# ECOLOGICAL DESIGN: STRATEGIES FOR THE VULNERABLE CITY 2

## Urban Green Infrastructure and Public Space in Latin America and the Caribbean.

Felipe Vera
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**ABSTRACT**
The second volume of the series Ecological Design: Strategies for the Vulnerable City II. Urban Green Infrastructures and Public Space in Latin America and the Caribbean, focuses on urban and national policies and case studies that deploy green infrastructure and nature-based solutions as a strategy to improve the quality of public space in the most vulnerable urban areas of the region and adapt them to climate change. The publication presents 30 projects of public space and green infrastructure developed in Latin America and the Caribbean in the last twenty years, distributed in various biogeographical regions and located in different urban and territorial contexts, analyzed through the environmental conditions, the main risk factors, the solutions implemented, the stakeholders involved, the construction and implementation processes, the environmental and social benefits provided, and the impact of the project over time.

**AUTHORS**

Felipe Vera, Jennifer Doherty-Bigara, Soledad Patiño, and Jeannette Sordi

**RESEARCH COORDINATOR**

Milagros A. Barchi

**PEER REVIEW**

Ophelie Chevalier, Verónica Adler

**RESEARCH CONTRIBUTORS**

Santiago Aurelio Mota Sosa

Maura Mantelli

**PHOTOGRAPHS**

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**PUBLICATION**

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**GRAPHIC DESIGN**

Otros Pérez

**DESIGN TEAM**

Jerónimo Pérez, Aribel González

**TRANSLATION**

Ishaan Kumar

**COPY EDITING**

Stephanie Carwin

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# TABLE OF CONTENTS

## PART I



## PART II


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## Introduction

Currently, approximately 55% of the world's population (4.2 billion inhabitants) lives in cities. Since more than 80% of the global GDP is generated in cities, urban areas have become the main place of the production of wealth. However, the speed and scale of urbanization also pose great challenges, including the search for a better quality of life and the need to accommodate the accelerated demand for affordable housing, well-connected transportation systems, and basic services and jobs. This is especially arduous for the nearly one billion poor urban dwellers who live in informal and precarious settlements.[1] Although the percentage of the world's population living in informal settlements decreased between 2000 and 2014 (from 28% to 23%), 2018 data from the United Nations indicates a new growth of 23.5% and in absolute terms – the inhabitants of informal settlements represent more than one billion people.[2]

1. World Bank. (April 20, 2020). Urban Development Overview. https://www.worldbank.org/en/topic/urbandevelopment/overview

2. United Nations Statistics Division. (2018). Sustainable Cities and Communities. https://unstats.un.org/sdgs/report/2019/goal-11/

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This means that cities, centers of innovation and concentration of social and economic capital, have an increasingly important role in the development of policies, technologies, and infrastructures that ensure distribution of wealth, accessibility to services, and opportunities for the inhabitants within a framework of environmental sustainability and adaptation to climate change.

The effects of climate change are magnified in expanding cities. One of the main effects of global warming is an increase in the frequency and intensity of heat waves, which in cities, is aggravated by the heat island effect. The projections for 2050 estimate that approximately 1.6 billion people will face conditions of sustained extreme heat, of which 215 million will be living in poverty.[3] Currently, more than a quarter of the world's population lacks access to safely managed drinking water services, and almost half of the population lacks access to safely managed sanitation services.[4] Nearly 500 million urban residents live in coastal areas, which increases their vulnerability to extreme precipitation, erosion, and the rise

**3.** C40 Cities and UCCRN. (2018, February). The future we don't want: How climate change could impact the world's greatest cities. UCCRN Technical Report , 59. With sustained extreme heat, the cited source refers to more than 95°F (35°C) during three consecutive months.

**4.** UNICEF. (2021). Progress on household drinking water, sanitation and hygiene, 2000-2020. The document shows that in 2020, only 74% of the global population had access to safely managed water services. In addition, only 54% of the global population (4.2 billion people) have access to safely managed sanitation.

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in sea levels. About 90% of urban sprawl in developing countries takes place near hazard-prone areas and is built through informal settlements that are not planned.[5]

The climate crisis and other global threats, such as the recent COVID-19 pandemic, have demonstrated that global challenges do not have borders. However, it is proven that the persistence of the edges (or boundaries) between rich and poor, privileged and marginalized, proliferate in all societies.[6] According to the New Urban Agenda, approved by the United Nations during the Habitat III conference in Quito, although the living conditions of millions of inhabitants in areas urban areas has improved since the first Habitat I conference in 1976, "The persistence of multiple forms of poverty, growing inequalities and environmental degradation continue to be one of the main obstacles to sustainable development throughout the world, with social and economic exclusion and spatial segregation often being irrefutable realities in cities and human settlements".[7]

**5.** Schewe, J. et al. (2013). Multimodel assessment of water scarcity under climate change. PNAS, 111(9), 3245-50. https://www.pnas.org/doi/10.1073/pnas.1222460110

**6.** Celik, A. P. ed. (2020). *Sustainable urbanization at the UN, for architects and other design professionals.* p. 14. https://consortiumforsustainableurbanization.org/wp-content/uploads/2020/10/BOOK_SU_August-282020_Final.pdf

**7.** New Urban Agenda, approved in the United Nations Conference about Housing and Sustainable Urban Development (Hábitat III) celebrated in Quito, Ecuador. (October 20, 2016). 3rd Paragraph. http://habitat3.org/wp-content/uploads/NUA-Spanish.pdf.



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At the beginning of 2021, the Inter-American Development Bank (IDB), the primary development institution in Latin America and the Caribbean, highlighted the importance of increasing the resilience of cities and investing in adaptation and mitigation in the publication *Vision 2025: Reinvest in the Americas: A Decade of Opportunity*.[8] The document reiterates the renewed focus of the institution on gender issues and climate change as key issues to promote a sustainable and inclusive growth.[9] Since urban planning and design play a fundamental role in the transformation of human settlements, it is becoming increasingly clear that they need to focus on improving the resilience of cities and the current living conditions of citizens to anticipate a more long-term equitable and sustainable transformation.

In the framework of *Vision 2025, the Housing and Urban Development division of the IDB* is developing this series of publications, Ecological Design: Strategies for the Vulnerable City, to measure the impacts of the climate crisis in the most vulnerable parts of our cities —the marginal,

**8.** Inter-American Development Bank (IDB, 2021). ***Vision 2025. Reinvest in the Americas: A Decade of Opportunity.*** This document defines the priorities for the 2021-2025 period and the response to the challenges that Latin America and the Caribbean face in relation to the economic and health crisis generated by the COVID-19 pandemic and the path to emerge from the crisis with resilience and more sustainable growth.

**9.** IDB. (2021). ***Vision 2025***, 1.6 Objectives (iv) and (iv), p.2. The other objectives identified to accelerate the restoration include (i) regional integration, (ii) development of the digital economy, and (iii) support to small and medium businesses







informal, and precarious settlements– and to explore strategies that can help improve their spatial quality, environmental performance, resilience to climatic events, and accessibility to urban services and economic opportunities.[10] The series of publications includes a series of data and visualizations on the main issues and opportunities, a risk and vulnerability atlas for the informal city, strategies to intervene in public space and housing, and a design manual that presents a catalog of design solutions, techniques, and materials to implement nature-based solutions of minimal economic cost, simple construction, and maintenance.

This volume presents a series of scalable and replicable case studies and strategies focused on the design of public space and construction of green infrastructures to improve the quality of the most vulnerable urban settlements in the different contexts of Latin American cities. Cities like Mexico City, Bogotá, Buenos Aires, São Paulo, Santiago de Chile, and Lima have among the highest rates of Gross Domestic Product (GDP) in the region. However, they have one of the highest disparities in the world in the distribution of

**10.** Vera, F., Sordi, J. (2021). *Ecological Design: Strategies for the Vulnerable City*. IaDB. https://publications.iadb.org/es/diseno-ecologico-estrategias-para-la-ciudad-vulnerable-adaptando-las-areas-precarias-de-america







income and wealth, with informal settlements being an expression of both inequality and absolute poverty. In the last twenty years, many countries have consolidated informal settlements and provided residents with access to land ownership and basic services while promoting neighborhood improvement programs. These projects intervene at the scale of public space and territory, to reduce the gaps of urban inequality and violence. The Favela Bairro project in Rio de Janeiro in the 1990s serves as an important precedent, due to its intervention in 200 communities benefiting more than two million people and the introduction of critical improvements in infrastructure, public space, housing, and local and metropolitan services.[11] This project was the first of many developed in Rio de Janeiro, such as Favela Bairro II from 2000-2004 and Morar Carioca in 2010, and in other cities across the continent, such as the Medellín Metrocable. Other examples have been developed by architects, non-governmental institutions, agencies, multilateral institutions, academic institutions, and citizens who have proposed and shared innovative solutions to improve the resilience and integration of the informal and

**11.** Libertun de Duren, N., & Osorio Rivas, R. (2020). Bairro: diez años después, IaDB. https://publications.iadb.org/publications/spanish/document/Bairro-Diez-anos-despues.pdf







precarious city in metropolitan areas, providing benefits that go beyond these settlements.[12]

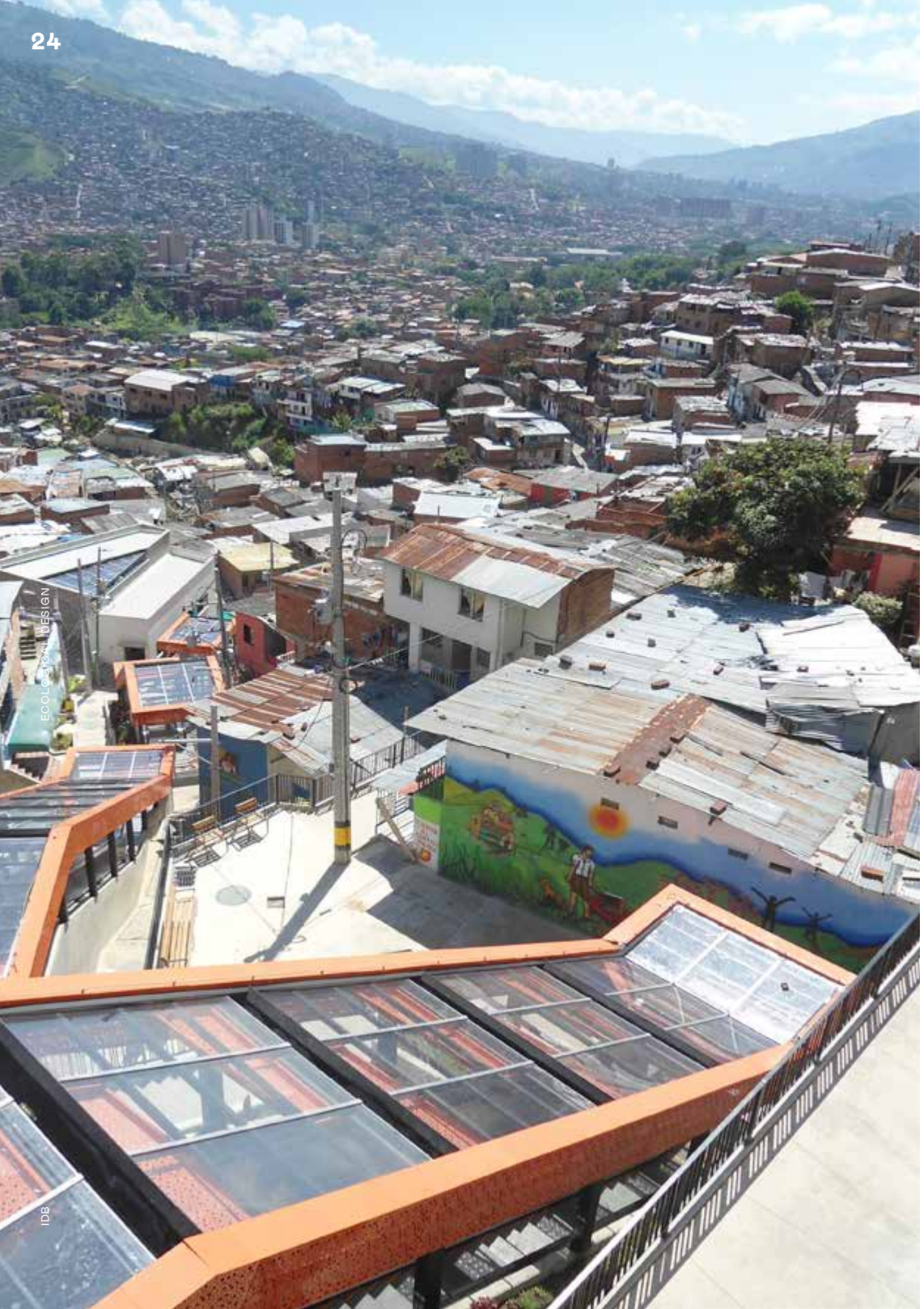
As shown in the following chapters, green infrastructures offer multiple advantages for improving the quality of public space and increasing the urban resilience of the most vulnerable areas. These include actions to protect, sustainably manage, and restore natural or modified ecosystems, effectively addressing evolving societal challenges and simultaneously providing benefits for human well-being and biodiversity.[13] However, the lack of knowledge of implementable solutions and important benefits of nature-based solutions are some of the main obstacles to their financing.[14] In many cases, the lack of appropriate political, regulatory, and technical conditions blocks both public as well as private investment.[15] This is even more relevant in informal settlements that are frequently left out of municipal or government plans and have extremely limited or non-existent investment potential of private investment in the public realm. This publication seeks to disseminate some of the best

**12.** Werthmann, C., & Beardsley, J. (2008). Improving informal settlements: Ideas from Latin America. In Harvard Design Magazine 28. Also see Sordi, J. (2020). Landscape as urban nexus. In NESS.docs 2: Landscape as Urbanism in the Americas. NESS; Silva, E. (2020). Puro Espacio. Expandiendo la esfera pública a través de transformaciones en el espacio público de la ciudad espontánea en América Latina. Actar; Libertun de Duren, & Osorio Rivas, 2020.

**13.** *IUCN Global Standard for Nature-based Solutions.* IUCN. https://www.iucn.org/theme/ecosystem-management/our-work/iucn-global-standard-nature-based-solutions

**14.** Castro Lancharro, B. (2017). *Paquete de soluciones de infraestructura verde urbana. Retos, oportunidades, y manual de buenas prácticas.* Banco Interamericano de Desarrollo.

**15.** *Ibid.*









practices that have been implemented in the region, policies and projects that can improve the resilience of the most vulnerable settlements and integrate them to future urban visions. The first part of this publication presents evidence of the social, economic, and environmental advantages of intervening in public space through nature, delineating a series of criteria and implementation strategies. The second part includes thirty projects of public space and green infrastructure developed in informal settlements across Latin America and the Caribbean, distributed across various biogeographical regions and implemented in very different urban contexts during the past twenty years. It includes the analysis of the site conditions, their main risks and precedents for the projects, adopted solutions, construction and implementation processes, environmental and social benefits provided, and their evolution over time.







Photo



# 1

# 1

# MAIN CLIMATE RISKS FOR LATIN AMERICAN CITIES AND ADAPTATION PROGRAMS IN ACTION

Valparaíso, Chile.
Jonny Joka.

The Latin American and Caribbean (LAC) region is one of the most urbanized on the planet, with 80% of the population living in cities.[16] The urbanization process of the region, which rapidly accelerated during the second half of the 20th century, has led to a large agglomeration of populations in large metropolitan areas, destroying ecosystems and pushing a large part of the population into living in areas of extreme risk. The transformations in land use and, in particular, the disappearance of ecosystems at the periphery of cities due to extensive urbanization has led to the loss of ecosystem services, directly impacting the habitat and quality of life in the Latin American cities. The deterioration of air quality, increase in the heat island effect, thermal discomfort, and the aggravation of hydrogeological risk factors are some of the direct consequences of the loss of planted areas.[17] Throughout Latin America and the Caribbean, climate change is increasing the range of risk vulnerable communities face and will have to confront in the future.

**16.** Vera & Sordi, 2021.

**17.** Romero, H., & Sarricolea, P. (2006, September 18–21). *Patrones y factores de crecimiento espacial de la ciudad de Santiago de Chile y sus efectos en la generación de islas de calor urbanas de superficie* [Conference presentation]. Towards Clima, Sociedad y Medio Ambiente: V Congreso de la Asociación Española de Climatología, Zaragoza, Spain; Mesa, N., & de Rosa, C. (2005). Estudio de los patrones de apropiación del suelo urbano por la expansión de las áreas residenciales: Análisis del área metropolitana de Mendoza. *Avances en energías renovables y medio ambiente*, 9, 591–59; Vásquez, A., Giannotti, E., Galdámez, E., Velásquez, P., & Devoto, C. (2019). Green infrastructure planning to tackle climate change in Latin American cities. In Henríquez, C., & Romero, H. (Eds.) *Urban Climates in Latin America* (pp. 329–54). Springer Cham. https://doi.org/10.1007/978-3-319-97013-4_13.

**In Latin America and the Caribbean, the urbanization process, which rapidly accelerated during the second half of the 20th century, has led to a large agglomeration of populations in large metropolitan areas, destroying ecosystems and pushing a large part of the population into living in areas of extreme risk.**





Madeira, Rondônia, Brazil

Throughout Latin America and the Caribbean, climate change is increasing the range of risk vulnerable communities face and will have to confront in the future. In Buenos Aires, for example, one of the most severe risks is landslides, particularly in areas close to the Río de la Plata where drainage areas are inadequate.[18] Projections show that in 100 years, the Río de la Plata will reach average water levels between 60 and 100 cm higher than today, coupled with stronger winds and storm surges. Within the metropolitan area, the areas of greatest risk of flooding are the lands of the lower basins of Reconquista and Matanza-Riachuelo, which have high concentrations of informal settlemen.[19] In Caracas, Bogotá, and other cities with tropical climates and mountainous terrain, the main risk in the precarious and informal settlements consists of floods and landslides. In many cases, the most vulnerable populations of precarious and informal settlements are located in these areas, multiplying the risk factors.[20] In the Gulf of Mexico, tourism, agriculture, and urbanization are destroying the wetlands and mangroves that are fundamental to sustaining marine ecosystems, thereby affecting local economies connected to these ecosystems and the coasts that must be protected against flooding and erosion.[21] Sea level rise is also a danger to the survival of wetlands and their adaptation; the sustainability of the ecosystem services they provide is only possible if there is enough land to move or extend them inward[22], a dynamic that can be naturally adopted, but at too slow of a rate to correspond to the observed changes. In 2016, 189 countries ratified the Paris Agreement, which aims to substantially reduce global greenhouse gas (GHG) emissions, to limit global warming to 2 degrees Celsius this century, and to seek ways to limit the increase to 1.5 degrees Celsius.[23] The Paris Agreement requires each Party to prepare, communicate, and maintain successive nationally determined contributions (NDCs) that it intends to achieve and outline a plan for mitigation and adaptation to climate change.[24] As of 2021, all Latin American countries have ratified the document and presented their NDC committing to a low-carbon and resilient development.[25] While the NDCs address the problem of urban transformation with special emphasis on sustainable transportation, waste management, and housing, it should be noted that cities are working, in a heterogeneous way, to finalize a vision of the implications of a vertical integration of national commitments, at both the mitigation and resilience levels.[26]

**18.** An ambitious plan is being developed to resolve flooding in Buenos Aires, with the support of the World Bank. However, this hasn't considered the variables of climate change. See: Satterthwaite, D., Huq, S., Pelling, M., Reid, H., & Romero Lankao, P. (2007). Adapting to climate change in urban areas. *Human Settlements*, 58. https://doi.org/10.1071/AR06192.

**19.** Ibid

**20.** Vera & Sordi, 2021. Chapters 1 and 2.

**21.** IDB. (2020). Plan de Adaptación, Ordenamiento y Manejo integral de las cuencas de los ríos Grijalva y Usumacinta . https://publications.iadb.org/publications/spanish/document/PAOM-Diagn%C3%B3stico-integrado-con-identificaci%C3%B3n-de-%C3%A1reas-prioritarias-Resumen-Ejecutivo.pdf; Núñez Gómez, J., Ramos Reyes, R., Barba Macías, E., Espinoza Tenorio, A., & Gama Campillo, L. (2016). Índice de vulnerabilidad costera del litoral tabasqueño, México . *Investigaciones Geográficas, Boletín del Instituto de Geografía*, 91, 70-85. https://doi.org/10.14350/rig.50172

**22.** Satterthwaite et al., 2007. Approximately 1 million hectares of coastal mangroves were destroyed in the Gulf of Mexico between 1970 and 1990, damaging the local territory and impacting the fishing industry.

**23.** UN. (2016). *Paris Agreement*. https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf

**24.** *UN. Registry of the NDC of the CMNUCC*. https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx

**25.** CEPAL. (2019). *Panorama de las contribuciones determinadas a nivel nacional en América Latina y el Caribe, 2019: avances para el cumplimiento del Acuerdo de París.* https://www.cepal.org/es/publicaciones/44974-panorama-contribuciones-determinadas-nivel-nacional-america-latina-caribe-2019

**26.** Dazé, A., Price-Kelly, H., & Rass, N. (2016). *Vertical Integration in National Adaptation Plan* (NAP) Processes. https://napglobalnetwork.org/wp-content/uploads/2016/11/napgn-es-2016-vertical-integration-in-national-adaptation-plan-processes-a-guidance-note-for-linking-national-and-sub-national-national-adaptation.pdf






**As of 2021, all Latin American countries have ratified the document and have presented their Nationally Determined Contributions (NDC), committing to low-carbon and resilient development. However, cities are working, in a heterogeneous way, to finalize a vision of the implications of a vertical integration of national commitments, at both the mitigation and resilience levels.**

**Cities represent the majority of building construction, generate more than 80% of the GDP, are responsible for 70% to 80% of energy consumption, and generate three quarters of the GHG emissions related to energy, including transportation.**







Counting on the proactive action of cities is critical, given that they represent the majority of building construction, generate more than 80% of the GDP, are responsible for 70% to 80% of energy consumption, and generate three quarters of the GHG emissions related to energy, including transportation. In addition, they present the greatest opportunity to increase the resilience of populations, bearing in mind their respective contexts when developing site-specific solutions.

Cities, as fundamental actors in the fight against climate change, include the facets of regulation, planning, investment, and local monitoring. Green infrastructure serves as an essential pillar where regulatory, planning, and investment priorities intersect to meet basic services and provide quality of life for all populations. Vulnerability to climate change not only depends on unfavorable climatic conditions, but also on a society's ability to anticipate, confront, resist, and recover from the impacts associated with this phenomenon. Some risk factors are direct, such as greater exposure to natural disasters due to the location of settlements, the lack of infrastructure, or precarious housing. Other risks are indirect, such as the probability that a disaster or emergency condition will reduce availability of basic necessities such as water or food, increasing their price and, consequently, their accessibility. Given that informal neighborhoods are often in conditions of higher risk compared to the formal city, it is imperative to include the challenges of informal settlements and precarious neighborhoods in risk management plans and atlases and to consider inclusive and contextual adaptation solutions. This volume, and the Ecological Design series as a whole, focuses on the potential of green infrastructure in informal settlements and nature-based solutions as adaptation measures and mitigation to climate change but also as a medium for urban integration. These interventions can improve the conditions of a settlement and the quality of life of its residents by enhancing the functionality of infrastructure and facilitating connectivity and development opportunities, thus simultaneously reducing environmental risk and augmenting future resilience.

The term green infrastructure is understood as a nature-based urban support system that responds to urban and climatic challenges, ensuring stormwater management, reduction of the effects of heat waves, increase of biodiversity, better air quality, clean water, and healthier soils, among others.[27] Some examples of how green infrastructure

**27.** See, for example, Pötz, H ., & Bleuze, P. (2011). *Urban Green-Blue Grids for Sustainable and Dynamic Cities*

can help include: improving the efficiency of how scarce water resources are utilized, restoring natural flood defenses using vegetation, implementing forest practices that are less vulnerable to storms and fires, incorporating natural measures to retain water, reducing heat islands in urban areas, and enhancing ecosystems and biodiversity.[28]

Some of the elements that define green infrastructures and improve their performance are the creation of networks or systems that serve as spatial connectors to allow movement of people, fauna, wind, and water. For example, the creation of pedestrian or bicycle corridors and complete streets that include green areas not only factor into the general landscape but also provide ecosystem services.[29] Green infrastructures are also considered Nature-Based Solutions (NBS),[30] as they replicate, imitate, or rely on nature, addressing the challenges of cities in a sustainable fashion. As evidenced in the *Paquete de soluciones de infraestructura verde urbana. Retos, oportunidades, y manual de buenas prácticas* [Urban Green Infrastructure Solution Package: Challenges, Opportunities, and Manual of Good Practices] published by the IDB in 2017, urban green infrastructure adds value to the concept of biodiversity management and conservation it can improve the well-being of the population, facilitate economic development, and reduce poverty.[31]

In recent years, many Latin American countries have adopted programs and promoted projects and guidelines focused on green infrastructure, although with some limitations. Colombia has incorporated the concept of a Primary Ecological Structure, equivalent to the concept of green infrastructure, to urban and regional planning, focusing the main efforts to the preservation of biodiversity.[32, 33] Mexico is implementing policies of mitigation and adaptation to climate change at the national and local levels.[34] In Chile, at the national level, the government is committed to the Paris Agreement, including the development of green infrastructure as a means to deal with climate change.[35] The country has also provided an excellent platform, Arclim, which benefits from having maps with layers of long-term climate change projections at a community scale.[36] Other sustainable urban planning projects with a focus on climate change have been approved and implemented at the city level, among which the following stand out in the large metropolises:

**28.** European Commission Directorate-General for the Environment. (2016). *Green Infrastructure and Climate Adaptation, 2.*

**29.** Quiroz Benítez, D. (2018). *Infraestructura verde como estrategia para la mitigación y adaptación al cambio climático en ciudades mexicanas: hoja de ruta.* Ciudad de México, 59.

**30.** Ver Watkins, G., Silva Zuniga, M., Rycerz, A., Dawkins, K., Firth, J., Kapos, V., Canevari, L., Dickson, B., & Amin, A. (2019). *Nature-based Solutions: Scaling Private Sector Uptake for Climate Resilient Infrastructure in Latin America and the Caribbean.* Banco Interamericano de Desarrollo. https://publications.iadb.org/en/nature-based-solutions-scaling-private-sector-uptake-climate-resilient-infrastructure-latin-america.

**31.** Castro Lancharro, 2017.

**32.** Andrade, G. I., Remolina, F., & Wiesner, D. (2013). Assembling the pieces: a framework for the integration of multi-functional ecological main structure in the emerging urban region of Bogotá, Colombia. *Urban Ecosystems*, 16, 723 cited in Vásquez, A., Giannotti, E., Galdámez, E., Velásquez, P., Devoto, C. (2019). Green Infrastructure Planning to Tackle Climate Change in Latin American Cities. In Henríquez, C., & Romero, H. (Eds.), 2019. See: IDEAM. (2011). *Subdirección de Ecosistemas e Información Ambiental Instituto de Hidrología, Meteorología y Estudios Ambientales de Colombia – Estructura Ecológica Principal de Colombia Proceso metodológico* y aplicación escala 1:500.000. http://observatorio.epacartagena.gov.co/wp-content/uploads/2016/06/estructura-ecologica-principal-ideam.pdf

**33.** Other Colombian development plans that include climate change, beyond green infrastructure, include the Integrated Plan of Climate Change Management promoted by Housing Development, City and Territory (2020) and the National Policy of Sustainable Building. https://colaboracion.dnp.gov.co/CDT/Conpes/Econ%C3%B3micos/3919.pdf

**34.** Vásquez et al., 2019.

**35.** Ibid.

**36.** Arclim is a climate risk atlas developed by the Ministry of Environment by the Government of Chile. https://arclim.mma.gob.cl/












**Urban green infrastructure replicates, imitates, or relies on nature, addressing the challenges of cities in a sustainable fashion. These have the potential to contribute to green growth, build a resilient society, improve the well-being of citizens, and provide economic opportunities.**

the Climate Change Action Plan Buenos Aires 2030 in Argentina (2009),[37] the agenda for sustainable construction in Bogotá in Colombia (2014),[38] the master plan for the sustainable development of the municipality of Rio de Janeiro (2009),[39] and the Guidelines for the action plan for the city of São Paulo [Guidelines for the Action Plan for the City of São Paulo for Mitigation and Adaptation to Climate Change] in Brazil (2011),[40] and the climate action plan for the Mexico City (PACCM) 2014-2020 in Mexico (2014).[41] Since 2000, Mexico City has been recognized for analyzing the sources and consequences of climate change. Among these was a specific focus on the development of its first ever inventory of greenhouse gasses (GHG), as a stepping stone to implement integrated mitigation strategies and synergies between policies of pollution reduction and improvement of air quality.[42] At the same time, secondary cities and smaller municipalities throughout Mexico have also increasingly developed their own strategies. Article 9 of the Mexico's General Law on Climate Change establishes that "the municipality is responsible for the formulation, performance and evaluation of the municipal policy on climate change in agreement with national and state policy; in accordance with the National Development Plan, the Strategy National, the State Plan on climate change and with the applicable laws. "As such, it establishes that the municipalities, in alignment with their city councils, may coordinate and/or associate to efficiently implement the provisions set forth in the article. This establishes the creation of the Municipal Climate Action Plans or PACMUN, such as those that must be carried out forward at the state level: State Plan for Action on Climate Change or PEACC.

These initiatives have been developed in countries and cities with the support of international support due to a growing interest in the desire to plan at the urban scale with a focus on climate change. The previously mentioned plans recognize and explore the multifunctional aspect of green infrastructures. However, the concepts of connectivity and systemic integration are not equally recognized. For example, in Buenos Aires, the planning tools are focused on the development of certain types of green spaces such as green roofs and urban trees but lack consideration of the need of spatial connections between them. In the cases of Rio de Janeiro, São Paulo, Mexico City, and Lima, the urban plans recognize green spaces as a network and incorporate specific actions that contribute to the larger infrastructural and ecological system, in compliance with planning objectives.[43]

**37.** Ciudad de Buenos Aires. (2009). Buenos Aires 2030. *Plan de acción contra el cambio climático.* https://buenosaires.gob.ar/areas/med_ambiente/apra/des_sust/pacc.php?menu_id=32408

**38.** District Environmental Secretary (2014).Programa Bogotá construcción sostenible. https://oab.ambientebogota.gov.co/category/ecourbanismo/programa-bogota-construccion-sostenible/

**39.** For the contents of the plan, see: De La Rocque, E., & Shelton-Zumpano, P. (2014, March 28). *The Sustainable Development Strategy of the Municipal Government of Rio de Janeiro* [Seminar presentation]. Citizen Security in Brazil: Progress and Challenges. Woodrow Wilson International Center for Scholars, Washington, D.C., United States. http://www.rio.rj.gov.br/documents/91329/89305a46-c32f-441e-a4d2-914e5a512925

**40.** The Municipal Committee on Climate Change and Ecoeconomy and the Working Groups for Transportation, Energy, Construction, Land Use, Solid Waste and Health. (2011). Guidelines for theAction *Plan for the City of São Paulo for Mitigation and A daptation to Climate Change.* https://cetesb.sp.gov.br/inventario-gee-sp/wp-content/uploads/sites/34/2014/04/saopaulo_diretrizes.pdf

**41.** Mexican Government. (2014). *Programa de acción climática de la ciudad de México* (PACCM) 2014-2020. https://cambioclimatico.gob.mx/ciudad-de-mexico/#:~:text=de%20M%C3%A9xico2014%2D2020-,El%20Programa%20de%20Acci%C3%B3n%20Clim%C3%A1tica%20de%20la%20Ciudad%20de%20M%C3%A9xico,a%20partir%20de%20las%20l%C3%ANDreas

**42.** Mexican Government. (2004). *Estrategia local de acción climática del Distrito Federal.* http://centro.paot.org.mx/documentos/sma/ELACDF.pdf

**43.** Vásquez et al., 2019.







**44.** Vásquez et al., 2019.

Unfortunately, social and environmental inequality have not been a central part of the strategies of any of the mentioned plans. For example, there is a lack of planning objectives related to a fair distribution of green spaces and ecosystem services and consequently, a lack of mechanisms to address environmental injustice.[44] Precarious settlements with high levels of informality are particularly vulnerable to the effects of climate change, since these aggravate pre-existing risk contexts, such as those derived from unstable hydrogeological conditions. In addition, the inhabitants of these settlements generally have limited access to public health and safety services, and they often lack the economic resources, such as a guaranteed income, personal savings, or insurance, which could help them recover in the aftermath of a disaster. The following chapters and the case studies presented in this booklet will focus on the advantages of implementing green infrastructures and nature-based solutions in the public realm of the informal city, highlighting objectives, strategies, and implementation criteria that can help fill this gap.

THE CARTOGRAPHIES PRESENTED IN THE FOLLOWING PAGES HIGHLIGHT THE MAIN CLIMATE RISKS FOR THE REGION AND THEIR PROJECTION TO 2050. OF A TOTAL OF 727 CITIES ANALYZED IN THE REGION, 592 CITIES (82% OF THEM) WILL SUFFER DEEP BIOCLIMATE CHANGES TOWARDS THE END OF THE 21ST CENTURY. THE THREE MOST IMPORTANT ISSUES OF CLIMATE TRANSITION WILL BE ARIDIFICATION, SABANIZATION, AND TROPICALIZATION. MOREOVER, THE MAPS EVIDENCE THE MAIN HYDROGEOLOGICAL RISKS UNDER THE NEW CLIMATE REGIME, THE STATE OF ENVIRONMENTAL DEGRADATION, AND PROJECTIONS FOR HYDRIC STRESS AND WATER AVAILABILITY, SUPPLY, AND DEMAND.W







Nelson Valkonde

# CLIMATE CHANGE

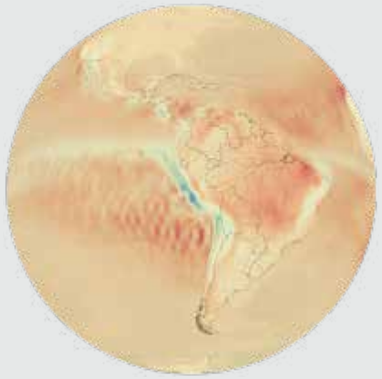
## CLIMATE CHANGE MID-21ST-CENTURY PROJECTIONS

### **1.1** Heat waves

0 +10 +20 +30 +40

Change in number of days with maximum daily temperature above 35C, projected for 2041-2060, relative to 1850-1900, under an intermediate climate change scenario (SSP2-4.5/CMIP6).
Units = days.

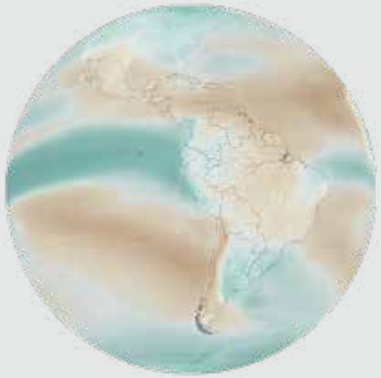
### **1.2** Dry spells



-40 -20 0 +20 +40

Change in consecutive dry days, projected for 2041-2060, relative to 1850-1900, under an intermediate climate change scenario (SSP2-4.5/CMIP6).
Units = days.

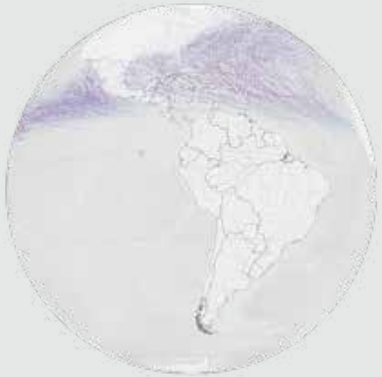
### **1.3** Annual precipitation



-30% 0% +30% +60%

Change in near-surface total precipitation, projected for 2041-2060, relative to 1850-1900, under an intermediate climate change scenario (SSP2-4.5/CMIP6).
Units = mm/year.

### **1.4** Tropical cyclone intensification



≥ 125 ≥150 ≥ 175 ≥ 200 ≥ 225 ≥ 250

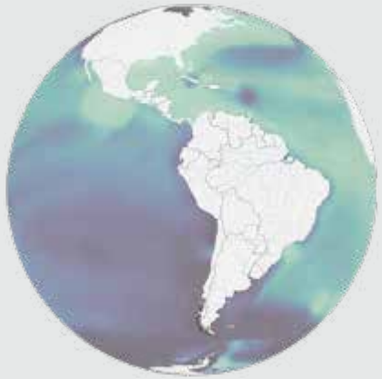
Registered sustained winds by tropical cyclone events, 1980-2020.
Units = kilometers per hour.

### **1.5** Sea surface temperature

0 +1.0 +2.0 +3.0 +4.0

Change in temperature of the sea at surface level, projected for 2041-2060, relative to 1995-2014, under an intermediate climate change scenario (SSP2-4.5/CMIP6).
Units = degree Celsius.

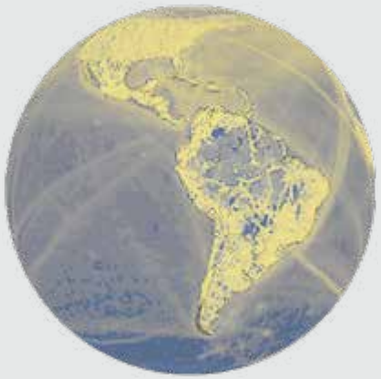
### **1.6** Sea level rise



0 +0.25 +0.50 +0.75 +1.00

Change in total sea level rise, projected for 2041-2060, relative to 1995-2014, under an intermediate climate change scenario (SSP2-4.5/CMIP6).
Units = meters.

### **1.7** Anthropogenic CO2 emissions



-10 0 +10 +20 +30 +40

Change in anthropogenic CO2 emissions, projected for 2041-2060, relative to 1995-2014, under an intermediate climate change scenario (SSP2-4.5/CMIP6).
Units: kg/m2.

### **1.8** Near-surface PM 2.5 atmospheric particles

-10 0 +10 +20

Change in near-surface PM2.5 atmospheric particles, projected for 2041-2060, relative to 1850-1900, under an intermediate climate change scenario (SSP2-4.5/CMIP6).
Units = microgram per cubic meter.





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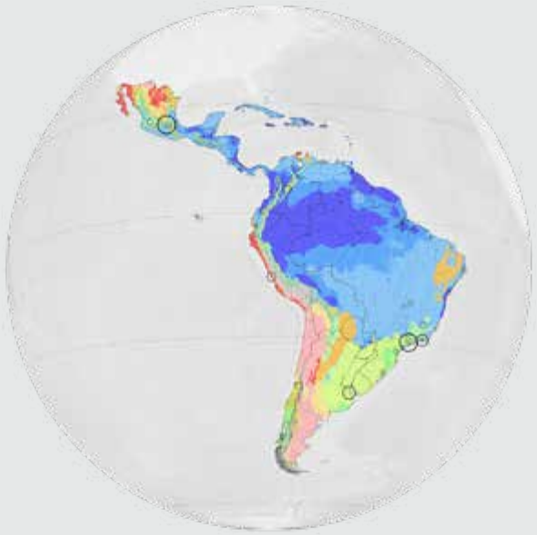
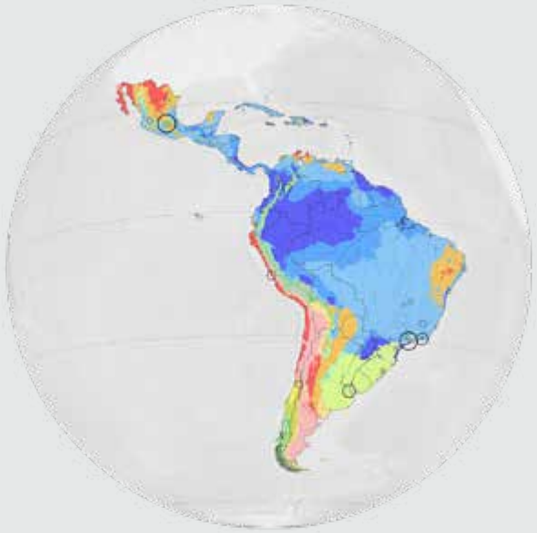
## CLIMATE CHANGE
## REGIONAL CLIMATIC FUTURES



**1.9** Köppen-Geiger bioclimatic zones, 1980-2016.



**1.10** Köppen-Geiger bioclimatic zones, 2071-2100.

**Climate Group A**
Tropical / Megathermal

- **Af** Tropical rainforest
- **Am** Tropical monsoon
- **Aw** Tropical savanna

**Climate Group B**
Arid (desert and semi-arid)

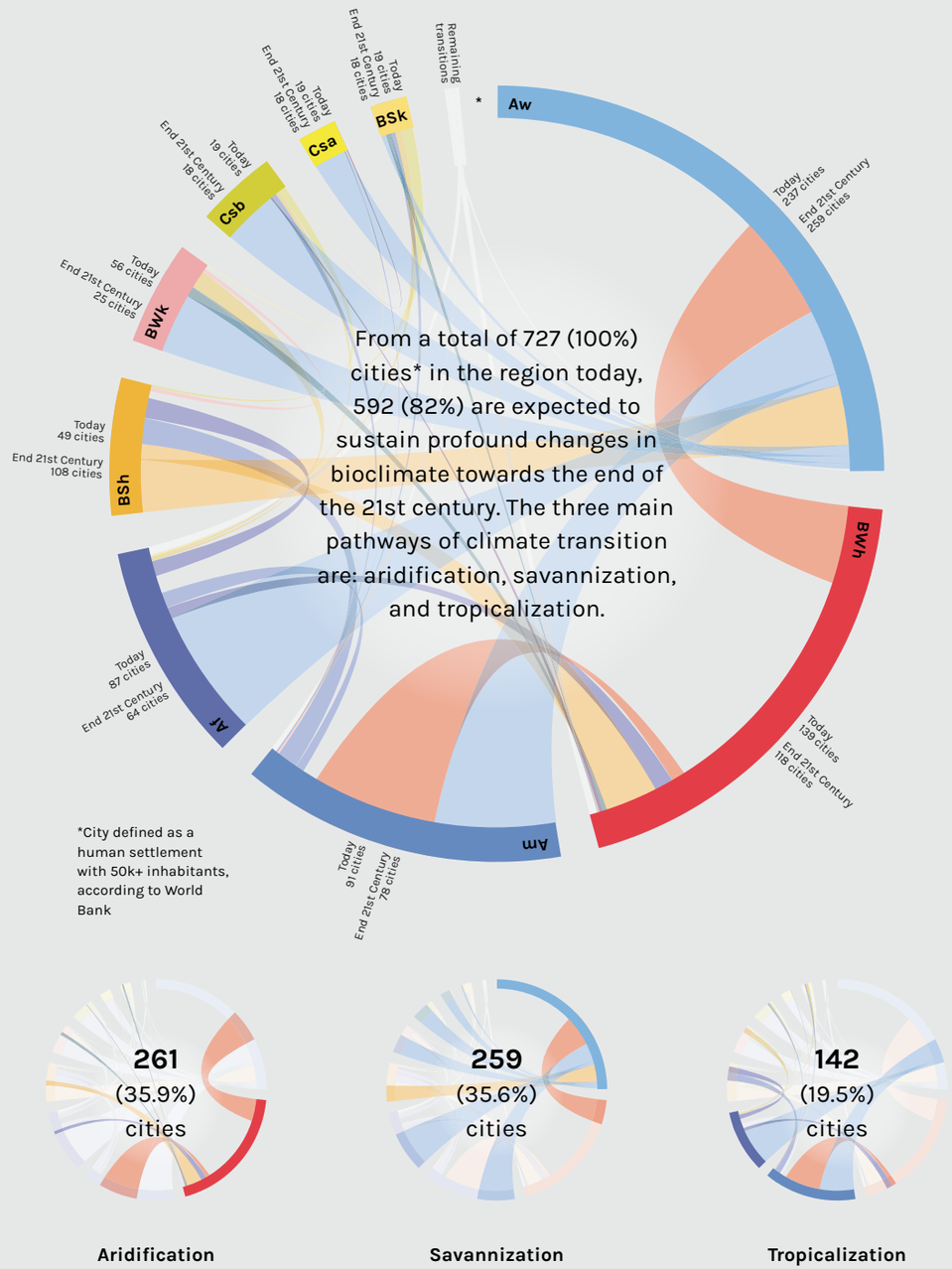
- **BWh** Hot desert
- **BWk** Cold desert
- **BSh** Hot semi-arid
- **BSk** Cold semi-arid

**Climate Group C**
Temperate / Mesothermal

- **Csa** Mediterranean hot
- **Csb** Mediterranean warm/cool
- **Csc** Mediterranean cold
- **Cwa** Dry-winter humid subtropical
- **Cwb** Dry-winter subtropical highland
- **Cwc** Dry-winter cold subtropical highland
- **Cfa** Humid subtropical
- **Cfb** Oceanic
- **Cfc** Subpolar oceanic

**Climate Group D**
Continental / Microthermal

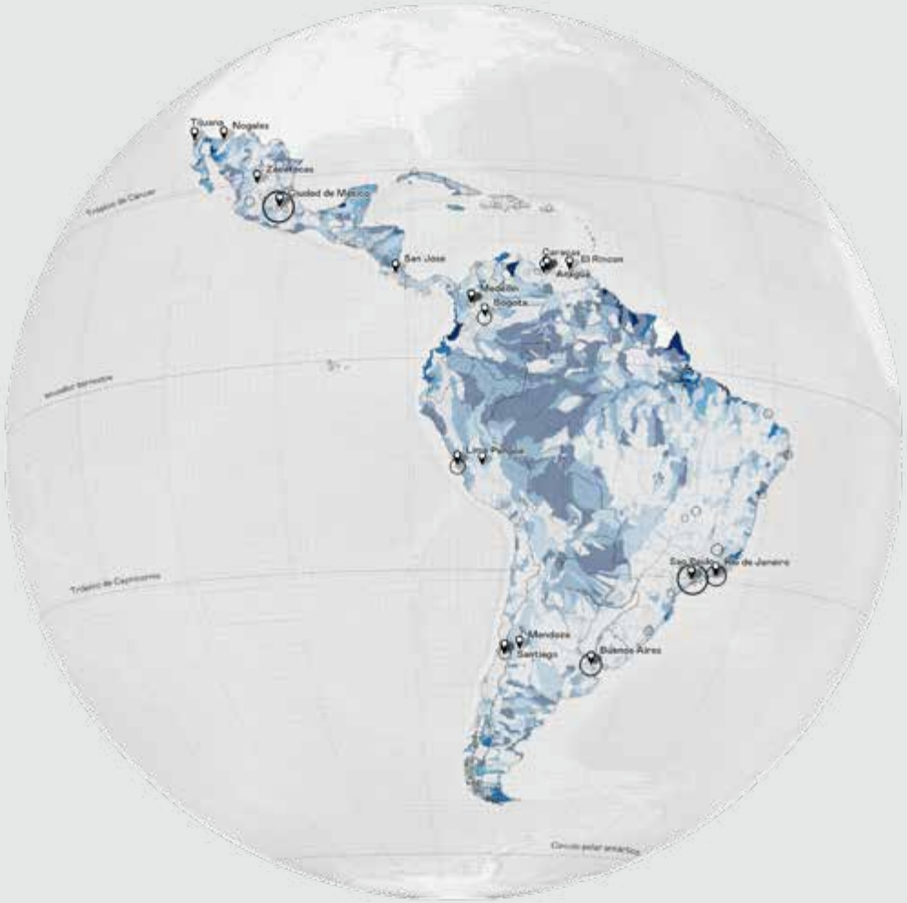
- **Dsa** Hot summer continental
- **Dsb** Warm summer continental or hemiboreal
- **Dsc** Subarctic or boreal
- **Dsd** Subarctic or boreal severe winters




**1.11** Climate pathways for cities in Latin American and the Caribbean, 2071-2100.

## CLIMATE CHANGE
## HYDROLOGICAL RISKS UNDER NEW CLIMATIC REGIME

**1.12** Coastal and riverine flood risk




Low Medium High Extreme

Coastal flood risk measured as the percentage of the population expected to be affected by sea level rise and storm surge events in an average year. Units = x per y inhabitants affected.

Low Medium High Extreme

Riverine flood risk measures as the percentage of the population expected to be affected by inundation caused by river overflow in an average year. Units = x per y inhabitants affected.

**Impact Scale for Inundation**

| **Low** | **Medium** | **High** | **Extreme** |
|---|---|---|---|
| 0-1 in 1,000 hab. | 2-6 in 1,000 hab. | from 7 in 1,000 hab. to 1 in 100 hab. | more than 1 in 100 hab. |

**1.13** Drought risk


0.1 0.5 1.0

Drought risk probabilities and projected spatial distributions.
(category D3-D4).
Units: 0.1 = Improbable / 1.0 = Imminent

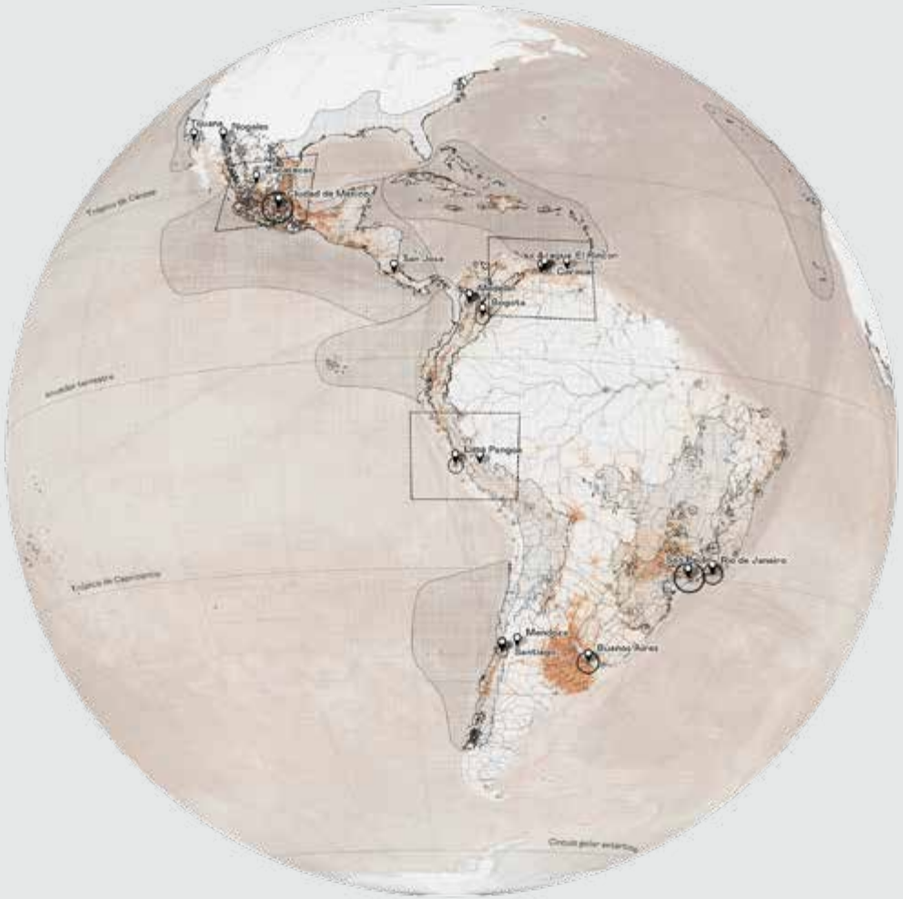
Arid regions

**Categorización de sequías** *
**D0** Abnormally Dry
**D1** Moderate Drought
**D2** Severe Drought
**D3** Extreme Drought
**D4** Exceptional Drought

*U.S. National Drought Mitigation Center

## ENVIRONMENTAL DEGRADATION
## DETERIORATION OF THE REGION'S ENVIRONMENTAL CONDITIONS

**2.1** Human transformation of marine and terrestrial ecosystems.




0% 50% 100%

Human transformation of terrestrial ecosystems maps the degree of human modification on land-based ecosystems, based on thirteen stressors and their respective estimated impacts, 2000-2016.
Units: degree of change (%).

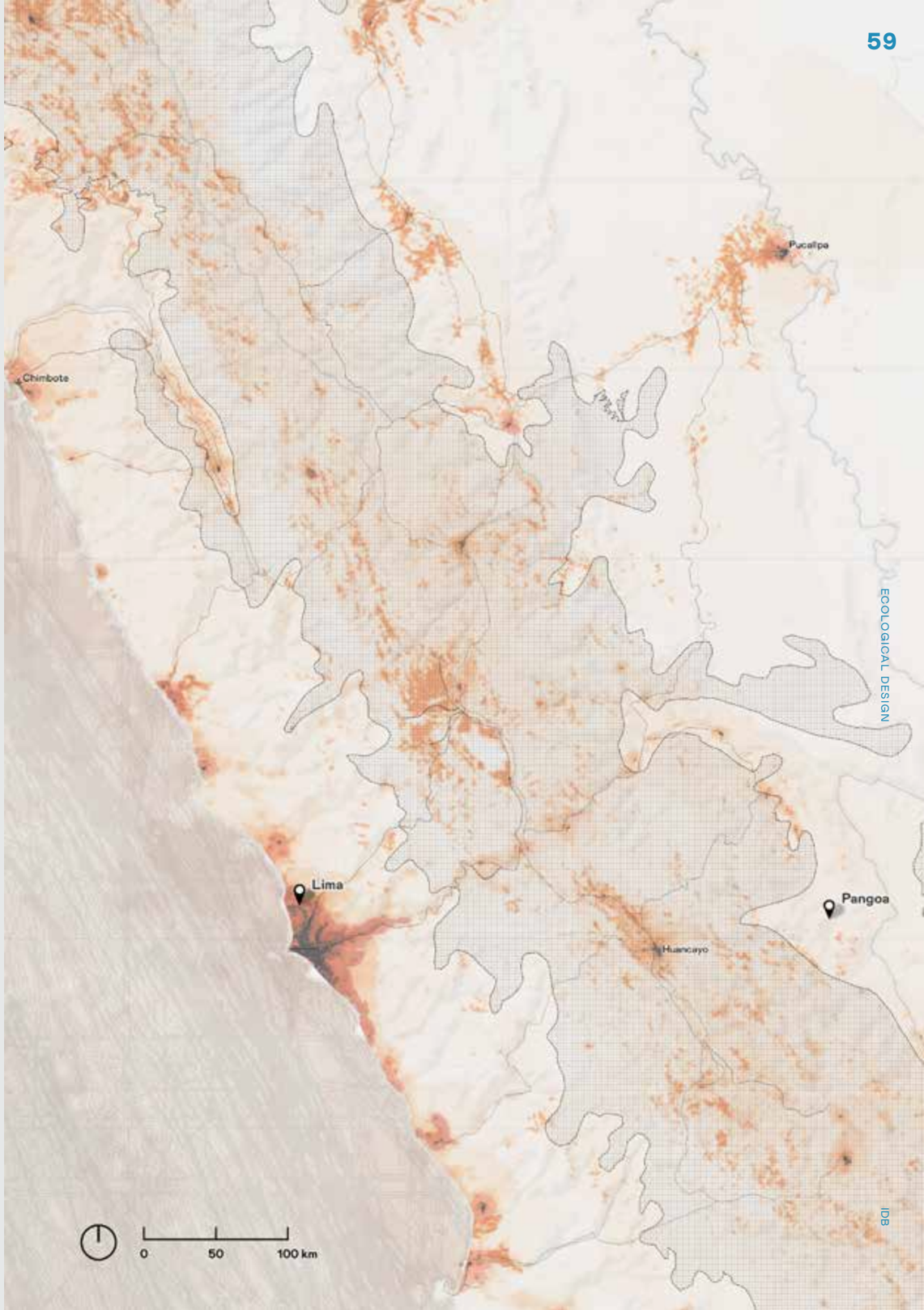
Low Medium High Extreme

Cumulative human impacts on oceans maps the recent change, over five years, in cumulative impacts to marine ecosystems globally from twelve indicators, including fishing, climate change, and ocean- and land-based stressors, 2008-2013.
Units: change in cumulative impact.

Biodiversity hotspots

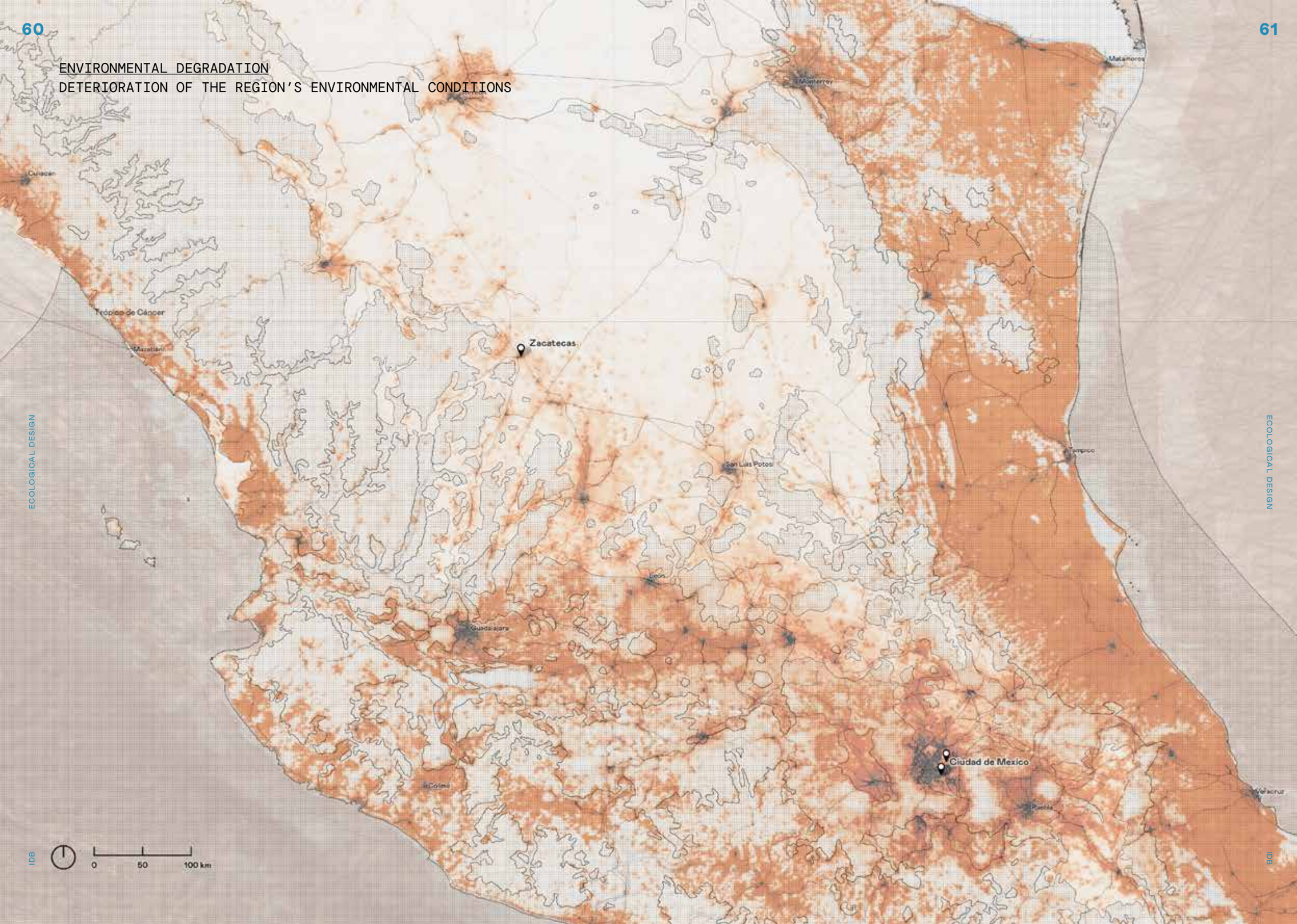






ENVIRONMENTAL DEGRADATION

DETERIORATION OF THE REGION'S ENVIRONMENTAL CONDITIONS





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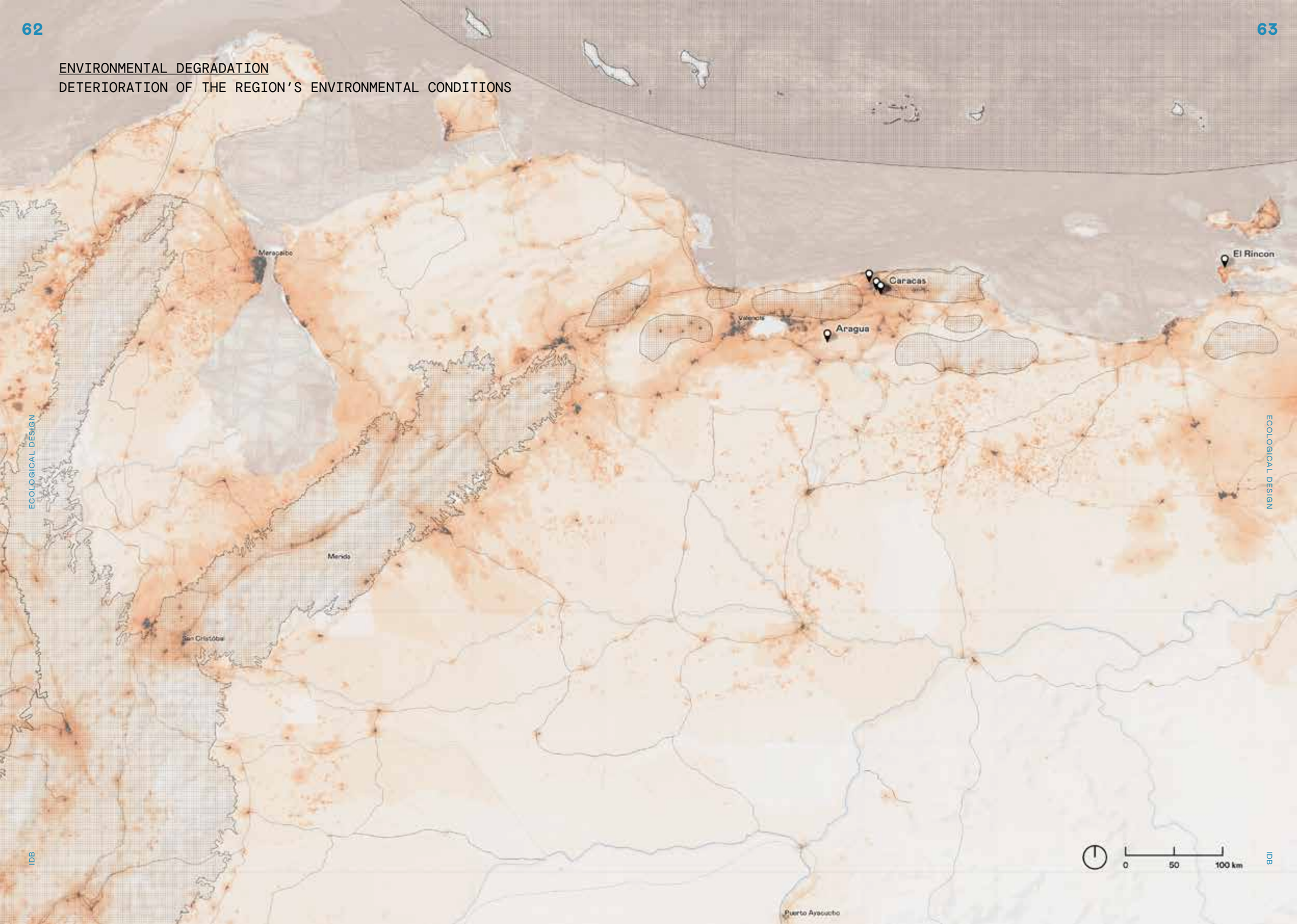
ENVIRONMENTAL DEGRADATION

DETERIORATION OF THE REGION'S ENVIRONMENTAL CONDITIONS





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# ENVIRONMENTAL DEGRADATION
## FOREST COVER LOSS

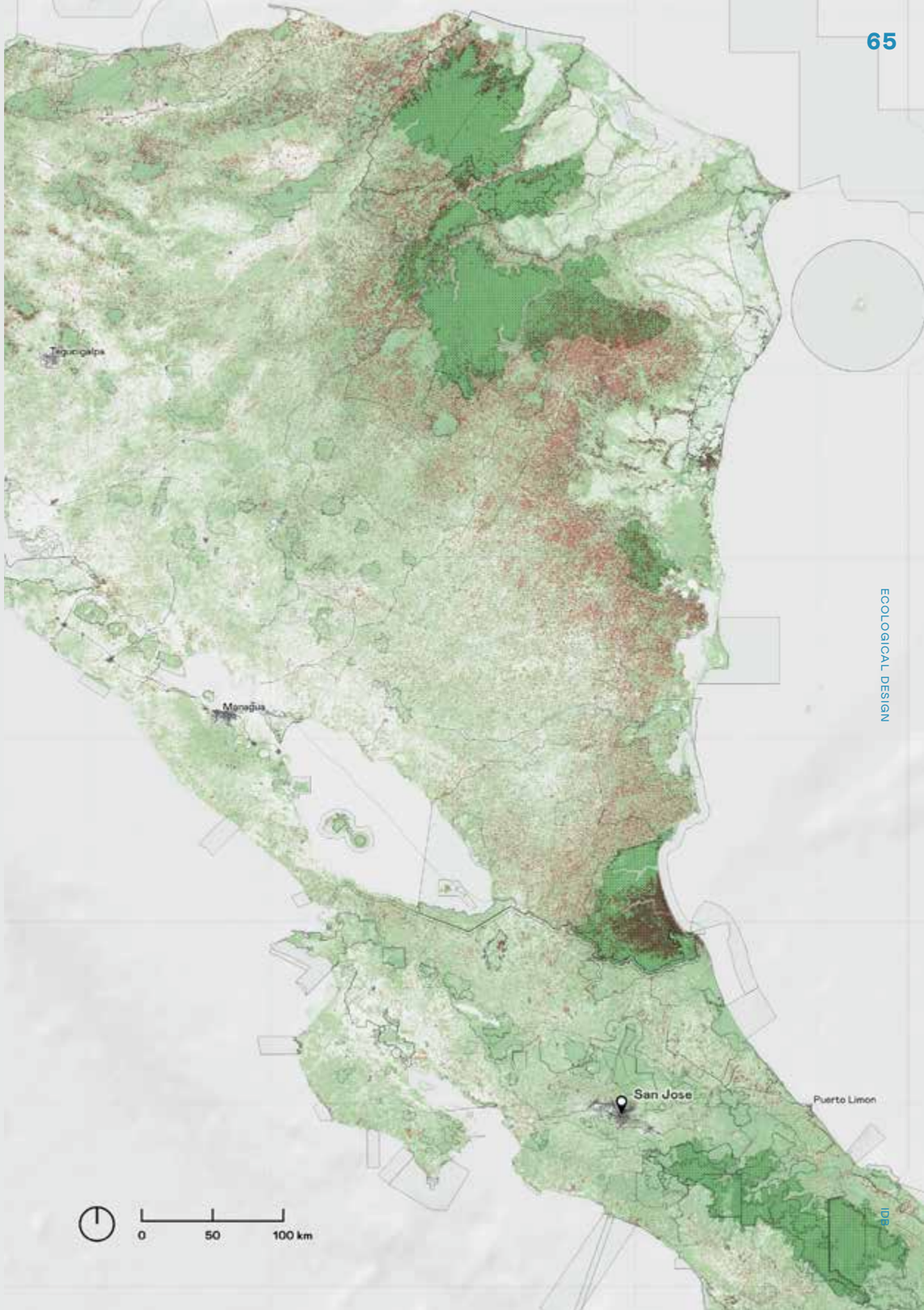
**2.2** Deforestation, 2000-2020.


Deforestation, presented in red, depicts the cumulative regional forest cover loss sustained during the first twenty years of the 21st century (2000-2020), derived from analysis and time series processing from Landsat satellite imagery. This map depicts forest cover as standing and visible trees, defined as vegetation taller than 5m in height. It also includes the World Database on Protected Areas catalog as an overlay, including terrestrial and marine protected areas. Intact forest landscapes (2000-2013) are highlighted, as a reference of the continuous arboreal mass, above 30m in height, showing no signs of significant human activity, and large enough to maintain native biodiversity. Average resolution of this map is 30 meters per pixel.

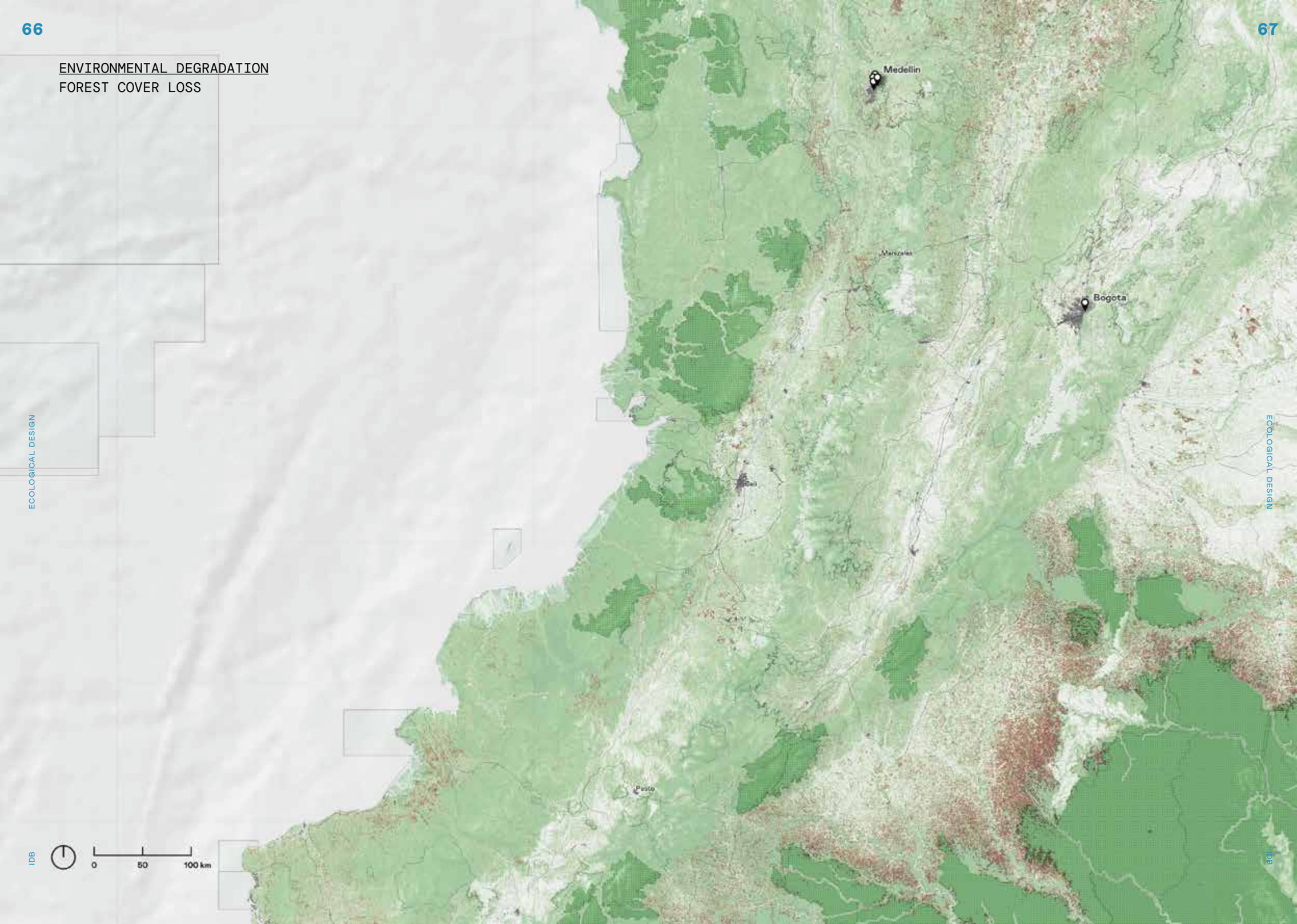
- Deforestation
- Forest Cover
- Intact Forest
- Protected Land
- Urbanization







ENVIRONMENTAL DEGRADATION
FOREST COVER LOSS





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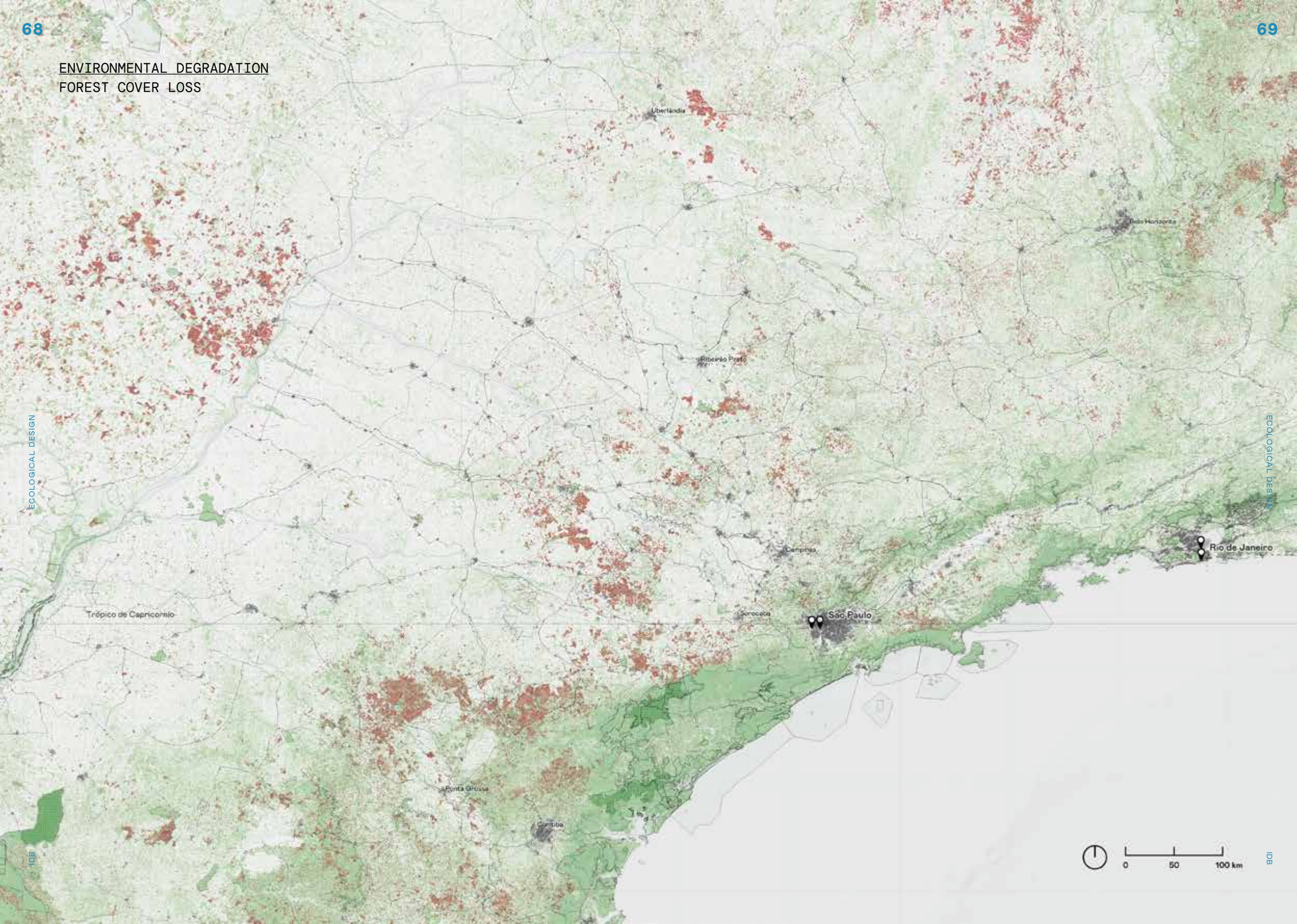
ENVIRONMENTAL DEGRADATION
FOREST COVER LOSS



# ENVIRONMENTAL DEGRADATION
## MAJOR ENVIRONMENTAL CHALLENGES OF THE REGION

**2.3** Soil erosion, 2002-2017.

Fifteen-year cumulative spatial distribution estimates for a major process of land degradation regionally, soil erosion. Arid regions and mountaintops are excluded from this visualization. The distribution, degree, and temporality of the processes of soil erosion are intimately correlated with issues around food security, land degradation, and biodiversity collapse in the tropics..

0% 50% 100%

Temporal distribution of cumulative soil erosion prevalence between the years 2002 and 2017.

Units: soil erosion prevalence (%).

**2.4** Wildfires by duration and magnitude, 2003-2016.

Between 2003 and 2016, 13.3 million individual fire events in the region became a major wildfire by burning a minimum area of .02km2, according to data the NASA Global Fire Atlas. The dataset is derived from processing of MODIS satellite platform imagery. Presented in this map are the daily dynamics of individual major wildfires: the location of ignition, fire size in square kilometers, and duration in calendar days.

10 20 40 60 80 100 + 120 días

Individual fire behavior of the region's major wildfires.

Units: duration (days) and fire size (km2).

Affected area (km2)

1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000

**2.5** Estimate of river plastic discharge into oceans, 2010.

Estimated contribution of plastic waste through rivers into oceans in 2010, as a proxy for plastic pollution found in rivers, lakes, estuaries, and coasts. This study considers only plastic waste larger than 0.3mm, therefore microplastic contamination, a major pollution source, which is extremely harmful toward humans and other living organisms, is not included in this visualization.

0 .00 1,250.00 2,500.00

Mass of mismanaged plastic waste, with a particle size larger than 0.3mm, transported via rivers into oceans, in 2010.

Units: kilograms per year.

**2.6** Nitrogen balance in the landscape, 2000-2015.

Observed concentrations of nitrogen in the productive landscape as a result of agricultural intensification and the application of fertilizers. The nitrogen balance indicates the level at which the crop(s) use(s) the applied nitrogen according to local conditions. A deficit of nitrogen indicates a reduction in primary land productivity, while a surplus in the total nitrogen available reflects an overuse of fertilizers that may result in groundwater and stream pollution, eutrophication, soil degradation, and negative structural changes in the environment.

Global average (+) 138

Deficit < (-) 130 | Equilibrium = (+/-) 0 | Surplus > (+) 360

Nitrogen content as a multiyear balance, 2000-2015.

Units: kilograms per hectare.





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# WATER CRISIS
## WATER STRESS, AVAILABILITY, SUPPLY, AND DEMAND PROJECTIONS

**3.1** Water stress, 2040.

Water stress measures the ratio of total water withdrawals to available renewable surface and groundwater supplies. Water withdrawals include domestic, industrial, irrigation, and livestock consumptive and non-consumptive uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users.

| Low | Medium | High | Extreme |
|---|---|---|---|
| <10% | 10-20% | 20-40% | 40-80% >80% |

Percentage of the population exposed to water stress for the year 2040 under an intermediate climate change scenario (SSP2-4.5/CMIP6).

Units: percentage of population (%).

Arid regions / Low water consumption.

**3.2** Groundwater table decline, 1990–2014.

Groundwater table decline measures the average decline of the groundwater table as the average change for the period of study (1990–2014). The result is expressed in centimeters per year (cm/yr). Higher values indicate higher levels of unsustainable groundwater withdrawals.

| Low | Medium | High | Extreme |
|---|---|---|---|
| <1 cm/a | 2-4 cm/a | 4-8 cm/a | >8 cm/a |

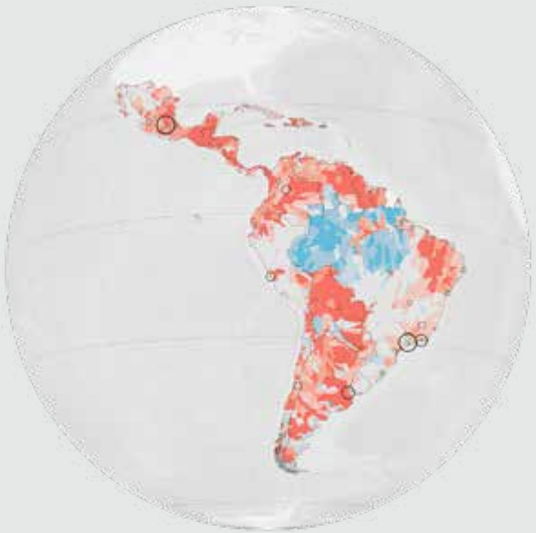
Ground water table decline

Units: Centimeters per year.

**3.3** Water supply, 2040.

Projected change in total renewable surface water supply available for human consumption and activities, under an intermediate climate change scenario (SSP2-4.5/CMIP6), with the year 2010 as the baseline.

- 1.7x (+) increase
- 1.4x increase
- 1.2x increase
- No change
- 1.2x decrease
- 1.4x decrease
- 1.7x(+) decrease



**3.4** Water demand, 2040.

Projected change in water demand, measured as water withdrawals, for human consumption and activities, under an intermediate climate change scenario (SSP2-4.5/CMIP6), with the year 2010 as the baseline.

- 1.7x (+) increase
- 1.4x increase
- 1.2x increase
- No change
- 1.2x decrease
- 1.4x decrease
- 1.7x(+) decrease





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# 2

# PUBLIC SPACE AND GREEN INFRASTRUCTURE AS CATALYSTS FOR R ESILIENT URBAN TRANSFORMATIONS IN THE VULNERABLE CITY







The IPCC [Intergovernmental Panel on Climate Change] has long recognized the importance of improving informal settlements to adapt to climate change. For example, the 2001 to 2007 IPCC reports identified the increased risks that those who live in informal settlements face due to low- quality housing, inadequate services, and circumstances for which many inhabit dangerous sites.[45] In 2014, the Fifth Report acknowledged the existence of informal settlements in conditions of increased risk and established that improvement interventions conducted with the community can lead to a future condition of greater resilience due to the training of its community and the enhanced functionality of its infrastructures.[46] Since the 1970s, governments and other international agencies have also recognized the difficulty of offering alternative accommodations to the inhabitants of informal settlements, given the magnitude of the phenomenon, and they have developed projects and programs to improve the conditions of precarious areas. These operations have limited displacement, favoring interventions with a focus on housing, infrastructure, and public space within the built settlements.[47] The Inter-American Development Bank has launched multiple neighborhood improvement projects throughout the continent, the most notable being Favela Bairros in Rio de Janeiro, Brazil.[48] These programs have improved existing neighborhoods by preserving housing and the economic and social networks built by the inhabitants over time and have shown the need to implement comprehensive mechanisms that ensure a consolidation of the settlements and the accessibility to urban services.[49]

**45.** Satterthwaite et al., 2018 . *Responding to Climate Change in Cities and in Their Informal Settlements and Economies* mentioned earlier demonstrate how the Work Group II of IPCC in the "Third Evaluation declared the necessity to 'Regularize the right to property for informal settlements and other means to permit lower income groups to buy, rent or build good quality housing in safe sites.' (Scott et al., 2001, 406). The Fourth Evaluation demonstrated how informal settlements within urban areas of cities in developed cities and countries are especially vulnerable, since they tend to build themselves in precarious sites and are susceptible to inundations, earthquakes and other disasters related to the climate.'" (Wilbanks et al., 2007, 372).

**46.** Satterthwaite et al., 2018

**47.** See, for example, the PROMEBA plan in Argentina, PMB in Uruguay, XX in Colombia.

**48.** The IDB has been working with the municipality of Rio de Janeiro in Brazil to improve the living conditions of families living in the poor informal neighborhoods of the city, known as favelas, since 1996 (Favela Bairro I). Two additional loans have been approved since then: Favela Bairro II, which completed its execution in 2007, and Favela Bairro III, approved in December of 2010. https://www.iadb.org/en/news/improving-living-conditions-low-income-neighborhoods-rio-de-janeiro. See also Rojas, E., & Fretes Cibils, V. (2009). Capítulo 1. Construir Ciudadanía para una mejor calidad de vida. In Rojas, E. (Ed.), *Construir ciudades. Mejoramiento de barrios y calidad de vida urbana*. IDB and Fund of Cultural Economy; and BID. (September 2019). Memory Help. Plan of Barrios Improvement (AR-L1119) *Jornada de lecciones aprendidas de PROMEBA III.*

**49.** Ibid.

These programs have focused on public space as an opportunity to implement new infrastructures while enhancing and consolidating the settlements from an economic, social, and environmental point of view. Public space plays a fundamental role as a platform for civic action, social exchange, and empowerment. While the inhabitants of spontaneous or informal settlements generally build their houses and maintain them, no one builds a common public space or ensures its maintenance.[50] Informal settlements are far from being successful forms of territorial occupation as shown by a range of indicators: quality of life, autonomy from world markets, dependence on the formal city, environmental impact, resource consumption, social mobility, governance, and happiness, among others. Basic services are nonexistent or insufficient, such as potable water, sewage treatment, and waste disposal. Residents do not have access to educational or health services – a basic human right –, economic opportunities are limited, rates of violence and crime can be astonishingly high, and rarely do they have public spaces.[51]

Green infrastructure and public space can help reduce many of the environmental risk conditions created by extreme climate events while enhancing public life, thus improving the social resilience of the settlements.

Public space also has the potential to play a fundamental role in climate change mitigation and adaptation to its impacts. In most cases, spontaneous settlements have arisen on vacant land in precarious areas, such as riverbanks, wetlands, flood-prone areas, or steep slopes, areas not considered suitable for formal urbanization. They also emerge in marginal areas, far from urban services, such as transportation, security, health services, education, garbage collection, and are deprived of infrastructure such as potable water, water collection systems, drainage, and slope stabilization. The increasing density caused by the growth of family units residing in the areas and new phenomena of migration is putting additional pressure on these areas, while the effects of climate change are aggravating the risk conditions. More intense and frequent rains are increasing the chance of floods in these hydro-geologically unstable areas, while extended droughts disrupt the supply chain of already precarious water

**50.** Silva, 2020.

**51.** Gouverneur, D. (2016). *Diseño de Nuevos Asentamientos Informales*. Fondo Editorial Universidad Eafit, Ediciones Unisalle







**The IPCC points out how improvement interventions conducted in informal settlements with communities can lead to a future condition of greater resilience, thanks to the training of the community and the enhanced functionality of local infrastructures.**

**Public space is a very scarce resource in many Latin American cities and particularly in some of the densest informal settlements. Green areas are also very scarce and unevenly distributed, with very few cities and neighborhoods meeting the 10 to 15 square meters of green areas per inhabitant recommended by the World Health Organization.**







supply systems and can impact food prices, and the effect of heat waves is amplified by the scarcity of green areas and the poor insulation and lack of cooling systems in the housing. The inhabitants of informal settlements are thus exposed to multiple levels of vulnerability.

Public space is a very scarce resource in many Latin American cities and particularly in some of the densest informal settlements. Green areas are also very scarce and unevenly distributed, with very few cities and neighborhoods meeting the 10 to 15 square meters per inhabitant recommended by the World Health Organization. For example, while the Metropolitan City of Buenos Aires has an average of 6m2 of green space per person and the most valuable areas exceed 18 m2 per person, the grayest and poorest areas located in the center do not reach even reach 1 m2.[52] A 2013 study carried out in Caracas showed that in the entire territory of Petare, the largest informal settlement in the city, the availability of public space was 0.1 m2 per inhabitant, with the general average for the city was 1.1 $m^2$.[53]

We carried out a territorial analysis of Buenos Aires (Argentina), Medellín (Colombia), São Paulo (Brazil), and Santiago de Chile (Chile) and saw a direct correlation between the availability of green and public spaces and the socioeconomic levels of each neighborhood or municipality.[54] In the Metropolitan Area of Buenos Aires, with the exception of some municipalities, the ratio of m2/inhabitant of green spaces and the average socioeconomic level appears to be organized in two parallel curves: one where there is a trend of a greater number of m2/inhabitant to a higher average socioeconomic status and another in peripheral areas (which can be high and low income). While central areas are characterized by a general lack of green spaces, low-income municipalities located in the center have a negligible presence of green spaces.[55] In Medellín, there is a clear relationship between green areas and income, with the exception of Robledo, a lower income area at the periphery, with a higher density of green spaces, and El Poblado, one of the highest income areas located in the center, with a lower density of green spaces. In the case of Medellín, the Mayor defined public space as that which is in service of the communes as "an effective public space of a permanence, destined for recreation, relaxation, leisure, and citizen encounters, ascribed to collective use."[56] São Paulo stands out for the density of green spaces in some of its districts. Green

**52.** GCBA. (2013). *La dimensión social en el Modelo Territorial Buenos Aires* (2010/2060). Buenos Aires data (2019). *Espacios verdes.* DGEEC (2010). *Población total por sexo, superficie y densidad de población según comuna y barrio.* City of Buenos Aires.

**53.** Study realized by Daniel Belandria in the Municipality of Sucre in Caracas. (2012). Mentioned in Silva, 2020, 36.

**54.** Analysis carried out by the IDB in collaboration with Groundlab AA Landscape Urbanism for the Ecological Design publication. See Vera & Sordi, 2021.

**55.** Vera & Sordi, 2021. Infographic 23: Green Areas and Social Economic Level. Buenos Aires. 249. The m2 of green areas per inhabitant are defined by the "Green Areas" layer available on the Buenos Aires website (https://data.buenosaires.gob.ar/) cross-referenced with the population projections for 2019 from the General Direction of Statistics, Surveys and Census (DGEEC. The socioeconomic status per commune is defined by the social dimension in the Territorial Model of Buenos Aires, in which the population is distributed among six strata that synthesize perceived salaries with data related to level of education, occupation, qualifications and categories of employment and housing characteristics. It should be noted that "green spaces" include "gardens, parks, recreational areas, plazas, squares, corners and sports centers" and that all these areas have a positive role in relation to climate change.

**56**. Vera & Sordi, 2021 . Infographic 22: Green Areas and Social Economic Status. Medellín, 248. The m2 of green areas per inhabitant are defined by the "Existing Public Space" layer available on the website of open data of the Mayor of Medellín cross-referenced with population projects for 2018 of the same source. The website indicates that the layer of existing public space is the Public Space of Recreation, and encounters exists for the validity of the Plan of Territorial Law and corresponds to the public space defined by permanence, destined for recreation, relaxation, leisure, and citizen encounters, ascribed to collective use. The average socioeconomic status of each commune is defined by a publication of the Mayor of Medellín, who defines housing in six socioeconomic statuses.







**Public space is a very scarce resource in many Latin American cities and particularly in some of the densest informal settlements. Green areas are also very scarce and unevenly distributed, with very few cities and neighborhoods meeting the 10 to 15 square meters of green areas per inhabitant recommended by the World Health Organization.**

spaces are delineated by the municipal public parks, urban state parks, plazas, and all the Units of Conservation of Integral Protection defined by the National System of Conservation Units.[57] There is also a direct relationship between Vila Mariana and Capela do Socorro, with some exceptions of high income and low density of green space at and below that line. The exceptions found in other cities, where some peripheral low-income districts are characterized by a decent amount of green space, does not exist in São Paulo, since all the neighborhoods of lower socioeconomic strata are in the center. In Santiago, there is also a direct relationship between the number of green spaces and socioeconomic levels, except for some downtown informal settlements that are characterized by high incomes and similarly lack green spaces, and some low-income districts in peripheral areas that have more than 10 m2 of green areas per inhabitant.[58]

Infrastructures and green spaces offer the possibility of improving the quality of life in informal settlements and increasing their resilience to climate change due to their flexibility of uses and multiple social and environmental benefits. This book presents a series of green interventions and infrastructure that, at different scales and through multiple actions, have a direct impact on informal settlements. The interventions are grouped in three transversal objectives that address the main environmental challenges for the neighborhoods, as well as their urban aspirations: Restore and Upgrade, Adapt and Connect, Mitigate and Anticipate.

The **"restore and upgrade"** section includes a series of projects that arose from the need to remediate areas subject to landslides, abandonment, contamination, and other conditions of local social and environmental risks. These projects respond to the question: How to intervene in situations of environmental risk while improving the quality of space and life in the settlement? The project goals included risk reduction and contributions to the improvement of the quality of life of the inhabitants of informal settlements. These types of interventions are mostly site-specific and transform public spaces such as streets, plazas, and buildings, offering other advantages such as reduced maintenance costs, increased economic value of adjacent urban land, and the opportunity to create recreational, educational, and social activities within the neighborhoods. They

**57.** The m2 of green areas per inhabitant are extracted from the graphic of "Green areas per inhabitant 2017" published on the Brazilian Social Network by Equitable and Sustainable Cities website; the indicator of m²/inhabitant of green areas is obtained by adding the green areas of public ownership, created and maintained by the Municipal Government and the State Government, including the municipal public parks, urban state parks, plazas, and all the Units of Conversation of Integral Protection defined by the National System of Conversation Units. The average percentage of socioeconomic status is defined by São Paulo's Social Vulnerability Index (IPVS) that divides the population in seven socioeconomic levels.

**58.** Vera & Sordi, 2021. Infographic 22: Green Areas and Socioeconomic Level. Santiago de Chile, 251. The m2 of green areas per inhabitant are extracted from the graphic "Public green surface areas per inhabitant" published in the page of the System of Indicators and Standards of Urban Development (SIEDU) where the "relationship between total area of communal green surface areas (the sum of surfaces of parks and public plazas) in regard to the communal urban population." The average percentage is defined by the percentages of socioeconomic level by the Indicator of Territorial Wellbeing, which distributes the population of each commune into ten socioeconomic classes. The density of public green space has a direct relationship with the social classes, sometimes blurred in several communes in the city center (Santiago, Nuñoa, Independencia, and San Miguel). However, in the southern limits of Santiago, San Ramón and Lo Espejo exhibit the opposite.





adopt nature-based solutions and different typologies of green infrastructures to offer multiple benefits to the community.

For example, the Plaza Estacional project in Caracas implemented various techniques to stabilize and contain terrains vulnerable to landslides and hydrogeological risks through stabilization walls made of sandbags and the incorporation of a variety of vegetation strategies to contain the land. In other cases, recycling materials such as disused tires were leveraged to build embankments and contain earth in steep sites while incorporating vegetation. This technique was successfully implemented in Parque Fazendinha in São Paulo, where a landfill was transformed into a communal public space. Another project in Brazil, the food garden in Manguinhos, developed by Hortas Cariocas in Rio de Janeiro, transformed an abandoned site with waste into a huge organic food garden, establishing a new public space capable of providing environmental, social, and economic services to neighbors through the garden.

These interventions can also improve the sense of security, foster economic activities, and include educational programs. For example, the redesign of the public section of the street in the Paseo Urbano of Calle 107 in Medellín not only increased green surfaces and tree planting while repaving an unstable road, but also allowed the creation of a new urban corridor that indirectly stimulated commercial activities in the area and created a new community meeting space. Similarly, the Trazando Sonrisas park by the Trazando Espacios team in Caracas created a play area with recycled materials for the Agustín García Padilla school, which became a public space for the entire community, offering educational, recreational, leisure, and social areas.

The second section of projects, "adapt and connect, "highlights solutions whose main objective is to improve the urban and environmental conditions of informal settlements, but accomplish it through projects that have a broader impact. Adapting to climate change, for example, by increasing permeable surfaces, improving drainage systems, ensuring access to water, protecting biodiversity, rebuilding ecosystems, and promoting healthy lifestyles, requires ambitious interventions that go beyond individual settlements and can benefit the entire city. To adapt to climate change, it is necessary to look at the city as a complex ecosystem, beyond the individual

**In Buenos Aires, as in many other capitals of the region, the central areas are characterized by a general lack of green spaces; however, the central districts with low-income families are characterized by a minimal presence of green spaces.**







neighborhoods. When it comes to initiating a change in informal settlements, it is imperative to also include them in the visions and plans of the city and facilitate accessibility to urban services, promote social and economic integration, and improve urban resilience overall.

The ten selected projects are examples of public spaces built in the informal city that can also be enjoyed by the inhabitants of the formal city,[59] offering ecosystem services and environmental benefits at an urban scale, improving the physical and mental well-being of inhabitants and generating a sense of belonging. For example, the Parque Fluvial de La Familia in Chile managed to repurpose a vulnerable area on the outskirts of the urban area, and now forms a new infrastructure that operates at the scale of the entire city, managing the water, improving the environmental comfort of the area, and connecting the precarious settlements that are adjacent to the park to central areas through a bike la ne that connects the park to the center and vice versa, making this intervention a resource for the whole metropolitan city.[60]

Climate change adaptation means anticipating future adverse effects and taking appropriate and flexible actions to prevent or minimize the damage it may cause, capitalizing on the opportunities that arise[61] and being mindful of future climate scenarios when designing.[62] This means, for example, using scarce water resources more efficiently; adapting building codes to the future climatic conditions and extreme weather events; building flood defense systems and raising levee levels; developing drought-tolerant crops; curating tree species and forestry practices that are less vulnerable to storms and fires; and reserving land corridors to facilitate species migration. Some of the selected case studies implement these strategies to build more resilient communities. For example, the Parque Represo Colosio in Nogales, Mexico, redesigned a body of water and its adjacent public space to prevent flooding in surrounding areas. In another example, Quebradora Park implemented a water management system as a key element. The water system was configured through the collection of stormwater runoff, the creation of natural infiltration basins, wastewater treatment and filtration in its wetlands, to provide easy access to potable water and quality public space to a vulnerable urban neighborhood. Finally, to address climate change and to develop more susainable

**59.** David Gouverneur and Oscar Grauer define these spaces as "urban connectors," highlighting as examples the Favela Bairro I and II projects in Río de Janeiro and the projects developed around the Metrocable in Medellín. Gouverneur, D., & Grauer, O. (2008). Urban Connectors: Fostering a Non-Hierarchical Integration of Formal and Informal Settlements. *Harvard Design Magazine*, 28, 24-30.

**60.** Leiva and Henríquez highlight how, in 2025, vegetation growth, in particular trees, in Parque de las Familias might have a notable impact in the thermal comfort of the area, since the process of evapotranspiration due to reforestation measures would be more significant than the water of the lagoon, fulfilling an important function for urban adaptation to climate change. See Henríquez Ruiz, C., & Rodríguez Leiva, S. (2014). *El rol de los parques urbanos en la regulación térmica y adaptación climática: Caso de estudio Parque Fluvial Renato Poblete, Santiago de Chile.* Study financed by the FONDECYT N° 1130305 project. Many thanks to the Sustainable Housing Development (CEDEUS) N° 15110020, 2013-2016.

**61.** European Commission Climate Action. *Adaptation to Climate Change.* https://ec.europa.eu/clima/policies/adaptation_en

**62.** UN. Climate Change. www.un.org/en/climatechange/

cities, it is necessary to intervene in the causes. In the "anticipate and mitigate" section, a series of case studies were selected that focused on reducing the causes of climate change, that is, reducing the sources of emissions of greenhouse gasses or increasing carbon sinks to avoid an increase in average temperature.[63] This means imagining new ecologies, economies, and societies to anticipate future conditions. However, from an urban perspective, anticipating future conditions in the region also requires considering informal settlements as an evolving reality, acknowledging their possible transformations and mitigating related risks. In recent decades, many Latin American cities and their informal settlements have been consolidating. According to the data surveyed by the United Nations, the percentage of the population living in informal settlements in Latin America and the Caribbean is gradually declining.[64] However, in 2018, 50% of the population did not have access to public transportation, and 23% of the population did not have garbage collection (it was 20% in 2001-2010).[65] In addition, new migration routes at the national and international level, along with demographic growth in some cities, continue to push the expansion and transformation of informal neighborhoods.[66] As stated by David Gouverneur, while organizations and international actors have written extensively about the consequences of such a population explosion and the nature of informal occupation, little has been done in terms of devising how to effectively deal with the consequences of these demographic pressures and how to confront population growth in predominantly informal cities.[67]

According to Gouverneur, the challenge of designing in marginal communities should be addressed in a preventative manner, since it must guide the growth of settlements before and as they occupy new territories, introducing creative actions and strategic designs during the first phases of occupation, while visualizing how they can evolve over time.[68] For this, cities should develop planning instruments to anticipate urban transformations. The BIO 2030 Plan for Medellí n, included among the case studies here, is a good example in the region, as it established strategies to mitigate the impact of urbanization and its burden in the face of climate change and defined criteria for territorial expansion. Acupunctural

**63.** Ibid.

**64.** UN. (2018). *Sustainable Cities and Communities*

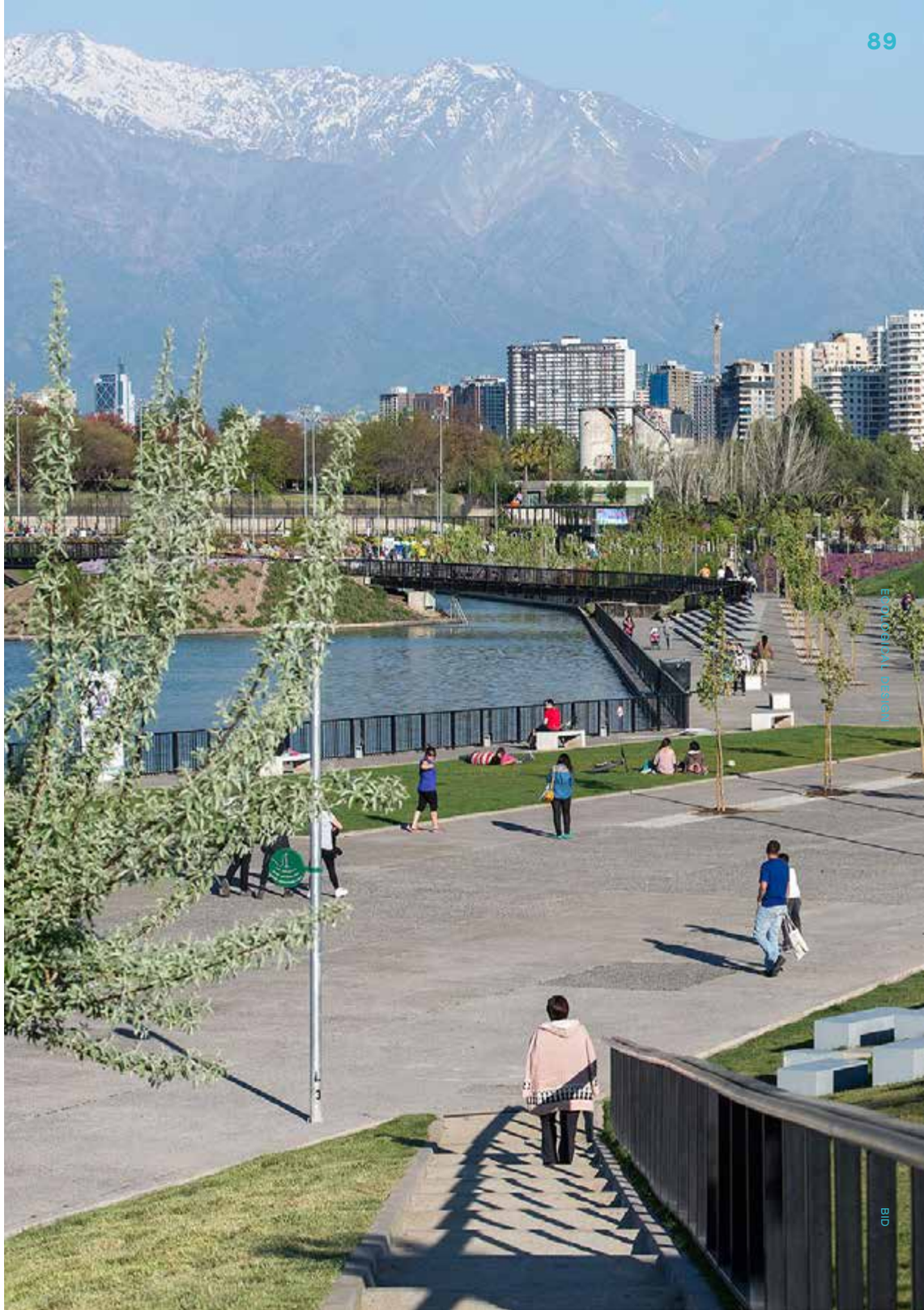
**65.** Ibid.

**66.** Vera & Sordi, 2021

**67.** Gouverneur, D. interviewed by Robleto Constante, L. (2013, July 1). Landscape strategies for informal settlements: creating armatures to shape urban form. *Metropolis*; Gouverneur, 2016.







interventions can become equally successful developments of complex and larger systems, improving the living conditions of hundreds of millions in these newly developing cities. In this sense, informal settlements cannot be considered an urban fringe condition, but rather the mainstream of dynamic forms of complex urban ecologies that are shaping the most populated cities in the developing world. It is possible to take advantage of this logic and its internal forces to promote an improved performance of the system through armatures that can assist informal settlements in managing social systems, water, food production, mobility, etc., infrastructures that Gouverneur calls "informal armatures."[69] Upgrading existing informal settlements is an important but also complicated, slow, and expensive task. One reason for the difficulty of this approach is the degree of consolidation and rigidity of the urban fabric in most of these settlements. To improve connectivity, provide infrastructure and community services, or relocate residents from inappropriate sites (due to the geological instability, the risk of flooding, locations under or over power lines, gas, etc.), it is necessary to have space, which is not usually available in the vicinity of extremely dense urban conglomerates. To confront these challenges and anticipate future transformations, both metropolitan and regional armatures can be defined that will guide the expansion and transformation of the predominantly informal city, which operates at different scales.[70] These armatures consist of infrastructures, which are often green infrastructure, and that incorporate different services and limit future construction, connecting the developing areas to services and one another. The armatures can be very malleable and function with very different spatial constraints. The main goal is to provide the conditions that transform these areas into new urban areas in transformation, instead of marginal components submissive to the formal city and the globalized market. These armatures can be understood as "dynamic hybrid urban ecologies that may well become the dominant and best form of territorial occupation in the developing world".[71] In the case studies section, we feature a series of projects that implemented a similar variety of these "armatures." Among these, for example, the Union for the Ecological Urbanization of Vila Nova Esperança, in São Paulo, restructured a favela through a model of ecological urbanization, with strategies to improve the relationship between nature and human development. This included creating facilities and infrastructures with sustainable criteria and self-sufficiency,

**68.** Ibid.

**69.** Ibid.

**70.** Gouverneur, 2016 .

**71.** Gouverneur & Constante, 2013.







**72.** Robleto Costante, L. (2012). *Pre-emptive versus retroactive: the beginnings of a post-informal landscape urbanism*" in Scenario Journal, August 14. Website: https://scenariojournal.com/preemptive-v-retroactive/ [last accessed April 2, 2020]

generating a waste management project and organic agriculture to produce food locally, and providing clean energy and community services. In Costa Rica, the Rutas Naturbanas project seeks to connect different areas of the city through nature, more specifically through the creation of 25 km of linear green infrastructure along the river, with the objective of contributing to the conservation of the ecosystem, the cleansing of the water course, and the creation of new recreation areas and safe mobility for people throughout the city. Similarly, the Mapocho 42K Project in Santiago de Chile is building an ecological and bike corridor that connects the entire metropolitan city, uniting municipalities of diverse social strata and topographies under a new green infrastructure and linear public corridor.

The international community has outlined three major transversal objectives to reduce risk conditions for the most vulnerable settlements: restore, adapt, and mitigate. These objectives require dynamic thinking that considers future climate conditions and implements structural changes in the urban environment. Informal settlements should be included in this transformation, with a special focus on preventative strategies. Currently, most investigations on informal settlements focus on retroactive strategies that improve existing conditions similar to "small-scale acupuncture," but don't address future growth. Landscape interventions in public space and green infrastructures address these gaps, providing flexible and continuous reorganization in addition to multiple environmental, economic, and social benefits.[72]





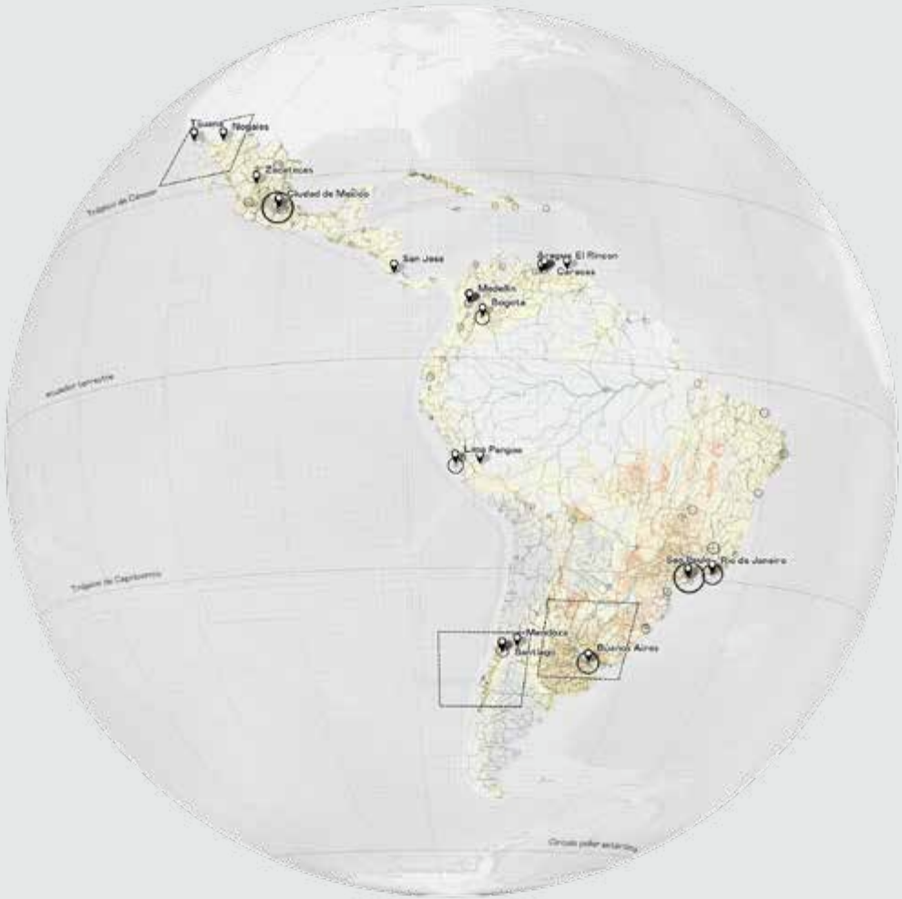


THE CARTOGRAPHIES PRESENTED IN THE FOLLOWING PAGES HIGHLIGHT THE MAIN RISK DRIVERS THAT AFFECT THE MOST VULNERABLE SETTLEMENTS AND ARE EXACERBATED BY THE CLIMATE CRISIS: THE TRANSFORMATION OF THE AGRICULTURAL FRONTIER AND THE CONSEQUENT FOOD INSECURITY, POORLY PLANNED URBAN DEVELOPMENT AND INFORMALITY, AND INEQUALITY AND POVERTY. THE MAPS HIGHLIGHT THE IMPACT OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTIVITY, FUTURE PATTERNS OF URBAN EXPANSION, REDUCED PHYSICAL ACCESSIBILITY TO URBAN CENTERS, LACK OF ACCESS TO BASIC SERVICES, AS WELL AS THE MAIN INDICATORS AND PATTERNS OF INEQUALITY AND POVERTY IN THE REGION.

ECOLOGICAL DESIGN

# FOOD INSECURITY
## CROPLAND EXTENSION

**4.1** Expansion and contraction of cropland extent, 2000–2019.



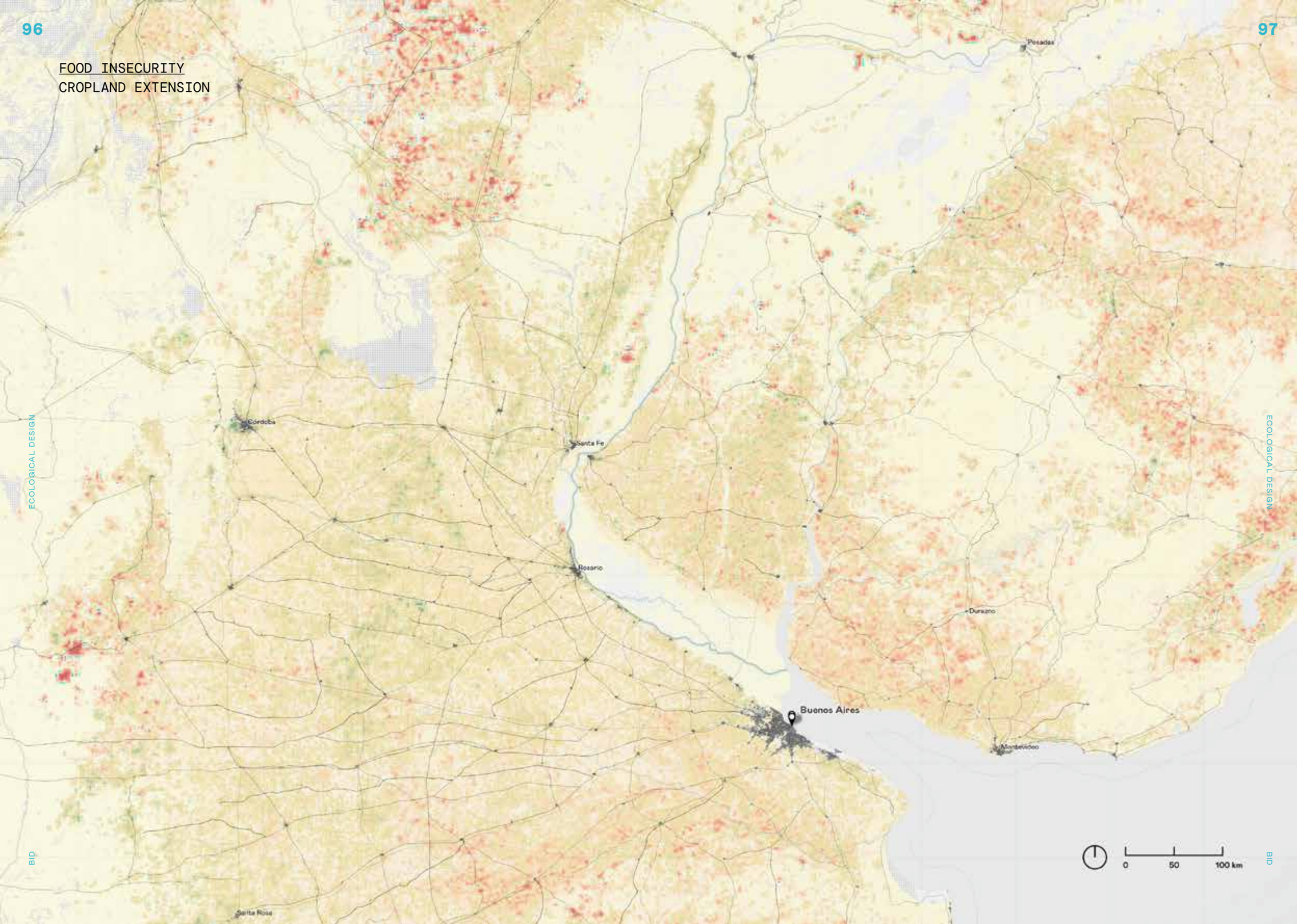

Expansion and contraction of cropland extent maps the changes in land use solely dedicated to agricultural production for the first two decades of the 21st century. Temporal analysis from the year 2000 to 2019 renders the dynamics of agricultural land use change and how cropland spatial processes impact ecosystems such as protected lands, conversion of arid land into productive regions through irrigation and other processes of urbanization. Gains in cropland are presented annually, while losses in cropland surface require four continuous years of land abandonment to be considered a contraction. The resolution of this visualization is equal to 30 meters per pixel.

- Gains in cropland
- Continuous & stable cropland
- Loss of cropland
- Arid land
- Urban areas



BID

FOOD INSECURITY
CROPLAND EXTENSION








ECOLOGICAL DESIGN

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FOOD INSECURITY
CROPLAND EXTENSION






ECOLOGICAL DESIGN

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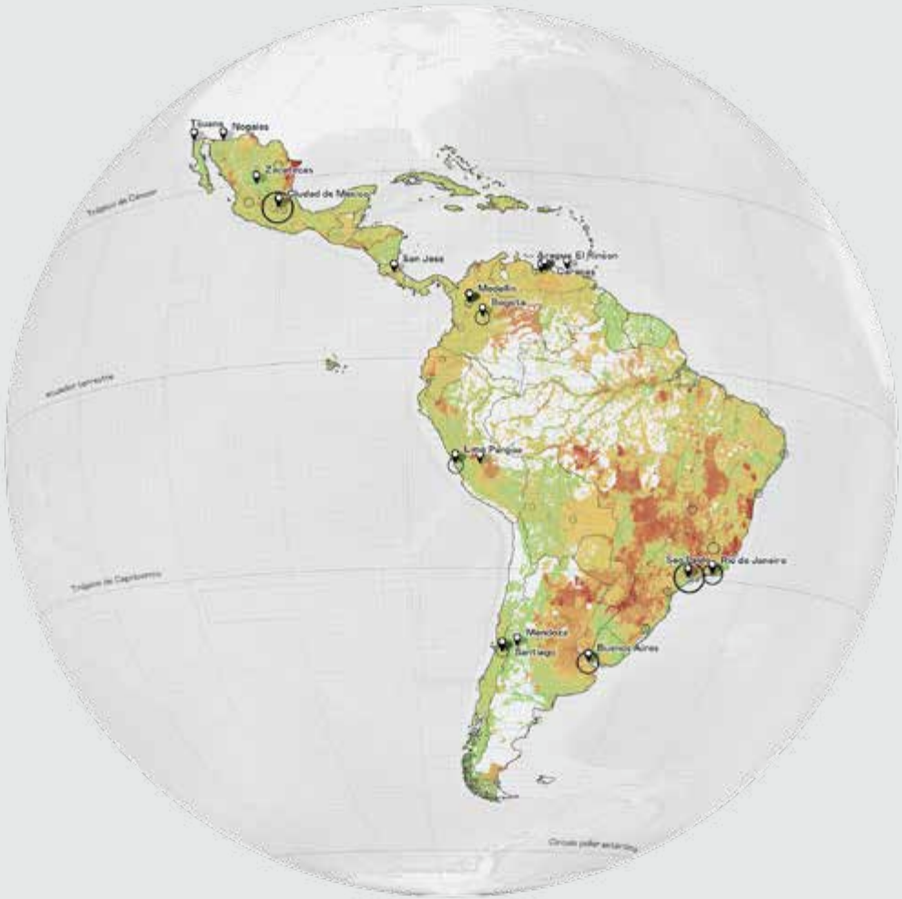
## FOOD INSECURITY
## LAND USE AND AGRICULTURAL YIELDS

**4.2** Cropland caloric end products: human food, animal feed or biofuels, 2000–2010




Foods systems support an increasingly growing population by expanding crop production, intensifying agricultural yield and/or increasing the fraction of the total agricultural production destined to human consumption. This map visualizes the spatial distribution of food production and allocation by mapping the land dedicated to agriculture during 2000-2010, explicitly describing the fraction of the caloric production towards three main demands: human food, animal feed or biofuels. Currently, 36% of all produced calories are used for animal feed, for which only 12% end up as a real contribution to human diets in the form of animal products. This represents losses of 41% of the calories produced on croplands due to inefficient feed to animal product conversion. Noteworthy in this map also is the pressure on available land dedicated or converted to the use of biofuels, further stressing food systems and local ecologies through land use change

- Biofuels
- Human Food
- Animal Feed

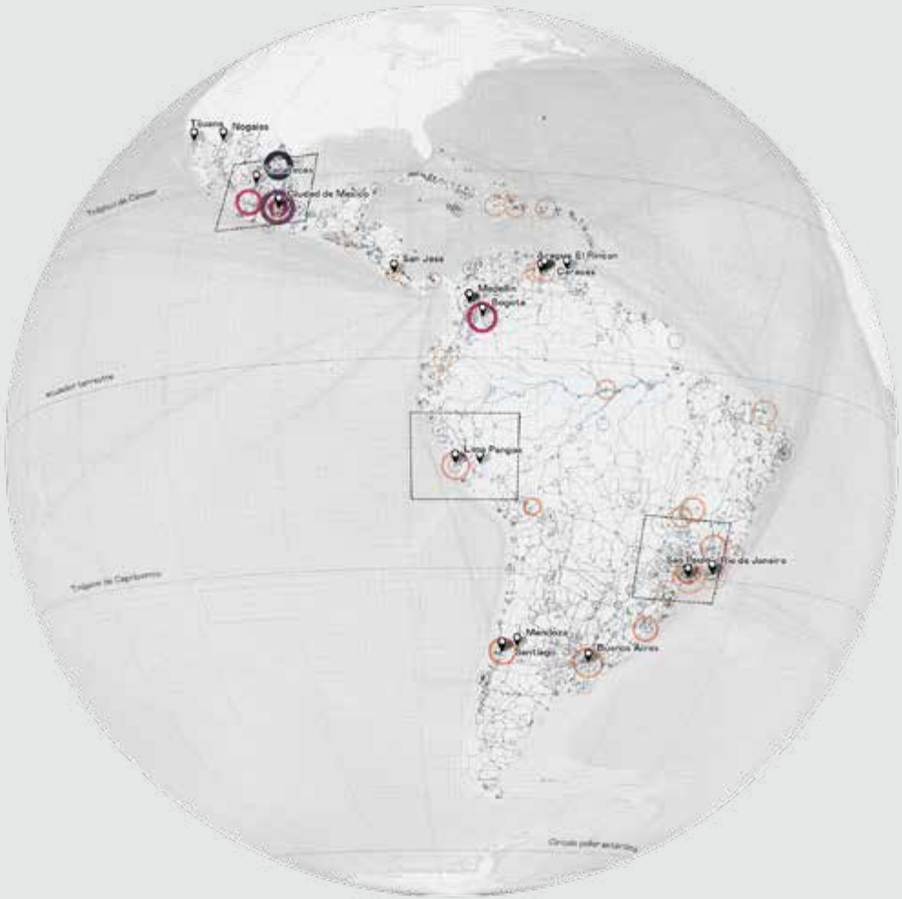


ECOLOGICAL DESIGN

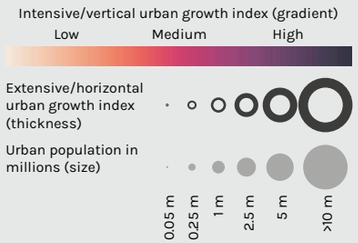
BID

## INADEQUATE URBAN DEVELOPMENT
## OBSERVED URBAN GROWTH & FUTURE PROJECTIONS

**5.1** City expansion index: vertical vs horizontal, 2000–2014.




The city expansion index map depicts urban growth according to two complementary processes: outward expansion and vertical intensification. The visualization is the result of remotely sensed data collected between 2000 and 2014 and it is intended to highlight regional trends in urban expansion and to understand the underlying processes of urbanization by developing a comparative approach to help governments understand how urban expansion can be managed in a way that achieves more equitable access to core services for the under-served while bringing wider economic and environmental benefits to cities.



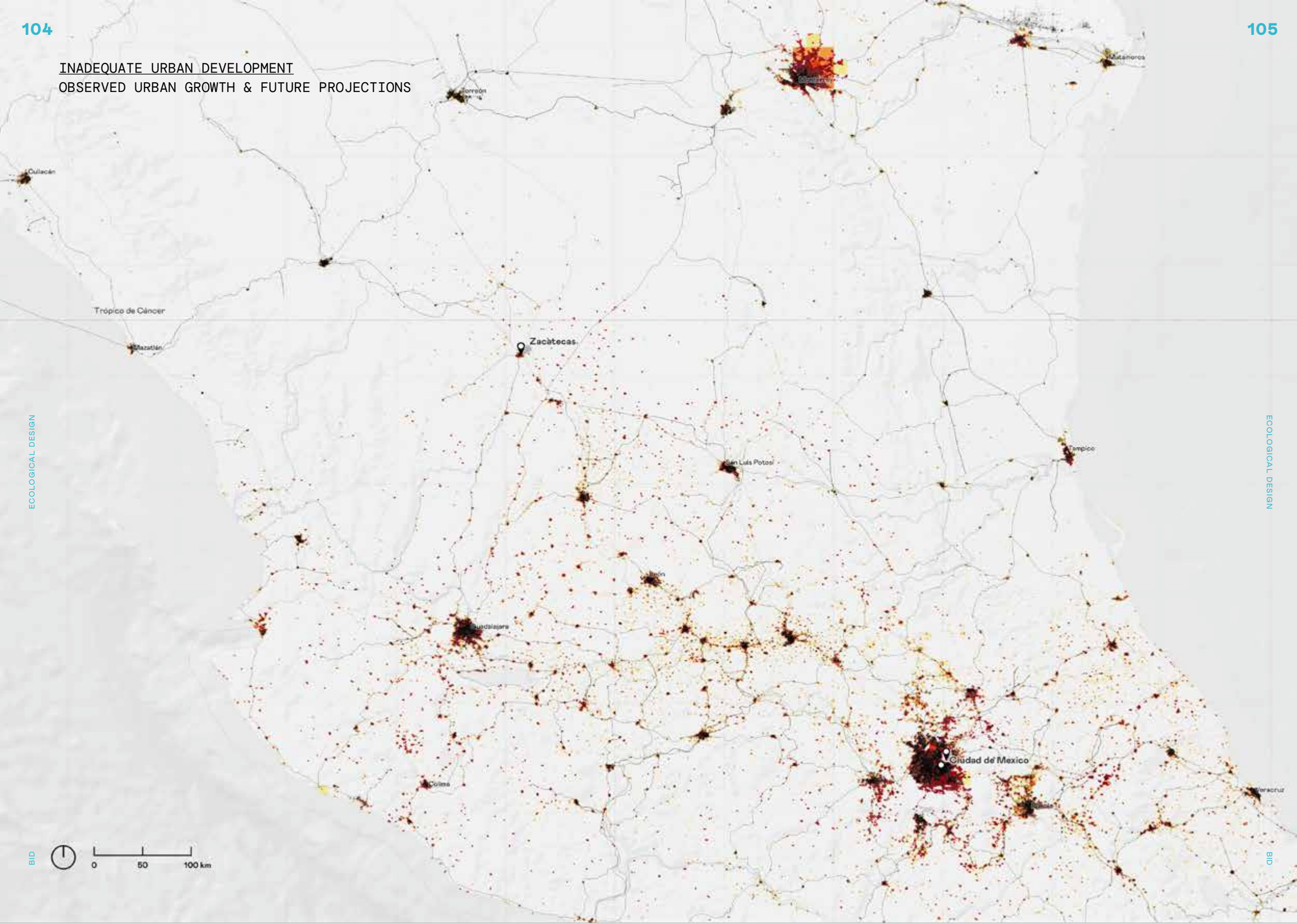



ECOLOGICAL DESIGN

BID

INADEQUATE URBAN DEVELOPMENT

OBSERVED URBAN GROWTH & FUTURE PROJECTIONS








ECOLOGICAL DESIGN

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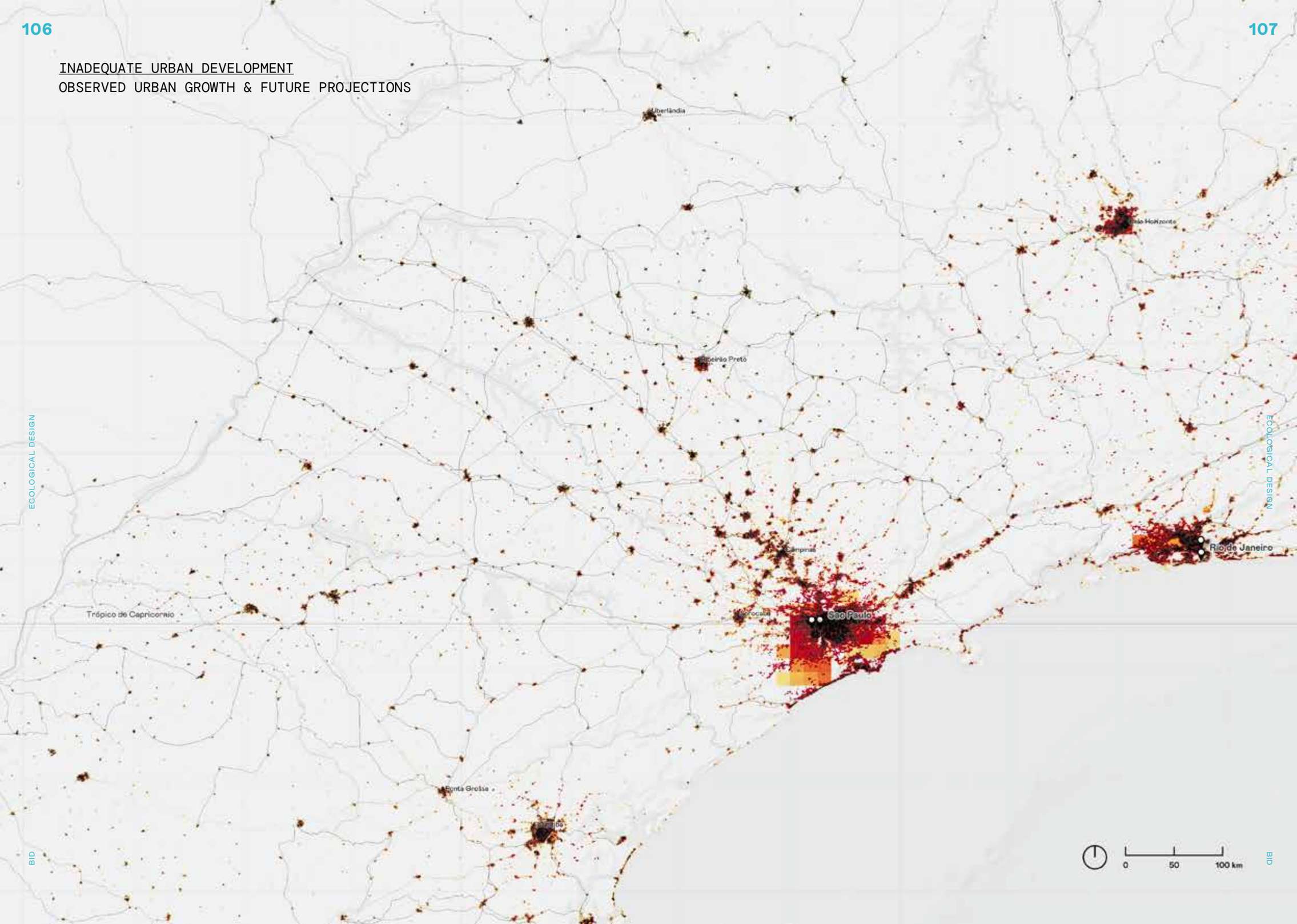
INADEQUATE URBAN DEVELOPMENT

OBSERVED URBAN GROWTH & FUTURE PROJECTIONS








ECOLOGICAL DESIGN

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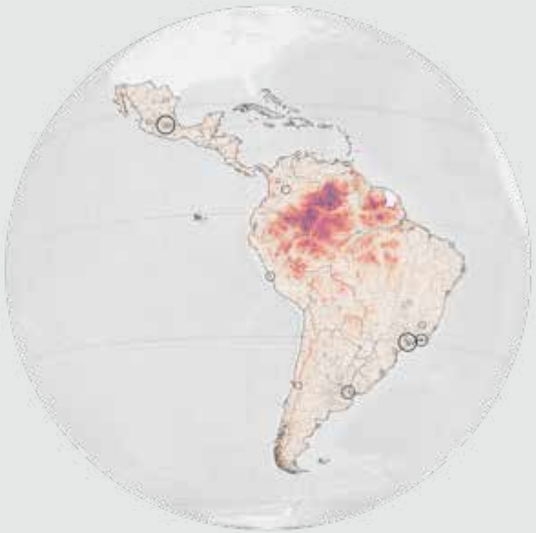
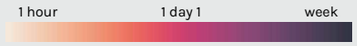
## INADEQUATE URBAN DEVELOPMENT
## INFORMALITY, SPATIAL & INFRASTRUCTURAL ACCESSIBILITY



**5.3** Access to urban centers via surface transport, 2015.

Accessibility to cities quantifies the time to travel to the nearest urban center via surface multimodal transport on different land cover types, calculated at 1km per pixel for any location in the region.




Time it takes to travel to the nearest city in 2015.

Units= minutes, hours, days.

**5.4** Percentage of urban population living in slums, 2018.

Population living in slums as the proportion of the urban population living in slum households. A slum household is defined as a group of individuals living under the same roof lacking one or more of the following conditions: access to improved water, access to improved sanitation, sufficient living area, housing durability, and security of tenure.


Percentage of urban population living in slums, 2018.

Units= percentage of urban population.





ECOLOGICAL DESIGN

BID

# POVERTY AND INEQUITY
## SUBNATIONAL INDICATORS

**6.1** Subnational gross domestic product per capita, 2015.

Spatially explicit distribution of gross domestic product per capita in Latin America and the Caribbean, in USD dollars, adjusted for inflation.

| Low | Mid | High | Extreme |
|---|---|---|---|
| <$1,200 | $12,000 | | >$120,000 |

Gross domestic product per capita.

Units = USD dollars, adjusted for inflation (2011).

**6.2** Subnational human development index, 2015.

Human Development Index or HDI is a composite index of 'average achievement in key dimensions of human development, which measures a long and healthy life, education, and decent standard of living. A high score, close to 1, represents a high life expectancy coupled with access to higher education and income levels near the highest national levels

| Low | Mid | High | Extreme |
|---|---|---|---|
| <0.500 | 0.750 | | >0.800 |

Subnational human development index

Units= compound index from 0(lowest) to 1(highest).





ECOLOGICAL DESIGN

BID

# 3

# URBAN GREEN INFRASTRUCTURE IN INFORMAL SETTLEMENTS: BENEFITS AND CRITERIA FOR IMPLEMENTATION





**73.** Vera & Sordi, 2021. Chapters 1 and 2.

**74.** In cities, erosion can affect the capacity of filtration and percolation of the soil and change water cycles, which is a risk that generally goes hand in hand with the risk of flooding and droughts. Castro Lancharro, 2017.

One of the main risks that affect cities in the region, and in particular the informal city, is thermal risk, or the impact of the increase in temperatures generated by the type of construction, degradation of the habitat, changes in the microclimate of human settlements, and the resulting consequences on the well-being of the citizens. This phenomenon is accentuated by the heat island effect, which generally produces higher temperatures in urban areas than in surrounding areas. Other risks are represented by drought and flooding, caused by changes in rainfall patterns that can limit the capacity of the potable water supply and, in case of floods and extreme climatic conditions, compromise the safety of urban infrastructures, housing, and commercial activities in precarious settlements, and is considered a health risk for the inhabitants.[73] The associated risks with rise in sea levels, erosion, and loss of biodiversity can also have a devastating effect on local economies and the lives of the most vulnerable, in addition to the ability of ecosystems to preserve their functionality over time and absorb extreme weather events.[74] These events can have very high human and economic costs. According to the Inter-American Development Bank, between 1970 and 2013, floods were the most common natural disaster in Latin America and the Caribbean. In 2002, in La Paz (Bolivia), the February storms caused economic losses equivalent to 70 million USD, in addition to the lives of seventy people. In addition, the 2005 and 2006 storms caused the overflow of the city's rivers, affecting the riverbed and hydraulic control works, whose damages were quantified at 4 million USD. In 2011, floods in Rio de Janeiro resulted in twenty-four deaths in Petrópolis, and 500 deaths if the entire region of Rio's barrios and favelas is

taken into consideration. In Ecuador, between the three months of January and March 2017, 127,500 people were affected by floods, and twenty-seven died. In 2019, cities such as Resistencia (Argentina) broke the rainfall record with 556.8 millimeters, which resulted in flooding in between 40% and 50% of the town. Other cities in the region are located in contexts of special risk, such as El Salvador, a city that, due to its location in an area of high rainfall, has recorded more than 2,100 flood events in the last century, and has faced damages of more than 300 million USD for every severe storm and hurricane in recent years.[75]

In this context, green infrastructures as an urban support system based on nature offer ecosystem services to cities and recreational spaces and create connections between contiguous urban areas, providing environmental, social and economic benefits.[76]

The European Commission, one of the first institutions to outline a roadmap for the implementation of green infrastructures, identified four main benefits: they promote sustainable urbanization, restore and enhance the value of degraded ecosystems, develop climate change adaptation and mitigation strategies, and improve risk management and the resilience of cities.[77] The various typologies of green infrastructure can be combined among themselves to mitigate distinct conditions of risk, or adapt to multiple activities and urban conditions and territories.

The guide, titled *Paquete de soluciones de infraestructura verde urbana. Retos, oportunidades, y manual de buenas prácticas* [Urban Green Infrastructure Solution Package: Challenges, Opportunities, and Manual of Best Practices],[78] published by the IDB, identifies seven main typologies. The first is represented by trees, planted in lines or small clusters. Trees can reduce the heat island effect, regulate air temperature, reduce emissions, improve carbon sequestration, reduce flooding, improve water quality, and enhance biodiversity. To optimize these benefits, native species should be promoted, as they are naturally adapted to local temperatures and hydrological conditions. In addition, the introduction of long- living species is highly recommended since they have proven to increase cooling properties. Finally, deciduous species are recommended instead of evergreen ones so that they offer shade in summer and allow for solar radiation in winter.

**75.** Castro Lancharro, 2017.

**76.** Quiroz Benítez, 2018, 42.

**77.** European Commission. (2015). Towards an EU Research and Innovation Policy Agenda for Nature-Based Solutions & Re-Naturing Cities, cited in Castro Lancharro, 2017.

**78.** Castro Lancharro, 2017.







A second typology of green infrastructure identified by the IDB manual is represented by green spaces, parks, gardens, and urban green corridors, which are used to reduce the heat island effect, regulate air temperature, increase carbon sequestration, improve air and water quality, increase and maintain biodiversity, and mitigate the effects of droughts and storm and coastal flooding. Open green spaces of urban parks produce an "oasis effect" with a temperature difference with respect to the adjacent urban area.[79] In addition, green spaces improve the quality of life and lead to healthier environments, since biodiversity contributes to pollution reduction, treatment of physical and mental illnesses, and the construction of social fabric.[80]

Another typology is represented by linear green transportation infrastructure and consists of the planting of herbaceous plants along transportation structures and/or other types of vegetation such as trees and large shrubs. This typology also reduces flood risks due to reduced surface runoff, stormwater filtration, regulation of environmental temperature by creating different microclimates and corridors that promote biodiversity.

A fourth typology is represented by rain gardens and floodable parks that capture surface runoff, reduce flood risk, store water in times of drought, and filter and purify water. In addition, they contribute to the reduction of thermal stress. These solutions include several different components: areas of herbaceous plants that reduce the speed of runoff, sandy areas that enable rapid infiltration, and robustly planted bioswales that facilitate rainwater infiltration and evapotranspiration, among others. In many cases, these gardens are combined with gray infrastructure, acting as runoff receptors, and once the gardens capacity to accumulate and filter water in extreme rain events is exceeded, excess water is discharged into the traditional sewage system.[81] A similar typology is represented by green terraces, shallow canals that function as rain gardens. Lastly, urban riverbanks and coastal green areas are two additional typologies implemented to reduce the overflow and the coastal flooding of urban rivers in times of flooding. Both can help improve water quality, reduce pollution, and contribute to biodiversity improvement.[82]

**79.** Urban Climate Lab. (2016). The Benefits of Green Infrastructure for Heat Mitigation and Emissions Reductions in Cities. Georgia Institute of Technology For The Trust for Public Land's Climate-Smart CitiesTM program; cited in Castro Lancharro, 2017.

**80.** A study in the journal Bioscience concluded that people who live in areas with more birds, trees, and shrubs are less likely to suffer from depression, anxiety, and stress. In 2007, in Sacramento, California, they found that city residents who exercised in parks spent less on medicine. The average difference in medical expenses between active and inactive users of the parks was for adults under 65 years of age, about 250 USD, and for adults 65 years of age and over, 500 USD. Significant environmental bneefits have also been recorded for noise reduction; cited in Castro Lancharro, 2017.

**81.** Castro Lancharro, 2017, 28-29.

**82.** Ibid.

Urban green infrastructures are particularly important in the case of informal settlements, since they fulfill several simultaneous functions, taking advantage of the minimal public space and the scarce availability of economic resources. In addition, green infrastructures have the capacity to increase their ecological value and functionality over time.[83] In comparison, the completion of the construction of gray infrastructure transitions into an immediate process of decay and depreciation. By increasing vegetation and stabilizing the soil, green infrastructure increases its ability to absorb pollutants by filtering water, reducing the heat island effect and creating shaded areas. However, the frequency of maintenance can be higher than traditional construction methodologies. For example, rain gardens and other green urban drainage solutions require more frequent cleaning compared to other water treatment solutions, and the soil has to be replaced periodically if it is subject to contamination. That being said, these maintenance operations have a relatively low cost and generate jobs,[84] which can be an added benefit in the case of informal settlements.

The second part of this book examines thirty case studies of green infrastructure implemented within informal settlements, throughout the region. For each project, we have identified the area of intervention where they can be implemented, the program, benefits, actors, and the main action that characterizes the project.

**83.** Strickler, K. (2015). *Green stormwater infrastructure in an informal context: feasibility and potential stormwater Impacts of Implementing rain gardens and rain barrels in peri-urban Santo Domingo.* Austin, TX.

**84.** *Idem.*

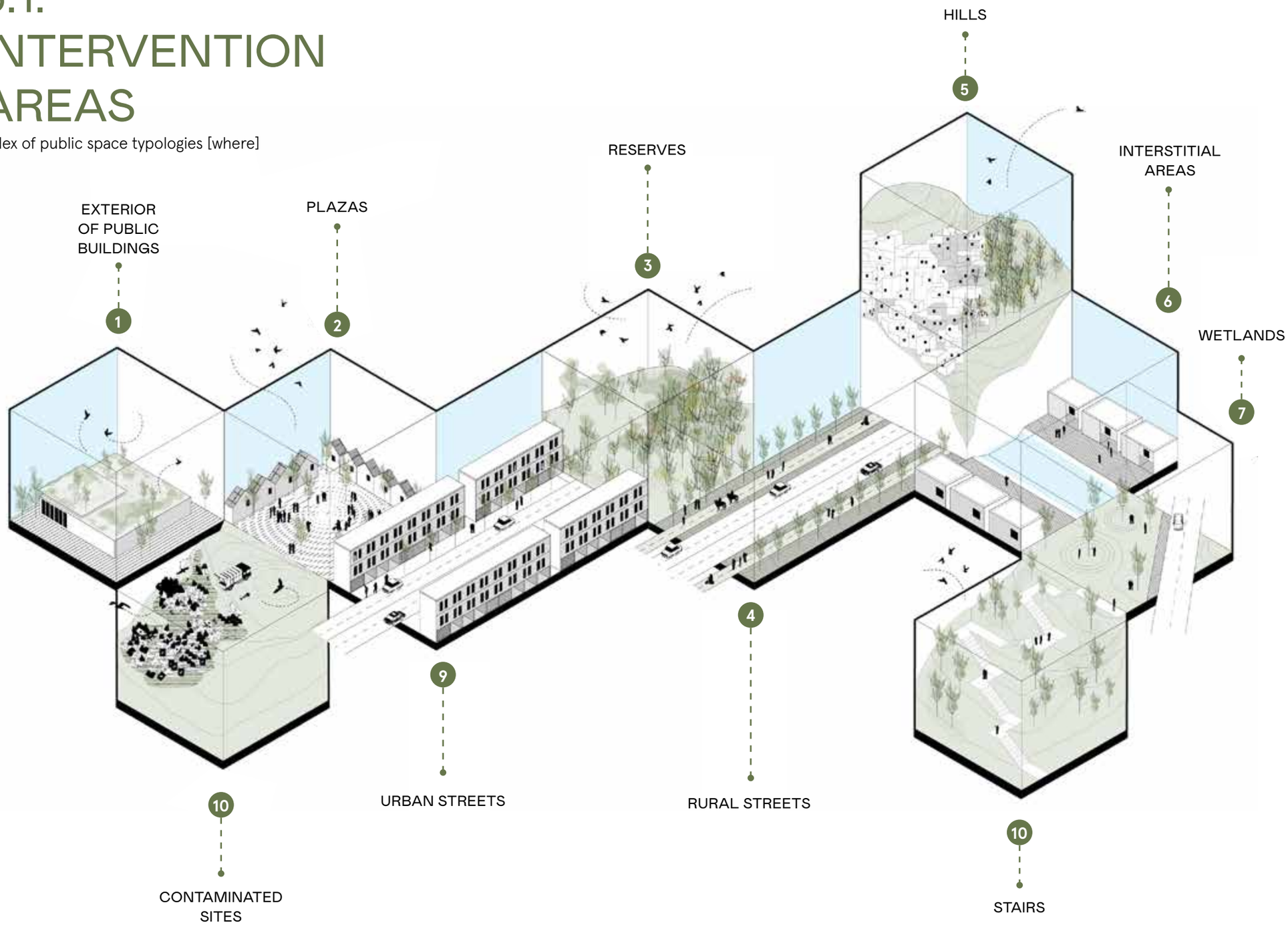






# 3.1. INTERVENTION AREAS

Index of public space typologies [where]





# 3.1. INTERVENTION AREAS

**85.** Quiroz Benítez, 2018. Demuzere, M., K. Orru, O. Heidrich, E. Olazábal, D. Geneletti, H. Orru, A. G. Bhave, N. Mittal, E. Feliu, & M. Faehnle. (2014). Mitigating and adapting to climate change: multi-functional and multi-scale assessment of green urban Infrastructure. *Journal of Environmental Management*, 146, 107-15. https://doi.org/10.1016/j.jenvman.2014.07.025; Institute for European Environmental Policy (IEEP). 2011. *Green infrastructure implementation and efficiency.*

Green infrastructures can be adapted to a multitude of spaces: plazas, urban streets, rural streets, stairs, reservoirs, hills, interstitial areas, vacant lots, contaminated sites, and roofs of public buildings, among others. It is important to identify potential public spaces to intervene and create resilience enhancement opportunities at such sites. The creation of permeable surfaces, for example, from parks to the roofs of buildings, increases infiltration, attenuates flooding, reduces landslides, and manages and cleans water.[85] Public spaces also provide the opportunity to channel existing urban forces, improve the resilience of sites, reclaim contaminated land, contribute to the identity of marginal areas, and dynamize the limit between the urban and rural. The areas of intervention for the case studies selected in this book vary in scale according to the objectives and strategies to be implemented. In some cases, the sites consist of small interstitial areas or urban streets, such as the Paseo de los Estudiantes in the community of Juan Moreno in El Consejo, in the state of Aragua in Venezuela, where a pedestrian alley was repurposed and is used daily by the neighbors. On a larger scale, the *Proyecto de Recuperación Urbana y Ambiental* [Urban and Environmental Reclamation Project] of the Morro de Moravia transformed one of the main landfills of Medellín into an urban park and a communal amenity. Furthermore, green infrastructures have the potential to activate even larger spaces as reserves, as is the case of the *Reserva Umbral Cultural Horizontes* [Horizontes Cultural Threshold Reserve] implemented as a pilot project of the Ecological Corridor of the Cerros Orientales in Bogotá.

# 3.2. PROGRAMS

Index of urban equipment and facilities [what]






**86.** Quiroz Benítez, 2018, 59.

The multifunctionality and value of ecosystems is one of the most important aspects of green infrastructures. Different types of green infrastructures such as trees, parks, rain gardens, riverbanks, among others, offer a multiplicity of ecosystem and environmental services, contributing to climate change adaptation and mitigation, increasing the capacity of stormwater infiltration, reducing the heat island effect, and sequestering carbon.[86] Parks, gardens, urban green corridors, and tree-lined streets can be combined with a series of activities such as trails, bike paths, public transit stations, markets, courts, lookouts, and playgrounds. These activities complement the ecosystem services offered by the green infrastructures, such as improved air quality and more favorable temperatures, while improving the physical well-being and social and mental health of citizens. For example, the Park in the Arroyo Xicoténcatl introduced a hybrid program and design that allows the water management and the reclassification of a water channel while offering a series of development platforms for a wide range of recreational activities including sports courts, children's playgrounds, gathering spaces, and shade structures for community use.

Green infrastructures also allow for the generation of additional resources, such as food and other consumable goods. Urban gardens, for example, in addition to improving soil fertility and air quality, have been shown to improve access to nutritious and high-quality food. If gardens

are large enough, they can also protect inhabitants of the most vulnerable and low-income areas against price volatility, reducing the risk of food shortages and, consequently, of chronic diseases. Green My Favela is a non-profit organization that operates in the favelas of Rio de Janeiro, creating productive green spaces within the communities, such as the project Rocinha Mais Verde, where a garden was set up to grow food and medicinal plants, promoting educational and artistic activities in the public realm. On the other hand, urban forests, treasured for absorbing carbon and rain and preventing soil erosion, present an opportunity to cyclically obtain wood and other plant species while offering a space for recreational activities sheltered from extreme temperatures and heat waves. The Ecological Corridor of the Cerros Orientales project in Bogotá seeks to protect the urban forest of the mountains surrounding the city but also to promote the creation of an ecological and recreational corridor for public use. This implies protecting biodiversity, while promoting artistic activities, viewpoints to contemplate the landscape, educational activities, forestation, and hiking.







# 3.3. ACTORS








**87.** Claghorn, J., Orsini, F., Echeverri Restrepo, C., & Werthmann, C. (2016). Rehabitar la montaña: strategies and processes for sustainable communities in the mountainous periphery of Medellín. *Urbe*, 8 (1), 42–60. https://doi.org/10.1590/2175-3369.008.001.SE03.

Actors are considered to be the entities, institutions, and people involved in the design, planning, implementation processes, and maintenance of projects. These may include the federal, regional, or local government, private companies, academia, civil society, non-governmental agencies, agencies, and multilateral development banks.

Most urban projects in the formal city are promoted by public entities, such as municipalities or regional and federal governments, which are interested in ensuring services and welfare for the community they represent, as well as private entrepreneurs and companies, or combinations of public-private alliances. However, in the case of informal settlements, public entities are underrepresented; public space, and open or green space in general, is often very scarce, and services are neither accessible nor developed.

Many scholars and city planners agree on the importance of including the community directly in the realization of public space and green infrastructure projects in informal settlements. For example, the designers of the Rehabitar la Montaña project state that the only effective approach to mitigating risk, especially in the dynamic context of informal settlements, is community-based approaches. Educating community members about the risk factors, raising awareness of the consequences of poor drainage, and providing incentives for them to participate in implementation and maintenance should be the first steps to implement a better drainage system. The education and mapping process can also lead to better construction practices in the future and improved monitoring of soil conditions. The same members of the community can be financially compensated to monitor and maintain drainage pathways, removing debris at regular intervals. When drainage pathways are sensitively integrated into the public space, an additional incentive is created to maintain and protect them.[87] In this project, as well as in others, the contribution of the ETSAM [Higher Technical School of Architecture of Madrid] and Leibniz University Hannover as laboratories of applied research and experimentation was fundamental. Another successful green infrastructure project that had academic support for its formulation and implementation is Mapocho 42K, which arose from an investigation at the Catholic University of Chile and was then successfully deployed with the collective support of public and private actors and the commitment of the various municipalities of the Metropolitan Area.

The inhabitants of spontaneous settlements already implement a series of mechanisms to deal with risk, such as retaining walls built with recycled materials, maintenance of rivers and water channels, and multi-story houses with floodable ground floors. It is important to recognize these efforts and their ongoing fragility, which can turn into vicious cycles of maintaining a home in a flood-prone area. A study in El Salvador of fifteen informal settlements subject to disasters showed that households spend an average of 9.2% of their income on reducing disaster risk (about $26 of a monthly income average of $284), not including building materials that are obtained for free, along with the free labor offered by family members.[88] These are significant expenses for vulnerable communities and, if the incremental development process of the marginal areas cannot keep pace with the frequency of disaster impacts, the result may be greater insecurity and "poverty traps".[89] Given the increase of the difficulties inhabitants of informal communities face compared to those of the formal city, despite the advantages of active stakeholder participation, it is problematic and contradictory to rely on purely ground-up efforts, without the support of public institutions for both implementation and maintenance of projects.

One of the main challenges of implementing green infrastructure and nature-based solutions is the lack of knowledge on the part of institutions, which prefer to utilize more traditional techniques and gray infrastructures. Although evidence shows that the economic benefits of urban green solutions far outweigh the costs, unfortunately governments continue to doubt their effectiveness due to a lack of information. As a result, there is a lack of public and private investment, which in many cases does not facilitate the political, regulatory, and technical conditions needed to implement such projects. Another challenge is that the implementation of urban green infrastructure implies the coordination of several jurisdictions. For example, stormwater management systems require the participation of governments at the local, regional, and national levels in addition to various departments (agriculture, environment, finance, development, transportation, etc.). This implies a coordinated effort of all the interested parties, which often implies a conflict of responsibilities and results in increased vulnerability of cities in the face of climate change. Avoiding these limitations requires a systematic change in the methodologies of public institutions and researchers.[90]

**88.** Chafe, Z. (2007). *Reducing natural disaster risk in cities*. In Linda Starke (Ed.), *State of the World 2007: Our Urban Future* (pp. 112-33, 124). Earthscan.

**89.** Ibid.

**90.** Castro Lancharro, 2017.







This is where other entities of research and investigation come into play, such as universities, non-governmental organizations, multilateral agencies, and multilateral development banks.

For example, in the case of the project in La Palomera, a project developed by Enlace Arquitectura, a new plaza was constructed through an educational program called Sembrando ciudad, sponsored by Citibank Venezuela and Fudep [Fomento del Desarrollo Popular]. In the case of the repurposing and recovery of the public urban canopy in Mendoza [Proyecto de Refuncionalización y de Recuperación del Arbolado Público Urbano], the initiative was led by the council for public policies [Consejo de Coordinación de Políticas Públicas para el Área Metropolitana de Mendoza], a public entity within the Department of Environment and Territorial Planning, and supported by the IDB through the Development Program for Metropolitan Areas of the Interior [Programa de Desarrollo de Áreas Metropolitanas del Interior o DAMI II]. In other cases, there are NGOs, in conjunction with academic expertise and organized civil society itself, which execute the projects, as in the case of Parque Bambú built in the indigenous community of the Nomatsiguenga, located in a rural area of the jungle of Peru with the support of NGOs like CPS and private and public donations, organized by architect groups Semillas, LAN, and ENSUSITIO, and built my students, volunteers, and community members.

# 3.4. BENEFITS



Promote healthy lifestyles

Increase access to fresh and local food

Provide accessibility to potable water

Improve connections with adjacent areas

Stabilize neighborhoods

Reduce crime

Promote new types of social life

Research + testing of new ideas

Reduce maintenance costs

Clean contaminated soils

Improve air quality

Manage and clean stormwater

Waste recycling

Reduce heat island effect

Increase biodiversity

Improve the productivity of abandoned sites

Generate energy

Create jobs

Green infrastructures provide multiple environmental, social, and economic benefits. Solutions and projects can be designed to respond to specific problems and present many opportunities for transformation to improve urban space and the quality of life of the population. For example, nature- based interventions in the public realm provide a positive effect on the environment and can contribute to cleaning contaminated soils, improving air quality, managing and cleaning storm water, recycling waste, reducing the impact of heat waves and urban heat island effects, and increasing biodiversity. These interventions also benefit the health of the community, promoting healthier lifestyles, increasing access to fresh and local food, expanding access to potable water, and improving connections to adjacent areas. In many cases, it also translates into economic advantages, due to the increased productivity of abandoned sites, the reduction of maintenance and transportation costs, and the creation of spaces that generate a sense of community. It can also translate into new job opportunities and typologies of social life and entrepreneurship, reduction of crime, and contributions to the consolidation and stabilization of the most vulnerable settlements. Each step has a positive impact on the quality of life of the inhabitants.

For example, the Park in Fresnillo, located in a housing development in Zacatecas (Mexico), managed to convert a paved sewage canal and unused site into public space, improving connections between neighboring areas, reducing crime, and promoting a healthy environment for the quality of life of the community. Another example, Parque 15 de Octubre, developed by the Public Spaces Recovery Team in Lima, repurposed a public space through small interventions that had a significant impact on the local community. The project improved the connection within the settlement, fomented the recycling of waste, and reduced maintenance costs of green areas, which ensured their maintenance in a dry climate and promoted new types of social life in the park that is now used by groups of all ages. Lastly, the Fog Water Farm Park + Gardens Project developed an innovative fog water collection system to reduce hydrological stress in the







Metropolitan Region of Lima. The investigation and testing of new ideas made it possible to ensure access to water and, as a result, the irrigation of home gardens and a local community garden. In addition, the project enabled social interaction and welcomed new users in the public spaces created for the community, achieving an overall improvement in the urban quality of the neighborhoods.

# 3.5. STRATEGIES: 30 ACTIONS FOR PUBLIC SPACE



Green infrastructures and nature-based solutions can be incorporated into informal settlements through strategies that vary according to the scale of the problem and the specific site conditions where they are implemented. These strategies and actions are aimed at restoring ecosystem services and improving the quality of spaces, utilities, and infrastructure of vulnerable communities at a reduced cost, while considering the feasibility of implementation through local means. Thirty cases in Latin America and the Caribbean were selected as case studies to highlight varying design solutions, means, and processes, offering examples of how to meet the related goals of neighborhood restoration and improvement, connection and adaptation of cities to climate change, anticipation of future transformations, and mitigation of the climate crisis. These projects, which have proven to be successful in incorporating strategies and techniques of green infrastructure in vulnerable settlements, serve as an example of good practices and operations implemented in Latin America and the Caribbean in the last twenty years.





## 1. Restore and Upgrade

The first group of neighborhood-scale strategies, Restore and Upgrade, seeks to intervene in a timely manner, transforming public space into multifunctional areas with benefits for the community. These actions are intended to restore the fragile condition of neighborhoods and their urgent risks, improving the quality of urban space and the quality of life of the community. Some of these strategies involve redefining existing spaces and their limits such as streets within the neighborhoods, or reprogramming abandoned and underutilized sites to provide community and environmental services, such as reintroducing soil and tree canopy. In sloping terrains and areas vulnerable to landslides with hydrogeological risk, it becomes important to implement techniques to consolidate and stabilize the soil through plant species and vegetable gardens. Landscape remediation is also necessary, to convert contaminated spaces into neighborhood-scale parks to reduce the presence of pollutants in the soil and air and incorporate recycling techniques for local materials, such as tires for slope stabilization. Another way to include green infrastructure into vulnerable settlements is to provide safe play areas for children. The play areas can leverage the potential of recycling by creating games with reused materials, such as ropes, plastic lids, cans, wood, etc., and reduce economic and energy expenses. It is also important to use local materials and techniques in the creation of these public spaces, as it presents an opportunity to incorporate members of the community and their knowledge of material sourcing and construction methods, as well as assuring its subsequent maintenance. Among the fundamental strategies for the successful implementation and subsequent maintenance of green infrastructure in informal settlements is to educate and train local communities through participatory processes that include workshops and activities, with the potential of these investments to better their well-being and quality of life. Lastly, it has been proven successful to incorporate productive spaces, such as orchards and community gardens. Localized planting and cultivation of food and medicinal plants not only improves the environment, through soil drainage and air quality, but can also add socio economic and health benefits to the families by providing fresh food and daily social interaction.

**REDEFINE:** redraw and redesign, establishing new and different characteristics. In this sense, the incorporation of green infrastructure in neighborhoods often requires the redefinition of borders and limits of urban spaces, sidewalks, streets, and facilities, opening up spaces to incorporate ecological design strategies such as trees, water absorption, and sanitation infrastructure, among other things. **The Paseo Urbano de la Calle 107** in Medellín is an intervention whose design included redefining the sidewalk of the street to create a pedestrian promenade and new urban and landscape corridor along eleven blocks of the cable car route of the Metrocable. The strategy included improvements to existing public spaces to meet code requirements and newly constructed open spaces to flank the new promenade. The objective of the project was to strengthen the role of the neighborhood corridor, recogniz its character as a pedestrian axis and indirectly diversifying commercial activities for the socioeconomic development of the local community. To achieve this, a vehicular lane was reclaimed for pedestrian use, expanding the sidewalk with a distinctive pavement design. Negotiations were also undertaken with storefront owners to intervene in their front gardens, to create homogeneity and rearrange the spatial layout. The project successfully increased the availability of public space in the area, reclaimed the value of the street as a meeting place, and increased the urban canopy. In addition, it managed to reduce the rates of violence and homicides, as well as generating new jobs. The intervention is part of the Comprehensive Urban Project in Medellín,[91] an example and model in the region that managed to complement the infrastructure network of the Metrocable by redefining a network of public spaces for the community. It consists of a series of planning projects and physical interventions developed with the participation of the local community that includes thirty infrastructure projects that improve the road network and public facilities (education, culture, safety, and employment) and restores the physical conditions and health of the surrounding streams through the implementation of linear parks.

**91.** Developed by the Mayor of Medellin, the Urban Development Division (EDU) and the architects Alejandro Echeverri Restrepo, Carlos Rodríguez Osario, and Carlos Alberto Montoya Correa of Medellín, (2004-2007).







Paseo Urbano de la Calle 107, Medellín
© Urbam EAFIT

ECOLOGICAL DESIGN

BID

Parque Cultural Tiuna el Fuerte, Caracas
© Irina Urriola







**REPROGRAM**: re-plan and ensure the provision of new activities and uses for underutilized, abandoned, or obsolete sites within the neighborhood. It also refers to the reconfiguration of open spaces that have the potential, due to their location and condition, to become public spaces.

This action not only allows the creation of new community meeting points, but also increases the area of permeable surfaces, in addition to the provision of trees to improve the local microclimate. **The Tiuna el Fuerte Foundation and Lab Pro Fab** took advantage of a vacant asphalt site to create an urban park and self-sufficient community space in the Valle de Caracas. The new destination served as a cultural meeting place, featuring professional training and sports, along with robust vegetation. The park's infrastructure was based on extensive research about the neighborhood and utilized low-cost, low-energy technologies, featuring recycling techniques, readily available materials, and close collaborations with local builders and craftsmen. In addition, the project recycled, reconditioned, and reprogrammed abandoned cargo containers in a modular way to create different spaces within the park. In addition, the project exponentially increased the plant cover of the once blighted parking lot.

**CONSOLIDATE**: another strategy designed to reduce the fragility of vulnerable settlements to cases of extreme climatic events, or on land with steep slopes where the effect of soil erosion puts the safety of neighbors at risk. Consolidation implies strengthening and providing stability and solidity to these vulnerable spaces. **The Plaza Estacional** project, developed by AGA Estudio, PICO, and the Community of the Canaima in Caracas, Venezuela (2010), took into account the need to improve the conditions of hydrogeological risk in the informal settlement to improve its facilities and urban quality. The intervention is part of a system of community facilities that included incorporating infrastructures for sewage and stormwater runoff, solar control devices, housing rehabilitation, and the stabilization of the land and common space in the most remote point of the community. The project, inserted in steep terrain that was vulnerable to erosion, capitalized on various planting strategies

to stabilize the soil. A slope stabilization wall was also built with sandbags, which allowed a garden to be installed there through permaculture techniques. The introduction of permaculture gardens seeks to emulate nature, optimize natural resources without the use of chemical products, reduce the ecological footprint, restore soils and biodiversity, create community around nature-driven work, and provide organic and fresh food. This garden of deep-rooted plants transformed the plaza into a shared space for the development of training and productive practices. In addition, permeable cobblestones were incorporated in the construction of the square to encourage rainwater infiltration. The collective system of landscape design interventions simulates or mimics the patterns and relationships of natural ecosystems, creating stable and sustainable agricultural systems and landscapes. All these techniques strengthen and consolidate the ground function as green infrastructure and enable the public space to be utilized as a workshop-training school, capitalizing on the agricultural tradition of the sector.

**STABILIZE:** a series of procedures and techniques, similar to the previous case, that provide the land with a stable structure. From an ecological design point of view, slope stabilization can be done through vegetation. Grasses, trees, and shrubs with deep roots provide extensive resistance to the soil, facilitating drainage and reducing the probability of landslides. The project Plaza en El Cardón, Antímano, located in Caracas and developed by Enlace Arquitectura together with the NGO Caracas Mi Convive, turned a hill into a play area for children, using techniques that allowed for slope stabilization. The project was developed on land where the neighbors used to leave garbage. An intervention was devised with slides, platforms, and stairs that allow for the use of public space, as well as a strategy of reforestation of the place, with the incorporation of trees that protect the soil against heavy rains, provide shade, and strengthen and stabilize the soil with their roots. The first phase included the construction of the first flight of stairs and slide supported by a retaining wall, along with a platform with a bench to use as a lookout point for a panoramic view of the city. Local children intervened on the retaining wall by drawing and carving a pattern of handprints into the concrete







Plaza Estacional, Caracas
© José Bastidas

Plaza en el Cardón, Caracas.
© Abraham Viera







surface. In addition, with the support of a local nursery, the slope was planted to retain soil and reduce erosion. The project, carried out together with the community, has also allowed neighbors to agree on the waste management of the area. The community organized to establish close communication with the truck drivers of garbage collection so as to be alerted when the truck is near and take out garbage bags only when the truck had arrived, eliminating the accumulation of garbage in a specific place. Complementing the garbage collection process, a recycling initiative was established with the support of a private entity.

**CLEAN:** actions aimed at the removal of garbage in the neighborhood, including the elimination of waste that pollutes the soil, air, and water of the settlements, as well as pests and illnesses. Most informal settlements have insufficiently functioning waste collection systems, resulting in the accumulation of waste in the public realm. Parque Fazendinha, in São Paulo, implemented recycling techniques to convert an unused site into a park open to the community. The strategy involved the transformation of a garbage dump, a landfill of 1,000 m2, into a collective space for citizen participation. Initially, more than forty garbage trucks removed waste, and the site was cleaned up with the local community. Later, other processes of collective participation took place, such as an art festival and workshops. In addition, techniques to retain the sloped land were applied, and the local residents would continue the cleaning and maintenance tasks. The construction techniques used were based on "resilience walls," from deserted tires collected around the area, filled with rubble and cement. These allowed the creation of a series of levels and platforms that structure the park, each with a unique purpose and activity. The main objective of the project was to make a historical reclamation of the site, and through urban design, restore contact with nature and reconnect the community with public space. These objectives were successfully fulfilled, and in the last two years neighbors have used the park, as a green space in the heart of the community, for various purposes and activities.

**REUSE** return to utilize spaces and materials, generally with different functions than the ones they originally had. The value of implementing waste reuse strategies in

the creation of public spaces in informal settlements lies not only in the reduction of the amount of waste, but also in the reduction of economic and energy costs. **Parque Trazando Sonrisas**, by the NGO Trazando Espacios (TE), at the Agustín García Padilla school located in the state of Sucre in Venezuela, serves as an example of a playground created with recycling of waste materials and participatory design tools. Similar to the Parque Fazendinha case study, the park managed to transform a green area into a public park and outdoor space for school children. Here, the TE team implemented and adapted its work methodology, 'empowering' participants and neighbors to collectively and democratically decide what space and elements should be transformed. In this way, the project was carried out in two phases. In the first phase, Imagine, the participants carried out various activities such as surveys, drawings, and scaled models to design interventions in the public realm according to their preferences and interests. In the second phase, Transform, the designs were brought to fruition with the participation of volunteers and neighbors. For this, the TE team created a series of technical drawings and a manual based on the ideas of the kids. The manual included tools and techniques for creating wooden benches and swings, roofs and metal pergolas, green roofs made with tiles, games with water hoses, a mosaic mural, a climbing wall, a bridge of disused tires, and a trampoline made of rope. All furnishings and elements were built with recycled materials.

**LEARN:** teach green infrastructure techniques applicable to vulnerable settlements and transfer tools and knowledge so that communities are capable of acting within their community and transforming public space using criteria of sustainability. The project Paseo de los Estudiantes is another initiative by Trazando Espacios, in this case in the community of Juan Moreno, in the state of Aragua in Venezuela. Here, the principal strategy of the project was to transfer participatory design tools to children and teenagers so that they can transform public spaces within their neighborhoods. The proposal implemented the methodology of the TE team and was divided into three phases. In the first phase, Observe, the public spaces in the area were







Parque Fazendinha, São Paulo.


Parque Trazando Sonrisas, Sucre
© Agustín Padilla







mapped and photographed with the aim of identifying them and collectively selecting the spaces to intervene. In a second phase, Imagine, strategies were devised to reclaim the space, including drawings and models, as well as sustainable design workshops and classes where participants learned about recycled materials and ecological techniques to build walls, roofs, and green walls, along with landscape and agricultural concepts. In the final phase, Transform, 700m2 of walls and floors of the Paseo were restored with various proposals. Murals were created, a pisé was made with recycled plastic caps, and a shade canopy was built. Landscape and urban furniture interventions were also incorporated, including the construction of benches, as well as the planting of trees and shrubs. The experiences of Trazando Espacios proved to be successful for implementing techniques and resistant, durable, and ecological materials in their projects, in addition to training the local community so that they can use and manipulate these materials during the construction of the space and in its subsequent maintenance.

**LEVERAGE:** obtain the highest performance outputs by diligently deploying materials, knowledge, techniques, and local tools. By nature, green infrastructure must respond to local bioclimatic conditions and should be built with local materials. This strategy includes encouraging the use of local natural materials that are readily available as the main materials for the construction of public space. For this, education is imperative, training the community in new construction techniques. This is the case of Parquebambu, located in the indigenous community of Nomatsiguenga de Jerusalem de Miñaro, in a rural area in the Peruvian jungle. A play space was created to respond to the need to provide boys and girls with a place to play freely, one that reflected their way of exploring nature. The park was developed through a participatory process with the community, seeking local appropriation for the sustainability of the project. The aim was to train the community in strategies of vernacular construction, using only four local materials: bamboo cane, palm tree leaf for the cover, and the bark of a tree called sachahuasca for the moorings, while local stone was used for the foundation, from which the bamboo

were spliced. At first, workshops were developed to design the park collectively with students, specialists, and members of the community. Seminars and training workshops were organized on the use and care of bamboo, and recommendations were provided for the planting of 100 of these tropical plants, which has enabled the replacement of damaged canes over time and maintenance of the park. In addition, this stimulated the use of bamboo for additional purposes throughout the sector. After the seminars and workshops, the park was built collectively with the guidance of professionals specialized in bamboo construction. The ecological benefits of this tropical plant include its rapid growth and sequestration of carbon, its antimicrobial properties, and a high resistance in relation to its weight. Today, the whole community uses the Parquebambu as a gathering place and play space for residents. In many cases, community gardens and urban agriculture have been tools of green infrastructure implemented in the public spaces of vulnerable settlements, generating great environmental, social, and economic benefits for communities.

**CULTIVATE:** establish the necessary means to allow the land and its plants to fruitfully develop. This includes creating productive green spaces with the appropriate site preparation intended for that purpose, such as flowerbeds, orchards, and vertical gardens that can be a variety of sizes. In particular, organic farming practices that limit the use of pesticides and agrochemicals, promote carbon sequestration, and improve the soil should be encouraged. **The Rocinha más Verde** project, implemented in the largest and most densely populated favela of Rio de Janeiro, created a community garden for children with recycled materials and local plant species. The initiative includes the pilot project Green My Favela, a non-profit organization that was founded with the objective of co-producing productive green spaces within vulnerable communities in Rio. The project was developed in a vacant site, contaminated with garbage, which was cleaned and transformed into a garden for growing food. The garden was implemented with the collaboration of the local community and children, as well as international volunteers.







Parque Bambú, Jerusalén de Miñaro
© Alejandra Orosco

Rocinha mais Verde, Río de Janeiro







Permaculture concepts were deployed for the cultivation of vegetables, fruits, and medicinal plants. The slope of the land was leveraged to achieve terraced spaces that allowed for the harvest of organic food and medical plants. The construction required the creation of retaining walls with reused materials found on site, the installation of a new water tank and pipes, and the purchase of seeds and topsoil. In addition, the project functioned as a platform for a series of educational and artistic activities in the public space that included seed planting, transplanting of saplings, painting classes and botanical drawings, among others. The initiative managed to catalyze a series of gardens incorporating these strategies that were later replicated in Rocinha and other favelas throughout Rio de Janeiro.

**PRODUCE:** a strategy that includes creating spaces that offer environmental, social, and economic services for the community. Community gardens, as green infrastructures, are capable of providing ecosystem services and, at the same time, new sources of work, education, and food, thereby reducing economic stress on the community. A good example of this is Hortas Cariocas, an urban organic agriculture program established by the Environmental Secretary of the municipality of Rio de Janeiro, in Manguinhos. **Huerta in Manguinhos** is among the largest gardens of organic urban food in South America. It is a public space open 24 hours a day, measuring more than 1km in length and consisting of more than 300 plots and productive gardens. The project began with the removal of tons of garbage from the sector, the elimination of the first layer of contaminated soil, the placement of gravel to increase drainage, and then the construction of brick beds filled with topsoil. An irrigation system connected to the city water supply was implemented to provide water to the garden. The garden provides fresh food throughout the year for 400 people, reducing the economic stress of the families and improving their nutrition by increasing the consumption of vegetables. In turn, it provides improved drainage, a garbage-free environment, a social and recreational space to walk, and a safe place where

children can play. In addition, the garden allowed neighbors and volunteers to be trained in agricultural skills, creating jobs for at least twenty local residents who receive monthly stipends for managing the space, and offers educational activities on agroecology and environment for schools and NGOs. Today, the Hortas Cariocas program produces approximately eighty tons of food a year in more than its thirty gardens dispersed throughout the favelas of Rio de Janeiro and is currently expanding its project in the city. While the replicable and scalable model is based on limited structural and economic support, it has the capacity to co-produce viable productive public spaces in the long run. Today, seven of these gardens are already fully self-sufficient.







Huerta en Manguinhos, Río de Janeiro

Project of social and urban integration Barrio Padre Carlos Mujica, Barrio 31, Buenos Aires © Secretaría de Integración Social y Urbana. Gobierno de la Ciudad de Buenos Aires.





## 2. Adapt and Connect

This group of actions describes strategies for the creation of green infrastructures at the metropolitan scale, which function as urban connectors serving both the formal and informal city.

These operations have the common objective of reducing urban inequity and the physical gap of barrios, integrating them into the city with long-term plans and contributing to the adaptation of areas vulnerable to climate change. On one hand, some strategies and initiatives are based on the construction of network systems between neighborhoods in the city, or within the same settlement. These networks range from systems of green spaces and facilities to the consolidation of shared management systems for services such as waste collection, recycling, water, and energy. In some cities, where the settlements are not recognized on official maps, it becomes necessary to map the networks to visualize the deficits and the projects of public service and infrastructure. On the other hand, it is fundamental to incorporate strategies and techniques for water management in vulnerable settlements to guarantee access to potable water, implement operations to reduce contamination and remediate unhealthy areas, avoid flooding, and ensure runoff and infiltration of water. Lastly, it's essential to critically and constructively analyze the existing conditions of the consolidated and built environment. The public spaces and existing infrastructure, in use or abandoned, often have the potential to be converted, recovered, and restored through various operations that present the opportunity to incorporate green spaces, infiltrate water, decontaminate the soil and the air, and offer public spaces that are safer, healthier, and more resilient.

The following strategies focus on building network systems and working with or for public institutions to improve the integration of neighborhoods into the formal city.

**INTEGRATE:** incorporate vulnerable neighborhoods into the fabric of the formal city, through new infrastructure and services. **The Social and Urban Integration Project of the Barrio Padre Carlos Mujica**, known as Barrio 31 in Buenos Aires, is an example of the transformation and connection of the informal settlement to its surroundings. Although Barrio 31 is emblematic for its strategic location, it presented various barriers that excluded and segregated it from the rest of the city, as well as a lack of green and public spaces. The project, led by the Government of the City of Buenos Aires with the support of the IDB, was possible thanks to the approval of a law for the urbanization of the barrio. Interventions included a comprehensive infrastructure plan, construction of public spaces that connected the barrio to the rest of the city, habitat improvements through adaptation of existing housing, and construction of new housing. In addition, new institutions, schools, and health centers were created to promote economic and social development. More than twenty-six public spaces totaling more than 12.8 acres of interventions were built and refurbished. Bicycle lanes and stations with free bicycles were incorporated, promoting sustainable mobility. A sustainable urban solid waste management program was also implemented, generating employment for cooperatives of the barrio. Throughout the process and to date, new projects have been developed with neighbors, consistently incorporating the barrio community.

**RECYCLE**: submit materials already used, abandoned, and/or contaminated, to a process that allows them to be used again in a sustainable way. The project **La Palomera Sembrando Ciudad** proposes a series of interventions to reclaim public space in interstitial and contaminated sites to improve the quality of life in a vulnerable and densely populated neighborhood south of Caracas and connect it to the formal city.[92] Among the interventions, for the Plaza de la Cruz project, the community selected an illegal landfill and transformed it into a new and dynamic public space that serves as a lookout point over the city. The design and implementation process was developed

**92.** See Enlace Arquitectura. (2017) Sembrando ciudad. *Catalogo de la XX Bienal de Arquitectura de Chile*. Metales Pesados; and the official website of Enlace Arquitectura. http://www.enlacearquitectura.net/obra/2017/08/sembrando-ciudad-la-palomera/ See image 2.1. Sembrando ciudad. La Palomera.







La Palomera, Caracas


Caminos de la Villa







with the participation of the neighbors: first, activities and games were used to discuss the value and opportunities of public space, then rubble and waste was removed with the help of the local municipality, and during construction, patterns were designed for the plaza with recycled plastic lids, a bench was made from scraps of painted pallets, and areas were reserved for the incorporation of vegetation. In addition, the project motivated the creation of a new waste management system that was organized together with the municipality and the community to ensure that the space was no longer used as a waste repository. The new waste collection system eliminates the presence of waste dumpsters at the entrances of the neighborhood, which greatly improves the public health of the community. Instead, today there are seven new door-to-door garbage collection routes in La Palomera.

**MAP:** locate and graphically represent the informal settlements, paying special attention to the distribution of infrastructures and urban services. This process is a fundamental strategy to subsequently propose the incorporation of green infrastructures. As an example, the **Caminos de la Villa** project arose as a response to the absence of informal settlements on the official maps of the City of Buenos Aires. The project promotes the recognition and integration of these working-class barrios through the participatory construction of detailed online maps of the villas, the informal settlements of the city of Buenos Aires, to visualize the deficits in the provision of public services and infrastructure projects, the problems and also the improvements that are developed in relation to them. This tool allows neighbors to access information, monitor public works in the neighborhood, and control compliance of their rights, strengthening urban integration and making the situation in the villas visible. The design and implementation process consists of the following stages:

a) Neighborhood coordination to design, present, and validate the tool;
b) Mapping, through the GPS route of all the internal trips with members of the neighborhood and validation of its cartographic data with the residents;
c) Publication of the maps and design of an interactive web platform for the use of the maps; and
d) Presentation of the platform to the neighborhoods and routine review of the information.

Most vulnerable settlements face problems associated with water coverage, sewage, rainwater collectors, water source contamination, and flood risks. In addition, they face the need to ensure access to water in a sustainable manner, considering climate change will increase the growing water stress in cities. For this reason, strategies that couple infrastructures of water management with green infrastructure as a way of guaranteeing the socio-spatial inclusion and integration of marginal neighborhoods in the city are particularly important. This process of surveying and continuously updating data is fundamental for the integration of the neighborhoods and the projection of green infrastructures.

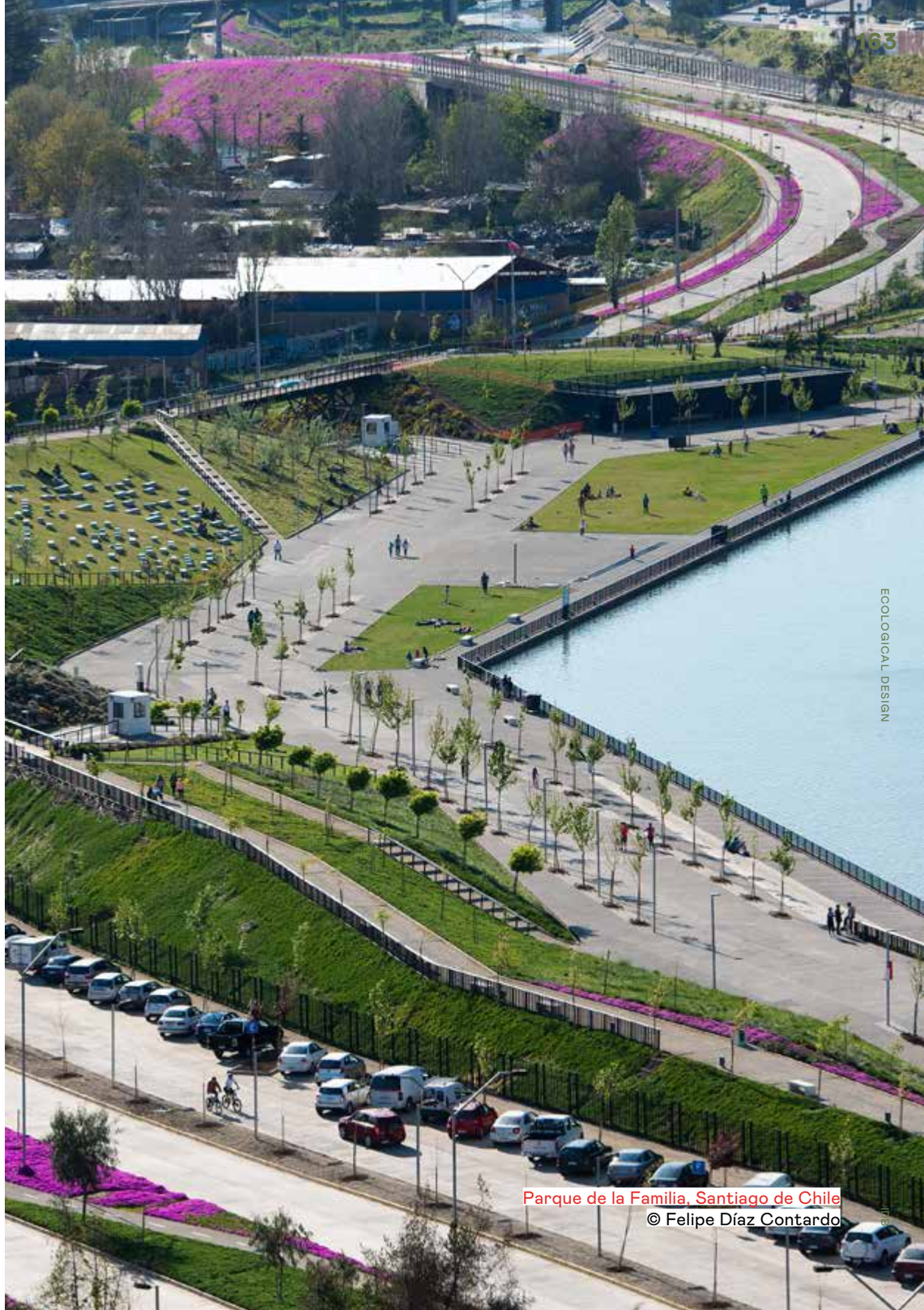
**HEAL:** remediate polluted soil and water and/or depressed areas of the city, improving health and safety conditions for local communities. In Santiago de Chile, the project of the **Parque Fluvial de la Familia**, set the recovery of the banks of the Mapocho River in the western sector of the city as the main focus of the project, forming a body of calm water through the installation of collapsible locks. The project was located in a particularly vulnerable area, an industrially contaminated site of 50 acres of public land on the outskirts of the metropolitan area with scarce presence of green areas, thus playing a critical role in the potential development of the involved communities and connection to central areas.[93] On one hand, the strategy consisted of building a new branch of the river, which included a large amount of excavation and removal. The adopted technology allowed development of nautical activities with small boats without motors such as kayaks, rowboats, and small sailboats. On the other hand, the surplus of excavated earth was used to generate an artificial topography and park and to contain the riverbed through a

**93.** Sordi, J. (2017) *Beyond Urbanism*. Sa Cabana Editorial-Listlab.









Parque de la Familia, Santiago de Chile
© Felipe Díaz Contardo

ECOLOGICAL DESIGN


Parque Hídrico La Quebradora, México
© Aldo Diaz





series of hills. The inclined planes of topography and manipulated surface were planted with a variety of native plant species to help stabilize the ground, featuring evergreen creeping succulents with low water consumption and long flowering periods. Various species of native trees were also planted, creating zones of fruit trees and shaded areas. The park works at the scale of the city, physically and visually connecting the communities in which it is inserted, controlling a stream and regulating its flow through advanced engineering, and transforming an abandoned dump into a public recreation space framed around water.

**RESTORE:** implement a series of actions and strategies to return the water system in a settlement to its natural capacities to capture, direct, absorb, infiltrate, store, purify water, and recharge aquifers. This can be achieved through green infrastructures such as infiltration basins, wetlands, and purification lagoons. The **Parque Hídrico la Quebradora**, located in Iztapalapa, one of the largest and most densely populated areas of Mexico City, introduced a contemporary water park to contribute to the water management of the area. The project aspired to reconfigure the hydraulic system by capturing the surface runoff from adjacent avenues and lead them to an infiltration basin in the landscape to reduce urban flooding in the area. The park also treats and filters wastewater through a hybrid system composed of a wastewater treatment plant and wetland. The resultant water is used to maintain the sustainable hydrology of the park, and its surplus is redistributed in the surroundings. Additionally, the park harvests and filters rainwater for human consumption. In addition to the water management systems of the park, the project structures the landscape through a series of platforms, stepped plazas and paths introducing a range of cultural, sports and recreational programs. Lastly, the project tripled the number of trees in the site, introducing both endemic species and those adapted to the Basin of Mexico ecosystem.

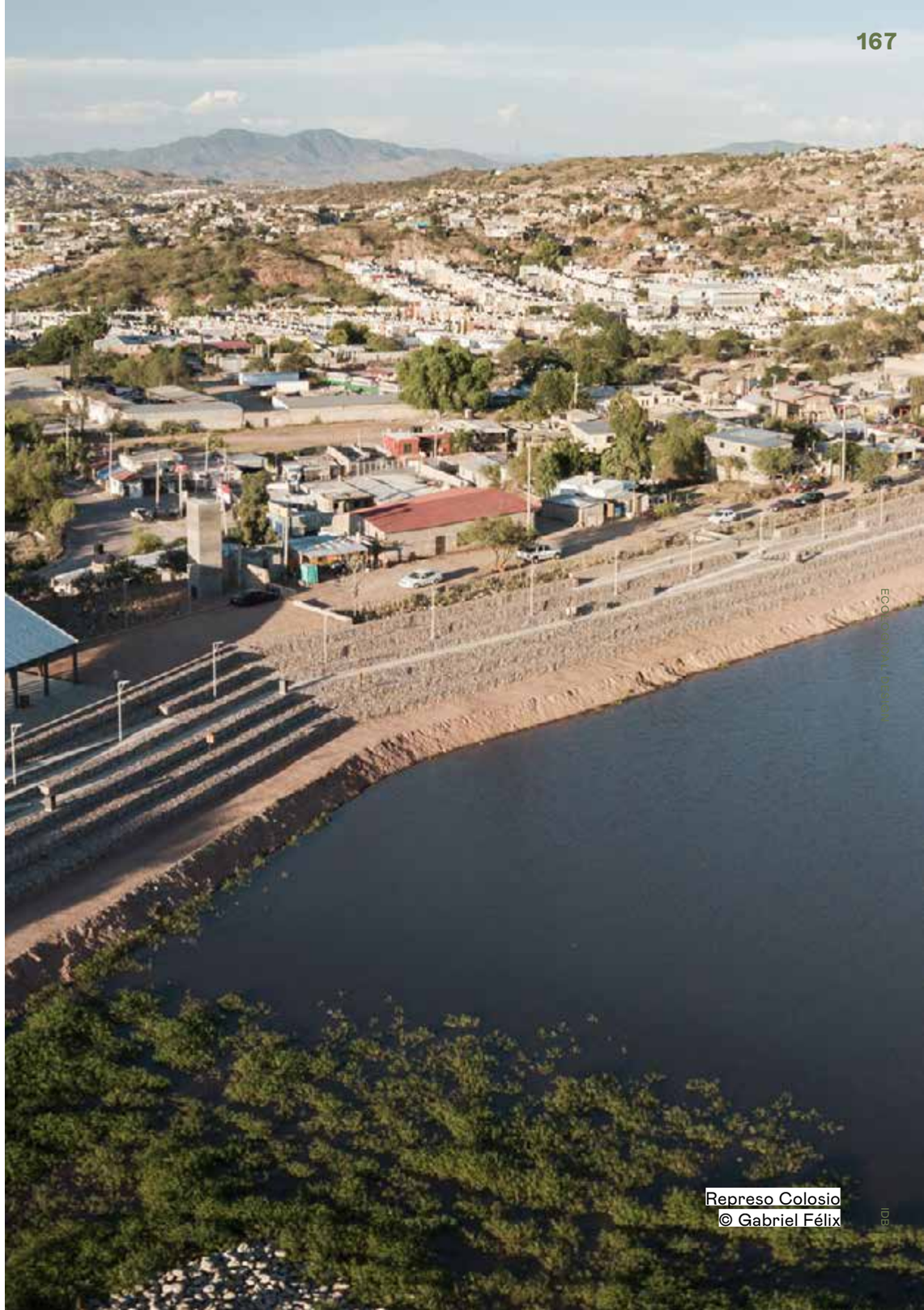
**EVACUATE:** for water, this is another strategy to consider when designing public spaces in vulnerable settlements, since in many cases the natural runoff path is modified, preventing the historical flow of rainwater and its outlet. This creates a variety of negative consequences for the environment and people, including flooding, due to the low capacity for retention and filtration. The park in the **Arroyo Xicoténcatl** is an example where water management, the study of both its conduction routes and retention, served as an essential component for the design of the public space. This project, located in the periphery of Tijuana, was designed by Taller Capital to reclassify a water channel as the heart of an informal settlement. At project kickoff, the stream bed had disappeared, and in its place were mounds of infill material held back by two parallel, steep, and eroded dirt roads through which water drained. The operation consisted of nine new embankments, or platforms, built with the infill material in the streambed, to house recreational and sports activities. The slopes of the embankments were stabilized with walls made of disused tires that were generated in the US, using traditional construction methods. The walls were then vegetated with endemic species. In addition, two canals that run parallel to the riverbed were built of concrete and stone to direct water runoff and reduce its speed. The program included sports courts, playgrounds, and communal spaces were incorporated, which are widely used by local children and youth.

**CONTAIN:** use the topography and vegetation to shape the public space, ensuring a place to store water and optimize the environmental and climatic efficiency of the bodies of water, during both dry and rainy seasons. The **Represo Colosio** park, in Nogales, Mexico, is another project developed by Taller Capital together with UNAM and promoted by the Secretary of Agrarian, Territorial and Urban Development (SEDATU) of the Government of Mexico. In this case, a body of water and its adjacent public space were redesigned to prevent the flood risk in an area of informal settlements. The adopted ecological design strategies consisted of containing the edges of the body of water and consolidating the curtain of the dam. Spaces for water runoff and









Represo Colosio
© Gabriel Félix

Parque en el Arroyo Xicoténcatl, Tijuana
© Gabanna





areas to receive flood waters in wet seasons were defined and serve as sports and recreation areas during the dry season. In addition, a perimeter circuit and a bridge were created to facilitate mobility and the evacuation of the inhabitants in emergencies. To actualize these strategies, regional materials and construction methods were used, facilitating an expedited execution and reduction of costs including retaining walls constructed with local stone, pavements of compacted earth and polished concrete, children's games with extruded steel, plazas paved with local stone, and gardens featuring local cacti resistant to the semi-arid climate and requiring minimal maintenance. The hydraulic aspect of the project is of particular interest because a study and model of the sub-basin identified the need to dredge the body of water to maximize water storage and thus prevent flooding. In addition, spaces adjacent to the body of water were designed to consider annual floods and enable these to continue to function once the water subsides.

In vulnerable neighborhoods and settlements, it is common to find infrastructures and spaces in obsolete, abandoned, and neglected conditions. Many of them are concentrations of pollution and garbage, becoming harmful sites for people and the environment. Therefore, it is important to implement strategies to re-designate, recover, and/or decontaminate these sites.

**OPTIMIZE:** a strategy that aims to reclaim public space and existing infrastructures in the neighborhood and redefine them and to regulate the use of scarce resources like water. Public spaces, with infrequent use and maintenance, represent an opportunity to be transformed and improved through small additions of green infrastructure that facilitate the infiltration of water and incorporate green space and trees. The Barrio Mío Program of the Metropolitan Municipality of Lima (MML) was created in 2012 to implement comprehensive urban projects in order to improve living conditions in vulnerable settlements of Lima. Within the program, the Recovery of Public Spaces (REP) worked on a range of projects with neighbors in hillside areas to improve public space and contribute to the transformation of neighborhoods. Among these projects, **Parque 15 de Octubre** stands out. Located in the Señor de Los Milagros neighborhood in Ensenada, the project repurposed and reconfigured an existing public space as a new

central site within the neighborhood. The ecological design strategies included a redesign of the park and its street furniture using local materials with reused and recycled waste items. In addition, the green areas were reduced and strategically concentrated for better maintenance due to the scarcity of water in the area. New trees were also planted. The project was carried out through a rigorous participatory process and the specific methodology applied in all REP projects, which consisted of a preliminary presentation of the project; two workshops to develop the main urban system and the "catalytic project"; a public assembly for final presentation and critique to undertake the management of materials; and, lastly, the execution according to the tradition of Sunday community work, together with neighbors, volunteers, and the REP team. The process concluded with the project delivery along with conclusions and future recommendations.

**RECOVER:** repurpose spaces and infrastructures that were in disuse in the neighborhood. These infrastructures can be roads, canals, bridges, or unused spaces – often sources of contamination and garbage – transformed into public benefit with the incorporation of nature-based techniques and solutions. The **Fresnillo Park** in the Manuel M. Ponce Housing Unit in Zacatecas, developed by Rozana Montiel and Alin V. Wallach, in collaboration with INFONAVIT, was part of an urban regeneration program that repurposed a paved sewage canal and transformed it into a multifunctional playground. The strategy consisted of recovering public space to create opportunities for recreation and cultural activities for groups in high risk situations.[94] Prior to the intervention, the abandoned canal existed as an obsolete infrastructure that divided the neighborhood through two embankments approximately 1km apart. The project included the reconstruction of the slopes of the canal to function as a multifunctional rest area, and replicable modules were used to integrate games, stepped seating, lighting, furniture, and vegetation. In addition, universal access bridges were built to facilitate crossings, children's games were painted on the ground, cellular pavements were incorporated to infiltrate water in previously impermeable areas, local vegetation was incorporated, and trees were planted. The power of the project lies in repurposing the residual infrastructure and conversion of the abandoned area into a park.

**94.** Glocal Design Magazine. (2019, March 7). Parque Fresnillo, reactivando el tejido social. *Glocal Design Magazine* (blog). https://glocal.mx/parque-fresnillo/.







Parque Fresnillo, Zacatecas
© Jaime Navarro y Sandra Pereznieto

**DECONTAMINATE:** entirely or partially eliminate contamination from a site or place. It deals with actions aimed at treating areas such as landfills, so that they lose their harmful impact on the health and life of people and the environment. This set of operations involves restoring environmental, social, and landscape values within urban settlements. An emblematic urban project is the case of the ecological park in the Moravia neighborhood in Medellín. The strategy consisted of reclaiming the space of one of the main landfills of the city, transforming it into an urban park rich in vegetation, trails, community gardens, and cultural activities for the local community. This example of reconstruction and restoration of a highly degraded territory was conducted with community participation and engagement, urban and landscape studies, and the design of environmental restoration technologies. The technical environmental strategy consisted of consolidating and decontaminating the artificial hill, which was a product of the accumulation of waste over several decades, and a water management system based on natural purification systems,[95] materialized in "community gardens" and constructed wetlands. The former consist of vegetated edges or buffer zones that function as an environmental solution, but also fulfill a social and educational purpose for the residents who previously lived in the landfill.[96] The wetlands, on the other hand, purify leachate through underground perforated pipes.

## 3. Anticipate and Mitigate

The objective of Anticipate and Mitigate is extremely relevant in strategies focused on reducing the effects of climate change. These actions include long-term thinking in order to offer environmental benefits at the scale of the entire city. In many cases, these operations incorporate a paradigm shift and low-

**95.** García, J., Rousseau, D., Morató, J., Usage, E., Matamoros, V., & Bayona, J.M. (2010). Contaminant Removal Processes in Subsurface-Flow Constructed Wetlands: A Review. *Critical Reviews in Environmental Science and Technology*, 40(7), 561 – 661. https://doi.org/10.1080/10643380802471076

**96.** Silva, 2020.







carbon planning, in conjunction with the introduction of new ecologies, economies, and societies as models to anticipate future scenarios. First, it is necessary to implement conservation strategies and remediation of natural ecosystems such as forests or bodies of water in cities that are sources of environmental services. These actions, such as the creation of natural reserves, reduces the carbon footprint, while preserving the biodiversity and ecosystem functions of important environmental remnants within the urban environment. Second, relevant strategies seek to capitalize on inherent elements in the landscape and topography, such as hills or rivers, in order to create territorial systems that increase green space and function as connective infrastructures at the scale of the city. The creation of bike lanes and linear parks around these elements not only present an opportunity to connect neighborhoods and communities, but also consist of ecological corridors that contribute to the conservation of ecosystems, protect bodies of water, and generate microclimates. Third, it is fundamental to plan cities with a sustainable model of occupation for the future, one that anticipates and directs urban growth so as to mitigate the effects of climate change and that considers long-term strategic actions to reduce greenhouse gas emissions and protect the environment and public spaces. For this reason, research and investigations are necessary in urban areas, as is the implementation of systems to prevent risks and avoid natural catastrophes due to the occupation of hazardous zones such as hillsides or flood zones. In addition, it is crucial to begin thinking of projecting and managing communities with ecological urbanization criteria. This involves looking for alternative forms of land occupation and new ways of living in communities, in balance with ecosystems, seeking to have minimal impact on nature. Finally, it is important to use technology to create systems that allow both the monitoring of elements and natural behaviors such as the use and provision of resources. This is particularly important in the case of vulnerable neighborhoods where resources are limited. Therefore, the implementation of innovative and low- cost technologies adapted to the local context can ensure the provision of scarce environmental resources in many cases.

Parque Texcoco, Mexico City







**REMEDIATE:** replace and correct some of the man-made damage to the environment by reestablishing biophysical processes that facilitate the balance of ecosystems. Among the natural resources in greatest need of remediation in cities are water, air, and soil. Remediation operations allow for the preservation of these resources and the landscapes and natural systems in which they exist, requiring the designation of storage areas with planning instruments. Projects like **The Lake Texcoco Ecological Park (PELT)**, by Iñaki Echeverría, adopt ecological design strategies for environmental remediation. The project aims to preserve a large lake reserve on the outskirts of Mexico City and restore the bodies of water lost as a result of exponential population growth, unplanned urbanization, and environmental degradation. The Ecological Park reactivates the hydrological processes through actions that help direct the development process of the eastern zone of the Valley of Mexico. These actions include the introduction of designated areas for restoration and reforestation, reintroducing endangered species of the ecosystem to restore the native flora and fauna; the incorporation of productive landscapes for local agriculture in areas with great deficiencies; and the recovery and expansion of lagoon regulation. Along with the remediation process, new recreational activities are dispersed, including areas for sports, ecotourism structures, museums, and research centers, all capitalizing on a new renewable energy network that feeds the entire system. The proposal focuses on three principles: facilitating accessibility to the territory for public use, ensuring the environmental protection of the 30,150 acres of parkland, and implementing actions for environmental restoration. In other words, the project seeks to generate greater resilience by agglomerating actions to mitigate environmental damage and climate change. In the first implementation phase (2020-2021), the project reclaimed the bodies of water, protected and maintained the lakes, monitored the flora and fauna, began defining the alignment of trails and paths for pedestrians and cyclists, and improved the dirt roads.[97]

**97.** The project has received criticism for being a large-scale design proposal without consulting the communities it affects. The implementation process has been halted for several years and resumed at the beginning of 2020 with the construction of the first phase.

**PRESERVE:** protect and safeguard the collection of natural, social, cultural, and economic resources that exist in an enviroment. This includes protecting native fauna and flora, water, soil, air, and the relationship between all of them. These actions aim to protect the remnants of natural landscapes within cities that offer significant environmental and ecological benefits. In Bogotá, the "Cerros Orientales" are a crucial element in the ecological heritage of the region. **The Ecological Corridor of the Cerros Orientales**, designed by Diana Wiesner, protects the perimeter between the city and the forest reserve of the mountains, transforming it into an ecological corridor and productive urban park that benefits the adjacent informal communities and metropolitan city. The corridor extends for 53km along the perimeter of the city as a regional biogeographic armature, with environmental, hydrological, symbolic, and scenic values. The 2006 project and model of land-use planning seeks to restore biodiversity as a strategy for social development and territorial appropriation, creating the largest ecological and recreational corridor in the city as a public benefit. The three-prong model is composed of an environmental and biophysical strategy that seeks to increase connectivity and restore the native forest; a social and cultural strategy that includes participatory planning; and a spatial strategy to physically delineate the city boundary with the reserve. In 2015, 7.5 acres of Natural Reserve were declared as a pilot project for the management and management of the Cerros Orientales: the Reserva Umbral Cultural Horizontes. Since its creation, it has become a laboratory for testing hypotheses and management practices, artistic and contemplative programs, civic and ecological education, and restoration and hiking. In addition, the mountains were reforested with native species of trees, and a nursery was created to provide plant specimens.

**SYSTEMATIZE:** identify, organize, prioritize, leverage, and replicate interventions to create a set of open spaces and large non-permeable surfaces in cities, with the goal of creating networks of open spaces and permeable green surfaces. This includes recognizing landscape elements such as







Corredor Ecológico de los Cerros Orientales, Bogotá
© Leonardo Centeno

Parque Metropolitano Cerro Chena,
Región Metropolitana de Santiago.
© GORE RMS





**98.** Forray, S. et al. (2012). Plan de Integración de los Cerros Islas al sistema de áreas verdes de Santiago. Center of Public Politics UC. Public Politics Competition 2012, Proposals for Chile. Pontificia Universidad Católica de Chile, 177-209; cited in Fundación Cerros Isla (Ed.). (2017). *Cerros Isla de Santiago. Construyendo una nueva imaginario de la ciudad a partir de su geografía.* Ediciones ARQ.

streams, hills, and rivers for their potential to be systematized and function as green infrastructures that offer ecosystem services at the urban scale, reducing the heat island effect and improving water infiltration. In the case of Chile, the Central Valley where the Metropolitan Region of Santiago is located is characterized by the presence of Cerros Islas, whose potential is twofold. On one hand, they represent an opportunity to be integrated into the green infrastructure and park system of the city at different scales to increase the open space area per inhabitant in Santiago. On the other hand, more than 70% of the hills are found in communities of middle and low socioeconomic strata, where public spaces are scarce, presenting an opportunity to reduce inequality and promote equity in urban development processes.[98]

**The Cerro Chena Metropolitan Park**, in the Metropolitan Region of Santiago, was initiated by the Regional Government of Santiago to take advantage of the potential of the hills to increase the open space areas, mitigate environmental problems, and restore the ecosystem. The Master Plan for the 3,647 acres of Cerro Chena establishes the ecological value of this territory, rescuing its value as a site in the Regional Biodiversity Strategy. The Plan's first pilot project implemented a new park, a children's play area, water games, restrooms, and a eucalyptus walkway. In addition, a reforestation process of the Cerro was also carried out in a participatory manner with schools and neighbors, where more than 12,000 native specimens were planted. The project anticipates continuing with the construction of the South Metropolitan Park at the foot of Cerro Chena, in order to continue leveraging the potential of the site to be used as a park, recreating a new dynamic with the ecosystem and integrating attributes of the native landscape into the regeneration of a degraded urban area.

**RENATURALIZE:** restore degraded landscapes and allow nature to recover its wild and natural state. This natural restoration, imperative to offset the effects derived from the ecological crisis and climate change, includes actions such as the reintroduction of native species, reconstruction of ecosystems, and reforestation. The goal is reached once the ecosystem manages to regenerate and sustain itself.[99] The renaturalization is not only beneficial for wildlife but also for people, as it provides both social and economic opportunities and offers enjoyment of the landscape. The **Rutas Naturbanas** project seeks to connect five municipalities, or cantones, in San José, Costa Rica, through nature. The region is known for housing part of the basin of the Río Grande de Tárcoles, the most polluted river in all of Central America.[100] The project proposes the creation of 25 linear km of green infrastructure to contribute to the conservation of ecosystems and the creation of interurban biological corridors. In addition, the project includes the cleaning and protection of rivers and the creation of new recreation areas and natural spaces for slow mobility and recreation. The project aspires to reduce the carbon footprint, link neighborhoods and urban centers, and provide greater security for people who walk or cycle between marginal areas, including informal settlements, and the urban center. The project seeks to regenerate the vegetation and forest canopy in the margins of the rivers by a categorization and curated selection of vegetation to implant, definition of zones for regeneration, and the establishment of native and pioneer species. In fact, an exhaustive study of the sections of the river and its varying qualities for construction of the route was conducted to guarantee access points and connections to adjacent areas, preventing future unplanned urban developments and concentration of waste contamination.

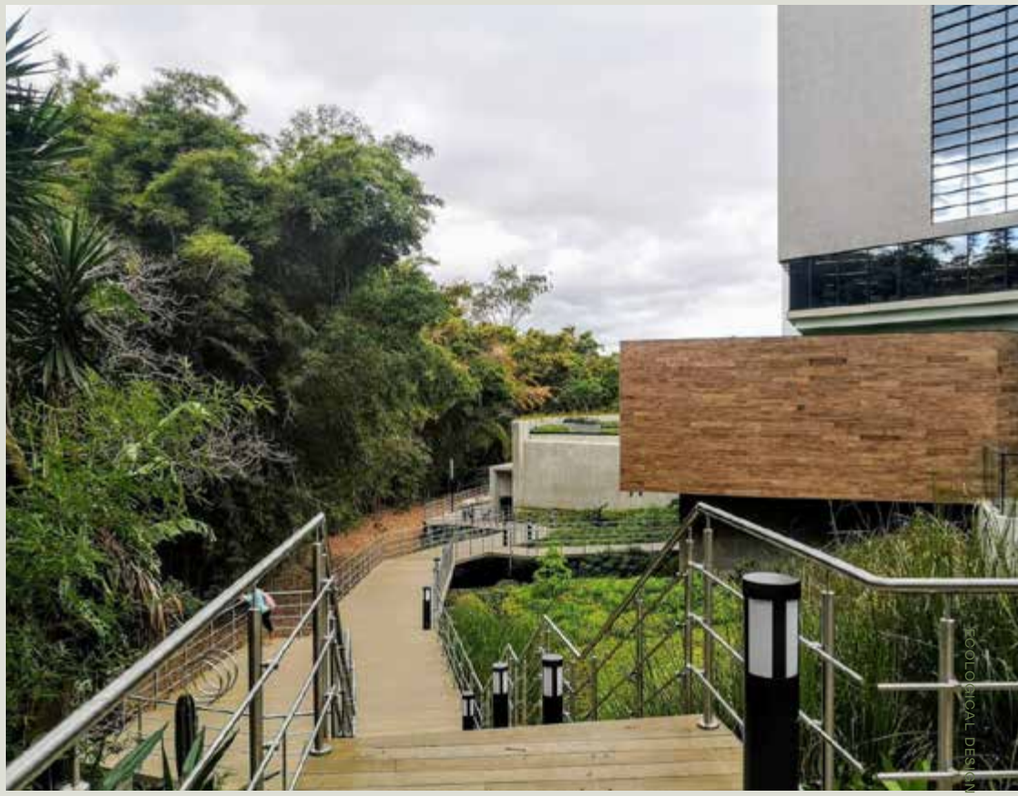
**99.** Ecopost. (2019, May 2). Cómo renaturalizar ecosistemas y que sean sostenibles. *Ecopost* (blog), https://www.ecopost.info/como-renaturalizar-ecosistemas-y-que-sean-sostenibles/.

**100.** Gutiérrez Wa-Chong, T. (2018, February 12). Represas eléctricas dan la mano al río más contaminado del mundo. *La República*.









Rutas Naturbanas, San José de Costa Rica


Mapocho 42 K, Santiago de Chile
© M42K Lab. F. Croxatto. C. Correa

**STITCH:** strategies to unify and connect separated, segregated, or inaccessible urban areas, facilitating mobility between the connected parts. Public space has the capacity to strengthen the social and urban fabric through bike paths, linear parks, and green corridors. These provide alternative mobility systems in addition to offering socio-environmental benefits to the neighborhoods they pass through. For example, rivers can function as urban armatures, linking dissimilar neighborhoods and areas and consolidating ecological corridors and linear green infrastructures throughout the city. A clear definition and articulation of construction stages is critical to the management of these infrastructures at the urban scale. Individual phases must have their own internal coherence, but in the long term, they must also consist of integrated units capable of interacting. **Mapocho 42k**, in Santiago de Chile, seeks to build a green pedestrian network, in this case bikeable, at the metropolitan scale. The main objective is to achieve social and territorial connectivity, while reducing the urban inequality gap. The metropolitan-scale pathway highlights the landscape features and geography of Santiago, connecting eleven communes of different social strata and topography. Following the course of the river, the public corridor forms an east-west backbone, defining a green corridor that connects all of the existing and potential green spaces located along the banks of the river, linking these previously fragmented or inaccessible areas to other nearby parks. The project, which arose in an academic context of research at the Catholic University of Chile, was designed and subsequently executed in phases and sections. In the first phase, the Strategic Plan was designed for the entire river. In the second phase, seven priority sections were selected, and to design and implement 20 km of cycle park, a series of components were agreed upon between the municipalities, as a kit of parts to provide a unified identity to the corridor and facilitate its execution and maintenance by all of the municipalities.

**PLAN:** prepare urban plans with an agenda that includes growth projection patterns, reduction of greenhouse gas emissions, climate change mitigation, and the creation of more resilient cities with strategies, objectives, and projects designed for the short, medium, and long term. The **BIO 2030 Plan** for Medellín aims to anticipate the transformation of the metropolitan city and mitigate future impacts.[101] Led by the Mayor of Medellín and the AMVA (Valle de Aburrá Metropolitan Area), under the technical coordination of URBAM EAFIT, the main objective is to establish criteria for the occupancy of the Valle de Aburrá, which would influence current growth trends toward a more sustainable occupation. This long-term strategic plan for the region, considered an essential tool to mitigate the impact of urbanization on the environment, consists of strategies critical for reducing greenhouse gas emissions, protecting the environment, improving the hydrological system, protecting natural and cultural heritage, optimizing waste treatment, and promoting energy efficiency, among others. These criteria are articulated following the two thematic macro-areas of river corridor and hillside and include the categories of environment, landscape and public space, and mobility and transport. Following these, strategic projects are implemented in different parts of the river corridor and hillside to prioritize and direct territorial actions as pioneers of a new model of sustainable occupation that is more equitable. These strategies, which help control the growth on the slopes along the edges, are especially interesting since they include measures to contain expansion, reduce risk, restore ecological integrity, and consolidate viable settlements within them. This implies a series of proposals to work in large areas occupied by informal settlements with adverse geographical conditions.

**URBANIZE:** prepare land or territory with the infrastructures, services, and operations necessary for urban use. Fortunately, there are alternative models of urbanization to the one that proliferates in most of the vulnerable settlements today, along with strategies to improve their relationship with nature and among neighbors. This includes creating communities

**101.** IO 2030 Medellín is a plan led and sponsored by the Mayor's Office of Medellín and the Valle de Aburra Metropolitan Area under the technical coordination of the Center for Urban Environmental Studies, URBAM, of EAFIT University. Through new management tools, BIO 2030 proposes to streamline the planning process, identifying common trends and operations through strategies on a metropolitan scale in order to promote urban projects that place the river and its valley as a central element in the future development of the city.







Bio Medellin 2030
© URBAM, BIO 2030

Vila Nova Esperança, São Paulo.





that implement green building and recycling strategies, promote local food production, regulate a waste collection and separation system, and utilize clean energy. In short, the model of ecological urbanization includes a paradigm shift, lifestyle changes, and communal effort, with great benefits for the environment and people's quality of life. To the west of the municipality of São Paulo, the **Union for the Ecological Urbanization of Vila Nova Esperança** initiative was implemented with a focus on restructuring a favela according to criteria of sustainability and ecological design. The project consisted of designing and executing facilities and infrastructures that allowed neighbors to establish a dignified life in harmony with nature, contributing to the self-sufficiency of natural resources and the enhancement of living conditions within the community. The idea of Villa Ecológica translated its intentions into the implementation of spaces for community coexistence such as a vegetable garden, seedling nursery, seed bank, experimental kitchen and cafeteria, educational facilities for environmental learning, an innovation center in socio-environmental technology, recreational spaces such as plazas and parks, and the installation of public service equipment including solar energy, basic ecological sanitation, and a waste collection warehouse. The Waste Management Project and Community Agriculture also forms part of the initiative, promoting the reuse of materials and inputs and recycling as a tool for green construction. In addition, permaculture techniques, agro-ecology and green construction were utilized. Community agriculture with a vegetable garden and kitchen made it possible to offer numerous jobs to neighbors of the community and served as a source of healthy food for the neighborhood, reducing the vulnerability for families. The transformation of this precarious settlement into an ecological neighborhood is a model of community organization that serves as a source of knowledge for replicating similar experiences in other groups and settlements.

**PREVENT:** anticipate and to provide advance warning of natural threats and geological, hydrological, and climatological risks that may affect communities. These actions include alert systems, disincentivizing the occupation of dangerous areas, mitigating risks, and directing growth. These are particularly important in the context of precarious settlements, which in most cases face greater exposure and vulnerability to catastrophes. **Reinhabiting the Mountain** is a model project that implemented strategies to reduce the risk of landslides along the slopes of Medellín. Due to its particular geographical position, the Aburrá Valley is affected by two types of natural threats that are common in areas of extreme slopes where vulnerable neighborhoods and settlements are concentrated: landslides and floods. Given these conditions, the project began in 2013 with a study of the management of informal borders in Medellín, with the objective of anticipating growth, discouraging the occupation of high-threat areas, preparing and training the community for possible disasters, and directing the growth of informal borders. After a regional analysis and case-by-case study of each neighborhood was conducted, five pilot projects were formulated to test the technical and social impact of promising strategies.[102] Since 2019, a pilot project called Inform@Risk has been implemented on the urban edge of Medellín in the neighborhood of Bello Oriente to anticipate earthquakes. The project included the development of an Early Warning System (SAT), a low-cost and low-maintenance monitoring system, and an effective evacuation system adapted to site-specific conditions through a network of geo-sensors installed throughout the neighborhood.[103] The case of Rehabitar la Montaña serves as an example of the implementation of technical systems adapted to localized conditions of the neighborhoods to prevent risk of landslides on slopes.

**102.** Claghorn et al., 2016.

**103.** Inform@Risk. (2020, September 23). Strengthening the Resilience of Informal Settlements against Slope Movements | CLIENT II. https://www.bmbf-client.de/en/projects/informris







Medellín

Refunctionalization and Recovery System of Urban Trees, Mendoza



**FOREST:** populate land with forest plants. This urban planting strategy is particularly beneficial for the environment and quality of life of citizens, since it improves the urban microclimate, the quality of the air, and the temperature due to the effects of shade and energy consumption by evapotranspiration, reducing the urban heat island effect. The incorporation of trees also improves soil quality and the level of biological diversity. In the city of Mendoza, Argentina, a **Refunctionalization and Recovery System of Urban Trees** was implemented, formulated by UNICIPIO, the Council for the Coordination of Public Policies for the Metropolitan Area. The project was created with the goal of implementing an integrated metropolitan system with institutional support and the improvement of existing infrastructure for afforestation and irrigation. This effort is aimed at the recovery of the urban canopy under sustainability development guidelines and the methodology of modern arboriculture and forestry. The initiative to reconstitute the urban forest contributes significantly to the improvement of the microclimate throughout the city, remediation, and environmental biomonitoring. This facilitates the reduction of ambient temperature and mitigation of the heat island effect, and contributes to air humidification, improving biological biodiversity and the quality of the urban landscape. The project is structured through five components that address the problem of the urban forest in a comprehensive manner:

a) A Management Board of Urban Trees (MEGAP);
b) A survey, information, and management system for urban trees through a georeferenced Census of Urban Forestry;
c) The refunctionalization of nurseries to guarantee the supply of trees;
d) The provision of agricultural equipment and machinery to the municipalities for the process of afforestation;
e) The permeabilization of ditches and improvement of irrigation infrastructure to achieve greater availability and infiltration of water. de agua.

Currently, progress has been made with most of the components, as the MEGAP has promoted the initiative to plant trees in municipalities and delivered agricultural machinery for reforestation tasks in the city as well as provincial nurseries responsible for providing specimens. In addition, the Census of Urban Forestry of the Metropolitan Region was conducted in late 2020 and throughout 2021, providing a georeferenced land and aerial survey of the forest canopy.

**IRRIGATE:** convey water and guarantee its availability for productive land. This type of strategy is necessary in areas with dry climates where water is scarce, presenting a problem for families in vulnerable settlements. Some strategies to guarantee water access stand out for their use of innovative technologies that are adapted to complex spatial conditions of these settlements. As a case study, the **Fog Water Farms Project Park + Gardens** is particularly unique. In the northern zone of the Metropolitan Region of Lima, in a neighborhood within the Lomas ecosystem characterized by a thick fog that covers the region during the winter (from six to nine months), a project was proposed that included a series of landscape interventions to solve the problem of water scarcity. The scarcity required a creative solution to address the community's priorities of green spaces and food and water security. These constraints required an innovative solution, one that implements a fog collection system that works by gravity, condensing the fog into drops of water when they meet the textile fabric of the collectors. The project was realized through a participatory process with the community, including the design, implementation, and construction phases. The new infrastructure for collecting, storing, and distributing water improved access to food through the proliferation of home gardens and the community garden that provides large quantities of fruits and vegetables to neighbors. In addition, there was an increase in the amount of green and public spaces, facilitating the stabilization of slopes and the sequestration of carbon.







Fog Water Farms Park and Gardens, Lima.

# 2

INDEX
LOCATION OF CASE STUDIES








## 1. UPGRADE AND RESTORE

**1.1** Paseo Urbano de la Calle 107. Urbam EAFIT, Alcaldía de Medellín, Agencia Francesa de Desarrollo y Empresa de Desarrollo Urbano. Medellín, Colombia. 2004 - 2005.

**1.2** Plaza Estacional. CATIA 1100: sistema de equipamientos comunitarios. AGA estudio, PICO. Caracas, Venezuela. 2015.

**1.3** Plaza en el Cardón. Enlace Arquitectura. Caracas, Venezuela. 2018-2019

**1.4** Parque Cultural Tiuna el Fuerte. LabProFab. Alejandro Haiek. Caracas, Venezuela. 2008 - 2020

**1.5** Parque Fazendinha. São Paulo, Brasil, 2017- Hoy

**1.6** Paseo de los Estudiantes. Trazando Espacios. Aragua, Venezuela. 2017.

**1.7** Rocinha + Verde. Green My Favela. Río de Janeiro, Brasil. 2011-2014.

**1.8** Huerta en Manguinhos. Green my Favela + Hortas Cariocas. Río de Janeiro, Brasil. 2012 - Hoy.

**1.9** Parque Trazando Sonrisas, Escuela Agustín García Padilla. Trazando Espacios. Sucre, Venezuela. 2017.

**1.10** PARQUEBAMBU. Semillas + LAN -Laboratorio architetture naturali + Ensusitio. Comunidad Nativa Jerusalen de Miñaro, Pangoa, Satipo, Perú. 2016 - 2017.

## 2. CONNECT AND ADAPT

**2.1** Plaza la Cruz, La Palomera. Enlace Arquitectura. Caracas, Venezuela. 2016 - 2017.

**2.2** Parque Fluvial de la Familia. Boza Arquitectos. Santiago, Chile. 2010 - 2015.

**2.3** Parque Hídrico la Quebradora. Taller Capital + UNAM. Ciudad de México. 2013 - 2020.

**2.4** Proyecto de Integración Social y Urbana del Barrio Padre Carlos Mugica – Barrio 31-31bis. Ministerio de D. Humano y Hábitat, Gob. de la Ciudad de Buenos Aires. 2015 - Hoy.

**2.5** Caminos de la Villa. Asociación Civil por la Igualdad y la Justicia (ACIJ) y WINGU –Tecnología Sin Fines de Lucro. Buenos Aires, Argentina. 2014 - Hoy.

**2.6** Parque en el Arroyo Xicoténcatl. Taller Capital. Tijuana, Baja California, México. 2019.

**2.7** Represo Colosio. Taller Capital. Nogales, Sonora, México. 2019

**2.8** Parque Fresnillo. Rozana Montiel. Zacatecas, México. 2017.

**2.9** Parque 15 de Octubre. Servicio REP, Programa Barrio Mío. Lima, Perú. 2013 - 2014.

**2.10** Recuperación del Morro de Moravia. Medellín, Colombia. 2009 – 2014.

## 3. ANTICIPATE AND MITIGATE

**3.1** Parque Ecológico Lago de Texcoco. Iñaki Echeverría Gutiérrez. Estado de México. 2019 - 2028.

**3.2** Parque Metropolitano Cerro Chena. Gobierno Regional Metropolitano de Santiago. Santiago, Chile. 2015 - 2022.

**3.3** Corredor Socio-Ecológico de los Cerros Orientales. Diana Wiesner Arquitectura y Paisaje. Bogotá, Colombia. 2007 - Hoy

**3.4** Mapocho 42k. M42K_Lab UC. Sandra Iturriaga. Santiago, Chile. 2010 - Hoy.

**3.5** BIO 2030 Plan Director Medellín. Área Metropolitana del Valle de Aburrá, Municipio de Medellín y URBAM. Medellin, Colombia. 2011 - Hoy.

**3.6** Rehabitar la Montaña. Urbam EAFIT, Alcaldía de Medellín y Universidad Leibniz Hannover. Valle de Aburrá, Medellín, Colombia. 2013 - Hoy.

**3.7** Unión por la Urbanización Ecológica de Vila Nova Esperança. Asociación Independiente de Vila Nova Esperança. Instituto Lia Esperança. São Paulo, Brasil. 2010 - Hoy.

**3.8** Rutas Naturbanas. Fundación Rutas Naturbanas. San José, Costa Rica. 2015 - Hoy.

**3.9** Sistema Integrado de Información y Gestión para la Refuncionalización y Recuperación del Arbolado Urbano. UNICIPIO. Mendoza, Argentina. 2017 - 2018

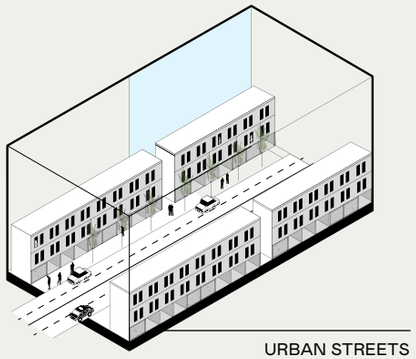
**3.10** Fog Water Farm Park + Gardens. Traction. Lima, Perú. 2011 - 2017.

# 1

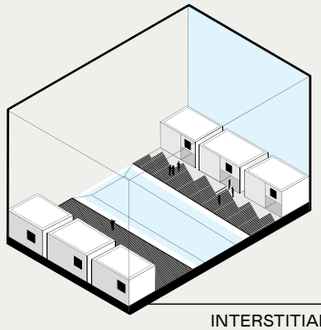
# UPGRADE AND RESTORE

RESTORE: assist in the recovering of the project or landscape or ecosystem that has been degraded, damaged, or destroyed. These consist of acupunctural and localized improvements. How can territories damaged or affected by extreme climatic events be recovered while improving the quality of future life?

AREAS OF INTERVENTION → WHERE



URBAN STREETS



INTERSTITIAL AREAS

ACTIVITIES → WHAT

Trails | Public Transportation | Park | Playground | Overlook | Market

ACTORS → WHO

Local government | Civil Society | Academia | Multilateral Organizations

SCOPE → WHY

Stabilize neighborhoods | Reduce crime | Improve connections with adjacent areas | Promote new types of social life

MEANS AND METHODS → HOW

**REDEFINE** —— Redesign of streets, facades and urban spaces, pedestrian mobility and water management.





PROJECT 1.1

# Paseo urbano de la calle 107

**Site**

Medellín, Colombia.

**Years**

2004 - 2005

**Team**

Urbam EAFIT, Mayor of Medellín, French Agency of Development and Department of Urban Development

**Coordinates**

6°17′53.63″N
75°33′18.04″W

PROJECT

**Elevation**

1,457 - 1,575

**Climate**

Tropical

**Area**

18,000 m$^2$

**Impact**

-

**A new urban pedestrian promenade was designed along a stretch of 11 blocks on Calle 107. The value of the street as a space of encounter was recovered, while the public space per inhabitant and afforestation increased.**



## CONTEXT

The creation of precarious and informal settlements in Medellin went hand in hand with excessive demographic growth and migration toward the city that resulted in the occupation of the hillsides by those in search of spaces to live. Displaced populations settled to the north of the city in the upper parts of the valley, in precarious conditions with great natural, social, and economic risks. These neighborhoods were the site of illegal gangs, high levels of marginalization, segregation, poverty, and violence.

The Calle 107 Project is part of the projects that made up the Comprehensive Urban Project (PUI) of the northeastern area of Medellín. The PUI contains a series of projects and physical interventions that were carried out with the participation of the local population in search of improving connectivity, creating public spaces, and improving educational facilities and housing and environmental conditions. The PUIs generated an intervention methodology that served as a model for areas of unplanned growth with deficiencies in urban facilities and public spaces.



Urban Corridor of the Calle 107
Photos: Urbam EAFIT

Plan

PASEO URBANO DE LA CALLE 107

The location of the projects was in a peripheral sector of the city (Communes 1 and 2), leveraging the opportunities of its proximity to the Metrocable. Constructed in 2004, the Metrocable is a cable car that connects these communities and informal settlements with the city's metropolitan transit system.

## VISION

Metrocable offered the PIU intervention 9,000m2 of urban space around the stations to improve accessibility to the sector. Within this area, Calle 107 was presented as a straight street along the entire length of the cable car, with a length of approximately 660m between the river and Andalucía station, and a section of 19m. The road, with steep topographic conditions, was one of the corridors most used by the residents of the neighborhood for mobilization.

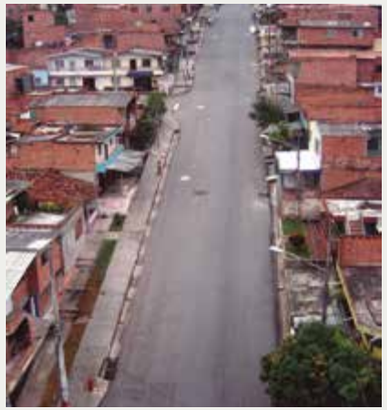
The project proposed repurposing the public section of Calle 107 for the implementation of a pedestrian walkway along its route, including the adaptation of existing public spaces and the construction of a park located near the access to the road. The objective was to strengthen the function of the neighborhood corridor of the street, recognizing its character as a pedestrian axis, and indirectly boost commercial activities for the socioeconomic development of the local community.

Along a stretch of eleven blocks on Calle 107, one of the sides of the large columns of the Metrocable was appropriated and designed as a new urban promenade with a special cobblestone paving pattern. In addition to adapting this vehicular lane for public pedestrian space, the project managed to coordinate a homogenous spatial experience among the front gardens of 395 buildings through developing consensus among all the owners. The opening of space for pedestrians was complemented by the reorganization of public service networks, which were relocated underground from their overhead position.[1]

**660 linear meters of public space.**

**Canopy cover increased 991%.**

1. www.elmundo.com, "Andalucía estrenará Paseo Peatonal" https://www.elmundo.com/portal/pagina.general.impresion.php?idx=15009.



↑ Before and after construction of Paseo Urbano Calle 107

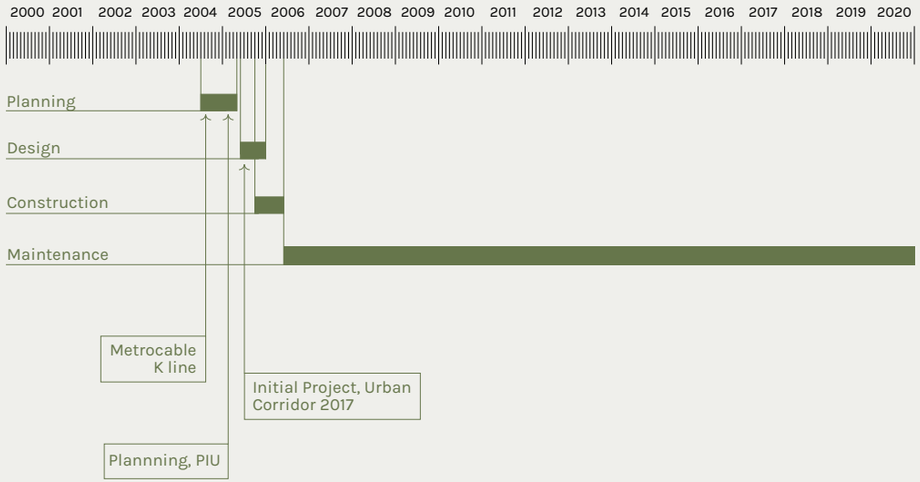
→ Urban Corridor Calle 107 after implementation of northeast PIU
Photos: Urbam EAFIT

## ENVIRONMENTAL AND SOCIAL BENEFITS

The physical intervention inserted a versatile urban promenade for all kinds of activities, giving the residents a decent and adequate place for social and economic development. The street was reestablished as a space for urban life and interaction. In addition, the construction of facilities such as bridges, spaces designed for commerce, connectivity, and recreation, managed to articulate in a timely manner the elements that make up the context of this specific territory.

The Calle 107 project and the Northeast Comprehensive Urban Project in Communes 1 and 2 increased the percentage of public space per inhabitant in an area where these spaces are scarce–from 0.65 to 1.48m2–, and increased afforestation by 991%.[2] From a social point of view, the projects reduced homicides and generated new jobs in the area. The project is a model for its positive results on critical issues such as reducing crime, improving quality of life, and building trust in public administrations.

**2.** Proyecto Urbano Integral (Pui) Nororiental, Comunas 1 Y 2 – Áreas de Influencia Sistema Metrocable -Medellín. | Archivo BAQ". http://www.arquitecturapanamericana.com/proyecto-urbano-integral-pui-nororiental-comunas-1-y-2-areas-de-influencia-sistema-metrocable-medellin/.











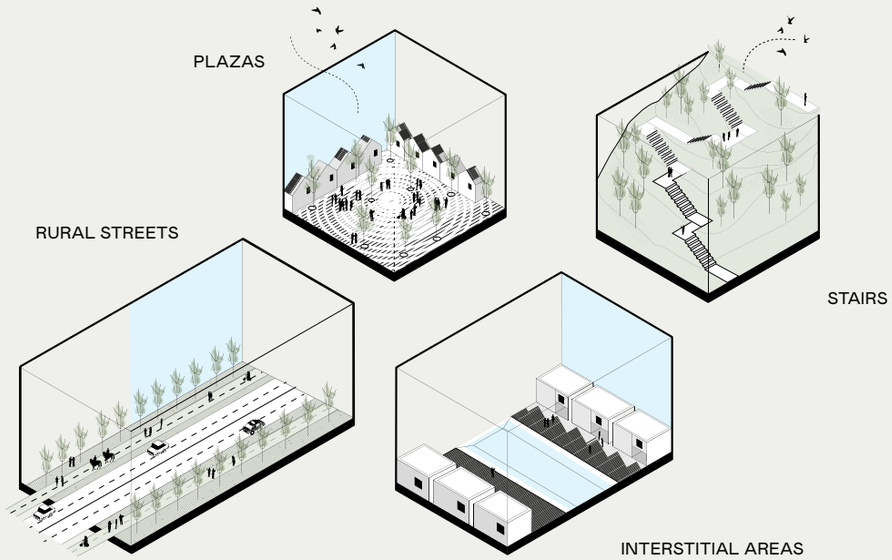

## CONSTRUCTION AND IMPLEMENTATION PROCESS

**The percentage of public space per inhabitant increased from 0.65 to 1.48m2.**

Part of the methodology was to work with the community to conceptualize, develop, and build the new networks of open spaces through collective workshops. The community was involved in all stages of the process, first by identifying problems and opportunities, and then formulating and approving the project through participatory design practices. The neighbors were also part of the construction of the works, which generated new jobs and employment.

Northeastern Comprehensive Urban Project

AREAS OF INTERVENTION → WHERE




ACTIVITIES → WHAT

Trail | Garden | Park | Overlook

ACTORS → WHO

Local Government | Civil Society

SCOPE → WHY

Improve connections with adjacent areas | Stabilize neighborhoods | Reduce heat island effect | Reduce maintenance costs | Increase productivity of abandoned sites

MEANS AND METHODS → HOW

**CONSOLIDATE** —— Redesign of streets, stabilization of slopes, citizen training.





PROJECT 1.2

# Plaza Estacional. CATIA 1100. System of community programs

**Site**

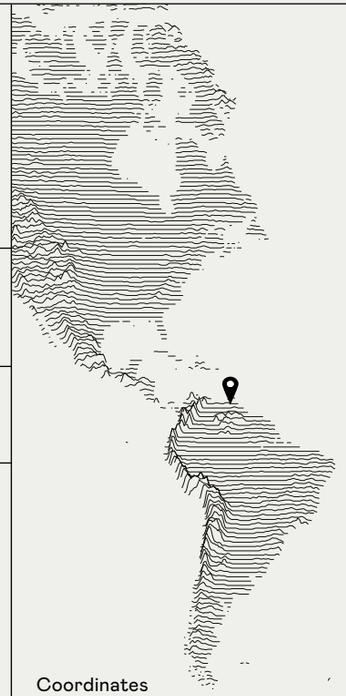
Los Frailes de Catia neighborhood, Catia, Parroquia Sucre, Bolivariano de Libertador Municipality, Caracas, Venezuela.

**Year**

2015

**Team**

**Design:** Gabriel Visconti Stopello [AGA estudio] + Marcos Coronel [PICO] + community of Barrio Canaima - Los Frailes de Catia. **Architecture:** María Ramírez, Stevenson Piña, Rodrigo Marín, Ricardo Sanz, Ana Cristina Morales, Laura Di Benedetto, Rolando Campos. **Social Territorial Team:** Nelifred Maurera, Ruth Mora, Ángel Chaparro. **Cultural:** Lusimar Marcó, Priscila Yépez. **Técnico:** Adriano Pastorino. **Production and Logistics:** Johan Martínez + local community **Construction:** Brigadas de autocons-trucción of Barrio Canaima. **Institutions:** Vicepresident of Territorial Deevelopment, Inst. National Institute of Parks, M.P.P. for the Communes and Social Movements, G.M. Saber y Trabajo, Barrio Nuevo Barrio Tricolor, Misión Árbol.



**Coordinates**

10°25′53.41″N
66°52′35.67″W

PROJECT

**Elevation**

1,100 m

**Climate**

Subtropical

**Area**

250 m²

**Cost**

132,000 USD

**Impact**

25 direct and 120 indirect.

# The idea for the Plaza Estacional has been to utilize the space as a studio-school of agricultural production and training in the management of ecosystems within the neighborhood, including the preservation of the Parque Nacional.

## CONTEXT

The Plaza Estacional (Seasonal Plaza) is part of a project called CATIA 1100 – System of Community Facilities: a systematic activation operation for the reordering of the physical and social fabric of the Canaima and Los Frailes de Catia neighborhood settlements. The two sectors are located within the territory of the Waraira Repano National Park in the city of Caracas. The project arises from actions initiated by the Venezuelan Institute of National Parks and community organizations to address a populated sector within the park, applying regulations that define the use of natural protected areas, and designating the height of 1,100 meters above sea level as the maximum elevation for construction.

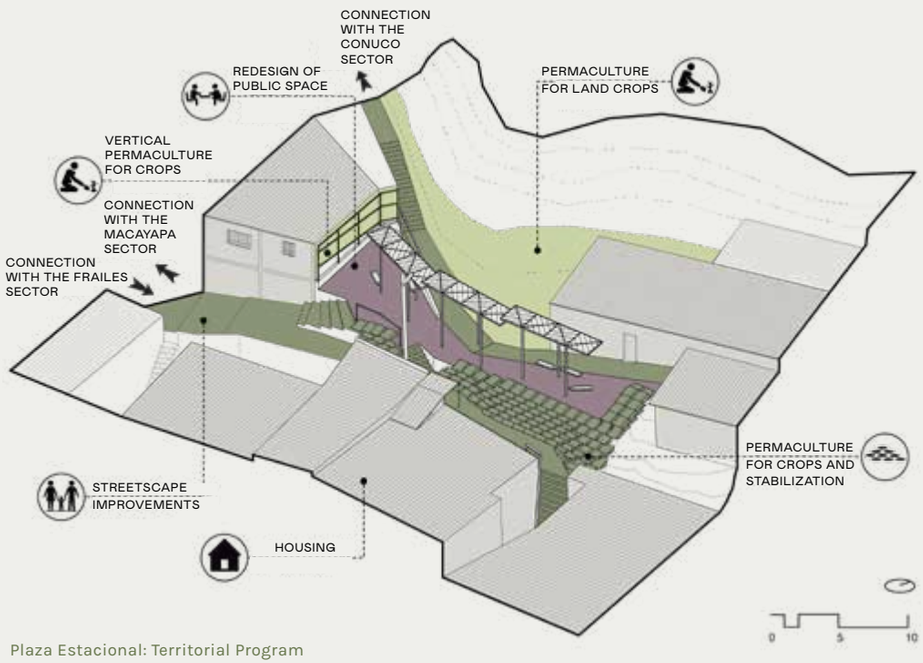







Territorial view of the Canaima and Los Frailes de Catia neighborhoods; i - Plaza Estacional; ii – Multifunctional La Ceiba; iii – Sports Complex La Canchita; 1100 - m.s.n.m

Photo: José Bastidas




Plaza Estacional: Territorial Program

## VISION

The System of Community Facilities project supports neighborhood organization practices in territorial management, including occupation protocols and agreements for activation and social coexistence. In addition, development plans considered a sustainable relationship with the natural ecosystem through the consolidation of a set of common benefits programmed for the public, including the renovation of houses and the updating of utility infrastructures in the neighborhood. The system is made up of El Multideportivo La Canchita, a sports center for recreational and training practices in sports; the Multifunctional La Ceiba, a multipurpose space to discuss public affairs, interact with others, and build community; the Plaza Estacional, a common plaza for sharing educational and productive practices in natural ecosystems; and a Corridor that articulates the pedestrian paths of the Canaima-Los Frailes neighborhood with the group of facilities, strengthening these communities' connection to the urban territory of the National Park.

## ENVIRONMENTAL AND SOCIAL BENEFITS

The Plaza Estacional promotes self-construction within the limits allowed by the National Park regulations. It is a space that serves as a place of passage and/or rest in the daily commute for the community, as it is a node located at the juncture of Los Frailes de Catia with two other sectors: Macayapa (to the northwest) and El Conuco (northward). The existing collective spaces within the neighborhood were limited and in precarious environmental conditions. Nonetheless, the Plaza Estacional and the shared meaning built around the Community Facilities System promoted a more holistic look for the site. On one hand, it suggested new ways of territorial appropriation; and on the other hand, it promoted inhabited sectors of this protected area to become agents of natural preservation in the park, capable of generating a sustainable relationship with the elements offered by the surroundings.



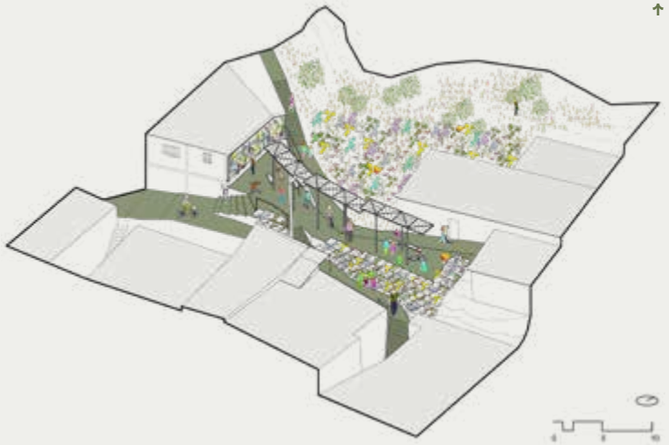






Seasonal Plaza
↑ Rest areas with shade canopy
Photo: José Bastidas

↓ Occupation Dynamics



## CONSTRUCTION AND IMPLEMENTATION PROCESS

The plaza strengthens the pre-existing conditions of passage and/or rest, developing the following operations: (1) incorporation of infrastructures for separation of sewage and rainwater runoff within the roadways; (2) introduction of devices for rest, shade, and pedestrian mobility; (3) rehabilitation of houses that make up the sector; and (4) land stabilization using bags of sifted earth from the same site. These low-tech, daily life techniques promoted the use of elements found within the native ecosystem. Plants with deep roots were incorporated to provide slope reinforcement. The land stabilization also facilitated the development of a broader training experience. These operations strengthened the site and consolidated a shared common area for the houses. In addition, its location as the least urbanized part of the community provided the opportunity to incorporate an orchard for the community that has an established sustainable relationship with the elements of the land. The orchard is managed by a group of neighboring families with urban agriculture knowledge who share their knowledge with the larger community through training workshops. The idea has been to use the space as a workshop-school for small-scale agricultural production and training in the management of ecosystems within the neighborhood, including the protection and preservation of National Park.

The project and system are based on methodologies of management and permanent participatory design, originating from the orchestration of the community (spokesperson, local knowledge, and workforce), the institutional capacities of logistics and operations (instrumental and material), and the tools of disciplines applied to the urban phenomenon (architecture, sociology, geography etc.). It is a project agreement for local empowerment and the right to the city.

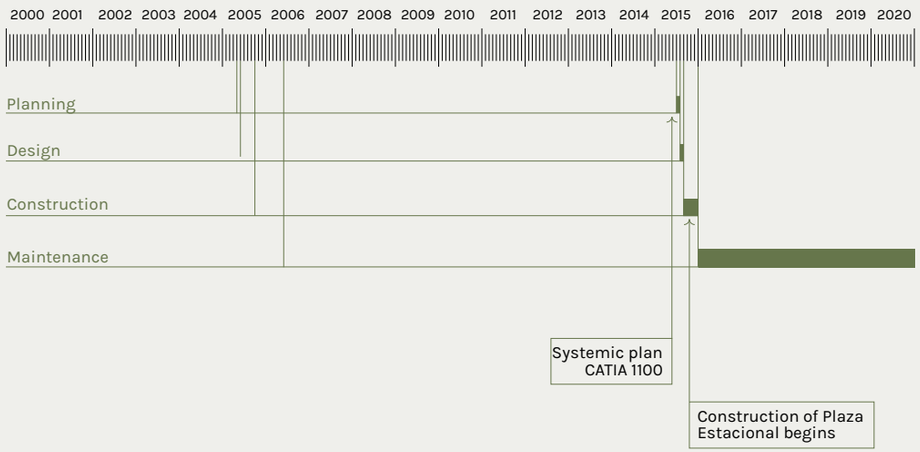
**Implementation of permaculture techniques, groundcover planting, and green wall vegetation to stabilize the soil.**







PLAZA ESTACIONAL. CATIA 1100.



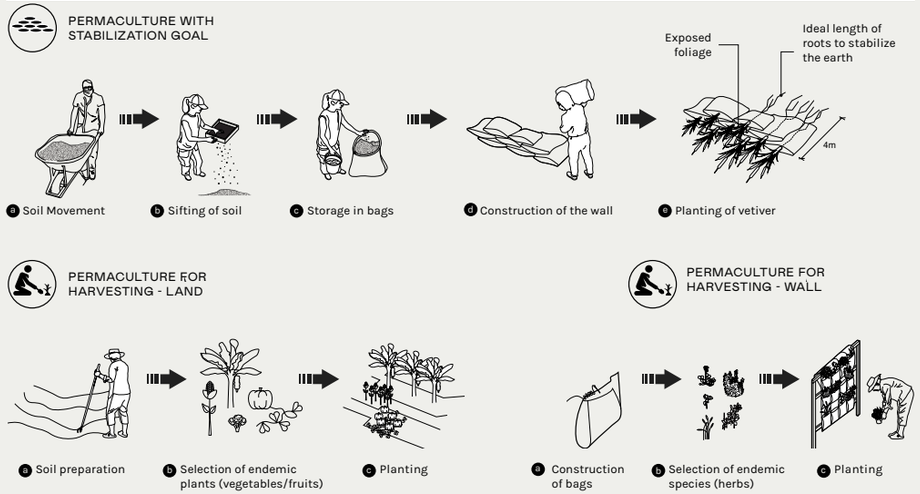

Slope stabilization
Photo: José Bastidas







1.2




**1. SLOPE STABILIZATION**

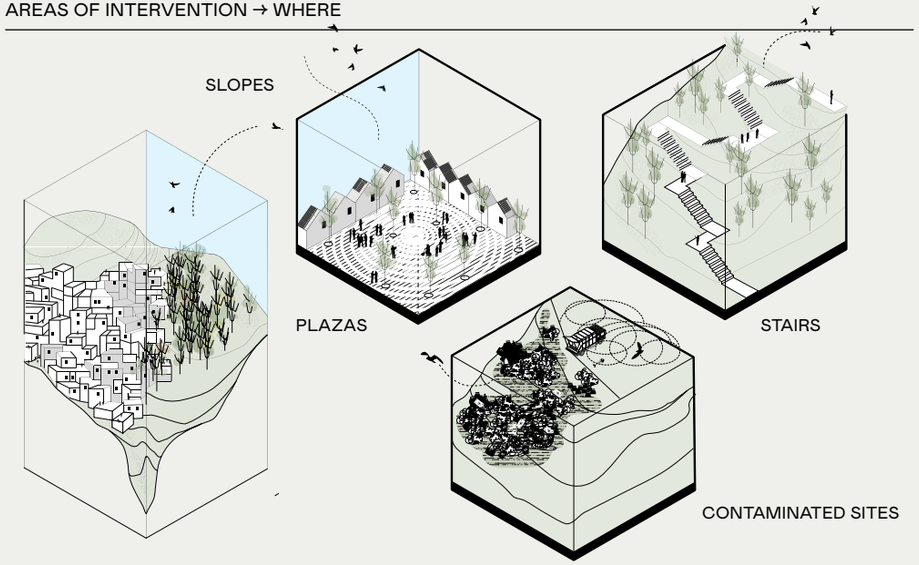
**3. MOBILITY AND SERVICES, CANOPY AND HOUSING**

**2. SOIL STABILIZATION**

**4. STUDIO/SCHOOL OF AGRICULTURE**

Permaculture Techniques and Construction Sequence of the Plaza

AREAS OF INTERVENTION → WHERE




ACTIVITIES → WHAT

Trail
Playground
Overlook
Plaza

ACTORS → WHO

Non-governmental organizations
Civil Society

BENEFITS → WHY

Waste recycling
Promote healthy lifestyles
Stabilize neighborhoods
Improve the productivity of abandoned sites
Clean contaminated soil
Promote new types of social life

DISPOSITIVOS → CÓMO

**STABILIZE** —— Leveraging a sloped landscape to create playgrounds, stabilizing the soil and promoting waste management.





PROJECT 1.3

# Plaza en el Cadón

## Site

Barrio El Cardón, Antímano, Municipality of Libertador – Caracas, Venezuela.

## Years

2018 - 2019

## Team

**Architects:** Enlace Arquitectura, (Elisa Silva, Miguel Salas, Eduardo Mouhtar, Valeria de Jongh). **Project:** Caracas Mi Convive (Roberto Patiño, Giorgina Cumarin, Oriana Medina). **Sponsor:** Swiss Embassay in Venezuela.

## Coordinates

10°48'15.80"N
66°97'93.83"W

PROJECT

**Elevation**

1.205 m

**Climate**

Subtropical

**Area**

30,4 $m^2$

**Cost**

3.732 USD

**Impact**

1,400 citizens

**A play space was created in a place where neighbors had become accustomed to leaving waste. The new design leverages and stabilizes slopes of the land and establishes new practices to manage waste.**



## CONTEXT

In 2016, the complex humanitarian emergency in Venezuela worsened, specifically affecting children with few resources and significantly increasing child malnutrition. This critical situation has prevented the most vulnerable children from accessing basic food to grow properly, affecting their psychosocial development and putting their lives at risk. “Alimenta la Solidaridad,” a sister organization of the NGO Caracas Mi Convive, has implemented a model of social intervention that, through a process of community organization and transformation, has established spaces for coexistence, where a daily lunch is provided for children and adolescents at risk of food insecurity, as well as for nursing mothers and pregnant women.





The real protagonists of the organization are the volunteer mothers and fathers. They offer spaces in their houses to establish dining rooms, kitchens, and daycares, and clean and carry out the daily operations of the cafeterias. This model strengthens the responsibility and empowerment of the social fabric at all stages of the process and develops the organizational capital of the communities.

The organization seeks ways to strengthen the comprehensive growth of children. It is known that play is a fundamental activity in the development of skills and emotional and social development of a child, which also improves their overall performance at school. The Swiss Embassy in Venezuela has taken a lead role in advancing this type of opportunity for children in the El Cardón de Antímano neighborhood of the Libertador Municipality of Caracas where, since 2017, one of the kitchens of the Alimenta la Solidaridad program operates.

The children of the cafeteria do not have spaces to play safely in the community. The topography is rugged, with steep slopes and few open spaces available for interventions in public spaces. While basketball courts are incorporated on the street, these only benefit young people and adolescents. Young children simply have nowhere to play.



## VISION

The opportunity to build a recreational space arose in an area where the neighbors had become accustomed to leaving their garbage, which was only occasionally collected by the municipal waste collection service. The community decided to clear the waste site and use the adjacent hill to create an intervention that stabilizes and capitalizes on the natural slope of the land. The project includes a seesaw, a slide, and a bench in front of a panoramic and privileged view of the city. In addition, the neighbors have agreed to manage the waste in such a way that they no longer place it, even temporarily, in the previous area.

Plaza in El Cardón Intervention
Proposal roposaltervención.

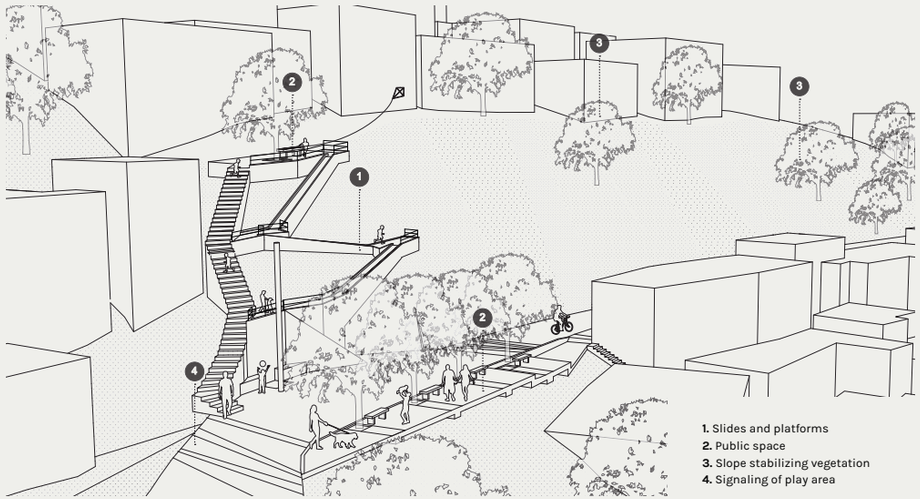








Proposed interventions
in the public realm



Plaza in El Cardón
Photo: Abraham Viera







## CONSTRUCTION AND IMPLEMENTATION PROCESS

**Planting over the slope functions as a mechanism to stabilize the earth, preventing its continuous erosion.**

In tropical climates, the combination of penetrating sun and heavy rain makes it difficult to preserve painted surfaces over time. To preserve the concrete surface as the final finish, children of the community utilized a designed pattern of handprints as a more resistant solution than painting. This idea emerged as a literal indicator of the growth of children and their intrinsic relationship to the food provided by the dining room. Not only did it make children the protagonists of the work, but it will also last over time. Each child can stand in front of the retaining wall, and with their hands outstretched, mark how far they can reach at that moment according to their height. As each child grows, they can return to the same place, extend their arms, and see how far they can reach. The act symbolizes their authorship on the wall and allows the visualization of the growth and health of each child, as they surpass the original mark.

To achieve the registration of these growth traces, three tests were carried out to evaluate the best technique. Once the procedure was determined, an activity was carried out in the community where more than sixty children from the dining area and their representatives participated. Each one drew the outline of their hands on the main wall of the project in white chalk. Then the trace of the hands was carved into the concrete surface.

The next step was incorporating a variety of plant species on the slope. These function as a mechanism to retain the soil and prevent its continuous erosion. The Mi Convive team and the El Cardón Alimenta la Solidaridad dining areas organized a planting day together with the community and the support of a local nursery.

Construction Process
Photo: Miguel Salas







Community workshop with kids and families. Drawing and carving of handprints on retention wall.
Photos: Abraham Viera

## ENIVRONMENTAL AND SOCIAL BENEFITS

While there is a lot of demand on behalf of children to play within this space, only a limited amount can since the project has only completed the first phase. To date, the project has a series of slides, platforms, and stairs that go from a height of 30 meters above to the current street level.





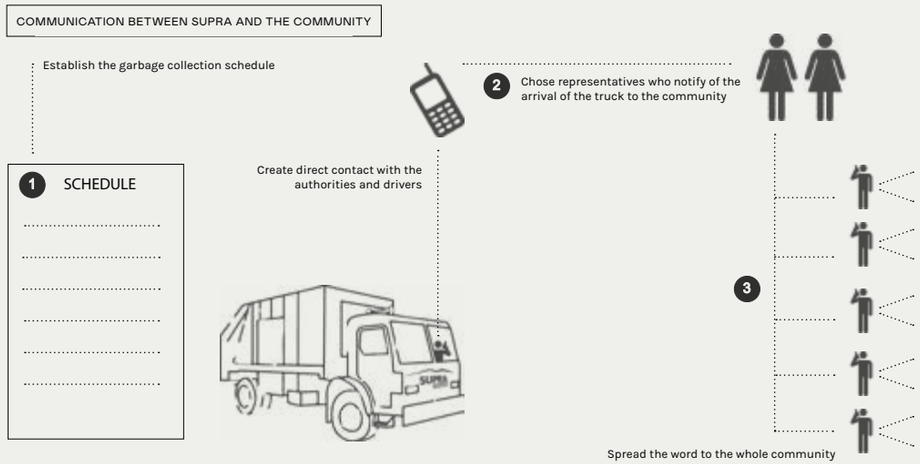



↑ Public space with children's play features
Photo: Abraham Viera

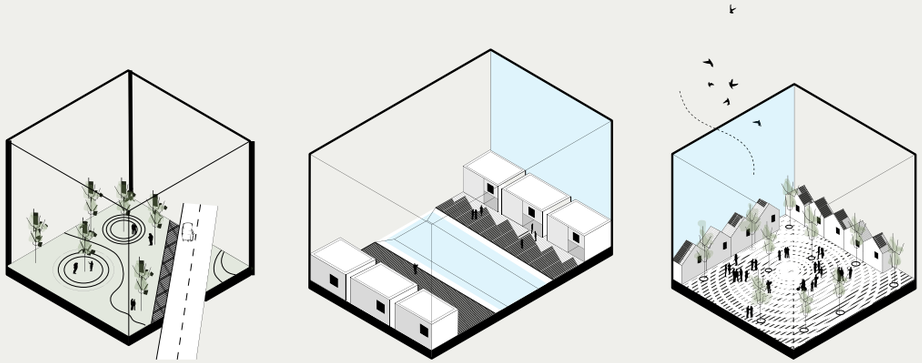
↓ New system of waste management in the community

187

**WASTE MANAGEMEN**



AREAS OF INTERVENTION → WHERE



WASTELANDS INTERSTITIAL AREAS PLAZAS

ACTIVITIES → WHAT

Trails Cultural Center Park

ACTORS → WHO

Non-governmental organizations Civil Society Local government

BENEFITS → WHY

Recycle Waste Improve the connection to adjacent areas Establish neighborhoods Increase the productivity of abandoned spaces Reduce maintenance costs Promote new types of social living

MEANS AND METHODS → HOW

**REPROGRAM** — Creation of self-sufficient community space in a wasteland: spaces of gathering, culture, professional training, and recreation.





PROJECT 1.4

# Parque Cultural Tiuna el Fuerte

## Site

Av. Intercomunal de El Valle, Municipio Libertador, Caracas, Venezuela.

## Years

2015

## Team

**Project:** Alejandro Haiek Coll / LAB.PRO.FAB. **Director of Art:** Eleanna Cadalso Vera. **Project Team 2015-2020:** Enrique Henríquez, Ana Gabriela Bastidas, Henrique Berni, Stefano Di Cristofaro, Fátima Ferreira, Alexandra Montes, Jonier Osorio, Fabiana Russo, Daniela Rodríguez, Ricardo Santafe, Mariana Silva, Tharamaroa Troconis, Irina Urriola. **Project Team 2005-2015:** Rafael Machado, César Castillo, María Alejandra Bausson, Sebastián Miranda, Betti Lamelo, Nashira Covarrubia, Pier Capecchi, Eduardo Sauce, Irina Guarecuco, Alejandra Pernalete, Ana Rivas, Carlos Alayon, Verónica Rojo.

## Coordinates

10°27′44.98″N
66°54′31.75″W

PROJECT

## Elevation

890 m

## Climate

Subtropical

## Area

9977 m$^2$

## Cost

-

## Impact

-

Photo: Iwan Baan

**The project emerges on an abandoned site, a parking lot. The idea was to recover and reprogram this interstitial and underutilized space in the city into a park and public space for the neighbors.**



## CONTEXT

The Tiuna el Fuerte Cultural Park is in the heart of the Paroquia El Valle, known as one of the most important communities of artistic expression in Caracas. The project emerges on an abandoned site, a parking lot, affected by the slow development of infrastructure, dominated by a network of roads and highways, and the presence of a favela and vulnerable settlement on its edges. In addition, there is a strong military presence from the Fort Tiuna military base. All these elements combine to create an intricate geomorphology of the site.

In the middle of this complex structure, the Cultural Park arose as a response to a problem of a severe lack of public space in the Capital District. The city of Caracas has less than 5m2 of green and recreational areas per inhabitant, and only 0.26m2 per inhabitant in the Libertador Municipality,



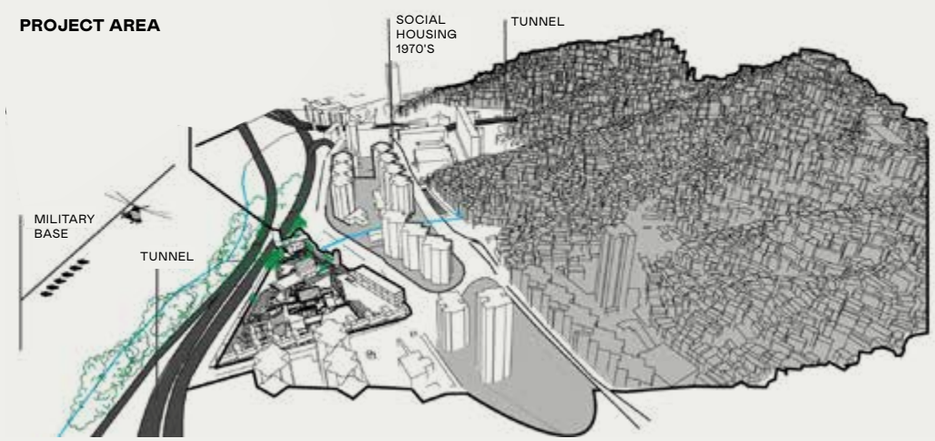


where the project is located.1 The idea of the intervention was to recover and reprogram this interstitial and indeterminate space in the city to turn it into a park and public space for the residents.

**1.** Parque Cultural Tiuna El Fuerte: Modelo De Microurbanismo Autosustentable | Archivo BAQ", consultado el 4 de noviembre de 2020, http://www.arquitecturapanamericana.com/parque-cultural-tiuna-el-fuerte-modelo-de-microurbanismo-autosustentable

Historic photo Tiuna el Fuerte


Cultural Park: Site implementation in the urban context



## VISION

The project seeks to establish itself as an ecological socio-productive park open to the community with a variety of programs, including open-air auditoriums and five warehouses among which complementary spaces emerge for training workshops, classrooms, dining areas, and civic and sports areas. It was created to provide academic and recreational production areas for arts, crafts, and communication. The space and its infrastructure (workshops, rooms, radio station, recording studio, multimedia rooms, library, auditorium, and small cafeteria) allow participants to develop training and educational programs. This has resulted in a self-management model, converted into a cooperative alternative for social, cultural, and environmental movements.

The design of the architecture and public space incorporated sustainability criteria of alternative technologies for construction, and energy control and management. Recycling strategies were also incorporated, through the reconditioning and reprogramming of abandoned industrialized containers, which were transformed into flexible modular elements with the possibility of progressive growth. The containers were organized and configured in multiple combinatorial patterns, as a support element for the various training activities that the place offers. In addition, a water collection and reuse system was devised for the park, along with the reintroduction of plant species and local fauna.

Multifunctional space
Photo: Iwan Baan





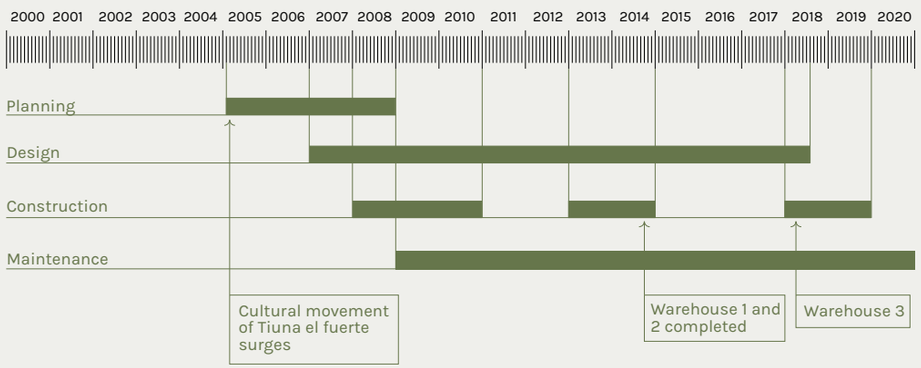
## CONSTRUCTION AND IMPLEMENTATION PROCESS

The project was promoted by local artists and a significant number of urban activists, who intervened in the abandoned parking lot thanks to a loophole in legal regulations allowing the possibility to occupy unused land for up to twenty years. From this first community action, a chain of cultural actions expanded that transformed the site into an elaborate support system for the collective dynamics of the community. The space experimented with various administrative, organizational, operational, and political formats (foundations, NGOs, collectives, groups, and research laboratories), holding weekly meetings as a participatory methodology where critical issues were discussed. The use of low-cost, pre-assembled, and modular systems for the configuration of the space minimized and facilitated its maintenance in the short and long term.

## ENVIRONMENTAL AND SOCIAL BENEFITS

The project serves as a model of sustainable micro-urbanism with complementary mixed-use programs for comprehensive social development. The park houses more than 500 children and adolescents for daily culture and art training. By 2013, in a matter of five years, the crime rate of the abutting neighborhood of the park was reduced by 32%. In addition, it is an urban development model that has emerged from recycling and reuse of waste, materials, and spaces for its creation. More than 60 containers were reconditioned, tires were recycled to function as flowerpots for trees, 120 pallets were repurposed as floors, ceilings, and thermal insulation, packaging was appropriated as acoustic insulation, and other materials were reused. In addition, endemic plant species and medicinal crops were incorporated to contribute to the improvement of the park's microclimate. In all, an obsolete, degraded, and unused site was transformed into a cultural park open to the community.

**Recycling strategies were utilized, through the reprogram-ming of abandoned industrial containers.**










Appropriating the space for cultural and educational activities. Photos: Iwan Baan

**60 repurposed containers**
**120 pallets reutilized as floors, roofs, and thermal insulation. In addition, rubber and boxes were recycled.**

**Vegetable and endemic species were incorporated to contribute to the improvement of the microclimate in the park.**

Self-sufficiency process of the Cultural Park





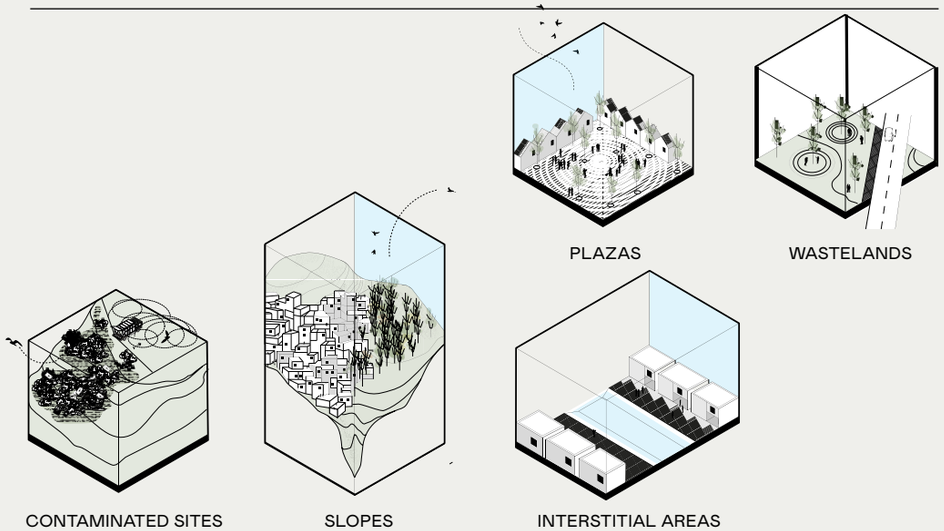


**URBAN GARDEN: TYPES OF VEGETATION IN THE PARK**

**WILDLIFE REINSERTION**

Urban Garden: Incorporation of flora and fauna

AREAS OF INTERVENTION → WHERE




ACTIVIDADES → QUÉ

Trails
Garden
Park
Plaza

ACTORS → WHO

Local Government
Civil society
Non-Profit Organizations
Academia

BENEFITS → WHY

Waste Recycling
Promote healthy lifestyles
Stabilize neighborhood
Create jobs
Clean contaminate soils
Promote new types of social life

MEANS AND METHODS → HOW

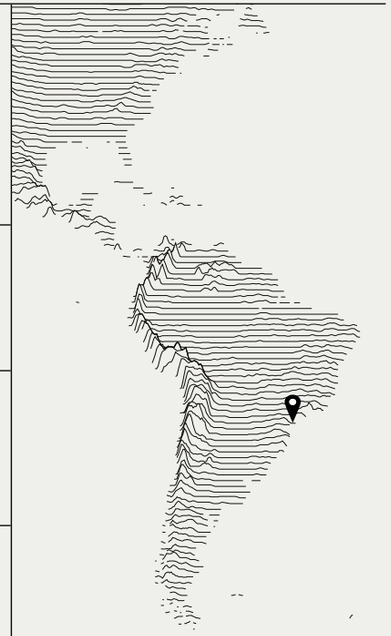
**CLEAN** —— Repurposing of a landfill into a park open to the community, a collective space of citizen participation.





PROJECT 1.5

# Parque Fazendinha



## Site

Jardim Colombo, Paraisópolis, São Paulo, Brasil.

## Years

2017 - 2020

## Team

Fazendinhando Movement, Union of Neighbors of Jardim Colombo, Arq. Futuro. **Sponsor and colaboration:** Catholic University of São Paulo, University INSPER, Town Hall of São Paulo (Vivienda), BEI Editora, Aron Birmann Foundation, Engineers without Borders (São Paulo), Red de Papel Solidario, RL Higiene, MIT (Massachusetts Institute of Technology).

## Coordinates

23°36′28.07″S
46°43′45.72″W

PROJECT

## Elevation

780 m

## Climate

Subtropical

## Area

1000 m²

## Cost

-

## Impact

-

**The project creates physical and visual permeability while providing a respite in the heart of Jardim Colombo. A gateway to the world for children and young adults.**



## CONTEXT

Located in the west of São Paulo, Jardim Colombo has a population of around 18,000 people and is part of the Paraisópolis Complex. The community is small in scale and has a communal neighborhood life. In 2017, a partnership was signed between Arq. Futuro and the leadership of Jardim Colombo. After several walks through the neighborhood, the land of the Fazendinha ("small farm," name given by the fact that it was once a place to cultivate food and animals) was viewed from a different perspective, the 1,000m2 landfill was considered as a possible leisure space for the community: Fazendinha Park. The initiative was inspired by the story of Mauro Quintanilha, founder and creator of Parque Sitiê (Rio de Janeiro), who presented the case of Rio to the residents of Jardim Colombo and demonstrated that it is possible to turn a dump into a public space for the community. This initiated the process of what would become the Fazendinhando Movement.





Fazendinha



## VISION

In December 2017, the project was initiated with the presentation of an earlier design of the park to the community and a large collective effort of volunteers to clean the land by removing more than 40 truckloads of garbage. Conversations then intensified on how to adapt the site, the only open space in the community, so that residents could use it as a central leisure and community public space. There were several challenges: the slope of the land, the remaining waste, the lack of vegetation, and the scarcity of resources and labor to continue with the daily maintenance of Fazendinha. In addition, there was the challenge of encouraging residents to care for the space and avoid using it as a waste point.

Workshop and participatory process with the neighbors. Imagining the transformation of the landfill into a space of leisure, rest, and gatherings.



## CONSTRUCTION AND IMPLEMENTATION PROCESS

In July 2018, an art festival was held in Fazendinha, as a kickoff and promotion of the project, allowing all the inhabitants of Colombo to see the space in a new way, taking advantage of its potential as a public space for leisure and enjoyment. Posters promoted the festival, which included workshops on urban furniture with reused pallets, landscaping and soil stabilization, production of vases with discarded materials, and photography, always in conjunction with new cleaning efforts. The land for the festival was prepared by searching for and collecting abandoned tires around Colombo for the construction of walls, daily removal of garbage and soil, and planning of activities. This work was conceived and carried out collectively and through a participatory process with the







residents, who led the workshops, contributed tools and materials, and shared their knowledge and labor as part of the construction of the park. From the outset, Fazendinha Park was developed by the community as a collective creation.

The Fazendinhando workshops were held in a participatory process where the imagination of the neighbors allowed them to visualize and design the landfill as a space for leisure, rest, and meeting through a variety of activities. After the festival, the results were analyzed, and the material facilitated the development and structure of the space as well as the architectural project.

The main objectives of the project were to complete a historical restoration, re-establish contact with nature, and reconnect the community with public space. The land was divided into five levels of activities based on the needs of the community, accessibility, and potential of each area. The final stage of implementation of the Parque Fazendinha Project will connect the upper part of the site to the stream, generating a contact with the water and a flow of trails, activities, leisure, and experiences. The project creates physical and visual permeability, while generating a respite in the heart of Jardim Colombo. The construction is based on “resilience walls,” made of tires with debris and cement. Approximately 20% of the work is complete, based on numerous donations from institutions and individuals.

## ENVIRONMENTAL AND SOCIAL BENEFITS

In the informal setting of the city, the Fazendinhando Movement has focused its efforts on understanding the context and connecting with neighbors, forming a team that responds to challenges, takes action, gets involved, raises awareness, and integrates the community. In the last two years, in parallel with the construction of the park, numerous groups have utilized the area, including volunteers who have organized clean-up sessions and implemented activities like festivals focused on children and young people, community members who have incorporated income-generating activities, and foreign professionals and students who have visited to join conferences and exhibitions on the Fazendinha case in schools and external events. In addition, a combination of private entities and public authorities, including health have facilitated the distribution of food baskets, hygiene products, clothing, and books in times of crisis. The name Fazendinha is not only universally known among the community, but it has also become a part of the common discourse of the residents. The park is not only a green space in the heart of the community, but also a gateway to the world for children and young people.

**1,000m2 of landfil.**

**Forty truckloads of garbage converted into public space.**



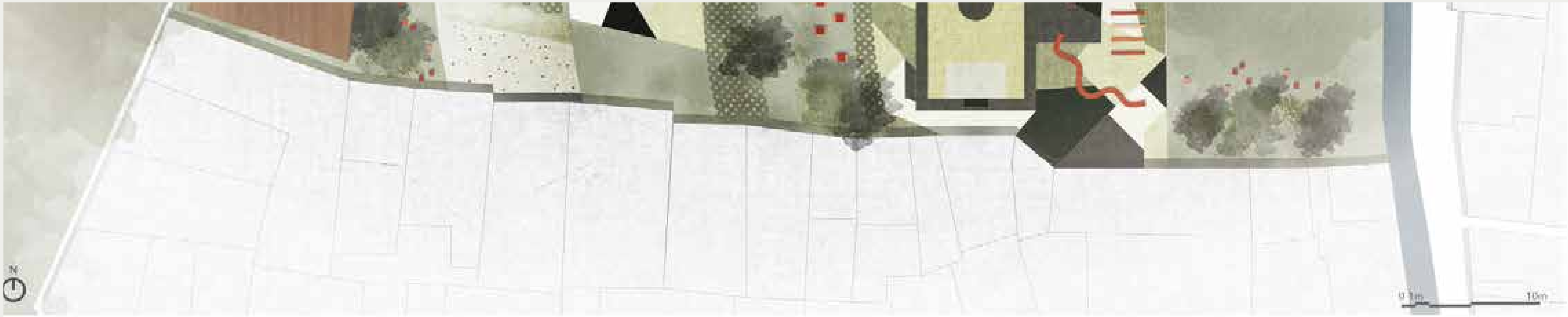





Workshops, festival and community gardens in Fazendinha

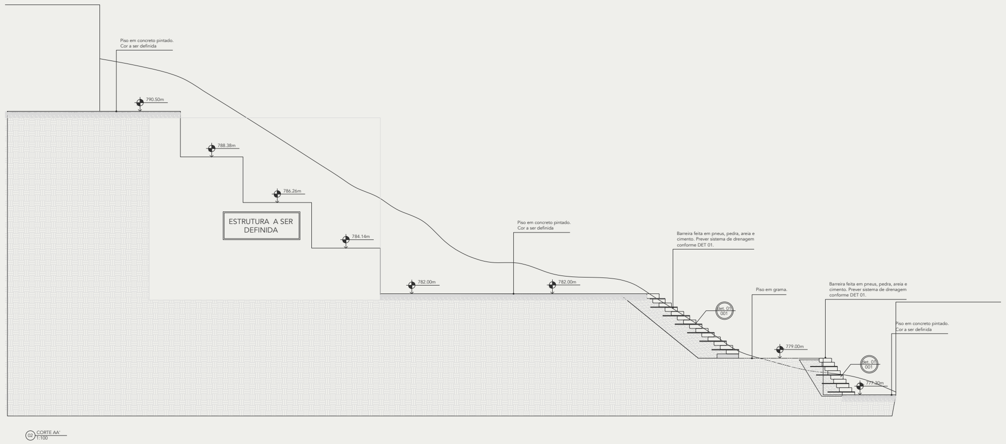
## PARQUE FAZENDINHA

Plan

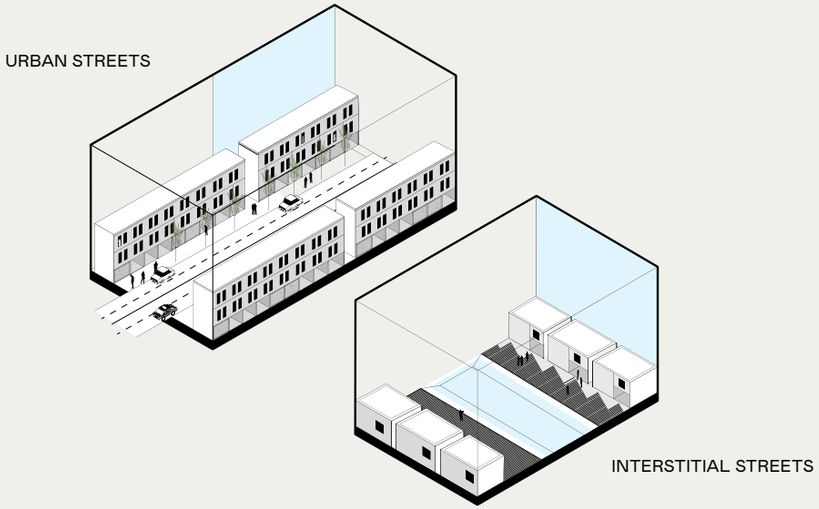


### DESIGN DETAILS

- ☐ PERMEABLE AREA WITH GRASS
- ▨ CONCRETE PLATE
- ▨ SLOPE- TIRE BARRIER WITH DRAINAGE SYSTEM
- ☐ SLOPE- CONCRETE STAIRCASE
- ▨ SLOPE- STRUCTURE FOR SLIPWAY AND CLIMBS



AREAS OF INTERVENTION → WHERE




ACTIVITIES → WHO

Trail | Garden | Park | Plaza | Playground

ACTORS → WHO

Civil society | No-Profit

BENEFITS → WHY

Improve connections to adjacent areas | Improve the productivity of abandoned areas | Promote new types of social life | Establish neighborhoods | Waste recycling

MEANS AND METHODS → HOW

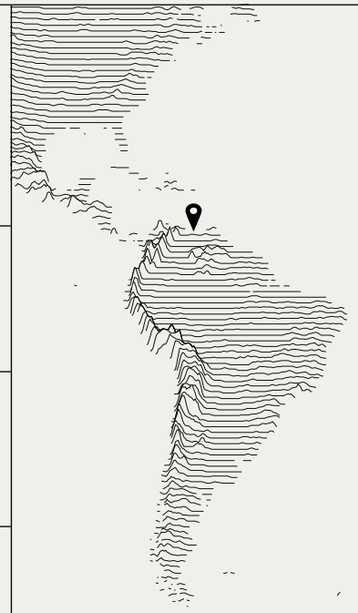
**LEARN** —— Repurposing of a pedestrian street with recycling techniques, incorporation of planting and painting.





PROJECT 1.6

# Paseo de los estudiantes



### Site

Juan Moreno, Edo. Aragua, Venezuela.

### Years

2017

### Team

Trazando Espacios and community of Juan Moreno.
Santa Teresa Foundation.

### Coordinates

10°38′13.84″N
64°14′09.02″W

PROJECT

**Elevation**

534 m

**Climate**

Tropical

**Area**

200 $m^2$

**Cost**

2800 USD

**Impact**

200 beneficiaries

# The transformation of a 60m-long pedestrian alley was transformed to include artistic and playful elements with reutilized materials and green infrastructure.

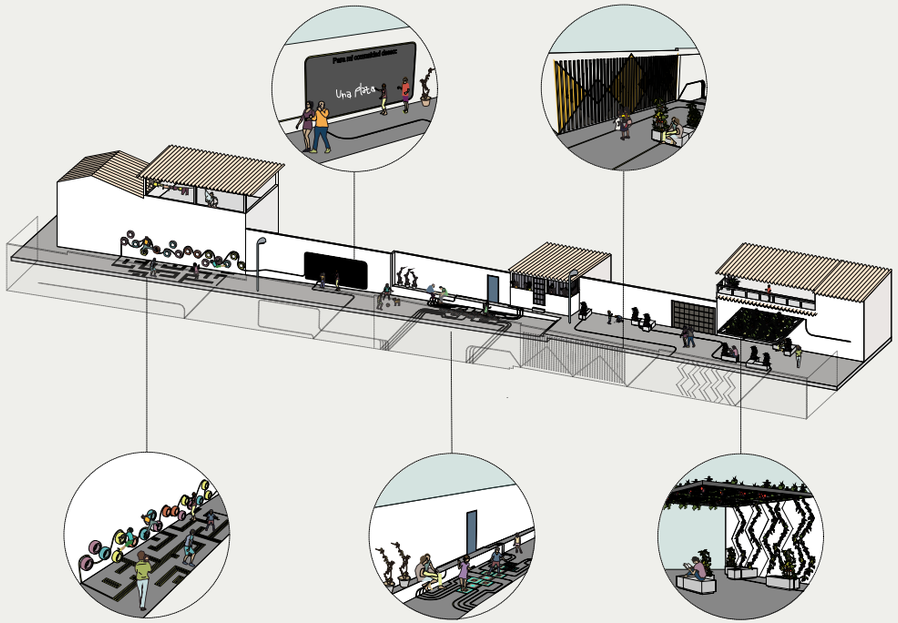


## CONTEXT

In December 2017, the Paseo de los Estudiantes project was completed as the fifth Trazando Espacios Públicos program in the community of Juan Moreno, El Consejo, Aragua State. The objective of the program was to teach children and adolescents between the ages of nine and fifteen participatory design tools to transform a public space and instill the value of citizenship. In alliance with the Santa Teresa Foundation and the help of more than 105 volunteers and neighbors, the Trazando Espacios team facilitated the transformation of a 60-meter-long pedestrian alley that connects the residential area to the main vehicular route of the neighborhood and vice versa.










↑ Paseo de los Estudiantes Intervention Proposal

→ Paseo de los Estudiantes Photo: Diana Ruiz Hueck

## VISION

The alley, constructed with reused materials, has an area of 700m2, which includes 500m2 of wall restoration and 200m2 of paving restoration, in which artistic elements such as murals, playful interventions such as a hopscotch and a labyrinth, teaching components such as blackboards have been added, and a canopy made of fabric provide a shaded area. Elements of green infrastructure have also been incorporated with the planting of úcaros and trinitarian plants.

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The Trazando Espacios Program sought to teach the participants to observe their community from a different perspective, identifying existing public spaces with potential for transformation so they could then select one of them through a voting process and reimagine how to improve and transform it. The Project was developed in three phases:

The first phase, Observe, worked to define local identity. Children learned about the neighborhood's public spaces, capturing their essence in photographs and then locating them on a community map. An exhibition of all the photos that represented public spaces that could be improved was then organized, where the community unanimously selected El Paseo de los Estudiantes as the project of intervention.

During the second phase, the participants began to imagine how they could rehabilitate this potential meeting space. Recognizing the importance of participatory design, children conducted surveys with the neighbors to define what they wanted for the place. In addition, they learned how to use tools to measure and draw to scale while maintaining proportions, allowing them to design and express their ideas in models. To get inspired and stimulate creativity to propose innovative ideas, they visited Villa Planchart, a jewel of architecture where participants were able to observe impeccable design details applied in

**Children learned about sustainable design with recycled and ecological technologies to construct walls, roofs, and vertical gardens.**







Interventions in the alley: Paving, Mural, Cloth pergola, Introduction of vegetation and housing

different spaces, and the Topotepuy Ecological Gardens, where they learned about sustainable designs with recycled materials through techniques for the reuse of materials and renewable energies. There they also saw ecological techniques to build walls, roofs, and vertical planters. The models made in this stage were exhibited for the community, who chose their favorite proposals. Between this phase and the next, classes complementing the workshop were held, where children learned basic concepts of landscaping and types of plants to incorporate into public space. Each student then planted seeds within the seedbeds that were made of recycled materials.

The final phase, Transformation, consisted of approximately 700m2 of restoration, including walls and pavements, in which different proposals were elaborated along the urban corridor. The interventions were of various types: some artistic, such as the palm mural and the chromatic mural, both inspired by the drawings and proposals of the participants during the workshop. In addition, and playful interventions were carried out. In addition, a canopy made of more than 100 fabric triangles was created to provide the community with a shaded rest space. Subsequently, a landscape intervention was included through the construction of benches, while the planting of úcaros and trinitarian plants visually integrated with the Casas Blancas of the Santa Teresa Foundation.

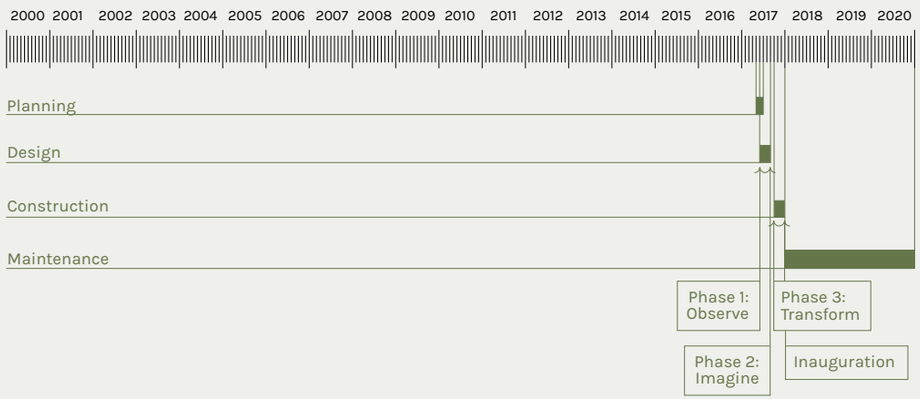
**A landscape intervention was included through the planting of úcaros and trinitarias plants.**

## ENVIRONMENTAL AND SOCIAL BENEFITS

The intervention made it possible to transform the important pedestrian passage into a desired and safe experience that promotes community encounters. In addition, during the participatory process, community members learned different techniques of reuse and recycling of materials, manual skills including painting and construction, and concepts of landscape and planting, which they then applied in an innovative way in the construction of the alley.



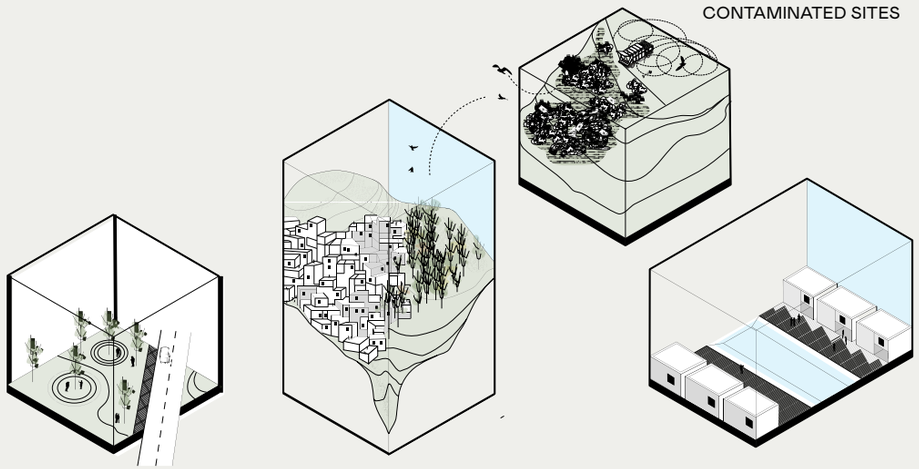





## COSTS AND MAINTENANCE

The experience of the Trazando Espacios team in other projects in the neighborhood helped instill the idea that interventions in public spaces must not only consider new techniques and durable materials, but should also be utilized by the community throughout the construction process as this encourages community empowerment and assures the subsequent maintenance by incorporating them into the decision-making process. Currently, the residents manage and maintain El Paseo de los Estudiantes and have incorporated it into their daily routines, including young people as they leave school and neighbors who now access their homes through the alley.

AREAS OF INTERVENTION → WHERE




ABANDON SLOPES INTERSTITIAL AREAS

ACTIVITIES → WHAT

Playgrounds Garden Park Plaza Trails

ACTORS → WHO

Civil society

Non-Profit Organizations

BENEFITS → WHY

Create Jobs

Increase access to local food

Clean contaminated soil

Reduce crime

Increase the productivity of abandoned sites

Stabilize neighborhoods

Recycle waste

MEANS AND METHODS → HOW

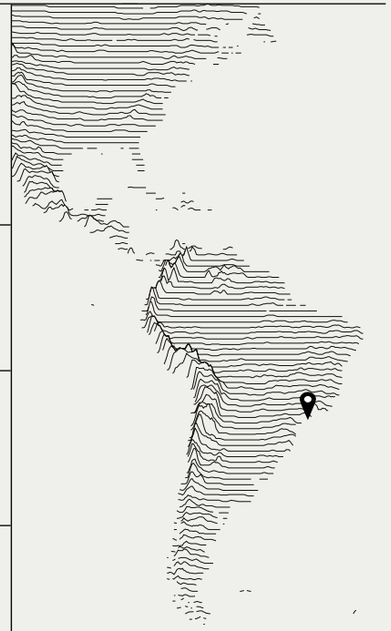
**CULTIVATE** —— Construction of a community garden for children with recycled materials and local species of vegetation.





PROJECT 1.7

# Rocinha + Verde Green My Favela



### Site

Río de Janeiro, Brasil.

### Years

2011 - 2014

### Team

Green My Favela (GMF)
Director: Lea Reakow.

### Coordinates

22°59′27°S
43°14′55°W

PROJECT

### Elevation

26 m

### Climate

Tropical

### Area

60 m²

### Cost

12.000 USD

### Impact

40-70 children, families and residents

**Rocinha is the largest and most densely populated favela in Rio de Janeiro, with scarce green spaces. Rocinha + Verde was the first community garden created in the neighborhood, on land that had been used as a garbage dump.**



## CONTEXT

Rocinha is the largest and most densely populated favela in Rio de Janeiro, with more than twenty neighborhoods and a population that ranges between 69,000 (Census 2010/IBGE) and 250,000 inhabitants, living in an area of less than 1km2. It is estimated that the continued urbanization of Rocinha – due to its convenient location1 – represents approximately 30% of the city's total population growth in recent years. It is located on a steep hillside between two of the most prosperous neighborhoods in the city, but it has a very low Human Development Index2. As density and sprawl increase exponentially in Rocinha, concrete and brick have replaced vegetation3 4. Much of the hillside is covered in cement, with little green space and poor access to water and sanitation services. This generates higher than average temperatures, floods, and high vulnerability to environmental

**1.** Cox, W. (2013) The Evolving Urban Form: Rio de Janeiro, New Geography.

**2.** Within the municipality of Rio de Janeiro, Rocinha ranked 120th out of 126 regions — or 6th worst — on the city's Human Development Index in 2000.

**3.** Rekow, L. (2016). On Unstable Ground: Issues Involved in Greening Space in the Rocinha Favela of Rio De Janeiro. Journal Of Human Security, 12(1), 52-73.

**4.** Rekow, L. (2016) Pacification & Mega-events in Rio de Janeiro: Urbanization, public security & accumulation by dispossession, Journal of Human Security, Vol 12 (1), pp. 4-34





Community Garden. Rocinha + Verde



risks such as landslides. Additionally, Rocinha has high levels of violence and unemployment and has been informally ruled by drug gangs for decades. Education levels are low, and almost half of the population is considered functionally illiterate. Public spaces are scarce, and vacant land is used almost exclusively for dumping garbage.

## VISION

Green my Favela emerged as a non-profit organization to co-produce and support productive green spaces within favelas and other informal communities. Their pilot project was developed in collaboration with Tío Lino, a local community leader who ran an art school for children and would develop a kindergarten called Rocinha + Verde. The space itself was created in partnership with the land of the Alegria das Crianças daycare. The land had been used for years as a garbage dump. The sanitation process began shortly before the police pacification of the neighborhood, and the construction took place during the initial stages of the police

occupation. Rocinha + Verde was the first community garden created in the area and had the goal of catalyzing micro-sets of community gardens to increase green areas, remediating degraded lands, reducing the prevalence of vermin and open-air burning of toxic waste, providing a platform for children to learn how to grow food and medicine, and experiencing educational and artistic activities in the public space. The project also created a local employment opportunity for a gardener who taught children about gardening and also presented at the Rio+20 United Nations Summit on Sustainable Development.

## CONSTRUCTION AND IMPLEMENTATION PROCESS

Three community meetings were held at the beginning to consult with residents on the goals, processes, ownership, and governance issues. Afterwards, twenty international volunteers were called in to collaborate with neighbors and local volunteers to remove tons of trash and half a meter of contaminated topsoil by hand.

The retaining walls were built with reused materials found on site. In addition, a contaminated underground water tank was cleaned and sealed, and a new water tank and infrastructure was installed. For the treatment of the land, a partnership was formed with EMBRAPA for the supply of worms, seeds, and clean topsoil and the purchasing of equipment, while a local gardener was hired for its maintenance and to teach gardening concepts to small groups of children.

International environmental students from exchange programs worked as interns to supervise and develop the programming with the children and the caretaker of the local garden. Educational programming included planting seeds, transplanting seedlings, caring for plants, studying seeds under microscopes, painting and botanical drawing classes, and making personalized terrariums for their homes.

**Tons of garbage and 0.5m of contaminated soil was removed.**

**60m2 of clean and adequately equipped garden.**

**One new tank of irrigation infrastructure was installed.**



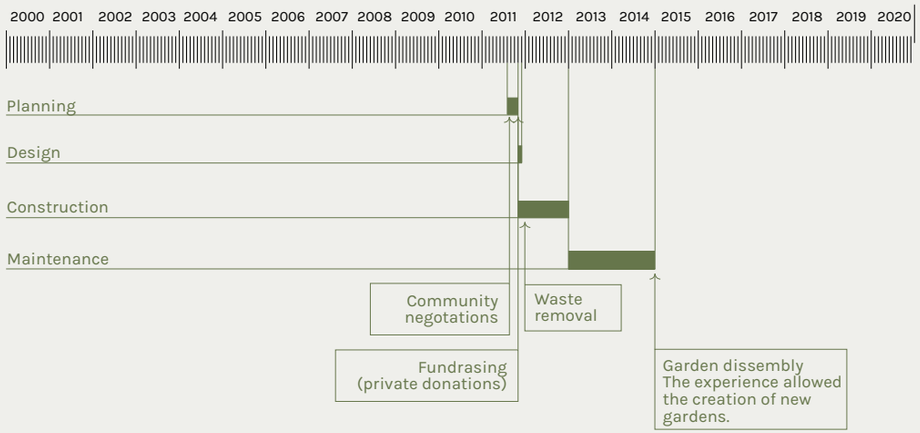




Community Garden. Rocinha + Verde

The intervention made it possible to develop concepts of organic gardening, permaculture, DIY irrigation, and cultivation of a food forest along with vegetables, fruits, and medicinal plants. The cultivated products were given to children to be included at the dining tables of their families.

The budget was used exclusively to buy seeds, equipment, and materials, and to finance the garden caretaker's salary. The management of the space passed to the Tío Lino art school a year after the inauguration, with additional support maintained by GMF for another year. At the end of 2014, after the death of Tío Lino, an escalation in the armed conflict and the development of community conflicts over control of the space, the garden fell into disrepair and was abandoned. Today, the space is used to store construction materials from the adjoining nursery.





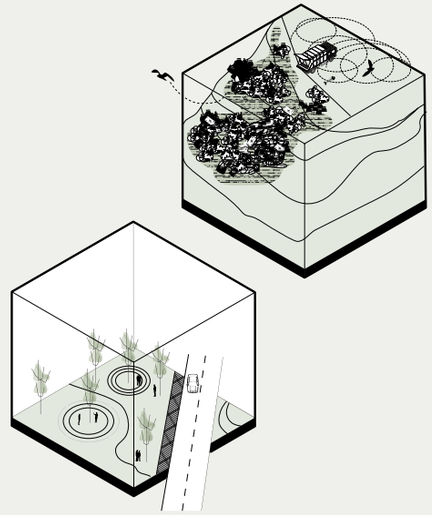



## ENVIRONMENTAL AND SOCIAL BENEFITS

The garden became a safe and desirable outdoor space to further education through art and gardening. Basic knowledge of the ecological and social benefits provided by the cultivation of productive green spaces also increased. Through Rocinha + Verde, Green my Favela catalyzed and supported a dozen more gardens that were subsequently co-produced throughout Rocinha and other nearby favelas in the southern zone. These included: a rooftop container garden, a large ornamental vertical garden, a protest garden, an orchard, two large food gardens, a large recreational eco-park, and two food provision projects.

Educational programs with children: Painting classes and botanical drawing

AREAS OF INTERVENTION → WHERE



CONTAMINATED SITES

ABANDONED SITES

ACTIVITIES → WHAT

Garden

Trails

ACTORS → WHO

Local Government

Non-Profit Organizations

Civil Society

BENEFITS → WHY

Create jobs

Increase access to local food

Clean contaminated soil

Reduce crime

Increase the productivity of abandoned sites

Stabilize neighborhoods

Promote healthy lifestyles

MEANS AND MEHTODS → HOW

**PRODUCE** —— Repurposing of landfill into a large productive urban garden to provide organic food to the community.

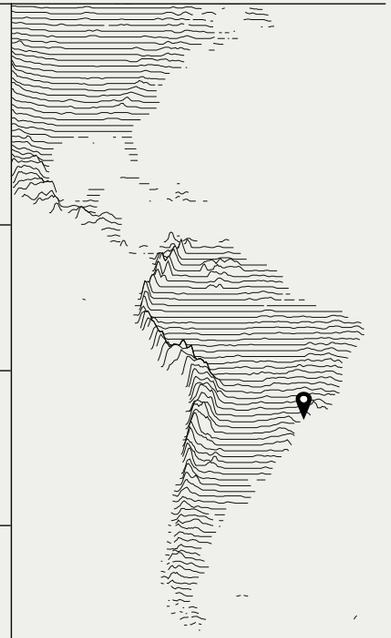






PROJECT 1.8

# Huerta en Manguinhos



## Site

Río de Janeiro, Brasil.

## Years

2012 - Present

## Team

Hortas Cariocas – of the Municipal Environmental Department of Río de Janeiro. **Director:** Júlio César Barros

## Coordinates

22°52′43″S
43°15′07″W

PROJECT

**Elevation**

7 m

**Climate**

Tropical

**Area**

6400 m²

**Cost**

225.000 USD

**Impact**

300 families

**In Manguinhos, in the North Zone of Rio de Janeiro, a large urban garden of organic food was created, among the largest in South America, consisting of more than 300 flower and agricultural beds.**

## CONTEXT

Located just six kilometers from the city center, Manguinhos is a large neighborhood in the North Zone of Rio de Janeiro that includes ten to fifteen favelas and is home to some 50,000 residents (IBGE Census 2010). Until recently, Manguinhos was considered one of the most neglected and violent favelas in the city of Rio de Janeiro, where drug trafficking and urban warfare proliferated along with high percentages of malnourished children, and a series of environmental and health hazards due to the accumulation of waste. Around 2007, the neighborhood began to experience large-scale changes that were connected to the city's extensive public security interventions facilitated by the Campaign of Police Pacification (UPP), including forced displacement, military occupation, regularization, and redevelopment. These interventions paved the way for the creation of one of the largest urban organic food gardens in South America. The Garden in Manguinhos was created by Hortas Cariocas (HC), an urban organic agriculture program established by the Municipal Secretary of the Environment in 2006. Manguinhos was the most ambitious of approximately thirty organic food gardens developed.







↑ Cariocas Gardens, Project in Manguinhos construction view – May 2013

↓ Green My Favela working with Huertas Cariocas, Project in Manguinhos December 2016

## VISION

The project was developed as a partnership between the Hortas Cariocas (HC) program, Light (the second largest electricity company in Brazil that granted the right to use the land under the high-voltage lines), the Mayor's Office and the Manguinhos Residents Association. The HC program opened a kilometer-long space to create the garden consisting of more than 300 raised beds and cultivated gardens. HC hired about twenty residents – many from drug rehabilitation programs – and trained them to work in the gardens, receiving a monthly stipend to manage the space and grow organic fruits, vegetables, medicinal herbs, and aromatics. Per HC guidelines, growers must distribute excess produce to food banks identified by the local Residents Association, in addition to working with the Department of Education to provide food to local school lunch programs. On the other hand, the garden managed to train neighbors and volunteers in agricultural knowledge and offer educational activities on agroecology and the environment for school groups and NGOs (O'Reilly 2014).

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The project began with the removal of 700 garbage truckloads of waste (between 250 and 450 tons). Afterwards, a half-meter layer of contaminated soil was removed along the kilometer-long easement that runs under the transmission lines. Subsequently, half a meter of gravel and crushed stone was placed to increase drainage and prevent the growth of weeds. This helped mitigate flooding and reduce potential trash buildup and standing water. More than 300 brick beds, each 10m x 1m, were built and filled with topsoil. Additionally, eight water tanks were installed on the site and connected to the city water supply to provide irrigation. Finally, several gardeners and a construction manager were hired.

**700 garbage trucks of waste removed on site.**

**+300 agricultural beds.**

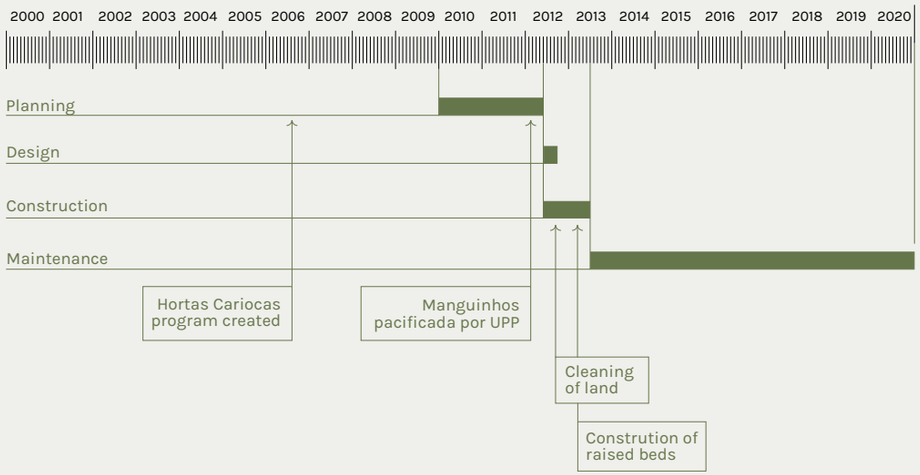
**8 tanks of water.**

**+20 local gardeners working.**

**+400 people receive food throughout the year.**







## ENVIRONMENTAL AND SOCIAL BENEFITS

Throughout the year, the garden provides fresh produce for up to 400 people. It is open to the public 24/7 and is visited daily by families and children. Because the growing season is year-round, each gardener can take produce home weekly to offset their food expenses.

Increasing the amount of nutritious food available is especially important for children suffering from malnutrition. The consumption of vegetables has increased substantially in the favela and, as the products are organic, they do not contribute to environmental pollution or to the absorption of pesticides by consumers. In addition, most families spend a high percentage of their income on food, preparing meals that lack vegetables. The garden relieves this economic stress on lower income levels by about 20% per month, increasing the socioeconomic stability of: gardeners who receive a cash stipend plus compensation in the form of products; beneficiaries of food banks; children with their school lunches; and people who receive small amounts of free food from the garden daily.

Another section of the garden, initially supported by the Green my Favela project, is managed by volunteers, retirees, the unemployed or underpaid, and their families. Together, they cultivate 48 garden beds in a self-organized manner. This section operates at full capacity, with volunteers donating excess produce to feed up to 100 members of the community, according to the gardeners (GMF 2014). The main function of this area is to provide an intergenerational space for families, children, and neighbors to work and/or socialize.

**Food provision alleviates the monthly budget by 20% for lower income families.**

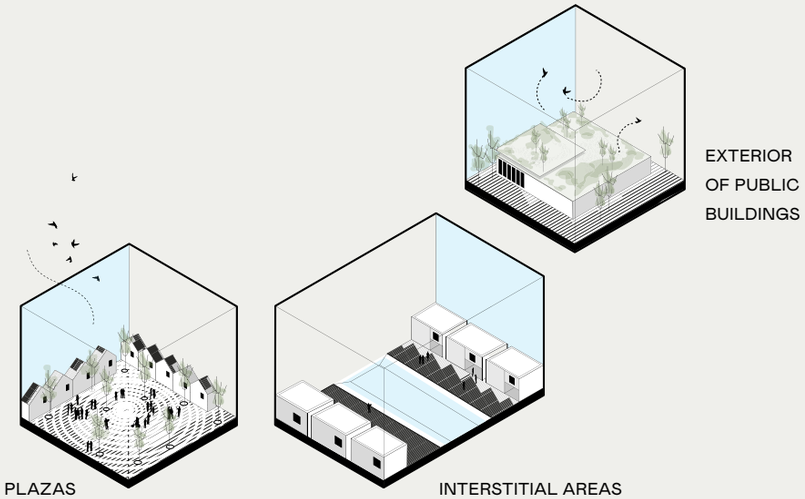




The garden provides better drainage, a litter-free environment, a social and recreational space to wander, and a safe space where children can play. The sense of pride that the community has for the garden steered the social and aesthetic transformation of the neighborhood.

Green My Favela working with Huertas Cariocas, Project in Manguinhos

AREAS OF INTERVENTION → WHERE




ACTIVITIES → WHAT

Playgrounds | Garden | Park | Plaza | Trails

ACTORS → WHO

Non-Profit Organizations | Civil society

BENEFITS → WHY

Promote healthy lifestyles | Promote new types of social life | Stabilize neighorhoods | Recycle Waste

MEANS AND METHODS → HOW

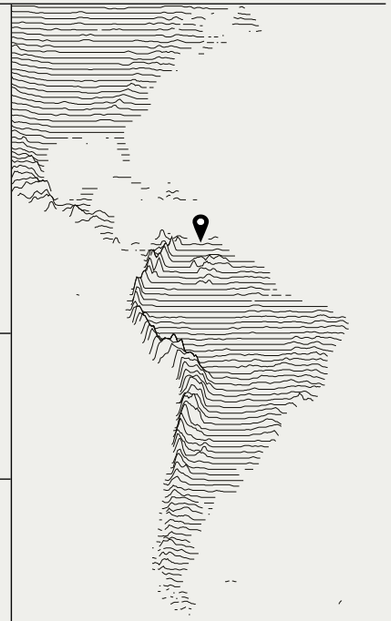
**REUTILIZE** —— Creation of a recreational park through participatory tools and recycling of materials.





PROJECT 1.9

# Parque Trazando Sonrisas



### Site

El Rincón, Edo. Sucre, Venezuela.

### Years

2017

### Team

Trazando Espacios and students of the Agustín García Padilla school.
San José Foundation.

### Coordinates

10°38′13.84″N
64°14′09.02″W

PROJECT

### Elevation

343 m

### Climate

Semi-arid

### Area

248 m²

### Cost

3.000 USD

### Impact

180 beneficiaries

# The park design for the school originated from participatory design tools, citizen values, and local identity.

## CONTEXT

The Agustín García Padilla school, located in the community of El Rincón in the state of Sucre, is one of the institutions the San José Foundation has worked with as part of its Leadership and Values Training Program. In addition, the Trazando Espacios association – focused on developing ownership through the participatory design of public spaces – has worked collaboratively to support comprehensive training and reinforce the identity of students. This is how the Tracing School Spaces program began, which has built a total of four parks in schools in the area to date.

## VISION

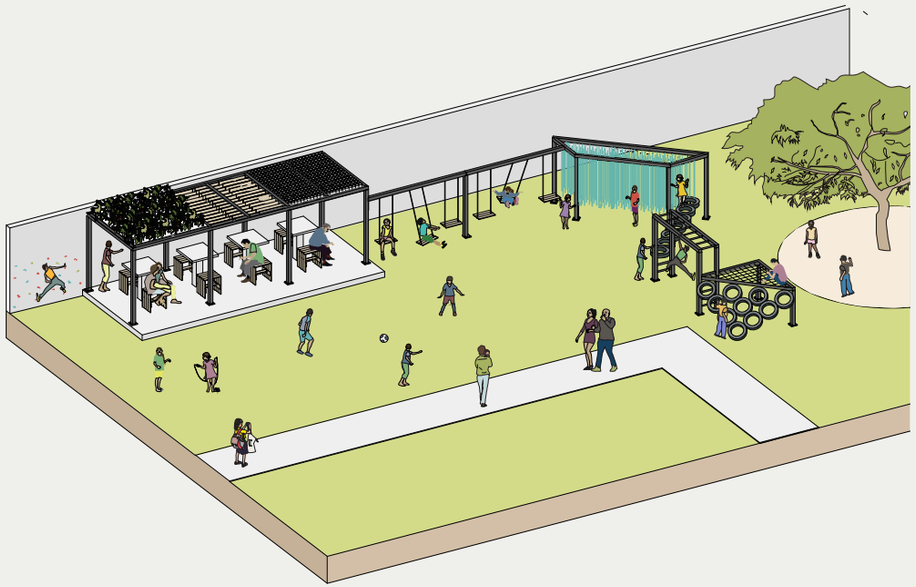
In February 2017, the Tracing Spaces (TS) team made its first visit to the educational institution to identify its needs. Fifth and sixth grade students expressed their desire to have a park so that they could enjoy it and play during recess. Immediately, the students, together with teachers, the Trazando Espacios team, and the support of the Fundación San José team, identified a green area where the park could be built.

To carry out this program, the collective adopted the methodology used by the Tracing Spaces team, in which the participants and neighbors decide – through









↑ Parque Trazando Sonrisas
Agustín Garcia Padilla School

↓ Participatory process with students and volunteers who collaborated in the construction of the park

public consultation – what the space should become and the elements to compose it. The identity was defined in the phases of Imagine (where the participants designed the interventions for the public space) and Transform (where the designs materialize with the participation of volunteers, specialists, and members of the community) to achieve the objective of designing a park for the school.

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The Imagine phase consisted of several activities where the forty-four participants, students from fifth and sixth grade, proposed what a park for the school could be like. To start, the students carried out surveys of the rest of the student community to find out what their favorite games were. Then they learned how to use the tape measure and to draw to scale the games and elements that predominated in the surveys. Afterwards, they made collages with magazine clippings to capture the environment of the park and the aesthetic of the elements that compose it. To conclude, each group made a scale model, depicting their proposals to transform the schoolyard into a park.

Each team presented their ideas and models to the rest of the student community, who voted for their favorite elements and surfaces. The TS team then transformed the ideas from the mock-ups into technical construction drawings. Among the winning elements and surfaces were: eight benches and six wooden swings, a pergola made of cans, a wooden pergola and a green roof made with plastic cases that provides shade to the area of tables and benches, a permeable wall of hoses of different colors, a mosaic mural inspired by the cultivation of cocoa, a climbing path, a bridge made of tires, and a rope trampoline.

The second phase was carried out in July with the technical plans and manuals to build the park with the help of the community and the students of the school, along with the support of the San José Foundation. For the construction of the park, a technical team of bricklayers and blacksmiths worked

**Recycling:**

**200 cans equivalent to 60kg of aluminum.**

**17 plastic cases.**

**14 tires.**

**12 wooden pallets.**







Space programmed for cultural and educational activities.
Photos: Iwan Baan

for two weeks to build the metal structure that would serve as the base. In just four days, the elements of the park were built with the support of 145 people of different ages reutilizing 200 cans equivalent to 60kg of aluminum, 17 plastic cases, 14 tires, and 12 wooden pallets.

**44 participants (students), and 145 volunteers.**

## ENVIRONMENTAL AND SOCIAL BENEFITS

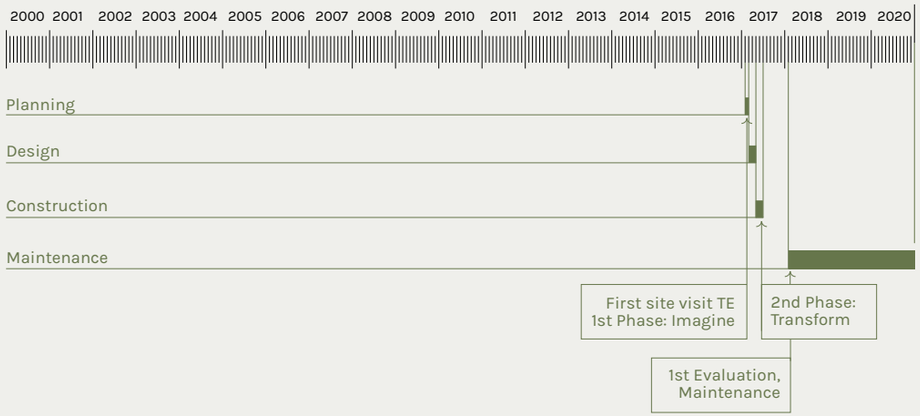
During this workshop, participants learned about teamwork, creativity, reuse of materials, and manual skills in carpentry, painting, and construction. In addition, the workshop facilitated the meeting between different community actors: preschool children hand in hand with adults, teachers with their students, or representatives exchanging construction ideas and ways of working with teachers. The park was baptized as "Parque Trazando Sonrisas" by the fifth and sixth grade students, and now the neighbors comment that this space is one of the few that the community of El Rincón has dedicated specifically to the recreation of children.

## COSTS AND MAINTENANCE

Six months later, the Tracing Spaces team returned to evaluate the state of the park and witnessed the enthusiasm and excitement from the students as they shared anecdotes of how much fun their breaks had become. The park was also in great condition thanks to the students and the proper management by the teachers. Unfortunately, the current state of the park has deteriorated, and the team has planned an upcoming visit to brainstorm ways to recover it with the help of the community by preparing workshops on participatory budgeting to guarantee its maintenance. Pinturas Corimon supported the TS team, donating paintings to bring the park to life, and the Fundación San José provided the logistics of the team's travel and lodging.








Transformation process and park construction with students

PARQUE TRAZANDO SONRISAS, ESCUELA AGUSTÍN GARCÍA PADILLA

## CONSTRUCTION MANUAL

### BENCH

### SWINGS

**TOOLS**

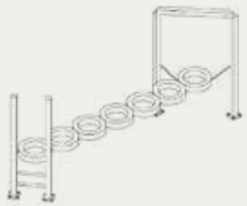
Jig-saw, circular saw, sander, security glasses, hammer, axe, brush, mask, pencil, tape measure, drill, 3/4" wood bit.

**MATERIALS**

- 3 50 cm square wooden bars per swing
- 2 30 cm square bars per swing
- 6 nails per swing
- Varnish
- 3 m of rope per swing

### CAN ROOF

### BRIDGE TIRE



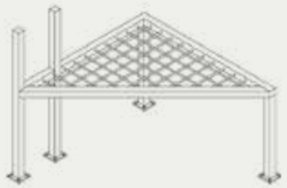
**TOOLS**

Drill, 5/32" and 1/2 " metal bit, chalk, tape measure, pliers, axe.

**MATERIALS**

- 7 tires
- 12 screws 1 1/2" diameter
- 12 butterfly nut 5/16"
- 28 large eyebolts
- 28 wooden pegs
- 4 lengths of 10 m rope
- 12 lengths of 1,10 m of rope
- 12 lengths of 10 cm of metallic tape with holes

### TRIANGLE OF ROPES



### GREEN ROOF

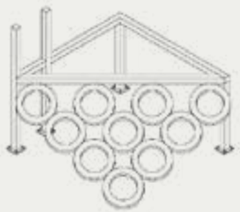
**TOOLS**

Scissors, hammer, stapler, markers, tape measure, ruler, gloves, spoon, bucket, brushes.

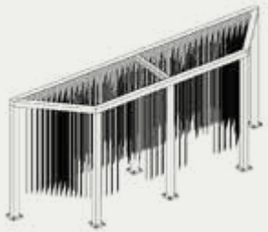
**MATERIALS**

- 25 plastic square tiles 40 cm x 40 cm
- 12 m de plastic mesh (60 cm x 60 cm per tile)
- 6 sacks of aliven (50 l)
- 50 bags of fertilizer
- Seeds or plants
- 250 1/4" staples
- Paint for external face of tiles

### TRIANGLE OF TIRES



### HOSE WALL



**TOOLS**

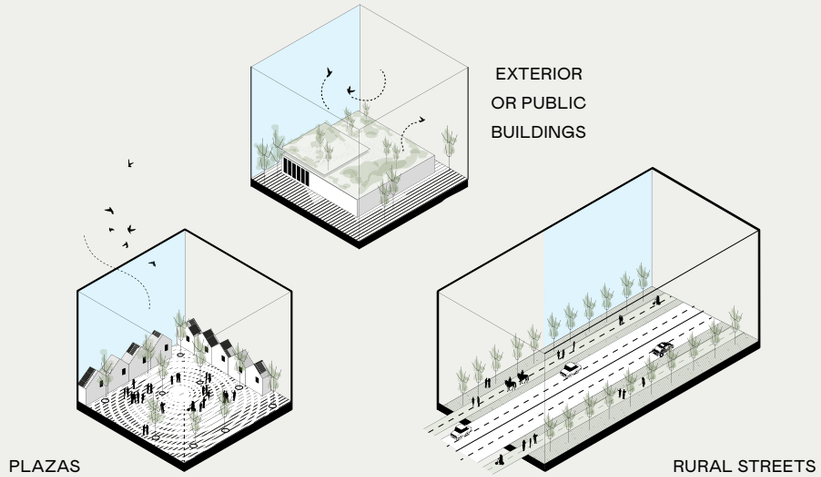
Scissor, 4 buckets, lighter, pliers, tape measure, marker, funnel.

**MATERIALS**

- 165 hoses of 1.50 m
- 107 hoses of 1.30 m
- 144 hoses of 1.10 m
- 100 hoses of 0.90 m
- 8 packs of paint wiki wiki (4 colors)
- Water
- 10 silicon tubes to seal windows
- 1500 small plastic t-wraps

Construction details – Manual of Tools and Materials for the park features.

INTERVENTION AREAS → WHERE




ACTIVITIES → WHAT

Playgrounds | Park | Plaza | Trails

ACTORS → WHO

No-Profit | Civil Society | Academia

BENEFITS → WHY

Promote healthy lifestyles | Promote new types of social life | Stabilize neighborhoods | Research + testing of new ideas

MEANS AND METHODS → HOW

**LEVERAGE** —— Construction of a communal playground and educational space with bamboo in a jungle.





PROJECT 1.10

# Bamboo Park

## Site

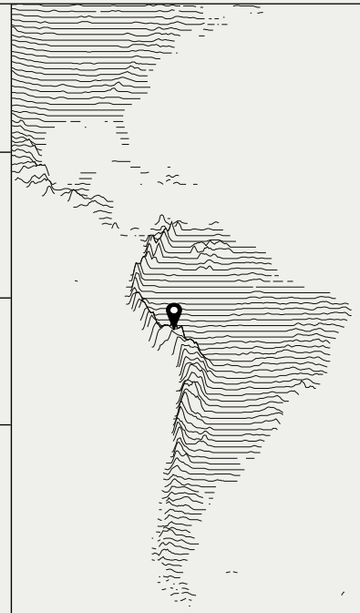
Comunidad Nativa Jerusalén de Miñaro, Pangoa, Satipo, Junín, Perú.

## Years

2017

## Team

Marta Maccaglia, Marta Anducas, Matteo Penzo, Pamela Amadio, Ilaria Pinto, Raffaella Ceparano, Martina Uda (Team organizer, Semillas), Sara Valente (Team organizer, LAN), Francisco Poli (Workshop tutor, LAN), Enrique Villacis Tapia (Workshop tutor, Ensusitio), Daniela Perleche, María Milagros Santos, Melizza Isabel Sánchez, Héctor Alberto Flores, Mario Elio Puma, Wilmer Gregori Peralta, Claudia Inés Acosta, Leonardo Barragán, Giulia Doretti, Cristina Tullio, Andrea Miccoli, Katherine Aurora Lopez, Diana Elizabet Bustamante, Estefanía Nathalí Vega, Bruno Farias, Nathaly Patricia Llacza, Monica Milagros Carrasco, Francieli Lopes, Lucero de María Arroyo, Melissa Apolaya, Pablo Esteban Yllatopa, Raúl Ignacio Arancibia, Katherine Vanessa Llayqui, neighbors of the community (participants), José Torrejón Limas (bamboo master builder).



## Coordinates

11°53′59.55″S
74°18′42.55″W

PROJECT

**Elevation**

1.400 msnm

**Climate**

Tropical Humid

**Area**

200 m²

**Cost**

20.000 USD

**Impact**

370 children and young adults

# The Parque Bambú is a play space for the indigenous community of the Nomatsiguenga, located in the rural area of the Central Jungle of Peru. The project originated with the intent to offer boys and girls a space to play freely and explore nature.

## CONTEXT

Currently, Peru is renewing the school curriculum and a new pedagogical commitment that includes an understanding of the environment as an important part of the educational curriculum, where open spaces and movement are part of the qualitative and equitable educational process. This implies a challenge in revolutionizing the way architecture has traditionally been built in Peru. For example, schools and their playgrounds are traditionally surrounded by high walls, without many recreational options. This is the case of the Jerusalem de Miñaro primary school, a community in which Bamboo Park was developed, a recreational space for the indigenous community of Nomatsiguenga in Jerusalem de Miñaro, located in the district of Pangoa, a rural area of the Central Jungle of Peru.

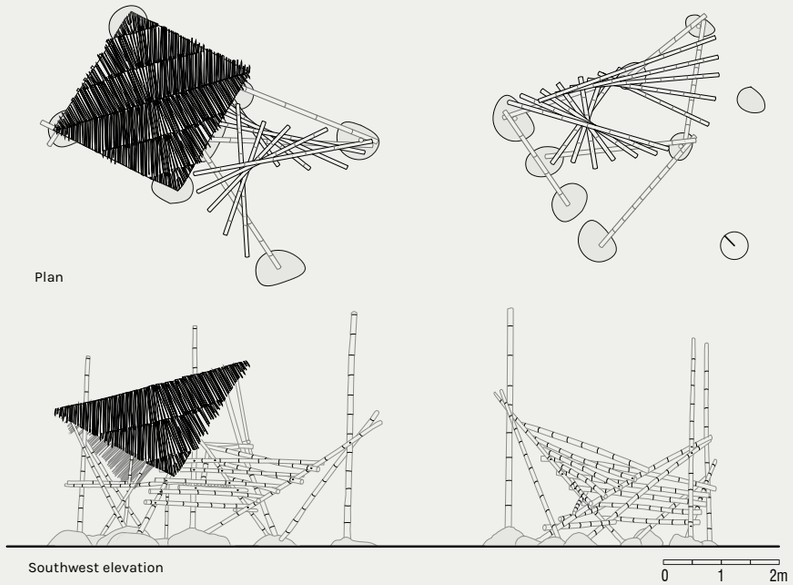







↑ Bamboo Park: Axonometric of Site

↓ Above: Ground Floor Plan
Abajo: Southwest Elevation



## VISION

Bamboo Park originated as a response to the need for children to play freely in a space that reflects their way of exploring nature while encouraging experimentation and belonging. The project was developed in parallel with the construction of the Jerusalem de Miñaro Primary School, seeking to complement the educational infrastructure with an open play space that served as a social catalyst for the community. The design of the park was based on investigating and reimagining the customs and typical games of the community.

Bamboo Park is made up of two modules. In both, the vertical canes are intended to recall the native game of "slippery stick," a competition of climbing a vertical log. The bamboo canes that join the vertical poles diagonally reinforce the structure and tie it together, forming twisted spiral "multipurpose stairs" that can function as slides, ocean waves, mountains, or whatever the children imagine. With the same design rules and structural system, the second module is characterized by three platforms that provide shaded spaces for children.

## ENVIRONMENTAL AND SOCIAL BENEFITS

The project goes beyond the design and construction of the park, seeking to promote the use of bamboo and sowing the seeds of best practices and confidence in its use for its multiple benefits including rapid growth, carbon sequestration, antimicrobial properties, and a high strength-to-weight ratio. For this reason, bamboo training and educational workshops were implemented to foster its proper cultivation, care, and harvesting in the various contexts of construction, cosmetics, decoration and food. The project also managed to put the forgotten territory of the jungle on the map, elevate the voices of the neglected community, and impact the educational experience. Both the school and its public spaces are used throughout the day, as teachers use the park to teach classes outdoors, and the school is not restricted to a window of time like a traditional educational infrastructure. The public space is open all day so that children, parents, and the greater community can use the common and public spaces freely.





## CONSTRUCTION AND IMPLEMENTATION PROCESS

The creation of the park was carried out through a participatory process of debate and reflection with the community, understanding the potential of education and educational spaces as sites for developing skills and promoting citizenship.

Respecting these principles, three stages of the project were developed:

1st stage – Workshop: While the construction of the school advanced during the months of February and March 2017, a summer workshop was held with the students at the school, with five sessions of group work. Through different tools, such as collective mapping and free play, the design of

Bamboo Park
Photo: Alejandra Orosco

the park was defined, mining the imagination of the children, analyzing the community context, and generating the foundation for a co-creation process.

2nd stage – Seminar: The park materials include bamboo cane, palmiche leaves for the roof, and the bark of the sacha huasca tree as ties. For the foundation, in-situ stones were used, from which the bamboo was spliced. A training seminar was organized with the advice of technicians and the participation of the community, where knowledge on the care and use of bamboo was shared. In addition, under the guidance of the technicians, 100 bamboo canes were planted.

3rd stage – Design and Construction Workshop: Conducted in the community from April 29 to May 6, 2017, the workshop helped define and construct the playground. Both the theoretical workshops, from which the design of the park was developed, and its construction, guided by bamboo professionals, were the result of a collective process in which students, specialists, and the community participated.

## COSTS AND MAINTENANCE

The project was financed through fundraising, and the design and construction were developed with the participation of students, architects, technicians, families, and children. Community participation at all stages of the project generated a strong sense of belonging, establishing the foundations for the future operation and care of the Park. 100 bamboo plants were planted, which made it possible maintain the park and replace deteriorated canes over time. In addition, the park is part of the educational institution of the Jerusalem de Miñaro primary school and receives financial support for its maintenance.

**4 local materials: bamboo cane, palmiche leaves, tree bark, and stones for cement aggregate.**

**100 new bamboo species planted.**







Bamboo Park
Photos: Alejandra Orosco

## BAMBOO PARK





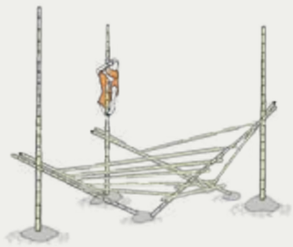



## BAMBOO STRUCTURES

**1. SLIDING POLE:** This game consists of a 5- to 6-meter buried pole. The pole is lathered and must be climbed to reach the prize at its top. This is an ancestral game of the indigenous community, which is played in teams and in competition. This is the departure point for the entirety of the design proposal.

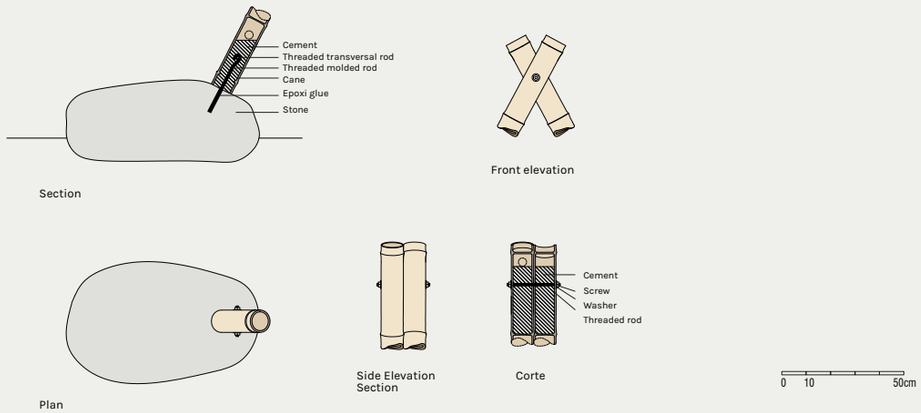
**2.** The vertical poles reference the game of the sliding poles. With the goal of reinforcing the structure, the poles are connected through diagonal bamboo canes, interconnecting the entirety of the structure.

**4.** The circuit of games consists of two modules: the three-point module, closest to the school, has been developed at ground level, and "multi-purpose stairs" invite children to climb, hang, slide, and move. The second module, closer to the soccer field, is characterized by three elevated platforms and shade canopies where children can rest, chat, and dream.



**3.** The diagonal supports aren't sufficient to create a solid and resistant structure. The problem has been resolved through bamboo canes that connect the diagonals of each column to each other and are knotted together. These braces convert the structures into a system that serves as a game: "multi-purpose stairs" in a twisted spiral.

## CONSTRUCTION DETAILS



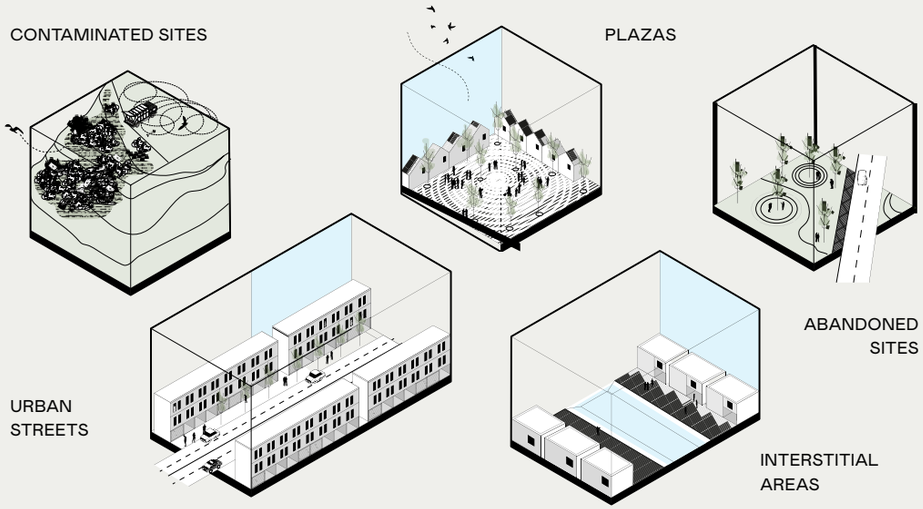

Bamboo structure and construction details

# 2

# ADAPT AND CONNECT

Adapting to climate change means its impacts in terms of people's vuln to current climate variability and fu changes in climate. It requires alteri behavior, practices, systems, and, in cases, way of life to protect our fa economy, and the environment in w live. How do we design and plan publ and communities that are resilient effects of climate change?

INTERVENTION AREAS → WHERE




ACTIVITIES → WHAT

Sports | Park | Playgrounds | Cultural Centers

ACTORS → WHO

Local government | Civil society | Non-profit organizations | International bank

BENEFITS → WHY

Promote healthy lifestyles | Clean contaminated soil | Recycle waste | Stabilize neighborhoods | Improve connections to adjacent areas | Promote new types of social life

MEANS AND MEHTODS → HOW

**RECYCLE** —— Reclassification of abandoned and contaminated sites and waste recycling through installations constructed with the community.





PROJECT 2.1

# Plaza la Cruz, La Palomera

## Site

La Palomera, Baruta Municipality, Caracas, Venezuela.

## Years

2016 - 2017

## Team

Urbam EAFIT, Mayor of Medellín, French Agency of Development and Department of Urban Development

## Coordinates

10°25'53.41"N
66°52'35.67"W

PROJECT

## Elevation

1.014 - 1.116 m

## Climate

Subtropical

## Area

137.04 m²

## Impact

9.710 people

**What had once been an open-air landfill for more than thirty years was converted into a public space. La Plaza La Cruz motivated the community to adopt a change in their behavior with regard to waste management.**

## CONTEXT

La Palomera is an informal settlement located on a hill to the South of the colonial town of Baruta. The community was founded in 1937, when the first houses were built in the settlement. The urban fabric of Baruta is a uniform square grid, and, although it originally formed as a separate town from Caracas, it was incorporated by the urban sprawl of the capital. The town grew and spread over 16 hectares. The houses progressively grew in height to between two and four stories, making La Palomera a dense urban area in the city.

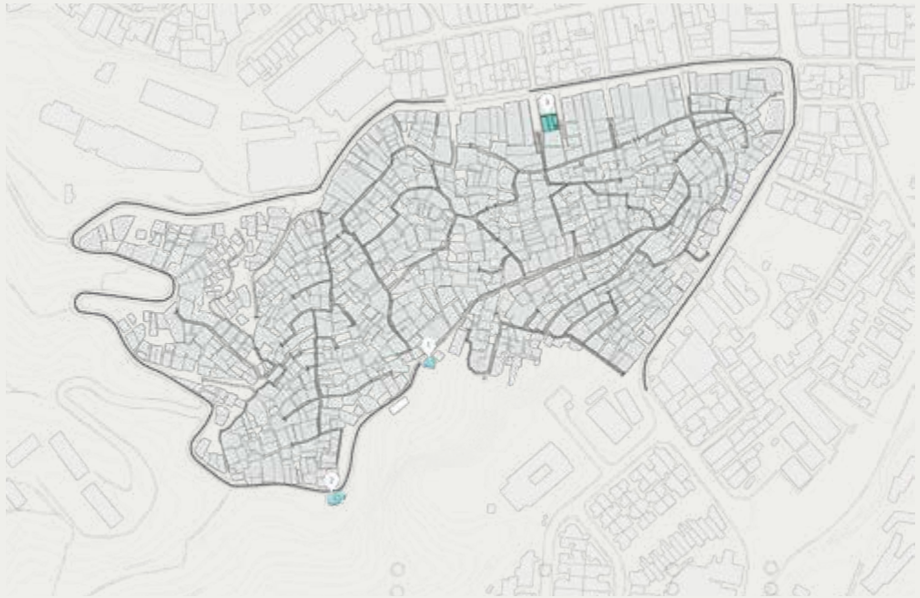






↑ Plaza de la Cruz - La Palomera

↓ General Plan of La Palomera: Waste recollection routes
References:
1. Plaza La Cruz
2. Plaza Las Brisas
3. Casa de Todos



The environmental risks that affect La Palomera originate from houses built precariously on unstable slopes, often without adequate foundations. The improvised collection of wastewater is severely flawed and allows the water to infiltrate the ground, causing landslides in the rainy season. Waste management was also a problematic issue that has seen substantial improvement with the implementation of a comprehensive door-to-door collection project, the transformation of clandestine open-air landfills and incorporation of garbage containers into parks and plazas. In fact, the conversion of Plaza La Cruz was the first change that motivated the community to adopt a different behavior regarding waste management.

## VISION

A new public plaza in La Palomera was built through an educational program called Sembrando Ciudad, City Planting, sponsored by Citibank and Fudep. The City Planting program motivates neighbors to reflect on their surroundings and imagine how public spaces can serve as a strategy for urban transformation. The project stems from a belief that public space has the potential to define the identity of a place and promote experiences that leverage social cohesion in neighborhoods where acute inequities manifest themselves in places fraught with violence, social exclusion, unemployment, and a low quality of life. In La Palomera, educational workshops were organized over several months and included people of all ages, with conversations focused on the role of public space in the community. The community selected what had been a clandestine landfill for more than 30 years and transformed it into a new and dynamic public space that overlooks the city.

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The plaza design process incorporated several activities to encourage community participation. During the initial phase, dynamics such as trivia and memory in terms of content about plazas and





playgrounds were played with children and neighbors as an excuse to talk about the value and opportunities that public space could create for them. The community also worked together with the municipality to organize a new waste management system to ensure that the space was no longer used as a dump. In addition, all rubble and waste was removed with the support of the community and the Municipality of Baruta. The space itself was designed jointly between Enlace Arquitectura and the community. During the construction phase, specific elements were designed so that children from the nearby school could also create paving patterns with recycled plastic bottle caps. Several areas were set aside so that neighbors could plant vegetation, and the community participated in the construction of a wooden bench made of scraps of painted palettes. Additional contributions included volunteer college students, a local carpenter, and local laborers.

Project Plan
Plaza de la Cruz

## ENVIRONMENTAL AND SOCIAL BENEFITS

The plaza has been adopted by the residents as a place that contributes positively to their well-being, but also functions as a generator of open dialogues between the neighborhood and the rest of the city. La Palomera and Baruta share numerous daily dynamics: the children of La Palomera attend schools in Baruta; the Paloma residents depend on services and goods they buy in Baruta, and from there they access transportation routes that go to other parts of Caracas. The relationship occurs mainly in one direction with little reason for Baruteños or people from other parts of the city to go up to La Palomera. The creation of quality public space presents a strategy to create destinations within La Palomera that may interest external visitors. In addition, the project established participatory processes and a new waste management system that serves the entire neighborhood. This leaves a future legacy, ensuring that waste will not be dumped into public spaces.

## COSTS AND MAINTENANCE

Each year, six communities participate and compete to build a larger public space, and the winning project is executed. Although La Palomera did not win the contest, the modest plaza that exists today stands as a reminder of the initial educational intervention of the program designed through educational workshops with the communities.

**1 landfill cleaned and reclaimed.**

**7 new waste collection routes in the neighborhood.**

**1 urban plaza.**

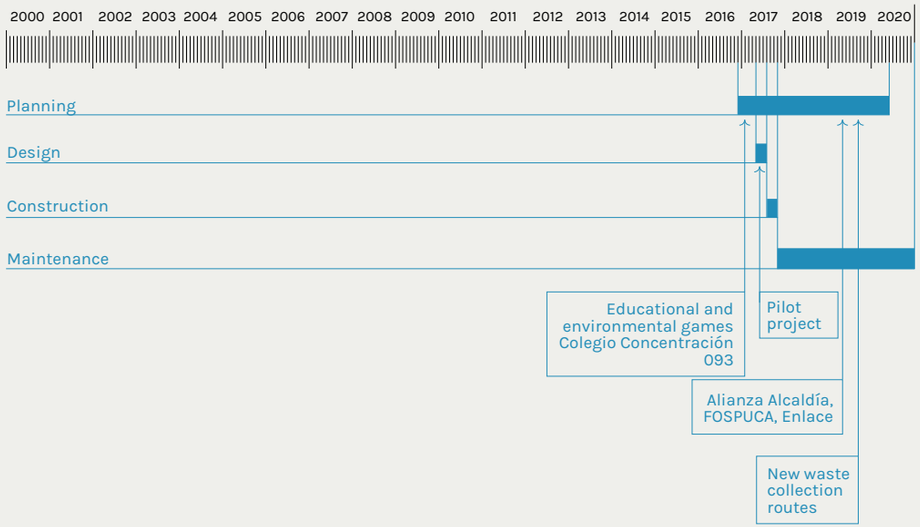






↑ Plaza de la Cruz

→ Wood bench assembly with pallets painted by children




Door-to door waste collection system in la Palomera

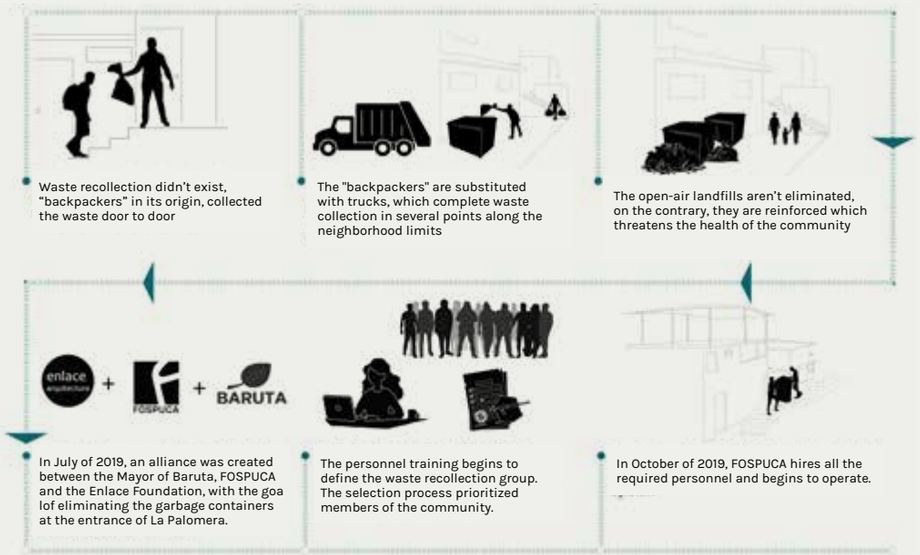




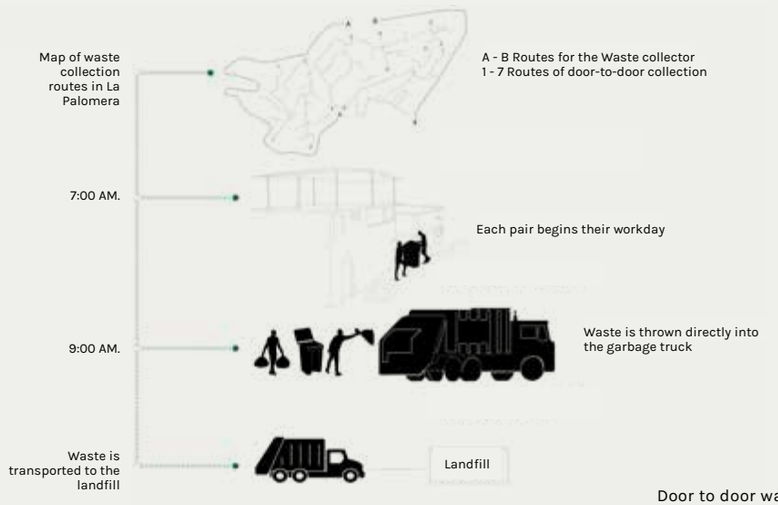




## FUNCIONAMIENTO DEL SISTEMA DE RECOLECCIÓN DE DESECHOS EN LA HISTORIA

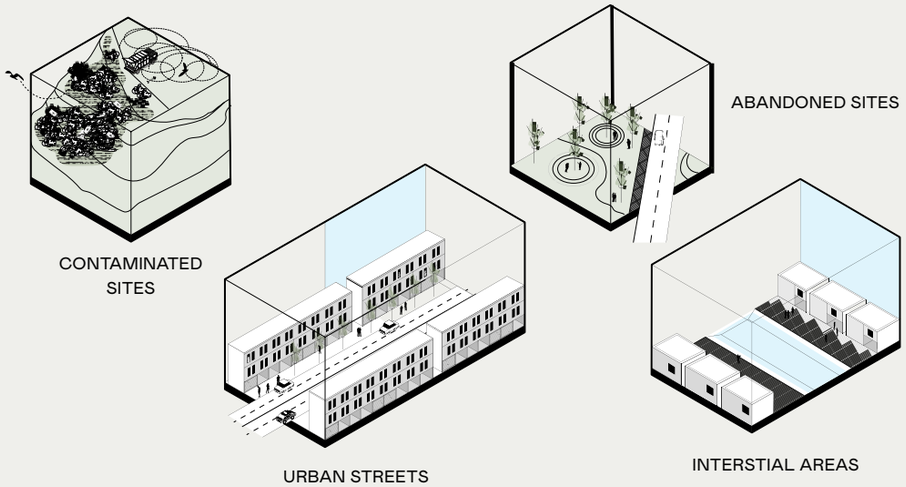



## CURRENT WASTE RECOLLECTION SYSTEM




Door to door waste collection system at La Palomera

AREAS OF INTERVENTION → WHERE




ACTIVITIES → WHAT

Wetland · Trail · Plaza · Park

ACTORS → WHO

Local government · Regional government

ALCANCES → POR QUÉ

Improve connections to adjacent areas · Promote healthy lifestyles · Reduce crime · Reclaim contaminated soil · Stabilize neighborhoods · Promote new types of social life

MEANS AND METHODS → HOW

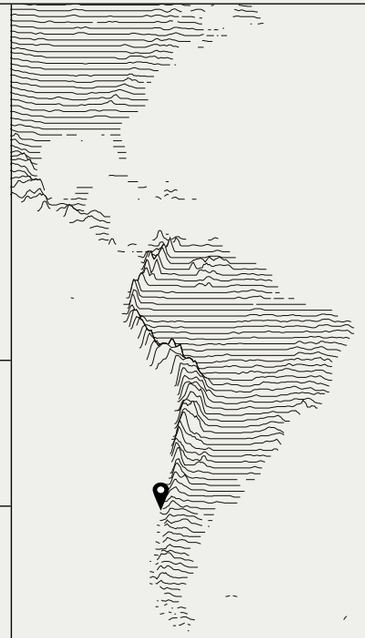
**HEAL** —— Recycling and transformation of a contaminated industrial site in a vulnerable area of the city into a metropolitan riverine park.





PROJECT 2.2

# Parque Fluvial de la Familia



### Site

Santiago, Chile.

### Years

2010 - 2015

### Team

Cristián Boza Diaz, Cristián Boza Wilson, Diego Labbé Pinto, Eduardo Ruiz-Risueño, Michel Carles Tapia.

### Coordinates

33°25′28.03″S
70°40′44.72″W

PROJECT

**Elevation**

526 m

**Climate**

Template

**Superficie**

20 ha

**Cost**

21.000.000 USD

**Impact**

-

# Rehabilitating a degraded industrial area through a series of locks provides a robust flood control measure and resolves all its technical challenges while creating a continuous park for low-income communities in the western area of Santiago.

## CONTEXT

The idea of a riverine park in Santiago arose in 2001 with the main objective of recovering the banks of the Mapocho River through the implementation of pneumatic locks along 34km. The original intent was to generate various points of development along the route, establishing the idea of a navigable river.

These ideas materialized in the creation of the Parque Fluvial de la Familia, which was inaugurated in 2015. The project area consists of a 20-hectare vacant lot and public land facing the river, in which four neighborhoods converge (Quinta Normal, Renca, Santiago, and Independencia), green and public spaces are scarce, and major deficiencies in terms ofrecreational, sports, and landscape areas exist.[1]

**1.** Architectural Design, "Parque de la Familia de Boza Arquitectos | Diseño Arquitectura" https://www.disenoarquitectura.cl/parque-de-la-familia-ex-parque-fluvial-renato-poblete-de-boza-arquitectos/







↑ Parque Fluvial de la Familia
Fotografía: Felipe Díaz Contardo

↓ Planta

## VISION

An urban intervention of public space was proposed in the western sector of Santiago with multifunctional green areas to provide citizens with a meeting, recreational, and leisurely place. The goal of the project was to recover and enhance the banks of the Mapocho River through the reclamation of a degraded industrial zone.

The park program is divided into two sectors: El Brazo de Río and Paseo Cauce. The first corresponds to the partial and controlled diversion of the Mapocho that generates an area of calm waters suitable for kayaking and aquatic recreational activities. El Cauce, on the other hand, located on the bed of the Mapocho River, is a park area with green areas accessible to the public and bodies of water created by inflatable dams.[2] The park is made up of a series of triangulated green slopes, with pedestrian paths and dry concrete plazas.

**2.** BIT Magazine. (2015). *Parque Fluvial Renato Poblete.* Oasis en la Ciudad.









## CONSTRUCTION AND IMPLEMENTATION PROCESS

The works began with the excavation to generate the river arm, where nearly 380,000m3 of earth was removed.[3] A percentage of the material was used as fill in the formation of the embankments, creating an artificial urban topography by introducing a series of hills with inclined planes that would later be covered with vegetation.

The project presented several construction challenges. The lagoon was created by lining its bottom with a geomembrane with a surface area of 35,000m², anchored at its edge to the concrete walls that gives it its shape.[4] On the other hand, to divert water to the park, the original channel has three collapsible pneumatic locks that accumulate water to achieve the required level inside.

The selection of vegetation included the planting of mostly native species, which consume less water than exotic ones. For the inclined planes, different creeping plants were used to stabilize the land, most of which have low water consumption, are evergreen and have a long flowering period.[5] The planting of trees and the introduction of new specimens was also carried out, with a variety of shaded areas composed of different fruit, exotic, and native species.

**3.** Ibid..

**4.** Ibid.

**5.** Ladera Sur. 2015. "*Parque Fluvial Renato Poblete*". https://laderasur.com/mas/parque-renato-poblete-entrevista-al-arquitecto

Parque Fluvial de la Familia Sección

## ENVIRONMENTAL AND SOCIAL BENEFITS

The park has three main benefits:
First, a series of locks to control flooding and regulate its flow was implemented, and a unique park was created for low-income communities in the western area of Santiago. The design and execution of the park was not a position of scarcity but from one of efficiency, rehabilitating a degraded industrial area and contributing to the mitigation of urban prejudices.

Second, the park works at the scale of the city, recovering the view of the river from the riverbank, and visually and physically connecting the adjacent neighborhoods. In other words, an abandoned dump was converted to consolidate the area as a place of recreation and public use around the water. From the riverine and bike paths, one can see the Mapocho basin, its relationship with Cerro Renca, and the axis that forms all the way to the Cordillera. The embanked retaining wall allows proximity to the channelized riverbed, and the park behaves as a riverine meander, diverting water and irrigating its vegetation.

Third, the park integrates contemporary forms and practices, such as the manipulation of the terrain in an instrumental way for the functionality of the park, the integration of infrastructures in the landscape, and the coexistence of plant species that are not only decorative, but also productive and resilient.

**20ha of floodable park.**

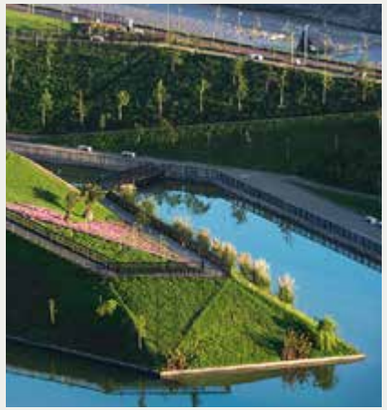
**380,000m$^3$ of earth removed.**

**3 pneumatic collapsible locks.**

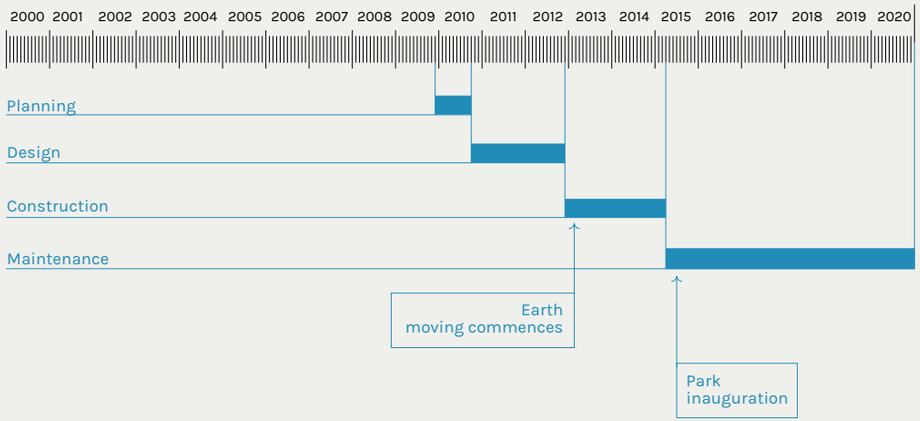








Parque Fluvial de la Familia
Photos: Felipe Díaz Contardo




**Native evergreen species with low water requirements and long bloom periods were featured in the planting palette.**

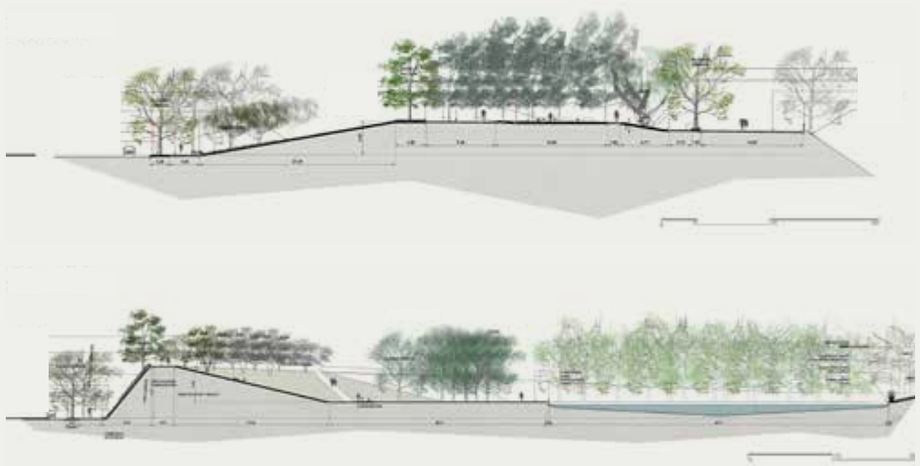
Parque Fluvial de la Familia
Photo: Felipe Díaz Contardo





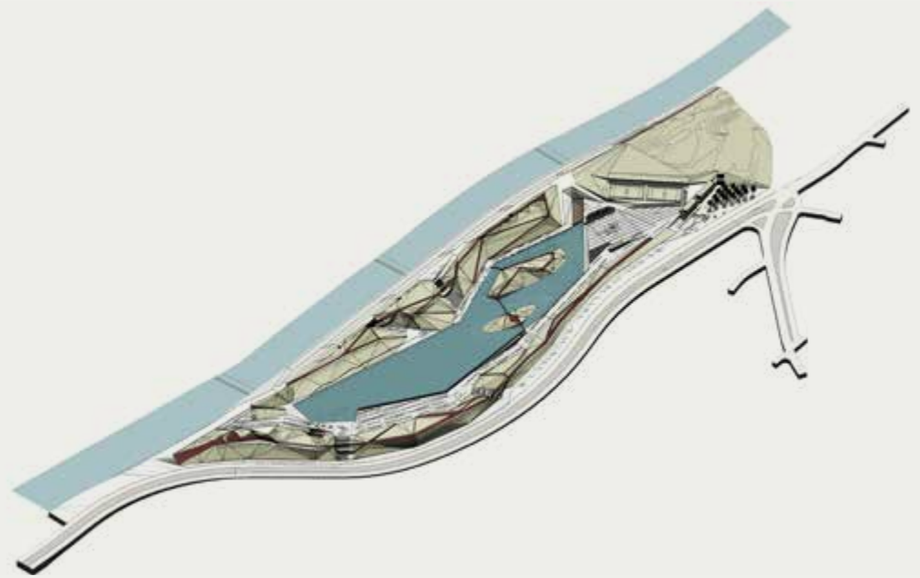




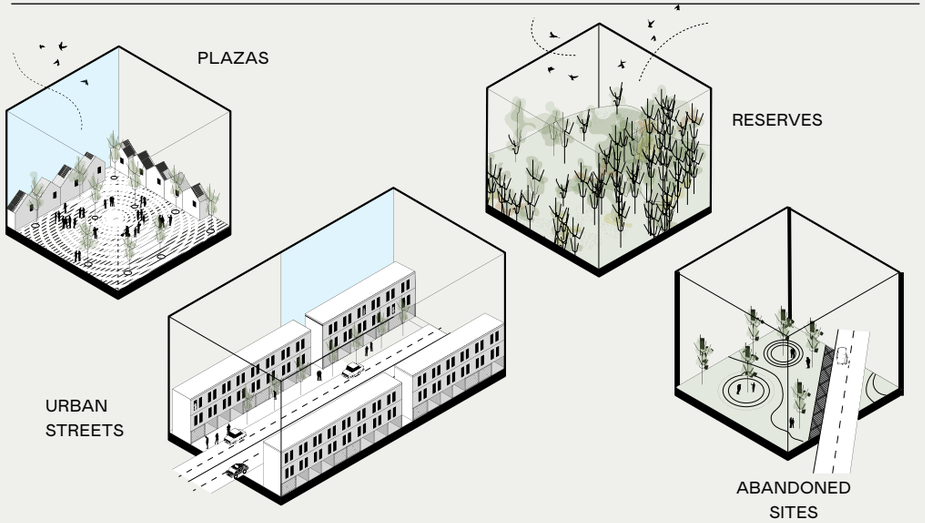


↑ Sections

↓ Axonometric Riverine Park



AREAS OF INTERVENTION → WHERE




ACTIVITIES → WHAT

Wetland · Trails · Playgrounds · Urban Forest · Market · Park

ACTORS → WHO

Empresa privada · Academia · Local government

ALCANCES → POR QUÉ

Promote healthy lifestyles · Provide accessibility to potable water · Manage and clean stormwater · Reduce heat island effect · Stabilize neighborhoods · Reduce crime · Promote new types of social life

MEANS AND METHODS → HOW

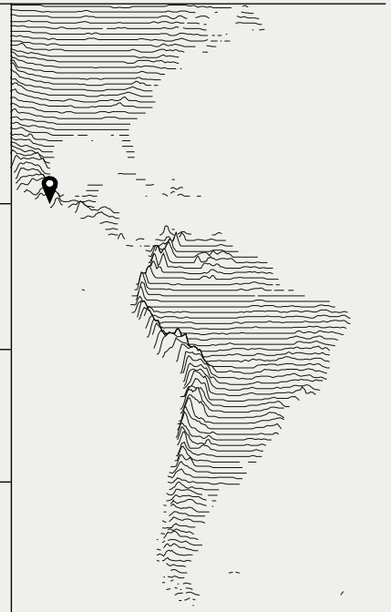
**RESTORE** —— A hydrologic park generating new water management and redistribution system for marginal neighborhoods.





PROYECTO 2.3

# Parque Hídrico la Quebradora



## Site

Iztapalapa, Ciudad de México.

## Years

2013 - 2020

## Team

Taller Capital + UNAM. Con colaboración de Facultad de Arquitectura y Facultad de Química. General coordination: Manuel Perló Cohen, Loreta Castro-Reguera; Proyecto Conceptual: Taller Capital; Project Management: Yvonne Labiaga Peschard; Urban Design: Elena Tudela Rivadeneyra; Arquitectural Design: Julián Arroyo Cetto; Landscape Design: Gustavo Rojas Paredes y Ana María Yumbe Guevara; Director of Social Participation: Oscar Torrentera Miranda; Workshop Leader: Jetro Centeno Lara; Civil and Hydrolic Engineer: Victor Luna Pabello, Fernando Gómez, Jorge Compeán, José Antonio Poncelis; Construction Support: Ing. Elvira León Plata, Ing. Juvenal Carballido.

## Coordinates

19°20′41.82″N
99°01′09.01″W

PROJECT

**Elevation**

2.253 m

**Climate**

Temperate subhumid

**Area**

4 ha

**Cost**

1.500.000 USD

**Impact**

28.000 people

**Mexico City lives in a paradoxical condition: every year it is flooded due to rains, but the population does not have access to drinking water. The design of the Parque Hídrico la Quebradora proposes a selfsufficient system, a new era in water management.**

## CONTEXT

Mexico City is arguably the city that has undergone one of the most drastic transformations of its natural context, in what was originally an endorheic basin that stored a lacustrine system of more than 1,100 km2. Over the last 400 years, the water has been absorbed by urban sprawl, leaving less than 50km2 of water bodies. This mutation has caused four major problems related to water management: lack of drinking water, floods, differential subsidence, and reduced aquifer recharge. The entire traditional hydraulic system of the Metropolitan Area of the Valley of Mexico, dependent on tubes and pumps, works at the limit of its capacity. Therefore, there is a need to implement an alternate water system that is decentralized, sustainable, and considersthe natural context and the form of the city as a fundamental part of its structure.







↑ Parque Hídrico Quebradora
Photo: Aldo Díaz

↓ Parque Hídrico Quebradora
Design Proposal

With a population of 1,800,000 inhabitants, Iztapalapa is one of the largest and most densely populated municipalities in Mexico City and suffers from daily water problems. The infrastructure responsible for infiltrating water is insufficient when it comes to managing excess rainfall, and instead there is a lack of drinking water throughout the year. In 2015, an investigation was carried out by the Institute of Social Research of the UNAM, on different water management systems utilizing public space in Iztapalapa. The resultant project, titled Hydrourban Acupunctures, derived the Hydrological Park la Quebradora.

## VISION

The park was conceived as a pilot project that seeks to contribute to resolving the water management problem. Located at the limits of the political boundary of the city on the slopes of the Sierra Santa Catarina, the proposal introduces a unique contemporary water landscape. The project aims to reconfigure the hydraulic system by capturing stormwater runoff from adjacent avenues, directing it to an infiltration basin in the ground to reduce urban flooding in the area. In addition, the new infrastructure system treats wastewater through a hybrid system consisting of a wastewater treatment plant and a wetland that helps filter it. The resultant water is then used to maintain the park, and its surplus is redistributed in the surrounding areas. Additionally, the park harvests and filters rainwater for human consumption.

La Quebradora introduces a four-hectare public space that opens up areas to cultural, sports, and recreational programs and accompanies the hydrological functions performed by the site. The land is structured through a system of platforms, stepped plazas, and paths and deviates from the traditional strategy of concealing the hydrological processes used throughout Mesoamerica when approaching the landscape.

**4 hectares of public space and hydrological infrastructure.**

**The area tripled its original urban canopy, introducing endemic species.**



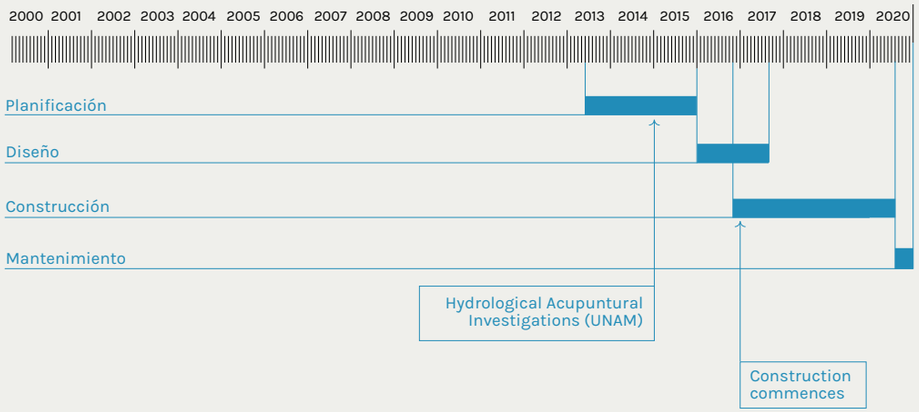




Parque Hídrico Quebradora
Photos: Aldo Diaz y Guillermo Mendia

## ENVIRONMENTAL AND SOCIAL BENEFITS

The project redefines traditional water management systems of cities and demonstrates the potential of hybridizing open spaces as infiltration sponges with water treatment and reuse systems. In addition, the project triples the original number of trees on the site, introducing endemic and/or highly adapted species to the ecosystem of the Basin of Mexico. La Quebradora positively impacts the lives of 28,000 people living in informal settlements within a radius of 700 meters. The park opens its borders to the neighborhood through a network of trails and a strategy that seeks to offer security. It proposes renewing the paradigms that govern the definition of public space beyond its function and aesthetics, serving as a hydrological and educational infrastructure responsible for managing and reintroducing the image of water within the city.








## CONSTRUCTION PROCESS AND IMPLEMENTATION

Construction of the park began at the pause in construction in 2018 due to a the interest from the new authorities and community were important components Following a review process, the final began in July 2019.[1] Although the original was modified, the essence of the original UNAM remained in the finished work.

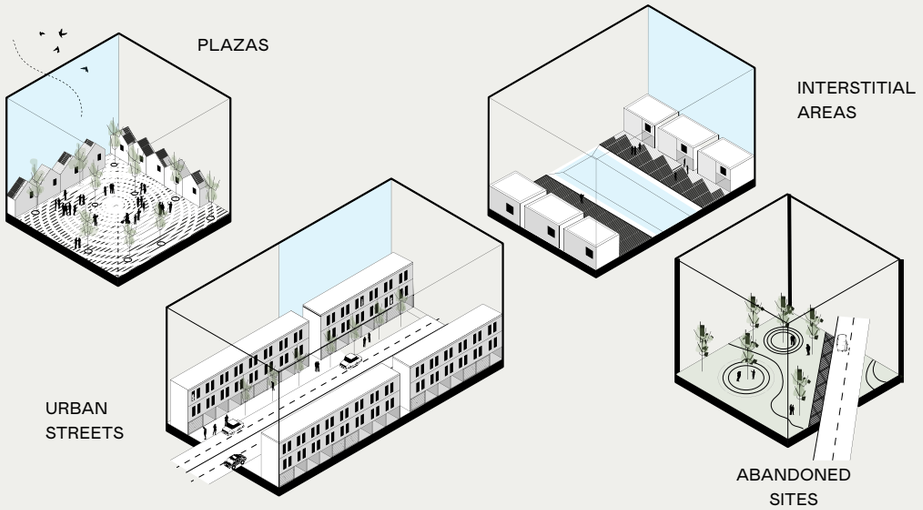
1. "Diseñar sobre el suelo húmedo: La Quebradora en la Ciudad de México", Arquine (blog), https://www.arquine.com/disenar-sobre-el-suelo-humedo-la-quebradora-en-la-ciudad-de-mexico/

## COSTS AND MAINTENANCE

The construction cost of the park was project is one of the first soft and infrastructures in the city, setting a new urban and landscape design considerations of water management Quebradora initiated a group of hydro-and opened the door to considering public infrastructures that have the capacity environmental, social, urban, cultural, services.

Parque Hídrico Quebradora
Photo: Aldo Díaz

## AREAS OF INTERVENTION → WHERE




## ACTIVITIES → WHAT

- Plaza
- Sports Fields
- Playground
- Bike lanes
- Park

## ACTORS → WHO

- Civil society
- Academia
- Local government
- Regional government

## ALCANCES → POR QUÉ

- Promote healthy lifestyles
- Stabilize neighborhoods
- Promote new types of social life
- Improve connections to adjacent areas
- Recycle waste
- Increase the productivity of abandoned sites
- Create jobs

## MEANS AND METHODS → HOW

**INTEGRATE** —— Transformation and connection of a neighborhood through an integrated plan of infrastructure, public space and habitat improvement.





PROJECT 2.4

# Proyecto de Integración Social y Urbana del Barrio Padre Carlos Mugica – Barrio 31 - 31 bis

### Site

Buenos Aires, Argentina

### Years

2015 - Present

### Team

Secretary of Social and Urban Integration, Ministerio de Desarrollo Humano y Hábitat, Government of the City of Buenos Aires.

Support from the Inter-American Development Bank

Support from the World Bank.

### Coordinates

34°34′58.89″N
58°22′55.92″W

## PROJECT

### Elevation

0 - 5 m

### Climate

Temperate Humid

### Area

72 hectares

### Cost

+18 million USD

### Impact

+50,000 inhabitants

**The project increased the permeable area, urban canopy, and area of public space per inhabitant. A sustainable program of waste management was also implemented.**



## CONTEXT

The history of Barrio 31 dates to 1930, when immigrants and workers began to populate the area, taking advantage of its proximity to the port of Buenos Aires. The neighborhood was populated spontaneously until it reached its current dimensions. Barrio 31 is in a strategic location, a few blocks from the financial center, from the most exclusive neighborhoods of Buenos Aires, and a few meters from the main bus station. However, it presents various barriers of exclusion and segregation: road infrastructure, train tracks, and a highway that physically separate it from the rest of the city. In addition, one of every two inhabitants receives informal wages, and only 1 of 4 people have access to health coverage. The neighborhood, which densified without a vision toward the future, had few green and public spaces, an average of 1.7m$^2$ of public space per inhabitant.






↑ Map of the plazas and public space improvements.
Secretary of Social and Urban Integration.
Government of the City of Buenos Aires

↓ Aerial View of Sports Fields
Photo: Secretary of Social and Urban Integration.
Government of the City of Buenos Aires

↑ Participatory Workshops with the neighbors

↓ Public Space "Towers and Pencils"

Photos: Secretary of Social and Urban Integration.
Government of the City of Buenos Aires









## VISION

**26 public spaces totaling more than 52,000m2 were built and retrofitted, adding 3,300m2 of green space to the neighborhood.**

The Social and Urban Integration Plan for Barrio 31, which is being carried out by the Government of the City of Buenos Aires, aims to improve quality of life and reduce existing separation from the rest of the city.

The goals of the project are as integration, connecting the neighborhood city through a comprehensive infrastructure public spaces; second, habitat improvement, legalization of the neighborhood, improvement conditions in both existing homes and homes; third, prioritizing the economic neighborhood, placing value on the resources that it can offer to the entire social integration, through new educational institutions and centers.

## ENVIRONMENTAL AND SOCIAL BENEFITS

The project has a direct impact within the bis, in addition to an indirect impact on opens up a unique opportunity to transform adjacent urban area. From an environmental permeable surfaces, trees, and the area inhabitant increased. Twenty-six public 52,000m2 were built and refurbished, 3,300m2 of green space in courts, plazas, Today, an 75% increase in residents make highlighting the impact of new public spaces, the common spaces below the highway. currently under construction after the with large housing deficits were neighborhood.

In addition, the project promotes sustainable mobility systems based on the construction of bicycle paths and the incorporation of stations with shared bicycle services (Eco-Bike). Electricity consumption was reduced by installing LED.

A sustainable management program of garbage collection was also designed based on a recycling network that raised awareness for the need to separate waste at the source into three streams. The program (To All Recycling) also has a direct social impact since it generates respectable employment for cooperatives made up of neighborhood residents. Today, 60% of households are part of the program, and there are eleven collection cooperatives.

The social benefits include improvement in access to rights, such as access to education and health services through the construction of new primary care centers and schools.

Training courses and alliances with the private sector were facilitated to insert the inhabitants of the neighborhood into the labor market; existing businesses were strengthened through support programs, and community networks and links were consolidated through citizen participation programs.

In addition, there are notable projects in the area that have yet to materialize that seek positive environmental and social impact, such as the construction of an elevated park over the existing layout of the Arturo Illia highway.

**60% of the homes are part of the Todo Reciclaje program.**

**11 waste collection companies.**

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The project was carried out from the beginning based on citizen participation, including the general population and representatives of the political system of the neighborhood at all levels. The interventions are based on acknowledgement and enhancement of what exists coupled with ongoing communication with the neighbors. A portion of the work was carried out by cooperatives made up of neighborhood residents. In fact, in tasks that were executed by construction companies, it was required from the competition phase that part of their personnel be made up of inhabitants of the neighborhood.





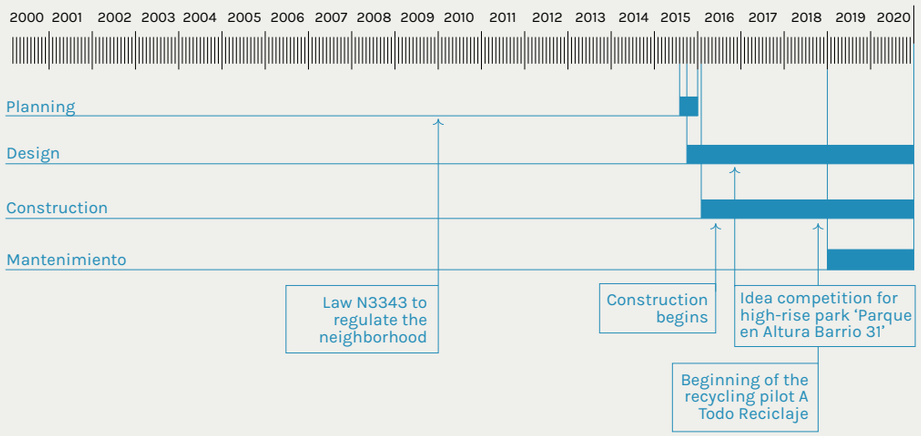



Cooperatives of waste recollection and recycling facilities. “A todo Reciclaje“ Program

Photos: Secretary of Social and Urban Integration, Government of the City of Buenos Aires

## COSTS AND MAINTENANCE

The costs associated with the comprehensive project are estimated at more than 18 million USD. The maintenance and sustainability of the project were aspects that were considered from the beginning, given that active engagement with the population was understaken to build awareness in the appropriation and care of interventions carried out. Concurrently, part of the services initially provided by the Social and Urban Integration Secretariat was transferred to different government agencies including the maintenance of public spaces, which is now the responsibility of the Ministry of Public Space and Urban Hygiene.



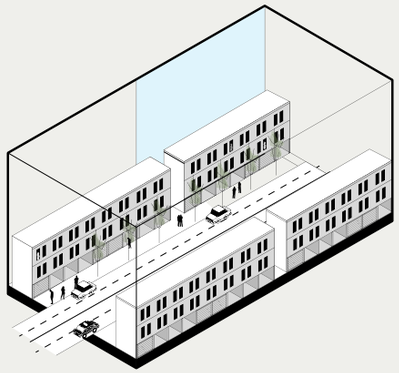




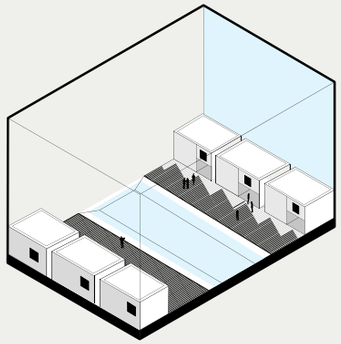



↑ Before
↓ After: Luján field

ÁREAS DE INTERVENCIÓN → DÓNDE



URBAN STREETS



INTERSTITIAL AREAS

ACTIVITIES → WHAT

Plaza

Fields

Playgrounds

Trails

Park

ACTORS → WHO

Civil Society

Non-governmental organization

BENEFITS → WHY

Research and testing of new ideas

Stabilize neighborhoods

MEANS AND METHODS → HOW

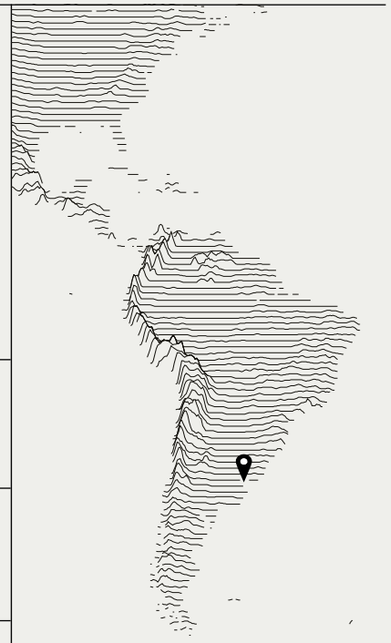
**VISUALIZE** —— Mapping of informal settlements for consciousness and integration to the city.





PROJECT 2.5

# Caminos de la Villa



### Site

Autonomous City of Buenos Aires, Argentina.

### Years

2014 - Present

### Team

Civil Association for Equality and Justice (ACIJ) and WINGU – nonprofit technology.

### Coordinates

N/A

PROJECT

### Elevation

N/A

### Climate

N/A

### Area

N/A

### Cost

N/A

### Impact

16 neighborhoods: 300,000 people

# Caminos de la Villa surged in response to the lack of informal settlements in official maps of the city. A participatory process of constructing detailed maps online of the settlements of the City of Buenos Aires was proposed.

## CONTEXT

10% of the population of the City of Buenos Aires lives in villas, informal settlements with inadequate housing that lack access to water and sanitation, electricity, fixed telephone lines, and a healthy environment, among other services. This situation of marginalization places them far from the formal economy and urban infrastructure. Caminos de la Villa arose as a response to the absence of these neighborhoods on the official maps of the city and the need to visualize the serious deficits in the provision of public services and urban infrastructure. Before this initiative, the villas appeared as voids on city maps, symbolically making these neighborhoods invisible, along with more than 300,000 inhabitants and the violations of rights that are experienced there. The lack of official representation of the villas has symbolic and material repercussions on their populations, which lack access to services and infrastructure and an official address.

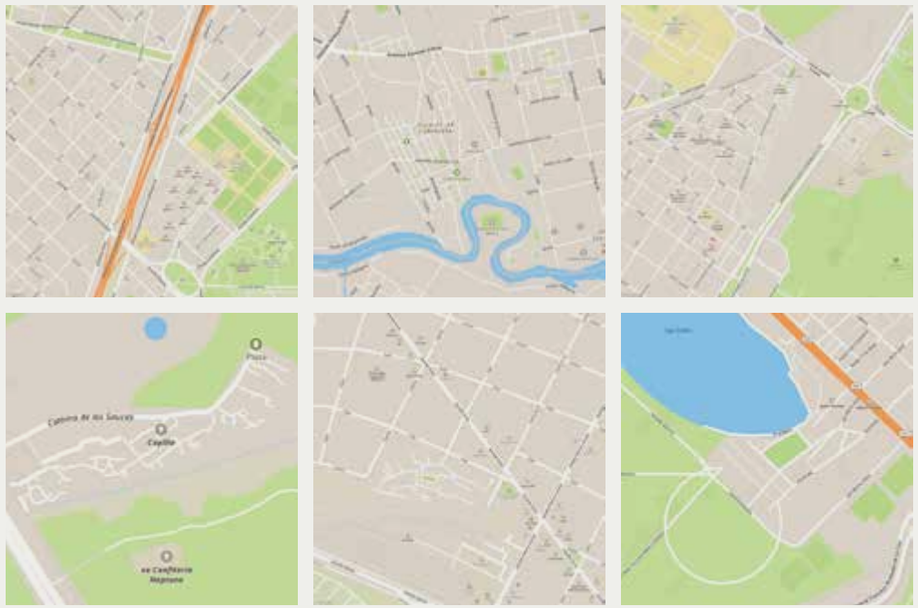






↑ Mapping process of Mapeo Colectivo

↓ Maps produced of the informal settlements of Buenos Aires, Villa 21-24, Villa 20, Rodrigo Bueno, Playón de Chacarita, Piletones



## VISION

The first version of Caminos de la Villa (2014) was proposed to achieve the participatory construction of detailed online maps of the villas of the City of Buenos Aires, where thenworks, public services, and their problems or improvements could be captured. The processes sought to strengthen collective strategies that promote urban integration through transparent developments that empower the neighbors to have access to information needed to monitor the fulfillment of their rights.

In 2017, the urbanization process in Villas 31, 20, Rodrigo Bueno, and Playón Chacarita, by the government of the City of Buenos Aires, began with ACIJ and Wingu adopting Caminos de la Villa and facilitating citizen participation to enable monitoring to guarantee that urbanization processes of social-urban integration could be executed effectively. Through the publication and georeferenced visualization of the proposed and in-progress works, neighbors could monitor how urban integration processes were being carried out, what type of public works were being prioritized, with status updates on budget and progress.

Concurrently, impact indicators based on the Agreement for the Urbanization of Villas facilitate a comparison of levels of progress, along with analyzing which goals have had the greatest or least number of results within each neighborhood. In addition, claims for problems with public services can be reported and inhabitants of the villas can add and visualize public and community spaces built within the neighborhood.

In 2020, recognizing that the villas of the City of Buenos Aires presented a great vulnerability made worse by COVID-19, a new version of Caminos de la Villa was realized, allowing those who live in villas and settlements to identify problematic areas within the neighborhood and useful places for emergency situations. It also facilitated the visualization of data on the progress of COVID-19 cases in the city's *villas*.





## ENVIRONMENTAL AND SOCIAL BENEFITS

The project incorporated the villas into the official maps of the City of Buenos Aires, reversing decades of symbolic omissions with serious effects on the daily life of these communities. This serves to advance public policies that allow reverse urban segregation and improves the quality of life of the inhabitants of the villas. On the other hand, the project enabled residents of the villas to appropriate new means for citizen participation (mapping, technological platforms, requests for access to public information). Caminos de la Villa was established as a tool for accessing information and citizen monitoring of public works in the villas including the visualization of violations of rights, key areas to address such violations, investment in public works, and the quality of urbanization processes in these territories. The initiative also provides free access to download the maps for the use of neighbors, institutions, and social organizations. This contributes to the use of cartography for different social initiatives that benefit the neighborhood: collaborative research through collective mapping, identification of key places, definition of routes to visit different houses in the neighborhood, etc.

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The design and implementation process of each of the versions of Caminos de la Villa can be summarized in the following stages:

**1.Coordinationwithneighborhoods:**Meetingswithneighborhood leaders and neighbors to design, present, and validate the tool.

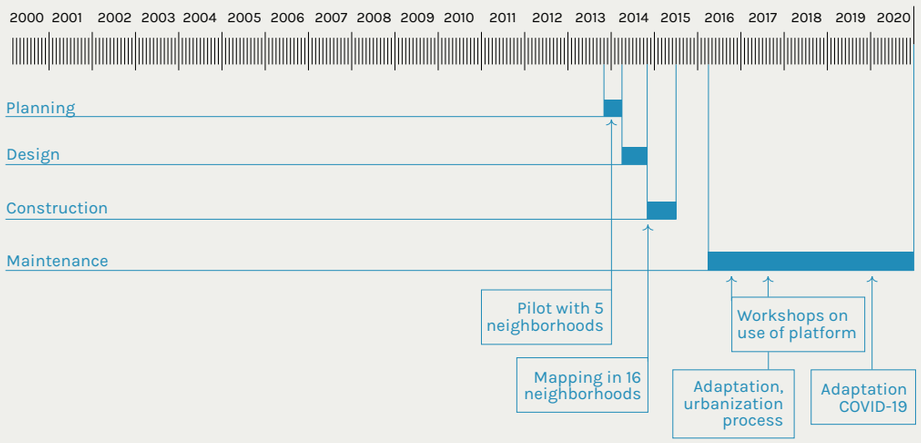
**2. Mapping:** GPS tour of all the internal passages together with members of the neighborhood, volunteer team, and geographers. The cartographic bases of Open Street Map were used to modify the existing information and add the generated file resulting from the route (".gpx"). Subsequently, the maps were validated with the neighbors to verify that no errors had been made in the transferring of data and that all the points of interest were captured (dining rooms, schools, community centers, soccer fields, health clincis, etc.).

Identifying these landmarks facilitates use of the map and is essential to building ownership of the map. The maps created in this stage were the basis for the following versions of Caminos.

**Sixteen neighborhoods mapped.**

**3. Publication:** Design of an interactive web platform for the use of the maps as a tool for citizen monitoring and visualization of conditions in the *villas*.

**4. Implementation:** Presentation of the platform for the neighborhoods, authorities, and the media. Official information is constantly reviewed, and requests for access to public information are made to update the data on the works that are being carried out in the *villas*.





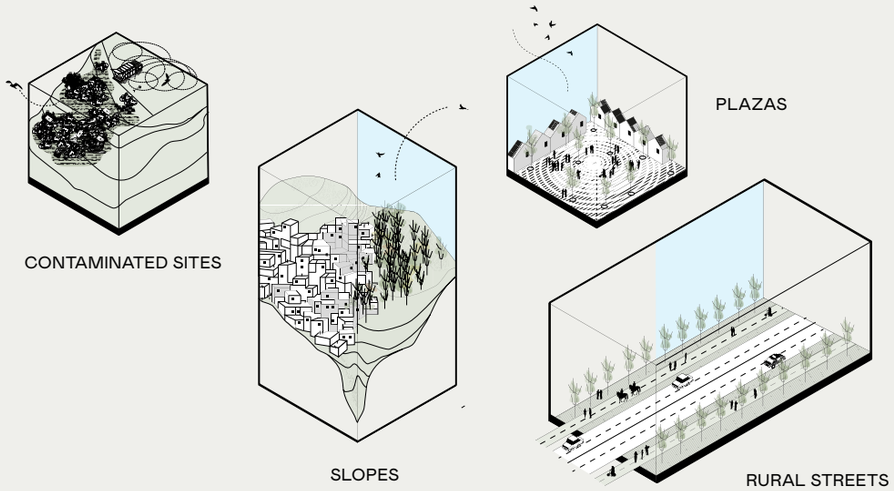






↑ Interactive web platform for viewing maps as a tool for citizen monitoring

AREAS OF INTERVENTION → WHERE




ACTIVITIES → WHAT

Plaza | Sports Fields | Playground | Trails | Park

ACTORS → WHO

Federal government | Local government | Academia

SCOPE → WHY

Reduce crime | Promote healthy lifestyles | Manage and clean stormwater | Promote new types of social life | Stabilize neighborhoods | Clean contaminated soil

MEANS AND METHODS → HOW

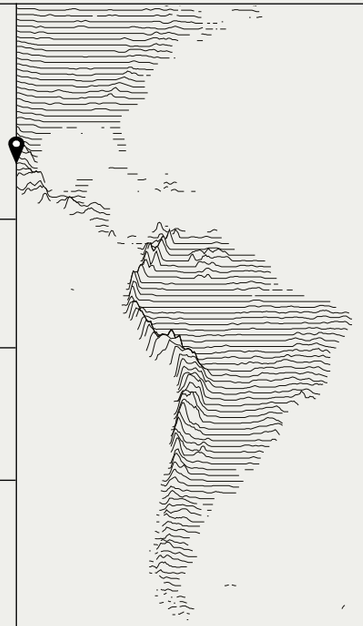
**EVACUATE** —— Reclassification of a disappearing riverbed through a redirection of water and creation of public space and sports area.





PROJECT 2.6

# Parque en el Arroyo Xicoténcatl



## Site

Tijuana, Baja California, México.

## Years

2019

## Team

**General coordination and design:** José Pablo Ambrosi y Loreta Castro Reguera. **Hydrological project:** Juan Ansberto Cruz. **Construction Documents:** Catalina Vega, Iván Rangel, Mariana Bobadilla, Alexis Escalante, Elizabeth López, Luis Iván Contreras, Oscar Torrentera. **Management:** Oscar Torrentera. **Structural Engineer:** Gerson Huerta, Grupo SAI. **Landscape Consultant:** Hugo Sánchez. Civil Engineering: Elvira León. **Installations:** José Arturo Martínez Acosta.

SEDATU - UNAM.

## Coordinates

32°28′48.44″N
117°04′03.03″W

PROJECT

## Elevation

208 - 180 m

## Climate

Dry

## Area

2,5 ha

## Cost

125 USD/m²

## Impact

6,200 inhabitants

**Through the streambed, the intervention links its parallel paths, while generating a series of platforms for public and sports programs, as well as channels to direct rainwater runoff.**



## CONTEXT

In April 2019, Taller Capital had the opportunity to bring together a team of specialists for the development and design of a project in Tijuana, Baja California, a city characterized as the hub of social conflicts that result in high rates of violence. The intervention is located in Col Xicoténcatl, on the stream of the same name, a space of 2.5ha, in the higher elevations of a hillside, in the heart of an informal settlement. The settlement has been populated over the last twenty years with homes that were initially built of wood and sheet metal, but today are mostly made of cement-sand blocks and concrete slabs.

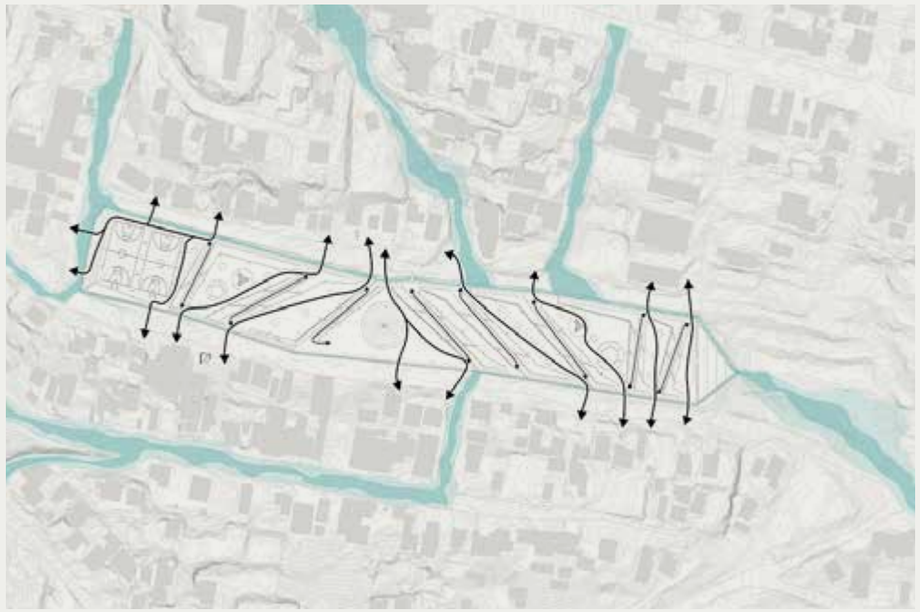
Decades ago, the stream was designed as a public space with sport and recreational activities for the residents. However, its nature contradicted that program. The inhabitants, moved by the desire to have it, systematically filled the channel with materials such as dirt, demolition rubble, and even garbage. At the time





↑ Parque en el Arroyo Xicoténcatl: Phase 1
Photo: Gabanna

↓ Internal park circulation:
Creek Course
Pedestrian circulation of Chacarita, Piletone



of initiating the project, the channel had already disappeared. In its place were mounds of fill material contained by two parallel, downward-sloping dirt roads. One was three meters higher than the other, and both were severely eroded. These, in turn, served as a perpendicular connection with streets in the same conditions. The water, which had to drain through a bed, now did so on these increasingly deteriorated paths.

The community that inhabits this area is made up of mostly young people. They come from other places both in Mexico and Latin America and are engaged in informal trade, hoping to cross the border into the United States at some point. The project directly benefits 6,200 inhabitants, which is the number of people who live within a radius of 670m around the park, as defined by the Ministry of Social Development of Mexico.





## SOLUTION

In this context and with a budget of 125 USD/m2, through the streambed, the intervention links its parallel paths, while generating a series of platforms for public and sports programs, and channels to direct rainwater runoff. To achieve this, the following strategies were proposed:

1. Nine embankments or platforms for the development of recreational and sports activities, built with the consolidation of existing fills in the stream bed.
2. Stabilization of embankment slopes, built with a construction system widely used in Tijuana based on waste tire walls and vegetated with endemic plants. The construction methodology exists because many waste tires are received from the US.
3. Transversal ramps to the channel that link the two parallel streets

and delimit the channel of the stream to generate interaction between the inhabitants who live along it.
4. Two canals that run parallel to the stream and the streets, made of concrete and stone to reduce the speed of runoff water and direct it to the area that is still preserved in its natural state.
5. Sports fields, playgrounds, meeting spaces, and shaded areas for the use of the community.

**800 m² converted to public space (Phase 1)**

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The construction of the project began in August 2019, anticipating that only an initial stage of 800m² would be carried out. However, given the positive reception of its completion in March 2020, the rest of the proposal began later.

## ENVIRONMENTAL AND SOCIAL BENEFITS

The project has generated multiple benefits for the residents: the community organized to maintain the public space and its vegetation, while young people under the age of 25 have embraced the basketball courts that are the heart of the project, and children make constant use of the playgrounds. Additionally, the construction system capitalizes on the materials and local knowledge of the inhabitants, demonstrating the ability of the designers to read the context and propose site-specific responses to create a canvas that links the environmental, urban, social, and cultural.

Overall, the redesign of the Xicoténcatl streambed in Tijuana has fostered urban improvements in the area and created a sense of identity among the inhabitants. The project also contributes to redefining the way in which public space can be conceived, implemented, and maintained. Quality public spaces can create opportunities for meeting and playing but also for education and stewardship of the land, especially in environmentally and socially degraded areas. The project

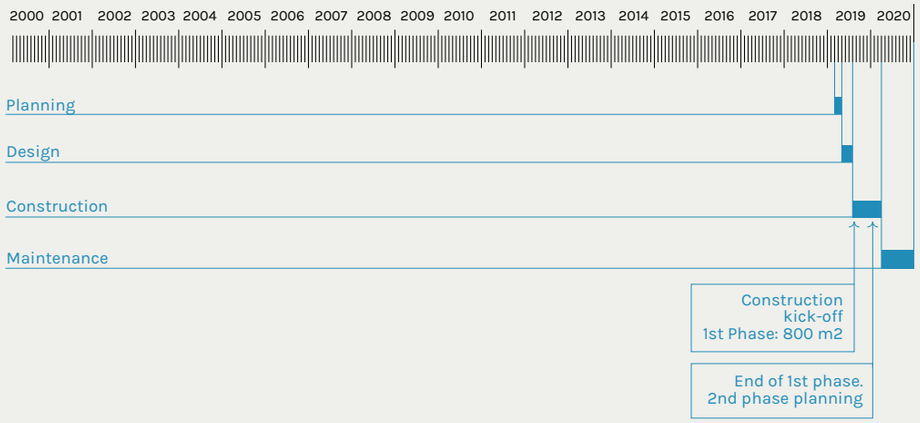






Parque en el Arroyo Xicoténcatl
Photo: Gabanna

demonstrates that subtle and small interventions, paired with a systemic vision, facilitate the creation of a territory in which specific geographical and cultural characteristics are embraced and enhanced.










## DESIGN DETAILS

1. Platform with tucuruguay bench, compacted to 90% in layers of 30 cm

2. Reinforced concrete pavement 10 cm thick

3. Slope based on reused tires, filled with dark earth

4. Rain gutter 1.10 cm wide and 40 cm Deep at Street level, local river stone base

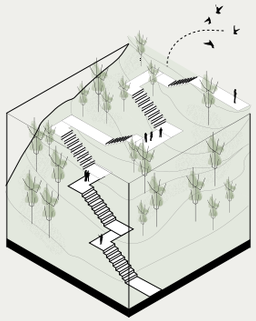
5. Reinforced concrete trim, trapezoidal in shape: 30 cm height x 20 cm base x 10 cm crown.

6. Mix of soil for vegetation, over 10 cm of gravel

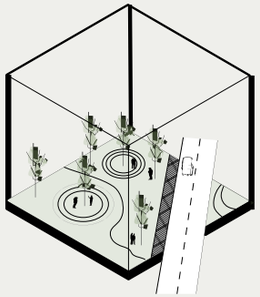
↑ Technical Detail - Section

↓ 1st Phase Plan

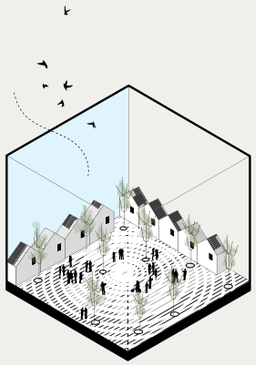
AREAS OF INTERVENTION → WHERE



STAIRS



VACANT SITES



PLAZAS

ACTIVITIES → WHAT

Wetland | Trails | Playgrounds | Plaza | Sports Fields | Park

ACTORS → WHO

Federal Government | Local Government | Academia

SCOPE → WHY

Promote healthy lifestyles | Manage and clean stormwater | Promote new types of social living | Stabilize neighborhoods | Reduce heat island effect

MEANS AND METHODS → HOW

**CONTAIN** —— Redesign of water body and adjacent public space to avoid flood risk in informal settlements.





PROJECT 2.7

# Represo Colosio

## Site

Nogales, Sonora, México

## Years

2019

## Team

**General Coordination and Design:** José Pablo Ambrosi y Loreta Cas- tro Reguera. **Hydrological Study:** Juan Ansberto Cruz. **Construction documents:** Arturo Frías, Andrea Ramírez, Iván Rangel, Manuel Abad, Lorena Chávez, Catalina Vega. Gestión: Oscar Torrentera. **Structural Engineer:** Gerson Huerta, Grupo SAI. **Landscape Consultant: Hugo Sánchez. Civil Engeneering:** Elvira León. **Installation:** José Arturo Martínez Acosta

SEDATU - UNAM.

## Coordinates

34°34′58.89″N
58°22′55.92″W

PROJECT

**Elevation**

1,287 m

**Climate**

Temperate semi-dry

**Area**

5.68 ha

**Cost**

130 USD/m²

**Impact**

32,000 inhabitants

**The site was subject to constant flooding, putting the population at risk. All spaces around the body of water were designed to flood annually and to continue to function once the water recedes.**

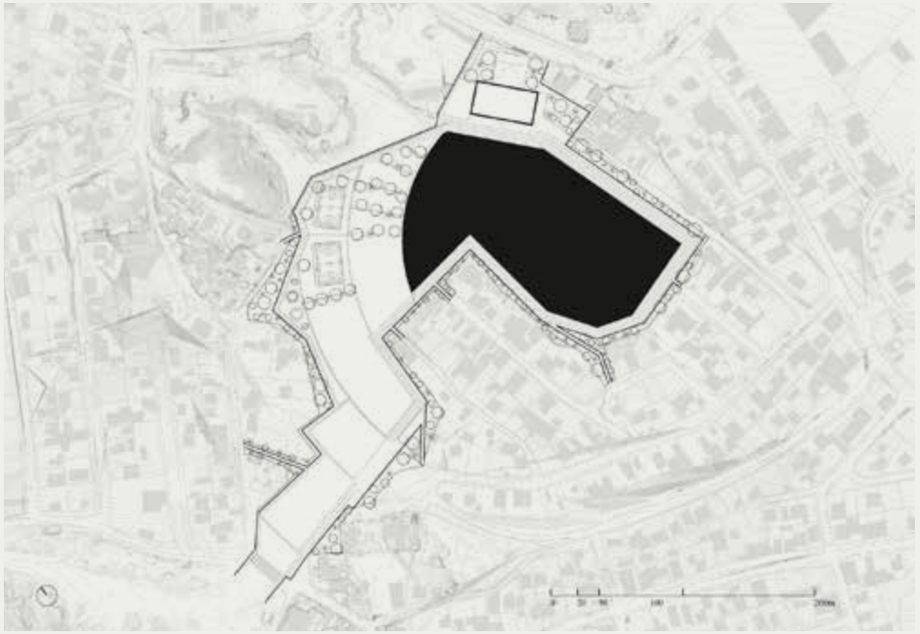
## CONTEXT

The Colosio Dam in the city of Nogales, Sonora, is an 8-ha project initiated by the Secretariat of Agrarian, Territorial and Urban Development (SEDATU) of the Government of Mexico and developed by the Faculty of Architecture of the UNAM through Taller Capital. The initial approach consisted of building a park in an area of unplanned urban settlements, vacant and adjacent to a body of water. The intervention area covered 5.68ha, of which 2ha consisted of a body of water. Based on the analysis, it was found that the site was subject to constant flooding during the rainy season, putting the surrounding population living along the perimeter of the body of water at risk of landslides, damaging the dam curtain year after year, and interrupting mobility and the evacuation route of local residents.



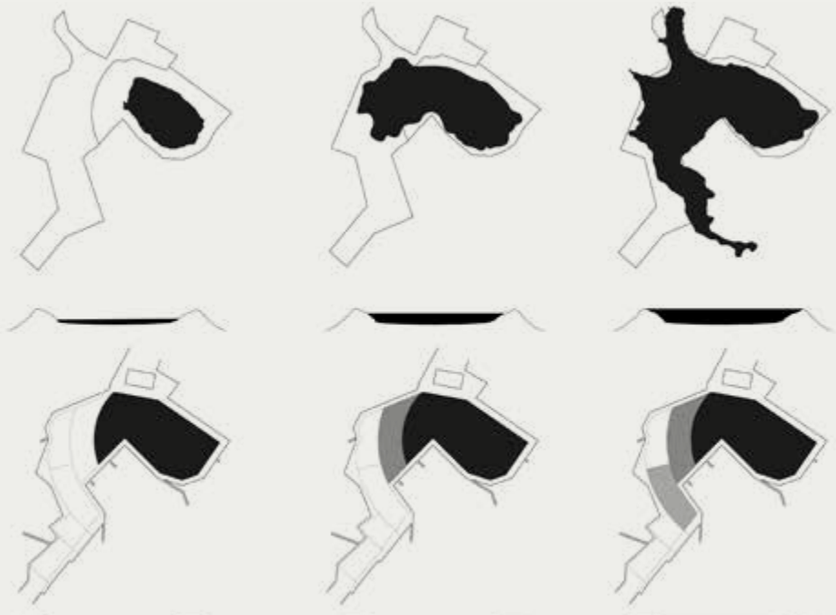






↑ General Plan

↓ Colosio Dam: Hydrology



## SOLUTION

A thorough analysis of the context (mountainous site, precarious constructions, plethora of desert flora, and a dire need for communal and recreational spaces), a series of design strategies emerged to address the identified problems:

1. Delineation of the edges of the body of water and consolidation of the curtain of the dam.
2. Design of stormwater infrastructure to capture water runoff from the mountains.
3. Determination of specific spaces to receive flood waters in the rainy season and function as places for sports and recreation during the dry season.
4. Creation of a perimeter circuit and bridge to facilitate the mobility and evacuation of the inhabitants in emergency events.
5. Design of a covered space to serve as a landmark of identity for the inhabitants of the place.

## CONSTRUCTION AND IMPLEMENTATION PROCESS

One of the most important requirements of the project, for which the design began in April 2019, was to propose a rapidly executable and low-cost system, since the work would have to be completed within a year with a budget of 130 USD/m2. To materialize the

Colosio Dam
Photo: Gabriel Félix





strategies listed above, simple construction systems and local materials were selected, favoring the construction systems and local materials. The containment and reinforcement of the dam were built with gabions filled with stones from the area; the pavements were made of compacted tucuruguay (the land of the region), while the walkways were made of polished concrete. The children's play areas were designed with tubular steel, and the covered multipurpose space was proposed with a combination of a metallic structure (PTR and open-core armor) and a corrugated sheet covered with an aluminum-type finish. The interior stands cover two service areas: restrooms and administration. These modules are made of flattened cement-sand blocks. Finally, the squares around the covered space are paved with local stone. All of these are bordered by gardens of regional cacti.

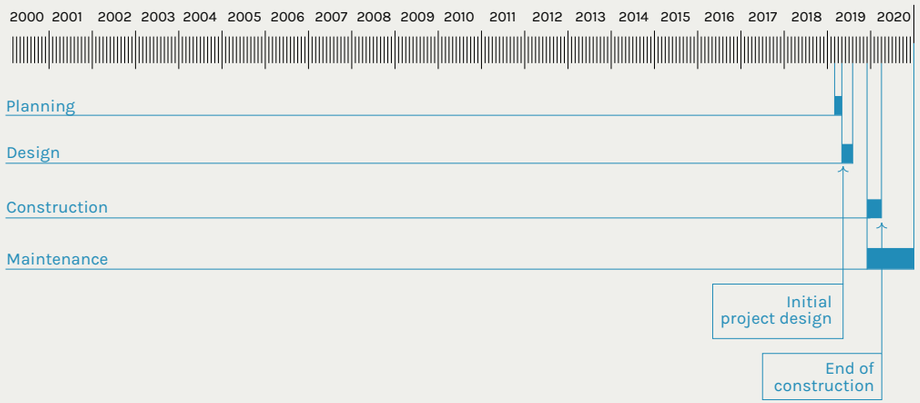
It is worth mentioning the hydrological aspects of the project since it was critical for the success of the project. A model for the sub-basin was developed to determine the amount of water it could hold according to a cyclical flow. It became evident that the storage capacity was limited, and it was necessary to dredge the area of the body of water in order to store more water. The design is made to withstand the 10,000-year storm. All the spaces located to the south of the body of water has been designed to be flooded annually and to continue to function once the water recedes. Lastly, a concrete bridge was built that traverses the area where the water enters with greater force, to maintain circulation during rain events.

## COSTS AND MAINTENANCE

The project is designed to need minimal maintenance, developing an architectural work based on inert materials such as stone, earth, and metal structures. In addition, the selected plant palette features native species, resistant to the semi-arid climate of the area and requiring little care. Given that maintenance was to become the responsibility of the municipality, the design stage considered elements that would not be very burdensome.

## ENVIRONMENTAL AND SOCIAL BENEFITS

The hydrological project and public space restore the environmental, urban, and socioeconomic conditions of the area while incorporating elements that make the site a unique place. It serves a population of approximately 32,000 inhabitants, within a radius of 670m2 around the project. The intervention proposes to become a beacon for the inhabitants of the area, providing places of leisure, sports, and recreation for children, young people, adults, and the elderly.

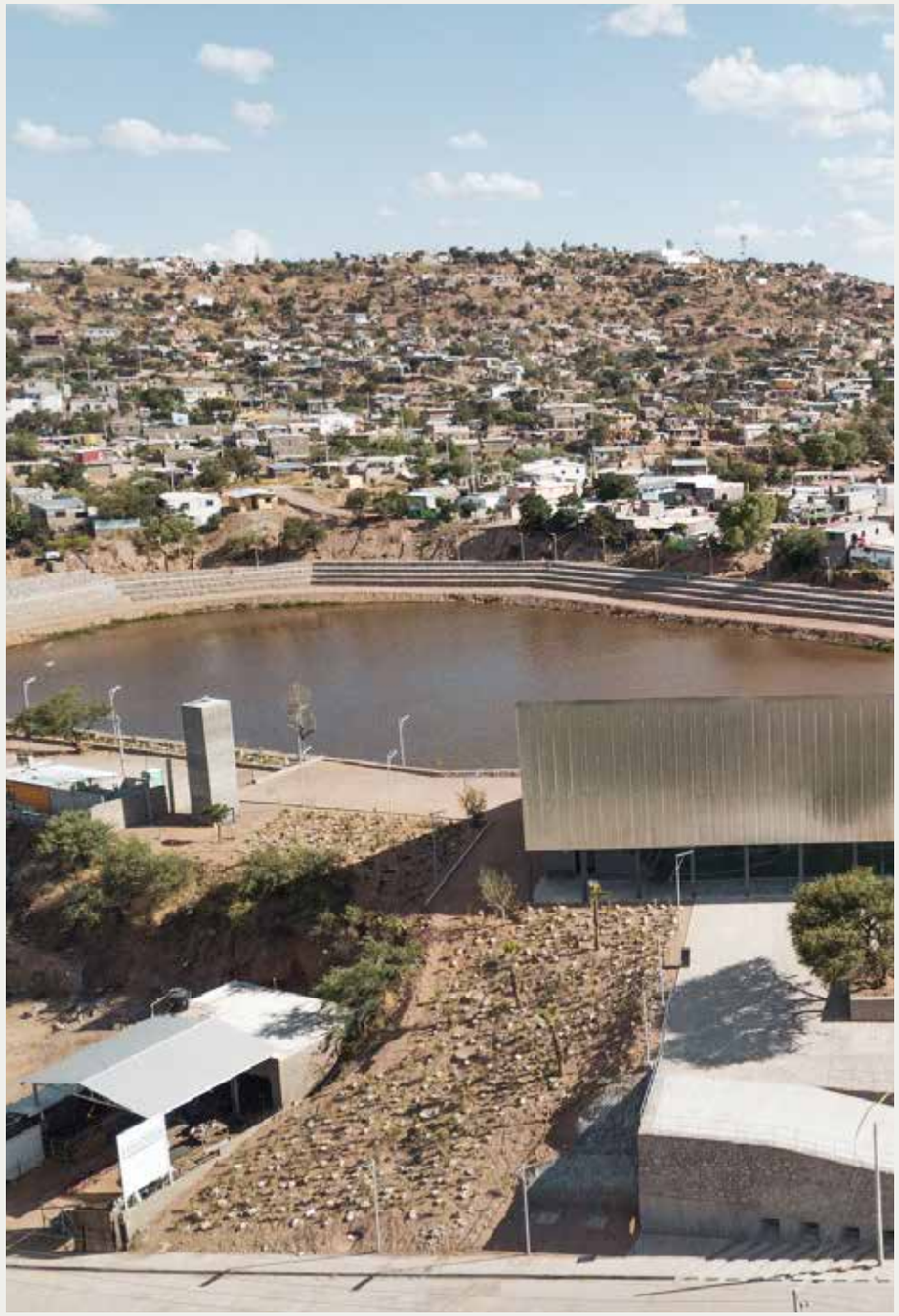









Colosio Dam
Photos: Gabriel Félix and Rafael Gamo



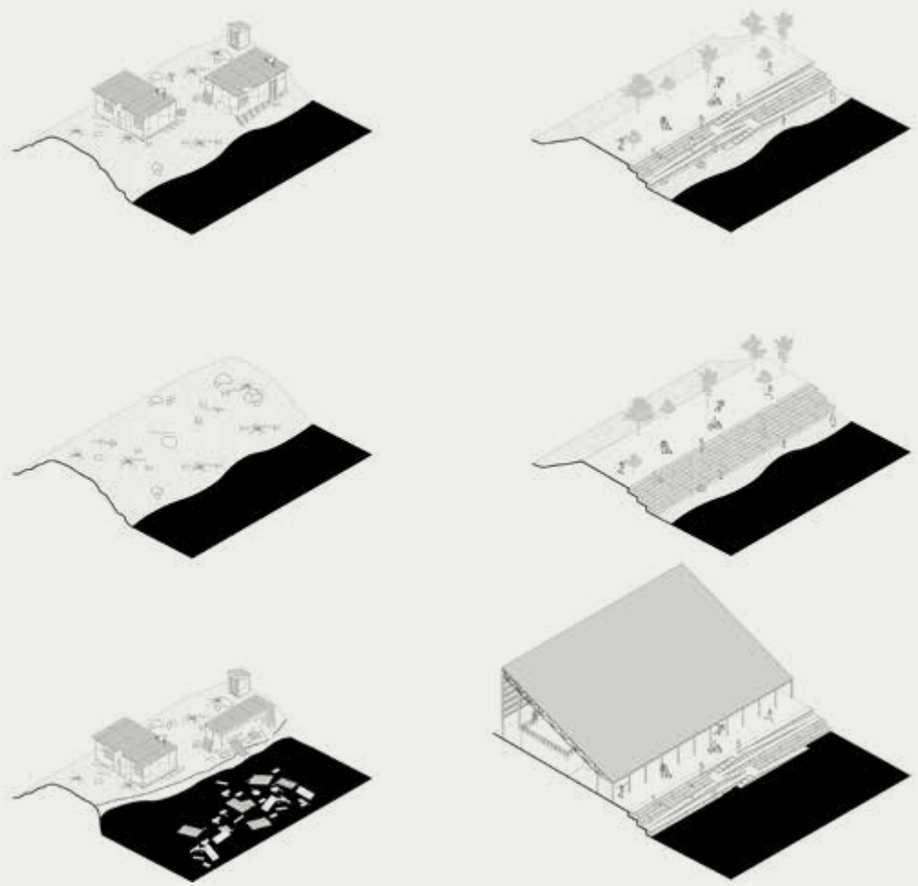
Colosio Dam
Photo: Gabriel Félix





**EXISTING CONDITIONS: FLOODING AND RISKS**

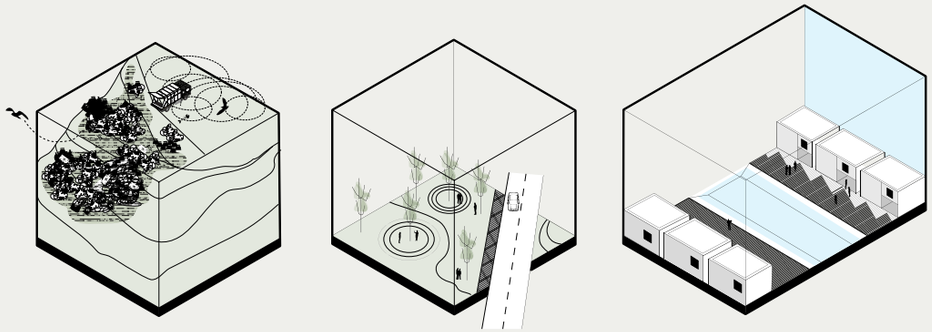
**PROJECT: CONTAINMENT OF FLOOD ZONES**



↑ Existing Conditions and Proposed Design

↓ Section

AREAS OF INTERVENTION → WHERE



VACANT SITES | CONTAMINATED SITES | INTERSTITIAL AREAS

ACTIVITIES → WHAT

Wetland | Trails | Playground | Plaza | Sports Fields | Park

ACTORS → WHO

Federal government | Local government

SCOPE → WHY

Reduce crime | Promote healthy lifestyles | Increase the productivity of abandoned sites | Promote new types of social life | Stabilize neighborhoods | Improve connections to adjacencies

MEANS AND METHODS → HOW

**RECUPERATE** —— Repurpose a paved graywater canal and rehabilitation as a communal public space.





PROJECT 2.8

# Parque Fresnillo

## Site

Fresnillo, Zacatecas, México.

## Years

2017

## Team

Rozana Montiel y Alin V. Wallach. **Collaborators:** Hortense Blanchard, Silvia Mejía, Alejandro Aparicio, Amaranta Guzmán, Ana Sofía Quirós, Caroline Figaro, Ombeline De Laage, Cristóbal Pliego. En colaboración con INFONAVIT.

## Coordinates

23°10′34.49″N
102°51′41.13″W

PROJECT

**Elevation**

2,210 m

**Climate**

Template Semi-dry

**Area**

2,260 m²

**Cost**

409,000 USD

**Impact**

5,000+ habitants

# The project repurposes a paved sewage canal to provide public space and generate recreational and cultural opportunities in one of the most populated and dangerous neighborhoods in Fresnillo.

## CONTEXT

In the Manuel M. Ponce Housing Development, located near the downtown area of Fresnillo, Zacatecas, two embankments approximately 1km in length divided the urban space. These consisted of an old paved sewage canal that was left abandoned and fragmented the fabric of the neighborhood. The housing development is in the middle of the sewage canal, and consists of 102 buildings, making up one of the most populated neighborhoods in the area, with high rates of violence and crime.

The neighborhood was selected among those in Fresnillo with the goal of improving the conditions of the neighbors and to serve as a model contributing to the reduction of crime rates by reclaiming its public spaces with the aim of improving coexistence among its inhabitants. The urban regeneration program within the Manuel M. Ponce neighborhood materialized in 2016 with the support of INFONAVIT, with the intent of improving common use areas and green areas.







↑ General Plan

↓ Section

## VISION

The project repurposes the paved sewage canal and transforms it into a multifunctional playground, empowering public space to create opportunities for recreation and cultural activities for groups living in conditions of risk.[1] The new transition space offers a safe recreational area that embraces the public in an immersive habitat of local vegetation. In addition, the designed bridge, ground, and slopes are equipped for multifunctional programs.

**One paved sewage canal transformed into public space.**

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The project incorporated participatory design processes that influenced the final construction. Universal access bridges were built to facilitate crossings, a roof was provided for the activity area, and the recreational program was consolidated around it. These meeting spaces are also habitable at night due to the addition of lighting. In addition, the slopes of the canal were reconstructed to function as a rest area, a forum, and a playground with stairs and slides. Games were also painted onto the ground for the children. A palette of colors was created in harmony with the surrounding environment, while the surrounding buildings and their bases and entrances were also repainted to form part of the public space improvement proposal. The design consisted of replicable modules that integrated games, stands, lighting, street furniture, and vegetation. The project concluded at the end of 2017 and was enabled for the use of neighbors at the beginning of 2018.

## ENVIRONMENTAL AND SOCIAL BENEFITS

The potential of the project lies in repurposing residual infrastructure once considered an urban scar and converting a vacant area into a recreational park, reinterpreting a typical urban element of the neighborhood into a space with an identity. The new space improved the quality of life for those living in the housing complex by offering opportunities to groups with the greatest exposure to risk and by contributing to the reduction of violence in the area. In addition, the project contributed to

1. Glocal Design Magazine. 2019. "Parque Fresnillo, reactivando el tejido social", Glocal (blog), el 7 de marzo de 2019. https://glocal.mx/parque-fresnillo

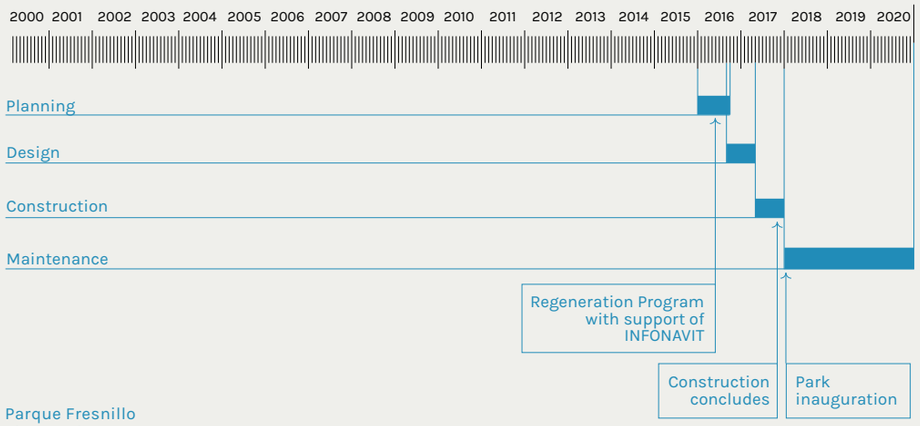






Parque Fresnillo
Photos: Jaime Navarro and Sandra Pereznieto

the incorporation of local vegetation and tree planting. The incorporation of permeable pavement and the combination of concrete and grass tiles on the slopes of the canal helped to contain the slope while incorporating vegetation and at the same time reducing the impermeability of the land.



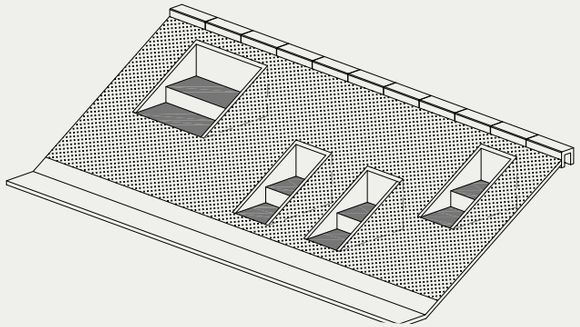

Parque Fresnillo
Photo: Jaime Navarro

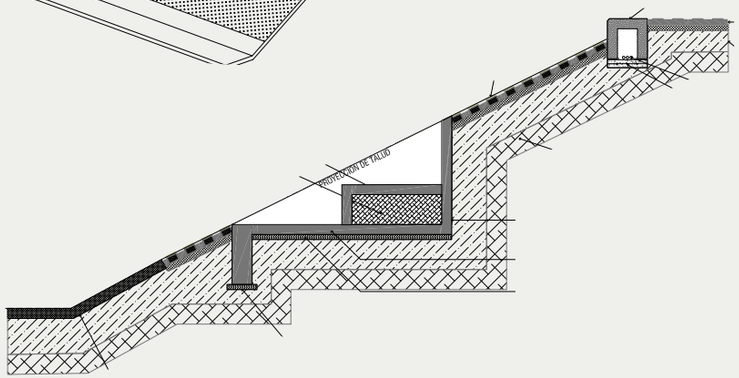






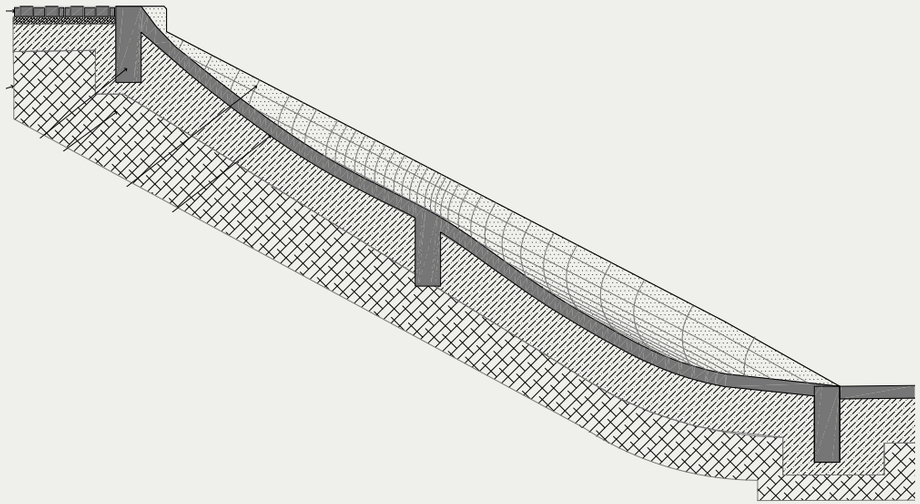
## PLAYGROUND CONSTRUCTION DETAILS



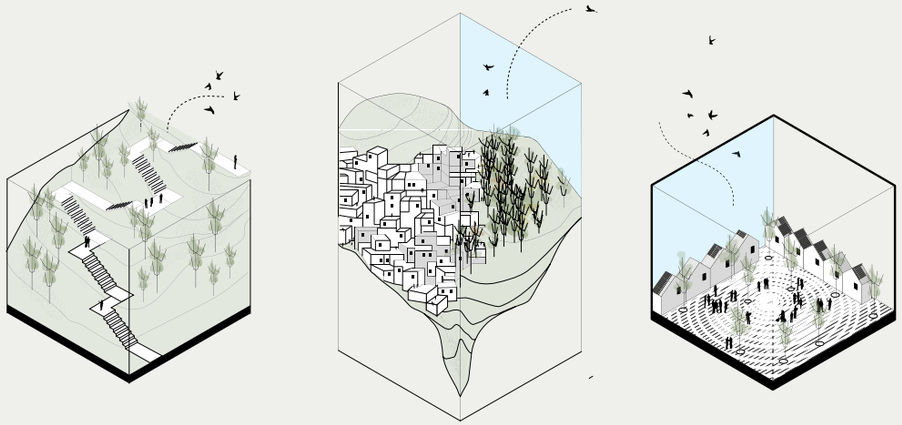



Construction details:
Sections and axonometrics

## SLIDE CONSTRUCTION DETAILS



AREAS OF INTERVENTION → WHERE



STAIRS SLOPES PLAZAS

ACTIVITIES → WHAT

Overlook · Trails · Playgrounds · Plaza · Park

ACTORS → WHO

Civil society · Academia · Local government · Regional govenrment · Private companies

SCOPE → WHY

Reduce maintenance costs · Promote healthy lifestyles · Waste recycling · Promote new types of social life · Stabilize neighborhoods · Improve connections to adjacent communities

MEANS AND METHODS → HOW

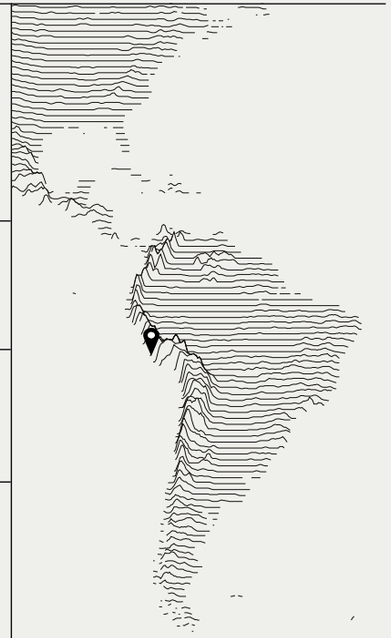
**OPTIMIZE** —— Reclaiming of communal public spaces through a participatory process and citizen management





PROJECT 2.9

# Parque 15 de Octubre, Programa Barrio Mío



## Site

Señor de los Milagros, Sector La Ensenada, Puente Piedra, Lima, Perú.

## Years

2013 - 2014

## Team

**Coordination and General Direction:** Javier Vera. **Project Coordination:** Álvaro Rodríguez y Carlos Ramos. **Project Assistants / Urban Promoters:** Nicolás Palacín, Mariel Valdivia, Manuel Burga y Marko Mendoza. **Socióloga:** Andrea Venini. **Coordinadora Territorial:** Barrio Mío / Rita Tantaleán. **Social Promoter:** Elizabeth Dueñas. **President of the Union of La Ensenada:** Félix Rosales. **Univ. Nac. Students of Engineering:** Leo Vás- quez, Alfonso Huamaní. **Scholarships Universidad de Navarra:** Carolina Larrazábal y Cristina Pérez.

## Coordinates

34°34′58.89″N
58°22′55.92″W

PROJECT

**Elevation**

80 m

**Climate**

Template Humid

**Superficie**

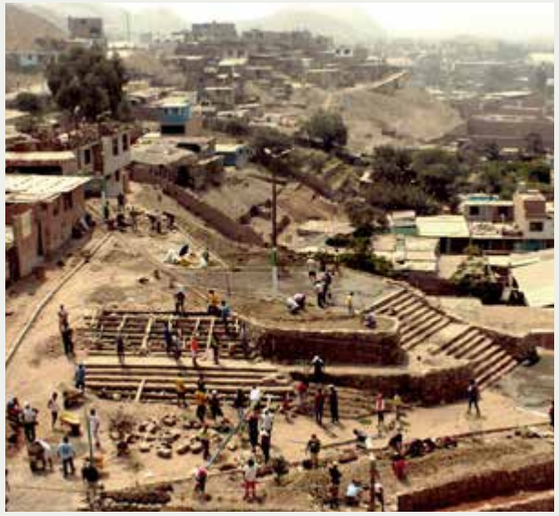
1,500 m²

**Cost**

0 USD of direct investment

**Impact**

12,977 beneficiaries of the program



**The project proposed to optimize the implementation of green areas and strategically concentrate them to facilitate maintenance due to the scarcity of water in the area.**

## CONTEXT

On August 14, 2012, Ordinance No. 1625 was approved, creating the Barrio Mío Program of the Metropolitan Municipality of Lima (MML). The program facilitated comprehensive urban projects that prioritized urban development, culture, sports, health, and recreation aspects with the goal of improving living conditions in vulnerable settlements and popular urbanizations throughout Metropolitan Lima. As a result of this initiative, Recuperación de Espacios Públicos (REP) was established as a municipal technical support service for residents organized in hillside areas of Lima. This service focused on projects that were reclaiming and improving public spaces within a comprehensive urban system. This platform for citizen participation focused on action from self-management, promoting spaces for reflection and transformation of neighborhoods. With this service, the MML was able to integrate different actors of local development – the municipality, universities, civil society, companies, and the general population – around a common vision that materialized in a short time and without direct investment by the MML.








↑ Integrated Project P.J. Señor de los Milagros, La Ensenada, Puente de Piedra
Archive REP-BM

↓ General Plan – Plaza Park: Parque 15 de Octubre
Archive REP-BM

In nine months of work, REP managed to benefit 12,977 people with eight processes and projects for public space improvements and four built works. One of those successful projects was the Project in the Señor de los Milagros neighborhood in Ensenada, Puente de Piedra. The neighborhood consists of a settlement between arid hills, geographically privileged for its views, and the potential for open and community spaces currently disconnected from each other.

## SOLUTION

The urban proposal for the Señor de los Milagros neighborhood aimed to integrate and reinterpret public and community spaces within an urban system woven with a new pedestrian network that took advantage of the geography and views. Five strategic projects were outlined, among which the Central Park was chosen unanimously among the neighbors as a "lever" to reconfigure the urban node as a new central area that connects and articulates its adjacent spaces. The project was named



Parque 15 de Octubre, in commemoration of the founding date of the Señor de los Milagros settlement. The project reused the existing infrastructure of walls, and a new staircase was added to improve the fluidity of circulation and to configure an amphitheater-type living space (staircase-bench). The public area was extended to the edges of the houses, leaving only a ramp for the eventual passage of cars or processions, presenting the possibility for young cyclists or skaters to appropriate the public realm. The green areas were strategically reduced and concentrated along visible edges (green containers) and on the central island to improve maintenance due to the scarcity of water in the area. The space was complemented with luminaires, vertical supports, and multimodal tetris-type prefabricated concrete benches.

Parque 15 de Octubre
Photo: Archive REP-BM

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The Barrio Mío Program designed a specific methodology for a rigorous participatory process that allowed the urban system, the lever project, and the work to be undertaken in the shortest time possible. The steps of this methodology, applied in all REP projects, can be summarized as follows: connect, familiarize, project, reach consensus, organize, build, and celebrate. The methodology consisted of: a preliminary meeting to present the service; a participatory process with two workshops in which the comprehensive urban system was defined and mapped and the "lever project" was developed; a presentation assembly and final critique to undertake the management of materials and organization of the workforce; and the execution according to the tradition of Sunday community work, intense days in which the REP team, in conjunction with neighbors and volunteers from various backgrounds, organized to collaborate. The process culminated in the delivery of the final documents with conclusions and recommendations for the future.

In the case of Parque 15 de Octubre, six days of work were required, with daily participation from up to 150 neighbors and thirty volunteers who were organized in teams with specific tasks. Master masons, gardeners, housewives, youth, and children enthusiastically participated in the process, working from 6am to 2pm and having a community lunch. The disposition of the community and the shared management of the materials enabled the work to be completed in five months.

**Programa Barrio Mío: 8 reclamation processes and 4 constructed projects.**

**Parque 15 Octubre: 6 work shifts, 150 neighbors and 30 volunteers per day.**

## ENVIRONMENTAL AND SOCIAL BENEFITS

Today, the park is a massive meeting point for children who play in all of the spaces, including the benches, stairs, supports, and tires which all make up a circuit with elements that are constantly reinterpreted according to the game of the moment. Older youth also use the space, especially the stairs, while adults gather on the benches at night. The space has been reclaimed and appropriated by the neighbors. Ecological design strategies were incorporated





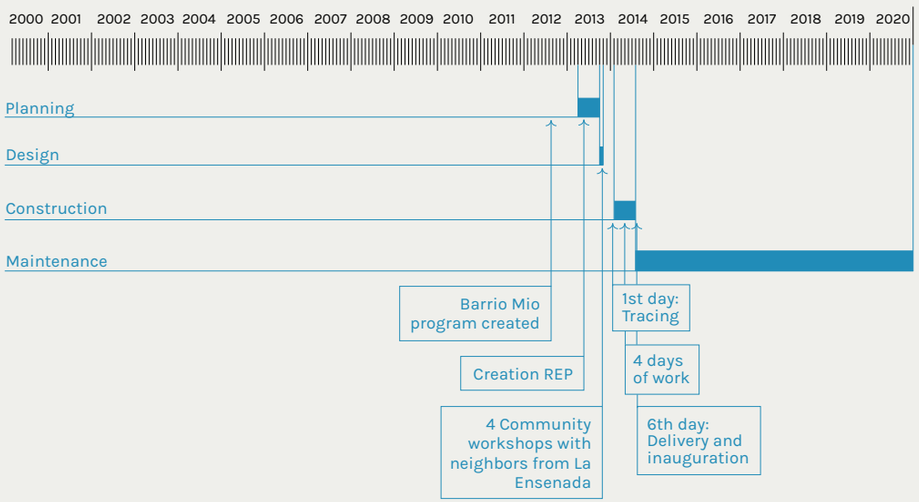


Parque 15 de Octubre
Photos: Archive REP-BM

into the design of the park, and its street furniture and discarded objects were reused and recycled as local materials. New trees were also planted under the guidance of a forestry specialist, while a planning strategy was implemented to address water scarcity and assure the green spaces could be maintained over time.

## COSTS AND MAINTENANCE

Despite the fact that the Program has been deactivated, and there has been no follow up on the projects, the recovered spaces remain alive thanks to the appropriation by the neighbors who participated in the various stages of the project, from diagnosis to construction.








### MATERIALS AND TECHNIQUES

**FLOORS**
Hard (traffic with tamped earth) and Soft (for living-playing with gravel or gravel and decorative with ground handmade brick)

**SARDINELES**
In-situ stone and concrete bricks (donation)

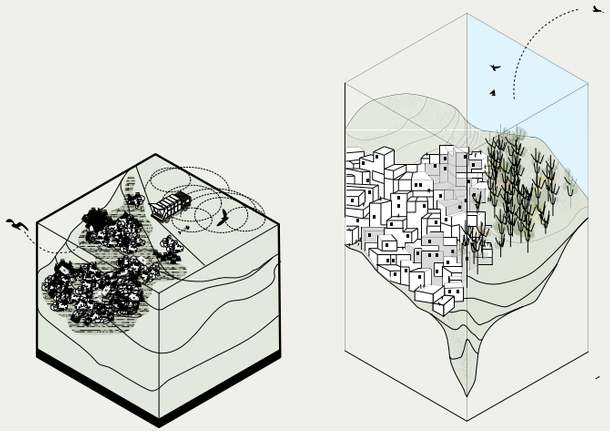
**BENCHES**
Rustic (large natural stones from the area arranged as seats and games) and Concrete (L-piece that is not anchored to the floor and can be used in various ways)

**PLAYGROUNDS**
With painted tires and rolliza wood

**LIGHTING**
Rolliza wood and slats

**VEGETATION**
Designation of green areas in areas with lack of water. Planting of ground cover species. The rest of the areas incorporate materials of dry landscape. Planting of trees with a forest specialist.

INTERVENTION AREAS → WHERE



CONTAMINATED SITES

SLOPES

ACTIVITIES → WHAT

Overlook

Trails

Wetland

Gardens

Park

ACTORS → WHO

Civil Society

Academia

Local government

Regional government

SCOPE → WHY

Promote healthy lifestyles

Stabilize neighborhoods

Promote new types of social life

Improve air quality

Clean contaminated soil

Clean and manage stormwater

Investigation + Research of new ideas

MEANS AND METHODS → HOW

**DECONTAMINATE** —— Transform an old open-air landfill, utilizing natural remediation technologies.





PROJECT 2.10

# Recuperación socioambiental y transformación urbanística del Morro de Moravia

### Site

Medellín, Colombia.

### Years

2009 – 2014

### Team

Cátedra UNESCO de Sostenibilidad de la Universitat Politècnica de Catalunya (UPC). **Project Coordinator:** Dr. Jordi Morató i Farreras. Institución Universitaria Tecnológico de Antioquia (TdeA). **Director of the Office of UNESCOSOST Colombia:** Prof. Jorge Montoya Restrepo. Alcaldía de Medellín. Area Metropolitana del Valle de Aburrá. Alcaldia de Barcelona – Programa Barcelona Solidaria.

### Coordinates

6°16′37.99″N
75°34′04.53″W

PROJECT

### Elevation

2,300 m

### Climate

Tropical

### Area

10 hectares

### Cost

470,000 USD*

### Impact

-

**For years, Morro de Moravia was the recipient of the solid waste produced in the city. The project transformed this degraded space into a cultural icon and landscape.**



## CONTEXT

In the 1960s, the Moravia neighborhood was strategically established within the alluvial depression created by the extraction of materials from the Medellín River. In 1977, the Mayor's Office of Medellín established a municipal waste dump there, displacing thousands of families who relocated to Moravia due to armed conflict in their native land or the attraction of Medellín's economic boom. Given that Morro de Moravia was the recipient of the solid waste produced in the city for years, recycled garbage became the means of subsistence for this community of displaced individuals. The socio-environmental problems in Moravia were underscored in 2004 thanks to the census, which indicated that the neighborhood population consisted of 2,224 families who lived on 10 hectares of land, on a 35-meter-high mountain made up of 1.5 million tons of waste. The instability of the soil, its high slopes, fragility of the buildings (0.37m2 of public space per inhabitant), the presence of industrial and domestic waste that was continuous emitting toxic gases and leachates all meant that the inhabitants of Moravia were subjected to a high chemical and microbiological risk. As a result, the "Comprehensive Intervention Project for Moravia





↑ Morro de Moravia in Medellín in 2014, at Project completion of social-environmental restoration
Photo: Secretary of Environment - Mayor of Medellín.

↓ Historic images of Moravia
Photos: Jorge Melguizo
Bottom; Vegetated edge (buffer strips), Garden of Identity and Treatment wetland of leachate designed by the Cátedra UNESCO of Sustainability in collaboration with the Univ. of Aarhus (2010-2011)
Photos: Cátedra UNESCO of Sustainability, Óscar Flecha, and Oihana Cuesta

and Its Area of Influence" was defined, and, in 2006, the Ministry of the Interior and Justice declared the site a public calamity (Resolution No. 31, 2006).

## SOLUTION

The project incorporated a comprehensive strategy of intervention, participatory transformation, and community empowerment, including the following lines of work:

· **Social**: improvement of the quality of life of users by strengthening the network of relationships between them and their environment, in many cases re-establishing contact with the countryside, which was lost after their arrival in Medellín, and reinforcing the identity and neighborhood cohesion weakened after the family resettlement program.

· **Landscape**: recovery of Morro de Moravia through elements typical of the place, such as flora and recycling of waste from the former dump site, which made it possible to transform the degraded space into a cultural and landscape reference for the city.

· **Environmental**: natural restoration after being a victim of a major environmental impact, through sustainable actions that respect the environment, combining natural bioremediation technologies, phytotechnologies with strips of vegetation (buffer strips), and treatment of the wetlands to rehabilitate the soil as a driver of environmental recovery.

· **Training**: dissemination of values and basic principles of equality, participation, collectivity, respect for nature, and training the community through workshops on composting, reuse, crop improvements, safety, hygiene, and environmental education.

· **Gender**: training of community leaders and entrepreneurship on the issue, with the creation of the Community Gardens Group of Moravia, which later created the Cojardicom Corporation.

**A combination of natural technologies of bioremediation, phytotechnology with vegetated edges (buffer strips) and treatment wetlands, to prepare the soil as a motor of environmental restoration.**





## CONSTRUCTION AND IMPLEMENTATION PROCESS

The Morro Recovery Plan consisted of the following: resettlement for families who inhabited the area and recovery of the social fabric, environmental assessment and study of technologies for its recovery, landscape and urban planning studies, and citizen participation processes. In July 2010, the Moravia Gardens Group was formed, with the collaboration of public administrations and coordination from the UPC-T Office. There, training was carried out, and activities began with an initial group of community leaders from Moravia. Furthermore, at the beginning of 2011, the resettlement of most families who inhabited the "Morro" into social housing was completed, and the construction of the first pilot wetland plant for the treatment of contaminated water was completed. While most families were resettled in the vicinity, some had to be relocated to more remote areas. These families were able to preserve a connection to Moravia through land ownership to practice urban agriculture.[1]

The cost of the project financed by the Barcelona Solidaria Program was 470,000 USD during its four years of operation. Once completed, the maintenance of the project was initially conducted through the Secretary of the Environment of the Mayor's office in Medellín.

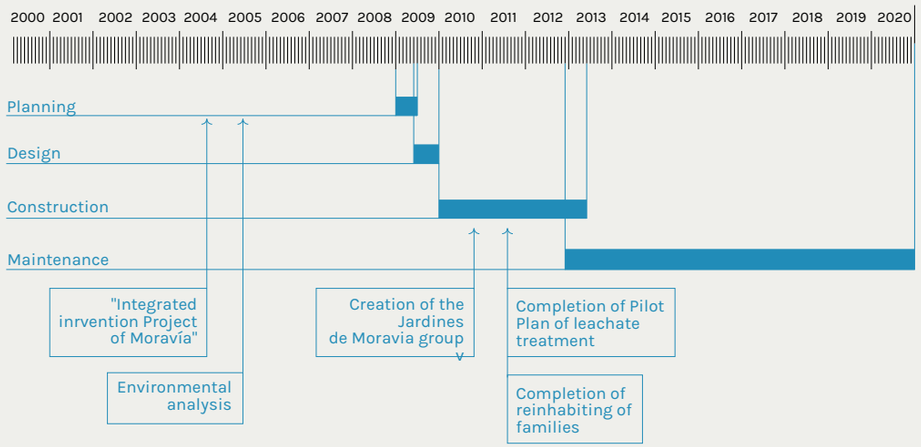
## ENVIRONMENTAL AND SOCIAL BENEFITS

The Moravia project follows urban design principles with a sensitivity to water, restoring a water balance with ecosystem management through natural and low-cost technologies while rehabilitating the soil in the area. The designed treatment chain uses three complementary systems: vegetated buffer strips as pretreatment, water runoff management, and treatment of the wetlands, as a natural system for leachate treatment. These constructed wetlands purify the leachate that is collected from the hill through buried perforated pipes.

**1.** Moravia, la ruta de la esperanza. Dir. Matías Boero Lutz. YouTube, Moravia UAB-Unesco. Diciembre 3, 2012. https://www.imdb.com/title/tt5097092.

In terms of the social benefits of the project, it is important to highlight that the construction of Moravia Community Gardens was developed based on two projects: Community Gardens and Identity Gardens. These were mechanisms meant to link the inhabitants of the neighborhood to the landscape and environmental transformation of the "Morro" through participatory activities around gardening, the cultivation of ornamental plants, promoting empowerment, territorial identity, and social cohesion.

## The Community Gardens establish activities around gardening and cultivation of ornamental plants.

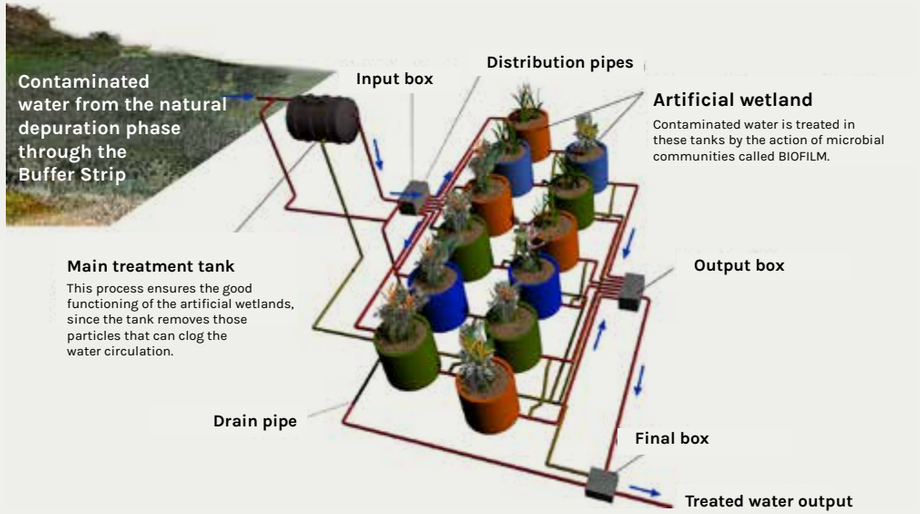









### TREATMENT WETLAND PLAN (VERTICAL FLOW) OF LEACHATE




↑ Treatment wetland (vertical flow) of leachate designed by the Cátedra UNESCO of Sustainability in collaboration with the Univ. of Aarhus

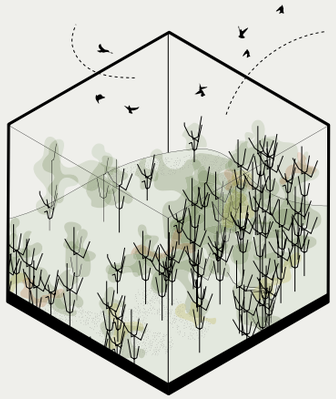
↓ Construction workshop for the vegetated edge (buffer strips) to control erosion and distributed contamination
Photo: Cátedra UNESCO of Sustainability

# 3

# MITIGATE AND ANTICIPATE

Mitigating climate change means avoiding and reducing its causes, such as greenhouse gas emissions - which trap heat - into the atmosphere to prevent the planet from more extreme warming. This means imagining new ecologies, economies, and societies to anticipate future conditions. How to design and plan future expansion of urban areas while reducing the impact of settlements on the territory?

AREAS OF INTERVENTION → WHERE



RESERVES

ACTIVITIES → WHAT

Wetland | Cycling | Trails | Overlooks | Urban Forest | Ecological Corridor

ACTORS → WHO

Federal Governemnt | Local Government | Regional government

SCOPE → WHY

Promote healthy lifestyles | Generate energy | Manage and clean water | Increase biodiversity

MEANS AND METHODS → HOW

**REMEDIATE** —— Instution of an ecological reserve and metropolitan park in the urban periphery.





PROJECT 3.1

# Parque Ecológico Lago de Texcoco

## Site

Texcoco, Estado de México.

## Years

2019 - 2028

## Team

Iñaki Echeverría Gutiérrez. **General Project Director:** Daniel Holguín Fernández. **Arquitectural Director:** Pedro Camarena Berruecos. **Landscape Director.**

## Coordinates

19°28′00.33″N
98°58′20.00″W

PROJECT

**Elevation**

2,234 m

**Climate**

Semi-Arid

**Area**

12,200 hectares

**Cost**

773,000,000 USD

**Impact**

12.5 millions people

**The park will serve to restore part of the bodies of water lost in the last 500 years, which once formed the system of lakes in which the Mexica people founded Tenochtitlán.**

## CONTEXT

Located within the sub-basin of Lake Texcoco, the Lake Texcoco Ecological Park will serve to restore part of the bodies of water lost in the last 500 years, which once formed the system of lakes in which the Mexica founded Tenochtitlan.

In recent decades, the eastern zone of the Valley of Mexico has developed environmental problems stemming from the drying up of water bodies, environmental deterioration, and effects of its demographic explosion. Population growth, along with the establishment of informal settlements under precarious conditions, has contributed to the economic and social stagnation of the area.

Currently, the Lake Texcoco area is an important source of suspended particle emissions, which, together with wind erosion, are responsible for respiratory and cardiovascular diseases among the neighboring population, along with detrimental effects to crop yields, reduction in the health of ecosystems, and other negative impacts, placing the well-being of the future population at risk.







↑ Fifteen times the size of Bosque de Chapultepec, the PELT has the potential to become on of the largest urban parks in the world.

↓ Action plan

## SOLUTION

The strategy consists of a set of actions that shifts the historical direction of development for the eastern zone of the Valley of Mexico, with a recalibrated way of inhabiting the territory in search of greater well-being, improved quality of life, and an expansion of opportunities in the region.

In addition to the scale of the project itself, the main challenge of the project is recognizing the pre-existing and adverse conditions present in the area, including its regulations, geography, hydrology, soil, social and built environment, and accessibility, among other facets.

The hydrological management of the landscape becomes the main axis of the Project.





- Productive landscapes
- Local agriculture
- Recovery of bodies of water
- Generalized grazing and targeted afforestation
- Social, cultural, and recreational infrastructure
- Leveraging of pre-existing conditions
- Recovery and expansion of regulatory opportunities
- Use of sustainable energy technologies

## ENVIRONMENTAL AND SOCIAL BENEFITS

The project benefits present an opportunity to create a sense of identity and belonging with the place where the neighboring community lives. It is estimated that the investment made by the project will directly benefit a population of 12.5 million people within a radius of 25km. In addition, the implied infrastructure and sports and cultural facilities of the completed project are estimated to generate more than 8 million visitors per year. Additional project benefits include the following:

· Strengthening the regulation of infrastructure and hydrological and landscape management.
· Mitigating risks to the health and physical integrity of people, ecosystems, and the environment.
· Opening the territory for public and collective use.
· Introducing agricultural, social, cultural and sports infrastructure in delineated areas for neighboring areas with notable deficiencies.
· Expanding climate change adaptation and generating greater resilience.
· Articulating equitable and accessible mobility and accessibility systems.
· Promoting clean and renewable energy generation, demonstration, and consumption systems.
· Facilitating flood prevention measures in neighboring municipalities by capitalizing on regulatory opportunities.
· Recovering native flora and fauna, as well as critical migratory species for the conservation of other ecosystems in the region.
· Mitigating the environmental damage caused by the emission of PM10 particles and contributing to the reduction of pollution rates.
· Organizing the participation of cultural, social science, engineering and technology, governmental, business, and civil society institutions, to establish the rules of government, as well as the operational, technical and scientific principles that ensure its viability in the medium and long term.

**12,300 ha protected.**

**600 ha of sports and fields and cultural areas.**

**2,500 ha of water bodies, reclaiming of lagunes and wetlands.**

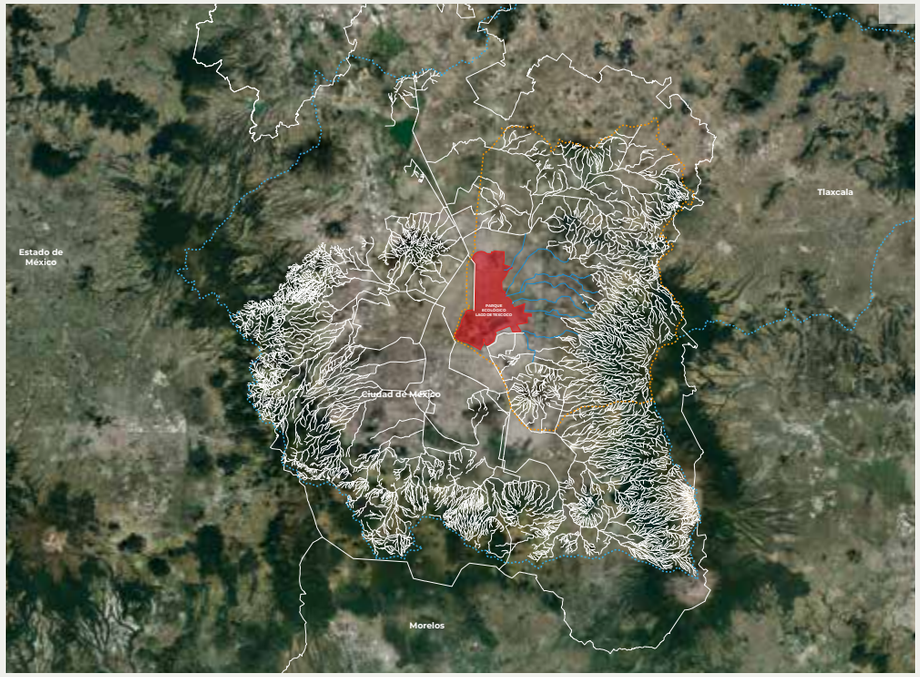
## CONSTRUCTION AND IMPLEMENTATION PROCESS

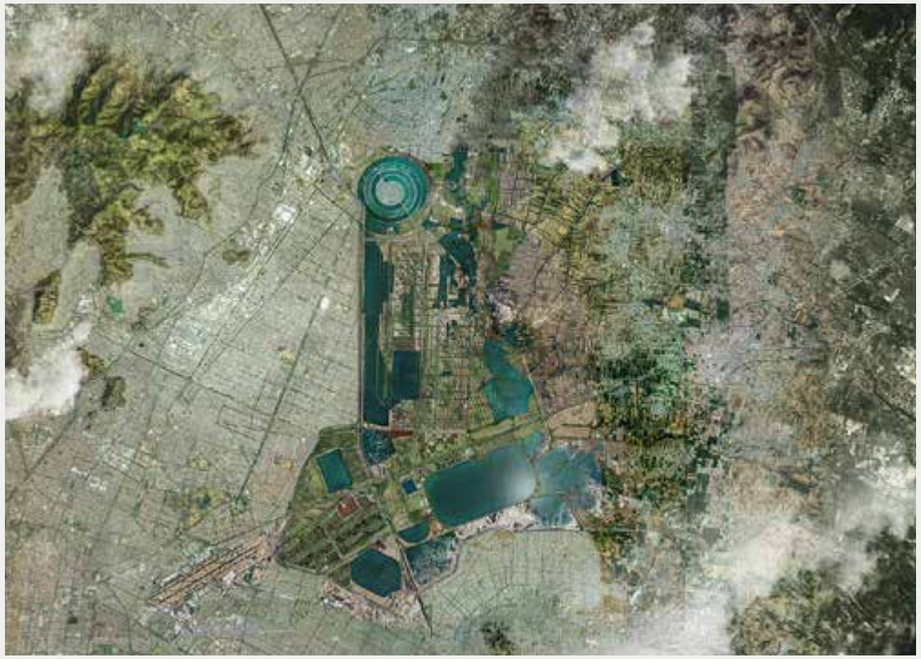
The Lake Texcoco Ecological Park is being developed by the Government of Mexico, through the Ministry of the Environment and Natural Resources (SEMARNAT) and the National Water Commission (CONAGUA). The project focuses on three lines of action: opening the territory to public use for specific events; ensuring the environmental protection of the 12,200ha; and implementing actions for environmental restoration and public use of the space. With an investment of 2 billion Mexican pesos









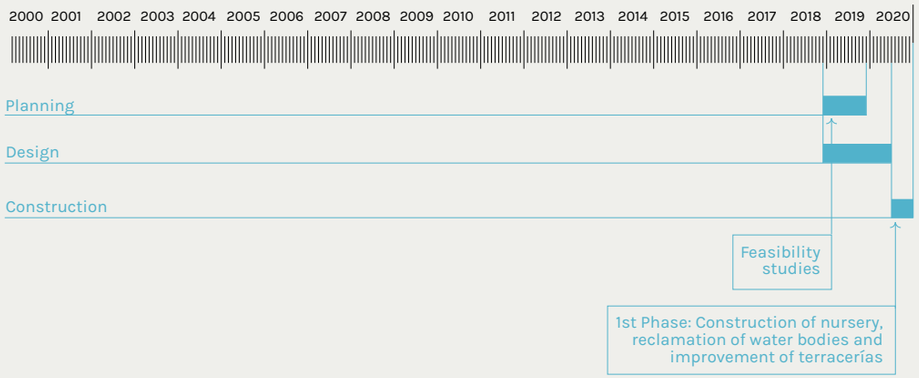
Estrategia general

for the first stage of 2020-2021 and a phased approach for the subsequent stages, the project seeks to materialize by 2028 with approximately 600ha of sports and cultural facilities, environmental restoration of more than 5,000ha of biocultural reserve areas, and up to 2,500ha designated to maintain bodies of water, including regulating and recovering lagoons and wetlands.

**5,000+ ha of biocultural reserve and enviornmental restoration**

## COSTS AND MAINTENANCE

One of the main concerns for the Lake Texcoco Ecological Park and its future development is its daily operation and long-term maintenance. However, the extension of the site's boundaries, designated for solar farms, will serve as a complementary source of income through the generation of clean and renewable energy. In addition to facilitating a self-sufficient energy model, it will also create a circular economic and environmental system.





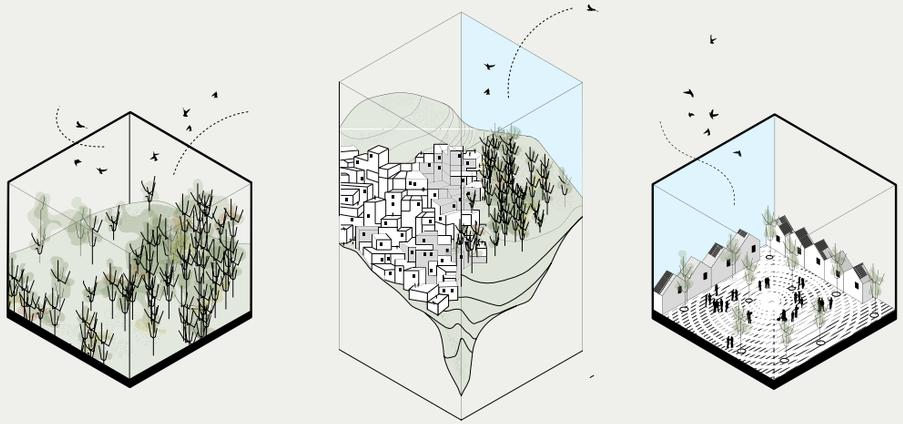





## PROPAGATION ZONES FOR TERRESTIAL AND AQUATIC SPECIES FOR REPRODUCTION

As part of the first phase, the construction of a structure for the reproduction of halophytic vegetation was considered to provide species for the reforestation of the site.

INTERVENTION AREAS → WHERE



RESERVES SLOPES PLAZAS

ACTIVITIES → WHAT

Playgrounds · Cycling · Park · Trials · Overlook · Urban Forest · Ecological Corridor

ACTORS → WHO

Non-governmental Agencies · Civil society · Local government · Regional government

SCOPE → WHY

Reduce heat island effect · Promote healthy lifestyles · Improve connections to adjacent communities · Promote new types of social life · Increase biodiversity

MEANS AND METHODS → HOW

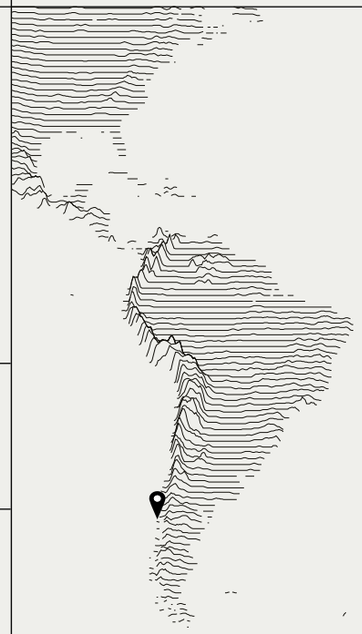
**SYSTEMIZE** —— Convert an urban hill in a vulnerable area into a park and green lung for the city.





PROJECT 3.2

# Parque Metropolitano Cerro Chena



**Site**

Comune of San Bernardo, Metropolitan Region of Santiago, Chile.

**Years**

2015 - 2022

**Team**

Regional Metropolitan Government of Santiago (GORE RMS).

**Coordinates**

33°35′35.27″S
70°44′36.26″W

PROJECT

**Elevation**

952 m

**Climate**

Temperate

**Area**

58 ha

**Cost**

389,490 USD (1st pilot)

**Impact**

3,497,122 habitants

**The island hills present an opportunity to integrate the open space network of the city at different scales, positively impacting the general population, as 70% of the total surface area of the hills are found within communes of medium and low socioeconomic strata.**

## CONTEXT

The Metropolitan Region of Santiago is located in the Central Valley of Chile between the Andes and the coastal mountain ranges. This geographical position implies that the region consists of island hills, which represents an enormous opportunity to integrate the network of open spaces at different scales. In response to the pressures on urban growth and natural systems, the Metropolitan Regional Government of Santiago proposed increasing green areas, mitigating environmental problems and improving access to the hills. As a result, in 2014, it promoted an environmental urban recovery project for four of these hills in the most deprived sectors of the region, inviting the municipalities involved to participate in the "Initiatives for Island Hills" competition. Its potential incorporation into the park system would increase the green area per inhabitant metric from 3.7m2 to approximately 11.7m2, reducing the deficit of green spaces and increasing the quality of life for the people of Santiago, given the social and environmental benefits associated with open spaces.[1] In addition, more than 70% of the total area of the hills are found

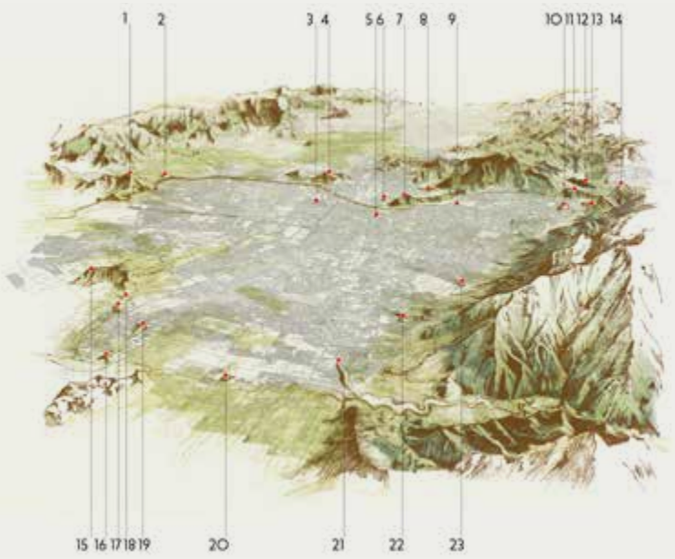
**1.** Fundación Cerros Isla, ed. Cerros Isla de Santiago. Construyendo un nuevo imaginario de ciudad a partir de su geografia. ARQ, Santiago, 2017. Datos Centro de Inteligencia Territorial UAI. Plano de estratos socio económicos por quintil de Santiago, basado en casen 2011. (2012)







1) CERRO LO AGUIRRE
2) CERRO AMAPOLA
3) CERRO NAVIA
4) CERRO RENCA
5) CERRO SANTA LUCIA
6) CERRO BLANCO
7) CERRO SAN CRISTOBAL
8) CERRO RINCONADA
9) CERRO SAN LUIS
10) CERRO CALAN
11) CERRO ALVARADO
12) CERRO DEL MEDIO
13) CERRO LOS PIQUES
14) CERRO DIECIOCHO
15) CERRO CHENA
16) CERRO LOS MORROS
17) CERRO ADASME
18) CERRO HASBUN
19) CERRO NEGRO
20) CERRO LAS CABRAS
21) CERRO LA BALLENA
22) CERRO CHEQUEN
23) CERRO JARDIN ALTO




↑ System of hills around Santiago
Image: Cerros Islas Foundation

↓ First Pilot of the Masterplan of Cerro Chena.
Photo: GORE RMS

in communes of medium and low socioeconomic strata, whose average green areas per inhabitant are significantly lower than that of the more affluent communes. In this sense, the island hills present a notable resource for reversing inequality and promoting principles of equity in urban development processes.[2]

The municipalities of Renca, San Bernardo, Calera de Tango, Recoleta, and Puente Alto presented their proposals. These had to address three main themes: the potential of the place and its opportunities; ideas for the hills and definitions of landscape and urban design; and finally, a demonstration of community commitment. A jury made up of representatives from the public and private sectors, experts in heritage, urban planning, and citizen participation chose Cerro Isla Chena as the winner. Among the characteristics that stood out was the joint work of the municipalities of San Bernardo and Calera de Tango in a holistic plan that accommodated regulations and restored the ecological value of the territory as a priority site within the Regional Biodiversity Strategy. After the competition, the creation of a Board of Directors was proposed to join forces with the Friends of Chena Association to support the phased development of the project.

## SOLUTION

An interdisciplinary team from the municipalities of San Bernardo and Calera de Tango, the Ministry of Housing and Urbanism, Parquemet, the National Forestry Corporation, and the Regional Government prepared a Master Plan for the 1,476ha of Cerro Chena, which was approved by the Council Directive in March 2015. The Plan for the hill was based on the winning proposal and consisted of four major interventions: a Metropolitan Park area, a heritage area on the southern slope, an ecological preservation area in the western slope for protection of biodiversity, and a designated green area within the urban expansion zone declared in the intercommunal regulatory plan.[3] In addition, observation trails and tours were proposed along with cable car access to the top of the hill.

**12,800 trees were planted, as a part of a forestation plan with native species.**

**2.** Forray et al., "Plan de Integración de los Cerros Islas al sistema de áreas verdes de Santiago". En: Centro de Políticas Públicas uc (ed). Concurso Políticas Públicas 2012, Propuestas para Chile. (Santiago: Pontificia Universidad Católica de Chile, 2012): 177-209 citado en Fundación Cerros Isla, ed. Cerros Isla de Santiago. Construyendo un nuevo imaginario de ciudad a partir de su geografía.

**3.** Gobierno Regional Metropolitano de Santiago "Plan maestro Cerro Chena"- Proyecto Parque Metropolitano Cerro Chena, consultado el 5 de octubre de 2020, https://www.gobiernosantiago.cl/plan-maestro-cerro-chena-05-03-2015_rrv/.





## CONSTRUCTION AND IMPLEMENTATION PROCESS

Based on the Master Plan of Cerro Chena, the first project of the management plan was developed as a pilot program of simple and rapid execution and a "work of trust." With an investment of 389,490 USD, a new children's play area was built and inaugurated in January 2016, which led to an increase in park use by the community. A second initiative was implemented in November 2017 and included the installation of water games and two new hygienic service modules, financed as a compensation measure for the nearby Autopista Central. Together, both initiatives doubled the number of visitors to the park. In addition, as further compensation for the highway, the Eucalyptus Walkway was built in 2018, improving pedestrian accessibility to the park.

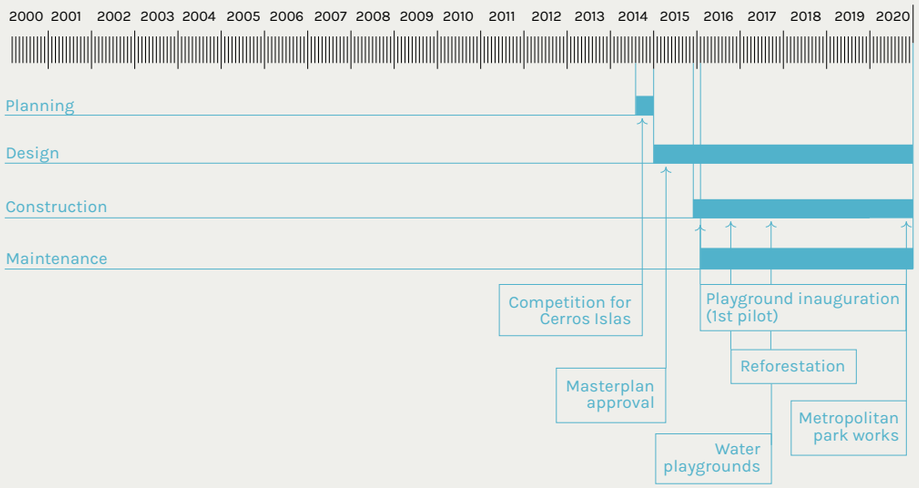
Cerro Chena stands out for the social, cultural, and historical values that this natural space provides for the community, which is manifested through the group "Amigos del Chena," who began a process of reforestation of the hill in the 1980s. In 2016, the Cultiva Corporation became interested in channeling private resources to reforest Cerro Chena in a participatory manner. The reforestation, which consisted of 12,800 native trees, was carried out with the collaboration of 450 boys and girls.

In parallel, with significant participation from the community, the design of the architecture and features of the 58 heaters of the South Metropolitan Park was developed and defined as the initial project of the Master Plan. The park project includes sports and recreational areas, a lagoon, exploratory trails, an environmental education area, a picnic area, and access to summits through viewpoints, among other features. Once the works are finished, they will be managed by Parquemet (MINVU) as part of its network of urban parks. The Master Plan is considering a second stage of the 38-ha park, which includes a human rights memorial, access to the highest peak, and the creation of the Pucará Intercultural Park on Cerro Chena.

## ENVIRONMENTAL AND SOCIAL BENEFITS

The proposal seeks to transform Cerro Chena into a new recreational center at the metropolitan scale, offering the possibility of developing sports, cultural and leisure activities, while responding to the needs expressed by the community of achieving urban, social, and environmental integration. It proposes enhancing elements of the landscape, ensuring their continuity and maintenance over time, and allowing citizens to enjoy the hill as a public space. In addition, the project facilitates the restoration of the existing ecosystem. The project demonstrates the potential of capitalizing on the possibilities of the hill as a park for recreational use, creating a new synergy with the ecosystem and integrating the attributes of the native landscape into the regeneration of a degraded urban area.

**The implemented pilot projects include playgrounds, water play, hygienic services, and a walkway.**





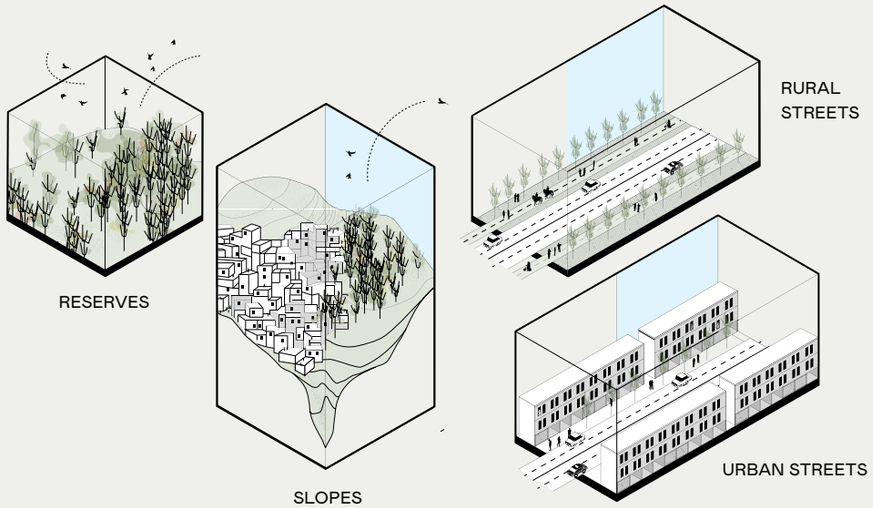





↑ Reforestation of Cerro Chena
Photo: GORE RMS

↓ Implemented pilot projects: Playgrounds, water play, and services of Southern Metropolitan Park
Photo: GORE RMS

## INTERVENTION AREAS → WHERE




## ACTIVITIES → WHAT

Cycling · Park · Trails · Overlook · Urban forest · Garden · Ecological corridor

## ACTORS → WHO

Academia · Civil society · Local government · Regional government

## SCOPE → WHY

Promote healthy lifestyles · Improve connections to adjacent communities · Promote new types of social life · Increase biodiversity · Create jobs

## MEANS AND METHODS → HOW

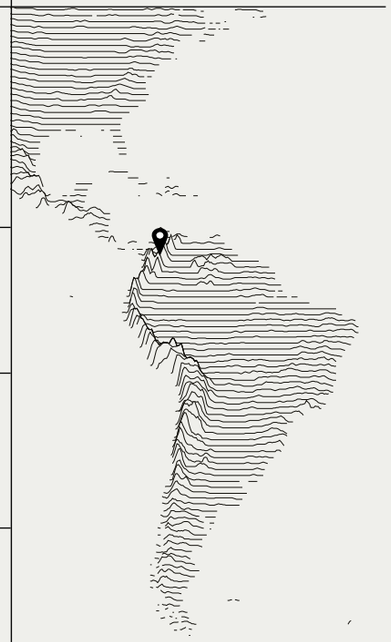
**PRESERVE** —— Transformation of the city edges in an ecological corridor and urban produtive park.





PROJECT 3.3

# Corredor Socioecológico de los Cerros Orientales



### Site

Bogotá, Colombia.

### Years

2007 - Present

### Team

**Director**: Diana Wiesner Ceballos, Arquitecta. Assistant: Otto Francisco Quintero. Coordination and cartography: Jean Carlo Sánchez Sanabria. **Social Consultant:** Andrés Mesa Ramírez. **Soil and Geotechnical Consultant:** Vicente Amortegui. **Support:** Ricardo Andrés Luna Nieto y Sebastián Puerta Giraldo. **Drawings:** Carmen Gil Von, Julián Restrepo, Pablo Forero, Daniel Azuero, Gaelle Berguin. **Illustrations:** Mateo Cely Tovar, Diana Wiesner. **Photos:** Jean Carlo Sánchez.

### Coordinates

4°39′32.42″N
74°02′48.09″W

## PROJECT

### Elevation

2,600 m

### Climate

Temperate oceanic, cold

### Area

415 hectares

### Cost

-

### Impact

Habitants of Bogotá

**The plan seeks to restore biodiversity as a strategy for social development and territorial appropriation by the communities. This implies generating the largest ecological and recreational corridor for public use in the city.**



## BACKGROUND

The eastern hills of Bogotá compose a set of environmental, economic, and aesthetic values. They provide a natural landscape and environmental services to the capital city of the country, making them critical elements of the ecological heritage of the region. Although the border area or border corridor between the city and the forest reserve of the eastern hills, also known as the foot of the slope, once had the greatest diversity of the high Andean forest, its substantial alteration over time has made it one of the most degraded areas of the entire ecosystem. While this intermediate area forms a corridor of flora and fauna and a site with enormous potential, it also has great fragilities given that 96% of the native plant cover has been replaced with infrastructure related to urban development, such as quarries, roads, and human settlements that prevent biological connections between the hills and the city.





↑ Planning Rendering: 53 Kilometers of Socioecological Corridor

↓ Planning Rendering: Farming

The proposal is the product of the Zonal Ordering Plan and consists of a corridor that has a coverage area of 415ha and is located along 53km of the western edge of the protective forest reserve and on the eastern edge of Bogotá's urban land. The importance of this corridor lies in its status as a regional biogeographic platform, as well as its environmental, hydrological, symbolic, and scenic values.

## SOLUTION

In 2006, a planning model was proposed to respond to the diagnostic work conducted by an interdisciplinary team after touring the study area to detect its potentialities and weaknesses. The model sought to restore biodiversity as a strategy for social development and territorial appropriation by adjacent communities. This implied creating the largest ecological and recreational corridor in the city for public benefit and established





a new Special Management Area[1] – called the Cerros Orientales Ecological and Recreational Corridor – which had to be integrated either as protected land in the case it became part of the adaptation strip, or as an Priority Public Occupation Area, if integrated into the Forest Reserve.

Three strategies define the model: the first is an environmental and biophysical strategy, which seeks to increase ecological connectivity and progressively restore the altered ecosystem at the foot of the slope; the second, a socio-cultural strategy that seeks to foster social development, territorial appropriation, participatory planning, sustainability, and the containment of urban expansion through the city's Edge Pact, and finally a spatial strategy that seeks to physically demarcate the border of the city and the reserve and make it available for public use and appropriation as a citizen oversight belt through mobility, recreation, education, culture, and tourism projects.

1. As established in the POT for the Bogota River.

Garden in Umbral Cultural Horizontes Reserve
Photo: Leonardo Centeno
v

## ENVIRONMENTAL AND SOCIAL BENEFITS

The corridor seeks to guarantee the preservation of the Cerros Orientales Forest Reserve through the creation of a public property corridor that establishes the delimitation of urban uses. Among the benefits of the proposal are ecological quality improvements, increase in biodiversity, and the restoration of the native forest, actions that will support recreational activities of contemplation, environmental education, and research. Other benefits include the promotion of social development, security and appropriation associated with the corridor, quality of life improvements (increase in the area of public space per inhabitant from 3.73m2 to 4.37m2 of park per inhabitant), public health, visual and air quality, as well as the urban articulation and containment of urban development, equity, the reduction of natural risks, and the creation of opportunities in the area of influence.

**3 ha of natural reserve (pilot plan).**

**1st Natural Reserve of the Civil Society in Bogotá.**

**500+ planted trees of 15 native species.**

## CONSTRUCTION AND IMPLEMENTATION PROCESS. A PILOT PROJECT: THE HORIZONTES CULTURAL THRESHOLD RESERVE

The Foundation Fundación Cerros de Bogotá is carrying forward this project as part as an overall proposal to restore and consolidate Bogota's hills. The Foundation strengthened its networks with local communities, research centers, universities, and the local authority, emphasizing the importance of consolidating the socio-ecological corridor. One of the main strategies was to adopt a fragment of the Cerros and turn it into a participatory restoration node to build community.

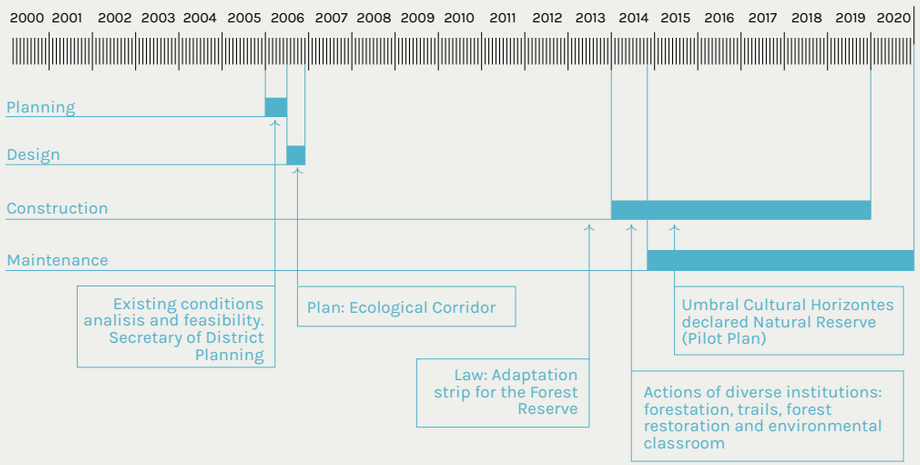
In 2013, the State Council established that the Bosque Oriental de Bogotá Protective Forest Reserve, specifically its Adaptation Strip, should become a "priority public occupation area, in order to project a large zone of ecological use for the inhabitants of the city." The Horizontes Cultural Threshold Reserve was declared a Civil Society Nature Reserve through Resolution 101 of July 30, 2015, and was designated as a leisure space for the community and coupled as a pilot project for the management and handling of the Cerros Orientales. The












↓ Aerial view of the Reserve

reserve implemented a management model for public use of a private property, demonstrating the possibility of managing and conserving territories within an urban area. The reserve consists of a laboratory for collaborative transformation and a space to host civic and ecological educational opportunities, as well as artistic, contemplative, hiking, and restoration activities.

The Horizontes Cultural Threshold Reserve serves as a means for the Foundation to test hypotheses and management practices, experimenting with the public policies that it promotes and/or those that it monitors (commitments derived from the ruling of the Council of State mentioned above). These practices stem from the possibility of developing a sustainable territory and public space for leisure, generating knowledge and fostering ecological culture as a form of citizen appropriation of nature, planning territories around hydrology, and using art as a tool to generate landscape and channel educational and playful processes.

In the last three years, the Foundation and its friends have planted more than 500 trees of fifteen species native to the hills. A nursery was created to obtain highly diverse material, although it has had sustainability difficulties. Among the findings and lessons that resonated from this process and the pilot project was the role of the community as an essential component of the restoration process, which included their participation and the training of leaders in abutting neighborhoods as producers of native plant material from the hills.

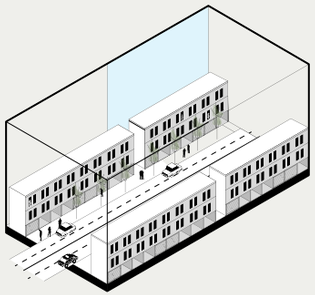




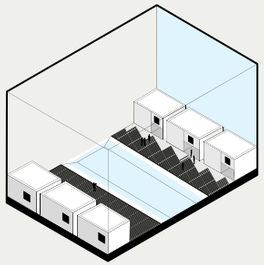


Umbral Cultural Horizontes Reserve
Photos: Carlos Lince

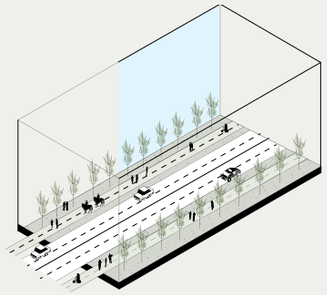
## AREAS OF INTERVENTION → WHERE



URBAN STREETS



INTERSTITIAL SPACES



RURAL STREETS

## ACTIVITIES → WHAT

Cycleway

Park

Trail

Urban Forest

Ecological corridor

## ACTORS → WHO

Academia

Civil Society

Local government

Regional government

## SCOPE → WHY

Promote healthy lifestyles

Improve connections to adjacent communities

Improve the productivity of underuitilized spaces

## MEANS AND METHODS → HOW

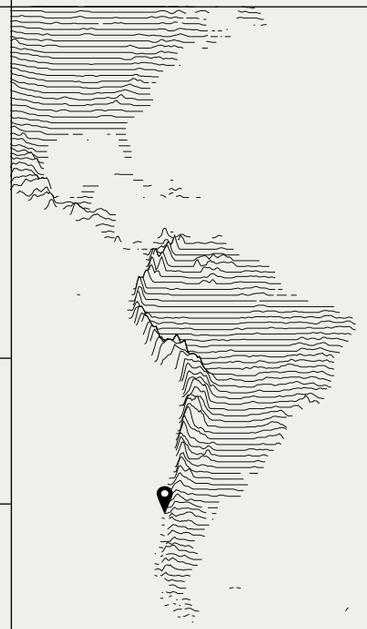
**STITCH** —— Conversion of a fluvial edge into a cycleway and linear park that cross the metropolitan city.





PROJECT 3.4

# Mapocho 42K



### Site

Santiago, Chile.

### Years

2010 - Present

### Team

M42K_Lab UC. Universidad Católica de Chile. **Director:** Sandra Iturriaga del Campo.

www.mapocho42k.cl

### Coordinates

33°24′43.29″s
70°43′54.64″W

## PROJECT

### Elevation

460 - 800 m

### Climate

Mediterranean

### Area

20km and 24.5 ha implemented

### Cost

100 USD / m²

### Impact

Habitants of Santiago

**The project proposes to create a riverside public space at the metropolitan scale through the recovery of 42km of the Mapocho River as it passes through the city. The large linear park and environmental infrastructure aim to reduce urban and social inequality.**

## CONTEXT

The Mapocho River is an essential and emblematic geographic element in the composition of the urban landscape of Santiago. However, as a consequence of the unregulated growth of the city over the years, the riverine space has transformed into a fragmented urban and social residual space with different types of occupation that interrupt its edges, making it inaccessible to the inhabitants of the city.

In this context, the Mapocho 42K Project arose, based on an academic investigation carried out in 2009 in an undergraduate seminar at the School of Architecture of the Pontifical Catholic University of Chile. The initial proposition was to study the Mapocho River and its banks through a detailed representation of the territory and its built environment. The







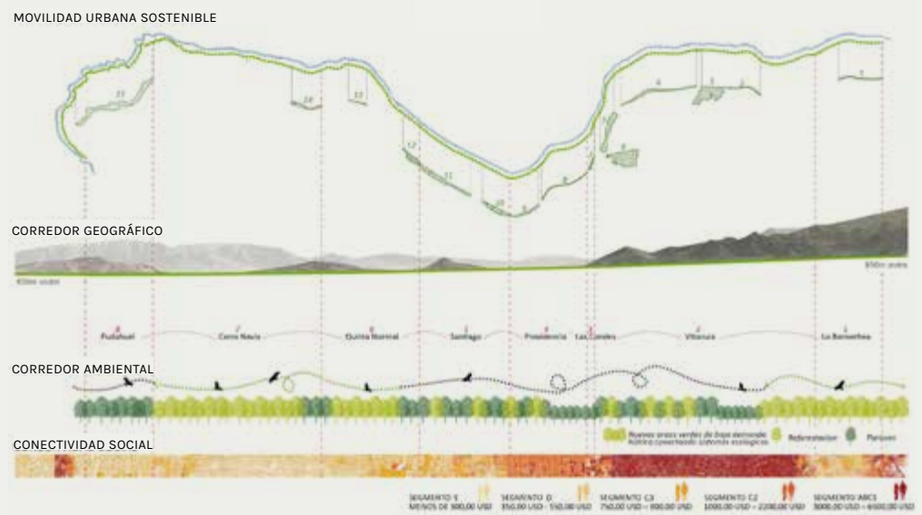

A Alto de la Cuenca del Mapocho
B Sitio Prioritario El Roble

a Río Molina
b Río San Francisco
c Estero El Arrayán
d Estero Lampa

1 La Ermita_nacimiento río Mapocho
2 Santuario de la naturaleza El Arrayán
3 Parque recreativo laguna Carén
4 Reconversión ex Mina La Africana

↑ Prioritized areas for conversion for biodiversity. M42K_Lab UC

↓ Geographic promenade: environmental corridor and social connector. M42K_Lab UC



first step towards transformation was to address the challenge of representing the river as an urban infrastructure. As a result, a complete and detailed cartography of the Mapocho was executed, which later served as the basis to approach the design of its borders.

In subsequent years, a group of architects, professionals, and teachers developed and finalized a project to rehabilitate the banks of the Mapocho River and create a riverside public space at a metropolitan scale.

## SOLUTION

The project proposed the creation of a metropolitan promenade for public use and recreation for pedestrians and cyclists through the conditioning of the banks of the Mapocho River, with a focus on the urbanized south bank. The main objective was to achieve landscape, geographic, and social continuity to reduce the urban inequality gap, connecting eleven communes of different social and topographical strata. The implementation of a greenway or cycle park was intended to serve as an ecological corridor





that would improve quality of life and social equity through the connection and completion of all existing and potential parks, fragmented areas, vacant lots, and inaccessible areas located along the banks of the river.

## ENVIRONMENTAL AND SOCIAL BENEFITS

The project simultaneously restores environmental, social, urban, and landscape values through the riverine connection. On one hand, the public space is memorialized at a grand scale as a large linear park and environmental infrastructure that integrates other public spaces of different scales and conglomerates them into a system of green spaces for Santiago. On the other hand, the project consolidates a sustainable and universal mobility corridor, creating a safe space through which to explore the city. The Cicloparque makes it possible to increase accessibility and opportunities for recreation and leisure around the banks of the river in lower-income districts, helping to reduce urban and social inequality.




Masterplan Mapocho 42 K.
M42K_Lab UC
www.mapocho42k.cl

Since its implementation, the Mapocho 42K Corridor has seen exponential growth in usage and facilitated pedestrian and cycle access to the Borderío Park System (six months after its implementation, the influx of cyclists increased from 3,500 to 10,500 cyclists per day in the central section alone).

## DESIGN AND IMPLEMENTATION PROCESS

The project was designed and executed in stages and sections as a collective project, with the participation of actors from both the public and private sectors. In a first stage, the Strategic Plan for the entire river was drawn up, evaluating the feasibility of the project and the regulatory, legal, urban, and landscape aspects.[1] For this, a Strategic Committee and a Collective Agreement were created, summoning public actors to discuss the Plan. At the end of this stage, the Ministry of Housing allocated funds for the execution of an initial phase of projects. As a result, during the second stage, seven stretches along the river were selected to implement a total of 20km of cycle park. The implementation process consisted of developing detailed design proposals with engineering, and outlining the design criteria for the entire route through two key concepts[2]: leveraging the conditions of an urban balcony open to the geography and a continuous tree-lined corridor. The design strategy was open-ended and consisted of a kit of parts that was agreed upon in conjunction with the municipalities. While it gave the entirety of the corridor a uniform identity, it also facilitated the implementation and maintenance processes for all the municipalities. The unifying element was the cycle path, which has a constant width of 3m. The complementary planting palette was curated to include species suitable to the local semi-arid climate with low water requirements.[3]

Despite the changes in the public administration, the Mapocho 42K project has managed to continue over time with the implementation of successive sections. The collective consensus to maintain an understanding of the river as a public space among the various communes

**11 communes of different social strata and topographies.**

**1st phase: Strategic Plan for the totality of the river.**

**2nd phase: 7 stretches were selected to implement 20km of cycleway.**

**1.** Iturragia del Campo, Sandra (2017) "MAPOCHO 42K. Cicloparque Riberas del Mapocho." Santiago de Chile, Editorial ARQ, 144 p. [link: http://www.edicionesarq.cl/2018/mapocho-42k/]

**2.** Ibid.

**3.** Ibid.



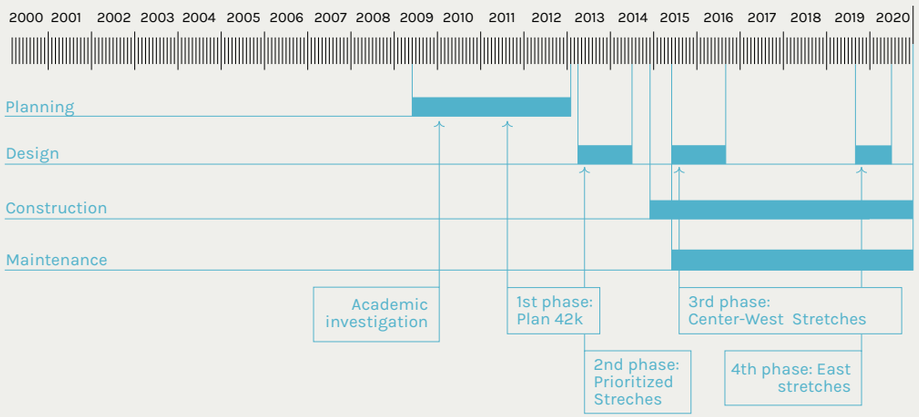





Parque 15 de Octubre
Photos: Archive REP-BM

and actors has been fundamental in the success of its continued implementation, allowing us to imagine the implementation of the entirety of this green infrastructure in the not-too-distant future.

**Vegetation areas incorporate species suited for the local climate, with low maintenance requirements.**







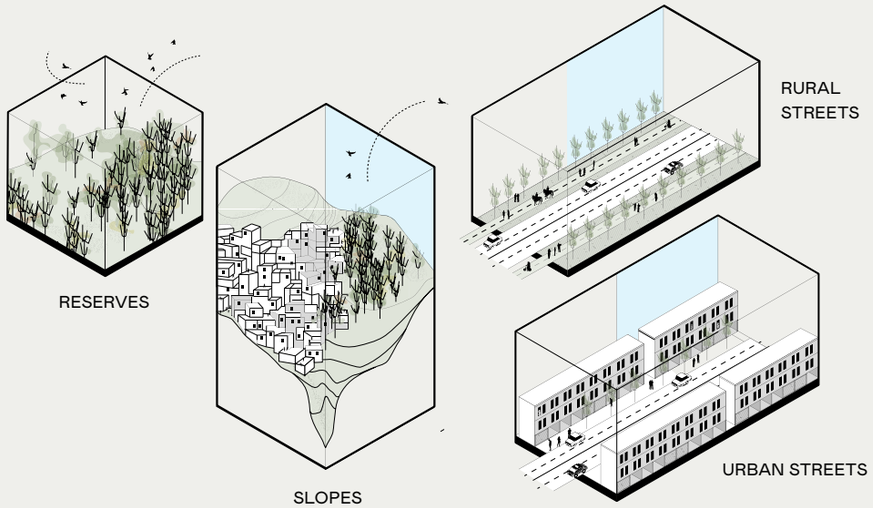



## CYCLEWAY COMPONENTS

1. **Cycle ride**
   Red pigmented asphalt
   + M42k concrete screeds
   Overall width: 3.0 - 3.40m
2. **M42k screeds**
   Prefabricated concrete
   Length: 20 / 100 cm
3. **Pedestrian promenade**
   Cobblestone, concrete
   patisserie, putty,
   washed concrete
   Minimum width: 2.40 m
4. **Intermediate girdles**
   Cycle ride and ride
   separator
   pedestrian in parks
   draining egg
   and low shrubby vegetation
5. **Green Corridor**
   Introduced vegetation from
   shade / native vegetation
   low water demand
6. **Urban furniture**
   Concrete seat
   prefabricated
7. **Luminaires**
   Single / double lighting
   for the bike ride and
   the pedestrian promenade
8. **M42k studs**
   Elements of continuity
   and cycle ride link and
   areas shared pedestrian
9. **Bike rails**
   Location in squares
   from the edge of the river
10. **Fountains**
    Location along
    of riverside parks
11. **M42k signaling**
    Signaling system
    vertical and demarcation
    horizontal for greenways,
    considering inclusive use

Cycleway Components
M42K_Lab UC
Photo: M24K Lab. C. Correa

AREAS OF INTERVENTION → WHERE




ACTIVITIES → WHAT

Urban forest

Ecological corridor

ACTORS → WHO

Academy

Local goverment

Regional government

SCOPE → WHY

Promote healthy lifestyles

Improve connection to adjacent communities

Increase productivity of underutilized sites

Stabilize neighborhoods

Increase biodiversity

MEANS AND METHODS → HOW

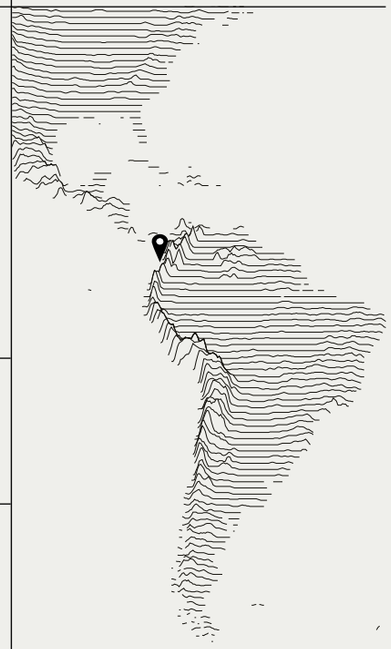
**PLAN** —— Formulation of a strategic plan to orient the territorial development in relation to the geographic challenges and climate change.





PROJECT 3.5

# BIO 2030 Plan Director Medellín, Valle de Aburrá



## Site

Medellín, Colombia.

## Years

2011 - Present

## Team

**Leadership:** Área Metropolitana del Valle de Aburrá y el Municipio de Medellín.
**Designer and Technical Coordination:** Urbam, Center of Urban Studies and Envrionment of the EAFIT University.

## Coordinates

6°14′50.77″N
75°33′56.94″W

PROJECT

## Elevation

1,495 m

## Climate

Tropical

## Area

-

## Cost

-

## Impact

Habitants of Medellin

# The BIO 2030 Plan for Medellín is a long-term strategic planning process centered around common goals to meet the challenges that the geography and climate change impose.

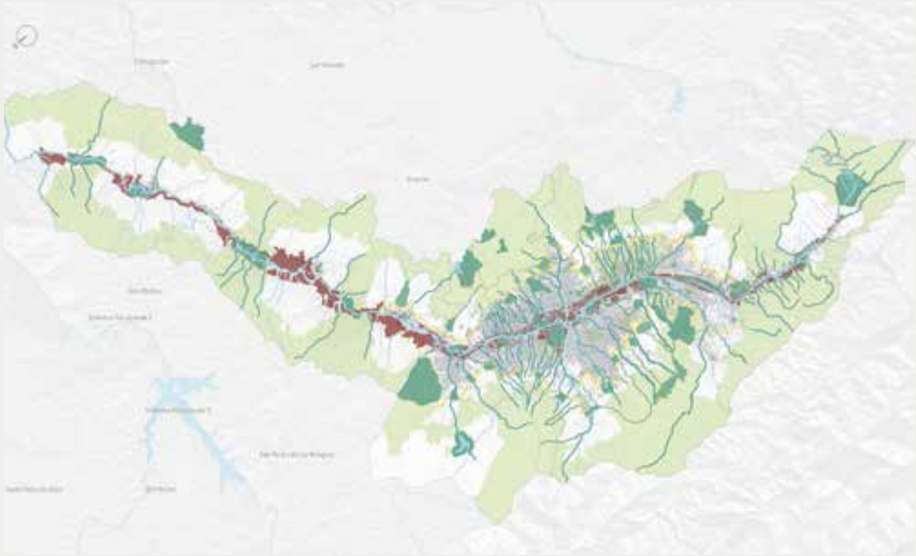


## CONTEXT

For more than thirty years, the Aburrá Valley Metropolitan Area institution (AMVA) has sought a collective work plan of all the municipalities that comprise it. As a result, the Bio 2030 Plan arose as an agreement of the mayors of the Aburrá Valley to work for the sustainability of the region. The Plan was led by the Mayor's Office of Medellín and the Metropolitan Area of the Valle de Aburrá under the technical coordination of the Center for Urban Environmental Studies, URBAM, of EAFIT University. The project consists of a territorial planning tool at the metropolitan scale that responds to the great challenges presented by the phenomenon of metropolitanization and proposes to overcome the existing administrative limits to harmoniously direct the growth of the ten municipalities that occupy the Valley according to a common vision.







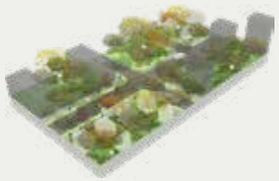
↑ Plan of the Ecological Corridor Armatures for the territorial organization. URBAM, BIO 2030.

↓ Criteria of Valle occupation

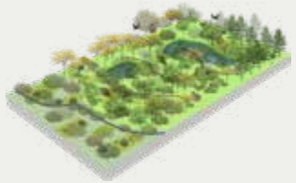
Transversal Ecological Corridor

Central Urban Park

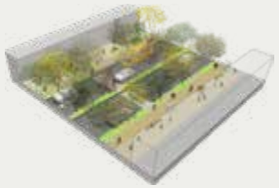
Ecological Corridor of the Quebrada



Urban Forest



Metropolitan Ecological Park



Green Corridor for the Bus Route

## SOLUTION

The BIO 2030 Medellín Master Plan is a long-term strategic planning process aimed at mobilizing municipalities, society, and its institutions around common goals to meet the challenges that the geography and climate change impose, in addition to those that derive from the processes of metropolitanization and globalization. The central proposal of BIO 2030 is to complement, through the structuring systems of Environment, Landscape and Public Space, and Mobility and Transport, as well as the strategic river and hillside scenarios, the occupation model established by the Metropolitan Guidelines for Territorial Planning, aimed at promoting a compact region with inward growth, in consideration of nature and the environment to reduce territorial imbalances and social segregation.

Once the diagnosis of the Valley was completed and its main challenges were defined, the Plan divided the occupation criteria into two systems that are defined as "structuring the metropolitan occupation." The first of these systems is the Environment, Landscape and Public Space, which consists of the main structure of the urban, suburban, and rural occupation of the valley. The system proposed to form a network of metropolitan ecological corridors articulated into the public space to promote biodiversity and essential ecological processes and provide environmental services throughout the territory. It also sought to expand the experience of the city as a public meeting place, ensure the integration between urban forms and the natural hydrological system, promote the safe occupation of the territory, strengthen the knowledge of disaster risk to carry out prospective planning, and guarantee eco-efficiency and the sustainable supply of natural resources.

In addition, the plan promoted a secondary structuring system for metropolitan occupation, which consisted of Mobility and Transport, and sought to reinforce and promote connectivity and both regional and international multimodality within the Valle de Aburrá, promote accessibility to

**Two structuring systems of metropolitan occupation: (i) Environment, Landscape, Public Space, and (ii) Mobility and Transportation.**





public transport. It also sought to humanize transport infrastructure and mitigate social, economic, and environmental impacts by promoting energy efficiency and sustainable travel.

The Plan also included two geographical scenarios of a strategic nature, including the river and hillside, which directly inform the occupation of the Valley. While the river forms the axis of transformations at the metropolitan scale and in the heart of the metropolis, the hillside presents diverse forms and geographical characteristics that severely impact the urbanization process based on its formal or informal origin. As a result, the Plan establishes a strategy to contain urban expansion and growth along the edges on the slopes, reduce risk, restore ecological integrity, and consolidate the viable settlements.

## CONSTRUCTION AND IMPLEMENTATION PROCESS

BIO 2030 selected the Northeastern community of Medellín as a place to study and implement exemplary strategies to control the growth of the informal urban fringe. The proposed occupation model was derived from the combination of two variables: urban occupation and hydro-geological constraints. The general proposal for the sector was based on the differentiated treatment of three linear strips that respond to the difficult geographical conditions of the territory.

## ENVIRONMENTAL AND SOCIAL BENEFITS

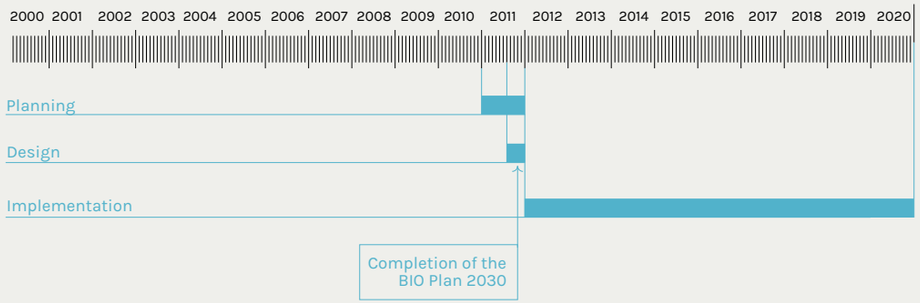
Through its structuring systems and strategic scenarios, the 2030 Plan promotes greater viability for environmental protection zones, the prevention of the unsafe occupation of hillsides and withdrawals from the hydrological system, and improves the water quality of the streams. favoring infiltration in aquifer recharge areas, improvement of microclimates, and protection of natural and cultural heritage.









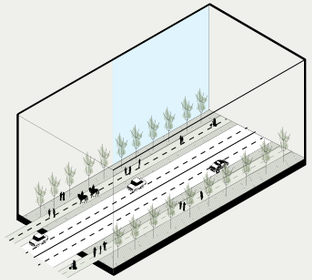



## Two geographic scenarios of strategic character: the river and the hillside

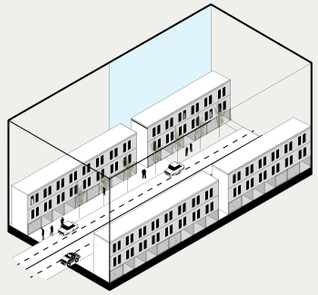
Proposal of opening stations to connect to the Ronda del Río. URBAM, BIO 2030

AREAS OF INTERVENTION → WHERE

SLOPES



RURAL STREETS



URBAN STREETS

ACTIVITIES → WHAT

Park

Overlook

Urban forest

ACTORS → WHO

Academy

Local government

Federal government

SCOPE → WHY

Improve connections to adjacent communities

Stabilize neighborhoods

Research and testing + new ideas

MEANS AND METHODS → HOW

**PREVENT** —— Analysis to prevent risk or erosion in mountains and development of an early alarm system for earthquakes.





PROJECT 3.6

# Rehabitar la montaña

## Site

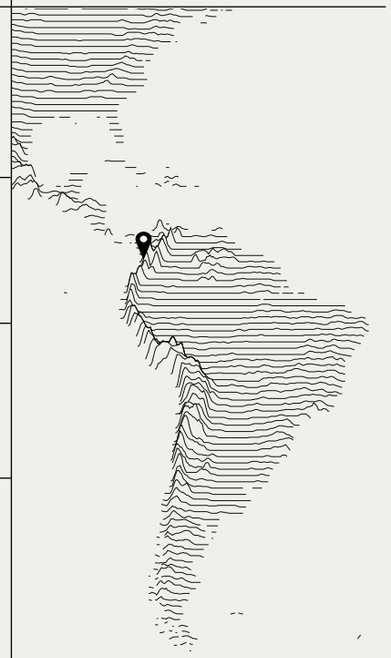
Medellín, Colombia.

## Years

2013 - Present

## Team

Urbam EAFIT, Alcaldía de Medellín y Universidad Leibniz Hannover. **Inform@Risk:** Leibniz Universität Hannover; Technische Hochschule Deggendorf; Technical University of Munich; German Aerspace Center, German Remote Sensing Data; AlpGeorisk; Sachverständigen Büro für Leftbildauswertung und Umweltfragen; Universidad EAFIT; Departamento Administrativo de Gestión del Riesgo de Desastres (DAGRD); Sistema de Alerta Temprana del Valle de Aburrá (SIATA); Departamento Administrativo de Planeación; Corporación Convivamos; Corporación Tejearaña; Sociedad Colombiana de Geología.



## Coordinates

6°16′38.15″N
75°32′15.68″W

PROJECT

## Elevation

2,000 m

## Climate

Tropical

## Area

20 ha (piloto)

## Cost

2,000,000 USD (pilot)

## Impact

300 to 500 families

# Reinhabiting the Mountain highlights the risks of landslides for inhabitants of the hillsides that face Medellín. Its pilot project detects slope movements and allows accurate forecasts for alerts.

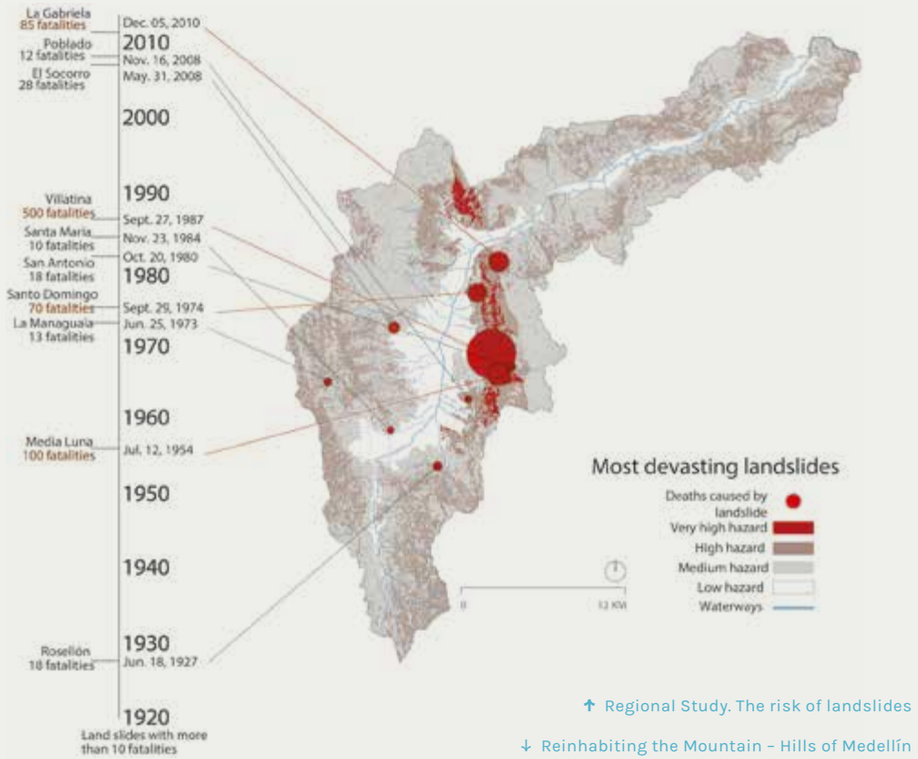
## CONTEXT

The natural environment of Medellín is defined by the hydrographic basin of the Aburrá River, a narrow and long valley, with an altitude of 1,650 meters above sea level, mountains that rise up to 2,500 meters, and high rainfall. This particular geography translates into two types of natural hazards for the valley: landslides and floods. This situation is especially critical in the upper parts of the northern and central eastern slopes of the valley, with high concentrations of informal urbanization. In this context, the slopes represent the natural destiny of the population that, displaced from the countryside, have not been able to integrate into the city. According to 2013 figures from the Medellín Planning Secretariat, there were around 27,000 homes located in high-risk and non-mitigable areas.










↑ Regional Study. The risk of landslides

↓ Reinhabiting the Mountain – Hills of Medellín

## VISION

In 2013, an interdisciplinary team from the Center for Urban and Environmental Studies (URBAM) of the EAFIT University, the Leibniz University of Hannover in Germany, and the Planning Secretariat of Medellín undertook a phased study and research project to propose risk mitigation strategies focused on the anticipation, direction, and disincentivization of occupation and to contribute to the technical and political discussion of the management of informal borders. In the first phase of Reinhabiting the Mountain, landslide risk phenomena were analyzed in a regional study. In the second phase, the La Cruz neighborhood and the La Honda sector were chosen as study cases. As a result, five small-scale pilot projects were formulated to test the technical and social application of promising strategies.[1] The resulting pilot projects were as follows:

**1.** Claghorn, Joseph, Orsini, Francesco Maria, Restrepo, Carlos Alejandro Echeverri, & Werthmann, Christian. (2015). Rehabitar la Montaña: Strategies and processes for sustainable communities in the mountainous periphery of Medellín. Urbe. Revista Brasileira De Gestão Urbana, 8(1), 42-60.





1. Anticipate disasters: alarm system and evacuation.
2. Discourage occupation: ecological restoration and forestry.
3. Discourage occupation: urban agriculture.
4. Mitigate risk: rainwater management and slope stabilization.
5. Direct growth: development of lots with services and environmental adaptation.

## CONSTRUCTION AND IMPLEMENTATION PROCESS

The implementation of the first pilot project (anticipating disasters) called Inform@Risk began in March 2019 with the goal of developing a low-cost, low-maintenance Early Warning System (SAT) in the face of mass movements on the urban edge of Medellín in the Bello Oriente neighborhood within commune 3. Inform@Risk was the result of an international cooperation alliance between German


Longitudinal section of the study area. Pilot Inform@Risk, Bello Oriente neighborhood. Physical proposal for the appropriation of evacuation routes and community

and Colombian institutions. In 2018, entities from both countries jointly participated in a call for proposals from the German Federal Ministry for Education and Research – BMBF – and obtained 1.9 million Euros to finance this first pilot and operate it at the neighborhood level, with an impact of 20ha for 300 to 500 families. The pilot project was developed in a collaborative, inclusive, and transdisciplinary process that spanned three years and included the participation of multiple actors from academia, civil society, government, and the community at risk.

The Inform@Risk pilot project sought to develop an Early Warning and Monitoring System which is 1) socially integrated; 2) spatially integrated; 3) multi-scalar; 4) multi-sector; 5) accurate; 6) affordable; and 7) replicable. The project aims to develop an effective evacuation system tailored to the specific, complex, spatial and social conditions of informal settlements through a network of geosensors installed throughout the neighborhood.[2]

## ENVIRONMENTAL AND SOCIAL BENEFITS

Reinhabiting the Mountain provides guidelines for managing informal settlements in unconventional and innovative ways that are suited to the dynamics of the environment, including the anticipation of growth, preventing and discouraging occupation in high-hazard zones, preparing and training the community in the face of possible disasters, and directing growth to prevent hazards. In addition, it visualizes the risk of landslides to which inhabitants of the hillsides of Medellín are exposed. The resulting project proposals mitigate risk to provide safer and more dignified housing conditions for the community, such as slope stabilization, water management, waste management, and infrastructure improvements. For its part, the Early Warning System developed in the Inform@Risk pilot project detects the smallest of slope movements and enables accurate forecasts for alerts.[3]

The following stages and pilot projects of the plan – ecological restoration, sustainable forestry, bioengineering, slope stabilization, and stream stabilization – are proposals with high environmental and ecological impact that will generate solutions that respond to the logic of natural systems

**5 proposed pilot projects.**

**1 implemented pilot project: Inform@Risk to provide an early warning system for earthquakes.**

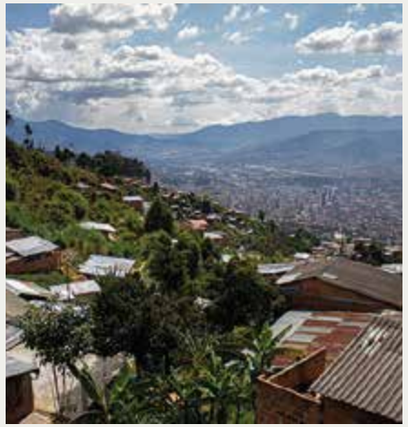
**2.** "Inform@Risk - Strengthening the Resilience of Informal Settlements against Slope Movements | CLIENT II", consultado el 23 de septiembre de 2020, https://www.bmbf-client.de/en/projects/informrisk.

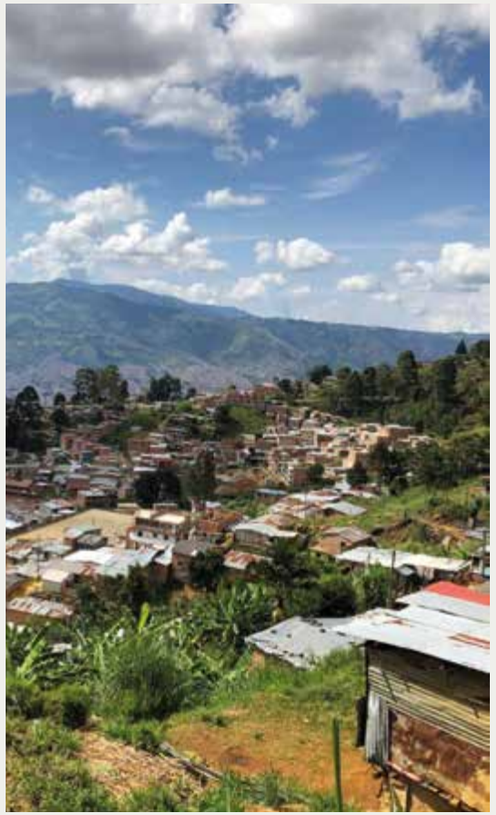
**3.** Ibid.





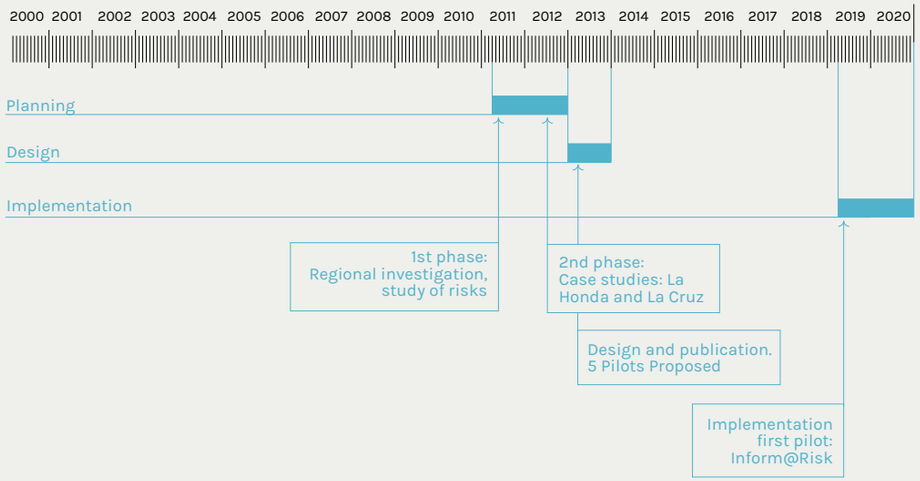






Pilot Inform@Risk,
Bello Oriente neighborhood

and high-risk areas, the ecosystem, and its hydrological dynamics. In addition, processes such as urban agriculture, forestry, and ecological corridors have been incorporated to promote resilience and economic sustainability. All outcomes are expected to have replicable technology and adaptable guidelines for multi-scalable and transferable applications.







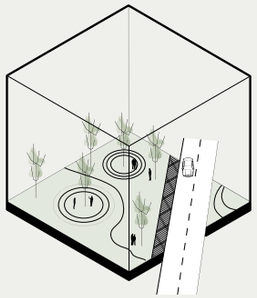
↑ Bello Oriente neighborhood and polygon of Pilot Project study

↓ Map of possible evacuation routes

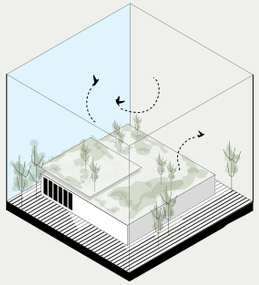


ECOLOGICAL DESIGN
BID

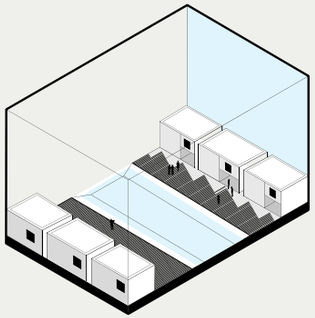
AREAS OF INTERVENTION → WHERE



ABANDONED SITES



EXTERIOR OF PUBLIC SPACES



INTERSTITIAL AREAS

ACTIVITIES → WHAT

Sports fields · Cultural center · Playgrounds · Garden · Park

ACTORES → QUIÉN

Non-governmental agencies · Civil society

SCOPE → WHY

Research and testing of new ideas · Promote new ways of social living · Stabilize neighborhoods · Reduce crime · Increase access to local food · Create jobs · Recycle waste

MEANS AND METHODS → HOW

**URBANIZE** —— Creation of community areas, waste management and urban agriculture, all in a process of ecological urbanization.





PROJECT 3.7

# Unión por la Urbanización Ecológica de Vila Nova Esperança

### Site

Vila Nova Esperança, São Paulo, Brazil.

### Years

2010 - Present

### Team

Asociación Independiente de Vila Nova Esperança
Instituto Lia Esperança.

### Coordinates

23°36′30.27″S
46°48′14.24″W

PROJECT

### Elevation

844 m

### Climate

Subtropical

### Area

73,000 m²

### Cost

-

### Impact

680 families

# The project of Ecological Urbanization seeks to implement the required facilities and infrastructure to achieve self-sufficiency of natural resources and optimize life in the community.



## BACKGROUND

Located west of the municipality of São Paulo, the land of Vila Nova Esperança (VNE) is located on top of a hill and has an approximate area of 73,000m2. The community emerged in 1960 with the arrival of the first inhabitants, and between 1993 and 2008, experienced significant population growth. In 2002, the Independent Association of Residents of Vila Nova Esperança was created, seeking to defend the rights of the community. In 2010, the residents of the VNE suffered a violent eviction attempt, which intensified the struggle that they had initiated along with other organizations, which included the use and recovery of empty spaces to avoid new occupations, reduce crime, and provide leisure areas for the inhabitants of the Villa.






↑ Map: Distribution of social infrastructures in the community

↓ Nursery, laguna and playgrounds, children's park, soccer field, construction of community gardens






## SOLUTION

The project Union for the Ecological Urbanization of Vila Nova Esperança focused on restructuring the favela by both designing and building the facilities and infrastructures that enabled the residents to develop a dignified life in harmony with nature, achieve self-sufficiency with natural resources, and thus optimize life in the community. As a result, the existing vacant spaces were analyzed, and certain uses were allocated to them in response to the needs of the Vila while considering the technical and economic viability and potential to balance the landscape and urban pressures. The idea of an Ecological Villa materialized these intentions with the implementation of a community garden, a nursery, environmental education, technology, solar energy, basic ecological sanitation, use of natural materials, and sustainability.

**The Villa Ecológica finalized its intentions with the implementation of a community garden, nursery, environmental education, solar power technology, basic ecological remediation, bioconstruction, and sustainability.**

## CONSTRUCTION AND IMPLEMENTATION PROCESS

Within two years of the creation of the Headquarters of the Vila Nova Esperança Independent Association in 2010, twenty-nine emergency homes were built by neighbors and volunteers. The urbanization process included the construction of communal spaces using technologies that respected the environment and had low economic cost and high social impact. Community facilities such as a seedling nursery, seed bank, community garden, experimental kitchen, and social cafeteria were created. In addition, a social cafeteria was provided to incorporate permaculture, agro-ecology, and bioconstruction techniques. Educational facilities such as a library, a training space for young people and adults, and a center for innovation in socio-environmental technology were also constructed in addition to recreational facilities such as a playground, squares, and an observation point. Public service facilities were also included, such as the renovation of the bus stop at the entrance to the community, installation of signs with street names, organization of house numbers, installation of an electrical network, and the construction of a masonry shelter to store rubbish bins.

## ENVIRONMENTAL AND SOCIAL BENEFITS

Transforming a precarious settlement into an ecological neighborhood through community action is innovative, as it demonstrates the possibility of living in greater harmony with nature and that this should not be a privilege limited to more affluent cities or populations. Promoting a popular ecosystemic neighborhood with an incentive for the local economy demonstrates that another way of life is possible and that low-income populations have the experience and capacity to be the protagonists of change in their own neighborhoods and serve as beacons to disseminate their knowledge for implementation in different contexts.

Vila Nova Esperança
Community Garden

## COSTS AND MAINTENANCE

Students from various national and international institutions use Vila Nova Esperança as a source of knowledge and a laboratory for sustainability and socio-environmental development projects. The developed projects have also contributed to assisting public authorities and the general society, as the community has served as an example of how its quality of life has improved, including access to their rights of housing, health, education, security, work, and environment.

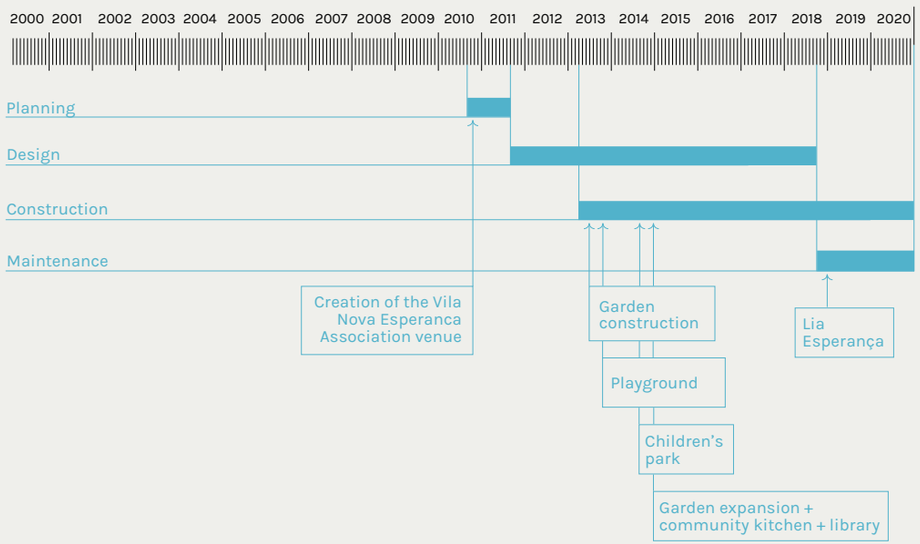
**The Project of Waste Management and Community Agriculture allowed the reutilization of materials and creation of jobs in the garden and kitchen.**





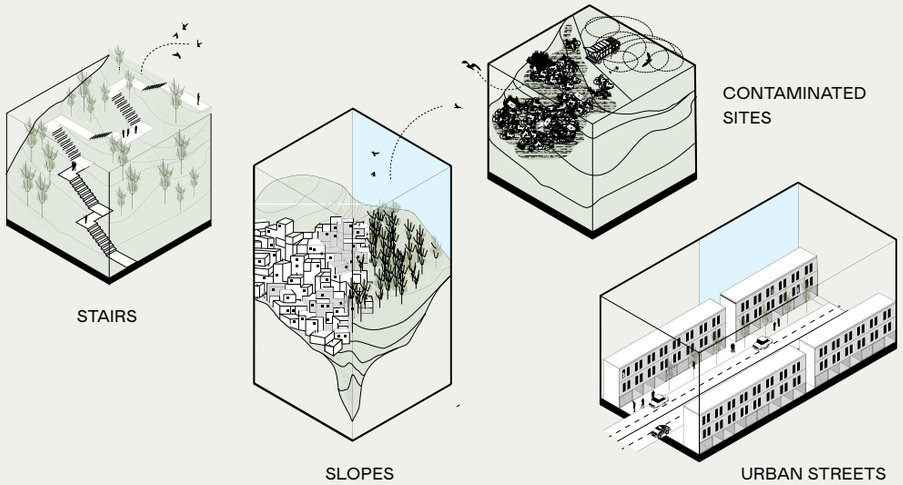







Institution Headquarters Lia Esperança, Kitchen, Library and Garden

## AREAS OF INTERVENTION → WHERE




## ACTIVITIES → WHAT

- Cycleway
- Park
- Trails
- Urban forest
- Ecological corridor
- Overlook

## ACTORS → WHO

- Local government
- Regional government
- Private companies
- Civil society
- Non-government agencies

## SCOPE → WHY

- Clean contaminated soil
- Manage and clean stormwater
- Promote new types of social life
- Improve connections to adjacent communities
- Promote new types of social life
- Increase biodiversity

## MEANS AND METHODS

**RENATURALIZE** —— Creation of shared streets along the margins of the rivers, regeneration of vegetation and prevention of contamination.





PROJECT 3.8

# Rutas Naturbanas

### Site

Metropolitan Area of San Jose, Costa Rica.

### Years

2015 - Present

### Team

Rutas Naturbanas Foundation, Federico Cartín and Eduardo Zúñiga (Personal Title), Dana Víquez and José Vargas (PPAR), Alonso Briceño (Río Urbano), Roberto Guzmán (Chepecletas), Carlos Velásquez (Amigos del Río Torres), Giancarlo Pucci (Árboles Mágicos), Henry Bastos (GAM Cultural).

### Coordinates

9°56′21.62″N
84°04′27.59″W

## PROJECT

### Elevation

1,100 - 1,200 m

### Climate

Tropical

### Area

25 linear km

### Cost

30 - 35 USD

### Impact

700,000 inhabitants, 1.3m visitors

# Rutas Naturbanas seeks to connect people with the city through nature via a regeneration of the vegetation and forest layer in the rivers, as well as looking to prevent future informal settlements and sources of solid waste.



## BACKGROUND

Environmental management and physical mobility represent two of the biggest problems in the Greater Metropolitan Area (GAM) of Costa Rica. Despite Costa Rica's reputation for environmental protection, natural areas in urban areas have not experienced significant changes in recent years. Environmental degradation has had disastrous consequences for urban settlements and negative impacts in other parts of the country. For example, the Río Grande de Tárcoles Basin, which represents 4% of the national territory, is the most polluted river in all of Central America, with more than 850 tons of solid waste per year.[1] This led to an action of unconstitutionality filed by citizens in 2008, which was declared admissible by the Supreme Court of Justice and the Central Government, and municipalities of the basin were ordered to respond.

1. Gutiérrez Wa-Chong, Tatiana. "Represas eléctricas dan la mano al río más contaminado del mundo", La República. San José, Costa Rica. Febrero 12, 2018.





↑ Rutas Naturbanas - Masterplan General Plan: Routes in Phases

↓ Visualization Km 1: Integration of the route with the neighborhood

Nonetheless, progress has been slow, and the urban rivers María Aguilar and Torres still register close to 484,000 and 1.3 million fecal coliforms per 100 milliliters, respectively. These figures far exceed the 1,000 fecal coliforms stipulated by the Regulation for the Evaluation and Classification of the Surface Quality of Bodies of Water of the Ministry of Environment and Energy (MINAE) to be considered a Class 2 river (healthy for recreation and for the consumption of fruits and raw vegetables).[2]

## SOLUTION

Rutas Naturbanas seeks to connect people with the city through nature. It does this through the creation of shared-use paths using construction setbacks on the banks of rivers. The proposal seeks to provide 25km to allow people to walk, run, or pedal along the banks of the rivers, as well as regenerating the existing vegetation and forest layer and preventing future informal settlements and sources of solid waste in the river.

**2.** Calvo, G; Mora, J. Contaminación fecal en varios ríos de la Gran Área Metropolitana y la Península de Osa. Tecnología en Marcha. Vol. 25, No 4. p. 33-39.



## ENVIRONMENTAL AND SOCIAL BENEFITS

The direct beneficiaries of the project add up to almost 700,000 inhabitants within the five districts included in the proposal. It is estimated that at least one million people directly benefit from the intervention among users of nearby municipalities who use public transport to reach these cantons, internal and external tourism, as well as small and medium-sized enterprises. Rutas Naturbanas aims to generate safe, active mobility, economic opportunities such as real estate development, urban ecotourism, and micro-enterprises of goods and services.

From an environmental point of view, the proposal seeks to reinsert nature into the city and to rehabilitate more than 30,000ha of properties along the María Aguilar and Torres Rivers that traverse the capital region of San Jose. It will reintroduce more than seventy different native and pioneer species to regenerate the environment and eventually reintroduce other species that require a more established habitat to succeed.

Map Km 1:
Urban integreation

## CONSTRUCTION AND IMPLEMENTATION PROCESS

So far, the first 600 meters have been built through an alliance between the National Bank of Costa Rica and the Central Bank of Costa Rica incorporating Rutas Naturbanas into the plans for new development for their Financial Superintendencies. In addition, H Solis donated an additional kilometer of road to connect to the first section. Additionally, new sections are being developed by the Costa Rica Fire Department and the real estate companies Garnier and RC Inmobiliaria. All the sections are part of the initial vision of Rutas Naturbanas and consist of steps towards the proposed 25km. The Rutas Naturbanas foundation's team accompanies all the processes, supporting the design and defining the design standards and best practices, in addition to community, institutional, and international support, as needed.

## COSTS AND MAINTENANCE

The total project was estimated at 30-35 million USD. Each section varies in cost according to topography, need for and length of bridges, etc. Similarly, the interventions needed to recover the vegetation cover varies (some areas are devastated, while others have tree cover). Currently, when Rutas Naturbanas are incorporated into real estate projects, the developers are responsible for the continued maintenance of their span. In the future, new ways of maintaining them will be sought in residential areas, particularly those with lower incomes, including generating income through activities and programming, sponsorships, local/national government support, and land management tools.

**The proposal reinserts native species and pioneers to regenerate the environment.**

**25 km of route proposed in the initial vision of Rutas Naturbanas.**







↑ Visualization Km 1, Garnier Stretch

→ Visualization Km 1, First stretch of Rutas Naturbanas - Rutas Naturbanas Foundation, Central Bank of Costa Rica, and National Bank of Costa Rica


## 600 m constructed
## 300 m in construction
## 3 km began in December 2020
## 1 km added in 2021

First stretch constructed of Rutas Naturbanas - Rutas Naturbanas Foundation, Central Bank of Costa Rica, and National Bank of Costa Rica

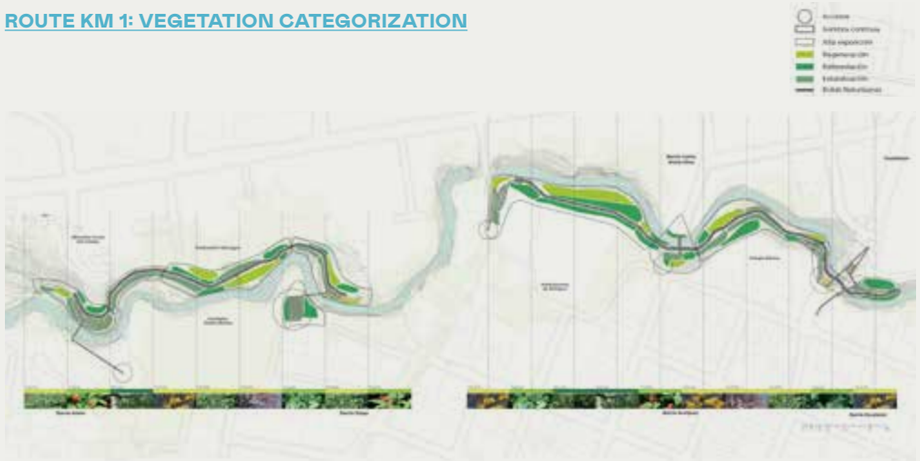




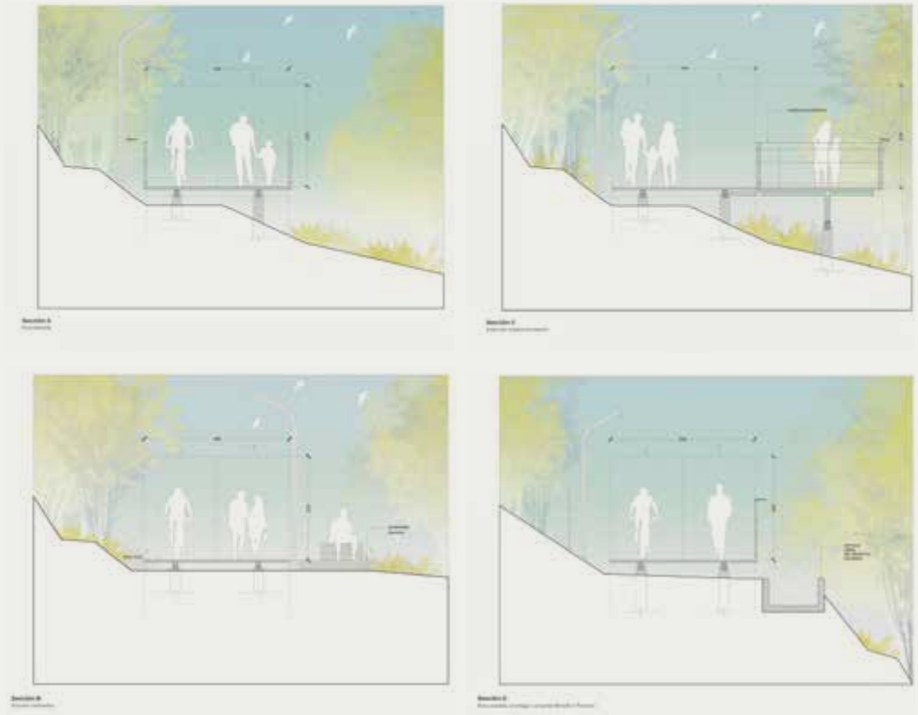




## ROUTE KM 1: VEGETATION CATEGORIZATION

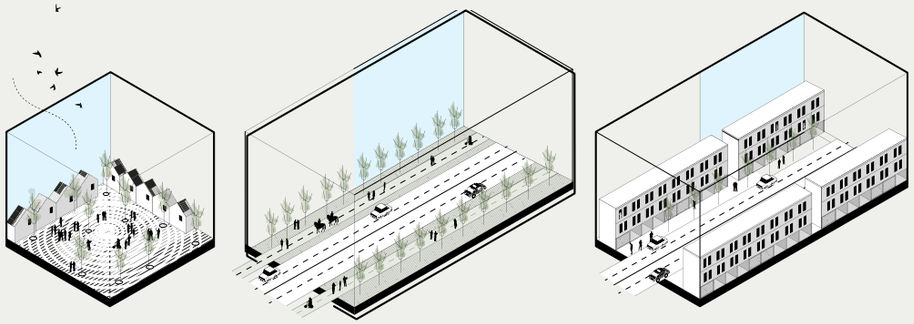


## TRAIL SECTIONS



Technical Details for the Route Km 1

AREAS OF INTERVENTION → WHERE



PLAZAS RURAL STREETS URBAN STREETS

ACTIVITIES → WHAT

Urban forest

Ecological corridor

ACTORS → WHO

Local government

Regional government

Civil society

SCOPE → WHY

Improve air quality

Reduce urban heat island

Increase biodiversity

MEANS AND METHODS → HOW

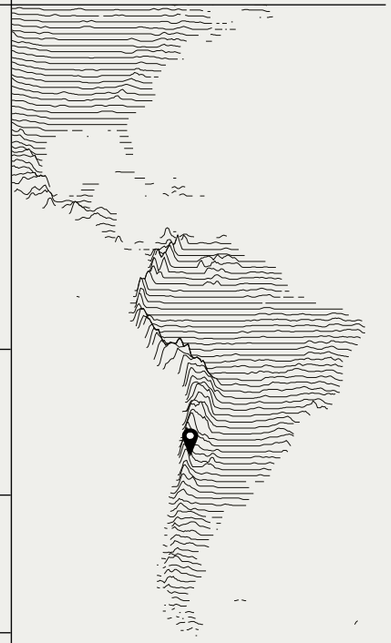
**AFORESTATION** —— Implementation of an integrated metropolitan aforestation system, irrigation and restoration of the urban tree canopy.





PROJECT 3.9

# Sistema Integrado de Información y Gestión para la Refuncionalización y Recuperación del Arbolado Urbano



**Site**

Metropolitan Area of Mendoza, Argentina

**Years**

2017 - 2018

**Team**

UNICIPIO (Consultant of Coordination of Public Politics for the Metropolitan Area of Mendoza), with the support of the Agency of Territorial Planning, the Direction of Natural Resources and the Provincial Advisor in defense of AP. Autor: Ingeniero Agrónomo Pablo Castellanos.

**Coordinates**

32°53′22.11″S
68°50′44.79″W

PROJECT

**Elevation**

700 m

**Climate**

Dry Template

**Area**

32,688 ha

**Cost**

2,457,000 USD

**Impact**

1,100,000 habitants

**The project is an integrated metropolitan system to improve the existing infrastructure for afforestation and irrigation, with the goal of recovering the urban canopy.**



## BACKGROUND

In recent decades, the province of Mendoza has had an accelerated urbanization process negatively impacting territorial stability and the sustainable use of resources and environmental services in the city. The urban canopy was prioritized within the framework of UNICIPIO, the council that coordinates public policy for the metropolitan area of Mendoza, due to its fragility and blatant deterioration. Historically, in Mendoza, the massive presence of trees in urban centers is what made the site within a desertic region a suitable place for development. The cultivated urban forest, called Public Trees, is the result of planting forest species along the road canals, streets, and avenues, and green spaces throughout various periods in the city's development. This intense afforestation gives Mendoza a unique character in the region and together with the “acequias” – Mendoza’s network of irrigation canals and ditches – make it a reference in the world.





Urban Tree Canopy of the Metropolitan Area of Mendoza

## SOLUTION

The Integrated Information and Management System for the Improvement and Recovery of Urban Trees was created in 2018 with the aim of implementing an integrated metropolitan system to improve the existing infrastructure for afforestation and irrigation with the goal of recovering the urban canopy. The initiative, which incorporates guidelines of sustainable development and modern arboriculture and forestry models, is a great contribution to the improvement of the urban microclimate. The project is structured through five components that address the problem of the urban forest in an integral way.

The Management of Public Trees (MEGAP), which manages public trees, implemented the first component of creating consensus on policies for the development of the urban canopy in the municipal jurisdictions that compose the metropolitan area, articulating and refining the implementation of forest management programs, and guaranteeing the participation of citizens and intermediate organizations.

The second component is the design and implementation of an information and management system for urban public trees on metropolitan roads. This is done through the Urban Tree Census, with 360-degree camera technologies, LIDAR, aerial photography, and high-resolution satellite images. These procedures allow collecting, analyzing, and systematizing qualitative and quantitative information on the trees and their environment. This survey constitutes a lasting tool over time since it can be updated through a management program managed by the municipalities. Through this tool, not only can the ecosystem benefits of trees be measured, but so can their influence in mitigating the urban heat footprint.

The third component is the refunctionalization of provincial incubators and institutional strengthening for interjurisdictional action in the system of Urban Public Woods. Strengthening the nurseries allows for the production of plants for urban trees, controlling the species produced, guaranteeing a supply of trees to the municipalities, and generating training in plant production.

**The initiative to plant trees in municipalities has been promoted with schools.**

**10,000 trees a year provide nurseries with replacement or renovation of the urban tree canopy.**









The fourth component is the acquisition of agricultural equipment for the management of Urban Trees in the Metropolitan Area, which implies providing both the municipalities and the province with tools, equipment, and technology that facilitate afforestation processes.

The fifth component is the permeabilization of irrigation ditches, in order to achieve greater availability and infiltration of water. The water resource is fundamental in forest growth, but the increasing urbanization and waterproofing of the bottom of ditches prevents the irrigation of the forest. This is one of the general causes of the deterioration of public trees. In response, the project seeks to improve the irrigation infrastructure, achieving greater water availability and infiltration.

Planting of trees in one of the municipalities of the Metropolitan Area with the help of students in primary school.

## CONSTRUCTION AND IMPLEMENTATION PROCESS

While UNICIPIO is in charge of the formulation, implementation, and launch of the project, it relies on the support of the Secretary of Environment and Territorial Planning. Several components of the project have begun to be implemented. As of November 2018, the Public Tree Management Board (MEGAP) has designed interjurisdictional policies for the management of urban trees, and, with the collaboration of schools, the initiative to plant trees in the municipalities has been promoted. In addition, machinery has been delivered to the Renewable Natural Resources Directorate of the province to carry out reforestation work, while agricultural machinery, such as a vineyard plow, harrow, brush cutter, plowshare, rotavator, and motorized cultivator, has been delivered to provincial nurseries. In return, the nurseries ensure the provision of a diverse variety of specimen species suitable to the urban environment. For example, the Pedriel and Notti Nursery of the city have been guaranteeing an annual supply of more than 10,000 specimens. An orchard-vineyard tractor was also delivered to manage the trees in one municipality, while stump cutters will be delivered to the rest. In addition, in the summer of 2020-2021, a georeferenced survey of the entire existing forest mass in the Metropolitan Area of Mendoza was conducted, enabling the operation of a new public tree management system. The digital survey will be conducted through a georeferenced mapping of each forest with its respective photo.

The complete project has financing from the Inter-American Development Bank (IDB), through the Interior Metropolitan Areas Development Program (DAMI II).

**Agricultural machinery has been distributed to nurseries that guarantee the provision of exemplary trees of different species.**

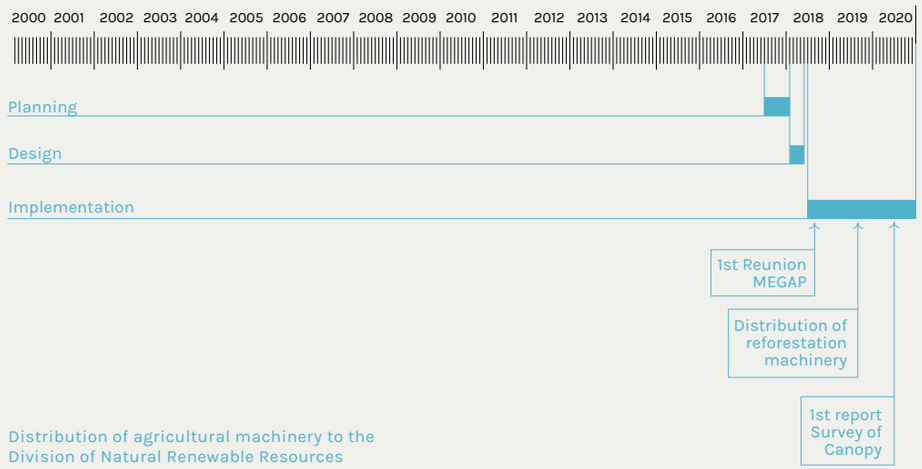
## ENVIRONMENTAL AND SOCIAL BENEFITS

While the Urban Forest improves the quality of life in the city due to its aesthetic value and its functionality, it also offers other environmental benefits, including improvements to the urban microclimate; environmental remediation and biomonitoring; reduction of ambient temperature due to the shade effect and



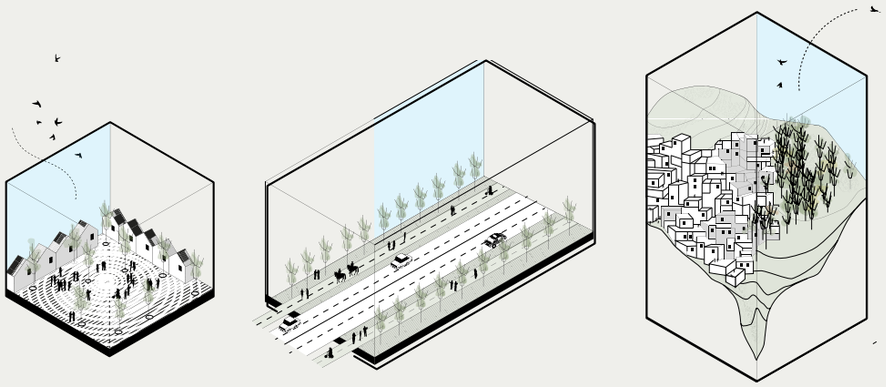


caloric energy consumption by evapotranspiration; mitigation of the urban heat island effect; air humidification; rainwater interception; regulation of natural lighting and control of ultraviolet radiation; reduction of air and noise pollution; improvement of soil quality; and elevation of levels of biological biodiversity.




Distribution of agricultural machinery to the Division of Natural Renewable Resources

## AREAS OF INTERVENTION → WHERE



PLAZAS | RURAL STREETS | SLOPES

## ACTIVITIES → WHAT

Sports Fields | Trails | Playgrounds | Gardens | Park

## ACTORS → WHO

Non-government agencies | Civil society

## SCOPE → WHY

Research and testing of new ideas | Promote new types of social living | Provide access to water | Promote healthy lifestyles | Stabilize neighborhoods | Manage and clean stormwater | Reduce urban heat island | Increase biodiversity

## MEANS AND METHODS → HOW

**IRRIGATE** —— Implementation of a recollection, storage and distribution system of fog water to irrigate community gardens.





PROJECT 3.10

# Fog Water Farm Park + Gardens

### Site

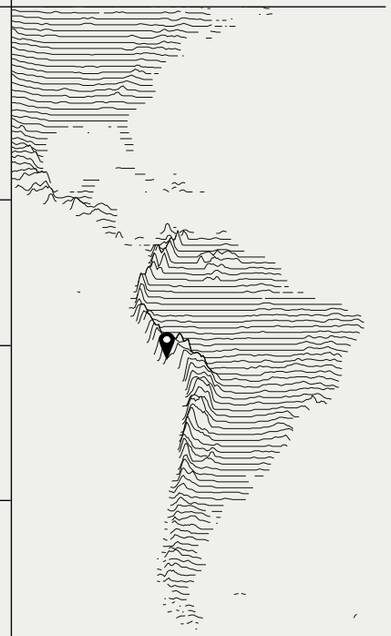
Eliseo Collazos, Lomas de Zapallal, Puente Piedra, Lima, Peru.

### Years

2011 - 2017

### Team

**Organizations:** Traction, Architects Without Borders - Seattle, University of Washington - Departments of Landscape Architecture, Nursing and Global Health, Peruanos Sin Agua, Community of Eliseo Collazos. **Key Contributors:** Coco Alarcon, Leann Andrews, Rebecca Bachman (case study author), Susan Bolton, Shara Feld, Brian Gerich, Taj Hanson, David Judge, Abigail Korn, Jess Smith, Ben Spencer, Joachim Voss, Students from the University of Washington.



### Coordinates

32°53′22.11″S
68°50′44.79″W

PROJECT

### Elevation

340 m

### Climate

Lomas ecosystem

### Area

555 m²

### Costo

10,000 USD

### Impacto

380 habitants

# The project included phased interventions to collect, store, and distribute fog water and the creation of an agricultural park, community gardens, and a sport field in a desert landscape.



## BACKGROUND

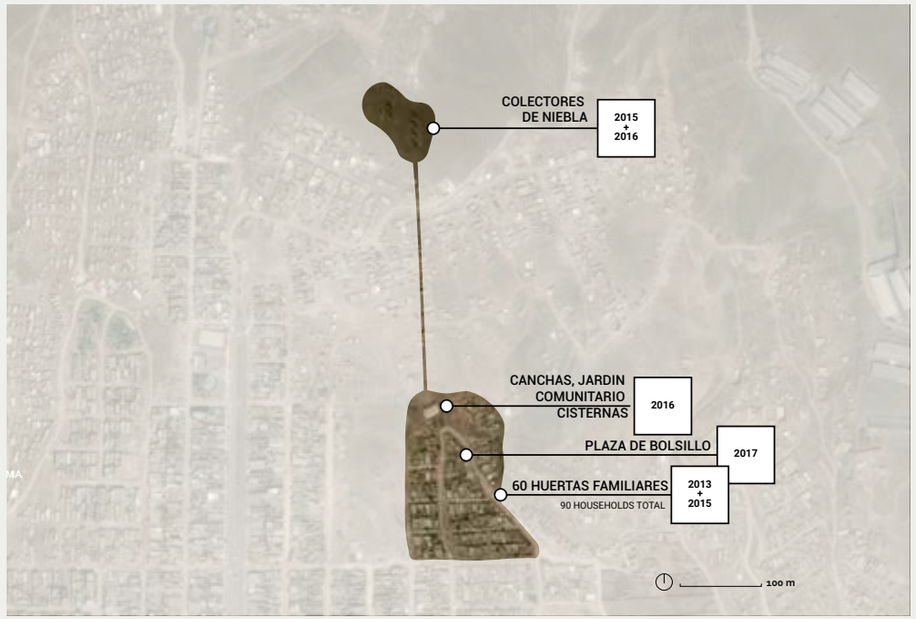
Located in the Lomas de Zapallal neighborhood in the Puente Piedra district of Lima, Peru, the Eliseo Collazos community is home to approximately 380 people living in 90 households. Set within the northern zone of Lima's metropolitan region, informal urban expansion has been rapid and continuous. Eliseo Collazos is located in the lomas ecosystem that, despite receiving less than 10mm of rain per year, is characterized by fragile vegetation adapted to the thick fog that covers the region during a winter of six to nine months. The hydrological changes associated with climate change are expected to continue to intensify and prolong the dry season of the lomas. In conclusion, in recent years, climate change and urbanization have contributed to the degradation of the fragile ecosystem within the hills that surrounds Lima.





↑ Fog collectors during dry season

↓ Plan of system and interventions by stages



As a result of ongoing changes, in 2011, the Eliseo Collazos and Traction communities came together for a collaborative meeting where they identified food and water security and access to green space, safe trails, and play spaces as primary needs and priorities. This meeting initiated a six-year series of participatory design-build interventions with phased research.

## SOLUTION

The Fog Water Farms Park + Gardens project spanned from 2011 to 2017 and included phased landscape interventions to respond to the community's need for green spaces and the lack of water: a fog water collection, storage, and distribution system; sixty home gardens; an agricultural park that included a terraced community garden and a sports field; and a pocket playground.

Irrigated Terraces





## CONSTRUCTION AND IMPLEMENTATION PROCESS

The research team conducted tests to determine which textiles would most efficiently condense the fog and the best location for the collectors.[1] The design team calculated the mist collection and storage needs to meet the irrigation needs of approximately 200m2 of year-round planted area and found that six mist collectors with a total of 132m2 of wicking cloth could collect an average of 3,000 liters of water per day, or 90,000 liters of water per month during the foggy season. Seven 500-liter water storage tanks had the capacity to store up to 35,000 liters of water, providing more than 6,000 liters of water to irrigate the green spaces throughout every month of the dry season.

The mist collection system is fully gravity fed. Mist condenses into water droplets as they meet the fabric that surrounds it and then drips into gutters that slope into pipes that carry the water through a settling tank before entering seven storage cisterns adjacent to the community farm park. Two taps provide access to the water for the home gardens, while a drip irrigation system distributes water throughout the terraced community garden. Unfortunately, in the years following implementation, due to recent land invasions and the presence of the mafia, the area around the fog collectors became increasingly unsafe, and community members were forced to temporarily abandon the collectors. Despite this setback, the remaining aspects of the project, including the water storage, gardens, and park, remain fully functional, and the cisterns have helped to permanently guarantee emergency water.

The project was carried out through participatory design processes with the community, which was also part of its implementation and construction. Mist collectors were developed through hands-on design workshops using small-scale models to gain insight into design and maintenance strategies, while also training the community on how to build them. In addition, each household that participated in the construction of home gardens customized and built their own gardens.

**1.** Feld, S. I., Spencer, B. R., & Bolton, S. M. (2016). Improved Fog Collection Using Turf Reinforcement Mats. Journal of Sustainable Water in the Built Environment, 2(3). doi:10.1061/JSWBAY.0000811

## ENVIRONMENTAL AND SOCIAL BENEFITS

The resulting social benefits from the Fog Water Farm and its gardens are multiple. Post-occupancy health assessments measured significant improvements in the mental and social well-being of neighbors, which motivated the team to implement another phase of construction of orchards. The project also improved the safety of the community and interpersonal relations between neighbors. In addition, quality of life improved, as participants noted that the interventions increased the amount of time they spent outdoors exercising and playing sports, and green spaces per capita increased to half the Lima average[3] from 0 to approximately 1.8m2 per capita.

The project also provides a great positive potential associated with home gardens by improving access to food and water.[2] Large quantities and varieties of fruits, vegetables, and herbs now grow in the orchards, as the mist collection system provides sufficient water and irrigation is not a burden on households. Home gardens contain a rich diversity of 81 types of edible plants. The plantations serve to provide slope stabilization, carbon sequestration, and urban cooling. The ecological benefits of the interventions also include increased biodiversity and water conservation.

**6 fog collectors collect 3,000 liters of water per day.**

**7 cisterns store up to 35,000 liters of water.**

**60 domestic family gardens with 81 species of edible plants.**

**2.** Korn, A., Bolton, S. M., Spencer, B., Alarcón, J. A., Andrews, L., & Voss, J. G. (2018). Physical and Mental Health Impacts of Household Gardens in an Urban Slum in Lima, Peru. International Journal of Environmental Research and Public Health, 15(8), 1751. doi:10.3390/ijerph15081751

**3.** Zucchetti, A., & Freundt, D. (2018). Ciudades del Perú: Primer Reporte Nacional de Indicadores Urbanos 2018.







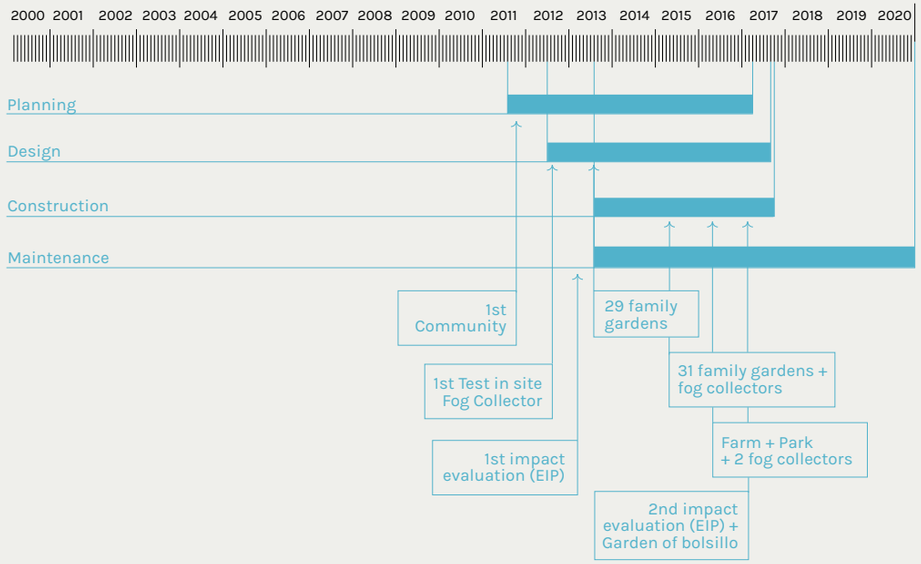
↑ Participatory design and construction with the local community

→ Fog Collectors

## COSTS AND MAINTENANCE

The participatory design methods used were instrumental in empowering the community to maintain the interventions. The project team also measured the social impacts of the intervention on members of the community once the project finished through Participatory Impact Assessments (EIP). According to assessments, 3.5 years later, the number of edible plants in the first round of twenty-nine home gardens roughly tripled from its launch. This growth paralleled the expansion of the thirty-one home gardens built in the second phase and highlights the stewardship and sustainability continued to be demonstrated by families who expanded their gardens in the years following project implementation.

**One agricultural park with terraced garden and sports field.**



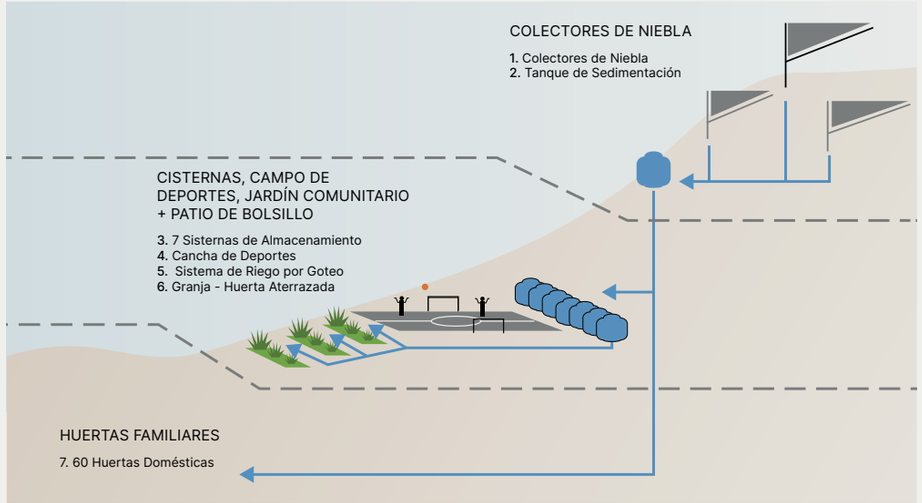









## SYSTEM OF RECOLLECTION, STORAGE AND DISTRIBUTION OF FOG WATER




↑ Detail of System

→ Aerial view that demonstrates the agricultural-park with playground, terraced community garden and cisterns of water storage

# MAPPING CREDITS

## CLIMATE CHANGE

### CLIMATE PROJECTIONS FOR MID-21ST CENTURY

**1.1 Heat Waves ("heat waves").** Iturbide, M., Fernandez, J., Gutierrez, J. M., Bedia, J., Cimadevilla, E., Ten-Sierra, J., & Milovac, J. ( 2021). *Repository supporting the implementation of FAIR principles in the IPCC-WG1 atlas*. Zenodous. DOI: 10.5281/zenode.3691645

**1.2 Days of continuous dryness ("dry spells").** Ibid.

**1.3 Annual precipitation.** Ibid.

**1.4 Intensification of tropical cyclones.** Knapp, K.R., Diamond, H. J., Kossin, J. P., Kruk, M. C., & Schreck, C. J. (2018). *International Best Track Archive for Climate Stewardship (IBTrACS) Project, Version 4.* NOAA National Centers for Climate Change Environmental Information. DOI: 10.25921/82ty-9e16

**1.5 Sea surface temperature.** Iturbide et al., 2021.

**1.6 Sea level rise.** Ibid.

**1.7 Anthropogenic CO2 Emissions.** Ibid.

**1.8 Near-surface atmospheric PM 2.5 particles.** Ibid.

### CLIMATIC FUTURES OF THE REGION

**1.9 Köppen-Geiger bioclimatic zones, 1980-2016.** Fick, S. E., & Hijmans, R. J. (2017). WorldClim 2: New 10km Spatial Resolution Climate Surfaces for Global Land Areas. *International Journal of Climatology,* 37(12), 4302-4315. DOI: 10.1038/sdata.2018.214

**1.10 Köppen-Geiger bioclimatic zones, 2071-2100.** Ibid.

**1.11 Climate transition avenues in Latin American cities, 2071-2100.** Own elaboration based on data analysis of Fick et al., 2017.

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### HYDROLOGICAL RISKS UNDER THE NEW CLIMATE REGIME

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