear master plan with proposed land use.

While strategies are typically established by the national government at a higher level than local authorities, local authorities and municipalities have their own methods to align with these national strategies. Additionally, local authorities and municipalities can develop their own strategies based on funding priorities. They can support specific policies, develop programs and plans that target green infrastructure focus on particular types of urban greening initiatives.

- **Operational level:** It is short-term management that focuses on the daily activities and processes needed to achieve the long-term strategies and policies set at the higher levels. To reach immediate goals, actions must be completed, resources managed, and processes followed. Operational management guarantees that the organization's everyday operations are carried out efficiently and effectively (Future Cio Club, 2022).



2



PLANNING GREEN URBAN INFRASTRUCTURE

© U.S. Department of Agriculture, 2015

PLANNING GREEN URBAN INFRASTRUCTURE

Green infrastructure is defined as "an interconnected network of natural and designed landscape components, including water bodies and green and open spaces" (Lamond & Everett, 2019). It can also be defined as a strategically planned network of high-quality natural and semi-natural areas, together with other environmental features, that is created and managed to provide a variety of ecosystem services and safeguard biodiversity in both rural and urban contexts (European Commission, 2013). Green infrastructure plays a significant role in supporting biodiversity while offering a wide range of ecosystem services, including water purification, air quality improvement, recreational opportunities, and contributions to climate change mitigation and adaptation. By integrating green (terrestrial) and blue (aquatic) spaces, such networks enhance environmental quality, promote the connectivity and resilience of natural habitats, and improve public health and overall quality of life. Additionally, the development of green infrastructure supports the growth of a green economy, fostering job creation and sustainable economic opportunities (European Commission, 2013).

2.1 Types of Governmental Planning Efforts

As mentioned before in Section 1, there are different levels of governmental planning efforts regarding green infrastructure.

- **Regulatory:** focus on mandating the integration or protection of green infrastructure in urban planning and development.
- **Incentive-Based:** motivate the voluntary implementation of green infrastructure via financial or non-financial incentives such as grants and tax rebates.
- **Environmental Conservation:** seeks to preserve and restore natural ecosystems in urban settings.
- **Planning and Design:** include green infrastructure in urban planning procedures.

Some initiatives generally focus on green infrastructure, while others target specific types of interventions, such as the city of San Francisco's Permanent Parklet Program(San Francisco Planning Department, 2021), as discussed in Section 11 on tactical greening interventions, and the Berliner Community Gardens Program, of which Prinzessinnengarten community garden, illustrated in Section 9, is part (Bezirksamt Friedrichshain-Kreuzberg, 2020). Furthermore, planning green urban infrastructure can operate at multiple governance levels. At the regional scale, for instance, the European Union's Green Infrastructure Strategy (European Commission, 2013) provides a framework for member states. At the national level, policies such as Singapore's Green Plan 2030 outline strategies applicable across the entire country (Government of Singapore, 2021). Additionally, green infrastructure initiatives can be localized at the municipal level, focusing on specific urban areas or cities. The following examples focus on such localized approaches.

2.2 Examples

(Senatsverwaltung für Stadtentwicklung und Umwelt 2014)

2.2.1 Berlin Urban Landscape Strategy, Germany

Location: Berlin, Germany
Date: 2014 - ongoing
Aim: Promote green areas in densely built urban areas.

Although Berlin is one of the few metropolises that have a high percentage of urban greenery, as around 44% of Berlin's land area is green open spaces, there is still a need for the development of those green open spaces in a socially and environmentally responsible manner. Between 2012 and 2017, around ten million euros were used in the implementation of the Berlin Urban Landscape Strategy. Its main goal is to enhance the current green space's structure and maximize its strengths through three themes: beautiful city, productive landscape, and urban nature. The first theme, "beautiful city", mainly focuses on the city's horticultural inheritance through the Historic parks, urban squares, tree-lined promenades, and the recreation areas. The second theme, "productive landscape", includes agriculture, allotments, the start-ups, and subsistence farming. And the third theme, "urban nature", emphasizes the integration of natural features into the urban environment.

For more information: https://www.berlin.de/sen/uvk/natur-und-gruen/landschaftsplanung/strategie-stadtlandschaft/

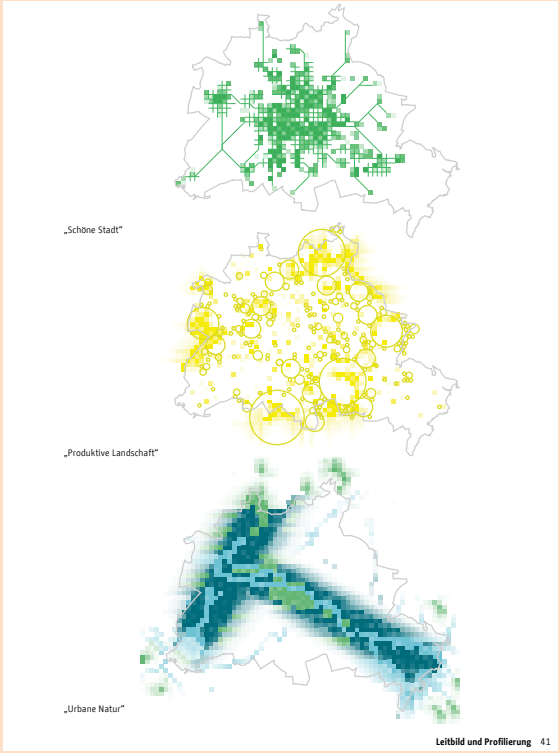


Figure 2.1: The Berlin Urban Landscape Strategy
© Senate of Berlin, 2014

2.2.2 Eco-Roof Incentive Program, Canada

Location: Toronto, Canada
Date: 2009 - ongoing
Aim: Encourage the establishment of green roofs through incentives.

In 2009, the City of Toronto introduced the Eco-Roof Incentive Program to encourage building owners to install eco-roofs, make buildings more sustainable, and create green employment. The program provides grant funds to building owners for the installation of innovative roofing materials that give environmental advantages while also building resilience, such as green roofs with live plants and cool roofs that reflect solar heat. The Eco-Roof Incentive Program offers funding for green roof installations on existing and new residential, industrial, commercial, and institutional structures with gross floor areas less than 2,000 square meters and new and existing Toronto public and separate school board buildings of any size. Qualified green roof projects can receive $75 per square meter, with a maximum of $100,000. To qualify for the Eco-Roof Incentive Program, a green roof must satisfy the following requirements: Being planned, erected, and maintained in accordance with the Toronto Green Roof Construction Standard, having a minimum covering of available roof area ranging from 20 to 60%, depending on the size of the structure. Since 2009, the Eco-Roof Incentive Program has financed the installation of 627 eco-roof projects, resulting in almost 1.14 million square meters of eco-roof area.



Figure 2.2: Eco-Roof Incentive Programin Toronto
© City of Toronto, 2017

For more information:
https://www.toronto.ca/services-payments/water-environment/green-your-roof/
https://www.c40.org/case-studies/toronto-s-eco-roof-incentive-program/

2.2.3 The Cloudburst Management Plan, Denmark

Location: Copenhagen, Denmark
Date: 2012 - ongoing
Aim: Mitigate flooding risks and adapt to climate change by creating green spaces

The Cloudburst Management Plan is a citywide strategy for coping with heavy rainfall occurrences. The City of Copenhagen, Denmark, approved the strategy in 2012 to supplement the Copenhagen Climate Adaptation Plan, which had been established the previous year. The Cloudburst Management Plan aims to mitigate the effect of flood events caused by torrential rains, which are predicted to become more frequent as a result of climate change. As part of the plan, two master plan options were created to evaluate expenses as well as the possible benefits and drawbacks of various alternatives. The Blue-Green Masterplan option emphasized the possibility of nature-based solutions for storing or draining surplus water at ground level, such as building new canals or creating lakes and green areas. The Blue-Green Masterplan has proven to be much more cost-effective, even without accounting for extra qualitative societal advantages such as improved health, environmental, and urban spatial quality. The targeted (peri-)urban areas include parks and semi-natural urban green areas, blue areas, green areas for water management, and urban green space connected to grey infrastructure.



Figure 2.3: The Cloudburst Management Plan
© Atelier Dreiseitl, 2023

For more information:
https://interlace-hub.com/cloudburst-management-plan-copenhagen

2.2.4 Greening Sydney Plan, Australia

Location: Sydney, Australia
Date: 2017-ongoing
Aim: increasing the quality and quantity of green areas

The Greening Sydney Plan was approved by the City of Sydney in March 2017 to support the Environmental Action 2016-2021 strategy and action plan, and it was updated in 2021.

The city has implemented urban greening programs and actions through this plan, which is a part of the Sustainable Sydney 2030 strategy, which aims to make the city more livable, green, and connected.

The Greening Sydney Plan aims to achieve a livable green city by increasing the quantity and quality of green areas and landscape amenities around the city in order to boost urban resilience, biodiversity, and climate change mitigation.

These possibilities will be available on both public and private property, with the goal of empowering the community to help deliver greening projects.

The plan focused on a vision that included expanding the urban forests, greening the streets, creating more parks and open spaces, greening new development and private land, creating green links and urban wildlife corridors, and empowering the community to green the city. The focus areas of this plan are:

- Urban canopy: focusing on developing the urban forest in the city through programs such as urban forestry policy, street tree planting, and tree protection. Their goal is to increase urban canopy by 50% in 2030, and 75% in 2050

- Urban ecology: focusing on greening to promote biodiversity, through programs such as urban ecology survey and action plan

- Public domain: focusing on greening to provide streetscape and public spaces through programs such as public domain landscaping, living colour, and wellness walks. Moreover, this also focuses on arterial transport and utility corridors through programs such as Landscaping of rail corridors, landscaping of arterial roads, and landscaping of utility corridors.

- New development that focused on guiding developers for more greening and landscapes in their new development and privately owned land through programs such as landscape code, which develops a policy of minimum targets of landscape in private spaces, green roofs policy, and Sydney DCP.

- Community greening: focusing on empowering the community to green the city through programs such as community gardens, sustainability and education, streetscape greening policy, community landscaping, tree donation policy, community greening grants, community engagement and recognition programs, and green volunteer network programs.



Figure 2.4: Canopy areas in Sydney
© City of Sydney, 2012

Each program mentioned in this plan has its own actions and action plan.

For more information:
https://greenroofsaustralasia.com.au/sites/GreeningSydneyPlan_CoS.pdf

2.2.5 The Sponge City Policy, China

Location: Shenzhen, China
Date: 2014 - ongoing
Aim: solve urban floods through increasing green areas

The Sponge City Policy in Shenzhen is part of a larger national strategy announced by the Chinese government in 2014 to solve catastrophic urban floods, water scarcity, and environmental degradation in fast-urbanizing areas. The policy in Shenzhen uses the urban living lab model to test innovative green infrastructure solutions for flood mitigation. Shenzhen was chosen because of its fast urbanization, frequent floods, and urgent need for sustainable water management. Since 2016, Shenzhen has implemented a number of various projects to promote the sponge city idea, such as permeable surfaces, green roofs and walls, constructed wetlands and retention ponds, rain gardens and bioswales in parks. Shenzhen has completed 1,361 projects, with the newly built-up sponge city area of 276 square meters; within these projects, they used different models such as the Public Private Partnership (PPP). Shenzhen ranked first among 14 sponge city initiatives in 2019.

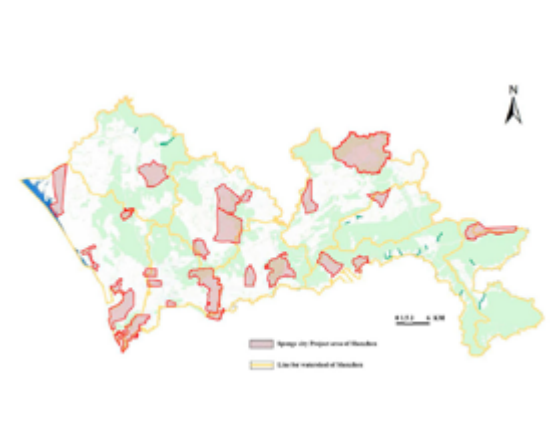


Figure 2.5: The Sponge city project areas within Shenzhen watersheds in China

© Wang, Jiang, & Zhang, 2022

For more information:
https://www.frontiersin.org/journals/environmental-science/articles/10.3389/
https://www.lincolninst.edu/sponge-city-shenzhen-explores-benefits-designing-with-nature/

2.2.6 Green Infrastructure Plan for Private Property, USA

Location: Richmond, Virginia, USA
Date: 2019 - ongoing
Aim: promote green infrastructure on private residential properties

The Green Infrastructure Plan for Private Property is a comprehensive plan developed for the City of Richmond's Department of Public Utilities in 2019 to encourage green infrastructure on private residential properties as an extension of the green infrastructure master plan that focused on city-owned public properties. The plan aimed to promote privately held green infrastructure, and it outlined ways to expand the use of green infrastructure, which replicates natural processes to efficiently manage stormwater, including rain gardens, green roofs, and permeable pavements. In addition to the measures that the city department of utilities can use to raise public awareness and participatory engagement in residential green infrastructure implementation, this plan offers possible financing sources for future green infrastructure programs, as well as zones of opportunity for green infrastructure and green investments.



Figure 2.6: Example of residential green infrastructure implementation in Richmond, Virginia

© Green Infrastructure Center, 2021

For more information:
https://scholarscompass.vcu.edu/murp_capstone/48/
https://core.ac.uk/reader/475368930
https://scholarscompass.vcu.edu/cgi/viewcontent.cgi?article=1051&context=murp_capstone

2.3 The Findings

Institutional level

Establishing the institutions and structures required to successfully execute green infrastructure programs is a significant responsibility of local governments.

- **Creating regulatory frameworks:** Governments have the power to enact legally enforceable laws that require the construction of green spaces in urban areas.

- **Collaboration and partnership with various sectors**, such as civil society, the private sector, and other governmental entities: The significance of multi-sectoral cooperation, including Public-Private Partnerships (PPPs), was illustrated by Shenzhen's Sponge City Initiative.

- **Providing financial and technical resources:** To promote the use of green infrastructure, especially on private properties, authorities must provide grants, financial assistance, and technical advice, such as the previous example of the green infrastructure initiative plan for private property in Virginia, USA.

Strategic Level

Long-term goals and plans for incorporating green infrastructure into private property development and urban planning must be established by local governments.

- **At the strategic level**, citywide strategy should ***align with national, regional and international strategies*** in order to collaborate with other cities within a network so the cities can learn from this network in various cases. For example, the Sponge City Initiative in Shenzhen is a part of a larger national strategy in China.

- **Creating a citywide strategy:** This entails formulating a particular green infrastructure plan with an emphasis on private properties. Green infrastructure should be viewed as an important tool for improving quality of life, urban resilience, and ecological services in the strategy.

- **Finding opportunity zones:** Zoning has been utilized by cities such as Richmond, Virginia, to identify places where investments in green infrastructure may have the biggest effects.

- **Aligning with more general urban and environmental objectives:** Sydney's Greening Sydney Plan, for instance, connects green infrastructure to the city's sustainability ambition, guaranteeing that such projects support climate resilience and general urban livability.

Operational level

At the operational level, local governments use direct action and community involvement to guarantee the effective execution of green infrastructure projects.

- **Participatory approaches:** It is essential to include local people in the planning and decision-making stages. In order to promote green infrastructure on private properties, Richmond's Green Infrastructure Plan places a strong emphasis on public knowledge and involvement. The MillionTreesNYC, USA, explained in detail in section 3, shows how the implementation of green infrastructure can include subcommittees from different actors.

- **Putting incentive schemes in place:** Financial incentives are one way that authorities might encourage private property owners. An excellent example is Toronto's Eco-Roof Incentive Program, which provides payments to homeowners for the building of green roofs.

- **Putting best practices and pilot projects into action:** Cities that have adopted nature-based solutions and urban greening initiatives, such as Sydney and Copenhagen (Cloudburst Management Plan), have shown how these strategies may lower flood risks and boost green cover.

- **Raising public awareness on green infrastructure benefits:** Awareness campaigns are essential for fostering community support and participation. Local governments can lead education programs, organize events, and collaborate with schools and NGOs to increase public understanding of the environmental, social, and economic value of green infrastructure.



3



AFFORESTATION

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AFFORESTATION

"Afforestation is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding, and/or the human-induced promotion of natural seed sources" (UNFCCC, 2008). So afforestation is the process of planting trees in regions that have not previously had any tree cover in order to establish a forest (Vartan, 2022). The term 'afforestation' is usually used to refer to the massive, large-scale greening process in the cities (Weeden, 2022). While the term "reforestation" refers to the process of restoring damaged forests (Weeden, 2022).

3.1 Benefits

Afforestation has a lot of environmental benefits, as its main goal is absorbing carbon dioxide (Weeden, 2022). It also increases the soil health and quality and helps to avoid desertification (Vartan, 2022). Moreover, it supports biodiversity and creates new habitats for wildlife (Weeden, 2022). It also helps in improving the air and water quality and creating windbreaks (Vartan, 2022). Moreover, it provides job opportunities and economic benefits for the local communities and for the business companies. As they benefit by obtaining wood and coal from trees, in addition to other products, they therefore provide job opportunities and strengthen the local economy (St. barbebaker, 2023). Additionally, some of the afforestation projects aim to produce food by planting trees with edible crops.

3.2 Types

There are three types of afforestation, as follows:

3.2.1 Natural Regeneration

Natural regeneration is defined as "the planting of native trees in an attempt to restore an area to what resembles a natural forest" (Vartan, 2022). Natural forests are the best at absorbing carbon and forming new habitats. Planted with a broader diversity of species, they have the possibility to one day become multi-dimensional forests that provide a home for a diverse range of animal species while also providing rich ecosystem services throughout time (Weeden, 2022).

3.2.2 Commercial Plantations

Commercial plantations are established to produce a specific commodity, such as wood or paper pulp. They can still store carbon but will ultimately be harvested. Depending on what is grown, the carbon might be released again (Weeden, 2022).

3.2.3 Agroforestry

Agroforestry is the practice of growing trees to produce crops such as cocoa, mangoes, avocados, almonds, and more. While carbon storage capacity varies by crop, this form of planting frequently offers a much-needed source of food and money for local populations and may be used to boost the carbon capacity of existing agricultural areas (Weeden, 2022).

3.3 Examples

3.3.1 MillionTreesNYC, USA

Location: New York City, USA
Date: 2007 - 2015
Aim: Creation of new green areas

MillionTreesNYC is an urban forest initiative launched in 2007 to plant and care for one million trees in New York City in a variety of locations, such as public housing complexes, schoolyards, and New York State property, spread around the five boroughs. It was a partnership between the City of New York Department of Parks & Recreation ("NYC Parks") and the not-for-profit New York Restoration Project (NYRP). The initiative was managed by the MillionTreesNYC Advisory Board to provide guidance to NYC Parks and NYRP employees on tree planting, education, stewardship, public policy, research and evaluation, and marketing. This advisory board is divided into seven subcommittees. Each subcommittee includes three co-chairs: one from NYC Parks, one from NYRP, and one from an independent agency or organization. Maintaining the recently planted trees and concentrating on outreach, education, and training was one of the main components of the initiative. The number of individuals that MillionTreesNYC contacts each year has been rising significantly, including additional partners, many volunteers, and nearly 50,000 New Yorkers who helped plant trees. A million trees had been planted throughout the city by the fall of 2015.



Figure 3.1: Trees planted since 2007 by the MillionTreesNYC
© McPhearson et al., 2010

For more information:
https://centreforpublicimpact.org/public-impact-fundamentals/milliontreesnyc-planting-and-tending-the-urban-forest/
https://www.nycgovparks.org/trees/milliontreesnyc

3.3.2 The Green River, Italy

Location: the abandoned railway, Milan, Italy
Area: 1,250,000 square meters
Date: 2017 (in planning stage) - ongoing
Aim: Creation of new green areas, Ecological restoration of ecosystems, Transformation of previously derelict areas

The Green River is an urban forestry project established as part of FS Sistemi Urbani's "Scali Milano" consultation in conjunction with the City of Milan and in accordance with the Agreement Programme. The project was ordered by the Ferrovie dello Stato, the railway firm partly controlled by the government. Architect Stefano Boeri and his design team aim to provide an integrated vision for the future of Milan's abandoned railway freight terminals by creating a continuous system of public parks, woods, oases, orchards, and gardens on 90% of the seven abandoned railways, connected by green corridors and bicycles built on the railroad tracks. The Green River runs through the city of Milan, bridging the gap between late-19th-century urban expansions, the Corpi Santi area, and early 20th-century suburbs. The project will also result in a new integrated and continuous cycle-pedestrian infrastructure, separated into 45 km of routes throughout the city. Stefano Boeri Architetti developed the project as a one-of-a-kind opportunity to rethink Milan as a whole, combining



Figure 3.2: Aerial visualization of the metropolitan scale of the "Green River" network

© STEFANO BOERI ARCHITETTI, 2017

urban development with green systems that are capable of improving air quality while also protecting and growing urban biodiversity. The Green River ecosystem is projected to absorb around 50,000 tons of CO_2 and create 2,000 tons of oxygen, counteracting 300 tons of pollutants. The project will save 30 GWh per year in energy consumption due to the cooling impact of plants on urban surfaces and generate approximately 400,000 MWh of clean energy per year through underground groundwater geothermal energy.

For more information:
https://www.stefanoboeriarchitetti.net/en/project/a-green-river-for-milan/

3.3.3 The Great Green Wall, China

Location: Northern China
Area: 4500 km
Date: 1978 - 2050
Aim: Delay desertification

The 'Great Green Wall,' also formerly known as the Three-North Shelterbelt Forest Programme, is one of the methods used by Chinese officials to delay desertification in this region. The 'wall' is made up of strips and patches of trees planted across large areas of northern China.

These trees serve as windbreaks against the dust storms that often sweep over the area from the Gobi and Taklamakan deserts. In certain places, trees are also used to stabilize sand dunes, and gravel stages are positioned to promote the restoration of a soil crust. These trees were first planted in 1978 and are expected to be finished by 2050, with the intention of raising the percentage of forest cover from 5% to 15%.

The program's tree belt is expected to be the greatest ecological engineering project in the world at that time, spanning 4500 km and containing 100 billion trees. The "wall" is already the biggest



Figure 3.3: The Great Green Wall

© Royal Geographical Society with IBG, 2015

man-made forest in the world.

For more information:
https://www.rgs.org/schools/resources-for-schools/chinas-great-green-wall
https://widerimage.reuters.com/story/the-great-green-wall-chinas-farmers-push-back-the-desert-one-tree-at-a-time, https://www.wordforest.org/2022/03/11/assessing-chinas-green-wall-lessons-to-the-world-on-afforestation/

3.3.4 Trees for Homes, South Africa

Location: Johannesburg, South Africa
Date: 2000 - ongoing
Aim: Food security, climate change mitigation, raising environmental awareness

This unique public greening effort promotes sustainable human settlements and improved living conditions in Johannesburg. It emphasizes the need for greening for climate change mitigation and increased environmental awareness while also contributing to food security. Trees for Homes gives free trees to inhabitants of Johannesburg's low-income housing developments, as each household receives one fruit tree and one indigenous tree. The effort employs rather simple technology in its planting and maintenance methods. The project also teaches communities how to care for the trees they've planted. So trees for homes not only raises awareness of environmental issues but also provides work to jobless individuals. In addition to making communities greener, the initiative raises the quality of life of the community. The initiative has planted more than one million trees since 2000, and over a 20-year period, a total of 369,003 metric tons of carbon dioxide equivalent (CO_2e) was sequestered. The project is now expanded, as trees for houses are now spearheading greenbelt projects in a number of townships in major South African cities in order to turn



Figure 3.4: Trees for Homes, South Africa
© Trees for Homes, n.d.

the townships into vibrant urban food forests brimming with life and biodiversity.

For more information:
https://unfccc.int/climate-action/momentum-for-change/activity-database/momentum-for-change-trees-for-homes
https://trees.org.za/csi-esd/corporate-social-investment/trees-for-homes/
https://amalicities.africa/wp-content/uploads/2023/09/UGRL-Urban-Green-Spaces-Brief-Good-Practices.pdf

3.3.5 Medellín's Green Corridors, Colombia

Location: Medellín, Colombia
Area: 700000 sqm
Date: 2016 - ongoing
Aim: reintroduce space in urban areas and reduce the urban heat island effect.

Since 2016, Medellín has established 30 green corridors, 'Corredores Verdes,' a linked network of greenery around the city, developed along major roads and waterways, and connecting natural features such as the surrounding hills. This project is a part of the three-year "greener Medellín for you" program. Medellín's Joaquin Antonio Uribe Botanical Garden taught 75 residents from underprivileged backgrounds to become city gardeners and planting technicians. They contributed to the planting of 8,800 trees and palms throughout 30 pathways spanning 65 hectares. 596 palms and trees, as well as over 90,000 smaller plant species, have been planted along one of the city's busiest routes. The corridors connect diverse green facilities, including squares, parks, and green curbs. These corridors are intended to simulate forest ecosystems, with over 72 natural plant species selected for their capacity to remove pollutants, give shade, and produce fruits. Green roofs and vertical gardens are being installed on major concrete structures such as metro stations and bridges in order to prevent heat absorption. These green corridors include 20 km of cycling networks within the green corridors. The initial investment to establish the



Figure 3.5: Corredor verde La Picacha at Carrera 76
© XalD, 2019

project cost a total of $16.3 million (£13.2m), and annual maintenance cost $625,000 (£504,000) in 2022, according to the local government. Three years after the project began, Medellín's temperature dropped by 2°C, and respiratory problems caused by air pollution decreased. The Green Corridors project also received the 2019 Ashden Award for Cooling by Nature.

For more information:
https://www.c40knowledgehub.org/s/article/Cities100-Medellin-s-interconnected-green-corridors

3.3.6 Saudi Green Initiative, Saudi Arabia

Location: Saudi Arabia
Date: 2021 - ongoing
Aim: Tackling climate change, improving quality of life, and protecting the environment

As a part of the vision 2030 of Saudi Arabia, the Saudi Green Initiative, established in 2021 by Crown Prince Mohammed bin Salman, is a comprehensive national policy aiming at tackling climate change, improving quality of life, and protecting the environment for future generations. Moreover, one of its three objectives is greening Saudi Arabia through growing 10 billion trees across Saudi Arabia in 13 regions by 2060, which is comparable to revitalizing approximately 74 million hectares of land.

This community-wide initiative will assist in restoring important biological services, enhancing air quality, minimizing sandstorms, and much more. Planting trees will be executed over several years. From 2021 till 2024, Saudi Arabia managed to plant over 100 million trees and shrubs, and it is expected to reach more than 600 million trees by 2030. Furthermore, till 2024, the planted tree canopy impacted the decrease of the temperature in the city centers by 2.2 degrees Celsius.



Figure 3.6: Saudi green initiative, Saudi Arabia
© 'Greening Saudi | Saudi Green Initiative Target', 2024

This initiative is relying on rainwater, treated wastewater for irrigation, and seawater for planting mangrove forests, and they used AI technology to improve water efficiency by utilizing sustainable sources like treated wastewater.

For more information:
https://www.sgi.gov.sa/about-sgi/sgi-targets/greening-saudi/
https://thesauditimes.net/en/saudi-arabias-75-year-greening-plan-a-bold-battle-for-cleaner-air-and-healthier-land/#utm

3.4 The Findings

Institutional level

The institutional level involves the establishment of governance frameworks:

- Collaborating with various actors through public-private partnerships, the engagement of local communities, and collaboration between different government agencies, civil society, research institutions, and private enterprises. For example, MillionTreesNYC, which is managed by an advisory board composed of city departments, NGOs, and independent agencies, ensures comprehensive oversight of tree planting, maintenance, and community engagement. Moreover, the Green River Project in Milan is led by the government and railway companies in collaboration with architects and urban planners to repurpose abandoned railways into green spaces.

- Institutional responsibilities often encompass funding allocation, legal regulations (e.g., land tenure rights), and capacity building through training programs and public awareness campaigns.

Strategic Level

- Afforestation projects must be strategically in line with climate action frameworks, sustainable development goals (SDGs), and regional and national environmental legislation. Carbon sequestration, biodiversity restoration, desertification prevention, and air quality enhancement are examples of strategic objectives. For example, the Saudi Green Initiative, which is a component of Saudi Vision 2030, is to improve biodiversity and lessen urban heat by planting 10 billion trees by 2060.

- Setting quantifiable goals, including incorporating afforestation into land-use planning, and encouraging global collaboration for finance and information sharing are important strategic initiatives. For example, China's Great Green Wall is a long-term plan (1978–2050) to stop desertification by establishing a tree belt spanning 4,500km.

Operational level

- Afforestation at the operational level entails doable tasks, including water availability, healthy soil, species selection, afforestation types, planting methods, site selection, and continuing upkeep, based on the community needs and situation. For example, Johannesburg's Trees for Homes program focuses on food production and economic support of the community through edible trees. While other programs, such as China's Great Green Wall, focus on delaying desertification, they choose kinds of trees to serve as windbreaks against the dust storms.

- Maintenance and Monitoring: Providing irrigation, pest control, and recurring assessments to ensure the long-term viability of trees. Medellín's Green Corridors is one example of a project that involves ongoing maintenance expenses and yearly assessments to gauge its effectiveness in lowering temperatures and improving air quality.

- Community Involvement: By giving local residents training and employment opportunities, community participation guarantees sustainability. Projects like Johannesburg's Trees for Homes program give out free trees to homes and provide tree care education, improving livelihoods and increasing environmental awareness.



4



GREENING THE SUBURBAN AREAS

© Antim, 2018

GREENING THE SUBURBAN AREAS

There are different approaches to defining the suburban areas. First, the census-convenient definition defines the suburban areas as outside the political boundaries of cities but within metropolitan area boundaries. By definition, suburbs are outlying areas that are connected to the city in some way. This definition highlights the relationships between cities and suburban areas. Second, the suburbanism definition emphasizes lifestyles as the primary differentiator (Airgood-Obrycki, Hanlon, and Rieger 2021). including the social and cultural norms of suburbanites that are influenced by the specific land-use patterns, the socio-economic conditions, and the relation between transportation, housing, and density. For example, the suburban areas in many cities are usually used for agricultural purposes. Moreover, the typology definition aims to specify particular suburb types and offer more information about a suburb's physical form, location, population, and/or history (Airgood-Obrycki, Hanlon, & Rieger, 2021).

4.1 Types

There are different types of greening the suburbs based on their purposes; some of them focus on controlling the urban sprawl of the cities and preserving the countryside and the surrounding agricultural lands, while others focus on maintaining and promoting the suburbs' agricultural production to ensure food security. For example:

4.1.1 Green Belts

A greenbelt is a physical tract of open space, such as a forest, farmland, or other green space, that encircles a city or metropolitan region with the goal of serving as a long-term deterrent to urban growth. On greenbelt territory, development is either tightly restricted or outright forbidden. Greenbelts can be established by acquiring development rights or open land by the government or a charity (Bengston, 2005).

4.1.2 Community-supported Agriculture

Community-supported agriculture is a model introduced in the United States to connect the city residents with where their food grows, which is usually in the city's suburban areas. As it is made up of a group of people who agree to support a farm operation that turns the land into the community's farm, either legally or spiritually, with farmers and consumers supporting one another and splitting the risks and rewards of food production (Prial, 2019).

4.1.3 Public Policies to Protect Agricultural Lands

There are some policies to protect the agricultural lands in the suburbs and stop the urban sprawl through restrictions and incentives.

4.2 Benefits

Greenbelts and greening the suburbs have a lot of environmental benefits, including climate change mitigation, pollution reduction, mitigating flood risks, and promoting biodiversity ('Cities Can Enhance Their Sustainable Wellbeing with Greenbelts,' 2025). From the economic perspective, greening the suburbs and greenbelts encourages and preserves agricultural production, including food and other goods. They also provide opportunities for rural and agricultural tourism and recreational activities, and that provides job opportunities for the city's residents (Friends of the Greenbelt Foundation, 2012). Moreover, from the social perspective, greening the suburbs helps in preserving the distinctive, historical identity of different rural communities around the city. Additionally, greenbelts and greening the suburbs provide the city's residents with access to nature, and that helps to improve their mental and physical health (Safdie, 2023).

4.3 Examples

4.3.1 London Metropolitan Green Belt, UK

Location: London, UK
Area: more than a million acres
Date: 1938 - ongoing
Aim: preserving the countryside and agricultural land

In order to control urban expansion, stop urban sprawl, and protect natural areas surrounding the city, London implemented the Green Belt Policy. It is a component of a larger UK-wide program that started with the 1947 Town and Country Planning Act. In order to preserve a buffer zone of open countryside and agricultural land, the strategy expressly defines sizable regions surrounding London where development is severely prohibited. The Green Belt in London spans more than a million acres, extending from Bedfordshire to the Sussex border and, in some locations, up to 35 miles from the city center. On August 3, 1955, the Ministry of Housing and Local Government issued an announcement urging planning authorities to create Green Belts. London's boundaries consist of 65% "green" area, with just 28% being developed. 59% of the Green Belt consists of agricultural land, and approximately 2% is made up of buildings, and there are hundreds of kilometers of roads. The London Green Belt Council (LGBC) is an independent, nonprofit umbrella organization for organizations and people who are enthusiastic about conserving and safeguarding London's Green Belt, and it unites more than 100 organizations and members of the public.

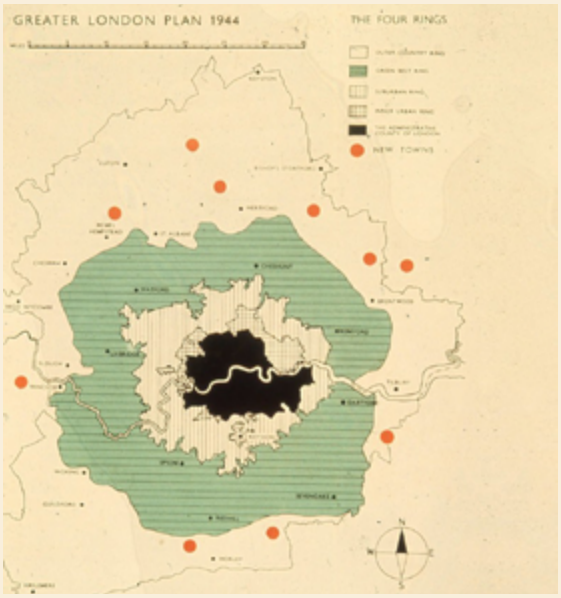


Figure 4.1: London Green Belt
© The JR James Archive, 2013

For more information:
https://www.businessldn.co.uk/sites/default/files/documents/2018-05/Green-Belt.pdf
https://www.cpre.org.uk/explainer/all-you-need-to-know-about-the-green-belt/

4.3.2 Green Belt Movement, Kenya

Location: Nairobi, Kenya
Date: 1977 - ongoing
Aim: Deforestation and social empowerment

The Green Belt Movement is a grassroots environmental organization founded in 1977. Deforestation, environmental deterioration, and the marginalization of women in rural Kenya were the movement's primary goals. It has developed over time into a potent force for social empowerment, sustainable development, and reforestation, including greening peri-urban and suburban regions surrounding major cities in Kenya, especially Nairobi. The Green Belt Movement cooperates with neighborhood churches, schools, and community organizations around Nairobi to green school grounds, public areas, and suburban areas. One noteworthy project is to beautify the surrounding region, enhance air quality, and decrease dust by planting trees along roadsides, in school grounds, and around public buildings in suburban areas. They also played a key role in preventing unlawful encroachment and destruction in the Karura Forest Reserve, a peri-urban forest close to Nairobi. It now provides a leisure area for locals and acts as a green lung for the city and its environs. The movement empowers women and local communities in the suburbs through training in sustainable land management, agroforestry, and tree nursery management so they are able to establish tree nurseries, providing income and enhancing neighborhood greenery.



Figure 4.2: The Green Belt Movement, in Kenya
© CC William Campbell/Sygma via Getty Images, 1988

For more information:
https://www.greenbeltmovement.org/

4.3.3 Zenger Farm, USA

Location: Portland, Oregon, USA
Area: 24-acre
Date: 1993 - ongoing
Aim: food production; education

Zenger Farm is a nonprofit organic farm in the suburbs of Portland that demonstrates, promotes, and teaches sustainable food systems, environmental stewardship, and community development. The City of Portland has entrusted the Zenger Farm organization with the preservation of a 24-acre farm and wetland. And they follow the community-supported agriculture method, so half of the community-supported agriculture shares are made accessible to community members who register directly. This includes people and families who want to support local farmers while also enjoying fresh, seasonal products. While the remaining half of the shares are earmarked for low-income households struggling with dietary diseases. This effort seeks to address food access and health inequities. Moreover, they offer hands-on educational activities in a natural setting, with an emphasis on kids from the farm's target communities in outer southeast Portland. So they provide numerous activities, including Farm School, field excursions, camps, and after-school programs. Every year, more than 6,000 students from the metro



Figure 4.3: The Zenger Farm in USA
© Portland, 2014

region visit the farm. One thousand families participate in the farm's "Healthy Eating on a Budget" programs. Every Sunday, 900 people attend the Lents International Farmers Market, which has been functioning in the neighborhood since 2006.

For more information:
https://www.pdxmonthly.com/news-and-city-life/2013/06/zenger-farm-grows-community-ties
https://zengerfarm.org/portland-csa/

4.3.4 Agricultural Land Reserve (ALR), Canada

Location: British Columbia, Canada
Area: 4.6 million hectares
Date: 1973 - ongoing
Aim: protecting agricultural lands in the suburbs

The Agricultural Land Reserve (ALR) is a provincial designation that recognizes agriculture as the primary use and protects the agricultural lands in the suburbs from urban sprawl and development. The ALR preserves over 4.6 million hectares of agriculturally appropriate land in British Columbia, where farming is promoted but non-agricultural uses are banned. Those allowed agriculture-related activities include Crop Production. Livestock Rearing. Dairy and Poultry Farming. Greenhouses and Nurseries and Apiaries. Additionally, other secondary uses are allowed, such as farm buildings and structures necessary for agricultural operations; agritourism activities, which involve opening up agricultural properties to the public for educational and recreational purposes; home-based businesses that are directly related to agriculture; temporary farmworker housing for seasonal farmworkers; and research and educational activities related to agriculture. However, those secondary uses should not overshadow the primary agricultural activities. Moreover, as a result of Bill 15-2019, private landowners will no longer be allowed to apply for exclusion beginning September 30, 2020; only the Provincial Government, municipal or First Nation governments, or designated public entities may do so, and the provincial Agricultural

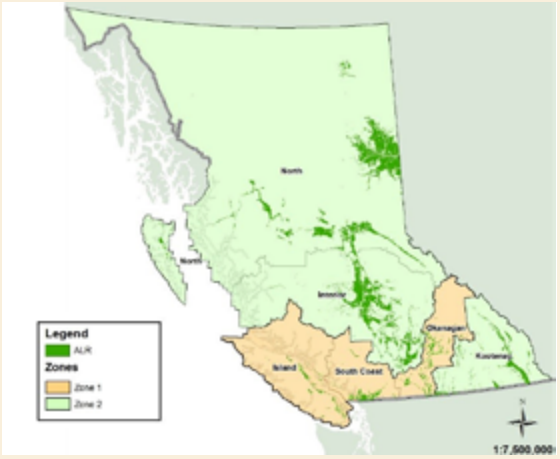


Figure 4.4: British Columbia's Agricultural Land Reserve land area in dark green and two administrative zones, 2014 - 2019
© Connell, 2024

Land Commission evaluates exclusion or inclusion requests considering different factors such as soil quality, climatic conditions, market demand, and agricultural sustainability.

For more information:
https://www.smythecpa.com/blog/overview-of-agricultural-land-reserves-in-bc/
https://civiclegal.ca/wp-content/uploads/2023/08/CircuLAWr-Aug-2023-The-Agricultural-Land-Reserve.pdf

4.3.5 R-Urban, France

Location: Colombes, a town of 80,000 inhabitants in the northwestern suburbs of Paris.
Date: 2011 - ongoing
Aim: urban resilience, food production, community engagement

R-Urban is a unique initiative that intends to integrate urban resilience, sustainability, and local food production using a community-based model. It began as a research project by architect Yona Friedman, in partnership with ENSAPLV (Paris-Val de Seine School of Architecture) and other local organizations. R-Urban focuses on suburban regions and seeks self-sufficient and environmentally friendly communities. It is based on three prototype production units that actively involve local people in and around Colombes:

1. AgroCité, an urban agricultural unit that includes a micro-experimental farm, community gardens, educational and cultural spaces, and energy generation, composting, and rainwater recycling systems.

2. RecyLab is a recycling and green building built around a series of equipment that recycles urban garbage and converts it into resources for eco-construction.



Figure 4.5: The micro-experimental farm and community garden at R-Urban
© Antim, 2018

3. AnimaLab is a residential farm located in the Agrocité, including microstructures such as beehives and chicken coops. The products are integrated into the local distribution network via the agrocity's local store. The three units operate on local production-distribution cycles and are gradually connected to other urban facilities. The project is expanded in other cities, such as Ile-de-France.

For more information: http://r-urban.net/en/sample-page/

4.3.6 Bauerngarten, Germany

Location: Brandenburg, suburbs of Berlin, Germany
Area: 2 hectare in Ahrensfelde (one of the four Bauerngarten)
Date: 2010 - ongoing
Aim: food production

Bauerngarten Berlin is a community-supported agriculture (CSA) project in the suburban areas around Berlin, Germany. It began in 2010 with two locations. However, it now expands to four locations around Berlin in Brandenburg: Ahrensfelde in the east, Mette in the south, Havelmathen in the west, and Pankow in the north, and 1,500 involved people who provide themselves with fresh, organic veggies that are cultivated by hand just outside the city's borders each year.

Participants apply to get a share for the growing season, and since 2018, every farm gardener has been able to choose how much money they wish to spend for their plot. They provide a pricing scale for self-assessment. They can select between a reduced charge, a regular fee, and a solidarity fee. Participation allows gardening for two to three hours per week and the cultivation and harvesting of organically certified young plants, seeds, and fertilizers. Throughout the season, the farms offer the participants free organic seeds and



Figure 4.6: The bauerngartenin Ahrensfelde
© Bauerngarten Ahrensfelde, 2014

high-quality young plants, as well as reliable watering. Benefits include access to the common herb garden, free participation in seasonal seminars, and community forum exchanges.

For more information:
https://www.bauerngarten.net/ueber-uns/

4.4 The Findings

Institutional level

Municipalities are responsible for creating institutional frameworks to protect, regulate and encourage greening in suburban areas. This includes:

- Encouraging the research and the prototype projects to implement agricultural projects in the suburbs, such as the R-urban in France

- Partnership: Local governments can promote greening programs by forming partnerships with nonprofit organizations, community groups, and other stakeholders; for example, the Green Belt Movement in Kenya.

- Encouraging the community to support agricultural projects by providing land in the suburbs.

Strategic level

Municipalities can create long-term plans to include green areas in suburban development, with an emphasis on controlling urban expansion and increasing agricultural production. This includes:

- Policy Development: Local authorities can set rules that protect the agricultural lands in suburban areas, such as the Agricultural Land Reserve in British Columbia.

- Greenbelts: Creating greenbelts around cities to protect agricultural land and avoid urban development, as shown in London's Metropolitan Green Belt.

- Community Supported Agriculture (CSA): Encouraging models such as community-supported agriculture, in which locals invest in local farms to ensure food security and a stronger connection to the land. For example, take Zenger Farm in Portland, which the city trusted to manage 24 acres in the suburbs to increase access to fresh vegetables and educate communities.

Operational level

Municipalities are responsible for carrying out daily initiatives to green suburban areas on an operational basis. This includes:

- Public Awareness & Education: Providing educational activities or community outreach programs, as seen by initiatives like Zenger Farm, which offers family and child education programs.

- Raising awareness about community-supported agriculture concepts and the projects in the city suburbs to encourage the city's residents to participate.

- Land management is the process of overseeing conservation areas or agricultural lands through partnerships, easements, or land purchase, for example, in the Agricultural Land Reserve in British Columbia.



5



FOREST WITHIN THE CITY

© Clifton Urban Forest, Courtesy of SUGi, n.d.

FOREST WITHIN THE CITY

"Urban Forestry" is defined as "networks or systems comprising all woodlands, groups of trees, and individual trees located in urban and peri-urban areas; they include, therefore, forests, street trees, trees in parks and gardens, and trees in derelict corners." It is characterized as an integrated, multidisciplinary, participative, and strategic technique for planning and managing tree resources in urban and peri-urban regions with economic, environmental, and social advantages. In practice, Urban Forestry could include planting trees where none existed previously, improving existing natural vegetation, or transforming urban sprawl into green areas. Urban and peri-urban tree resources, which include dispersed single trees, small groups of trees, and forests, help to create green infrastructure, which refers to natural or constructed biological systems that preserve ecosystem values and services (FAO, 2017).

5.1 Benefits

The urban forests strive to maintain and restore urban ecosystems in cities, including their distinctive ecological functions. Trees in urban forests can serve as a barrier to prevent erosion and noise pollution, in addition to other environmental benefits, such as promoting biodiversity and climate change mitigation and pollution reduction. From the social perspective, urban forests provide relaxation benefits, as they strive to create wellness zones in cities, allowing inhabitants to spend free time in nature (e.g., hiking, sports) that improves the residents' physical and mental health. Moreover, similar to the afforestation, the urban forest creates jobs and economic opportunities (Lee et al., 2009; Sánchez, n.d.).

5.2 Types

Urban Forestry can be classified into different types, including

5.2.1 Road Forest

Trees are planted along railroads, highways, boulevards, roads, and streets to protect and guide vehicles while also beautifying the environment (Lee et al., 2009; Sánchez, n.d.).

5.2.2 Attached Forest

Trees near schools, campuses, hospitals, commercial and business districts, city centers, industrial zones, and residential areas provide amusement and enhance quality of life. Urban forests are strategically placed near buildings to enhance the quality of life for certain populations, such as children, students, and hospital patients, while also enhancing commercial and tourism activity in cities (Lee et al., 2009; Sánchez, n.d.).

5.2.3 The Miyawaki Method

The Miyawaki is an innovative forestry technique that is gaining favor across the world, particularly in urban settings, created by the Japanese botanist Akira Miyawaki in the 1970s. It enables the fast growth of biodiverse, thick forests in limited areas. It is a reaction to contemporary concerns such as urbanization, climate change, and biodiversity loss. Using this strategy, even tiny areas may be transformed into healthy, productive ecosystems that provide valuable ecological and social services (Oliwia, 2024). It is efficient because it is founded on natural forestry principles:

1. The selection of native species is because they are more adapted to the local temperature and soil conditions, enhancing their chances of survival and development (Oliwia, 2024).

2. Plants are grown relatively close together, replicating circumstances in real forests. This density enables plants to assist one another, resulting in rapid development (Oliwia, 2024).

3. The soil is specifically prepared before planting. This technique entails nourishing the soil with organic materials such as compost in order to create the ideal conditions for plant development. Furthermore, the soil is aerated and tailored to the requirements of certain plant species, improving its ability to retain water and nutrients (Oliwia, 2024).

4. The Miyawaki approach excludes the use of pesticides and fertilizers. Natural methods of plant protection are preferable, as they support a healthy and balanced ecology. As a consequence, plants and wildlife coexist peacefully, with no detrimental environmental impact from chemical use (Oliwia, 2024).

5. Following the first development stage, which might last two to three years, the small forest requires little upkeep. The plants become self-sustaining, and the ecosystem starts to operate independently. The forest begins to self-regulate, requiring less human intervention and becoming more adaptable to environmental fluctuations. As a result, the expenses and labor required to maintain the forest are much cheaper than traditional afforestation methods (Oliwia, 2024).

5.3 Examples

5.3.1 Pla Natura Barcelona, Spain

Location: Across multiple urban sites in Barcelona, including Montjuïc, Collserola, and Parc de la Ciutadella.
Area: Over 100 hectares of new or restored green space across the city.
Date: 2021 - ongoing
Aim: Biodiversity restoration, climate resilience, and community engagement.

Pla Natura Barcelona is a flagship urban forestry initiative led by the Barcelona City Council, aligned with the city's long-term vision for resilient infrastructure and equitable access to green space. It enhances ecological connectivity through native tree planting, restoration of degraded areas, and the integration of micro-forests into dense urban neighborhoods. Core components include biodiversity shelters, green corridors, and forested schoolyards, with over 20,000 climate-adapted trees and shrubs planted by 2023. The initiative prioritizes citizen participation, involving schools and communities in planting, monitoring, and stewardship. Selected as a case study within the Uforest project, co-funded by the Erasmus+ Programme of the European Union, Pla Natura Barcelona showcases scalable urban forestry practices for European cities. Its contributions support multiple environmental and health global goals and deliver measurable nature-based benefits.



Figure 5.1: Participants in a supervised urban gardening activity, planting native species as part of a community-led urban forestry in Barcelona

© Uforest, 2022

For more information:
https://www.uforest.eu/wp-content/uploads/2022/01/Barcelona-Nature-Plan-Uforest-factsheet.pdf
https://oppla.eu/case-study/uforest-case-study-barcelona-nature-plan

5.3.2 The Danehy Park Miyawaki Forest, USA

Location: in Cambridge in the Northeast United States
Area: 4,310 square feet (around 400 meter)
Date: 2021 - ongoing
Aim: Biodiversity, decrease urban heat island effect

Using the Miyawaki technique, the Danehy Park Miyawaki Forest is a leading urban forestry project that promotes dense and quick native forest development. It is the first Miyawaki forest in Cambridge and the Northeastern United States overall. This Miyawaki forest includes 1400 trees of 32 native species. Local volunteers, environmental organizations, and city authorities worked together on the project, demonstrating the community's strong dedication to environmental restoration. In 2023, the Danehy Park Miyawaki Forest saw its second full growth season and underwent significant transformation between January and October as the canopy height rose sharply and the density filled out, naturally suppressing encroaching development. Although the forest edge has still benefited from maintenance, the ecology is growing wonderfully, and biodiversity, from insects and birds to invertebrates and small mammals, is flourishing. After approximately three years, the forest became self-sustaining. They no longer require human maintenance or watering and can be handed over to nature for biodiversity and complexity



Figure 5.2: Volunteers work to plant 40 native species of plants at the Danehy Park Miyawaki Forest

© City of Cambridge, 2022

to naturally develop. Air temperature measurements taken at Danehy Park on a hot day in June 2024 revealed a significant cooling effect, with surface temperature differences reaching up to -27.8°C.

For more information:
https://bio4climate.org/miyawaki-forest-program/danehy-park-forest/

5.3.3 Clifton Urban Forest, Pakistan

Location: Karachi, Pakistan
Area: 300 sqm
Date: 2015 - ongoing
Aim: To address climate change-related issues such as the floods and the heat waves

Clifton Urban Forest was founded by Shahzad Qureshi after Karachi's first "official" heat wave in 2015, which caused the death of more than 2000 people owing to the 'Urban Heat Island' impacts induced by crowded concrete buildup and a lack of green cover. Qureshi got inspired by the Miyawaki method, and in December 2015, he and his team established the first prototype forest of 300 square meters in the Clifton region, which had previously served as an open dumping site. The project landscape design was developed by a German-trained landscape architect on an area (3 acres) and transformed into an urban forest park. Then the project was expanded to the whole park (12,000 square meters). The initiative aims to improve Karachi's ecosystem by establishing sustainable forests. The project now has 1050 trees and it aims to plant 50,000 trees, over 50 native species, 1.2 kilometers of nature paths, vegetable gardening, community composting, a butterfly garden, a natural playground, a fruit forest, a center lake, and a skywalk. The self-sustaining forest uses recovered wastewater



Figure 5.3: Aerial view with dense vegetation at Clifton Urban Forest

© Clifton Urban Forest, Courtesy of SUGi, n.d.

and includes an organic vegetable garden, playground, surplus water storage lake, composting station, and recycling station. Qureshi and his team have received national and international praise and have since established 24 more forests across Pakistan. In 2022, this forest served as a significant tool during the heavy floods in the summer, absorbing standing water from both within and outside the forest.

For more information:
https://www.sugiproject.com/forests/clifton-urban-forest
https://una.city/nbs/karachi/clifton-urban-forest

5.3.4 The South Padbury Primary School, Australia

Location: South Padbury Primary school, in a northern Perth suburb, Australia
Area: 100 sqm
Date: 2021 - ongoing
Aim: promote biodiversity, assist with climate challenges, and educate the schoolchildren.

It is the first Miyawaki forest to be planted in an Australian school and the first of its kind in Western Australia, using rare flora specific to the area, which is recognized as a worldwide biodiversity hotspot. The forest was planted in 2021 as part of a dedicated science initiative led by Murdoch University's Harry Butler Institute, as well as an outreach activity for schoolchildren, to promote biodiversity, assist with climate challenges, and provide kids the opportunity to participate in a STEM research project. The school outreach program not only taught children about the Miyawaki technique by planting a forest alongside them, but it also included lessons on urban sustainability, climate change, and urban greening. The forest includes 350 trees from 26 native species, and it has impacted 110 young people. Moreover, the forest proved its significant influence in cooling the urban areas, as it showed that the air temperature decreases 3.6°C and the surface temperature also declines 36.3°C in the forest compared to the surrounding area. The



Figure 5.4: Dense native vegetation planted using the Miyawaki method

© 'Miyawaki Urban Tiny Forest Project,' 2022

forest project has also been acknowledged and selected by UNESCO Green Citizen as a locally original and influential project that is spreading off and thriving far and wide. UNESCO Green Citizens is a global program that strengthens local efforts and promotes citizen-led environmental projects on a global scale.

For more information:
https://southpadburyprimaryschool.wa.edu.au/teaching-and-learning/miyawaki-urban-tiny-forest

5.3.5 Khoi First Nations Forest, South Africa

Location: Pinelands, Cape Town, South Africa
Area: 200 sqm
Date: 2022 - ongoing
Aim: promote local cultural heritage and biodiversity

The Khoi First Nations Forest, located at the Oude Molen Eco Village in Pinelands, Cape Town, South Africa, is part of an initiative to create urban Miyawaki forests aimed at educating visitors on native tree species, biodiversity, and the advantages of rewilding urban areas in South Africa, where land remains a contentious issue. Moreover, the forest aims to promote local cultural heritage and reconnect communities with nature, so it was planted in cooperation with the First Nations people, "Kraal," an indigenous South African community, and has reconnected community members with native tree species. It includes around 800 trees and 17 native species, and the average height of the trees reaches 2.8 meters. The forest attracted around 200 visitors in 2022, which created a source of income for the local Khoi First Nations people. The forest has actually become a wild zone of the Kraal, with turtles, a snake, aphids, ants, butterflies, and bees. In addition, a group of birds flies past and lingers in the forest, particularly in the mornings.



Figure 5.5: Different plant species at the Khoi First Nations Forest
© Khoi First Nations Forest, Courtesy of SUGi, n.d.

For more information:
https://www.sugiproject.com/forests/khoi-first-nations-forest

5.3.6 The Urban Micro-Lungs, Jordan

Location: East Amman, Jordan
Area: Each selected area is around 100 to 250 square meters
Date: 2020 - ongoing
Aim: Enhance the quality of life in urban areas, address climate change-related issues like urban heat island effects, and promote local biodiversity.

The Urban Micro-Lungs is an Urban Living Lab initiative in East Amman, Jordan, that uses the Miyawaki afforestation process to generate new green areas. The Urban Micro-Lungs (UML) initiative is a green infrastructure intervention carried out by the Improving Living Conditions in Disadvantaged Areas of Amman (ILCA) project, which is funded by the German Federal Ministry for Economic Development and Cooperation (BMZ) and implemented by GIZ in collaboration with the Jordanian Ministry of Environment and Greater Amman Municipality. The program, which is being executed with the technological expertise of Tayyun Research Studio, intends to build two urban micro-forests in East Amman's highly populated areas. First, two locations were selected, and then dense forests were planted on the two selected areas using the Miyawaki Method. The Miyawaki Method comprised soil engineering, biomass production, and plantation of chosen plants that match the area's environment. Capacity-building workshops and training were offered to municipal



Figure 5.6: The Urban Micro-Lungs
© 'Urban Micro-Lungs | Urban Nature Atlas,' 2023

workers on managing and maintaining the Urban Micro Lungs Project locations. Moreover, training was offered to partner organizations to construct additional urban microlungs in the city, and walks and site activation workshops were offered as well to educate locals about the significance of green infrastructure. The initiative used a participatory approach, including community members of all ages in the change process of the chosen regions.

For more information:
https://www.c40.org/case-studies/amman-urban-micro-lungs-initiative/, https://news.mongabay.com/2022/06/in-jordan-the-middle-easts-first-miyawaki-style-baby-forests-take-root/

5.4 The Findings

Institutional level

- collaboration with international organizations such as GIZ in the implementation of the urban forest, such as the example of urban microlungs in Jordan.

- Capacity-building workshops and training were offered to municipal workers on managing and maintaining urban forest projects, such as the example of urban microlungs.

- Public-Private Partnerships: Encourage partnerships with businesses and social responsibility programs for funding, planting, and maintaining urban forests.

Strategic Level

- Integration into Urban Planning: Incorporate urban forestry as a crucial tactic into the city's larger master planning framework by determining which regions should receive priority attention for urban forestry, such as those areas impacted by urban heat islands, poor air quality, or a lack of green space. For example, in the Tiny Forest Muziekplein, Netherlands, the municipality of Utrecht implemented an urban forestry project in an underutilized urban space.

- Long-Term Objectives and Vision: Set quantifiable targets to increase the number of trees in the urban forests within predetermined time limits, such as the expansion of the urban forest in Danehy Park Miyawaki Forest, USA, and the Clifton Urban Forest in Pakistan's long-term goal of planting 50,000 trees.

- Collaboration with Experts and Stakeholders to develop integrated urban forestry plans with ecologists, architects, community leaders, and urban planners, in addition to partnerships with academic institutions to conduct research and develop innovative forestry and ecological management strategies, for example, the South Padbury Primary School in Australia and the Tiny Forest Muziekplein in the Netherlands.

Operational level

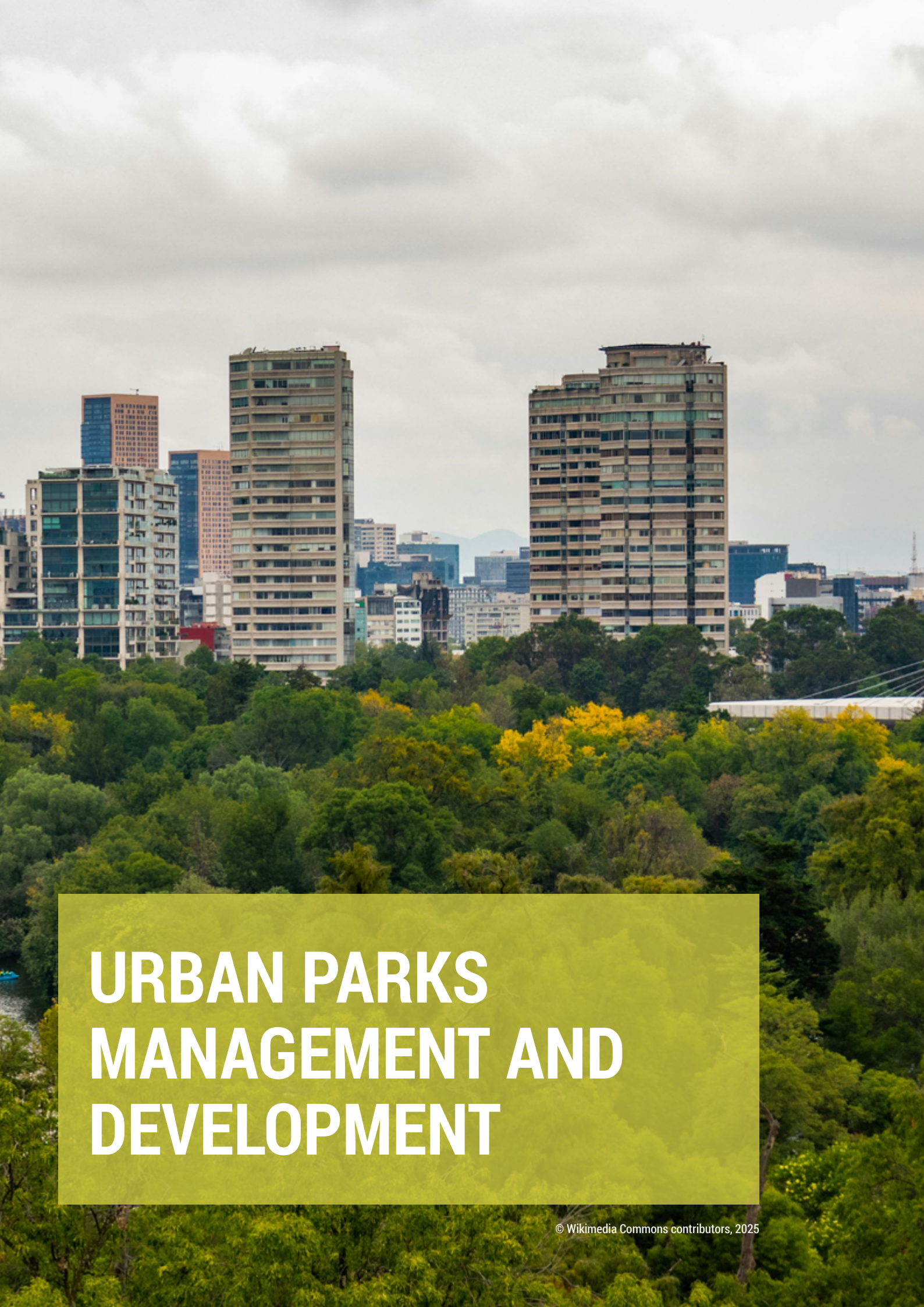
- Regular Maintenance and Monitoring: Create maintenance schedules for control, trimming, and watering, particularly during the establishing stage. By using locals for maintenance work, green job possibilities are created, as shown in the example of Danehy Park Miyawaki Forest, USA, where the local community, environmental organizations, and city authorities worked together to maintain this forest.

- Educational and Recreational Use: organizing activities within urban forests, such as hiking, sports, and environmental education, such as the Tiny Forest Muziekplein in the Netherlands, where the involved schools in the management use urban forests for outdoor education programs.

- following community involvement methods and participatory approaches in designing and implementing the urban forests. For example, in the Danehy Park Miyawaki Forest, USA, the local authorities can foster community engagement by involving volunteers in planting trees and maintaining the forest.



6



URBAN PARKS MANAGEMENT AND DEVELOPMENT

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URBAN PARKS MANAGEMENT AND DEVELOPMENT

Urban parks are defined as delimited urban open areas characterized by flora and water elements that are normally available to the public. They are often bigger than other urban green areas, so urban parks can have a positive influence on biodiversity, even if their primary use is recreational (Nielsen et al., 2014). Parks' functions have changed over time as our cities grow and culture and lifestyles shift from rural to urban. Understanding the importance of parks and the different functions they play in urban life is becoming more crucial in order for parks to maintain their place as a critical public service and an integral element of society's urban infrastructure. Urban parks are universally recognized as valuable assets; nonetheless, the primary tangible benefit connected with urban parks is often viewed as their capital and maintenance costs.

Parks, like the majority of publicly supplied services, are not immediately lucrative; thus, the case for investment is not always evident. Recreational activities in parks can be difficult to describe and measure. The assets in parks and the activities supported by an urban park system are often regarded as extremely vital to a community, but planning and maintaining them to optimize their services is difficult without a thorough grasp of their functions and values (Ellis & Schwartz, 2016). To understand the different types of urban parks, many purposes and benefits will be illustrated.

6.1 Benefits

Urban parks play an important environmental role, especially in climate change mitigation and pollution reduction. Many studies argued that urban parks are typically 4.52ºC (3.77ºC) colder than surrounding areas throughout the summer season. Moreover, they also help to manage rainwater and promote biodiversity. From the social perspective, parks promote culture through a variety of means, such as art and music, as parks are usually venues for festivals, outdoor concerts and theatrical performances. Urban parks aim to offer culturally accessible and significant experiences to residents and tourists of diverse cultures, ages, and abilities, promoting inclusion through playgrounds, festivals, and art programs.

Moreover, parks provide passive, spontaneous, and scheduled recreational options. Those passive recreational opportunities include walking, running, children playing, relaxing, social meetings, reading, seeing animals, strolling, photography, or simply enjoying the environment, as well as organized sports such as tennis courts and basketball courts. However, those facilities can also be spontaneously used.

Culture and recreation experiences in the urban parks indirectly contribute to community development (Vert et al., 2020). Furthermore, urban parks play a significant role in improving the mental and physical health of the citizens, providing opportunities for social interactions during stressful periods, such as the COVID-19 pandemic (Kong et al., 2022). From the economic perspective, parks have a significant effect on real estate value, and they provide job opportunities for the inhabitants to operate and maintain the different activities inside the parks (Ellis & Schwartz, 2016).

6.2 Types

There are various types of urban parks based on their purposes; these types are mainly based on studying and analyzing the examples:

- **Parks with biodiversity as the key concern**

  These parks are dedicated to maintaining and strengthening local ecosystems, fostering native flora and animals, and sustaining urban biodiversity. They are frequently built as natural reserves or ecological corridors inside metropolitan areas.

- **Parks as recreational hubs**

  These parks promote leisure and recreation, including sports facilities, playgrounds, cultural activities, and events. They are critical for promoting physical and mental health and establishing community relationships.

- **Parks to address local climatic challenges**

  These parks use green infrastructure and sustainable methods to prevent urban heat islands, decrease air pollution, manage stormwater, and address other climate-related challenges.

- **Parks to celebrate a national/local history and identity**

  These parks serve as cultural landmarks, including monuments, sculptures, and areas that represent local or national history. They frequently organize events or exhibitions commemorating history and community identity. Moreover, some parks have a political history and were a part of important political events such as demonstrations.

Urban parks can also be designed to serve multiple functions, simultaneously catering to recreational activities and environmental needs.

6.3 Examples

6.3.1 Chapultepec Park (Bosque de Chapultepec), Mexico

Location: Mexico city, Mexico
Area: 1,695 acres (686 hectares).
Date: 1428 - ongoing
Aim: Recreation

Chapultepec Park is Latin America's oldest and largest urban park, as well as one of the world's oldest. It is said to have been designated as green space in the 1300s but was not legally preserved until 1428 by King Nezahualcoyotl. It plays an important role in Mexico's history, as Chapultepec was the site of the last-ditch Mexican defense during the conflict between Mexico and the United States (1846-48). It is located on a hill about 200 feet (60 meters) high on the western edge of Mexico City; it used to be on the outskirts, but it is now surrounded by the urban center, and it is considered a significant source of oxygen for the city. The Chapultepec Park is divided into three sections: Primera Seccion, which features an internationally renowned zoo; Chapultepec Castle, which was a Royal residence; the National History Museum; the National Anthropology Museum; the Modern Art Museum; the Tamayo Museum; and an artificial lake. The second section features a large amusement park, museums, lakeside restaurants, Mexico's national cemetery, fountains, and public art. The third section is less frequented and mainly consists



Figure 6.1: The Chapultepec Park (Bosque de Chapultepec) in Mexico City

© Wikimedia Commons contributors, 2025

of natural areas with wooded areas and wildlife. Moreover, there are three man-made lakes at Chapultepec Park. There are many bike paths and a zero-emission electric trolley bus. Up to 15 million people visit the urban park every year. Chapultepec received the World Urban Parks' Gold Award in 2019 for its contributions to urban green spaces.

For more information:
https://www.chapultepec.org.mx/chapultepec-park/?lang=en

6.3.2 Stanley Park, Canada

Location: British Columbia, Vancouver, Canada
Area: 405 hectares (1,001 acres)
Date: 1888 - ongoing
Aim: recreation; biodiversity

Stanley Park, located in British Columbia, Vancouver, Canada, spans over 400 hectares and is one of North America's largest city parks. It is surrounded by the Coast Mountains and the Pacific Ocean, and it welcomes many visitors and residents every year. It was established in 1888, as it became Vancouver's first official green space. Stanley Park has transformed over the years from a primarily natural woodland to an integrated urban park. Roads, pathways, and attractions, such as lovely beaches, delicious food, natural, cultural, and historical attractions, and a variety of other activities, including the Vancouver Aquarium, were added. Stanley Park features a network of well-marked walking routes that span over 200 kilometers and connect the park's many areas. Around nine kilometers of this route comprise the so-called "Seawall," which began construction in 1917, a popular path that travels straight beside the ocean. Visitors may tour the park on their own, either by walking or biking. Moreover, the park may also be explored via a two-kilometer train trip. A large area of Stanley Park is densely



Figure 6.2: The master plan of the Stanley Park

© OpenStreetMap contributors, n.d.

forested with firs, maples, and red cedars, such as the Hollow Tree, a 700- to 800-year-old red cedar that is a favorite photo subject for Stanley Park tourists. Moreover, the park's natural characteristics provide an ideal home for approximately 500 animal species and over 230 bird species.

For more information:
https://www.explorer.de/reiseziele/kanada/british-columbia/stanley-park.html

6.3.3 The Chulalongkorn University (CU) Centenary Park, Thailand

Location: in a university campus in the center of Bangkok, Thailand
Area: 45000 sqm
Date: 2017 - ongoing
Aim: climate change mitigation

Celebrating Chulalongkorn University's 100th anniversary as Thailand's oldest university, the university gave the site extending beyond its central campus for a new public park as part of a design competition in 2012; the park was opened to the public in 2017. Unlike other public parks in the city, this is the first park in Thailand that assists in minimizing urban flood risks and helps cities deal with climate change, all while providing a space for city inhabitants to reconnect with nature. The park features various ecological design components, such as the green roofs for the university buildings and the construction of wetlands complete with a rain garden, retention pond, and underground water drainage system. Rain and runoff are channeled through the park's terrain, creating a comprehensive water circulation system. The park can retain up to a million gallons of water during heavy rain when the municipal sewage system is overloaded. It is a multi-functional park including a museum, parking lots, three underground rainwater tanks, and eight landscape "outdoor classrooms" on two sides; each room offers diverse ways for students, communities, and visitors to interact with the space. The



Figure 6.3: Lake and trees in Chulalongkorn University Centenary Park in Bangkok in Thailand
© Schwarzbach, 2021

Park enhances Bangkok's green infrastructure by connecting an essential "green corridor" from the main academic campus to a commercial district on university-owned land, and it reduced from four to two lanes in favor of widened pedestrian walkways and new bike lanes

For more information:
https://landezine-award.com/chulalongkorn-university-centenary-park/,
https://worldlandscapearchitect.com/chulalongkorn-centenary-park-green-infrastructure-for-the-city-of-bangkok/?v=b870c45f9584

6.3.4 Platzspitz Park, Switzerland

Location: located in the heart of Zurich, Switzerland, it spans a triangular area nestled between the Sihl and Limmat Rivers, adjacent to the Swiss National Museum and Zurich's main train station.
Area: 10 acres (4 hectares)
Date: 2016 - ongoing
Aim: recreation

Platzspitz is one of the oldest and most historical parks in Zurich. It dates back to the Middle Ages and was used as fenced pastureland for livestock and a shooting range for riflemen. In the 18th century, a double-row avenue was planted along the Sihl and Limmat Rivers, transforming it into a popular promenade. In 1780, Schanzenherr Johann Caspar Fries created a late baroque pleasure grove. The construction of the first train station in 1845-1847 interrupted the Sihl-side avenue, creating a barrier between the city and Platzspitz. The site was redesigned in 1883 for the first Swiss National Exhibition and the Swiss National Museum between 1884 and 1898. The park came to popularity in the 1990s as a gathering spot for drug users from across the world. Due to the terrible circumstances, the park became known as "Needle Park" on a global scale. In 1992, the park was closed for a year to be restored, and international drug users were returned to their home countries. Platzspitz was reopened to the public during the day



Figure 6.4: The Platzspitz park
© Zh, 2011

in the summer of 1993, although it still has to be closed at night. Another redesign of the park started in 2007, and its official opening occurred on August 1, 2016. The park includes old trees, playgrounds and lawns, riverside promenades, pavilions, benches, a playground with climbing equipment, a seesaw, a turntable, a children's swing, chess, and a WC.

For more information:
https://www.zuerich.com/de/besuchen/natur/platzspitz-park,
https://www.stadt-zuerich.ch/ted/de/index/gsz/natur-erleben/park-und-gruenanlagen/parkanlagen-von-az/platzspitz.html

6.3.5 Millennium Park, Nigeria

Location: Abuja, Nigeria
Area: 32 hectares (about 79 acres).
Date: 2004 - ongoing
Aim: recreation

Millennium Park, which is located in the center of Abuja, provides a calm sanctuary for both inhabitants and visitors. It is Abuja's biggest urban park. It was designed and developed by the Italian architect Manfredi Nicoletti. It has a small river that divides it into two parts by bisecting its main rectilinear axis. One side of Millennium Park features an unspoiled environment, brushwood, and greenhouses for butterflies and tropical birds.

The other side is dedicated to scientific understanding of the natural environment, with a conventional and strict Italian-style garden layout. Millennium Park also includes a line of fountains that runs beside the roadway, refreshing the people on the warmest days. The park includes different activities such as bird watching, a children's playground, a water fountain and green plants.

The park is intended to create an atmosphere of tranquility while also celebrating Nigeria's rich cultural history with sculptures and art installations that reflect the country's artistic culture. The entrance of the park is free



Figure 6.5: The Millennium Park
© Kritzolina, 2019

For more information:
https://evendo.com/locations/nigeria/abuja/landmark/millennium-park

6.3.6 Al-Shaheed Park, Kuwait

Location: Kuwait City, Kuwait
Area: 200 square meters
Date: 2013 - ongoing
Aim: environmental - recreation

Al Shaheed Park, which translates to "Park of the Martyrs," is the largest park in Kuwait, located in the heart of a heavily populated area with a network of busy roadways that intersect the park. It is a conversion of the historic Green Belt Park of 1961, a green belt surrounding the capital city. It is part of the Kuwait City Structure Plan (2005-2030), as the Emir Office in Kuwait recovered it for national ceremonies commemorating war martyrs.

The park is divided into three different parts of green space, each with its own master plan and development phase. The first two components have been completed, while the third is under construction.

The park includes walking trails, botanical gardens, fountains, environmental and historical memorial museums, tourist centers, cafés, shops, an amphitheater, a multifunctional event space, an architecture display area, and underground parking. A development plan is underway to incorporate two museum buildings, botanical gardens, and various social amenities into the park, including an outdoor cinema, a shaded playground for children, a sports facility, an ice rink, a snow park, and an indoor skydiving center. Most of the buildings in the park are recognized by their green roofs.



Figure 6.6: Phase 2 of Al Shaheed Park and miniature city
© B.alotaby, 2019;

For more information:
https://araburban.org/en/infohub/projects/?id=6294

6.4 The Findings

The local authorities play a significant role in the establishment, management and development of urban parks.

Institutional level

- Establishing a dedicated department tasked with the development and management of urban parks within cities. This department would focus on the creation of new urban parks as well as the effective oversight and maintenance of existing ones. This department would be supported by special committees that include private entities and civil society entities to oversee and support the development of the parks and ensure the participatory approach.

- Cooperation and partnerships with different stakeholders, including the private sector and foundations, can help in the funding and management process of urban parks.

- In partnership with a private development company that owns the land, the company can use part of the park for recreational development projects (restaurants, cafes, sports courts, fairs, etc.) while conserving the rest of the land as natural areas to be designed into a park. This model reduces the financial load on the government while also demonstrating the business sector's profits.

Strategic Level

- Setting regulations to protect existing urban parks and ensure their maintenance.

- Developing/adapting guidelines that ensure that urban parks will be accessible, inclusive, and aligned with urban needs, and following those guidelines in the design process and implementation.

- Policies to facilitate the land allocation to the urban parks as a part of the master plan in each city to enhance the quality of life of the residents and provide them a recreational place.

- Designing master plans of cities that include urban parks as a key component.

- Setting regulations by the national government and imposing them on city authorities to mandate that urban parks incorporate advanced water management systems. These systems would be designed to harvest and conserve rainfall while employing efficient irrigation technologies to optimize water usage.

Operational level

- Organizing participatory workshops within the design process of the urban parks to involve the community in the design making.

- Partnering with private or civil society organizations to organize cultural and recreational events in the urban parks to encourage public use and foster community connections.

- Designing urban parks that require less maintenance and future interventions.

- Regularly maintaining urban parks to guarantee their utility and aesthetic appeal to avoid any neglect, damage or mis-use of the parks, such as what happens in the example of Platzspitz Park.

- Regularly monitoring ecological health indicators, such as soil quality, vegetation, and biodiversity.

- Developing a participatory approach to involve residents in the planning and decision-making process of designing the urban parks.

- Designing the urban parks with various activities to target the different user groups, such as the example of Chapultepec Park in Mexico.

- Designing the urban parks to address the local climatic challenges for example, the example of The Chulalongkorn University (CU) Centenary Park in Bangkok, Thailand, that provides many solutions regarding the urban floods risks , such as the wetlands and the underground rainwater tanks.



7



GREENING POLLUTED AREAS AND DEINDUSTRIALIZED BROWNFIELDS

© United States Department of Agriculture, 2013

GREENING POLLUTED AREAS AND DEINDUSTRIALIZED BROWNFIELDS

"Greening polluted areas" refers to the process of rehabilitating ecologically deteriorated or contaminated land through using vegetation and ecological restoration techniques. Land damage can occur on a local, landscape, or regional scale as a result of a variety of activities such as the cultivation of dryland or irrigated annual or perennial crops, industrialization, mining, pastoralism, recreation, resource exploitation, and urbanization (Mentis, 2020), as well as the solid waste dumpsters and landfills and cementing riverbanks. This can have a variety of negative consequences, including biodiversity loss, pollution by biocides, heavy metals, or radionuclides, and soil quality degradation due to processes such as acidification, compaction, salinization, and sodification. It may also disturb critical ecosystem activities such as nutrient cycling and water control, as well as contribute to erosion, eutrophication, decreased land productivity, destabilized landscapes, nutrient depletion, overgrazing, and a decrease in soil organic carbon content (Mentis, 2020).

7.1 Benefits

Beyond the general environmental, social, and economic benefits associated with urban greening, the rehabilitation of polluted areas offers distinct advantages in these domains. Regarding the environmental benefits, greening in formerly polluted areas has a substantial influence on pollution reduction and rehabilitation, as well as stormwater filtering, which reduces runoff and contaminants entering rivers. This will also contribute to restoring biodiversity. From a social perspective, greening the formerly polluted areas will improve the visual appeal of neighborhoods, fostering pride among residents. Moreover, it will enhance the health of the residents by replacing the polluted areas with green spaces. Moreover, regarding the economic benefits, transforming polluted areas into green spaces can significantly enhance the real estate value of surrounding neighborhoods.

7.2 Types

Greening polluted areas includes different types, such as:

- Industrial Brownfields are industrial facilities that have been abandoned, idled, or underutilized and whose growth or redevelopment is hampered by actual or imagined environmental pollution ('Brownfields Basics | Environmental Law Institute', n.d.).
- Former Landfills can be defined as the final regulated disposal of garbage into or onto the land, known as landfills (United Nations, 2016).
- Contaminated Riverbanks and Waterways
- Mining Sites
- Urban Wastelands are land that was previously built on and used, but it is now abandoned and left for nature to take over (Cartwright, 2024).
- Agricultural Land Contaminated by Pesticides and Fertilizers
- Land Affected by Chemical Spills or Hazardous Waste

7.3 Examples

7.3.1 De Ceuvel, Netherlands

Location: Amsterdam North, Netherlands
Area: 3,500 square meters.
Date: 2014 - ongoing
Aim: rehabilitation

De Ceuvel was built on a former industrial site, a contaminated region beside the Johan van Hasseltkanaal. In 2012, a group of architects, artists, and sustainability specialists launched the initiative after winning a municipal tender to turn the facility into a creative and sustainable work environment. To rehabilitate the damaged soil of De Ceuvel, the entire region is planted with plants that absorb and regulate soil pollutants. Through community-driven development, the property circular economy approaches by purifying wastewater, investing in solar-powered heating and air conditioning, and composting toilets, as well as using nutrients to produce food. Old houseboats were used to create 17 environmentally friendly ateliers for businesses and artists. A wooden deck joins the ateliers, protecting the healing ecology and limiting visitors' contact with dirty soil. After ten years of use, the property will be returned to the Amsterdam municipality, cleaner and more prosperous than before.



Figure 7.1: De Ceuvel, Amsterdam in the Netherlands
© Nowek, 2015

For more information: https://green-circle.eu/doughnut-case-study-de-ceuvel-a-model-of-sustainable-urban-development/, https://deceuvel.nl/nl/about/sustainable-technology/

7.3.2 Power Plants Phytoremediation Garden, Australia

Location: Sydney, Australia
Area: 1,000-square-meter
Date: 2019 - ongoing
Aim: "living laboratory" for scientific research

Power Plants Phytoremediation Garden is an experimental land management design research project located at the former White Bay Power Station (WBPS) in Rozelle, Sydney. This design research project is a cross-discipline collaboration between the University of Newcastle (Landscape Architects), the University of Technology, Sydney (Phytoremediation Lab) and the University of New South Wales (Artists/Filmmakers). WBPS's prior operation as a coal-fired power plant resulted in site pollutants that remain in place. This joint project uses techniques to visually depict recovery while also offering an environmental teaching platform. The phytoremediation garden contains a variety of both native and non-native species, such as sunflowers, marigolds, mustard, and lupins, which eliminate toxins from polluted soils, while the plant materials serve as a visual litmus. Over the course of a year, the plants metabolized toxins, with significant amounts of pollutants removed in successive harvests. The 1000-square-meter garden was split into ten 100-m² areas. The planting design proposal



Figure 7.2: Power Plants Phytoremediation Garden, Australia
© 'Chulalongkorn University Centenary Park', n.d.

comprised two plot types: monocultures and meadows. Monoculture plots were 2 m in diameter, arranged in a grid of 25 subplots, each hand-sown with a single species. Meadow mix plots used a variety of seeds mixed into 100 m² sections, aiming to create ideal rhizosphere conditions for toxin removal.

For more information: https://powerplantsphytoremediation.com/
https://www.landcom.com.au/assets/Uploads/Power_Plants_Phytoremediation_Gardens.pdf

7.3.3 Freshkills Park, USA

Location: New York, USA
Area: 2,200 acres
Date: 2036
Aim: rehabilitation

Freshkills Park will be nearly three times the area of Central Park, making it the largest park in New York City in over a century. Prior to its closure in 2001, this was the biggest landfill in the world. After the shutdown of the landfill, the Municipal Art Society (MAS) partnered with the City of New York to host a worldwide design competition organized by the Department of City Planning. The process culminated in an illustrated park plan, known as the Draft Master Plan. Since then, the environment has been built up with layers of soil and infrastructure, and the region has become a hub for wildlife, recreation, research, education, and art. The park's interior is presently only accessible during organized park activities, which provide for early access to learning and exploring possibilities. The park is being created; some parts of the park are already open to the public, offering hiking, bird watching,



Figure 7.3: The Master Plan of Freshkills Park
© Freshkills Park Alliance, n.d.

and community events. The park will be open in phases until 2036.

For more information:
https://freshkillspark.org/the-park/the-park-plan

7.3.4 Cheonggyecheon Stream Restoration Project, South Korea

Location: Seoul, South Korea
Area: 252000 square meters
Date: 2005
Aim: Urban revitalization, environmental benefits, cultural heritage, flood protection, and economic growth.

The Cheonggyecheon Stream Restoration Project involved the deconstruction and removal of an elevated expressway, as well as the discovery of a 5.84 km part of the ancient Cheonggyecheon stream in the heart of Seoul, South Korea. Throughout its history, the stream served several purposes in the city before being covered by an elevated expressway in the 1970s. For more than 30 years, this natural artery was buried. It wasn't until 2003 that the municipal administration initiated a restoration effort to reintegrate this urban canal into the city fabric, reinvigorate the local economy, and bring back the area's history and culture. The project offers the city an environmentally sensitive green pedestrian corridor in an area that was previously identified as congested, overcrowded, and dirty. The restoration has offered environmental, social, and economic advantages. For example, the land prices of the properties within 50 meters of the restoration project increased by 30-50%. The project protects



Figure 7.4: The Cheonggyecheon Stream Restoration Project
© W00kie, 2006

against floods; it reduces the urban heat island effect by keeping temperatures near the stream 3.3° to 5.9°C lower. Moreover, it has become one of Seoul's most popular tourist destinations.

For more information:
https://una.city/nbs/seoul/cheonggyecheon-stream-restoration-project
https://www.archdaily.com/1020945/re-naturalization-of-urban-waterways-the-case-study-of-cheonggye-stream-in-seoul-south-korea

7.3.5 Parque La Mexicana, México

Location: Mexico City, México
Area: 30 hectares
Date: 2017 - ongoing
Aim: Recreation, Rehabilitation

The park La Mexicana is located in the center of Santa Fe, a high-density and highly urbanized area in western Mexico City. The location was originally a sand mine, leaving behind an abandoned, environmentally deteriorated area. When the mining process was completed, the government seized them, and a few years later they were utilized for a real estate project. However, the people of the region proposed the idea of a metropolitan park to the government due to the lack of green areas in the district. After a decade of neighborhood management, a deal with Mexico City's government was reached in 2016. The arrangement provided for the sale of 30% of the total property to developers, with the proceeds used to build the park on the other 70%. The Government of Mexico City granted the Association of Colonists of Santa Fe a concession to run and maintain the public park using self-generated resources. This means that the park does not rely on public funds and is self-sustaining. The park's green spaces include more than 2,500 trees and 70,000 square meters of grass for various activities such as



Figure 7.5: La Mexicana Park and its surroundings
© Wikimedia Commons, n.d.

picnics, 80,000 shrubs, the majority of which are pollinators, and 40,000 square meters of ground cover on slopes. It also offers free cultural, athletic, and social programs to the general public. La Mexicana attracts over two million visits each year, with children accounting for 30% of them, and its entrance is free.

For more information:
https://parquelamexicana.mx/la-mexicanas/

7.3.6 Al-Azhar Park, Egypt

Location: Cairo, Egypt
Area: 300 square meters, 72 acre
Date: 2005 - ongoing
Aim: Recreation, Urban Development

Al-Azhar Park is an enormous public park and urban development project in Cairo's historical city. It was originally an abandoned landfill site that was chosen due to its central location to create a green lung in the heart of Cairo. The project was initiated by the Agha Khan Foundation in 1984 to donate a park to the citizens of Cairo. The implementation process had three main phases: First Phase [1990-1999]: Ayyubid wall restoration; the Second Phase [2000-2005]: Development and implementation of the Al-Azhar Park.

The Third Phase [2000-2009] mainly focused on urban renewal and social projects in Darb al-Ahmar. The master plan of the park includes a large pedestrian spine that runs north-south, connecting many landscape components built in an Islamic style. The park has water channels, fountains, underground gardens, and plazas with Islamic geometric shapes, as well as custom-designed furniture and lighting fixtures installed by local artists from adjacent neighborhoods. The park also has conference facilities, children's playgrounds, cafés, and a restaurant overlooking an artificial lake. The master plan's main spine provides areas for social gatherings and activities that are open to both residents and visitors. Al Azhar Park attracts over 2 million people annually.



Figure 7.6: Al-Azhar Park, Egypt
© Nazmi, 2013

For more information:
https://araburban.org/en/infohub/projects/?id=3623
https://azharpark.com/about-us/

7.4 The Findings

In administering and implementing urban greening programs for deindustrialized brownfields and contaminated regions, local authorities play a variety of roles with duties that extend across the institutional, operational, and strategic levels:

Institutional level

- Collaboration with international funding agencies such as Al-Azhar Park, Egypt, when the local government's partnership with the Agha Khan Foundation resulted in transforming an abandoned landfill into a public park, showing the government's role in supporting urban green infrastructure projects.

- Coordination and Oversight: Local governments often manage the coordination between various stakeholders, including environmental agencies, urban planners, landscape architects, universities, and community groups. As a mere example, the idea of establishing Parque La Mexicana, Mexico, was based on the community's proposal, and it needs arrangement between the real estate developers and the community. Additionally, the example of the Power Plants Phytoremediation Garden was an experimental land management design research project based on collaboration with two universities, the University of Newcastle and the University of New South Wales.

- Capacity Building: Developing institutional capacity is another duty of local governments. This may entail training regional organizations or cultivating alliances with academic institutions, research centers, or non-governmental organizations that focus on urban greening and environmental restoration.

Strategic Level

- Land Use Planning and Zoning: Authorities need to determine the deindustrialized sites, polluted areas, or brownfields that can be converted into parks, gardens, or recreational spaces and make decisions about land use planning, such as illustrated in the example of the Cheonggyecheon Stream Restoration Project, South Korea.

- Regulation and Enforcement: They can enforce environmental laws, including those pertaining to cleaning up contaminated land, following guidelines, and making sure green initiatives are sustainable.

- Funding and incentives program: the local authority can organize a specific program that offers funds and grants for those greening projects in the deindustrialized sites, polluted areas, or brownfields.

Operational level

- Organizing design competitions can be one of the solutions that help in the design process of greening polluted areas, such as the example of Freshkills Park, USA.

- Organizing participatory workshops within the design process to involve the community in the design-making, such as the example of De Ceuvel, Netherlands, and Parque La Mexicana, Mexico

- Implementation and Maintenance: Once projects are planned, local authorities oversee the physical transformation of sites, or they can grant a private sector agency or a civil society entity to manage and maintain the project. For example, it granted the Association of Colonists of Santa Fe a concession to run and maintain the Parque La Mexicana in Mexico using self-generated resources.

- Providing activities in the green spaces to become more livable, such as the activities and community events organized in the example of Freshkills Park, USA.



8



VERTICAL FARMING

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VERTICAL FARMING

Vertical farming involves growing plants in layers indoors under LED illumination and regulated growth and nutrition systems (Masterson, 2022). This farming system uses Controlled Environment Agriculture (CEA) technology to monitor humidity, temperature, gases, and light levels in indoor environments. For example, farmers utilize artificial lighting and metal reflectors to simulate natural sunshine ('Vertical Farming - All You Need to Know!', n.d.). Automation is the key to increased efficiency. Vertical farms utilize a variety of technologies to monitor crops and generate optimal growing conditions, including software, robotics, and data analytics (Masterson, 2022).

8.1 Benefits

Vertical farms have a lot of environmental and economic benefits. From the environmental perspective, they are built in a small footprint and even integrated into existing buildings and rooftops. They are built in urban settings, reducing the distance food travels between farms and grocery shops and cutting their carbon impact ('Vertical Farming: Everything You Need to Know | Eden Green,' 2023). In addition, they utilize a variety of technologies to monitor crops and generate optimal growing conditions, including software, robotics, and data analytics. This involves regulating temperature, humidity, CO , and light. This controlled environment agriculture helps reduce the environmental effect of vertical farms by decreasing the need for pesticides (Masterson 2022). From the economic perspective, using vertical farming techniques will save a lot of resources, as farmers may utilize 98% less water and 99% less land than the traditional farming methods. Moreover, they increase food production. As it has faster growth cycles than traditional outdoor farms, which are dependent on the weather conditions, It may produce agricultural yields 240 times higher than regular farms in a year ('Vertical Farming: Everything You Need to Know | Eden Green,' 2023).

8.2 Types

8.2.1 Hydroponic Systems

It involves growing plants without soil by utilizing mineral fertilizer solutions in water. This strategy is appropriate for urban environments with limited area, such as roofs or empty lots. This methodology encompasses multiple submethods. Probably the most frequent hydroponics approach is the floating raft system. Growers insert a polystyrene raft in a huge container with water and fertilizers for the plants. The raft features holes or net pots for growing lightweight, fast-growing plants like lettuce and spinach, as well as herbs like basil, cilantro, and parsley ('Vertical Farming - All You Need to Know!', n.d.).

8.2.2 Aeroponic Systems

It is an innovative form of hydroponic system that replaces water with nutrient-rich mists. This system has no growth media. Cultivators place the seeds in tiny containers lined with foam. While the plant's top stays exposed to light, the roots are nourished by a periodic spraying of nutrient-rich water or fine, high-pressure mist. This approach was inspired by NASA's crop-growing efforts in space. Aeroponics encourages quicker plant development than the other methods and uses less water ('Vertical Farming - All You Need to Know!', n.d.).

8.2.3 Aquaponic Systems

Aquaponics is a sustainable farming system that combines aquaculture (fish cultivation) and hydroponics (soilless plant growth). In an aquaponic system, fish are raised in tanks, and their waste fertilizes plants growing in water, while the plants filter and clean the water for the fish. This results in a closed-loop, symbiotic interaction between the two, lowering the demand for chemical fertilizers and reducing water waste. An aquaponic system is very water-efficient, using just roughly one-sixth of the water to produce up to eight times more food per acre than typical agriculture ('Vertical Farming - All You Need to Know!', n.d.).

8.2.4 Dryponics Systems

A new farming technique that would allow them to keep plants alive, with roots intact, until the final moment of consumption. Dryponics still uses extremely small quantities of water, as it uses 68% less water than known hydroponic systems and 37% less water than aeroponic systems. This is feasible because of the specific growth medium, which exposes roots to higher levels of oxygen compared to dissolved oxygen in water, resulting in superior overall growing circumstances (Farmers Cut, n.d.).

8.3 Examples

8.3.1 Eden Towers, Australia

Location: Perth, Sydney
Date: 2019 - ongoing
Aim: food production

Eden Towers is an innovative future food company that specializes in using vertical farming technology to provide fresh, wholesome, and high-quality vegetables. It was founded in 2019 with a headquarters in Perth, Western Australia, and many farms, one in every major city in Australia. Eden Towers uses cutting-edge vertical farming systems that automate everything from sowing to harvesting by utilizing robots, IoT, and AI, and they use one-tenth the space and 98% less water than conventional farming. Their vertical farm in Perth is based on a collaboration with IGS (Intelligent Growth Solutions), Scotland's top supplier of vertical farming technology. Four 12-meter-tall Growth Tower structures were constructed, creating a precisely regulated indoor environment that will allow plants to flourish year-round without the need for soil.



Figure 8.1: Indoor vertical farming at Eden Towers
© 'Our Story | Eden Towers, 2025

For more information: https://www.edentowers.life/pages/about-us

8.3.2 Sky Greens, Singapore

Location: singapore
Area: 36,500 square meters
Date: 2010 - ongoing
Aim: food production

Sky Greens is the world's first low-carbon, hydraulic-powered vertical farm. It is established as a people-public-private collaboration between Sky Greens Company and the Agri-Food and Veterinary Authority of Singapore (AVA). Sky Greens' vertical farms take the shape of towers housed in enormous greenhouses, following the hydroponic technique. Each tower has 38 shelves that store the vegetable pots. Each pot contains around six plants. Each tower, which is just 9 m tall, 3 m long, and 1.6 m broad, can hold up to 2500 plants. To guarantee that all of the plants receive an adequate quantity of sunshine, the shelves are rotated at a modest and consistent rate of one rotation every 16 hours. To do this, a hydraulic system consisting of a series of reduction gears is employed to guarantee the shelves rotate consistently and efficiently. Sky Greens' greenhouses are 24m long and 8.5m wide, with each capable of housing 16 towers. Greenhouses are designed not only to prevent heat loss, but they also keep animals and insects out while allowing sunlight in, reducing the use of pesticides and making plants safer to eat. Large portions of greenhouse walls are made with wire mesh, preventing insects and animals from entering and allowing air circulation to keep plants cool. This circulation ensures a fresh oxygen and carbon dioxide supply, but temperatures in the upper portions can reach up to 40 °C.



Figure 8.2: The greenhouses of Sky Greens from outside
© Kai et al., 2017; 'Sky Greens, about Us', n.d.

For more information: https://chemproj2017.wordpress.com/the-sky-is-greener-on-the-other-side/
https://www.skygreens.com/about-skygreens/

8.3.3 Nordic Harvest, Denmark

Location: Copenhagen, Denmark
Area: 6,700 m²
Date: 2020 - ongoing
Aim: food production, commercial

Nordic Harvest is Europe's largest indoor vertical farm. The farm consists of 14 floors in a hall in a controlled environment in Taastrup, using LED lights for photosynthesis and CO for air temperature and humidity. The farm follows the hydroponic system, as the plants grow in water with added nutrients, free from pests, fungal spores, soil bacteria, and pollution particles. This method eliminates the need for pesticides and other harmful chemicals, allowing the plants to grow big and full of flavor and nutrition. Under controlled vertical farming conditions, plants can achieve a remarkably rapid growth cycle, requiring only 14-21 days from seed to harvest, due to the absence of environmental stressors like wind, extreme weather, and soil-borne challenges. The vertical farm reduces the time from harvesting to refrigeration, packing, and supermarket distribution to less than an hour. This method eliminates the need for washing, allowing plants to remain fresh for two to three times longer than traditionally farmed vegetables. This extends freshness, reduces food waste,



Figure 8.3: The Nordic Harvest in Denmark
© CC Getty Images, 2020

and simplifies customer preparation. The farm is powered entirely by 100% renewable energy from Danish wind farms, and it recycles all water used in production, ensuring a closed-loop system with no discharge of nutrients into rivers or streams.

For more information:
https://www.nordicharvest.com/saadangoervi/sadan-gor-vi

8.3.4 AeroFarms, USA

Location: Newark, New Jersey, USA.
Area: 30,000-square-foot
Date: 2015 - ongoing
Aim: food production, commercial

AeroFarms is a pioneering company in aeroponic vertical farming, using cutting-edge technology and environmentally friendly techniques to deliver year-round fresh, local food. They employ a patented aeroponic technique to sprinkle the roots of the plants with the exact quantity of targeted nutrients, water, and oxygen. The employed aeroponic system is a closed-loop system, which uses up to 90% less water than field farming and hydroponics. The plants are cultivated in vertical towers with numerous layers stacked to maximize space and productivity. The company developed a patented indoor growing system with precise controls, ensuring superior plant performance. This system includes advanced lighting, automated nutrition delivery, and specialized HVAC and building designs. It allows year-round growth without pesticides, ensuring food safety and allowing for year-round cultivation without reliance on chemicals. Due to financial difficulties, AeroFarms filed for Section 11 bankruptcy at one time. But it showed their resilience and persistent dedication



Figure 8.4: The aeroponic vertical farming at AeroFarms in New Jersey
© Weiss/AFP/Getty Images, 2019

to promoting sustainable agriculture, and it demonstrated AeroFarms' willingness to overcome difficulties and continue its aim of changing the agricultural environment.

For more information:
https://www.aerofarms.com/about-us/

8.3.5 AquaFarms Africa, Guinea

Location: Conakry, Guinea
Area: 12x12 m area
Date: 2019 - ongoing
Aim: food security, youth employment

AquaFarms Africa is an agritech business with headquarters in Conakry, Guinea, with ambitions to expand throughout West Africa. In order to sustainably and locally produce fish as well as specialty vegetables and fruits that are often imported from outside the continent, they use aquaponics farming methods, which combine soilless agriculture and fish farming. The aquaponic systems from AquaFarms Africa are designed to be simple and affordable, and they are easily set up in a 12x12 m area that can produce 1 ton of vegetables and fruits. Because these systems are climate-controlled, it is possible to grow crops that aren't usually suitable for tropical climes, opening up more lucrative markets. The company's main mission is to encourage youth employment and food security in West Africa. As they do not only produce fresh food, they empower the youth by providing the tools and training necessary to run their own aquaponic farms. Their model enables young business owners, especially women, to raise their salaries by up to 10 times the national average.



Figure 8.5: The AquaFarms Africa in Guinea
© Thomas, n.d.

For more information:
https://www.forbes.com/sites/meghanmccormick/2020/02/28/aquafarms-africa-is-using-aquaponics-to-grow-food-and-entrepreneurs/,
https://solve.mit.edu/challenges/digital-inclusion/solutions/49231
https://www.aquanet.com/guinea/conakry/aquaculture-aquaponics/aquafarms-africa

8.3.6 &ever farm, Kuwait

Location: in the middle of the Kuwaiti desert
Area: 3,000 square meters
Date: 2020 - ongoing
Aim: food production

&ever is a Hamburg-based farming enterprise that grows high-quality plants inside while conserving natural resources. It has established its first commercial indoor vertical farm in Kuwait in cooperation with Kuwait's NOX Management. This farm utilizes Dryponics technology to produce up to 550 kg of leafy greens, herbs, and microgreens daily (around 250 varieties of greens and herbs). The project demonstrates an innovative technique to decrease water and pesticide use. It utilizes 90% less water and 60% less fertilizer than traditional agricultural methods, and it uses zero pesticides, resulting in an environmentally sustainable system. Because of the farm's monitored environment, the fresh greens do not need to be washed and are gathered right before consumption, ensuring great nutritional value. The company seeks to be the most energy-efficient indoor vertical farm and hence the most ecologically friendly. Key factors include the utilization of insulated, climate-controlled rooms, a high level of automation, and an AI-based continuous improvement cycle. Internet of Things (IoT) sensors and



Figure 8.6: Bird's-eye view of &ever Farm in Kuwait
© &ever, 2021

edge computing devices collect data from several hundred data points spread around the farmhouse, monitoring sowing and germination as well as critical characteristics like carbon dioxide levels, temperature, humidity, and ventilation.

For more information:
https://news.sap.com/2020/04/indoor-farming-ever-revolutionize-food-chain/

8.4 The Findings

Institutional level

- Cooperation with the Private Sector: Governments have the ability to encourage collaboration between public and private organizations. As demonstrated by Sky Greens in Singapore, the partnership between Sky Greens and the Agri-Food and Veterinary Authority (AVA) made it possible to build the first hydraulically driven, low-carbon vertical farm in history.

- Fostering Innovation and Research: Local governments may encourage the study of vertical farming technologies like aquaponics, hydroponics, and aeroponics. Investing in vertical farming-focused innovation hubs or incubators might hasten the creation of new agricultural techniques and boost output.

- Establishing Industry Standards: To guarantee food safety, water management, and environmental sustainability in vertical farming operations, governments should collaborate with industry associations to develop standards and certifications. These rules can assist in guaranteeing that the industry conducts itself in an ecologically conscious way.

Strategic Level

- Policy Development: Local authorities have the authority to enact rules that support vertical farming. In order to promote sustainable urban agriculture, this may involve zoning regulations that permit the installation of vertical farms on roofs or in repurposed buildings.

- Funding and Incentives: Governments might provide funding and incentive programs to support the vertical farming projects with tax incentives, grants, or subsidies. The use of cutting-edge farming technology that serves sustainability objectives is encouraged, and farmers' initial investment burden is lessened with financial help.

- Supporting Sustainability Goals: Local governments may tackle problems like food security, carbon emissions, and water conservation by incorporating vertical farming into larger sustainability strategies. As demonstrated by the examples (such as Nordic Harvest and AeroFarms), vertical farming uses less water and land, which is in line with sustainability initiatives.

Operational level

- Education and Training: To equip people with the knowledge and abilities needed for vertical farming, such as data analytics, robots, and hydroponic growing methods, governments can offer educational programs. This would contribute to the development of a trained labor force to sustain the expanding vertical farming sector, such as the example of AquaFarms Africa

- Monitoring and Data Gathering: Establishing networks and databases for vertical farms to exchange information and best practices might be considered operational assistance. To monitor environmental conditions, local governments might promote the adoption of IoT (Internet of Things) technology, which would increase production and efficiency in all vertical farming operations.

- Enhancing the cooperation between different international companies that use different technologies of vertical farming, such as the example of Eden Towers.



9



COMMUNITY GARDENING

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COMMUNITY GARDENING

Community gardens are pieces of land cultivated by local individuals who grow fresh produce, such as fruits, vegetables, and herbs, for personal and communal consumption (Hond, Ratima, & Edwards, 2019). A community garden is defined as a type of edible urban greening as an area within a city that is either communally or individually cultivated by local citizens, who may be from the adjacent neighborhood or other areas of the city (Veen, 2015). Community gardening differs from other types of urban agriculture in that it is inclusive, community-focused, and accessible to individuals of all ages, genders, and cultural backgrounds, as community gardens are considered common spaces where people join together to grow (Kingsley, Townsend, & Henderson Wilson, 2009).

9.1 Benefits

Community gardens have a lot of environmental benefits, such as climate change mitigation, promoting biodiversity, and reducing rain runoff, as well as reducing the use of fossil fuels as they reduce food transport (McKelvey, 2015). From the social perspective, community gardens play a significant role in social cohesion and interactions (Dolley, 2020). They strengthen communities' feelings of identification, ownership, and stewardship (McKelvey, 2015). Moreover, they help the refugees and immigrants to integrate into their new communities, as they assist them in rediscovering their feeling of belonging by adopting gardening traditions from home or creating relationships with the local area (Agustina & Beilin, 2012). They provide social resilience during crises such as the two World Wars; community gardens have been crucial in ensuring food security for urban residents (Barthel, Parker, & Ernstson, 2015).

Community gardens also contribute to youth education and knowledge exchange (McKelvey, 2015), and they provide chances for community empowerment and democratic principles through participation and cooperation in the decision-making process (Ghose & Pettygrove, 2014). From the economic perspective, community gardens provide training and job opportunities for the community (Cohen & Reynolds, 2014). They provide access to fresh food, contributing to food production, accessibility and affordability (Rusciano, Civero, & Scarpato, 2020). They also raise the real estate value of nearby properties, especially in the disadvantaged neighborhoods (McKelvey, 2015).

9.2 Types

There are various types of community gardens, as they differ in their privacy level, management and purpose.

9.2.1 Privacy Level

There are different types of community gardens based on their privacy level regarding plot leasing and policies.

1. **Allotment gardens** are considered a type of community garden. Despite being private plots that individuals or families rent or lease for growing their own food, they are defined as "a collective of garden plots that lie adjacent to each other, effectively subdividing a larger piece of land" (Bellows, 2004).
2. **"Shared community gardens,"** which consist of a land plot where everyone is welcomed to engage in agriculture together throughout the entire land.
3. **Another type that combines the two models** is where the people divide the land into small plots or beds, and everyone is responsible for their own plot or bed; however, they share the whole plot together without any fences (Lilith, 2014).

9.2.2 Management

The management of community gardens and farms can be categorized into four types:

1. **Community gardens:** managed by local individuals or volunteers.
2. **Institutional gardens and farms:** affiliated with institutions like schools, hospitals, or churches.
3. **Community farms:** operated by non-profit organizations.
4. **Commercial farms:** run as for-profit businesses (Veen, 2015).

9.2.3 Purpose

According to the Urban Harvest Organization, community gardens (CGs) come in various types, each serving unique, yet sometimes overlapping, purposes.

1. **Donation gardens:** These gardens donate produce to local food banks, soup kitchens, and homeless shelters to help address food insecurity (Urban Harvest, n.d.).
2. **Educational gardens:** Designed for learning, such as school gardens, these serve as outdoor classrooms managed by teachers, volunteers, and students. They reinforce school subjects while teaching children essential skills in cooperation, decision-making, and healthy living (Grant, 2023). School gardens also foster qualities like responsibility, patience, self-confidence, and curiosity (Bradley, 2019). Some educational CGs emphasize non-formal environmental education for the broader community, allowing locals to learn site-specific gardening techniques (Grant, 2023).
3. **Therapeutic gardens:** These focus on promoting health and well-being for participants, including patients in hospitals or eldercare facilities. Therapeutic CGs provide sensory stimulation and outdoor activity, particularly benefiting those with physical or mental disabilities. They are often designed with accessible features such as elevated beds, sturdy walkways, and Braille signage for blind gardeners (Grant, 2023).
4. **Commercial gardens:** Aimed at economic sustainability, these gardens allow local gardeners to sell produce to the public, including consumers, restaurants, and farmers' markets. They offer training in gardening and entrepreneurship, educating participants on the complete process from planting to selling (Grant, 2023). This type is especially beneficial for youth who may lack experience in growing and understanding the origin of food (Bradley, 2019).

9.3 Examples

This part will show different examples from various countries all over the world. The examples were chosen based on the different types illustrated in the previous part.

9.3.1 Prinzessinnengarten Community Garden, Germany

Location: the New St. Jacobi Cemetery, Berlin, Germany
Area: 7.5 hectares
Date: founded in 2009, relocated in 2020
Aim: Ecological, Educational, Social

The Prinzessinnengarten Kollektiv Berlin is a community garden that was established in 2009 by Nomadisch Grün, a non-profit organization, on a former wasteland in Moritzplatz in the Kreuzberg neighborhood of Berlin. This location was around 6000 square meters, which includes numerous raised beds, open workshops, urban bee colonies, a garden café, a learning kitchen for processing the local harvest, and spaces for markets, workshops, and networking gatherings for individuals dedicated to participatory and sustainable urban design. Since then, the Prinzessinnengarten has become a pioneer example. In 2020, the garden was moved to a new location in Neukölln, at the new St. Jacob cemetery, which includes a garden cafe, a raised bed meadow, an agricultural field, and raised beds belonging to the kindergartens in the surrounding neighborhood as an environmental education meadow. Moreover,



Figure 9.1: The gardening activities in the agricultural field in Prinzessinnengarten
© Author, 2024

Prinzessinnengarten is one of the 300 community gardens supported by the Berliner community gardens program, established by the Senate Department for the Environment, Transport and Climate Protection (SenUVK).

For More Information:
https://prinzessinnengarten-kollektiv.net/ueber-uns/

9.3.2 The Battery Urban Farm, USA

Location: The Battery, at the southern tip of Manhattan, New York, USA
Area: one acre
Date: founded in 2011
Aim: educational

The Battery Urban Farm is an educational farm where New York City's students, citizens, and tourists may experience sustainable farming, taste organic fresh vegetables, and learn environmental responsibility. It was founded by the Battery Conservancy, a non-profit organization that manages Battery Park, 25 acres, at the southern tip of Manhattan. This community garden was inspired by eight students from Millennium High School, who initially wanted a small vegetable garden. Within a year, the farm had grown to 870 children from Lower Manhattan schools. Today, the farm receives almost 5000 kids from over 100 schools in the five municipalities and beyond, in addition to community volunteers, to raise hundreds of pounds of vegetables, fruits, herbs, grains, and flowers each year. It is the biggest educational farm in



Figure 9.2: Aerial view of the Battery Urban Farm
© 'Battery Urban Farm - NYC Urban Farms,' 2024; Zavatto, 2014

Manhattan. The community garden is usually open for volunteers on Wednesdays.

For More Information:
https://www.thebattery.org/destinations/urban-farm/

9.3.3 Kibera Community Garden, Kenya

Location: Kibera, an informal settlement in Nairobi, Kenya
Area: small plots distributed in Kibera, including Kibera Park (50 square meters)
Date: started 2006
Aim: source of income, education, and food security.

The Kibera Slums Community Garden is a sustainable project in Nairobi, Kenya, aimed at providing income, education, and food security to residents of the slum. Kibera, one of Africa's largest informal settlements, has over 200,000 residents living in poverty. The Kounkuey Design Initiative (KDI), a non-profit community development company, is working to turn the slum's marginal lands into productive public spaces. Local groups, NGOs, and international organizations collaborate to run the project, with contributions from Solidarités International and the Kenya Slum Upgrading Programme (KENSUP). The team has developed projects involving different scales, such as Kibera Park, a 50-square-meter farm with a greenhouse irrigated by recycled water, and KPSP05, a smaller site completed in 2015. Due to space constraints, residents use sacks filled with manure, soil, and stones for vegetable cultivation.



Figure 9.3: The vegetable community garden in Kibera
© Tyrrell, 2016

For more information:
https://landscapeaustralia.com/articles/kibera-public-space-project-1/

9.3.4 Al Khalifa Heritage and Environmental Park, Community Garden, Egypt

Location: Al Khalifa neighborhood, Cairo, Egypt
Area: 3000 square meters with 9 levels
Date: 2017 - ongoing
Aim: Educational, Food Security

Al Khalifa Community Garden, part of the Athar Lina Initiative in Historic Cairo, was launched in 2012 as a pilot project for a research project on Integrated Solutions for Groundwater Problems in Historic Contexts.

The park, operated by the Built Environment Collective-Megawra, is a multidimensional park that includes a children's playground, an open theater, murals, waste collection points, a women's multi-use space, green areas, and an urban agricultural sector.

The micro-gardening space, spanning 300-400 square meters , is designed to train women and children in urban gardening. The "Khalifa Heritage Urban Greens Project," funded by the US Forest, organizes interactive educational workshops in the garden to involve women and children in gardening activities. Around 20 women participate in these workshops, focusing on food security due to Egypt's economic situation. The garden provides access to fresh food and encourages gardening on balconies. The project aims to provide a sustainable and engaging environment for urban gardening in Cairo.



Figure 9.4: Multi-colored pedestrian pathways at Al-Khalifa park intersecting with cultural preservation
© Author, 2024

For more information:
https://atharlina.com/projects/alkhalifa-park/

9.3.5 The Manguinhos Garden, Brazil

Location: Manguinhos, Rio de Janeiro, Brazil
Area: 2.4 to 3.2 hectares
Date: 2013
Aim: food security and employment

The Manguinhos garden, part of the Hortas Cariocas initiative, is located in Rio's poorest and most violent favela, Manguinhos. Established in 2013, the garden, which is the largest community vegetable garden in Latin America, has over 300 raised beds filled with soil. In 2020, it produced 82 tons of food, most of which was donated during the Covid-19 pandemic. In 2022, the garden provided free, affordable food to around 800 families per month, employing over 20 local workers. The project, funded by municipal and federal funds, works in partnership with the Manguinhos Residents Association and provides workers with training, basic equipment, and enough food to feed their families once a week. In compliance with standards, the garden must also provide a portion of the product to at-risk members, while the remainder is sold commercially to Brazilian distributors. Some of the employees have a history of drug use and criminal activity, making the garden a life-saving tool and potentially a therapy for those affected by the epidemic.



Figure 9.5: Bird's-eye view of Manguinhos Garden
© Peet, 2021

For more information:
https://www.aljazeera.com/news/2021/3/6/food-security-is-security-brazil-urban-farm-success-story

9.3.6 Community garden at Kasturba Nagar, India

Location: Kasturba Nagar, located in the Adyar region of Chennai, India
Area: 139.35 square meters
Date: 2018 - ongoing
Aim: Knowledge creation and awareness-raising

In 2018, Samyuktha Kannan (a citizen of Chennai City) proposed the Community Garden Project to the resident Welfare Association (RWA), a non-governmental organization (NGO) in Kasturba Nagar. She convinced them how a community garden can bring communities together, keep the area clean, and allow everyone to attempt gardening. The RWA uses a public park community hall for meetings and activities, but the community hall is surrounded by open dry ground and an unmanaged field, which was later used to build a 1500-square-foot community garden. The original project team, led by Samyuktha Kannan, discussed the necessary infrastructure for the activities. For example, different proposals addressing what sort of greening ideas may be carried out (such as the utilization of native species, cultivation of local crops, providing a habitat for pollinating bees, etc.) were considered, and a plan was prepared for future implementation. The garden is a volunteer-driven project where residents of all ages, from children to the elderly, come together to engage in weekly gardening activities every Saturday, free for the public. Moreover, on a daily basis, three or four committed volunteers look into and carry out the specifics of garden care. In addition to the gardening activities and sapling and seed exchange programs, events and workshops are organized. The community garden has allowed people to come together to reclaim their common area and be outside even during the COVID-19 pandemic.



Figure 9.6: Community prepping the soil for planting at the garden
© Muthukumar, 2021

For more information:
https://citizenmatters.in/chennai-kasturba-nagar-community-garden-green-space/

9.4 The Findings

Although community gardens are community-based projects that are usually initiated by community members and civil society organizations, community gardens often rely on local authorities for support. Local authorities play a significant role in promoting these gardens, providing both direct and indirect support through different levels, as follows:

Institutional level

- Fostering collaborations and building networks with NGOs and international organizations that are interested in transforming marginal lands into productive community spaces, such as the Kibera Community Garden in Nairobi.

- Provide financial backing, as seen in Manguinhos Garden, Rio de Janeiro, where municipal and federal funding sustains operations, supports workers, and aids food distribution.

Strategic level

- Local authorities can organize a specific governmental program to support the community gardens, such as this community gardens program in Berlin, Germany.

- Local authorities can develop policies to facilitate the land allocation to the community garden initiatives to guarantee that community organizations have safe access to the property for gardening activities.

- Empowering residents through participatory approaches, as in the Kasturba Nagar Community Garden, Chennai, where residents proposed and managed the garden, ensuring community ownership and involvement.

Operational level

- Land Allocation: the local authorities can offer vacant or underutilized land for community gardens with reduced or no rent.

- Raising Awareness: Local authorities can help to raise the awareness of the communities about the community gardens concept and their environmental, social and economic benefits. They conduct seminars, events, or campaigns to promote gardening principles and show how to establish and manage a community garden.

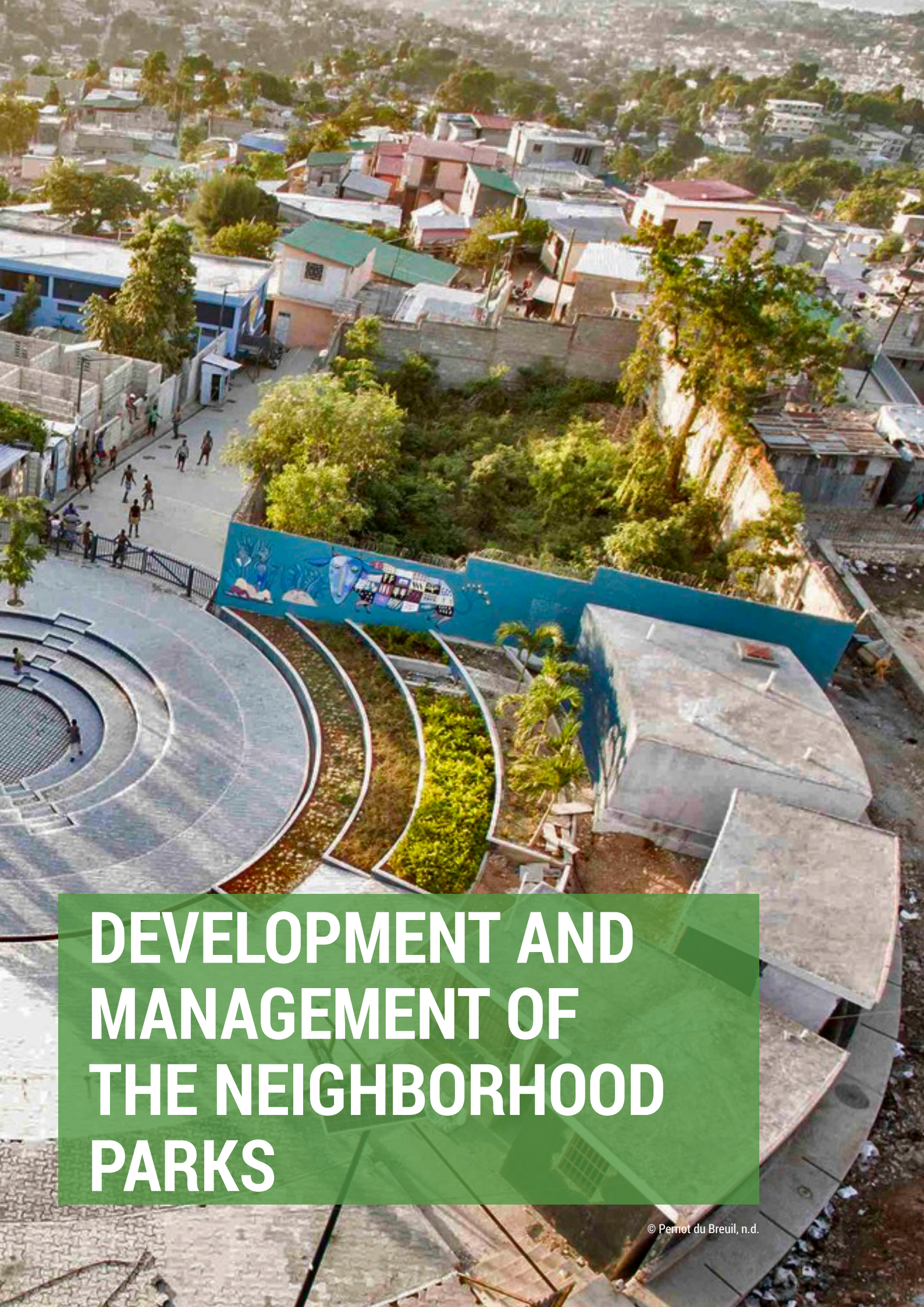
- Facilitating workshops and skill-building sessions, such as the Battery Urban Farm in New York, which educates thousands of students and citizens about sustainable farming and environmental responsibility.

- Resource Provision: Local authorities can help in providing the needed resources, including water, soil, compost, and gardening tools.

- Funding: Local authorities can provide grants or funds for infrastructure such as fences, paths, and storage facilities, such as the example of the Manguinhos Garden in Rio de Janeiro, Brazil.



10



DEVELOPMENT AND MANAGEMENT OF THE NEIGHBORHOOD PARKS

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DEVELOPMENT AND MANAGEMENT OF THE NEIGHBORHOOD PARKS

A pocket park, also known in much literature as a microgarden, a neighborhood park, a mini park and a vest-pocket park, can be defined as a tiny outdoor place, typically no more than a few city lots, meant to provide vegetation, entertainment, and a tranquil refuge in densely populated neighborhoods ('Micro Parks and Pocket Gardens: The Benefits of Small-Scale Parks' 2020). It is also defined as an accessible small open space of 0.125 acres (around 500 square meters). Additional common characteristics of those neighborhood parks, in addition to size, are that they service a population of 500–1000 people within 5-10 minutes' walking distance; are accessible by bicycle or foot, while driving is not advised; and provide a range of amenities and activities to draw in as many diverse users as possible (Sinou, 2013). They are usually accessible from two to four sides of the street, with a minimum frontage of 30 m for visibility (Hamdy & Plaku, 2021).

10.1 Benefits

These small parks have a lot of environmental benefits, as they preserve nature's presence in the city while protecting environmental resources, enhancing the microclimate, mitigating climate change, reducing pollution, and promoting biodiversity. They integrate sustainability and climate change into day-to-day activities, balancing environmental and social responsibility with personal financial security. From the social perspective, neighborhood parks act as communal spaces for social cohesion and provide social interaction opportunities. Moreover, by encouraging lively public areas, they may even improve neighborhood safety and security. Some parks serve as outdoor classrooms for both adults and children, with educational programs on sustainability and the environment.

Additionally, those neighborhood parks are inclusive, as they are open to all the people from different social and age groups. It also can include handicaps, and this is particularly helpful in crowded cities when bigger parks may be far away. From the economic perspective, small parks that are aesthetically beautiful and inviting can benefit local economies by drawing in additional companies and increasing property values. Moreover, they support the nearby shops and the surrounding cafes and restaurants (Hamdy & Plaku, 2021; Vasilevska, 2020).

10.2 Types

10.2.1 Based on the Activities

The activities in those neighborhood parks differ according to the characteristics of the surrounding neighborhood, which could be residential areas, community centers, or business districts, and they also depend on the potential users' needs (Hamdy & Plaku, 2021).

- **Active neighborhood park** that provides some type of recreation through a variety of activities such as children's playgrounds, dog parks, open gyms, and tiny courts. Additional contents include gardens, trees, plants, and lounging areas. The development of this kind of pocket park is the most challenging since it calls for more community involvement, meticulous planning, and the identification of activities that are necessary for the local community as well as for the wider network of open spaces (Vasilevska, 2020).

- Passive neighborhood park

  Passive parks are designed primarily as tranquil seating areas featuring benches, chairs, and tables. They often include a central focal element, such as a sculpture or fountain, and are intended for relaxation rather than active recreational activities (Vasilevska, 2020).

- Bonus neighborhood park

  These spaces were either developed into parks organically as a result of impromptu meetings of locals or visitors or were intentionally designed as parks to make use of leftover spaces created by other projects (Vasilevska, 2020).

10.2.2 Based on the Funding and Management Responsibilities

- **Privately owned public spaces (POPs):** these areas are owned and maintained by private investors. This lessens the financial strain on the municipality and curtails its authority over the area. In exchange for advantages like acquiring additional development property, it provides a win-win scenario for the private owner, who is urged to provide a public space in pricey neighborhoods. Since they are privately owned, these pocket parks typically have gates and set hours.

- **Community ownership:** locals band together and seek licenses and start-up money for things like fences, gates, benches, plants, and land purchases. Local residents are in charge of the pocket park's long-term upkeep when it opens. establishing a maintenance schedule with designated responsibilities for every local member. It is possible to split maintenance expenses with community associations or the municipal council.

- **Municipal ownership** is a top-down strategy in which the government owns the property and has full responsibility for its maintenance and financing. This provides longer public access hours but a lesser degree of community engagement and sense of ownership.

- **Public-Private partnership (PPP):** The private sector or any fundraising partner does not take ownership of the space, but they play an important role by providing financial resources, materials, or urban furniture. In exchange, they may earn recognition through the placement of their logos in the area. This concept reduces the financial load on the government while also demonstrating the business sector's commitment to corporate social responsibility (Hamdy & Plaku, 2021).

10.3 Examples

10.3.1 Paley Park, USA

Location: 3 East 53rd Street, Midtown Manhattan, New York City, USA.
Area: 390 m² (4,200 square feet).
Date: 1967 - ongoing
Aim: social interaction, providing a calm place in the middle of busy business district

It is an example of a pocket park in a business district; it follows the privately owned public space model, as it is created in a very expensive district, as it was established by CBS founder William S. Paley as a memorial to his father, Samuel Paley. It is owned and operated by The Greenpark Foundation, Inc., and is supported by the William S. Paley Foundation, Inc. Its main focal point is a small fountain 20 feet high; this reduces the background noise of the city while simultaneously offering an enthralling visual and aural backdrop. The park includes movable chairs and tables to encourage social interaction. There are perennial plants, as English ivy grows on the west wall and Thorndale ivy on the east wall, so both walls remain green all year. There are 17 Honey Locust trees in the park, including 5 on the walkway. Honey locusts were chosen to provide shade to park visitors. Additionally, the park includes 20 planters with flowers and evergreens changed over the seasons.



Figure 10.1: The Paley Park in USA
© Jim.henderson, 2011

The park is open from 8 AM to 8 PM, Monday to Saturday, six days a week. With the exception of the hours of 4 to 8 p.m., smoking is not permitted in the park. National holidays are a time when the park is closed. Throughout operating hours, a security guard is on duty.

For more information:
https://www.paleypark.org/

10.3.2 The Ogród Motyli (Garden of butterflies), Poland

Location: at the intersection of Dekerta, Wałowa and Kiełkowskiego streets in the Zabłocie district of Kraków, Poland
Area: 554 square meters
Date: 2017 - ongoing
Aim: biodiversity and social interaction

The Ogród Motyli was created as a joint effort by Jagiellonian University students as part of the "Na rogu Dekerta" ("At the Corner of Dekerta") project. They launched a crowdfunding campaign and gathered 20,000 PLN for the park's development. The Municipal Greenery Authority of Kraków offered additional funds and support. Butterfly-friendly infrastructure has been built, including insect homes and particular flower and shrub kinds that draw butterflies. Plans also call for planting sparse and thick grasses, some of which will have solar lights to mimic fireflies. There are concrete slabs with yard games, cozy chairs, and a wooden sculpture that has the word "butterfly" in several languages. A board with information on the students' effort will be positioned next to an attractive cherry tree in the middle of the square. The park is intended to provide green space, amusement, and a peaceful haven in crowded areas. It is reachable by foot or by bicycle and serves the local community within a 5- to 10-minute walking radius. In addition to improving the



Figure 10.2: A close-up shot of the plantations at the garden of butterflies
© Krakow Municipal Greenery Board, n.d.

local environment, the Ogród Motyli encourages community involvement and social contacts.

For more information: https://www.krakow.pl/aktualnosci/212625%2C29%2Ckomunikat%2Cpark_kieszonkowy_z_odlotowymi_motylami.html
https://www.whitemad.pl/krakow-zmienili-klepisko-w-zielony-skwer-oto-ogrod-motyli/

10.3.3 The Nanalal Mehta Garden, India

Location: beneath the Tulpule Flyover on Dr. Babasaheb Ambedkar Road in Matunga, Mumbai, India
Area: 3.5 meters in width and 600 meters in length
Date: 2016 - ongoing
Aim: recreation, social cohesion and interaction

The Nanalal neighborhood park is Mumbai's first under-flyover park. Soon after the flyover was opened to the public, it began to develop into a gathering place for drug users, gamblers, hawkers, and other criminals. At that point, the people of Matunga assumed responsibility for stopping this from occurring. A group of 40 people called "One Matunga" raised money through crowdsourcing to pay for professional security to guard the space around-the-clock for two years and to regularly clean it and prevent it from turning into a landfill. In 2011, they began contacting several government officials with the intention of creating a little garden there, and they approached the Brihanmumbai Municipal Corporation (BMC) to develop green spaces in their neighborhood, and in 2014, they received the final approval. And after two years of groundwork, the park was opened. The park design was inspired by the Narmada River. The main pathway is a walking track covered in blue and green mosaic tiles, and there is lush flora on either side. The garden is open from 8 am to 1 pm and 4 pm to 9:30 pm. The local community plays a significant role in ensuring cleanliness and security, fostering a sense of ownership and responsibility among residents.



Figure 10.3: The Nanalal Mehta Garden in India
© The Architects Diary, 2023

For more information:
https://www.architecturaldigest.in/content/walk-through-mumbais-newest-garden/
https://thebetterindia.com/58845/matunga-flyover-garden-mumbai/
https://timesofindia.indiatimes.com/city/mumbai-needs-more-spaces-like-matungas-under-flyover-garden/articleshow/52808164.cms

10.3.4 Ras Mekonnen Urban Park, Ethiopia

Location: along the Shega River, Addis Ababa, Ethiopia
Date: 2019 - ongoing
Aim: Recreation

The Ras Mekonnen Urban Park is located along the Shega River. It is part of a broader intervention constructed by ICLEI Africa (an international non-governmental organization dedicated to the promotion of sustainable development) through its Urban Natural Assets: Rivers for Life project in collaboration with the UN-Habitat's Ras Mekonnen Riverside Rehabilitation project, the Addis Ababa municipality, and different community stakeholders. The site used to be utilized as an informal dumping facility. The design process included many participatory workshops aiming to include a diverse range of local residents in co-creating the park's layout. Between July and August 2017, 72 participants attended two block-by-block workshops focused on the Ras Mekonnen-Seba Dereja area. The Minecraft methodology was used within those workshops. By the end of the workshop, 12 concepts had been presented to the Addis Ababa City Administration, and they served as the foundation for the site's final design. The project at Ras Mekonnen includes exposing a branch and building gabions to prevent flooding. It also included repairing the historic stairs, fountain, and monument of Ras Mekonnen, a former Ethiopian governor and military leader. Moreover, a new playground, grass, chairs, trees, bins, and a bike lane were added.



Figure 10.4: Ras Mekonnen Urban Park as a green infrastructure amidst the city density
© Adel, 2019

For more information: https://cbc.iclei.org/inclusive-urban-park-replaces-informal-waste-dumping-site-in-addis-ababa-ethiopia/, https://una.city/nbs/addis-ababa/ras-mekonnen-urban-park

10.3.5 Tapis Rouge Public Space, Haïti

Location: the Carrefour-Feuilles neighborhood (informal neighborhood) of Port-au-Prince, in Haiti
Area: 1300 square meters
Date: 2016 - ongoing
Aim: social cohesion, participatory design, community engagement, post-disaster recovery

Tapis Rouge public space is a small, compact park located in Carrefour-Feuilles, one of the dense informal neighborhoods that were severely damaged in the 2010 earthquake. This park is a part of the LAMIKA program, funded by the American Red Cross and implemented by Global Communities. The project's goal is to build a multifunctional place that promotes social cohesion using inclusive techniques. It was designed primarily to optimize usability in a small space, including amenities such as an amphitheater, outdoor exercise equipment, seating, green spaces, and terraces of greenery, each with different plants, and infant trees planted to provide shade. At the highest point, a row of palms covers storage tanks for the nearby water distribution facility. The water for the tanks and station comes from a well 100 meters below. The cash earned from water sales will be reinvested in the maintenance of the public space. The design focuses on community identity and social connections, utilizing public space as a foundation. It emphasizes a participatory approach and active community engagement to empower residents and instill ownership and pride. The goal is to create a safer environment, reducing crime, violence, and antisocial behavior and contributing to a cleaner community.



Figure 10.5: Tapis Rouge public space in Haiti
© Pernot du Breuil, n.d.

For more information:
https://www.archdaily.com/802993/tapis-rouge-emergent-vernacular-architecture,
https://www.architectural-review.com/buildings/tapis-rouge-in-port-au-prince-haiti-by-emergent-vernacular-architecture

10.3.6 Skakkeringen Park, Norway

Location: Etne, Norway's west coast
Area: 2000 square meters
Date: 2024
Aim: social interaction, sports

Vestland Municipality is implementing a pilot program to transform public schools and their schoolyards into multipurpose community spaces. The Skakkeringen park, owned and managed by the municipality, is designed by private sector companies. The park's design is based on a community-first strategy, with locals providing feedback through seminars, interviews, and questionnaires. The park's design includes a full-size basketball court and an uninterrupted red jogging track. The park's ring design accommodates various activities, including busy and calm areas, serving Etne residents of all ages. The open area in the center is adaptable for space-intensive activities and larger events. The park includes trees, shrubs, low-maintenance grass, and a green roof that is planted with meadow plants. Skakkeringen encourages social engagement and physical activities year-round, with shared usage being a key aspect of the project. Despite its use for events, Skakkeringen is primarily used as a schoolyard for Enge Secondary School students.



Figure 10.6: Top view of the Skakkeringen Park in Norway
© LOCAL, 2024

For more information:
https://architizer.com/projects/skakkeringen/
https://localllll.com/projects/etne-innovative-schoolyard/
https://stupiddope.com/2025/01/norways-skakkeringen-park-a-model-for-community-centric-design/
https://landezine.com/skakkeringen-by-pir2/

10.4 The Findings

Institutional level

- Public-private partnerships: Local governments have the ability to collaborate with private organizations and entities to secure funding, materials, or urban furniture for the parks and the management of the neighborhood parks.

- Local authorities support the private sector to create private pocket parks within business districts by facilitating the land allocation and the required legal procedures.

- Local authorities support the grassroots initiatives by the local community to create pocket parks by facilitating the required legal procedures, as shown in the example of the Nanalal Mehta Garden, India.

- collaboration with international organizations in the funding and the implementation of the neighborhood parks, such as the American Red Cross and the Global Communities in the example of Tapis Rouge Park.

Strategic level

- Local authorities establish and enforce regulations that guarantee the existence of neighborhood parks in the district within walking distance. Especially in the vulnerable communities such as the Tapis Rouge park, located in a densely populated informal neighborhood.

- Community Engagement: Strategic planning entails working with local communities to understand their requirements and ensuring that the park satisfies the expectations of a varied range of visitors. This can involve arranging seminars, surveys, and consultations, as seen in initiatives such as Skakkeringen Park and Ras Mekonnen Urban Park.

- Urban Planning and Design: Local governments are in charge of integrating parks into larger urban development plans. This involves zoning, planning, and ensuring that park development aligns with community requirements, such as providing areas for social interaction, leisure, and environmental advantages.

- Flexibility and adaptability: Due to the challenge of the lack of accessible vacant lands within the dense neighborhood, strategic planning for multifunctional neighborhood parks entails looking beyond typical park designs to include schools and other public buildings as multipurpose community spaces, as shown in the example of the Skakkeringen Park in Norway. Moreover, the local authorities follow the strategic planning for multifunctional neighborhood parks to optimize limited space for various uses, such as the example of Tapis Rouge public space, Haiti

Operational level

- Raising awareness campaigns: local authorities can provide training sessions and capacity-building campaigns for the local community about crowdfunding to support them to initiate urban parks, as shown in the example of The Ogród Motyli (the Garden of Butterfly).

- Maintenance and funding: Local governments are frequently active in acquiring money for parks, whether through direct government spending, grants, or collaborations. They oversee the operational components, such as guaranteeing regular maintenance, maintaining security, and arranging park programming.

- Community Ownership Models: In certain circumstances, local governments may encourage community ownership models in which locals have a more active part in park maintenance, such as the community-driven initiatives at Ogród Motyli Park and the Nanalal Mehta Garden, India.

- Promotion of Inclusivity: Local governments ensure that parks are accessible to all populations, including the elderly, children, and those with disabilities. They can support measures that improve accessibility and inclusion, such as the development of specialized infrastructure and programs.

- Utilization and Scheduling: Authorities also organize the daily use and scheduling of these places to optimize their value, ensuring that school programs, community events, and recreational purposes coexist peacefully. For example, Skakkeringen Park operates as both a schoolyard and a community park, necessitating efficient scheduling to guarantee that all roles may be fulfilled at various times.



11



TACTICAL URBANISM GREENING INTERVENTIONS

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TACTICAL URBANISM GREENING INTERVENTIONS

Tactical urbanism, a growing concept in the dynamic area of urban planning, is changing the way cities are constructed and developed. This novel strategy is reshaping the urban landscape by allowing people to take control of their surroundings and implement rapid, low-cost improvements that have significant effects. Tactical urbanism is changing the way people think about cities by emphasizing public engagement and rapid, adaptive solutions (Urban Design Lab, 2023). So tactical urbanism refers to a variety of citizen-led initiatives aimed at reclaiming public places and promoting interaction. These spaces are often small in size and temporary (Kilani & Dhaher, 2024). So, the concept is defined by five principles: a forward-thinking attitude to change, a focus on the local level, short-term and achievable commitments, and low-risk actions (Kilani & Dhaher, 2024). By using tactical urbanism greening interventions, the cities can experiment with the proposed ideas and solutions through temporary interventions that can have a long-term influence on the urban fabric (Urban Design Lab, 2023).

Guerrilla Gardening is a form of tactical urbanism that transforms neglected or abandoned urban spaces by planting and cultivating greenery without official permission. This grassroots initiative is often carried out on vacant lots, abandoned buildings, or underutilized urban areas. Guerrilla gardening provides an opportunity to address urban blight, improve the aesthetic value of neglected spaces, and contribute to environmental benefits (Urban Design Lab, 2023).

11.1 Benefits

Tactical urbanism interventions help to raise community awareness about sustainability and the environmental issues. The tactical urbanism greening interventions help to increase green cover, improve air quality, reduce heat island effects, and contribute to biodiversity in cities. From the social perspective, tactical urbanism greening interventions are bottom-up approaches, as they involve the local residents with the design, production, and implementation of urban solutions (Urban Design Lab, 2023). They help to gain a deeper understanding of the residents' needs at the intervention location as they rapidly examine current difficulties and possibilities (Mohankumar et al., 2020). So they enhance the sense of belonging for the residents and promote collaboration among people, non-profits, local companies, and government organizations via innovative use of the system. This increases public participation by allowing for more productive exchanges with residents (Mohankumar et al., 2020).

The community engagement in the tactical urbanism interventions fosters social interactions between the locals, enhances communication, and fosters social cohesion (Urban Design Lab, 2023). Moreover, tactical urbanism greening interventions promote public safety by enhancing visibility and activity in public places (Ottner, 2023). Additionally, from the economic perspective, the tactical green interventions are designed to pilot proposed projects in a cost-effective manner, without committing large financial investments, minimizing financial risks while assessing their feasibility and impact (Mohankumar et al., 2020). It enables adaptable designs, where adjustments can be quickly done according to community feedback without any additional cost obligations (Urban Design Lab, 2023). Repurposing underutilized or neglected places is a popular approach in tactical urbanism, so as a consequence, the economy may grow, and the city may become more dynamic and desirable to both businesses and tourists (Urban Design Lab, 2023).

11.2 Types

11.2.1 Pop-up Parks

Temporary parks or plazas constructed with low-cost elements such as planters, seats, and tables. Pop-up parks may be used to revitalize unused areas and create locations for people to socialize and enjoy the outdoors (Ikiz, 2023).

11.2.2 Parklets

Small parks or seating areas are formed by transforming a few parking spots into public space by using semi-permanent structures. Parklets can give more seats and green space in congested urban areas (Ikiz, 2023).

11.2.3 Guerrilla Gardening

It is the practice of growing flowers, vegetables, or other plants in public places without authorization. Guerrilla planting can help to beautify areas and increase green space (Ikiz, 2023).

11.3 Examples

11.3.1 Die Wanderbaumallee ("walking tree alley"), Germany

Location: Munich, Germany
Date: 1992-2022 (six weeks in one street)
Aim: to promote permanent greening

Die Wanderbaumallee ("walking tree alley") was a project by Green City e.V., a civil society association, to convert the neighborhood streets into green "alleys" or "avenues" for only 6 weeks. In an inaugural event, they used 15 mobile trees on one street before moving them to another street. The "walking tree alley" was usually accompanied by a modest display on the values of trees for the microclimate, shade provision, or aesthetics to educate the residents about environmental concerns and urban greening. The Wanderbaumallee's main aim was to encourage permanent greening in Munich's streets. Since 1992, the project has demonstrated its value by occupying more than 60 different streets, and 150 trees have been permanently planted as a consequence of the project. It enhanced not just the quality of life on the streets but also the city's climate. The project was based on community engagement, as the residents were notified in advance by posting posters on their front doors that their street would shortly be changed into a green avenue. The individuals were also asked to volunteer as watering sponsors, as the trees need to be watered every day. Moreover, the moving trees were used to promote citizen initiatives dedicated to greening their community. Because of the project's operation for over 30 years and its success in many green street transformations, it even encouraged other towns to create similar "avenues," such as Stuttgart's walking forest and Cologne's Wanderbaumallee.



Figure 11.1: Moving the 15 moved trees from one neighborhood street to another in Germany

© 'Die Wanderbaumallee von Green City e.V.', n.d.

For more information:
https://www.thenatureofcities.com/2023/03/06 /greening-the-streetscape-tactical-urbanism-in-munich/
https://www.greencity.de/projekt/wanderbaumallee/

11.3.2 Park to Park 103, USA

Location: Manhattan, New York, USA
Date: 2019 - ongoing
Aim: to provide a public space in the street to socialize

Park to Park 103 is a community-driven tactical urbanism initiative intending to turn West 103rd Street into a tiny park and pedestrian-friendly corridor connecting Central and Riverside Parks. It was initiated in 2019 by local residents and organizations, including the Park to Park 103 Community Coalition and Open Plans, in collaboration with the New York City Department of Transportation (NYC DOT) and the Street Plans company. In early 2020, the team started surveying and studying a single block, and it contains a considerable number of senior residents who are unable to reach Central Park or Riverside Park. So the project involved the implementation of temporary interventions, such as streetside greenery and public features, and 30 pots filled with flora. The Horticulture Society of New York is responsible for daily maintenance. This project inspired New York City during COVID-19 to start the Open Street program to provide people with a secure, accessible, and free outdoor place where they may socialize with friends and neighbors while maintaining social distance. Since then, W. 103rd Street has been operated as a successful Open Street. The W. 103rd St. Open Street is maintained by the W. 103rd St. Community Coalition, a group of some 30 neighborhood groups, businesses, and community partners. The project expanded in the surrounding streets and they still organize regular events for further interventions.



Figure 11.2: The Park to Park 103 project in USA

© Street Plans, 2023

For more information:
https://street-plans.com/project-page-2/tactical-urbanism-project-page/park-to-park-103-new-york-ny-uws/
https://parktopark103.nyc/planter-power/

11.3.3 Park(ing) day, USA

Location: San Francisco, USA
Date: 2005
Aim: to show how a parking area might be used as a micro-park

Park(ing) Day was founded in San Francisco in 2005 by a group of artists, who later became "Rebar," an art and design firm located in San Francisco. The group selected a parking spot in a particularly dreary area of downtown San Francisco and turned it into a little park. Their initial parklet was a basic arrangement of grass, a seat, and a tree, as their aim was to show how a parking area might be used as a micro-park. The Rebar group also published a manual on how to create a parklet, including the design process and design elements. In 2007, in collaboration with the Trust for Public Land, a national conservation nonprofit, they launched Park(ing) day as a national annual event in September, so the concept spread over many cities across America, and they got temporary new downtown parks for a few hours. This event expanded later to be an annual global event celebrated in around 200 cities across the world. In 2009, the project inspired the city of San Francisco's Permanent Parklet Program, an extension of its Pavement to Parks initiative that formalizes the conversion of parking spots into public areas known as parklets. So the city agencies offer permission schemes for retailers, organizations, and residents to convert metered parking spaces into micro public places. San Francisco's Permanent Parklet Program has sparked similar programs in cities such as New York, Toronto, Melbourne, and London.

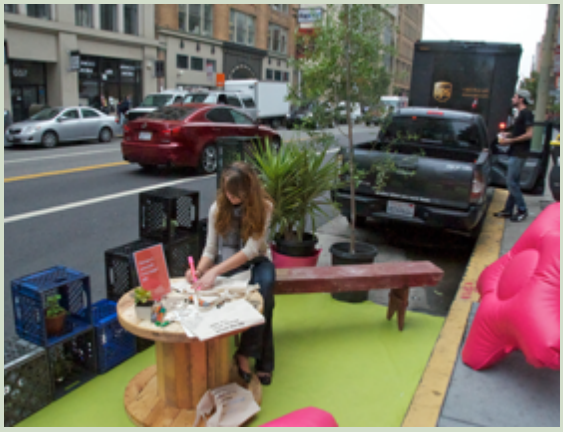

Figure 11.3: Park(ing) Day San Francisco in 2010
© Rhodes, 2010

For more information:
https://www.myparkingday.org/about
https://www.bloomberg.com/news/articles/2017-09-15/a-brief-history-of-park-ing-day
https://diveshguttee.com/2019/09/22/parklets-parking-day-reclaiming-city-spaces/

11.3.4 The Yarraville Pop-Up Park, Australia

Location: Yarraville, Melbourne, Australia
Date: 2012 - ongoing
Aim: recreation

The Yarraville Pop-Up Park is a project that promotes public open space within an entertainment zone. The project was executed by the city council based on the conclusions of the Yarraville Urban Design and Traffic Study in 2006, which proposed transforming the intersection of Ballarat Street and Anderson Street in Yarraville Village, a bustling suburb of Melbourne, into a public space and an entertainment zone. In addition, surrounding traders were approached to gain their support. Since summer 2012, this project has been introduced as a three-month event to transform the street into a public space through mobile elements such as synthetic grass, potted plants, picnic tables, deck chairs, and umbrellas. To keep visitors interested, the area is continuously reinventing itself with popular community events, art exhibits, and neighboring pop-up stores (most recently a rotation of small business incubators). When the project's future viability was questioned, local traders organized a community movement to advocate for its return. Furthermore, because of the positive response from people year after year, it is now a permanent installation only for pedestrians all year.



Figure 11.4: Ballarat Street, Yarraville in Australia
© ICON Science, 2020

For more information:
https://www.healthyactivebydesign.com.au/case-studies/yarraville-pop-up-park

11.3.5 Paseo Bandera / Bandera Avenue, Chile

Location: Bandera, Santiago
Area: 3,300 square meters
Date: 2020
Aim: turning street into pedestrian walkway

Bandera Street is one of the routes to Santiago's historic district. The greatest concentration of government buildings, banks, museums, shops, and other tourist attractions may be found in this neighborhood. Since 2013, Bandera Street has been closed to automobile traffic due to the Santiago Metro Line 3's development through the Chilean capital's historic core. It was turned into car parking and warehouses for a period.

The city administration initiated an intervention at Bandera Street, a pedestrian walkway, during the 9 months remaining to finish the construction of a subway and reopen the street for vehicular flow. The roadway was fenced and covered for a month, and around 20 local and Latin American muralists worked together to create a visual choreography for 350 linear meters of asphalt. The Paseo Bandera, a 3,300-square-meter intervention, features graphic references. The intervention also consists of urban furniture, meeting points, vegetation and murals. The intervention has been embraced by locals, migrants, and tourists, making it a friendly and vibrant space. Initially, the project was supposed to be temporary. However, when the railway line development was completed, the municipal government chose to keep Paseo Bandera as a permanent pedestrian promenade due to the intervention's widespread acceptability and popularity.



Figure 11.5: A long communal table set along Bandera Avenue that transformed into a pedestrian promenade
© Wikimedia Commons contributors, 2023; Wikimedia Commons contributors, 2018

For more information: https://www.instituteforpublicart.org/case-studies/bandera-avenue/
https://www.archdaily.cl/cl/tag/paseo-bandera

11.3.6 The Kerb Garden, UK

Location: London, UK
Date: 2011
Aim: Reclaim abandoned land

In March 2011, the neighborhood initially banded together to guerrilla grow an abandoned area on Landor Road. Throughout 2012, the first Edible Bus Stop took root and continued to expand. Then the founders of the social enterprise "the Edible Bus Stop" made different proposals and applications, so at the beginning of 2013, the project received a fund from the Mayor of London's Pocket Park initiative and Lambeth Council's Neighbourhood Enhancement Programme.

The newly planned garden, which was the first Pocket Park to be realized, was launched on May 18, 2013, with a large turnout from the public and media. On the site, committed locals cultivate a variety of foods and plants that are beneficial to bees. The garden, an urban orchard with more than five fruit trees planted, is a haven for tall sunflowers, leafy greens, and herbs. Every second Sunday of the month, there are gardening afternoons with equipment available for anybody who wants to participate. Moreover, some benches were added so that people may relax and enjoy the garden, have lunch, or wait for a bus.



Figure 11.6: The Edible bus stop in the UK
© The Edible Bus Stop®, 2024

For more information:
https://theediblebusstop.com/the-kerb-garden/

11.4 The Findings

Institutional level

- Local authorities can organize a program to support the creation of the parklets in the cities through facilitating the allocation of the parking spots and transferring them into micro public spaces, such as the Permanent Parklet Program in San Francisco. These programs can financially and institutionally support the grassroots initiatives and the tactical interventions on the city scale.

- Resource Allocation: Provide cash, permits, and technical knowledge to citizen-led or community-based tactical interventions to reduce obstacles to participation.

- Partnerships: Encourage collaboration across municipal agencies, non-profits, and commercial groups to institutionalize tactical urbanism activities, resulting in a more sustainable and inclusive approach.

- Monitoring and Adaptation: Monitor the impacts of tactical interventions and adjust based on community feedback and operational data to maximize benefits and address challenges efficiently.

Strategic level

- Project Testing: The local authorities can adapt the tactical greening methods to test any initiated project, such as the walking trees project in Munich.

- Long-term Vision: Make sure tactical urbanism initiatives support neighborhood resilience, sustainability objectives, and climate adaptation plans by coordinating them with larger urban development plans.

Operational level

- Local authorities follow a participatory approach to engage the local community in the tactical urbanism greening interventions.

- Local authorities should collaborate closely with the traffic department to ensure that the street closure and its transformation into a pop-up park do not adversely affect traffic flow. If potential disruptions are identified, alternative traffic management solutions must be implemented. A notable example is the Yarraville Pop-Up Park in Australia, which was developed based on the findings of a comprehensive traffic study.

- Local authorities can reuse the streets that are closed to automobile traffic due to construction for tactical interventions, such as the Paseo Bandera in Chile



12



BUILDING-SCALE GREENING

© Adam J.W.C., 2014

BUILDING-SCALE GREENING

Urban greening in the building's envelope includes green roofs and green walls, using multilayer techniques and innovative architectural features (Teotónio, Silva, & Cruz, 2021).

Green roofs, also known as ecoroofs, living roofs, or vegetative roofs, are all systems that allow for the development of various forms of plants on top of buildings (Manso et al., 2021). Green roofs are not intended and constructed as typical roof gardens but rather as engineering constructions consisting of the following layers that preserve the support and enhance system performance, including (Mihalakakou et al., 2023a):

- Plants play a major role in enhancing air and runoff quality and conserving energy.
- The soil layer as the growth platform has a key role in determining green roof parameters.
- The filter layer divides soil and drainage materials.
- The drainage layer provides the essential balance between air and water systems and enhances the thermal properties of green roofs.
- The root barrier avoids roof structural damage from plant roots.
- The waterproofing layer is crucial for providing green roof protection.

Furthermore, the green roof system must be installed atop a layer with a minimum slope of 2% to drain excess rainfall down the roof.

Green walls, also known as vertical greening systems or vertical greenery systems (VGS), are all systems that enable greening a vertical surface of a structure (e.g., façades, walls, blind walls, partition walls, etc.) with a selection of plant species (Manso et al., 2021). Although the green roofs and green walls have a lot of environmental, economic, and social benefits that enhance the building performance and the whole urban environment, they are still underutilized since they are generally more expensive and require more maintenance depending on the plant type and irrigation requirements compared to those traditional options (Manso et al., 2021).

12.1 Benefits

12.1.1 Environmental Benefits

Green roofs and walls have a lot of environmental benefits. At the building scale, green walls and roofs help with greywater treatment, lower sound levels entering buildings, and extend the life of the envelope. Green walls may protect and shade bare walls, lowering air and surface temperatures. While on the urban scale, green roofs and walls help to reduce the urban heat island effect, and they also contribute to water management, urban noise reduction, and improved air quality. Moreover, they promote biodiversity (Manso et al., 2021). From the economic perspective, green walls and roofs increase a building's property value (Manso et al., 2021). Green roofs' and walls' capacity to insulate interior spaces can lower air conditioning power use and save energy expenses (Wu & Smith, 2011). Some green roof projects are used to provide job opportunities for certain user groups. Moreover, those green roofs that focus on urban farming contribute to food production. From the social perspective, green roofs in some cases provide social opportunities for recreational public areas, and they enhance citizens' health and well-being (Manso et al., 2021).

12.2 Types

12.2.1 Green Roofs Types

Green roofs can be categorized, based on the substrate depth and plants employed, as:

- **Intensive green roofs:** feature a large substrate layer (around 15-40 cm), which can reach around 1 meter, allowing for the incorporation of a diverse range of plants (shrubs, bushes, and small trees). However, they need frequent irrigation and maintenance (Manso et al., 2021).
- **Extensive green roofs:** are recognized as one of the most effective strategies for promoting sustainability within the building sector. They are typically characterized by a shallow soil layer (less than 20 cm) and vegetation types such as low-growing plants, grasses, herbs, short grasses, and moss (Mihalakakou et al., 2023b). Because of their thickness (6-20 cm), extensive green roofs have a limited plant variety (Manso et al., 2021). These green roofs require minimal maintenance and do not necessitate a permanent irrigation system, making them a cost-effective solution (Mihalakakou et al., 2023b). These lightweight systems may be put in existing flat or sloping roofs up to 30°C, enhancing the attractiveness of non-accessible areas (Manso et al., 2021).
- **Semi-intensive or simple intensive green roofs:** offer intermediate qualities, including a thicker base (12-25 cm) than extensive solutions, characterized by tiny plants, grasses, lawns, and small shrubs, needing modest maintenance and occasional irrigation (Manso et al., 2021).

In addition, there are many projects that use other techniques to create green roofs, such as raised beds or hydroponics. Due to differences in roof types and building architecture and construction, not all buildings can fit the green roof method. Thus, understanding the potential for mobilizing green roofs on a city scale is a necessary precondition for their implementation

(Joshi et al., 2020). Building parameters, such as building slope, size, orientation, and strength, are mostly utilized to determine the possibility of producing green roofs (Joshi et al., 2020).

12.2.2 Green Walls Types

There are many projects that use various techniques to create green walls, such as raised beds. Yet, green walls may be broadly classified into two categories (Manso et al., 2021):

- Green facades: are often composed of climbing plants that grow directly against the wall (by aerial roots, leaf tendrils, and adhesion pads) or have an indirect support system (e.g. wire, mesh, or trellis). Green facades often have sluggish surface covering and restricted plant choices.

- Living walls, whether modular or continuous, enable more consistent vegetation development along the surface and the use of various plant kinds. However, living wall systems may require regular watering and nutrient input.

12.3 Examples

12.3.1 The City Hall, Chicago, Illinois, USA

Location: Chicago, Illinois, USA
Area: 20,300 square feet
Date: 2001
Aim: to reduce the urban heat island

The Chicago City Hall's green roof was installed as part of an Environmental Protection Agency program to reduce the city's urban heat island effect and improve air quality. The roof covers half of the historical building, allowing for comparisons between the green roof and regular roofs. The green roof is semi-intensive, with 20,000 herbaceous plants, 112 shrubs, and two trees. The depth ranges from 3 inches for widespread plants to 24 inches for intense plantings, with semi-intensive regions averaging 8 inches. The intense sections are built on cantilevered platforms supported by structural columns. Unplanted portions of the roof are used to collect rainwater during droughts, which is kept in two 150-gallon cisterns. The plants are established using a supplementary irrigation system. The city initially wanted the green roof accessible to building users, but the low parapets made railings visible and posed safety concerns. Currently, the green roof is only accessible for maintenance. The green roof won the American Society of Landscape Architects Professional Merit Award in 2002.



Figure 12.1: The green roof at the city hall of Chicago
© TonyTheTiger, 2010

For more information: https://insideinside.org/project/green-roof-city-hall-chicago/
https://www.nps.gov/articles/000/green-roofs-on-historic-buildings-chicago-city-hall.htm

12.3.2 The Vertical Forest, Milan, Italy

Location: Milan, Italy
Area: 20,000 square meters
Date: 2014
Aim: Promote the biodiversity

The Vertical Forest could be considered a prototype for a totally new style of biodiversity-inspired architecture, in which design is no longer simply human-centric but rather we are joined by other living species, including plants and birds. Milan's Vertical Forest consists of two residential towers of 80 and 112 meters in height. The facility houses 480 large and medium trees, 300 small trees, 11,000 perennial and covering plants, and 5,000 shrubs. The tallest trees in the Vertical Forest reach heights of three stories. The Vertical Forest is an ever-evolving landmark of the city whose colors change depending on the season and the different natures of the plants used. Moreover, the vertical forest has become home to a diverse range of animal species, including 1,600 birds and butterflies. The facade is not a surface but a three-dimensional environment completed in porcelain stoneware that delicately reflects the brown of the tree trunks. The architects repeated the same concept of vertical forest in other cities after Milan, such as the Tower of Cedars in Lausanne, a Vertical Forest in Nanjing, and a Vertical Forest in Utrecht.



Figure 12.2: The Vertical forest in Milan
© CC Getty Images, 2024

For more information:
https://www.archdaily.com/777498/bosco-verticale-stefano-boeri-architetti
https://www.webuildvalue.com/en/infrastructure-news/vertical-forest-milan.html

12.3.3 One Central Park in Australia

Location: Sydney, Australia
Area: 7 linear kilometers of vegetation surrounding both buildings
Date: 2014 - ongoing
Aim: urban biodiversity,

One Central Park, two residential buildings in Sydney, Australia, is well-known for its creative use of vertical gardens and sustainable design features. They were designed by the French architect Jean Nouvel in conjunction with local architects Johnson Pilton Walker and Peddle Thorp Walker. It consists of two buildings that serve as an entrance to Sydney's downtown region: a 34-story residential apartment tower and a 12-story managed apartment tower on a shared retail floor. The residential skyscraper is distinguished by a massive cantilever that includes a common area and a panoramic terrace for the residential flats. A motorized heliostat mounted on the cantilever collects sunlight and reflects it down into the park area dominated by the tower. A vertical landscape spanning roughly 50% of the building's façade was designed in partnership with French botanist and artist Patrick Blanc. Using 250 types of Australian flora and plants, the buds and blooms of the vegetation create a harmonic symphony on the façade. Vines and green flora rise up between levels, creating the ideal backdrop for Sydney's skyline. 2,700 linear planter boxes for balcony and loggia spaces, resulting in about 7 linear kilometers of vegetation surrounding both buildings, encircling all façades from level 2 to level 33. Water use was a major concern, so the irrigation used recovered and processed sewage (blackwater) from the building, and it is a pioneer automated watering system. This project is considered the largest green facade in Australia with considerable microclimatic challenges.



Figure 12.3: The One Central Park in Australia
© Adam J.W.C., 2014

For more information:
https://www.jeannouvel.com/en/projects/one-central-park/
https://www.archdaily.com/551329/one-central-park-jean-nouvel-patrick-blanc

12.3.4 Santalaia Building, Bogotá, Colombia

Location: Bogotá, Colombia
Area: 3117 m²
Date: 2015 - ongoing
Aim: to promote biodiversity

Bogotá is one of the green wall capitals in the world, as it is full of green walls in different projects such as the airport and the Santalaia building. Santalaia is a high-end 11-story residential skyscraper in central Bogota, Colombia. All eleven levels are covered in various varieties of plant fauna to promote biodiversity, with 115,000 native plants from ten distinct kinds and five distinct families to establish urban environments that attract insects and birds, significantly impacting biodiversity. The plants on the building's facade use a hydroponic system and serve as a model for increasing green zones in urban areas.

Moreover, the plants generate a "green carpet" that serves as insulation and reduces the need for air conditioners, an increasingly valuable contribution during times of rising temperatures caused by climate change.



Figure 12.4: The Santalaia Buildingat Bogotá in Colombia
© 'Santalaia Building Vertical Garden | Urban Nature Atlas', n.d.

For more information:
https://una.city/nbs/bogota/santalaia-building-vertical-garden,
https://www.greenroofs.com/projects/santalaia/

12.3.5 Thammasat University, Thailand

Location: Bangkok, Thailand
Area: 236,806 sq. ft. (22,000 sq. m)
Date: 2019 - ongoing
Aim: food production, biodiversity, recreation, rainwater storage

The Thammasat University Urban Rooftop Farm (TURF) is Asia's largest urban rooftop farm. It is an H-shaped building with slopes resembling a big mound, particularly built to be ecologically friendly and outfitted with a number of energy-saving features. Thammasat University Urban Farming Green Roof integrates elements of 'architecture' and 'landscape architecture' to create an all-in-one solution that functions as a public green space, urban organic food source, water management system, energy house, and outdoor classroom, as well as a model of adaptation for expected climate impacts that can be implemented and developed throughout Thailand and Southeast Asia. It combines contemporary landscape design concepts with traditional rice terrace agriculture. 7,000 square meters on the Green Roof are destined for organic Farming and they are accessible for Thammasat students, teachers, staff, and the public to produce organic vegetables and crops for consumption and sale in the university's canteens. Regarding the water management system, the green roof collects rainfall and slows runoff by up to 20



Figure 12.5: Terraced agro-urban design at TURF
© Holmes, 2020

times, efficiently using runoff for campus food cultivation. It features four retention ponds at each corner, reducing rainwater volume and saving it for future irrigation during dry seasons.

For more information:
https://sdgs.tu.ac.th/2022/11/24/green-public-spaces-at-thammasat-university-learning-hub-for-the-community/

12.3.6 The Rooftop Farming Program in Palestinian Refugees Camps, Lebanon

Location: Ain El Helwe Camp, Saida, and Rashidieh Camp in Tyre City, Lebanon
Date: 2018 - ongoing
Aim: to economically and socially empower Palestinian women

The Nashet Social Cultural Association runs the Rooftop Farming program in two Palestinian refugee camps in Lebanon: Ain El Hilweh in Saida City and Rashidieh in Tyre City. This pilot project was created in conjunction with the Karma group in Palestine and supported by Medico International and the Lush Cosmetic Company.

The project's three main goals are to economically and socially empower Palestinian women by providing job opportunities and generating income, to reconnect Palestinian refugees with their agricultural heritage, and to improve the environment through urban agriculture while ensuring access to healthy food. The project involves two sorts of agricultural activities: planting plastic pipes within greenhouses and cultivating half-plastic barrels outside greenhouses. The first phase was a prototype project at Ain El Helwe Camp, where 52 pipes were planted, each within 10 plastic greenhouses. Each greenhouse has seven pipes, with each pipe holding seven seedlings. External planting was also carried out on rooftops using unique half barrels. Then, in the second phase, the project extended to the Rashidieh camp in Tyre City. Over one hundred households across both camps benefited from agricultural greenhouses.



Figure 12.6: The farming in half barrels outside the greenhouses
© Nashet Association, 2024

For more information:
https://araburban.org/en/infohub/projects/?id=7865

12.4 The Findings

Institutional level

- Conduct training programs for city staff, architects, and builders on green building technologies and maintenance practices.

- Encourage partnerships with developers, environmental organizations, and academic institutions for research, development, and promotion of urban greening projects, such as One Central Park in Australia.

Strategic level

- Develop policies promoting green infrastructure, such as mandating green roofs and walls for specific building types, particularly in high-density areas.

- Offer financial incentive programs to building owners for constructing and maintaining green walls or roofs, such as grants, tax breaks, or subsidies (e.g., Eco-Roof Incentive Program in Toronto, Canada)Establish technical standards and guidelines for the construction, maintenance, and inspection of green roofs and walls.

- Integrate green roofs and urban farming into local climate action and disaster resilience plans, addressing heat island effects, rainfall management, and local food systems (e.g., Thammasat University in Thailand).

Operational level

- Implement pilot projects on public buildings (city halls, schools, universities, and community centers) to showcase the benefits of green roofs and walls (e.g., Chicago City Hall in USA and at Thammasat University in Thailand).

- Use green roofs to socially and economically empower vulnerable groups, such as women in Palestinian refugee camps in Lebanon.

- Launch awareness campaigns about the ecological, economic, and social benefits of green walls and roofs.

- Apply modern technologies, such as hydroponics (e.g., Santalaia Building, Bogotá, Colombia).

- Establish regular monitoring and maintenance systems to ensure long-term functionality.



13



DISCUSSION, LESSONS LEARNED and RECOMMENDATIONS

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DISCUSSION

This study illustrates global examples of urban greening interventions. While these examples originate from diverse climates, cultures, and governance contexts, they can be adapted to the Arab cities. Local authorities and municipalities play a significant role in implementing these interventions.

However, their role varies from one type to another. Large-scale urban greening initiatives, such as developing green infrastructure through strategic planning, establishing green belts, and creating large urban parks, are in significant need of active engagement and leadership by the local governments. Because they are complex planning processes and require massive resources, including water and land. So the local authorities are the best coordinators of those kinds of projects, responsible for the financial management and regulatory oversight. On the other hand, other forms of urban greening projects, such as vertical farming systems managed by the private sector or community gardens started by local citizens and civil society organizations may be developed and executed independently.

However, even in these conditions, local governments play an important supporting role. They can give financial help, technical skills, and facilitate legal frameworks to ensure the success and sustainability of these initiatives. This involves allowing access to land, distributing resources and water facilities, and providing funding or incentive schemes to assure viability and sustainability. For example, the Manguinhos Garden in Rio de Janeiro, Brazil, the largest community vegetable garden in Latin America, is funded by municipal and federal funds and conducted in partnership with the Manguinhos Residents Association, explained in more detail in Section 9 of Community Garden. Therefore, while the level of engagement varies, the assistance of local governments is still necessary across all urban greening programs to solve obstacles and allow revolutionary urban solutions.

Common challenges in Arab cities include limited access to public land and water scarcity. However, global examples can inform solutions adapted to these conditions.

This issue is especially prevalent in densely populated cities, where the demand for more housing projects often takes priority, leaving limited places for green spaces. Moreover, the water shortage is another key challenge that faced the urban greening interventions' implementation in most of the Arab cities due to the arid climate and the limited freshwater resources. Despite those challenges, the illustrated examples in the previous sections are still valid to be adapted to the Arab cities' conditions through these following lessons learned.

- **Large-scale urban greening initiatives,** such as developing green infrastructure, green belts, or large urban parks, require strong municipal leadership due to their complexity, resource needs, and regulatory requirements.
- **Smaller-scale initiatives,** like vertical farming or community gardens, can be initiated by the private sector or local communities but still benefit from municipal support, including financial assistance, technical skills, and legal facilitation (e.g., Manguinhos Garden, Rio de Janeiro, Brazil).

LESSONS LEARNED

Decentralization and Local Authority Role

The decentralization helps to increase the power and the ability of the local authorities. Importantly, these local activities are not carried out in isolation but rather in tandem with overarching national and international plans, maintaining consistency between greater policy objectives and localized measures.

- Although a lot of the planning for green infrastructure in the cities is conducted at a strategic, higher level, often shaped by national and international frameworks, local authorities and municipalities retain significant autonomy to influence and support urban greening projects.

- Municipalities play a crucial role in launching specialized programs and providing financial incentives that promote various sorts of urban greening projects.

- Tactical interventions, like grassroots movements, can lead to long-term programs when institutionalized by local authorities, as shown in Section 11, especially the Park(ing) Day in San Francisco.

Collaboration and Partnerships

A key concept that empowers local authorities in developing the urban greening interventions is promoting cooperation with various stakeholders.

- The coordination between different municipal departments and entities at the local governance level plays a crucial role in enriching the co-creation process with innovative solutions. Such interdepartmental and inter-organizational collaboration ensures that urban greening projects are comprehensive, addressing diverse needs and leveraging a wide range of expertise and resources. A prominent example of this approach is the development of Freshkills Park in the USA in Section 7, as a collaboration between the Municipal Art Society (MAS) and the department of city planning in the City of New York.

- The collaboration with international organizations can financially and technically support the urban greening projects. Such partnerships enable access to resources, expertise, and innovative practices, enhancing the scale and impact of these interventions. That is illustrated through various examples, such as the Urban Micro-Lungs project in Jordan, which is funded by the German Federal Ministry for Economic Development and Cooperation (BMZ) and

implemented by GIZ in collaboration with the Jordanian Ministry of Environment and Greater Amman Municipality, in Section 5. Additionally, as a novel example, Al-Azhar Park in Egypt, in cooperation with the Agha Khan International Foundation, is in Section 7. And the example of Tapis Rouge public space in Haiti, in Section 10, is a part of the LAMIKA program, funded by the American Red Cross and implemented by Global Communities.

- The private sector can support urban greening through direct initiatives such as the Paley Park in the USA, in Section 10 or public-private partnerships, reducing financial strain on municipalities.

- The collaboration with universities contributes through research-based projects and pilot programs. This collaborative method combines practical application with academic perspective, resulting in solutions that are both innovative and evidence-based. Additionally, educational campuses and facilities can serve as test grounds for innovative greening projects, offering not only physical space but also intellectual and technical knowledge to help with the development and execution of these efforts. This was clearly demonstrated in many examples, such as the Ogród Motyli (the Butterfly Garden) in Poland in Section 10, the Chulalongkorn University (CU) Centenary Park in Thailand in Section 6, and the South Padbury Primary School in Australia in Section 5.

- The collaboration with civil society organizations, such as non-profit organizations, social enterprises, non-governmental organizations (NGOs), and local grassroots initiatives. bridge the gap between governments and communities, ensuring participatory approaches in urban greening projects. This collaborative dynamic not only increases the relevance and acceptance of urban greening initiatives, but it also fosters community ownership and long-term sustainability, for example, the Kibera Community Garden in Kenya in Section 9.

The participatory approach

The participatory approach is critical for municipalities in developing urban greening initiatives because it encourages community engagement throughout the implementation phase.

- Community involvement throughout the implementation phase ensures project success and sustainability by fostering a sense of ownership.

- The participatory approach enables local governments to customize urban greening projects to the specific requirements and goals of the local community. By combining multiple perspectives and ideas, towns may create innovative and context-sensitive solutions that reflect the community's distinct environmental, social, and cultural goals. For example, the Parque La Mexicana, Mexico, explained in detail in Section 7.

- The primary goal of the participatory approach is to involve diverse user groups, ensuring that their voices are heard and their perspectives are considered in the decision-making process.

Raising awareness and Capacity building

- Public awareness campaigns can help sustain urban greening efforts. Raising awareness among the local community about numerous types of urban greening and their various advantages is critical for including locals in the process of starting, protecting, and sustaining urban greening initiatives.

- As shown in Section 11, tactical green interventions can be used by the local authorities as a way to raise the awareness of the local community about the effects of the urban greening projects through testing them.

- Capacity-building programs for municipal staff enhance project management and stakeholder engagement.

The allocation of resources

- The water shortage can be addressed through using treated wastewater or seawater and other techniques that ensure the water efficiency in the irrigation system.

- Many examples from Asia focus on mitigating the flood risks and saving the water; these innovative urban planning examples can be adapted to the areas in the Arab world that suffer from floodwaters and enhance their long-term water resilience.

- Limited land availability in the dense Arab cities can be addressed through green roofs, walls, greening the abandoned polluted areas, transforming infrastructure such as streets and parking lots into parklets, and small parks

- Using techniques such as vertical farming that require significantly less space, soil, and water compared to traditional agricultural practices, making it an ideal method for massive food production in densely populated urban environments, as shown in Section 8.

Moreover, it is important to protect the existing green spaces through green belt programs and urban agriculture initiatives such as the Zenger Farm in the USA and the Bauerngarten in Germany, illustrated in Section 4.

The management and maintenance

- In addition to privately owned urban greening projects and those developed through private-public partnerships, urban greening initiatives can be managed and maintained in various ways, depending on the type of project. Urban forests can become self-sustaining with minimal human intervention,

as seen in the Danehy Park Miyawaki Forest in Section 5. In contrast, urban parks, illustrated in Section 6, often generate income through recreational activities to support their upkeep. Additionally, as shown in Section 9, Community gardens rely on volunteer participation for maintenance, while neighborhood parks, discussed in Section 10, like Nanalal Mehta Garden in India, benefit from local community involvement in cleanliness and security.

- The selection of materials and techniques can also contribute to reducing maintenance costs. For example, using low-maintenance grass, recycled water, or durable, eco-friendly materials can significantly lower long-term maintenance needs. For example, in the case discussed in sSection 10, Tapis Rouge public space in Haiti,), water storage tanks have been installed, and the revenue generated from the sale of water is reinvested into the maintenance of the public space, ensuring its sustainability.

The following matrix synthesizes the main findings and lessons learned from the global benchmarking of urban greening interventions. It consolidates insights across the eleven types of interventions according to institutional, strategic, and operational dimensions.

Figure 13. Summary Matrix of Findings and Lessons Learned

Urban Greening Type	Institution	Strategy	Operation
Planning Green Urban Infrastructure	- Creating regulatory frameworks. - Collaboration and partnership with various sectors. - Providing financial and technical resources.	- Citywide strategy should align with national, regional and international strategies. - Finding opportunity zones. - Aligning with more general urban and environmental objectives.	- Participatory approaches. - Putting incentive schemes in place. - Putting best practices and pilot projects into action. - Raising public awareness on green infrastructure benefits.
Afforestation	- Collaborating with various actors. - Institutional responsibilities often encompass funding allocation, legal regulations (e.g., land tenure rights), and capacity building.	- Afforestation projects in line with climate action frameworks, sustainable development goals (SDGs). - Setting quantifiable goals, including afforestation into land-use planning.	- Community Involvement. - Maintenance and Monitoring.
Greening The Suburban Areas	- Encouraging the research and the prototype projects. - Partnership with NGOs, community groups, and other stakeholders. - Encouraging the community to support agricultural projects by providing land in the suburbs.	- Policies to protect the agricultural lands in suburban areas. - Creating greenbelts around cities. - Community Supported Agriculture (CSA).	- Public Awareness & Education. - Raising awareness about community-supported agriculture concepts. - Land management.
Urban Forestry	- Public-Private Partnerships. - Collaboration with international organizations. - Capacity-building.	- Integration into Urban Planning. - Long-Term Objectives and Vision. - Collaboration with Experts and Stakeholders to develop integrated urban forestry plans.	- Regular Maintenance and Monitoring. - Educational and Recreational Use within urban forests. - Participatory approaches in designing and implementing the urban forests.
Urban Parks	- Dedicated department tasked with the development and management of urban parks. - Cooperation and partnerships with different stakeholders. - Partnership with a private development company that owns the land.	- Regulations to protect existing urban parks. - Policies to facilitate the land allocation to the urban parks. - Master plans of cities that include urban parks as a key component. - Regulations regarding water management systems. - Guidelines to ensure accessibility and inclusivity of the parks.	- Developing a participatory approach within the design process. - Organizing cultural and recreational events in the urban parks. - Designing urban parks with less maintenance. - Regularly maintaining urban parks and monitoring ecological health indicators. - Designing the urban parks to address the local climatic challenges.

Urban Greening Type	Institution	Strategy	Operation
Greening the Polluted Areas and Deindustrialized Brownfields	- Collaboration with international funding agencies. - Coordination and Oversight. - Capacity Building.	- Land Use Planning and Zoning. - Regulation and Enforcement. - Funding and incentives program.	- Design competitions that help in the design process of greening polluted areas. - Implementation and Maintenance. - Providing activities to become more livable.
Vertical Farming	- Cooperation with the Private Sector - Fostering Innovation and Research - Establishing Industry Standards	- Policy Development to support vertical farming - Funding and incentive programs - Supporting Sustainability Goals	- Education and Training - Monitoring and Data Gathering - Enhancing the cooperation between different international companies
Community Gardens	- Collaborations and networks with NGOs and international organizations - Provide financial backing	- Program to support the community gardens - Policies to facilitate the land allocation to the community gardens - Empowering residents through participatory approaches	- Offering vacant or underutilized land for community gardens - Raising Awareness - Workshops and skill-building sessions - Providing the needed resources and funds
Neighborhood Parks	- Public-private partnerships - Supporting the private sector to create private pocket parks within business districts - Collaboration with international organizations - Support the grassroots initiatives to create pocket parks by facilitating the required legal procedures	- Regulations that guarantee the existence of neighborhood parks - Community Engagement - Integrating parks into larger urban development plans. - Flexibility and adaptability: strategic planning for multifunctional neighborhood parks	- Raising awareness campaigns - Training sessions and capacity-building campaigns - Community Ownership Models - Maintenance and funding - Utilization and Scheduling of these places to optimize their value. -Promotion of Inclusivity
Tactical Urbanism Greening Interventions	- a Program to support the creation of the parklets - Provide cash, permits, and technical knowledge to citizen-led or community-based tactical interventions - Collaboration across municipal agencies, non-profits, and commercial groups to institutionalize tactical urbanism activities - Monitoring and Adaptation	- Adapting the tactical greening methods to test any initiated project. - Make sure tactical urbanism initiatives support long-term Vision	- Participatory approach to engage the local community - Collaborating with the traffic department to ensure the street closure and its transformation - Reusing the closed streets due to construction for tactical interventions
Building-Scale Greening (Green Roofs and Green Walls)	- Training programs for city staff, architects, and builders - Partnerships with private developers, environmental organizations, and academic institutions	- Developing policies to promote green roofs, and walls - Technical standards and guidelines for the construction, maintenance, and inspection - Climate Adaptation and Resilience Planning	- Pilot projects on public buildings - Using green roofs as a tool to socially and economically empower vulnerable groups - Awareness campaigns to educate the public about the benefits of green walls and roofs - Monitoring and Maintenance system

This structured overview serves as a bridge between the analytical lessons and the forthcoming recommendations, providing a concise summary of how different governance levels can effectively support the implementation and long-term sustainability of urban greening projects.

RECOMMENDATIONS

Institutional

- Strengthen the role of local governments in urban greening by integrating green infrastructure policies into municipal planning frameworks.
- Establish legal and financial mechanisms to support grassroots initiatives, ensuring long-term support for community-driven projects.
- Foster interdepartmental collaboration within municipal governments to enhance coordination and streamline urban greening initiatives.
- Promote collaboration between municipalities, private sector entities, and civil society groups to enhance participatory urban greening approaches.
- Develop frameworks for sustainable public-private partnerships (PPPs) that facilitate long-term investment in green infrastructure.
- Encourage collaboration with international organizations and research institutions to leverage technical expertise and financial resources.
- Establish policies that protect and promote urban greening projects, ensuring that they receive long-term legal and financial backing.
- Provide local government workers with capacity-building programs focused on urban greening implementation, management, and stakeholder collaboration.

Strategic

- Align local urban greening strategies with national and international sustainability goals to ensure policy coherence.
- Prioritize participatory planning approaches by actively involving communities in decision-making processes through workshops, surveys, and digital tools such as online surveys to reach broader audiences.
- Promote public awareness campaigns to educate residents on the benefits of urban greening and encourage active participation.
- Integrate urban greening with climate adaptation and mitigation strategies, ensuring resilience against environmental challenges.
- Establish incentive programs to encourage private sector involvement in green infrastructure development, such as tax benefits for green roofs and walls.
- Develop policies to protect and enhance urban and peri-urban green spaces, including greenbelt initiatives, urban agriculture programs, and policies or initiatives to regulate urban expansion.
- Encourage municipalities to collaborate with research institutions and universities to ensure urban greening projects are backed by scientific data and best practices.
- Support community-led initiatives by offering technical assistance, legal recognition, and funding opportunities to scale up successful grassroots projects.
- Implement policies to repurpose abandoned, polluted, or underutilized land for green infrastructure, ensuring efficient land use in dense urban areas.
- Establish programs that incentivize green roofs, green walls, and vertical farming to maximize green space in highly urbanized settings.

Operational

- Implement financial mechanisms such as green bonds and municipal funds to ensure the sustainability of urban greening projects.
- Encourage the adaptive reuse of abandoned and polluted lands for green infrastructure projects.
- Promote the use of innovative technologies like vertical farming and phytoremediation to maximize green space in dense urban areas.
- Establish clear guidelines for the long-term maintenance and management of urban greening projects, incorporating community involvement and revenue-generating mechanisms.
- Use the tactical green interventions as a way to raise the awareness of the local community about the effects of the urban greening projects through testing them.
- Develop monitoring and evaluation frameworks to assess the impact of urban greening projects and ensure continuous improvement.
- Implement participatory management models for urban green spaces, encouraging local residents to take an active role in maintenance and governance.
- Promote multi-functional land use by integrating urban greening initiatives into public infrastructure, such as schoolyards, rooftops, and abandoned spaces.
- Ensure that urban greening projects incorporate sustainable

water management strategies, including rainwater harvesting and wastewater reuse.

- Use techniques that ensure the water efficiency in the irrigation system of the urban greening interventions.

- Use the municipality's existing properties as a starting point for launching green projects through projects like green roofs and green walls, which can transform existing infrastructure into sustainable green spaces without requiring additional land, as shown in the example of The City Hall of Chicago in the USA in Section 12.

CONCLUSION

In conclusion, this report highlights the significant role of local authorities in supporting urban greening initiatives. By exploring a wide range of global examples, it demonstrates the environmental, social, and economic effects of diverse greening interventions on cities worldwide. Urban greening contributes to climate change mitigation, pollution reduction, flood risk management, biodiversity enhancement, and desertification control. At the same time, these interventions strengthen social cohesion by providing inclusive public spaces that promote physical and mental well-being and empower communities through participation and ownership. Economically, greening projects raise real estate values, support local food production, create job opportunities, and encourage resource efficiency.

The report identifies eleven types of urban greening interventions that vary in scale, from large-scale urban policies and suburban greening strategies to localized actions such as community gardens, neighborhood parks, and green roofs or walls. Drawing from global benchmarks, several lessons emerge, including the importance of decentralization in urban planning and the capacity of municipalities to lead greening interventions effectively. The report also stresses the need for cooperation among stakeholders, including private sector entities, international organizations, academia, and civil society, whose partnerships can enrich implementation through research, funding, and management support.

Finally, the report advocates for participatory approaches that ensure local communities are actively engaged in the planning and decision-making processes. Raising public awareness and building institutional capacity within municipalities are essential for sustaining greening efforts. Practical solutions such as using treated wastewater, seawater, and water-efficient irrigation can address water scarcity challenges, while space-efficient strategies like green roofs, tactical greening, and rehabilitation of abandoned sites can overcome land constraints in dense urban areas. These findings underscore the indispensable role of municipalities in fostering resilient, inclusive, and sustainable urban environments through well-integrated greening strategies.

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