

THE CITY AS A SYSTEM

METABOLISM, RESILIENCE AND SUSTAINABILITY

Florencia Rojas (compiler)

Andrés Borthagaray, Angélica Marques, José Chong,
Juliana Strobel, Luis Bonilla, Marcela Mondino,
María Fernanda Pineda, Paula Ellinger,
Pedro Carrasco, Yanina Nemirovsky



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THE CITY AS A SYSTEM

Metabolism, resilience and sustainability

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PRO URBAN LOGO

Pablo Vagliente

Which is the scent of a city? The question invites us to think of ourselves as inhabitants of a complex and dynamic space, that is constantly changing and leaving us, over the course of a lifetime, fragments of memory from which we construct an urban identity and a particular narrative: sometimes appealing to mythical, heroic, singular, disruptive elements, sometimes to the weight of traditions, continuities, and inertia.

In this game, where the individual sphere is intertwined with the collective one, we accept a certain degree of consensus on the concept of city, though still maintaining our objections. When a city is considered as revolutionary, traditional routines can be perceived and valued; on the contrary, when a city is viewed as cosmopolitan, opposite localist or nationalist features will be easily appreciated by many. And both viewpoints will be right.

From this perspective, city management has been and still is imprisoned in the idea of progress. It's worth noting the unequivocal linearity of progress: applying the binary logic that separates and delegitimizes, the city is assessed as a relic of an unwanted past, or as the gateway to an inexhaustible transformation. Those who victoriously advocate for this need, rely on the deployment of modern infrastructures that should gradually cover the urban territory. An eternally unfulfilled

promise, where the ghosts of inequality, inequity, and poverty of the peripheries are clear reminders.

Instead, the possibility of promoting a paradigm of good living in cities may lead us to a different place, combining capabilities together with hard and soft resources (in praise of softness). In such a place, alongside material and technological improvements, there would be those that come from participation in public production, from commitment to localized work, from the emotions generated in the collective synergy of one's own and others, acquaintances and strangers. As if, somehow, we were seeking to recover the dimension of the small homeland, without losing the possibilities the big city offers. Some of these features is accompanied by the concept of 15-minute city.

And where civil society also organizes itself to accept the challenge of improving the urban promise. Sometimes by calling for experimental innovation, which can then be leveraged until it reaches the threshold of public policy or market adoption. Sometimes by recovering ancestral knowledge that, revisited, is elbowing its way into the urban matrix, as it is happening with the regenerative agriculture, which is increasingly producing food that competes with ultra-intensive modes of production. Or, also, by seeking to mitigate the failed promise of progress, assisting with its dwindling resources populations ravaged by all the threats that take their toll on urban life: from climate change to drug trafficking, or by seeking to raise hope that can reverse unviable future, from indispensable access to water to expanding children's enjoyment of sports and culture when domestic violence is rife.

Constantly thinking about the city we inhabit. Trying to somehow grasp that scent. As life and death course through us, many people pour their energy into making the city a place of hope, fleeting, but also possible. This book, undoubtedly, is a testimony of that commendable effort.

INTRODUCTION

Florencia Rojas

Cities are territories where the natural, social, and built environments coexist. They are mostly inhabited by people who engage in all kinds of activities: recreational, work, commercial, industrial, etc., taking advantage of the resources that the city offers.

While cities are centers of economic development as they contribute to the largest percentage of global GDP, they are also centers of pollution, releasing a significant amount of greenhouse gas emissions, generating wastes, and making inefficient use of resources that degrade the natural environment. This is why we believe it is essential to rethink cities regarding their planning and their management in a systemic manner, taking into account their metabolic functioning and implementing sustainable urban ecosystems. To achieve this, it is key to develop resilient and sustainable cities.

The goal we set for this book was to shed light on and understand the concept of urban metabolism, considered as a metaphor that aims at mimicking the functioning of a city with the perfect functioning of living cells or natural ecosystems, and also to define sustainable cities and urban resilience. Besides, we also aim at showing some possible course of action

through technical dimensions and city models that are already being globally implemented for the systemic transformation of urban environments.

To achieve these objectives, the proposal is to explore these concepts through a narrative that links the history, present, and future of the topic, together with opportunities, challenges, and an analysis of cities in the “Global South.”

The concept of the “Global South” is used to distinguish between developing countries or emerging economies that perceive themselves as located southeast and southwest, versus developed economies located in the “Global North.” Avina Foundation proposes and takes a stance on the implications of being part of the “Global South” as a Latin American region:

We understand the “Global South” beyond a geographical and/or geopolitical reference, as a symbolic space for positioning visions and as a specific context for a thought/knowledge reference framework that describes and, at the same time, gives identity to regional and global collectives of people who inhabit the eastern and western hemispheres. Stating that we position ourselves from the “Global South,” expresses our acknowledgement of scientific knowledge and also our desire to enrich it with other forms of knowledge. This need of trying to understand completely different contexts and cultures, inherent to our global vocation, is not based on anthropological curiosity or a colonizing spirit, but rather on the acknowledgment as peers, the appreciation of being different, and the assumption of the shared responsibility of making a unique contribution to the construction of “the global.” Thus, it states, for example, how we relate to Africa or to actors from the North. We understand the “Global South” as one of the two narrative hemispheres into which the virtual map of the globalization process is divided, tracing an institutional political cartography that allows us to navigate the waters of power. It calls for building the global and observing the planet from this different stance and from this particular identity.

Based on this positioning and definition, we establish the foundations of this book when we refer to the context of cities in the region.

From the outset, we sought to understand and define the three key ideas that underpin the narrative of “*The City as a System*”: urban metabolism, resilience, and sustainability; in this way, we completed a first chapter that aims at providing guidelines for planning, managing, and implementing sustainable urban ecosystems.

Then, we analyzed the social, environmental, and climate context of cities in the “Global South.” By understanding the challenges and opportunities urban environments are facing in the region today, the most significant conditions of inequality, how equity builds up resilience, the environmental risks and vulnerabilities to which cities are exposed and the climate impacts, we will be able to determine the solutions and proposals to achieve a transformation with a positive impact.

In the third chapter, we describe three dimensions that, proven globally, contribute to the development of new city models. We also describe the circular economy and industrial symbiosis, nature-based solutions and their application in general, as well as in public spaces in particular and urban commons, understanding them as solutions to the needs cities are facing today and whose implementation results in urban resilience and economic, social, and environmental sustainability. But much further work is required for the implementation of these dimensions to reach a scale that allows for the promotion of public policies and the creation of systemic change. Each of these dimensions is illustrated with project stories and new business models implemented between 2021 and 2023 within the framework of Fundación Avina’s urban resilience strategy, in the cities of Asunción, Boa Vista, Buenos Aires, Córdoba, Lima, Quito, and Xochimilco (Mexico City). These pilot pro-

jects foster circularity, the efficient use of natural resources and technological innovation, and represent concrete evidence that it is possible to rethink urban value chains systemically for the efficient functioning of the city.

In the last chapter, we briefly describe the new city models being implemented, especially in cities of the “Global North.” The compact city concept proposes new models such as smart cities, 15-minute cities, the doughnut model applied to urban environments, circular cities, and “green cities.” Based on the theoretical description of each of these models, we open discussion on their contributions to urban sustainability and resilience, as well as identifying benefits and some hindrances these models present when implementing them.

Finally, at the end of this book, we propose a review and a contribution path to follow for the implementation of resilient, sustainable, and metabolically efficient urban ecosystems for cities in the “Global South.”

The City as a System was written by a group of eleven authors who bring their perspectives from theoretical and practical knowledge of the topics already mentioned and, through their professional experience, offer key proposals for achieving systemic change in cities. The authors who accompany this publication are located in cities in the “Global South” such as Buenos Aires, Mexico City, Córdoba, Curitiba, Lima, Nairobi, Porto Alegre, and Quito, experiencing very different contexts and situations that offer a broad perspective on urban planning, development, and management.

Why do we believe this book is necessary? Because the paradigms it addresses are often fragmented in the existing literature on these topics, so, including them in a resource that can offer an articulated and systemic discourse, will provide a comprehensive and innovative perspective. Furthermore, we believe that, based

on an understanding of the current context, the opportunities for change, the identification of new technical models being tested, and the proposal for systemic transformation, we will be able, in the near future, to move closer to building sustainable and resilient urban ecosystems.

CHAPTER 1: CITIES ARE ECOSYSTEMS

Florencia Rojas

In this first chapter, we aim at providing key definitions for understanding everything that will be discussed in the following pages. We attempt to explain the concepts of city, sustainability¹, resilience, and urban metabolism. We will then provide a brief account of their origins to understand their current importance.

By doing so, we aim at highlighting the opportunities and challenges that the society is facing to change urban environments into sustainable and resilient ones.

URBAN METABOLISM

When making reference to a city, we generally think of a space inhabited by a large number of people, where commercial, productive, service, recreational, and sports activities, among many

1. Throughout this book, the word “sustainability” will be understood as “whatever makes it possible to meet the needs of the present without compromising the ability of future generations to meet their own needs,” as defined in the 1987 Brundtland Report. Produced and published by the United Nations, this report represents the first document from the international organization to provide a clear definition of sustainable development, relating it to the three pillars of sustainability: the environmental, the social, and the economic ones, while setting objectives for its implementation. It is the baseline report for international conventions related to socio-environmental issues.

other public and private spheres, take place. At the same time, we are talking about a constructed space that predominates over the natural one within a defined territory.

Cities can also be defined by their density (number of inhabitants per square meter) or, simply, by the minimum number of people inhabiting them. Since there is no global standard for that number, the concept of a city by density can be very broad. For example, in Japan, a city is considered as such with a minimum number of 50,000 inhabitants, while in Argentina, it is 2,000 inhabitants. To address this diversity of criteria, the United Nations Statistical Commission defined the “degree of urbanization” that a territory can have and which indicates the urban population percentage of inhabitants living in an area, regarding the total population. The problem is that the definition of “urban area” also depends on the decision of each country, which still represents a hindrance for a homogeneous approximation, according to what the ECLAC Observatory defined in 2009. Thus, the degree of urbanization includes three different categories: cities, towns and rural areas, making them comparable across countries². Comparability between cities and the possibility of reaching a uniform definition allow for the identification of common problems not only in urban areas within a single country, but also at the regional and global scales. At the same time, it also represents a tool for providing common and/or adaptable solutions to each identified need.

Apart from providing the definition of city, this book aims at understanding its metabolic, sustainable, and resilient functioning. Relying solely on the number of people living in an urban space would not be enough to determine how that space functions, the complexities it presents, the challenges it faces and its

2. International cooperation agencies rely on this definition to characterize the different types of territories. The information used to define the “degree of urbanization” was taken from various blogs and websites of international organizations such as ECLAC, the World Bank, and UN-Habitat

development opportunities. To truly understand what happens in a city, we need to know its composition, the structure of the constructed, social and natural environments, as well as the activities developed there, the way spaces are defined and distributed, the different land uses and the type and quantity of resources flowing in and out. In this way, we will be able to approach the problems and challenges the city may face.

If attempting a definition of city is complex, describing and understanding how it functions is even more difficult. Each urban environment has its own unique dynamics, and not all cities face the same challenges or opportunities. There are cities where green spaces are scarce, there are coastal cities and cities that developed by carving out their way through challenging natural environments, there are cities located in areas with high risk of natural disasters and cities placed high in the mountains, among many others. Some have a planned territorial development, while others grew haphazardly and unevenly as their populations increased. But there is one thing that the vast majority of cities have in common: they function in such a way that their inhabitants live in constant interaction and exchange with the constructed and natural environments that comprise them. This interaction implies that the city functions as a system, which implies that there are components interacting with each other and are affected by that interaction. These systems interact within the city itself, but also with other cities and with their surroundings.

There are systems in which human intervention is constantly present, for example, social systems, urban transportation, and productive systems. But there are also natural systems, such as the Solar System or living systems (like forests, coral reefs, jungles, valleys, or any type of aquatic, terrestrial, or mixed ecosystem). This means that, if nature and cities operate systemically, the functioning of a city can be compared with any other type of natural ecosystem.

In its 2022 edition, The Royal Spanish Academy includes the following definition of an ecosystem “an ecological system made up of an environment and the living beings that inhabit it, as well as their mutual relationships.” The analysis of this definition, allows to draw a parallel with cities: a system (in this case, an urban one) made up of living beings (presumably mostly human beings, but also with the presence of urban flora and fauna) and an environment (in this case it is both: the constructed environment and the infrastructure, as well as the natural environment) in which they live.

So, it can be said that the city is a territory working as a space for coexistence and action, where the natural environment, with fauna and flora as protagonists, is related to the social environment, which constitutes the city and rurality.

The social environment is firstly defined by citizens and institutions as the core of the idea of urban ecosystem, as defined by Newman and Jennings in their book, “*Cities as Sustainable Ecosystems: Principles and Practices*,” but also by every constructed component; while the natural environment is, obviously, the medium which humans have not modified or altered yet. Citizens and their surroundings are constantly exchanging matter and energy, so their functioning, as mentioned above, can be compared to any natural ecosystem or living organism.

Is it possible, then, to compare the functioning of a city to that one of a cell? In an extremely simplified way, a cell develops from two basic functions: 1) nutrition through the reception of resources, their metabolism, and the elimination of waste; 2) its relationship with the environment through its components exchange of energy and matter. There are similar processes when making a parallelism between the cell and the city: the resources that enter the cell/city are transformed, consumed, metabolized, and finally eliminated. This is known as “urban metabolism,” as defined by Esmartcity, the means of communication specialized on this subject.

The concept of urban metabolism was firstly presented to the scientific community in 1965 by Abel Wolman, in a publication entitled “*The Metabolism of Cities.*” Wolman suggested analyzing and quantifying the matter and energy inflow and outflow, as well as the stocks present in urban environments, after identifying the problems of pollution and lack of access to natural resources that cities in the United States were facing. Once quantified, measures can be adopted to optimize these flows by simulating their functioning like that of natural ecosystems, where there are neither losses nor wastes, making them more efficient, and offering the possibility of reuse and feedback, thus reducing environmental impacts. As it can be seen, concepts like circularity of materials and energy within cities were already present by 1965. These ideas that will be further explained in the third chapter of this book.

It was Douglas, in 1983, who revisited the concept of urban metabolism by establishing the equations used to calculate flows, which allowed for the quantification of urban processes and the impacts they can have.

Nevertheless, over the years, the concept of metabolism and the comparison of cities with natural ecosystems have been largely restricted to the scientific literature. In practical terms, cities around the world—and specially in the “Global South”—have grown according to the population rate, without taking into account, in most cases, efficient planning.

Latin American cities are highly urbanized spaces, lacking an orderly planning, dense cities with small areas and large populations. Conclusions are that, when it comes to urban planning, in general, the systemic functioning idea according to which a city resembles a living cell is not taken into account. This is why, in their publication “*The City Modeled as an Ecosystem: Principles and Strategies for the Sustainability of Urban Metabolism Systems in the City*”, Córdova-Canela and Villagrana-Gutiérrez state that: “The systems building urban metabolism present a linear sequence of operations, so the func-

tioning of a city completely depends on the import of high-quality resources, and that makes it highly inefficient.” This linear metabolism forces the functioning of cities to depend on the import of material, energy, water, and other resources from other urban or rural areas. This generates waste that is generally managed inefficiently, leading to two negative consequences for the ecosystems that are part of the city: excessive consumption of resources that damages their availability and environmental pollution.

At present, very few cities—especially in the “Global South”—are efficiently planned so as to emulate a living cell, although there is an increasing interest on transformation and re-planning to achieve an efficient and sustainable use of resources. In other words, the concept implies a systemic functioning of a city but, at the same time taking into account sustainability.

In 1998, the scientist Hartmut Bossel wrote the book *“Cities as Sustainable Ecosystems,”* which revisits the concept of urban metabolism not only to describe cities as sustainable ecosystems, but also to associate their social component to the construction of sustainability. In this document Bossel initially highlights that cities are articulated ecosystems, which are connected to broader ecosystems that even constitute the biosphere. Therefore, the functioning of the urban ecosystem does not depend solely on its internal capacity, but also on the interaction with the rest of the ecosystems in which they belong.

It is important to put the theoretical foundations into practice in order to foster the changes that are necessary to build new and metabolically efficient cities.

In recent years, and in light of the debates present in the global political agenda regarding climate change and the environmental crisis the world is facing, international organizations have revived the cell/city analogy in theory, once again drawing the attention to the concept of urban metabolism, but this time clearly stating that it must be circular, sustainable, and efficient.

An example of this is the proposal of the International Resource Panel, a panel launched by the United Nations Environment Programme in 2007, where scientists aim at generating and sharing knowledge on how to make resource consumption more efficient at a global scale. In 2018, this panel produced the report “The Weight of Cities,” which revisits the concept of urban metabolism and its applicability to urban planning processes from a perspective of efficient, sustainable, and circular metabolism. This document establishes that cities metabolism can be determined by the flow of resources through urban systems (including supply, processing, and waste to reuse or waste systems), but also at the scale of urban systems as a whole (global, national, regional), a subsystem (a particular area), or a productive sector, focusing on local value chains (transport, energy, food, etc.).

This means that efficient planning can scope from the production and consumption models that permeate the city to the entire functioning of the systems that comprise it; or even between cities, countries, or regions. The potential for replanning and introducing efficient metabolic functioning within and between cities at a global scale is huge; all that it takes is to start the necessary transformation processes.

To fully understand the metabolic functioning of a city/ecosystem and how to move from a linear to a circular and efficient functioning, it is important to understand what does it mean for a city to be sustainable and resilient, and which is the role of the social component is, together with other features that must be considered for this transformation.

SUSTAINABILITY AND URBAN RESILIENCE

Cities occupy 3% of the Earth’s surface and are home to 50% of the global population. In Latin America, urban ecosystems are highly populated, as in Argentina and Brazil, where 92% and 82% of the population, respectively, live in cities.

Cities, as centers of economic development that contribute 60% of global GDP, face major challenges as well as opportunities for growth. Furthermore, according to the International Resource Panel in 2018 and 2020, cities produce large negative environmental impacts: consumption of 60% of material resources; consumption of between 60% and 80% of energy resources; and production of 75% of global carbon emissions. The conflicts and challenges that cities are facing at present are caused by an excessive consumption of natural resources, which contributes to the production of greenhouse effect gases and the climate crisis; the loss of natural ecosystems, the reduction of green areas and increased risks of natural disasters. High levels of poverty and marginalization and unsustainable consumption and production models as a result of daily operations and the installation of infrastructure and services are among the factors causing these conflicts and challenges.

From a social perspective, inequality and lack of opportunities are also rife in urban settings. According to the United Nations 2016 report, 828 million people live in slums.

In short, nowadays, cities – especially those located in the “Global South” – contribute to deepening the social, ecological, and climate crises the world is facing, and this is so due to a lack of planning, weak governance, and the absence of public policies that promote economic development based on socio-environmental protection. To minimize and restrain these impacts, the United Nations has promoted the Sustainable Development Goals (SDGs) since 2015. These SDGs emerged from the global political agenda and set 17 objectives among which we find the improvement of living conditions and the elimination of poverty. As regards cities, SDG 11 establishes that “the setting and context of cities evidence the need to transform cities towards new models of sustainable, resilient, safe, and inclusive cities.” This means that the functioning of the city must be aligned with

the concept and variables of sustainable development, in order to ensure that city dwellers have access to a good quality of life, equitable opportunities for economic development and live in healthy environments.

But what is sustainable development? Where does this concept come from? How is it related to the notion of sustainable and resilient cities?

The idea of introducing environmental variables linked to the socioeconomic functioning of communities was firstly introduced in the global political agenda in the 1970s, at the United Nations Summit in Stockholm—the first international conference to address environmental issues linked to social issues in 1972—where the relationship between people and nature was discussed. The right to live in healthy environments, population growth and its distribution and relationship to environmental impacts, the access to and use of natural resources, the industrialization and its impact on natural environments and the role of countries in the “Global North” and their responsibility for potential damage to countries in the “Global South” were among the most outstanding concepts discussed in Stockholm. At this point, it is worth remembering that it was not until COP27 (the Summit of the Parties on Climate Change), held in Egypt in 2022, 50 years after the Stockholm summit, that a global agreement was formally established for the first time to create a loss and damage fund, through which countries in the “Global North” must allocate financial resources to remedy impacts in the “Global South.” At the time of this book publication, the agreement was still unregulated, which indicates that there is still a long way ahead and much work to be done.

At the Stockholm Summit there was an agreement on the importance of setting goals to improve environmental quality similar to the goals set to achieve global peace and economic development. It was the first time that the ecological issue was as relevant

on the political agenda and with the level of commitment as the social and economic agendas. Furthermore, Stockholm raised the need to care for new generations, protecting, through these ecological goals, both present and future generations.

It is interesting to note that as early as 1972, what would later become the definition of sustainable development was already emerging, i.e. the idea of linking environmental and social variables with economic development, understanding that all three must function systemically and that human activities should be conceived and practiced from a perspective that goes beyond increasing access to economic resources and where people and their natural and/or built environment were placed at the center of development.

In 1983, the United Nations defined sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” In the well-known 1987 Brundtland Report, “Our Common Future,” that the need to conceive the planet as a system was clearly manifested, linking the variables promoted by the concept of sustainable development when making political and economic decisions in countries.

Nevertheless, this concept was controversial from the outset. Alonso and Parada, in their publication “*Building Bridges for Comprehensive Sustainability*,” discuss the content of the Brundtland Report. On the one hand, they state that the report only focused on fostering improvement actions for vulnerable populations without a clear proposal for systemic change. On the other hand, they point out that this study raised awareness on the relationships between the social, economic, and environmental spheres, drawing attention on the need to start measuring the environmental impacts produced by human interventions. Furthermore, they emphasize the need for transformation, since *business as usual* would continue causing damage at a global scale. The authors

highlight an aspect that is fundamental to the definition of sustainable development and that is also present in discussions on the global political agenda to this day: the contradiction between environmental protection and constant economic growth, since the need to consume natural resources through extraction activities to achieve economic development damages the socio-environmental, ecological, and climatic quality.

Daly, another author who also discusses the contradictions of the term sustainable development, in his 2008 publication, *Sustainable Development: Definitions, Principles and Policies*, states that the words development and sustainability are not compatible and should not be used together, since the term development is posed in economic terms and is determined by GDP growth, while sustainability is posed in terms of resource longevity. The author questions the concept of sustainability; since resources are finite, future generations will inevitably not have access to them in either quantity or quality. Suárez and González, in their book “*Sustainable Development: A New Tomorrow*,” reinforce this idea by stating that “environmental reality is systemic and growth is based on available natural and social resources; it is impossible to think of long-term growth.”

The availability of resources on Earth is limited. Even though there are renewable and nonrenewable resources, uncontrolled consumption and the disarticulation of social awareness about this consumption jeopardize availability of resources, regardless of the technological development available.

To achieve economic growth in terms of GDP (it is important to state this clearly because economic growth in sustainable development is exclusively linked to this), the current production and consumption model implies the extraction and a significant use of natural resources. This leads to productive growth and the opening of a variety of industries that have a direct impact on citizens lives. Daly then asks whether this growth and

the proposed model actually are leading to economic growth linked to wealth and its equitable distribution, together with an increasing environmental pollution. Given the current context of inequality, which is present not only in urban environments but also at a general level, we could say the answer is they are not. Increasing GDP does not necessarily contribute to socio-environmental sustainability. Sustainable development and its applicability are also linked to the inequality that exists between countries: in the most privileged ones, economic growth comes hand in hand with the pollution that occurs in the poorest. There is nothing new in setting this topic up for discussion, although it is of outmost importance to rethink how, based on this definition, a real systemic change can take place and create an opportunity to close inequality gaps.

After the release of the Brundtland Report, political dialogue on the sustainability agenda continued and, among the most outstanding events, we can mention: Rio Principles in 1992, Agenda 21 in 1997, the Johannesburg Summit in 2002, Rio+20 in 2012, and the aforementioned Sustainable Development Goals of the 2030 Agenda for Sustainable Development. In these spaces for international debate, topics such as the fight against poverty, the protection of natural resources and the atmosphere (here the climate action agenda began to emerge, which would follow its own path a few years later), the strengthening and support of vulnerable social groups, training, education, and technological development were open to discussion.

Over the years, these international conferences and summits led to some progress on and strengthening of the application of the notion of sustainable development to human activities. However, the applicability of actions from these spaces has been prioritized over economic growth disregarding the social and environmental axes that are currently gaining greater importance, primarily due to social movements.

Authors such as Calixto and Prados in *Evolution of the concept of sustainability*, or Suárez and González, present a more positive viewpoint regarding the concept of sustainable development and state that it is applicable to all areas of life, that it is a concept that must necessarily imply economic, social and environmental quality growth in a systemic way and that the functioning of nature could be replicated by societies to guarantee a good quality of life for present and future generations. Regarding some of the principles indicated by these authors to transform traditional social models into sustainable ones, below there are some guidelines which are considered as essential to take into account when defining sustainability in cities:

- Transforming the functioning of urban systems in a circular way: resources are consumed, metabolized, eliminated, and re-consumed by other organisms. Is it possible to think that environments built by humans could function in the same way as natural environments? Yes, it is. Later in this chapter, circular and sustainable metabolic functioning will be explained.
- Working on a growth model that implies an appropriate cost-benefit balance of productive activities and the consumption of natural resources and their impact on present and future generations.
- Pursuing social sustainability by fostering equity, justice, health, and safety.
- Fostering technological development at the service of socio-environmental development.
- Rethinking economic growth models, taking into account environmental sustainability, seeking to guarantee the rational use of resources and avoiding degradation and pollution. Unequal economic growth generates poverty and poverty, in turn, is the greatest source of environmental degradation. Furthermore, protecting the quality and

health of natural ecosystems, both rural and urban, requires efficient use of the resources they provide. To this end, there are some alternatives present in the literature and documents issued by international organizations such as UNIDO (United Nations Industrial Development Organization) that in 2010 proposed the concept of resource decoupling, which refers to increasing GDP in such a way so as to reduce the consumption of primitive natural resources and minimize negative environmental impacts. Some authors, based on ecological economics studies, state the necessity for a complete dematerialization of the economy: producing without consuming natural resources and without having negative environmental impacts. These are major challenges that require a complete rethinking of current production and consumption models.

- Having institutions that support the development of public policies integrating socio-environmental issues into economic growth.

Suárez and González conclude that, to achieve sustainability, “the current challenge is to find the most inclusive development model that creates greater opportunities for the majority; one that meets their physical and material needs over the long term.”

Having said all this, and in light of the evidence, studies, and analyses presented, we must ask ourselves: how is sustainable development linked to cities? Over the years, actions have been sought and proposed to translate the concept of sustainability into practical application in various human activities.

One of the most important approaches was made in 2002 through the Principles for Sustainable Cities, an international convention led by the Environmental Technology Center of the United Nations International Environment Programme and the Victorian Environment Protection Authority in Melbourne, Australia. More than 40 professionals participated and organized a list of 10 princi-

ples that brought the notion of sustainable development closer to its implementation in urban environments, emphasizing the need to incorporate environmental factors into economic and social development, intergenerational equity and equality, social justice, citizen participation, protection of the natural environment together with the valorization of biodiversity. They pointed out, among other aspects, that cities should mimic the metabolic functioning of natural ecosystems in order to function in a sustainable way. Though not prescriptive, these principles are proposals and guidelines for the construction of new sustainable cities.

PRINCIPLES FOR SUSTAINABLE CITIES

- **First Principle:** *To offer a long-term vision for cities, based on sustainability, intergenerational, social, economic, and political equality, and their individual characteristics.*
- **Second Principle:** *To achieve a long-term economic and social security.*
- **Third Principle:** *To acknowledge the intrinsic value of biodiversity and natural ecosystems, and to protect and restore them.*
- **Fourth Principle:** *To enable communities to reduce their ecological footprint.*
- **Fifth Principle:** *To build on the characteristics of ecosystems in the development and strengthening of healthy and sustainable cities.*
- **Sixth Principle:** *To acknowledge and build on the distinctive characteristics of cities, including their human and cultural values, their history, and natural systems.*
- **Seventh Principle:** *To empower citizens and encourage their participation.*
- **Eighth Principle:** *To expand and enable cooperative systems to work toward a common sustainable future.*
- **Ninth Principle:** *To foster sustainable production and consumption through the appropriate use of environmentally sound technologies and an effective governing body.*
- **Tenth Principle:** *To facilitate continuous improvement based on accountability, clarity, and a good management.*

The quest for sustainability in cities continued to deepen the global political agenda following the SDGs.

SDG 11, which aims at the sustainability, safety, resilience, and health in cities, establishes urban planning goals and strategies that foster guaranteed access to housing and basic services for all people living in urban environments, especially those on the slums. This SDG also comprises the following aspects: increasing inclusive urbanization; implementing development plans by local governments that consider the efficient use of resources and population distribution; protecting cultural assets and the historical heritage of cities; protecting natural assets and biodiversity in cities by means of capacity building; reducing negative environmental impacts; managing waste and controlling emissions that could harm air quality. This objective is associated with a series of goals that help define specific action plans and address all the components that may be present in urban environments.

Finally, one of the latest proposals from international organizations, which provides tools for building sustainable cities—and is taking center stage for planning—is the United Nations Habitat III New Urban Agenda, presented in Ecuador in 2016 and republished in 2021. This document aims at guiding cities around the world achieve an orderly urban planning that will help them comply with the SDGs. It establishes a series of principles, guidelines, and tools for sustainability, resilience, and fighting the impacts of climate change and the ecological emergency the world is currently experiencing.

The New Urban Agenda (NUA) proposes four different dimensions of sustainability in cities: a) *social sustainability*: it implies the empowering of marginalized groups, gender equity, planning and inclusion for migrants, ethnic minorities and people with disabilities as well as age-sensitive planning; b) *economic sustainability*: which implies the creation of employment and livelihoods, productivity and competitiveness; c) *environmental sustainability*:

which proposes the protection of biological diversity and ecosystems, the resilience and adaptation to climate change as well as climate change mitigation actions; and d) *spatial sustainability*: which comprises efficient urban planning and adequate demographic distribution.

The NUA establishes the need to implement “soft” measures, such as capacity building, and “hard” tools, such as the construction of infrastructure, the creation of public policies, participation of citizens and minimizing risks. The New Urban Agenda states the modern foundational guidelines for building new city models that are linked to an efficient, resilient, and sustainable metabolic functioning.

So far, we have reviewed the concept of sustainable development, its contradictions, and its evolution over 50 years. International organizations, considering that sustainability can be applied to all components of social life, aim at implementing actions that foster a change of society’s activities toward that sustainability. The objective is that the concept does not remain as something theoretical, but rather to transform current models of habitat, production, consumption, recreation, and lifestyles in general, so that the socio-environmental variable can be integrated more strongly and not merely have an economic vision of sustainability. Consequently, it is possible, in the pursuit of transformation, to apply the concept of “sustainable cities.” What does this imply?

The social, environmental, and economic variables of sustainability—although political aspects should also be included, understood as city governance—are so broad and encompass so many aspects that it is difficult to find a single definition that fully explains what a sustainable city is. Instead, we offer some examples of definitions from countries in the Latin American region:

- The Ministry of Environment and Sustainable Development in Argentina defines a sustainable city as:

A city resilient to the adverse impacts of climate change that identifies and reduces the vulnerabilities of its population and increases adaptive capacity while managing disaster risks. A city that reduces the environmental impact of its activities and fosters sustainable consumption and production patterns consistent with its own territorial, geographic, social, economic, and cultural conditions.

- In the document titled “Sustainable Mexican Cities: A Sustainable City,” Sobrino defines a sustainable city as “the one that is ecologically sustainable, socially just, and economically viable.”
- For the Ministry of Environment in Peru:
A city is sustainable to the extent that, by integrating the environmental dimension, it successfully weaves together the economic and the social development while protecting natural resources on which it is based, guaranteeing the right of future generations to use it to meet their own needs.

As stated above, these definitions address the meaning of the concept of sustainable development from different perspectives, but sharing some common concepts such as: good quality of life, environmental protection, social justice, equity, well-being, adaptation to climate change, reduction of vulnerability, mitigation of environmental impacts, resource efficiency, social cohesion, and citizen participation, among many others.

So, by putting together the concepts of these definitions, we allow ourselves to attempt this definition of a sustainable city: *the one where the socioeconomic development of citizens is guaranteed in a decoupled manner (reducing the consumption of pristine resources and environmental impacts as GDP increases), social equity and ecological well-being for its inhabitants and the new generations that will inhabit it.*

But there is even more. The concept of a sustainable city implies the notion of “resilience.” SDG 11, considered by the international scientific community as the basis for building new urban environments, establishes that a sustainable city is the one

that is, among other aspects, resilient. What is urban resilience, and how does it complement sustainability?

The Resilient Cities Network organization defines a resilient city as “the one that is able to adapt itself to any chronic or acute stress situation that impacts it.” Thus, the social and natural environments of cities must be prepared to adapt and recover, on the one hand, from any type of impact related to natural disasters, economic recessions, health crises, high unemployment rates, violence, or crime, among other things.

The concept of resilience applied to cities is not a new one. Historically, cities development has been transformed and adapted according to the contexts and adversities they were facing. The construction of walls in Troy is clear example of this; so are the drainage systems for flood prevention in Singapore, if we consider more recent adaptation and resilience actions, we can mention the natural disaster evacuation plans in Mexico City.

Although urban resilience has historically been applied in practice, it began to be used as a tool for adaptation to natural disasters on the international political agenda in the 1970s. This concept recovered center stage in the 2000s, when cities faced the first impacts caused by climate change. The current effort is aimed at establishing a broad concept of urban resilience, in such a way that city design and planning consider the implementing of adaptation measures to any type of environmental, social, or economic impact or shock.

Dufourmont, in his text “*Resilience and the Circular Economy: Opportunities and Risks*,” states that there are different categories of resilience, ranging from individual to collective ability to overcome impacts: a) *Individual resilience* refers to the resilience that each person has according to their physical and psychological capability to recover from situations of stress or shock, in the same way that they have the capability to support themselves and others who depend on them; b) *Organizational resilience* is linked to

the capability of organizations to respond to disturbances or disruptions, while being able to adapt to new environmental risks; c) *Social resilience* refers to groups or communities with the ability to face changes and impacts at a political, social, economic or environmental level; and d) *Ecological resilience*, which refers to the ability of an ecosystem – natural or urban – to withstand impacts or shocks, maintaining its original state in a stable manner or adapting to a new stability.

CIPPEC, in its online publication “Urban Resilience, Institutional Dialogues,” explains that:

The first researcher to associate resilience with ecological ecosystems was Crawford Stanley Holling, who, in 1973, published *Resilience and Stability of Ecological Systems*. He distinguished two important properties in the behavior of ecological systems: the first is stability, that is, the ability of a system to return to a state of equilibrium after a small disturbance (...); the second (...) was what he called resilience, or the amount of persistence of ecosystems and their consequent ability to absorb changes or disturbances generated by random events, such as the possibility of maintaining the same relationships between populations and variables present before the phenomenon. Thus, he determined that resilience is the persistence of relationships within a system and is the degree of the ability of such systems to absorb changes and even persist.

Sustainable natural ecosystems, as Newmann and Jennings explain, are capable of functioning and maintaining their structure under normal conditions. Furthermore, agreeing with Holling, these ecosystems have the ability to recover themselves after facing external impacts or system changes. What these authors also emphasize is that this ability to recover and adapt depends not only on the ecosystem’s internal conditions but also on the context, the region of which they are part, the ability of the larger ecosystems that hold them, or the networks of interdependent systems.

Can cities, then, remain stable and resilient after facing change and shock? Can only cities with efficient metabolic be-

havior, like natural ecosystems, be resilient? How do we build resilience in cities?

The Resilient Cities Network, the Rockefeller Foundation, and ARUP propose a framework for defining resilience in cities. To build resilience, these organizations describe four dimensions which they consider essential to implement in urban environments:

- *Health and well-being*: guarantying these variables are optimal for people who live and work in cities.
- *Economy and society*: establishing social and financial systems that allow city dwellers to live peacefully and act collectively.
- *Infrastructure and environment*: relying on natural and built systems in the urban environment that provide critical and essential services, protecting and connecting citizens.
- *Leadership and Citizenship*: establishing that decision-making in cities must be informed, inclusive, integrated, and iterative.

These four dimensions are composed of 12 impact indicators that help measuring resilience. These indicators are determined by the four variables of sustainable development: social, environmental, economic, and political.

Based on all the above, we propose to expand the definition of urban resilience as: *the individual and collective ability present in a city to maintain its stability, persist and/ or adapt to acute shocks or chronic stress situations of natural or anthropic origin linked to environmental, social, economic and/ or political impacts.*

URBAN ECOSYSTEMS: INTERACTION BETWEEN THE CITY'S METABOLIC FUNCTIONING, RESILIENCE AND SUSTAINABILITY

So far, we have been defining the three key concepts that allow us to talk about urban ecosystems.

We said that urban metabolism describes the internal functioning of a city, identifying the efficiency and circularity of

matter and energy flows within it and in exchange with the surrounding ecosystems.

We also analyzed that a sustainable city is the one in which citizens can guarantee a good quality of life in economic, environmental, social, and political terms.

Finally, we described urban resilience as the individual and collective capacity of cities to persist and adapt to impacts.

Now, which actions need to be implemented so that the functioning of the city can emulate the functioning of natural ecosystems that are inherently resilient and sustainable? How will it be possible to imitate a hundred percent natural ecosystem when cities are characterized by the coexistence of the social and constructed environment with the natural environment? How can these concepts be implemented in the territory to build sustainable urban ecosystems?

In “*Creating Sustainable Cities*,” Girardet poses the need to propose a new way of managing cities, applying the principles of nature, promoting biodiversity in urban areas, the creation of green spaces and the application of more sustainable construction and planning techniques.

Apart from incorporating an ecological/environmental perspective on cities, Hartmut Bossel, in his 1998 book “*Systems and Models for Building a Sustainable Society*,” made visible the construction of urban ecosystems as a social component. He states that the fundamental difference between natural and constructed ecosystems is the social factor: people who add an additional component to the biotic and abiotic factors of any ecosystem. He also emphasizes that in cities those biotic and abiotic factors comprise the social interactions, politics, economics and culture, which represent an added value to urban functioning.

Furthermore, Bossel explains that sustainable ecosystems have the following basic operating characteristics:

- They are healthy and effective through the storage of sufficient matter and energy to ensure their functioning and the needs of biotic factors.
- They do not produce any type of waste or discards.
- They are self-regulating, resilient to impacts or disturbances, and facilitate evolutionary development.
- They are resilient and they adapt to adversity and external shocks.
- They are flexible, operating through networks and in a decentralized way, facilitating the flow of transaction exchanges within the ecosystem itself and between neighboring ecosystems.

When it comes to urban ecosystems, these characteristics must be complemented or mainstreamed by society, culture, and human intervention. The German ecologist incorporates social components reflected in the words of Córdova-Canela and Villagrana-Gutiérrez, who point out that the social aspects of the urban ecosystem are based on “an ethical commitment that fosters cooperative coexistence and psychological fulfillment.” They expand on this description by specifying that the social component for building sustainable ecosystems promotes the ethic of care by encouraging individual care and the care for living space, fostering social connections and cultural expressions, giving visibility to the world beyond the human, protecting cultural, economic, and ecological diversity, and fostering local and regional economies, among other aspects.

Basically, these authors describe the minimum necessary attributes and conditions for the construction of sustainable urban ecosystems.

Finally, in order to establish proposals for action and territorial transformation that allow for the implementation of resilient and sustainable city models that promote circular and efficient metabolic functioning, we propose—based on Bossel’s ideas for

the creation of urban ecosystems—activities and/or actions for the transformation of cities.

The first necessary action is linked to promoting citizen participation in urban management and planning to achieve the consensus required for any systemic change. It is essential that this participation takes place within the framework of multi-sectorial alliances, and that citizens, the private and public sectors, academia, and civil society can collaboratively think of new public policies for the city's territorial planning, land use, the means of production and consumption, and the functioning of urban value chains with a focus on sustainability.

At the same time, it will be necessary to encourage cultural activities and ensure respect for the cultural identity of the communities that coexist in the city, the interconnection of people, the ethics of solidarity and activities that connect diverse social groups.

On the other hand, citizens access to a healthy and quality environment must be guaranteed, a kind of environment where the use of public space is prioritized as a space for meeting, recreation, shopping, and demonstration. The development of public space as a place of belonging and linked to a city's cultural identity is one of the most outstanding objectives set forth in SDG 11.

To improve the city's quality of life and air quality, a key action is linked to changing mobility towards sustainable mobility by fostering public policies that value pedestrian space and the use of alternative non-motorized means of transportation and travel.

As indicated at the beginning of this chapter, it is essential for a city that aims at being sustainable and resilient to emulate the behavior of nature. To achieve this, it will be necessary to foster the protection of the natural environment and promoting the protection of local biodiversity, which makes up

the flora and fauna of urban environments. Material and energy flows and nutrient cycles must be identified and protected, and linked to the functioning of the built environment. Besides, the material and energy flows of the ecosystems that support the city must be identified and protected. This will allow for the ecological, environmental, and climate services of the natural environment to be valued in the built environment.

As regards the socio-political sphere, it will be necessary to adopt the following actions: protecting the city's human, cultural, economic, social, and ecological diversity, raising education and public awareness about the challenges of urban sustainability as well as environmental education, emphasizing water management, energy efficiency and minimizing waste generation. It will also be necessary to develop policies and practices that foster the citizens' health and well-being, including the creation of green spaces and the promotion of active and healthy lifestyles; to promote social justice and equal opportunities, including the elimination of barriers to access to services and opportunities and to develop policies and practices that foster social inclusion and the integration of marginalized and vulnerable groups.

At the economic level, it is essential to strengthen the local and regional economy. The objectives in this aspect would be fostering sustainable production and consumption models based on short value chains that allow local access to raw materials and energy, encouraging the creation of new employment opportunities, green jobs, new innovative business models, and sustainable economic opportunities in cities, including the promotion of local businesses, small businesses and productive and consumption activities based on the circular economy (this concept further developed in Chapter 3).

Both local and national governments should be the driving forces behind new city models linked to urban ecosystems, while also promoting decentralized decision-making that facilitates the

acceleration of urban transformation processes and their scalability and replicability.

Furthermore, it will be important to define public policies that have a positive impact on the construction and installation of housing, infrastructure, and services through the implementation of sustainable architectural standards. This will make it possible to efficiently use material, energy, and water resources, eliminate waste, leverage renewable energy sources and reduce the ecological, water and carbon footprints. Implementing new construction models or resuming ancestral sustainable practices offers the potential to open up new employment opportunities, new business models, and social well-being as well as improving the environmental quality of the urban context for its inhabitants.

The actions presented above which, of course, are not the only ones that could be implemented when building a sustainable urban ecosystem, determine the minimum necessary conditions for cities to function efficiently and circularly and to be resilient and sustainable in economic, social, environmental, and political terms.

Throughout this chapter, we have addressed the definitions of key concepts that lead to the construction of sustainable urban ecosystems. We analyzed the concept of urban metabolism and the implications behind the idea of a sustainable and resilient city. In addition, we provided possible actions to take so as to begin the journey toward systemic change and the construction of true urban ecosystems that allow for symbiotic functioning between the built and natural environments.

Cities can be sustainable in socio-environmental and economic terms; they must be resilient and able to mimic the perfect functioning of natural ecosystems. This will require a transition to new urban models.

CHAPTER 2:

THE CONTEXT OF THE CITIES OF THE “GLOBAL SOUTH”

The purpose of this chapter is to present a description of the current context of cities, especially those that are part of the “Global South.”

To achieve systemic change in urban models, it is essential to understand their current situation, the negative and positive impacts and the gaps and opportunities regarding resilience and sustainability.

Therefore, the first section of this chapter focuses primarily on describing the social context and the most significant gaps in citizenship in southern cities, analyzed from an intersectional perspective. Intersectionality theory, a term introduced in 1989 by the African-American legal expert Kimberly Crenshaw, allows us to see the interaction and intersection posed by different oppressive systems. At the beginning, it was conceived to describe these oppressive systems against women, although it is a theory applicable to all people affected by the vectors of intersectionality. According to this theory, there are several vectors such as sex, ethnicity, race, sexual orientation, gender, class, etc. that interact with each other and through which a person can be doubly or triply oppressed if he is affected by more than one, causing, in

turn, social injustice. Based on this theory, in this chapter we aim at showing the need to identify the impact of intersectionality on citizenship for the subsequent construction of equity and access to basic rights for society, which also build up urban resilience.

Subsequently, the idea of risk and vulnerability at the urban level will be explained as well as the way the natural or human-caused origin can affect a city. Besides, there is an analysis on the importance of urban planning in terms of disaster risk reduction and its contribution to resilience, making an emphasis on the actions that need to be adopted and taken into account for urban planning in response to natural disasters.

Finally, the impact of the climate component on cities is described. Climate resilience is a fundamental part of the global political agenda, as it provides guidelines to ensure the persistence and adaptation of urban ecosystems.

The three topics discussed in this chapter are interwoven with the economic and political components of sustainable development. Bridging social gaps, safeguarding cities from the impacts of natural disasters or climate change, and establishing adaptation and resilience measures are initiatives that lead to a positive economic impact and require citizen involvement and participation and transparent local government.

UNRAVELING INEQUALITY TO BUILD MORE RESILIENT SOCIETIES

Luis Bonilla

Global interconnectedness, coupled with the acceleration of time, increasingly transcends the limits of space and distance. The systemic nature of our world is turning increasingly complex as time passes by. And, when there are distortions in this structural framework, consequences spread widely and rapidly.

Therefore, it is now more difficult to talk about events with localized effects and it is more common to witness that the effects of one event or another are interrelated. Their impacts affect many places; they are multidimensional and develop throughout time. The global crisis presents a cascading effect and is increasingly becoming commonplace.

However, even though crises are totalizing, this does not imply that their effects occur in the same way, everywhere, all the time. On the contrary, inequalities lead to asymmetric effects. The impacts are disproportionately unbalanced and, generally, the territories, ecosystems and communities with least responsibilities over the causes of the crisis are the ones who experience the most acute consequences.

To cope with this situation, it is increasingly necessary to have better-prepared systems to address challenges that are getting more and more complex and acute. Resilience, in this sense, can be understood as the ability of systems, cities, communities, and

individuals to survive, adapt, and thrive in the face of the various acute shocks and chronic stresses they experience.

In an increasingly urbanized world, cities are the places where inequalities and the diverse impacts of the cascading crisis intersect most intensely, making them priority areas for accelerating the transition toward a more inclusive, sustainable, and resilient world. Likewise, unraveling inequalities also implies addressing their multidimensional nature which in a dynamic and complex way, accumulates in certain groups and communities. Either within countries or at a global level, these groups and communities are more exposed to risks and disproportionately experience the impacts of disasters.

INEQUALITIES BETWEEN GLOBAL TERRITORIES

Inequalities between global territories affect cities in less developed countries in an unbalanced way. This is a group of countries with a long history of social backwardness, with dependent economic development models and a peripheral role in contemporary multipolar geopolitics. At the same time, these countries are also crisscrossed by internal inequalities turning them into areas with the highest levels of poverty and socioeconomic vulnerability.

CO₂ emissions are representative. These emissions are considered the greatest global climate threat and controlling and reducing them practically represent the future of the planet. Although all communities, territories, and species are affected by climate change caused by the greenhouse effect, the territorial, economic, and social balance between responsibility for CO₂ emissions and the effects they produce is completely disproportionate between the main emitters and those most vulnerable to their effects. The 2022 IPCC report states this very straightforwardly: “Mortality due to floods, droughts and

storms affects highly vulnerable countries 15 times more than the least vulnerable.”

There are other examples to illustrate the multidimensional nature of these dynamics such as the consequences of the trade war between the United States and China on less industrialized economies; to the global economic effects produced by invasions by military powers. Similarly, the hoarding of COVID-19 vaccines by central countries with greater resources at the expense of the shortages experienced by peripheral countries, with less access to resources and technologies is another example.

In this sense, when discussing global challenges, it is always necessary to incorporate the notion of territorial asymmetry between responsibilities and the consequences they produce.

To address these global challenges, common but differentiated responsibilities must be fostered and agreed upon among world regions. These responsibilities are shared because the fact that less developed countries contribute less to the cascading crisis does not mean they are exempt from responsibility. But these responsibilities must be differentiated, both due to the asymmetry of responsibilities and because of the availability of resources to assume them. Therefore, a global reorganization based on a new commitment to multilateral cooperation is necessary, while leveling the playing field between the richest and least developed countries.

SOCIOECONOMIC INEQUALITIES IN THE TERRITORIES OF THE “GLOBAL SOUTH”

The “Global South”—comprising countries from Latin America and the Caribbean, Africa, and Asia—is home to some of the world’s most unequal cities. Just as there are asymmetries between the most and least developed regions, within the countries of the South, and especially in their cities, we find the most

vulnerable and impoverished communities that are experiencing the harshest effects of the global crisis. Fighting these internal inequalities is a necessary condition not only for the development of these countries, but also for global sustainability.

Over the past few years, less developed countries have been experiencing an accelerated urbanization rate, significantly contributing to the trend towards a more urbanized world. In fact, one of the regions of the “Global South,” Latin America and the Caribbean, is already emerging as the most urbanized region in the world, surpassing North America and Europe.

High urban population growth rates, combined with structural weaknesses in territorial planning and management, foster inequalities between and within the territories of Southern countries. First, there are the differences between urban and rural areas, characterized by the push-out effect of the former and the pull-in effect of the latter, which become the national and international escape valve for the deterioration of rural living conditions.

However, territorial inequalities are also replicated within cities, where they combine with socioeconomic differences, which are highly correlated with the distribution and segregation of cities in less developed countries. According to the CAF (Central American and Caribbean Fund), more than 130 million people live in informal settlements in Latin America and the Caribbean. In this sense, it is common to see that the most vulnerable and least prepared communities are located in territories more exposed to natural hazards and, consequently, to disaster risks. In other words, the lack of access to urban services related to decent housing, water and sanitation, electricity, or social rights such as education and health services, diminish the ability of vulnerable communities to cope with acute impacts.

The intertwined territorial and socioeconomic inequalities within cities represent a threat to the possibility of building more resilient societies in the face of global challenges. First, because

the poorest communities are disproportionately exposed to disaster risks, and secondly, because the most fragmented societies are less prepared to cope with these impacts.

Therefore, reducing territorial and socioeconomic inequalities within countries, with a focus on cities and their rural environments, becomes crucial for the resilience agenda. This, ultimately, involves a process of institutional strengthening, which, in regions with increasingly consolidated urbanization processes, encompasses all aspects related to strengthening metropolitan governance, participatory urban planning and management, and the role of local governments, among other aspects that can contribute to more balanced territorial planning, more effective public management, and more harmonious socioeconomic development.

MULTIDIMENSIONAL AND INTERSECTIONAL INEQUALITIES THAT GO BEYOND TERRITORIES

Intersectional inequalities are the result of the combination of various dimensions of inequality: gender, sexual orientation, race, ethnicity, age, disability, among others. These dimensions are strongly linked to historical processes of discrimination, marginalization, and exploitation that, although with particular aspects in different regions and times, have been present throughout history and across the planet.

The mere existence of these multiple dimensions of inequality is a factor that determines the levels of exposure to risks. However, the dynamics of intersectionality—which accumulates several dimensions of inequality in certain groups—produces a multiplying effect on risk. Therefore, speaking of resilience without taking into account multidimensional inequalities and their intersectional nature places a disproportionate burden on the already most vulnerable groups. And in that case, what would truly be tested is their collective ability to resist over and

above the social and systemic ability to include and integrate in order to prepare, adapt, and prosper together.

While this is a phenomenon that transcends territories, it is in those societies where democratic institutions periodically or constantly experience challenges to their stability and strengthening and where the challenges are most acute. Becoming more innovative, flexible, and strong are essential qualities for building resilience, since the agenda requires inclusive, integrated, and unifying adaptation systems, as well as the acknowledgement of the abilities, knowledge, and expertise distributed among various social actors in order to learn from them.

MORE INEQUALITIES MEAN LESS RESILIENCE, AND VICE VERSA

Social fragmentations permeating global spaces, together with the territorial dynamics and relationships within societies, undermine the ability to build a more cohesive global community and local communities.

This undoubtedly impacts on the construction of resilience, as it poses strict limits on the societies' ability to adequately anticipate, overcome, adapt, and thrive in the face of the challenges of the cascading crisis and the diverse and unbalanced ways it unfolds around the world.

First, inequalities directly affect a society's ability to respond to an acute shock: fragmented societies are less effective at uniting in times of hardship. Conversely, the more cohesive they are, the more assets they have in terms of knowledge, networks, and tools to address difficulties in a more communal manner. For example, a fragmented response to climate change, where the agenda is mainly intern—especially in wealthier countries—can be counterproductive when the moment comes to answer in joint responsibility to face shared responsibilities, leading to wreak havoc in the most vulnerable countries.

Likewise, inequalities also amplify the effects of natural disasters. That is, they add a social component to natural hazards, which increases their impact. Therefore, it is worth reminding that, while hurricanes are caused by nature, poverty is caused by human beings. In cities where inequalities cause extreme poverty to coexist with super wealth, the impacts of earthquakes or hurricanes preferably strike the poorest in a harder way. In this sense, the wrong distribution of resources and capabilities becomes an accelerator of social disaster, amplified among the most vulnerable sectors.

Finally, the persistence of inequalities, which generates a pressure-cooker effect where social unrest accumulates, not only undermines the ability to respond and amplifies the effects of natural disasters but also represents a potential social disaster. Several countries in Latin America and the Caribbean have experienced this situation over the last decade: the accumulation of a complex combination of diverse social unrest has resulted in dramatic social upheavals that have represented impacts as acute as those that could have been caused by a natural disaster. This is the reason why more democratic and cohesive societies, who are able to acknowledge differences and to include and integrate their diversity more equitably, are not only better prepared for the acute impacts produced by nature but also they are better prepared to avoid social disasters at home and, at the same time, to mobilize effectively to face global challenges.

A LATIN AMERICAN PERSPECTIVE ON A GLOBAL RESILIENCE AGENDA

In a context of global geopolitical reorganization, the global struggle to build more cohesive societies and a more egalitarian world highlights the need to build a new agenda that includes the following aspects:

1. **Common action for planetary co-responsibility:** this means promoting shared responsibility from peripheral countries in the fight against the progressive problems that affect and threaten the future of our planet. For example, the governments of Latin American, Caribbean, African, and Asian countries not only need to make every effort to halt the internal effects of climate change and the economic crisis, but also, they have to do it together to influence a global change in which the wealthiest countries and societies have a central responsibility. In a highly urbanized world, this also implies strengthening the participation and voice of local governments and cities in the global agenda, since they represent the first institutional line of action vis-à-vis the population. Recovering multilateral action with a powerful voice and agendas that foster new perspectives and paradigms that draw on territorial, historical, and cultural diversity must be an urgent contribution to addressing the cascading global crisis efficiently.

2. **South-South integration of cities for a new global balance:** in line with the plan for global action, the reorganization of global politics is an opportunity to strengthen South-South integration between regions, countries, and cities; something that, in the last decade, has been severely weakened. Such an integration can start by recovering and changing the integration mechanisms that have played an important role in the past. But also new levers of integration must also be established, fostering relationships between cities that often, despite geographical distance, experience similar and sometimes shared problems. At the same time, territorial distances must be bridged through the construction of new collaborative agendas regarding technology, finance and services, among other

areas, which are essential for providing greater resources and strength to socioeconomic systems. Likewise, strengthening collaboration between cities within and across regions is a booster for implementing a new urban agenda in times of global crisis.

3. **Deepening democratic city governance:** as mentioned above, highly unequal, fragmented and fragile cities are more exposed to disaster risks. Moving forward towards global integration must go hand in hand with an internal commitment to building more inclusive and egalitarian societies in an increasingly urbanized world. The challenge of ensuring countries’ resilience and sustainability necessarily involves changing city governance: making them more inclusive, participatory, integrated and flexible.
4. **Trans-territorial construction of global agendas:** in different ways, intersectional inequalities permeate all societies around the world. A way to promote the construction of the global social fabric implies fostering solidarity among groups and populations that, with their respective nuances, share demands, struggles, and aspirations and that shape life in cities. Furthermore, it is a necessary component both for global resilience—articulating the multiple connecting channels that exist among communities in the world’s territories—and for regional and local resilience, combining networks and resources capable of contributing to better- internally-prepared societies.

The global agenda for equality is a determining factor for the humanity and the world’s future. And for this reason, it is an essential element for building more resilient territories, societies, cities, and communities. Cities are at the heart of

this challenge because of their relevance in an increasingly urbanized world and because of the potential they represent to transform life together, both locally and globally.

URBAN RISKS AND VULNERABILITIES

Pedro Carrasco

In 2021, Latin America already had a population of approximately 640 million people, almost 80% of whom lived in cities. This percentage is the highest in the world, making it the most urbanized region on the planet.

These urbanization processes began suddenly between the 1950s and 1990s, causing environmental degradation and increasing social inequality. Even though countries in the region have made considerable progress in reducing poverty over the past ten years, informal settlements house more than 111 million people in urban areas, providing concrete evidence of the inequality that still persists. This is evident in the enormous disparity regarding income, unemployment, informal employment, the educational gap, the weakness of social security systems, and the increase of large families within the vulnerable population. Living in a slum reduces a person's opportunities to have access to work, education, and basic services while increasing exposure to violence and vulnerability to disasters.

Thus, the challenge implies improving the living conditions of the urban poor population by cultivating the political will necessary to improve social services and infrastructure (health, education, cultural, welfare, and recreational facilities). To achieve these objectives, territorial policies must promote strategies that improve existing urban growth patterns, prevent sprawl, and reduce population density, by making better use of available space to prevent further physical and social segmentation.

But that's not all. Cities face another huge challenge: the disaster process in urban environments, i.e. the complex interrelationship between natural hazards, social and urbanization processes together with other vulnerability conditions that explain the nature and impact of disasters in the region.

The relationship between urban poverty and risk is determined by the ability of local governments to plan and regulate urban development using risk management approaches. Integrating risk and disaster management into urban planning fosters equitable urbanization processes that reduce vulnerability. In this sense, resettlement programs are probably the most complex examples of risk management in Latin America, as they include components of land use planning, information, training, and regulation.

Much has been said about risks, but this concept has not been defined yet. Specifically, risk is the probability that an event (threat) will cause harm. It depends on the intensity and danger of the *threat* and the *vulnerability* of exposed structures.

Threats are understood as a latent danger associated with the potential occurrence of a natural-origin phenomenon—for example, an earthquake, a volcanic eruption, a tsunami, or a hurricane—whose origin lies in the natural processes of transformation and modification of the earth and the environment. Threats can be caused by natural, socio-natural, and anthropogenic phenomena.

Vulnerabilities, on the other hand, constitute the internal risk factor of an element or group of elements exposed to a threat. They depend on the community's physical, economic, political, or social predisposition or susceptibility to being affected or suffering adverse effects.

Now, that said, to better understand risk management in cities, it is important to provide another definition: *disaster risk reduction* (DRR).

DRR is a broad and relatively new concept³. There are various definitions of the term in the technical literature; however, it is generally understood as the development and implementation of policies, strategies, and practices to minimize vulnerabilities and risks within a society.

DRR considers disasters as complex problems that require a collective response from different disciplines and institutional groups—that is, from partnerships. This is an important factor when analyzing the characteristics of a resilient community, as organizations will have to individually decide where to focus their own efforts and how to work with their counterparts to ensure that other important aspects of resilience are not disregarded. DRR, therefore, is the sum of actions taken or the process of achieving resilience.

As stated in the previous chapter, resilience to natural disasters or man-made events is defined as the ability to absorb pressure or destructive forces through resistance or adaptation, the ability to manage or maintain certain basic functions and structures during contingencies and the ability to recover after an event.

Therefore, focusing on resilience means placing greater emphasis on what communities can do for themselves and how their abilities can be strengthened, rather than focusing on their vulnerability to disasters or their needs during an emergency. And in this sense, the concept of community is viewed in spatial terms, as a group of people living in the same area or near the same risks.

On the other hand, a community's level of resilience is influenced by abilities that are external to the community—particularly emergency management services, but also by other social and administrative services, public infrastructure, and a

3. In December 1989, the United Nations General Assembly designated the second Wednesday of October as the "International Day for Natural Disaster Reduction."

network of socioeconomic and political connections with the surrounding world.

There are factors that contribute to reducing disaster risk and it is essential that they be included in public policymaking and local planning processes. Some of these factors are:

- *Strengthening* local abilities to better prepare for organizing and facilitating operations for effective and timely warning, for rescuing and rehabilitating the population in case of a disaster.
- *Prevention* through measures and actions arranged beforehand to warn about new risks or prevent them from appearing.
- *Mitigation* through the planning and execution of intervention measures aimed at reducing or decreasing the risk.

MILESTONES IN RISK MANAGEMENT IN LATIN AMERICA AND THE WORLD

Taking into account what has been said so far, let's look at what has been done in Latin America and the Caribbean regarding the establishment of agreements on disaster risk management.

The first milestone worth highlighting took place in 2002 with the creation of CAPRADE (Andean Committee for Disaster Prevention and Response). To achieve its objectives, CAPRADE coordinates and promotes policies, strategies and plans; and fosters activities to prevent, mitigate, prepare, respond, rehabilitate and reconstruct in case of disaster. It also fosters cooperation and mutual assistance and the exchange of experiences. One of CAPRADE's most notable achievements took place on July 10th, 2004, when the Andean Council of Foreign Ministers sanctioned the Andean Strategy for Disaster Prevention and Response.

On a global scale, in 2005, 168 countries signed the Hyogo Framework for Action (HFA) with the aim of increasing nation-

al and community resilience to disasters. Five priority areas were defined, which we transcribe here:

1. Guarantee that disaster risk reduction is a national and local priority with a solid institutional basis for implementation.
2. Identify, assess and monitor disaster risks and enhance early warning.
3. Use knowledge, innovation, and education to create a culture of safety and resilience at all levels.
4. Reduce underlying risk factors.
5. Strengthen disaster readiness to ensure an effective response.

Following this trend, later, in March 2011, the delegations of the UNASUR member states (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela) constituted the so-called High-Level Group on Disaster Risk Management.

Subsequently, and still in force, on March 18, 2015, in the context of the Third United Nations Conference on Disaster Risk Reduction, the Sendai Framework for Disaster Risk Reduction 2015-2030 was approved, which replaces the Hyogo Framework for Action and was signed by all 193 member countries of the United Nations. Its main objective is to prevent and reduce new and existing disaster risks through the implementation of integrated and inclusive measures in different fields (economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional).

This framework recommends that States adopt specific measures across all sectors, at the local, national, regional and global levels regarding the following four priority areas:

1. *Understanding disaster risk*: Disaster risk management policies and practices should be based on an understanding of disaster risk in all its dimensions such as vulnerability, capacity, degree of exposure of people and property, haz-

- ard characteristics and the environment. This knowledge is useful for pre-disaster risk assessment, prevention and mitigation, and the development and implementation of appropriate readiness and effective response measures.
2. *Strengthening disaster risk governance for disaster risk management:* Disaster risk governance at the national, regional, and global levels is of great importance for effective and efficient disaster risk management. It is necessary to establish clear objectives, plans, competence, guidelines, and coordination within and across sectors, as well as to guarantee the participation of relevant actors. Therefore, strengthening disaster risk governance is mandatory as it fosters collaboration and partnerships among mechanisms and institutions in the implementation of relevant instruments to achieve the objectives.
 3. *Investing in disaster risk reduction for resilience.* Public and private investments in disaster risk prevention and reduction through structural and non-structural measures are essential to increase economic, social, health, cultural, and environmental resilience. These factors can drive innovation, growth, and job creation.
 4. *Increase disaster readiness for effective response and “better rebuild” in the areas of recovery, rehabilitation, and reconstruction.* The constant growth in disaster risk—including the increased exposure of people and property—combined with lessons learned from past disasters, highlights the need to strengthen disaster readiness, to take action in advance, to integrate disaster risk reduction and readiness and to guarantee enough capacity for effective response and recovery. It is essential to empower women and persons with disabilities to lead and publicly advocate for approaches based on gender equity and universal access. Disasters have shown that the recovery, rehabilitation, and recon-

struction phase—which must be prepared before the disaster—is a critical opportunity to “better rebuild,” including by integrating DRR into development measures.

But analyzing risks also requires paying attention to *risk management*, and that is the purpose of the Risk Management Index for Latin America and the Caribbean, shared by INFORM-LAC⁴.

This tool allows for understanding and measuring risks in humanitarian crises and disasters and assessing how the conditions that lead to them affect sustainable development. It can help identify where and why a crisis may take place, in order to reduce risk, build people’s resilience and provide tools for better readiness.

The INFORM index simplifies a wealth of information on natural and human-caused hazards, human exposure, vulnerability, and the abilities (of governments, communities, and individuals) to respond to disasters and crises. This index was developed through a collaborative work involving a wide range of regional actors coordinated by the United Nations and supported by DFID (the UK Department for International Development) and ECHO (European Community Humanitarian Aid Office).

The calculation is made by combining 96 indicators that measure three dimensions: *Hazard and exposure*, *Vulnerability* and *Lack of coping capacity*.

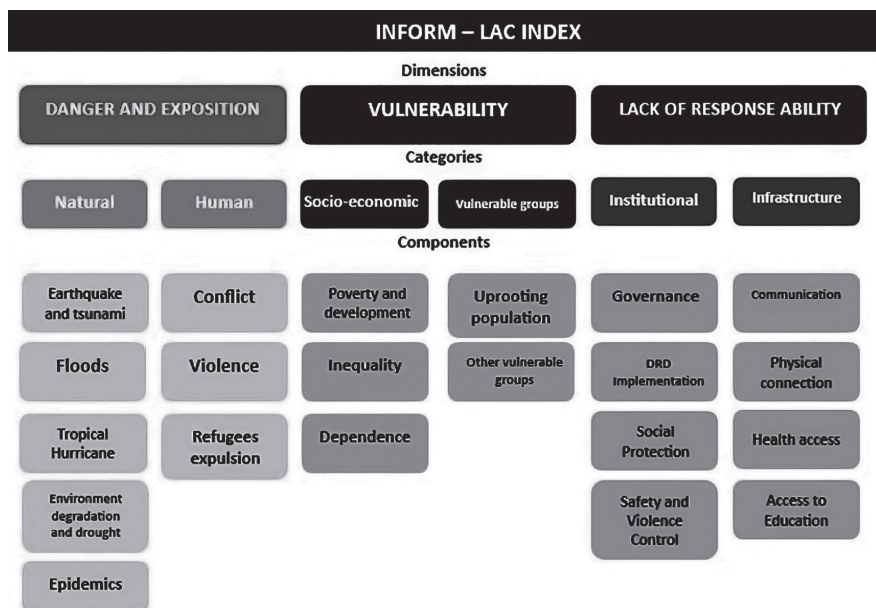
Each dimension is defined by two different categories. For example, the *Hazard and Exposure dimension* is defined by the categories “natural” and “human.” Categories are made up of components, which are carefully selected sets of indicators that capture specific topics. Finally, indicators are the individual data sets that form the basis of the model (such as the percentage of

4. The INFORM-LAC model includes information about 33 countries in the region and represents a regional adaptation of the Global INFORM model. among them. INFORM-LAC results are available at <http://www.inform-index.org/Sub-national/LAC>

children under five who are stunted or the number of people exposed to earthquakes of a certain magnitude).

All countries have a score between 0 and 10 for risk and all its dimensions, categories, and components. Low index values represent a lower risk level while high values represent a higher risk level. The indices allow for a relative comparison of risk and its components among countries. They also allow for contrasting different components within the same country. Thus, for example, according to INFORM-LAC 2020, the countries with a very high risk of disasters and humanitarian crises are Haiti, Guatemala, and Honduras; and those with a high risk are Bolivia, Colombia, El Salvador, Mexico, Nicaragua, Peru and Venezuela.

The results of this index are a valuable contribution to any regional decision-making process aimed at reducing disaster risk and building resilience. Therefore, it is important to continue actions that strengthen regional and national capacities to manage information on different aspects of risk.



Graph 1: INFORM-LAC index

REFLECTIONS ON CAPACITY BUILDING

At present, cities face the enormous challenge of disaster urbanization, that is, the complex interrelationship between natural hazards, social and urbanization processes—in addition to other vulnerability conditions that explain the nature and impact of disasters in the region. Under these conditions, as previously stated, it is imperative to integrate risk and disaster management into urban planning.

In order to create more resilient cities, it is essential to work collaboratively with different actors to reduce disaster risk. This requires identifying and better understanding the threats present in a given area, reducing existing vulnerabilities in the community, not increasing them, and building local capacity.

Global agreements, such as the Sendai Framework, guide states toward DRR and outline priorities in a unified manner.

In the current context, where we hear daily news about natural or man-made disasters anywhere on the planet (earthquakes, tsunamis, volcanic eruptions, landslides, droughts, floods, or forest fires, among others), it is the duty of governments, societies, academia and private companies to contribute to raising greater awareness and building capacity for disaster risk reduction at all levels.

It is common to hear about highly sophisticated technological processes for monitoring volcanic activity, identifying changes in ocean temperatures, and satellite tracking of hurricanes or tropical storms. However, it is also critical to consider the importance of local processes which, generally, are based on simple and achievable agreements and could have a significant impact on vulnerable populations to reduce disaster risk through the strengthening of local capacities and better managing vulnerabilities.

An example of this are the early warning systems. Communities located in the upper reaches of a watershed make the commitment and have the minimum equipment necessary to alert

communities in the lower reaches of the watershed about rising water flows. These systems have proven highly effective in preventing the loss of human life and property.

Furthermore, having risk maps technically produced but with the knowledge and testimony of the community—which is capable of identifying flood zones with great accuracy—is of outmost importance in territorial planning and management processes.

Readiness plans at family, school, and health center levels are essential for disaster risk reduction and for adequate emergency response. Identifying safe zones, meeting points, escaping routes, among other actions, may be easy to prepare and highly effective and strategic when implemented in emergency scenarios.

In short, strengthening local capacities for early response, having the minimum equipment necessary to carry out rescues and provide first aid or defining escape routes and safe places are achievable for any community, city, or country and do not require large investments. However, to be implemented and become operational, they require the support of local governments and public policies that prioritize these processes.

Finally, we must leave some lines to ourselves, as human beings. As a species, we must learn to identify nature messages and raise awareness. There are studies on bioindicators. Birds' behavior, for example, can represent an early warning of the occurrence of a natural phenomenon. Experts on the subject agree that, among other things, if people had followed the behavior of animals and headed for higher ground before the Indonesian tsunami, an incalculable number of human losses would have been avoided.

CITIES RESILIENT TO THE CLIMATE CRISIS

Paula Ellinger

CLIMATE SHOCK

A resilient city is capable of sustaining itself and its inhabitants' development despite shocks. Among all the possible shocks, one is emerging for any contemporary city: the climate crisis.

Since recorded history, our lives have been shaped by climate: the geographic distribution of our species, our diet, our clothing, the architecture of our homes, our language, and our overall development are and have been widely influenced by climatic factors. For example, in places where there is regular snowing, house roofs are often sloped to prevent snow from accumulating on the roofs, while in areas prone to flooding, stilt houses protect people from rising water.

The climate crisis is the term many of us use to refer to the alarming rate at which the climate is changing. It refers to the transformation of the climate system brought about over the past 150 years by human activity.

But this is not the first time the climate has changed on our planet. *Homo sapiens* appeared 150,000 years ago, and during that time we have gone through two complete cycles of ice ages interspersed with warmer periods. However, on previous occasions, the change has been slow, over millennia, as a result of small variations in the Earth orbit. Its spaced-out rhythm has allowed humanity and ecosystems to respond progressively and to adapt successfully.

The end of the last Ice Age has shaped humanity's social organization as we know it today. Around 18,000 years ago, the Ice Age began to experience a warming period, until the modern climatic era began around 12,000 years ago. Higher temperatures led to more rainfall, and this combination of conditions was ideal for wheat and other cereals to flourish in the Middle East and other parts of the globe⁵. Humans began to eat more of these grains, spread them, and organize settlements where the activities were their collection and processing. And so, favored by changing climatic conditions, agriculture began to emerge in the Middle East and other parts of the world around 8500 BC. From these agricultural settlements, the first cities on record also emerged, precisely in the fertile lands of Mesopotamia and along the Nile (Egypt) and Huang (China) rivers, places that allowed human beings to settle near production areas and the routes that facilitated trade.

All of this represented a slow process that spanned over millennia. Generation after generation, people learned to adjust and adapt to a slowly changing climate and, in parallel to the dawn of the modern climatic era, the most complex forms of human civilization emerged.

However, current climate change is anything but slow. On the contrary, it is considered a crisis because it is happening so rapidly and abruptly. In just a few decades (not centuries), the Earth's climate is changing substantially, generating a state of imbalance. People, human communities, and ecosystems have only one generation (not tens) lapse to transform their way of living. This makes climate change a shock.

To understand what shock feels like, let's consider hypothetical but very possible scenarios: what does it mean for a tourist neigh-

5. It is worth mentioning that while climate change has favored the emergence of agriculture, it is not the only factor and does not explain the diversity of forms, times, and places in which agriculture has emerged, as explained by the Encyclopedia Britannica.

borhood in a coastal area to learn that, in a few decades, newly constructed buildings could be flooded by rising sea levels? Or for families living in precarious housing in the drab suburbs of cities to experience increasingly unlivable summers, with heat waves that would turn their homes into ovens? Or for doctors, nurses, and firefighters to incorporate emergency practices into their routines to deal with increasingly frequent floods, heat waves, and fires? Or for schools, hospitals and restaurants, what will it mean to operate under water stress and scheduled water outages, when before it was just a matter of turning on the tap? From another perspective, let's imagine what will happen to cities, whose economies are centered on fossil fuels extraction and refining, when they will be forced to change their economic vocation overnight.

If the last period of global warming allowed our ancestors to develop agriculture and build the first cities, this global warming could lead to the decline of many contemporary cities, precisely because it is occurring so dramatically and in such a short period of time. To understand and deal with this process, it is essential to agree that the cause is distinct: it is not a cyclical and natural change, but a change induced by anthropogenic actions, that is, by human activity.

Since the Industrial Revolution, humans' way of living on Earth has led to a growing accumulation of greenhouse gases, especially CO₂, released into the atmosphere. Since the pre-industrial era, the concentration of CO₂ in the atmosphere has risen by 50%, from around 280 parts per million in 1870 to 419 in 2022⁶. The sources of these emissions are mainly the burning of fossil fuels for energy production and the deforestation of tropical forests.

In addition to CO₂, other gases generated by human activities contribute to climate change, such as NO₂, released during

6. Information available in: <https://data.giss.nasa.gov/modelforce/ghgases/fig1A.ext.txt>, <https://climate.nasa.gov/>

the production and use of fertilizers in agriculture; methane (CH_4), released during livestock farming –as a result of livestock digestion– and during the production and transportation of fossil fuels; and CFCs, industrial chemicals used in solvents and refrigeration.

Both CO_2 and other greenhouse gases (GHGs) accumulate in the atmosphere and trap the heat emitted by the sun, causing only a portion of it to be reflected back into space. The more greenhouse gases are released into the atmosphere, the greater the sun's heat retention on Earth and the higher the planet average temperature is. In turn, rising temperatures generate changes in the climate system, modifying rainfall patterns, ocean acidity and glacial melting, among other effects. Each of these changes has cascading consequences for human health, economic activity, the functioning of ecosystems and the metabolic function of cities.

As of the publication of this book, the increase of GHGs in the atmosphere had already led to an average temperature increase of 1.1°C , according to NASA Earth Vital Signs Monitor.

This will certainly not be the end of anthropogenic warming, as greenhouse gas emissions from human activity continue to grow. Multiple efforts are underway to decarbonize human activity and reverse the root causes of the climate crisis but, even if net GHG emissions were to reach zero today, climate change would not be reversed because GHGs remain in the atmosphere for long periods of time. Methane is one of the shortest-lived gases – about 12 years – but it has a warming potential almost 25 times greater than CO_2 , while CO_2 can vary in its remaining time in the atmosphere, lasting up to thousands of years.

Bad news is that the climate crisis is ongoing and growing and it will define the future of cities. Among the projected changes in cities are rising of sea levels, which could affect more than a billion people living in low-lying urban areas by 2050; heat waves, which will be most strongly felt in cities and areas with a high de-

gree of concrete construction (heat islands); water stress, which will affect at least 350 million of additional people in urban areas (if global warming reaches 1.5°C to 2°C); and fires, which particularly threaten informal settlements (95% of deaths).

However, good news is that humanity is aware of the imbalance it is causing and has the ability to stop it. For more than three decades, nation states have gathered around the United Nations Framework Convention on Climate Change to seek solutions and, since 2015, the Paris Agreement has established a global goal to avoid more drastic effects of climate change: not to exceed a 2°C increase and do everything possible to stay below the 1.5°C threshold. The Paris Agreement also acknowledges that the responsibility to achieving this goal depends on everyone. Cities, in particular, have a key role to play, as they are responsible for a large part of the problem—nearly 70% of global GHG emissions take place in urban areas—and it is also in cities where much of the effects of climate change will be felt. To face this certain future of changing climate, we must invest in the resilience of cities now.

WHAT IS A CLIMATE-RESILIENT CITY?

A climate-resilient city is one that will have thrived by 2022, 2050 or 2100 by creating social, economic, and/or environmental value amid the effects of the climate crisis. Resilience is evident (and will increasingly be evident) when significant disturbances, which could destabilize a person, an institution, or a social or ecological system, fail to do so. Conversely, when there is resilience, shocks become recovery and rebirth.

According to the IPCC (Intergovernmental Panel on Climate Change), which brings together scientists from around the world to synthesize what is known so far about the crisis we are experiencing, climate resilience means both a process and an outcome.

Resilience combines two capacities that may sound contradictory but, actually, are complementary: the ability to maintain essential aspects of the system functioning and the ability to transform. Increasingly, the literature acknowledges the link between resilience and concepts like justice, power, and politics as factors linked to a system's capacity for change and transformation, especially a social one.

Will all cities be affected by the climate crisis? Yes, they will; but not all in the same way, and not everyone living in the same city will experience the climate crisis in the same way. A city's resilience to climate change will depend on its ability to respond to impacts and to integrate into a transition economy. Resilience is dynamic, in the sense that it strengthens or weakens depending on the city's development, and it is variable and plural, as different sectors and geographies will have different degrees of resilience.

A city that has historically proven resilient to climate events may not be so in the future. Amsterdam, for example, has long been a flood-resilient city. Founded on a low-lying plain, on the edge of the ocean and the Amstel River, with parts of its territory located below sea level, the threat of water runs through its history and has turned it into the "Venice of the North." Indeed, it's not just Amsterdam but the entire Netherlands that is at hydric risk, which has driven the development of innovative technologies, such as windmills that drain water from remote areas –developed in the 15th century– or the Delta Works, a massive hydraulic system to prevent flooding – designed after the Great Flood of 1953 and chosen as one of the Seven Engineering Wonders of the Modern World.

As regards Amsterdam, this context has allowed it to transform into a (*Water -Wise City*)⁷. The water management system has been at the heart of its identity and has allowed it to be-

7. Retrieved from <https://www.mdpi.com/2073-4441/13/8/1099>

come a prosperous capital city today, where more than 800,000 people live with high-quality living standards, although success so far does not mean being safe in a context of changing climate. The climate crisis amplifies the risks that Amsterdam has been struggling with for centuries. According to the 2050 Cities and Climate Change Index, Amsterdam is the second city most at risk of impact from rising sea levels since now and until 2050. To remain resilient, it needs to scale up solutions to address more frequent rainfall, rising sea levels, and other effects of climate change.

To this end, the RainProof network was created, connecting citizens, the private sector, local government, and all interested parties to exchange information and solutions for capturing rainwater and using it as a raw material. Among the innovations they presented are blue-green roofs (*Polderdak*), which are garden terraces *where* plants are grown and water is storage which, in turn, serve as cooling systems during heat waves. There is type of dam installed on these terraces, with a valve that releases water in a controlled way, taking into account upcoming rainfall.

Other solutions developing toward a climate-resilient Amsterdam include the restoration of a dune ecosystem, where two-thirds of the capital's drinking water is under treatment, and the emergence of floating neighborhoods with circular water, energy, and waste management systems, such as the *Schoonschip*.

Resilience can be built at any time and can be achieved with the contribution of multiple actors. Something like this is already happening in Asunción, the capital and most populated city in Paraguay, with an estimated number of around 525,000 inhabitants. Asunción is located in a floodplain area, on the banks of the Paraguay River, which makes it susceptible to flooding, similar to Amsterdam. The river can rise two to three meters in just a few days, and flooding typically affects thousands of people each year, displacing families from their

homes, causing property damage and having a negative impact on people's safety and health.

According to a study carried out by UN-Habitat⁸, flooding due to rising rivers and rainfall, as well as severe storms, are among the shocks prioritized by Asunción in the context of climate change. These and other climate threats, such as heat waves and the risk of dengue fever, will be exacerbated this century by the growing climate crisis.

To address this future, the city government has done the same as in many other capital cities: they developed its Local Climate Action Plan (LCAAP), a tool for analyzing and planning climate change mitigation and adaptation policies and measures. In its LCAAP, the city prioritizes improving the stormwater drainage system, improving the conditions of the road network, and identifying, marking, and preparing evacuation routes to be used in case of disaster. Improving the quality of buildings, especially those in areas prone to flooding, and relocating homes placed in flood-prone zones are other important aspects included in this plan.

In addition, there is a project to establish an early warning system or a standardized process for monitoring, reporting, and taking action in the event of alerts issued by the National Directorate of Meteorology and Hydrology. Finally, to reduce its contribution to the crisis and move toward lower-emission development, Asunción prioritizes the energy sector – including measures to replace wood-burning stoves with energy-efficient ones – and the transportation sector – with measures aimed at improving the public urban mobility system and promoting biofuels.

8. Retrieved from <https://urbanresiliencehub.org/wp-content/uploads/2020/04/SP-Recommendations-of-Actions-for-Resilience-and-Sustainability-Asuncion%C81n-Online.pdf>

In 2022, the World Bank approved a resilience project for the Asunción Coastal Strip, which seeks to build an eco-inclusive district and promote local economic and institutional development, public spaces, and green areas. The coming years there will be evidence of the roles that the private sector and civil society will play in this transformation.

As complementary to structuring projects, there are other processes carried out by multiple participants that strengthen social capital and the vision of resilience for a city. Among these projects we find the Resilient Asunción Challenge, coordinated by the Avina Foundation, BIDLab, Citi, and the Resilient Cities Network supported by Citi Foundation. The Challenge has used a methodology to promote innovation, in which academia, civil society, the national government, and philanthropy have identified, awarded, and supported businesses that contribute to a more resilient urban metabolism. The award-winning initiative in Asunción, Chakra Nativa, allows citizens from the capital city to buy directly from agroecological food producers, and allows producers to support each other and barter with each other. In the context of torrential rains, these producers are likely to feel fewer impacts than their neighbors, as agroecology is based on ecological principles and social relationships that foster resilience. Furthermore, agroecological production contributes to mitigating GHGs emissions through soil carbon sequestration.

Although the local government plays a key role in defining the foundations for urban climate resilience, implementation depends on the involvement of multiple sectors.

Climate resilience is closely linked to a city's GHG emissions footprint and economic vocation. Nearly 70% of global GHG emissions are produced in cities, which means that halting the crisis will require changes in urban metabolism. In cities whose main productive activities are linked to GHG emissions, such as cities centered around coal mines, the transition will be more profound and with greater impact. In these cases, a reduction in economic activity can push many people into poverty and the social context into greater inequality. For a fair transition, it is key to ensure the

construction of a shared vision of the future and multi actors alliances that guide the transition towards value creation on sustainable, equitable, and resilient urban foundations.

In this sense, municipalities in forested areas of the Amazon are an example of how to harness pressure for changes in the emissions-intensive economic matrix to generate positive transformation. In the second half of the 2000s, when deforestation in the Brazilian Amazon declined significantly, one of the measures behind this was to restrict access to credit for municipalities with high rates of deforestation. The national government issued a list of municipalities with high rates of deforestation called the “blacklist,” and several of them implemented a social, economic, and governmental response to curb deforestation.

One of these has been the municipality of Paragominas, which occupies 19.3 thousand km² of the Brazilian Amazon. In 2007, the municipality ranked 33rd on the list of the country’s most deforested areas and experienced high rates of violence. Based on pressures from national public policy, a major local pact has been forged to curb illegal logging, involving the local government and more than 30 organizations, including rural and timber producers. Various pilot projects have been implemented on farms, demonstrating the possibility of combining environmental protection and a fourfold increase in productivity. Furthermore, the municipality has been a pioneer in the regularization of its rural properties and technical assistance. The set of measures to transform the municipality from a leader in deforestation to a green municipality has brought it great international acknowledgement and has become a slogan that defines its identity to this day.

The three cases shared here demonstrate different stages, aspects, and degrees of progress toward climate resilience. For Amsterdam, the climate crisis invites a reinterpretation of its historical resilience; for Asunción, it opens doors to address ex-

isting socioeconomic vulnerabilities and promote infrastructure development; and in the case of Paragominas, it changes the local economic vocation. None of these cases is a recipe to be copied, nor is it a finished process. On the contrary, resilience is iterative and nonlinear. There is no defined path; rather, "the road is made by walking," as Antonio Machado said in his historic poem⁹.

CLIMATE RESILIENCE AS A LENS FOR SEEING THE FUTURE

The future of cities will be defined by the scale of the climate crisis and their exposure to climate threats but, above all, by how their metabolic functioning responds to the crisis. Local government representatives, business owners and citizens build cities every day with every decision they make, and these decisions often stem from the known behavior of the climate. But therein lies the danger. For example, in a coastal city where houses have always been located a few meters from the beach without being threatened by the tide, architects and business owners tend to continue planning homes located that same distance from the sea. However, rising sea levels caused by the climate crisis may flood areas where construction was once common. To be resilient to the climate crisis, coastal construction must consider projected sea level rise.

Similarly, a city's transportation system may be designed for the use of private, gasoline-powered cars, but to reduce transportation emissions, investment should be directed toward public and electric transportation, with broad benefits for quality of life and air quality. Thus, when investing in transit improvements, decision-makers should incorporate designs geared toward rapid bus lanes, electric charging stations, and bike lanes, among other measures.

9. *Caminante, no hay camino*, in *Fields of Castile*. 1912. Spain. Renacimiento Publishing House.

Incorporating the climate crisis as a contextual factor into decision-making means *adopting a climate lens*. This lens addresses not only the risks that threaten a city, but also the opportunities to lead the transition toward low-emission development. To curb the climate crisis to less dangerous levels, all the humanity must reduce its emissions to net-zero by 2050. This entails a profound transformation in transportation, energy and food production and consumption systems, waste management, and land use. A resilient city, therefore, is one that embraces the transition toward carbon neutrality and protects its people and its operations from climate threats.

With this in mind, the lens for making decisions toward a climate-resilient city must incorporate two main perspectives: adaptation and mitigation.

The adaptation lens seeks to understand how citizens and systems are exposed to climate hazards (droughts, floods, typhoons, heat waves, sea level rise) and how vulnerable they are to these hazards. Vulnerability is often understood as the combination of sensitivity and ability to respond to climate hazards and it generally interacts strongly with issues of justice and power distribution. For example, in a city exposed four months a year to more intense, extensive, and frequent heat waves (hazard), low-income children and the elderly tend to be more sensitive (sensitivity) and often have fewer resources to respond to them (capacities). It follows that one adaptation measure could be to improve the capacities of children and the elderly to cope with heat waves. This lens can be interpreted using the equation proposed by the IPCC to define climate risk: $\text{Exposure} + \text{Hazard} + \text{Vulnerability}$ ($\text{Sensitivity} - \text{Capacity}$).

The mitigation lens, on the other hand, is oriented toward emissions reduction, aiming for the global goal of net-zero

emissions by 2050¹⁰. To analyze a decision through a mitigation lens, it is necessary to understand its implications for greenhouse gas emissions and the possibilities for reduction. The indicator to be analyzed is objective—tons of CO₂ eq—but it should not be read or used in isolation. On the contrary, a systems perspective is essential to understand how much a given emissions source represents in the overall scenario, so that reductions can be prioritized to significantly transform the emissions matrix.

Adopting a climate lens, including both mitigation and adaptation, allows key questions to be asked on a daily basis both in individual and institutional decision-making. It is, therefore, the possible compass for urban resilience, because it informs and guides, opening up possibilities for the city itself and its citizens to walk the path of resilience in the context of the climate crisis.

10. The United Nations Climate Action Coalition explains what “net zero” means, detailing that “net zero indicates cutting greenhouse gas emissions as close to zero as possible, with some residual emissions being reabsorbed from the atmosphere, for example, by the ocean and forests”. <https://www.un.org/es/climatechange/net-zero-coalition#:~:text=%C2%BFQu%C3%A9%20indica%20el%20%22cero%20neto,el%20oc%C3%A9ano%20y%20los%20bosques>.

CHAPTER 3:

THREE DIMENSIONS FOR URBAN TRANSFORMATION

Cities in the “Global South” are plagued by risks, inequality, and negative environmental impacts, largely due to their linear operation, poor planning, and the disconnection of the natural and built environments.

As the goal is making the city’s metabolic functioning be efficient, circular, resilient and sustainable, this chapter describes three dimensions of transformation. These are, essentially, tools that, when implemented on the ground, allow for systemic modification of a city’s functioning.

The three dimensions selected for this book are linked to the variables behind the concept of sustainable development, seeking to ensure that their implementation achieves an economic development that transcends the exclusive link to GDP growth and instead proposes new production and consumption models, new business models, short value chains, innovation, and technology with consequent positive socio-environmental impacts. These dimensions are also proposed because we believe they exist within a local collaborative framework, where multisectoral coordination and active citizen participation will be necessary

for their implementation. Finally, the dimensions are directly linked to measures that allow for mitigation and/or adaptation to environmental and climate impacts.

Of course, these are not the only possible dimensions or tools for action as international organizations also propose countless tools, methodologies, initiatives, and/or models that could also be implemented.

In this case, we believe that implementing innovations based on the circular economy and industrial symbiosis, nature-based solutions applied in the city, particularly in public spaces, and installing urban commons are effective ways for cities to emulate the functioning of natural ecosystems, becoming resilient and sustainable.

Each dimension presented in this chapter includes a description of the problem it seeks to address, the technical and theoretical content of the proposal and ideas so it can be implemented in urban environments.

In the specific case of nature-based solutions (NBS), a team from UN-Habitat shares its tools and successful experiences in applying this dimension to public spaces. In addition, there is a section that includes details about the programs implemented by this international organization in cities in the “Global South.”

Finally, the systematization generated by the implementation of pilot projects within the framework of the Avina Foundation’s Sustainable Cities strategy is presented to close the chapter and highlight the implementation of these dimensions in Latin American cities.

There are stories of eight startups and business chambers that have implemented new business models based on the circular economy, industrial symbiosis, nature-based solutions, sustainable agriculture, technological innovation linked to the efficient use of resources, and urban commons in cities such as Buenos Aires, Córdoba, Asunción, Lima, Quito, Mexico City, and Boa Vista.

These eight success stories show that it is possible to propose systemic change and new business models by focusing not only on innovation and new technological solutions, but also on public policies that ensure the replicability and scalability of innovations.

CIRCULAR ECONOMY AND INDUSTRIAL SYMBIOSIS

María Fernanda Pineda

The city is a symbol of opportunity in the economic, academic, health, and even entertainment fields. Everything tends to be concentrated in these large spaces of interaction and exchange of materials and services. Cities are considered the territory where housing and habitat are most likely to provide a better quality of life for their inhabitants.

In a similar way of a living organism, the city comes alive under a vision of urban metabolism. While a person obtains from food to survive, the city—as indicated in the report “Urban Metabolism for Resource-Efficient Cities: From Theory to Implementation” by the Sustainability Institute and UN Environment—functions and takes shape through the flows of energy, materials, people, and information in a space where complex social, technical, and ecological processes coexist and interrelate.

Currently, as discussed in previous chapters, the city’s metabolism functions in a linear fashion; this means that raw materials are received, produced, consumed within the city and disposed of on its outskirts. The linear model is adept at generating and disposing of garbage. Even for residents who are “more aware” of the impact of their actions on the environment, classifying their waste represents an individual logistical challenge. Local governments do not necessarily offer a differentiated management system and there is often not enough market interest in transforming and adding value to

these materials. It is definitely not easy to break away from the buy-consume-dispose *status quo*.

The way the world works shows us that raw materials are extracted, transformed, used, and discarded always ending up in formal or informal landfills. According to the World Bank's "What a Waste 2.0" report, the total global municipal waste is 2.01 trillion tons per year. According to UN Environment, by 2017, urban solid waste generation in Latin America and the Caribbean reached 540,000 tons per day, 30% of which ended up in unsuitable locations.

Interestingly, although there is a high level of waste collection (90% according to UN Environment estimates), poor waste disposal causes it to instantly lose its value. In the region, according to an analysis by the study "Circular Economy: Opportunity for a Transformative Recovery," on average, a person generates almost one kilogram of waste per day, half of which is organic and the rest is made up of plastic, paper, cardboard, glass, metal, and other non-organic waste.

How does this linear metabolism fail? The flow of materials results in poor solid waste disposal, which pollutes the urban ecosystem, rivers, and oceans, affecting people's health while also generating greenhouse gas emissions that increase the planet's temperature. Inadequate use of energy and water can lead to waste and inefficiency, increasing the consumption costs of these resources and preventing these services from reaching residents throughout the city. On the other hand, with an inadequate public transportation system that runs on fossil fuels and consumes significant time in people's daily lives, citizen mobility can become a hostile, polluting, and even unsafe activity.

Faced with this "*city as usual*," a solution that the planet itself has been applying for millions of years through its natural cycles is presented: the "circular economy." For some, a paradigm; for others, an economic model; for many, a sustainability strategy. The truth is

that the circular economy as a concept provides a response to the impact of an inefficiently functioning urban metabolism.

According to the Ellen MacArthur Foundation, the circular economy is based on three fundamental principles: *material redesign*, *waste reduction*, and *ecosystem regeneration*. For the circular economy, the concept of waste turns into the concept of resource, which we must learn to value and contribute to this chain of constant exchange of materials and services.

The concept of a circular economy, applied to a city, seeks to integrate the flows of products, private services and basic services, redesigning new business and product models; reducing the amount of waste in the city and making it recirculate in the market, which implies that the city is more sustainable, resilient, inclusive, and citizen-friendly. In other words, moving from a linear urban metabolism to a circular urban one.

We can also see the concept of the circular economy, specifically the principle of waste reduction, applied to what is known as industrial symbiosis.

Data from the United Nations Industrial Development Organization indicates that the industrial sector consumes one-third of the produced global energy, 20% of global water and a large portion of raw material.

Although urban metabolism or industrial symbiosis may sound like concepts from this millennium, examining their origins helps us better understand them. In the chapter on industrial ecology and cities in the publication *Taking Stock of Industrial Ecology*, author Christopher A. Kennedy points out that the concept of “industrial ecology” emerged in the late 1970s, as part of the planning of greener cities in the United States. This concept implied thinking about waste reuse, water recycling, sustainable transportation and infrastructure, and factories running on clean energy. This represented the basis for the analogy between industrial systems and natural ecosystems, according to which biological systems are

used as a source of inspiration for redesigning industrial systems. Thus, applying industrial ecology allows us to move from a linear to a circular concept, where environmental impact is reduced and resource efficiency and responsible consumption are fostered.

Industrial symbiosis, as part of a vision of circular urban metabolism and as part of the study and application of industrial ecology, allows for synergies between different industries to strengthen their value chains; even more if they are close together, as it may be the case of industries placed within an eco-industrial park. As Ana María Hurtado and Lucía Jordá point out in the text *“Industrial Symbiosis as a Tool of the Circular Economy Paradigm,”* industrial symbiosis can be of three different types: by mutuality, by substitution or by genesis.

When we refer to mutual synergies, we refer to the shared use of common services, facilities, or infrastructure. On a smaller scale, an example of this is *coworking* or shared spaces. These spaces, which can range from an office to a floor or an entire building, allow companies from different industries and sizes to share a single location, thereby reducing costs for services such as cleaning, electricity, water, telephone, internet, security, and even reception.

Substitution, on the other hand, involves synergies based on the reuse of flows or residual fluids. An example of this is the use of greywater for watering parks or the return of treated sewage from a factory. Such is the experience of a textile company, whose factory located in the city of Chíncha, Peru, has a sewage-treatment facility and an ultrafiltration and reverse osmosis facility. The latter assists in an additional sewage purification process, allowing 33% of the effluent to be recycled and reused. This water is donated to the municipality of Chíncha Baja for watering green areas and cleaning public spaces in the district.

When we talk about synergies by genesis, as the name suggests, it means the creation of a new activity based on the need to reuse waste streams. What a better way to harness the waste

streams generated in the city than with this type of symbiosis! And not just from the city itself, but also from those generated by companies that collaborate with each other, such as the ones in eco-industrial parks, which seek to reduce pollution, reduce the use of natural resources, and generate environmental and economic benefits for the community where they are settled.

Regarding organic waste, there are companies that collect waste generated by restaurants, institutions, and homes to transform it into soil fertilizer and animal feed. Considering the tire waste oasis that plagues various cities in the region, there are also solutions that view this problem as an opportunity and use it as raw material to transform it into shock-absorbing flooring for public spaces, health centers, gyms, and factories.

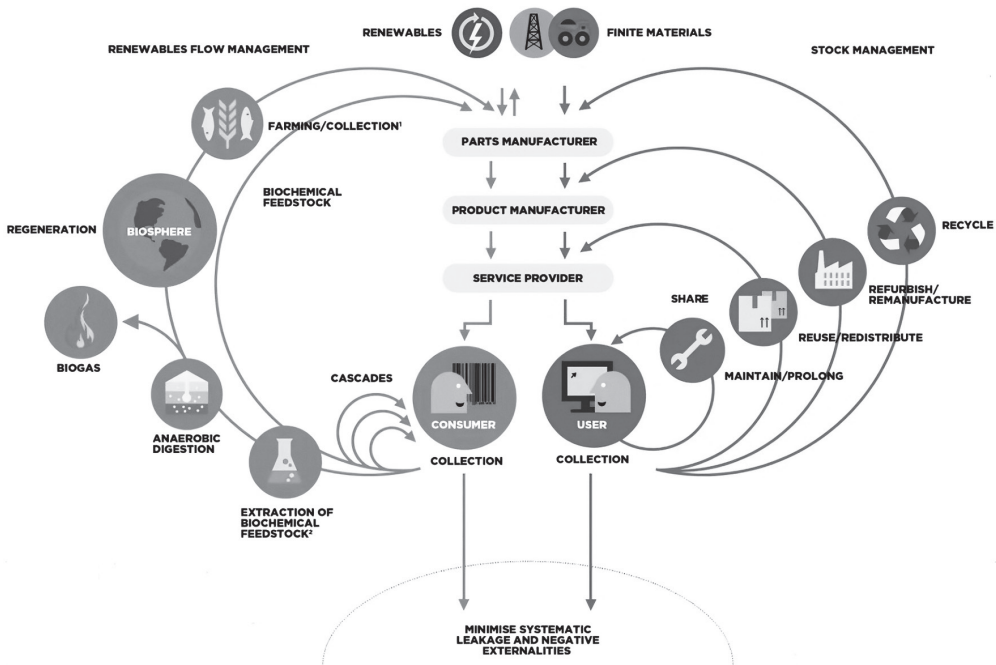
Identifying material and service flows that are currently generating waste is a first step towards starting to see what other industrial flows can be used for synergy in urban spaces, where the flow can be redirected, and even what value it can generate for people's quality of life and the environment.

What do these concepts presented above have in common? Their theoretical explanation may remain at an academic level, for those reading or taking a course on circular economy or industrial symbiosis; however, their application in the reality of cities can transform them into innovative solutions that provide a pause and a new appearance to a city that is constantly under environmental pressures that affect not only the ecosystem but also its inhabitants.

WHAT SOLUTIONS ARE WE TALKING ABOUT?

Cities are the places where the opportunities lie to implement the necessary changes at the metabolic level, with a perspective that involves the intervention of all participants in society and focuses on the flow of materials and energy to enrich the space. But how is this being applied in reality? What kind of innovation is currently taking place?

Going back to the idea of circularity and discussing the continuous flow of materials, it is important to mention the Ellen MacArthur Foundation's butterfly diagram, which illustrates two key cycles when talking about the circular economy. One is the *technical cycle*, which pushes products and materials to be in constant circulation through processes such as reuse, repair, remanufacturing and recycling. The other is the *biological cycle*, which seeks to regenerate ecosystems through composting and anaerobic digestion.



If we return to the principles of the circular economy, we can see that the technical cycle refers to the principle of *waste reduction*, and the biological cycle refers to the principle of *ecosystem regeneration*. The question is: where does the principle of *materials redesign* fit into this framework? This principle can be applied as a cross-cutting practice on each side of the butterfly. Additionally, applying a

circular economy means applying process and resource efficiency, as it involves thinking about and redesigning key steps and processes to make smarter and more efficient use of available resources, reducing negative environmental impact and seeking to have a positive environmental impact. For example, this can be clearly seen in the elimination of the use of chemicals in biological processes or in the use of clean energy in the technological cycle.

The *technical cycle* refers to actions and strategies that involve technology and investment, to a greater or lesser extent, to transform non-organic resources, add value to them, and prevent them from becoming waste. These actions and strategies are:

Sharing: from a circular perspective, sharing goods and services allows for greater use of underutilized resources. Complementarily, the sharing economy connects supply and demand to meet the needs of both. And on the basis of the date this type of economy began to emerge, it seems that humanity has a tendency to share in times of economic crisis. In the wake of the 2008 recession, companies like Uber and Airbnb began to emerge or gain popularity, while later, cities began to adopt this strategy to improve the quality of life of their inhabitants.

In Salvador de Bahía (Brazil), Santiago de Chile, and districts of Lima (Peru), there are bicycle-sharing systems for tourists or users traveling through the city on multimodal trips. With options that range from simple user registration to daily or annual payments for bicycle use with stations located throughout the city, this system offers an alternative for people passing through the city or whose travel routes would complicate the constant use of their own bicycle. This increases people's physical activity, which in turn improves their health and quality of life, leads to more efficient use of bicycles as a means of transportation, reduces travel time, and prevents greenhouse gas emissions.

Repair, maintain or care: as the name suggests, in this case, the strategy implies keeping a product in good condition and of

high quality to lengthen its useful life. Simply put, this might bring to mind the work done by electricians, plumbers, bicycle repairers, or shoe repairers; services offered locally that help maintain the value of everyday products.

In this sense, there are movements like the Repairers' Club, which promotes local traveling meetings to encourage repair as a responsible consumption strategy and, in turn, connect skilled repairers with the demands. There are also tools like the Córdoba Menders' Map (Argentina), which provides the location of more than 50 organizations and individuals, including seamstresses, cobblers, and leather products repairers, with the goal of making local repair specialists available.

This category also includes initiatives that collect and receive donations of furniture, appliances, and clothing at different locations throughout the city. These donations are then cleaned and repaired, and finally offered at fair prices or distributed among families living in vulnerable areas.

Reuse: once again, as the name suggests, this involves using a product more than once in its original form, generally for the same purpose for which it was created. One example of this includes reusable grocery bags (whether plastic or cloth), whose use is most promoted in countries that already have or are in the process of developing legislation banning single-use plastic. While efforts at the individual, business or civil society levels are valuable and important to reuse bags, bottles or clothing, connecting with the government is key to widespread and generate systemic change in cities.

A growing number of private-sector initiatives are seeking to develop reusable packaging and work hand in hand with brands, manufacturers, and retailers to provide collection points to make the return process for these long-lasting packaging easier and more convenient. At the urban level, the Tokyo Metropolitan Government (TMG) has been a key partner in such initiatives, helping to fund pilot projects and consumer surveys for the reusable lunch container project.

Reusing or repurposing allows us to extend the lifespan of a product or object at virtually zero cost. In terms of responsible consumption, this is a widespread and highly recommended practice for individuals, as it also encourages people to seek out, identify, and purchase higher-quality products with more durable packaging that can be reused, without generating plastic waste.

Remanufacturing: this stage of the technical cycle takes place when products can no longer be used and need to be restored to function as well as, or even better than, their original version. According to the Remanufacturing website, this process involves seven different stages: collection, disassembly, separation, cleaning, inspection, restoration and reassembly. Within the mining sector, there are companies that offer hydraulic pump remanufacturing services, saving time and energy at a lower cost.

On the other hand, waste electrical and electronic equipment (WEEE) is the fastest-growing type of household waste. An example of this is Kenya, where e-waste generation increased 17-fold between 2011 and 2021.

According to a life cycle assessment study conducted by the Center for Sustainable Systems at the University of Michigan, remanufacturing midsize car engines in the United States resulted in up to 83% less energy and 87% less CO₂ emissions; in some cases, up to 90% less raw materials were required.

If a life-cycle analysis were performed¹¹ for each device with remanufacturing potential, it would likely demonstrate savings in energy, water, transportation, and money, since by having the parts or components of the equipment to be restored and reassembled, there is no longer a need to acquire new raw material to transform it from scratch.

11. Life Cycle Analysis (LCA) refers to the methodology for evaluating the environmental impacts associated with all stages of a product's life, from its extraction to its management as waste.

Recycling: the most famous and widespread R (and sometimes confused with other circular economy strategies or with the concept of the circular economy itself) consists of the reuse of materials that undergo a mechanical or chemical process, transforming them into a new material that can have the same or different purposes. Although it is the most widespread strategy, it represents the last possible step before a resource becomes waste, which is why it is placed at one end of the butterfly.

Local governments around the world have recycling strategies, regulations, and programs that, depending on management capacity, can be demanding, encompass different sectors and involve different points in the value chain. A key player in this chain is the grassroots recycler, the person who takes to the streets or informal landfills every day to collect plastic bottles, paper, cardboard and glass. According to data from the Latitud R initiative, approximately two million people in Latin America and the Caribbean contribute 50% of what is recycled in the region. Those who recycle, in the course of their work, are exposed to pollutants, hazardous waste, and toxic gases, which pose a risk to their health and the environment.

Here concludes the *technical cycle*. Let's now have a look at the *biological cycle*. By biological cycle, we are making reference to the process of returning nutrients to the soil to help it regenerate. In other words, returning to nature what belongs to nature. The following processes help us understand how this cycle takes place.

Cascades: this refers to the use of renewable materials and resources and their use in a process of creating new materials, usually in a different field. For example, there are companies in the fashion industry that use fruit leaves (banana and pineapple) as raw material for the production of fibers used in garment manufacturing.

Another interesting case is the use of agro-industrial waste to make packaging or tableware, products that are then offered in supermarkets, convenience stores, grocery stores, or warehouses

throughout the city. In Greater Noida, 30 km from New Delhi (India), there are startups offering machinery for the production of molded pulp fiber from non-wood resources, using chemical-free technology as an alternative to single-use plastic.

Thanks to this cascading strategy, we can maximize the efficient use of renewable resources and add value to them through new products.

Biochemical raw material: the use of traditional fossil-fueled refineries to generate oil and its derivatives is one of the main sources of GHGs. It promotes the single-use plastic industry and implies severe environmental pressure, issuing solid waste and liquid effluents which contain hydrocarbons, organic matter, and heavy metals. There is also the constant risk of an oil spill, as it happened in January 2022 in the Peruvian sea, where more than 10,000 barrels were spilled, polluting nearly 50 beaches in Callao and northern Lima.

Biorefineries have emerged to face this problem, which, instead of using petroleum as a raw material, they use agro-industrial waste. A very common waste product in the tequila and mezcal industries is the bagasse from the agave plant. In the biorefinery, it undergoes a pre-treatment process to be deconstructed (disassembled) into its main components, which can be used to manufacture products such as biofuels, biogas, biodegradable plastics, and adhesives, among others.

By 2024, Panama will have started operations at Ciudad Dorada, the world's largest biorefinery, with a capacity to produce 180,000 barrels on a daily basis. This joint effort between the private sector and the national government aims at generating biofuels for airlines from vegetable oils grown for energy use, as well as waste fats and other oils. The goal is to be a solution to decarbonization initiatives. The aim of this project is to connect the agriculture, biorefinery, and aviation sectors and plans to create more than 1,000 jobs in the cities of Colón and Balboa.

Through a strategy for generating biochemical feedstock through biorefineries, the goal is to reduce GHG emissions into the atmosphere and integrate and repower industries (like industrial symbiosis through eco-industrial parks). Furthermore, the goal is to reduce transportation costs and provide solutions and value for agro-industrial waste.

Composting: this involves taking organic waste and decomposing it with oxygen and the help of natural microorganisms to transform it into fertilizer or compost. When returned to the soil, it helps strengthen and regenerate it, and this can be applied to both industrial and urban agriculture. It is important to mention that organic decomposition is a natural process that has always existed, but composting allows it to be produced under controlled conditions for faster fertilizer production.

According to the UN Food and Agriculture Organization (FAO), 1.3 billion tons of food produced for human consumption are lost—one-third of total production. How can this challenge be addressed at the municipal level? Cities like Buenos Aires offer green collection points for organic waste, which is then used in city squares and parks. In municipalities like San Borja, Peru, a composting training program and home kits are offered. In addition, there is a composting plant with an 8,000 m² area in partnership with members of the military, where weeds from the district parks and gardens are sent daily. Thanks to these initiatives, organic waste is prevented from ending up in landfills or dumps, the emission of gases generated by contact with non-organic waste is avoided, and savings are generated for municipalities, as they no longer have to transport organic waste to landfills.

Anaerobic digestion: this biological process also involves a decomposition stage with the help of microorganisms, but unlike composting, it is carried out without the presence of oxygen. This releases gases such as CO₂ and methane, which are redirected and utilized through biodigesters to later be used as fuel.

In Uruguay, the Biovalor initiative co-financed small and medium-scale biodigester projects. On the one hand, in the municipality of Solís de Mataojo, a biodigester was installed in the municipal cafeteria. It uses the peels produced daily to generate gas for the cafeteria's kitchen; literally, there is no waste. Additionally, byproducts such as leachate are generated, which increases microbial activity in the substratum to improve the growth of fruits, vegetables, and plants.

In addition, the agricultural association Rincón de Albano, just over an hour from Montevideo, invested nearly \$200,000 to create a large biodigester for the production of methane gas from the manure of 500 cows. This makes the electric power generator produce the electric energy that the association consumes, while the surplus production is sold to the National Administration of Power Plants and Electric Transmissions (UTE).

Having said this, we conclude our review of the *biological cycle* presented in the butterfly diagram proposed by the Ellen MacArthur Foundation. It is also important to know the best practices that have been being implemented for more than five decades within the framework of industrial symbiosis.

When considering experiences of industrial symbiosis with a circular approach at the urban level, it is crucial to mention the case of Kalundborg, a port city in northern Denmark with a population of 16,000 and highly developed industrial development. For over 50 years, this city is known to be the first example of industrial symbiosis in the world.

Thanks to the efforts made by 16 public and private companies that have identified and continue to identify opportunities to leverage their energy, water, and material flows, the city is increasing its resilience, improving its economy, and reducing its environmental impact. According to the European Union's Circular Economy *stakeholder platform* and the Kalundborg Symbiosis website, companies in this consortium achieve net annual

savings of €24 million, avoid the emission of 586,000 tons of CO₂, recycle 62,000 tons of recyclable materials and avoid the consumption of four million m³ of groundwater (surface water is used instead).

Despite these innovation efforts, according to the recent Circularity Gap 2022 report, the world is 8.6% circular; a lower percentage compared to the 9.1% presented in the first version of the report in 2018. In recent years, concepts such as the circular economy have appeared increasingly in projects, *papers*, social networks, conferences, and public and private initiatives; nevertheless, actions are needed to scale toward circular city models.

NECESSARY ACTIONS FOR THE CIRCULAR ECONOMY GROWTH

Citizens and their habitat as main users

What do people who live in cities have in common? We could say they share routines, activities, and lifestyles that require a constant flow of materials and energy within a given space and territory, and that imply the involvement and management of transportation, waste management, the supply of food, goods, and services, and the consumption of energy, water, and sanitation.

To carry out these activities in the most optimal conditions and in a healthy environment, it is necessary to provide solutions to improve citizens' quality of life. Through *design thinking*¹², we can begin to group people who share certain lifestyle characteristics, learn how to *empathize* with them, identify and *define* the main problem we want to solve for that specific group, *devise* solutions for that problem, *generate prototypes*, and *assess* their application. In this way, we can work toward continuous improvement for citizens' quality of life.

12. Although the origins of design thinking date back to the 1950s, as a result of a need to understand design from a more scientific perspective, this concept has evolved into a methodology for seeking and proposing innovative solutions to real problems faced by individuals or communities. This involves a five-step process: empathize, define the problem, devise solutions, prototype solutions, and evaluate their impact.

As part of the green transition, the Circular Cities project in Denmark applies a *design thinking strategy* that enables municipalities to systemically and practically work on local circular challenges in collaboration with businesses, research institutes, and, of course, with citizens themselves.

In this case, municipalities can launch a challenge based on their climate action plan, aiming at achieving a more intersectoral and holistic circular transition. These processes focus on capacity building, political participation, the creation and testing of specific circular solutions with different participants and cooperation between municipalities.

In addition to placing people and their environment at the center of improving their quality of life, it is also important to analyze the perspective from the responsibility and scope of action held by citizens viewpoint. A perspective and practice based on the approach of responsible consumption empowers people to make better decisions when choosing and purchasing a product or service that not only benefits their specific needs but also meets criteria of lower negative impact, net impact, or positive impact on the environment, in addition to providing social benefits to the community.

According to Argentina's National Strategy for Sustainable Consumption and Production, this is the definition for sustainable consumption and production:

It refers to the use of services and goods that meet basic needs and offer a better quality of life, while minimizing the use of natural resources and toxic materials, as well as the emissions of waste and pollutants throughout their life cycle. This way, the needs of future generations will not be jeopardized.

Thus, these concepts are closely related to the efficient use of resources, the decoupling of economic growth and environmental impacts, the circular economy, life-cycle analysis, industrial

symbiosis, and eco-design—the latter being a process that considers environmental criteria for the design and development of a product, so that it does not harm the environment.

Political and public action

The political commitment of mayors, political parties, and public institutions is key and fundamental to generating a *top-down impact* within their organizations and *bottom-up* or toward their peers as best practices at the national level.

As part of the European Union's Circular Economy Action Plan, the Circular Cities and Regions Initiative (CCRI) was launched. It seeks to synergize and strengthen the circular initiatives already being implemented by European cities. The initiative also offers financing for the development of demonstration projects, technical assistance projects, and cross-cutting projects.

On the other hand, according to the Platform for the Visualization of Public Initiatives in the Circular Economy in Latin America and the Caribbean, by 2022, nearly 400 initiatives have been already identified, including programs, regulations, projects, plans, strategies, agreements, policies, and even institutions, out of which 309 were of a national scale and the rest were local, provincial, and regional. Although the national scale serves as a guide and mandate, there is a great opportunity and need to transform these initiatives into local projects that start the engine of the circular movement.

Thus, in the context of the COVID-19 pandemics, the Avina Foundation, in collaboration with the Resilient Cities Network and IDB Lab, with the support of the Citi Foundation, launched the Urban Resilience Challenges initiative. This initiative identified and acknowledged innovative ideas and solutions based on the circular economy that are being implemented in nine cities across Latin America. Thanks to these initiatives, materials are recycled, resources are valorized, creating new lines of business, and opportunities are provided to communities that previously lacked them.

Another crucial issue within the scope and decision-making of government agencies is public procurement. Leading by example is key for local governments. Although it is well known that most public procurement decisions are governed by price-quality criteria, adding or prioritizing circular criteria for sustainability can have a significant impact to start accelerating the transition.

To get a good idea of this, according to the OECD, public procurement represents up to a fifth of global GDP and, in the case of subnational governments, that figure can reach up to 50%. Furthermore, the Argentina's National Strategy for Sustainable Consumption and Production states that:

Public procurement is the State's best mechanism for promoting sustainability and establishing clear market rules for sustainable products. Therefore, to the extent that goods and services with well-established sustainability criteria are in demand, the market will tend to adapt and transform over time.

A particular case is the city of Mendoza, which, as part of a sustainable public procurement measure, announced that as from June 2023, the municipality will only purchase products and services that meet sustainability standards and have triple impact certification. The certification consists of a scoring system with a maximum of 15 points and a mandatory minimum in the categories of energy, water, waste, emissions, and work equipment.

Another important form of action is through the promotion of specialized training for municipal technical groups. Here, it is essential that participants include not only members of the environment and sustainability teams, but also teams from other areas such as logistics, urban development, health, and strategic planning. In this way, more cross-cutting circular actions can be developed.

In 2021, through a partnership between the Konrad Adenauer Foundation and its climate and energy program for Latin America and five organizations in the region, teams from more than 15 mu-

municipalities from Argentina, Chile, Guatemala, and Peru received circular economy training. The goal was to support them in their own roadmap development processes in priority thematic areas for their communities. While these local-level advances are taking place, it is also important to maintain spaces for dialogue with the national level through ministries. Actions that have been implemented in the municipalities—with their own progress and results—serve as pilot projects and lessons learned, so that national governments can replicate these experiences systematically in other cities across the country.

Business action

Investors must understand that, in the long term, it is a smart decision to invest in stocks and business models that ensure the continued existence of a company (and the market that sustains it). To achieve this, it is necessary that, starting now, the business sector begins to shift toward transforming business models that respond to the need to improve people's quality of life and their environment. This is the way to envision a socially, environmentally, and climate-fair future.

To achieve this, it is necessary to identify the flows of materials and resources that respond to citizens' current lifestyles and also to respond to the demand for responsible and sustainable consumption. Besides, it is during this transition of the private sector to large conglomerates, associations, and corporations that the entrepreneurial ecosystem can play a leading role and take action: 1) helping to transform business lines toward more circular structures and models; 2) providing services with circular and sustainable characteristics; 3) jointly building new circular business models that respond to the need for closed circuits of material and energy flows in eco-industrial parks and under a focus on industrial symbiosis. In this sense, for the Latin American region, the International Labor Organization (ILO) has estimated the creation of 4.8 million jobs in the circular economy by 2030.

HOW CAN THESE SOLUTIONS HELP INCREASE THE RESILIENCE OF CITIES?

Going the definition of resilience from chapter one, we can say that a circular approach in the city would make it possible to move from a linear metabolism – with energy and material flows that generate waste, pollution, GHGs, economic losses and little capacity to respond to climate risks – to a circular metabolism, which allows energy and material flows to be integrated, feed different value chains, reduce GHGs, generate savings, make efficient use of resources, reduce pollution and increase the regeneration of ecosystems and the capacity to respond to climate risks.

In this context, a tool like The City Resilience Index, developed by Arup and supported by the Rockefeller Foundation, allows for the measurement and monitoring of different factors that contribute to a city's resilience. With a holistic and coherent approach, this tool is divided into four dimensions and 52 key indicators for working on city resilience.

In this context, *Health and Well-being* dimension identifies several indicators that, with a circularity approach, could begin to benefit citizens and their interactions. When referring to the “Safe and Affordable Housing” indicator, we can think of housing offerings that adhere to sustainable criteria, are built in a short timeframe, use local materials or waste from other construction projects, and have facilities that allow for operation with renewable energy and efficient use of water and sanitation.

Likewise, when thinking about the indicator “Sufficient supply of affordable food” or, in other words, food security, local urban agriculture programs can be activated with high neighborhood participation during the design, development, and maintenance processes. A network of these programs can also be considered, which, in turn, allows for the regeneration of soils and public spaces, with the use of gray water for irrigation systems and the

promotion of urban policies focused on prevention and health through a healthy diet and interaction with green spaces.

The *Economy and Society* dimension, a circularity approach to impact the “Attractive business environment” indicator allows for the promotion, development, and valorization of business models that focus on one of the cycles or principles of the circular economy, which seek to redesign energy or material flows, to reduce the use of virgin raw materials, or are dedicated to the regeneration of urban green areas as a way to recover and rescue biodiversity in areas, create sustainable tourism routes and activate the local economy. On the other hand, a circularity approach to generating a more attractive local business ecosystem allows for the recognition of opportunities in energy and material flows, with the potential to generate industrial symbiosis between different business sectors.

The *Infrastructure and Ecosystems* dimension, includes the “Diverse and Affordable Transportation Networks” indicator. Following a circular economy approach, the city can prioritize the installation and promotion of low- or-zero CO₂ emission transportation systems. Considering implementing stations or bus stops with clean-energy lighting, electric public transportation, or a bicycle-sharing system would allow for a more integrated, less polluting city with improved health and quality of life for its inhabitants.

In turn, the *Knowledge dimension* is key, as a large part of its indicators involve integrated work between different participants (citizens, businesses, and government). With citizens who adopt responsible consumption practices and demands, with organizations focused on more efficient use of resources and synergies between material and energy flows, and with governments (local and national) focused on providing a better quality of life for citizens and the environment, the necessary basic conditions will be in place to start the transformation towards more fair, circular, and resilient cities.

Throughout this text, we have reviewed concepts such as the circular economy and industrial symbiosis, which have been around for decades. We have seen how they are applied at different levels in innovative solutions for a more efficient flow of resources and energy. However, it is still crucial to take more coordinated action from the different participants interacting in the city so that solutions move from theory into practice and that what has already been working and contributing to the value chains is replicated and scaled to achieve more circular cities.

Finally, the opportunities and actions of circularity and industrial symbiosis will be more successful to the extent that they are linked to other sustainability strategies to achieve resilient cities in the face of a climate-challenged scenario—a scenario that is no longer a prediction, but a reality.

NATURE-BASED SOLUTIONS

Juliana Strobel

Throughout history, pressure on natural resources and environmental degradation have always existed but at a speed that allowed for the natural recovery of ecosystems. However, recent studies on ecosystem health reveal that over the past 50 years, an extremely rapid process of environmental degradation has occurred, unprecedented in any other historical period.

Cities are particularly affected, as they are centers of human activity, concentrating populations with a growing demand for natural resources. Unbridled urban growth in most cities in Latin America and the “Global South” has brought with it significant environmental challenges, such as pollution, flooding, water scarcity, and biodiversity loss. Consumption patterns, population growth, and traditional strategies for development and land use have advanced at an accelerated pace, affecting the quality of life in cities considerably.

In this context, nature-based solutions (NBS) seek to counter this trend by integrating nature into urban areas, harnessing the benefits of ecosystems to promote the sustainability and resilience of cities while simultaneously preserving themselves. For countries in the “Global South,” characterized by ecosystem diversity, these solutions can help address environmental challenges and create healthier, more resilient, and sustainable urban environments for residents.

Unlike conventional urban development models that focus on artificial and resource-intensive infrastructure, NBS acknowledge the importance of ecosystem services provided by nature, such as air and water purification, water regulation, local climate regulation and biodiversity promotion. Among these solutions we find the creation of urban parks, ecological corridors, green roofs, artificial wetlands, and many other strategies that incorporate natural processes to solve urban challenges sustainably.

Therefore, NBS represent a promising and highly important approach to addressing environmental problems and promoting nature conservation in cities. By integrating nature into the urban environment, these solutions offer environmental, social and economic benefits, contributing to the quality of life of populations, the health of ecosystems, and the construction of more sustainable and resilient cities.

WHAT ARE NATURE-BASED SOLUTIONS?

Nature-based solutions are territorial intervention approaches that seek to solve environmental and social challenges through the sustainable use and restoration of natural ecosystems.

Representing a Latin American approach, the Grupo Boticário de Proteção à Natureza Foundation (FBPN) has developed its own concept to reflect its vision of NBS and the work it has been doing for several years in Brazil. According to this organization, NBS are:

Actions that use natural processes and ecosystems to address the most pressing challenges of these days, such as the risk of water scarcity and the impacts of extreme weather events (floods, landslides, etc).

It is a natural resource management approach that generates benefits for biodiversity while promoting solutions for socio-economic development and human well-being.

The concepts of other international organizations vary slightly. The UN adopts the concept of “Green Infrastructure,” which refers to the network of ecosystems and natural areas strategically planned and managed to provide essential ecosystem services integrated into urban policies and planning. The IUCN (International Union for Conservation of Nature) emphasizes ecosystem protection and restoration as fundamental pillars of NBS, highlighting the direct relationship between ecosystem health and the benefits they provide to people, stressing scientific and traditional knowledge, and the participation of local communities when defining interventions. On the other hand, the European Community emphasizes resilience as an important characteristic of NBS, highlighting their capacity to cope with change and uncertainty, and underscoring the importance of the economic sustainability of interventions. This approach is closely linked to economic growth and job creation, clearly including the economic dimension of profitability.

Although there are still some differences in approach among the definitions, they all agree on the importance of using nature as a tool to address environmental and social challenges. These differences reflect distinct priorities and approaches: some are more oriented toward the economic efficiency of solutions, while others are more closely linked to ecological benefits. However, they all agree on the need to value ecosystem services, biodiversity, and resilience to achieve positive outcomes through nature-based solutions.

There are a few other concepts related to NBS, which are worth mentioning, and that are also used depending on the context. Natural Climate Solutions (NCS) are strategies that involve the conservation, restoration, and sustainable management of natural ecosystems, such as forests, mangroves, wetlands, and grasslands, with the goal of harnessing their potential to remove carbon dioxide (CO₂) from the atmosphere and store it, thereby contributing to climate change mitigation.

On the other hand, ecosystem-based adaptation (EBA) is a NBS focused on climate change adaptation and seeks to harness the benefits of ecosystems as part of adaptation strategies, strengthening ecosystem resilience so they can continue to provide ecosystem services, such as climate regulation, protection against natural disasters, provision of water and food, and support of biodiversity.

With the goal of establishing evaluation criteria and indicators that standardize the concept globally, a global standard for NBS has been developed by various experts around the world. These criteria are essential for determining whether a particular project can be considered a nature-based solution:

1. **Addressing social challenges:** it is essential that the project clearly identifies the problem it aims to solve.
2. **Considering scale and interested parties:** the economic, social, and ecological context surrounding the challenge to be addressed must be taken into account in the proposed SBN intervention.
3. **Benefiting biodiversity and ecosystem integrity:** NBS must generate benefits for biodiversity and maintain or improve the quality of the ecosystem in which it is implemented.
4. **Being economically viable:** economic viability is an important criterion for ensuring long-term sustainability and ongoing funding for the solution's maintenance must be considered. Green infrastructure also has maintenance costs; simply implementing it is not enough.
5. **Promoting inclusive, transparent, and empowering governance:** the participation of all actors in the processes of challenge identification, intervention decision-making, monitoring, and feedback must be part of NBS governance. Local community ownership of NBS is critical to successful long-term implementation.

6. **Balancing trade-offs between primary objectives and multiple benefits:** NBSs must be able to deliver multiple benefits simultaneously, bearing in mind the economic viability of the actions.
7. **Being managed based on adaptable evidence:** NBS should be designed based on scientific evidence and local knowledge, allowing for adjustments and adaptations over time.
8. **Being sustainable in the long term and integrated into an appropriate legal framework:** implementing NBS requires structural modifications that guarantee the sustainability of the implemented solutions, regardless of project timelines. Changes in regulations, government plans and corporate guidelines are examples of how the legal framework can be adapted to ensure the long-term sustainability of NBS.

It is important to note that there are different scales of intervention depending on the different interests of the entities working with nature-based solutions and the different types of financing.

The *building scale* is primarily used by businesses and citizens in their facilities, as in the case of green roofs. The *urban environmental scale* is used in city development, such as the implementation of urban natural areas that help reduce temperature and pollutants and improve soil permeability. The *landscape scale*, meanwhile, includes financial mechanisms and public policies such as payment for environmental services and strategies to promote the bioeconomy, for example. It is important to emphasize here that the financial mechanism or public policy is not the NBS itself, but rather a strategy for implementing NBS in specific areas.

Typically, the building and urban environment scales most obviously relate to NBS applied in cities, but it is clear that cities also depend heavily on what happens at the landscape scale,

as they rely on clean air, biodiversity, and water regulation and quality—ecosystem services that are often provided by interventions in the rural environment in strategies promoted at the landscape scale.

It is important to emphasize that NBS implemented in rural areas have a significant impact on the urban context of cities. Rural and urban areas are interconnected through food production systems and supply chains, and NBS play an important role in ensuring food security and promoting a healthy socioeconomic connection between rural and urban areas.

The socioecological resilience of cities depends on urban and rural NBS, which play a fundamental role in providing essential natural resources to urban areas, such as clean water and food. Besides, protecting rural areas contributes to reducing the risks of natural disasters (floods, for example), provides ecosystem services that directly benefit cities (such as regulating the local climate and improving air quality) and offers tourism and recreational opportunities in preserved natural landscapes.

In short, NBS implemented in rural areas directly contribute to the provision of natural resources, protection against natural disasters, the promotion of sustainable tourism and the creation of socioeconomic connections between rural and urban areas.

STRATEGIES AND BENEFITS OF NBS IMPLEMENTED IN CITIES

There are several nature-based solutions strategies that can be implemented in cities, either individually or in combination, depending on the needs and characteristics of each urban area and the biome in which they are located.

Integrating these solutions into infrastructure and urban planning can generate a range of environmental, social, and economic benefits for cities, contributing to the construction of more sustainable, resilient, and livable cities.

Green infrastructure involves the creation of green areas and natural spaces within urban areas. This can include parks, gardens, plazas, green corridors, and green roofs. These areas help improve air quality, reduce the urban heat island effect, provide habitat for urban wildlife and offer recreational and leisure spaces for residents.

On the other hand, *ecosystem recovery and restoration* involve the revitalization of degraded ecosystems within urban areas. This can include the restoration of rivers, streams, lakes, wetlands and urban forests. The restoration of these ecosystems helps improve biodiversity, water quality and carbon storage capacity.

Rain gardens and infiltration areas are structures designed to capture and direct stormwater runoff sustainably. They allow rainwater to be absorbed into the soil, recharging aquifers and reducing the risk of flooding. These strategies also help filter water and reduce pollution.

Urban agriculture, in turn, involves growing food and plants in urban spaces, such as community gardens, vertical gardens, and urban farms. It not only provides fresh and healthy food but also helps improve food resilience, reduce food waste, and promote environmental education.

Ecological connectivity involves the creation of ecological corridors that connect natural areas within cities. These corridors allow wildlife to move between habitats, facilitating species dispersal and maintaining biological diversity in fragmented urban environments.

Finally, *natural drainage systems* are structures designed to manage stormwater runoff in a more natural and sustainable manner. This can include vegetated ditches, retention ponds, constructed wetlands and filtration systems. These systems help reduce water pollution, recharge aquifers and prevent flooding.

Regarding the environmental benefits of NBS, the most notable ones are climate change mitigation by reducing green-

house gas emissions and capturing carbon; improvement of air quality by filtering atmospheric pollution; improvement of water quality by promoting water purification and water regulation, which is of great relevance for urban water supply; and biodiversity conservation by providing shelter and food for local flora and fauna.

In social terms, NBS benefits are observed in terms of residents' health and well-being by providing spaces for physical activity, recreation, leisure, and relaxation, which also represent a positive impact on people's mental health. On the other hand, the creation of more pleasant and sustainable environments, which makes cities more attractive and livable, improves the inhabitant's quality of life. NBS can also play an important role when fostering social inclusion by providing accessible public spaces available to all community members, regardless of their socioeconomic background.

Finally, NBS provide economic benefits, such as increased real estate value in areas near green and natural spaces in cities; reduced infrastructure costs by reducing the need for investments in conventional infrastructure, such as drainage systems; and the creation of green jobs, as the implementation and maintenance of NBS in urban areas create job opportunities in related sectors, such as landscaping, ecological restoration, and natural area management.

RELATIONSHIP BETWEEN THE TYPE OF URBAN NBS AND THE BIOME WHERE THE CITY IS LOCATED

The connection between the NBS specificities and the biomes where cities are located is a widely discussed idea in the scientific literature and in reports from organizations such as the UNEP (United Nations Environment Programme), the CBD (Convention on Biological Diversity) and the IPCC (Intergovernmental

Panel on Climate Change). This idea is related to the specific environmental, ecosystem, and cultural characteristics of each region. Each biome has a unique diversity of ecosystems, species, natural resources, threats, and environmental challenges. NBS must be adapted and developed taking these specificities into account, harnessing local natural resources and ecosystems sustainably and promoting biodiversity protection.

For example, in Amazonian regions, NBS may focus on the protection and restoration of tropical forests, while in coastal areas, strategies may involve mangrove restoration and the sustainable management of marine resources. The connection between the specificities of NBS and the biome is critical to guarantee the effectiveness and sustainability of the implemented solutions.

Besides, listening to the indigenous communities of each biome/region and letting them participate is crucial to ensuring the best design and implementation of NBSs, as they possess deep traditional knowledge and ancestral relationships with local ecosystems, giving them unique expertise in sustainable natural resource management and conservation practices. Active and respectful listening to these communities allows for their inclusion in the process and guarantees that their needs, priorities, and perspectives are taken into account in decision-making.

The participation of indigenous or native communities also strengthens their sense of belonging and empowerment, promoting shared responsibility in natural resource management and ensuring the fair, equitable, and effective NBS implementation. This respects the rights and knowledge of local communities and fosters biodiversity conservation, climate resilience, and the well-being of people who depend on these ecosystems.

CHALLENGES FOR NBS PROJECTS IN URBAN AREAS, SOLUTION STRATEGIES AND INTERESTED PARTIES

Implementing nature-based solutions (NBS) projects in urban areas implies several challenges. First, it is necessary to overcome obstacles related to changing the mindset and culture of professionals, public managers, and the community at large regarding the issue. Regarding professionals involved in urban infrastructure implementation, as their training was mostly based on techniques commonly used in the late 20th century, they did not receive adequate training to understand the broader benefits of NBS for the environment, quality of life, and urban resilience. Integrating NBS requires a multidisciplinary approach that goes beyond traditional engineering or architectural practices, demanding an understanding of ecosystem principles and processes, as well as the interactions between the natural environment and human activities.

Another challenge is space constraints, as urban areas often have limited available space for the creation and implementation of NBS. This requires identifying suitable areas and optimizing the use of available space, either by integrating NBS into existing infrastructure or by implementing innovative solutions such as vertical gardens or green roofs.

In this sense, the support and collaboration of diverse interested parties, including municipal authorities, urban planners, architects, engineers, community organizations, and citizens is essential to ensure the successful implementation of NBS. Education and public awareness also play a crucial role in promoting NBS and generating community support and engagement.

In summary, the implementation of NBS in urban areas faces challenges related to changing mindsets, space restrictions, and the need for collaboration and participation.

Furthermore, guaranteeing the necessary financial resources for these projects can represent a challenge, especially consider-

ing the budgetary constraints local governments and civil society organizations face.

Lack of buy-in from the local community, due to a lack of understanding of what a NBS strategy entails, can also be a challenge to consider. It requires investing time and effort in raising awareness and educating the community, as well as promoting dialogue to gain their support and ensure the sustainability of the projects.

Coordination and collaboration among different interested parties, such as municipal governments, NGOs, the private sector and the local community, can also be challenging due to the diversity of interests and levels of participation.

The maintenance and management of NBS also require ongoing resources and efforts to ensure their proper functioning and long-term benefits. Establishing effective governance mechanisms and ensuring the ongoing commitment of interested parties is critical in this regard. While these challenges may vary depending on the specific context of each urban area, it is important to identify and address them to promote the effective and successful implementation of NBS projects in cities. This requires integrated approaches, cooperation among different interested parties and an ongoing commitment to urban sustainability.

According to the Convention on Biological Diversity (CBD), to overcome these challenges when implementing nature-based solutions, it is necessary to adopt integrated and collaborative approaches, such as:

1. **Political commitment and governance:** it is essential to involve political decision-makers from the beginning of the process. This can be achieved by raising awareness about the benefits of NBS and showing how they can address cities' environmental, social, and economic problems.
2. **Strategic planning and regulation:** it is necessary to incorporate NBS into cities' public plans and policies.

This can be achieved by including guidelines and regulations that encourage and promote the implementation of NBS in infrastructure and urban development projects. It is also important to establish coordination mechanisms between different government sectors to ensure an integrated approach.

3. **Adequate financing:** it is important to seek diversified sources of financing, including public-private partnerships, international resource acquisition and specific financing programs for conservation and sustainability projects. Also, it is necessary to develop investment strategies that demonstrate the economic benefits of NBS, such as reduced infrastructure and environmental service costs, in order to scale and promote NBS as a financially sustainable intervention strategy.
4. **Awareness and education:** public awareness of the importance of NBS is essential for their success. It is necessary to invest in environmental education campaigns, promote local community participation in NBS projects, and spread information about the benefits of these solutions. In addition, it is important to involve the media and civil society organizations to raise awareness on the issue.
5. **Partnerships and collaboration:** planning and implementing NBS requires collaboration among different actors, including governments, academia, the private sector, NGOs, and local communities. Establishing partnerships and collaborative networks can facilitate the exchange of knowledge, resources, and experiences, as well as strengthening capacity for NBS implementation.
6. **Monitoring and assessment:** it is important to establish monitoring and assessment mechanisms to track the progress and results of NBS projects, helping to identify gaps and adjust strategies as needed, ensuring the effectiveness

and success of the implemented solutions. Furthermore, the measured results can provide a strong argument for the scalability of these types of solutions in cities.

The participation of various interested parties is necessary for these strategies to be implemented in cities. These include local and national governments, which establish policies and guidelines and allocate financial resources. Civil society organizations play an important role in raising awareness and mobilizing public support, while businesses and the private sector can contribute technical and financial resources through public-private partnerships.

FINAL CONSIDERATIONS

The implementation of nature-based solutions strategies is of utmost importance in the face of worsening environmental degradation and climate impacts, especially in cities in the Global South, where biodiversity is rich and ecosystems play a fundamental role in the livelihoods of local populations. NBS offer an innovative and sustainable approach to addressing these challenges, utilizing natural ecosystems as allies in building more resilient and sustainable cities.

NBS have the potential to mitigate the effects of climate change, promote biodiversity conservation and improve the quality of life in urban areas. By adopting practices such as ecosystem restoration, the creation of urban green spaces, sustainable water management and the promotion of urban agriculture, cities can reduce greenhouse gas emissions, improve air and water quality and provide habitats for local fauna and flora.

Also, NBS can contribute to climate change adaptation, making cities more resilient to extreme events such as floods and heat waves. The use of green infrastructure, such as green roofs and vegetation corridors, can help reduce the vulnerability of ur-

ban areas to these events by providing greater water absorption capacity, shading and reducing heat islands.

Faced with so many challenges and opportunities, cities in the Global South have much to gain from implementing NBS as a strategy for building long-term resilience. By incorporating ecosystem conservation and restoration initiatives into their urban development plans, cities can achieve sustainability, strengthen their resilience to environmental and climate impacts and promote the well-being of their populations.

In other words, SBNs promote benefits in various areas of urban management, with an integrative, innovative approach aligned with the vision of a sustainable future that fosters care for the planet and human dignity.

ACHIEVING SUSTAINABLE URBAN ENVIRONMENTS THROUGH NATURE-BASED SOLUTIONS

José Chong

(contributors: Nikolas Lanjouw y María Valentina González)

OPEN PUBLIC SPACES AND NATURE-BASED SOLUTIONS

According to the 2013 Public Space Charter, public space is “any place of public ownership or public use that is accessible and usable by all, free of charge or on a non-profit basis.” These spaces are often parks, squares, streets, or riverside areas. They represent vital locations in a city, as they attract investment and new residents and provide social and health benefits. But, if designed with sustainable, nature-based solutions in mind, they can also play an important role in mitigating the effects of climate change and reducing its impacts on urban areas.

Improving green public spaces can be important for balancing the carbon cycle, controlling climate change, and minimizing the likelihood of extreme natural disasters. They can also serve as water retention areas to prevent widespread urban flooding, while restored urban shorelines can act as buffers against extreme winds and storm surges. When nature-based solutions are combined with the creation of public spaces, they help foster more active lifestyles, enabling healthier and more resilient urban populations. Despite their widely known benefits, public spaces and green areas are often neglected in urban planning, forc-

ing their appearance as isolated solutions and fragmented green spaces in cities. Therefore, it is crucial to plan public spaces with NBS in mind from the outset of the planning process, applying a holistic and multidisciplinary approach.

City planning must consider long-term scenarios and strategies and take into account the diverse needs of all interested parties to create, maintain and use the public space system. To this end, the United Nations Human Settlements Programme (UN-Habitat), through the Global Public Space Programme (GPSP), supports local governments in the creation and promotion of socially inclusive spaces, integrated, connected, environmentally sustainable and safe streets and public spaces, especially for the most vulnerable.

The Programme has developed various tools and processes to help incorporate NBS into urban design and planning processes and ensure their successful implementation. Each of these solutions is designed with specific objectives and varying degrees of technical detail, with governance models that respond to the same degree of specificity and complement collaborative planning requirements. It is worth emphasizing that none of these tools or methods will be equally deployed in all cities and contexts; however, a general understanding of the underlying process and its technical requirements establishes the foundation for a flexible and rigorous methodology. The available resources can be classified as standards and tools, indicators, assessment guides, solutions and case studies.

There are a large number of publicly accessible publications on the Program's portals, which can be consulted to learn more about this topic.

SPECIFIC TOOLS FOR BIODIVERSITY AND CLIMATE CHANGE

The cities and biodiversity perspective, which analyzes urban development projections for the coming years, estimates that 60 percent of urban surface will have not be constructed yet by 2030.

The human spatial footprint will more than double in the near future, making it vital to rethink current urban planning processes, practices, and tools to halt and reduce biodiversity loss and address the worsening climate system. Recent studies suggest that cities can contribute more to regional biodiversity than previously thought; however, these studies have revealed that urban ecology is poorly understood in those places where it has been studied and largely unknown where it has not still been researched.

Most urban ecology and climate studies focus on North America, Europe, and Australia, while few formal studies have been conducted in Latin America and Asia. Consequently, tools and methodologies for assessing, implementing, and maintaining NBS for biodiversity are based on experiences from the “Global North.” Nevertheless, some resources can be found that are relevant to urban areas in the “Global South,” such as the “*Singapore City Biodiversity Index*” and the UN-Habitat “*White Paper on Cities and Nature*”.

The *Singapore Index* is a resource for assessing and monitoring biodiversity in urban areas. It encompasses 28 indicators on native biodiversity, ecosystem services, and biodiversity governance and management, providing a multi-sectoral approach. This tool was designed to establish biodiversity trends with low or limited data requirements, and with minimal need for spatial data and continuous monitoring. Combining this tool with broader regional and national assessments will provide a clearer picture to guide the prioritization of interventions. As such, it represents a valuable tool for municipalities or urban settlements with limited technical capacity in the “Global South.”

The *White Paper on Cities and Nature* provides a new methodology for future, long-term urban planning, explained through a case study and a biodiversity lens. The methodology’s main objective is to provide a spatial analysis of the potential outcome of the urbanization process, based on the superposition

of scenarios from regions noted for their high biodiversity value. The resulting analyses generate detailed spatial maps capable of informing decisions that guide urban expansions that reduce the negative impact on critical habitats where they are deployed. This tool involves complex technical levels and a significant amount of spatial data. To mitigate these factors, the methodology collects standardized and commonly available global and regional data, which can be verified through on-site data collection and interested parties' engagement.

CITY-WIDE ASSESSMENT OF PUBLIC SPACES

The “*Citywide Public Space Assessment*” guide is a tool that helps local governments to gather accurate data on the condition of public spaces, identify areas that need to be protected for the creation of new spaces and develop plans and strategies to achieve this.

Conducting a citywide public space assessment consists of four progressive stages, the results of which are as important as the processes that generate them. These four stages are preliminary fieldwork, data collection, reporting and post-assessment at a city level. Each of these steps is, in turn, comprised of activities, tools, and case studies compiled from the experiences of partners and UN-Habitat's work in various cities.

The tool aims at promoting the restoration of urban ecosystems by creating green public spaces, ensuring the sustainability of citizens, and “consolidating one microecosystem at the same time.” The creation of green public spaces provides design and supports initiatives to restore waterways and wetlands, plant native trees, and create urban forests and other wildlife habitats along roads, rail lines, and public spaces.

Furthermore, ensuring citizen participation for sustainability offers campaign opportunities for sustainable urban planning, including the restoration of underused or polluted sites, green spac-

es in new housing developments, and strong and reliable public transport networks. Digital tools, such as apps and other technology-enabled collection and sharing platforms, can support these efforts by tracking and coordinating individual contributions.

ASSESSMENT OF PUBLIC SPACES AT A SITE/ NEIGHBORHOOD-SPECIFIC LEVEL

When we talk about “neighborhood level,” we refer to sub-municipal regions, but also to smaller general areas that are delimited by architectural, social, or cultural boundaries. “Site-specific” makes reference to a spatial point (park, street, or waterfront) and a five-minute walking distance from that point. These definitions are not interchangeable, but both are often used to refer to a single space.

In this sense, the “Site-Specific Assessment of Public Space” tool is used to assess the quality of public spaces and influence in the site design through a participatory, incremental, and iterative process. Developed by UN-Habitat, this tool focuses on a selected public space within a five- to ten-minute walking radius of the site at issue. The methodology developed for this tool aims at generating safer, more inclusive and easily accessible public spaces by proposing innovative design and planning solutions. This methodology implies four phases and guides professionals when measuring the quality of public spaces through the assessment of 20 indicators attributed to five dimensions. These guidelines are a valuable resource for assessing the quality of an existing public space in need of improvement and establishing a quality framework for creating a new site.

NBS can be incorporated into the site-specific tool by creating a network of green public spaces to mitigate climate change-related risks. The tool can also support the greening of streams and riverside areas to improve stream health and stormwater quality.

GO BLUE PROJECT

Some practices in the “Global South” can provide a territorial anchor to what has been mentioned so far. These are cases in which the adoption of nature-based solutions in the planning and implementation of public spaces has been fostered. The projects prioritize participatory, inclusive co-creation and a better integration of cultural, political, spatial, social and natural dimensions. The Go Blue project in Kenya is a good case to show this.

This is an initiative developed by UN-Habitat, the United Nations Environment Programme (UNEP), the Government of Kenya, and the European Union, and it was implemented in six counties—Mombasa, Kilifi, Taita Taveta, Lamu, Kwale, and Tana River—that together make up *Jumuiya ya Kaunti za Pwani* (JKP). The project seeks to address the socioeconomic and environmental challenges emerging from rapid urbanization on Kenya’s coast. According to the 2019 census, the six counties of JKP have grown by 28% over the past ten years, with 40% of the population living in urban and peri-urban regions. As a result, the unplanned nature of urbanization on the coast has led to increased urban poverty, unplanned informal settlements, environmental degradation, limited access to basic services and a deterioration in the population’s quality of life.

To address these challenges, the project adopted a comprehensive ecosystem-based approach to land-sea planning and management of blue and green resources, seeking to integrate people, cities and the ocean for a more sustainable and resilient Kenyan coast.

In Kilifi City, where Mathagi Public Park is located, we worked with SBN. Within walking distance of the park, there are several residential and commercial nodes, with approximately 5,000 buildings within the area. The site-specific assessment tool was

used to support the analysis, design and implementation of the project. To promote a shared community vision for the site, the Block-by-Block methodology¹³ was used, and additional measures were included to support the greening of the park and stimulate its biodiversity, mitigate the impact of coastal flooding through mangrove restoration and support and stormwater management.

DONGHU GREENWAY (WUHAN, CHINA)

The project was led by the Wuhan Land Use and Urban Spatial Planning Research Center (WLSP) with technical counselling from UN- Habitat and it is an example of the application of the assessment tool at the urban level that has used the nature-based solutions approach in its design. The study aimed at providing citizens with greater access to green areas, improve green and inclusive public spaces for leisure and increase residents' living standards through the Green Way project.

The project results significantly increased the number of visitors, from 94,000 tourists in 2015 to more than 10 million, generating job opportunities and local economic development. The Greenway was also free to all, hosting numerous events and recreational activities. Following the ecological restoration, the total number of trees increased by 53,000. The total restored area was approximately 10 square kilometers, with the removal of 10.2 km of road and the restoration of 34 km of shoreline, improving water quality.

CONCLUSION AND RECOMMENDATIONS

Cities are now home to more people than at any other time in natural history. Inhabitants—human and nonhuman—and nature face the challenges of this overcrowding, which have large-

13. Information available in <https://ciudadesincluyentes.org/integration-toolbox/co-creation-of-habitat-and-right-to-the-city/block-by-block/>

ly been addressed through engineering. However, nature-based solutions offer an approach to urban planning and design that significantly improves the well-being of both parties by reconnecting humans with nature. NBS function most effectively when framed within human-nature relationships and the principles of inclusion for all interested parties. Through inclusive planning, public spaces can offer all the benefits of NBS while simultaneously creating places for people to meet and exchange.

To guarantee projects have a positive impact, we recommend using assessments and standards for preliminary analysis, consulting case studies to know about best practices and following guides and manuals to understand the step-by-step procedures implemented.

If NBS are to be applied, it is crucial that the context of the city, neighborhood or site be taken into account throughout the citywide assessment and prioritization. NBS cannot solve all the challenges cities are facing, but they can become the backbone of prosperity in a stable climate and a healthy biosphere.

URBAN COMMONS AND THE CO-PRODUCTION OF INNOVATION CITIES

Angélica Marques

Previous chapters of this book have addressed the complexity of the city as a system, with all its components, needs and possibilities. This highlights a constant and inherent social conflict and instability and adaptability as principles of this system. Addressing this requires a transdisciplinary perspective, with profound transformations in relationships, policies and governance approaches. In this sense, innovative solutions for urban sustainability can be achieved through the co-production of innovation, building bridges between people, places, meanings, visions and ecosystems.

The innovation co-production approach is presented as an alternative for building more human, intelligent and sustainable cities, centered on urban commons. It is an iterative and collaborative process that involves different types of experiences, knowledge and actors, all with the goal of innovation.

URBAN COMMONS AND THE THEORY OF THE COMMON GOOD

In every city, citizens share access to a range of tangible and intangible local resources in which they have a common interest. These are known as the “urban commons.” These resources can include local streets and parks, shared public spaces or neighborhood amenities and intentionally constructed, used or

reserved urban spaces. These places or resources, including natural or green spaces, come into existence and are reproduced, in part, through social interactions and human attributions of social significance. They are not just products of nature or the physical environment but they are also social constructions, in the sense that they are created and reproduced through human interactions and the attributions of social significance they receive. From this perspective, places have cultural, historical, and social meanings that are constructed through the human practices and relationships that take place within them. These resources are important for building a cohesive community and promoting urban quality of life. The use and management of urban commons require the active participation and engagement from city residents.

Commons theory, or common good theory, is an economic theory that studies how shared resources can be managed sustainably and equitably. Elinor Ostrom proposed the theory that earned her the Nobel Prize in Economics in 2009. After analyzing thousands of cases of common-pool resource management, she identified that as long as the set of principles and rules of common property are well-defined, accepted, and respected by all participants, it is possible to avoid overexploitation of the so-called “commons.” If this does not happen, overexploitation can lead to a state of tragedy of the commons, which occurs when each individual acts according to his own interest rather than in the collective interest. In these cases, shared resources collapse and become unusable for all users.

The commons approach strengthens cooperation through collective action, avoids individualism and seeks the social well-being of the community, contributing to equity, collaboration and governance. Considering that innovation ecosystems depend on knowledge flows that drive collaboration and co-creation to translate this knowledge into added value, commons

theory provides a basis for establishing relationships between different actors for the co-production of knowledge and innovation, aiming at managing resources more fairly and sustainably.

Besides, this approach is multidisciplinary. Urban ecology, for example, acknowledges that shared resources in urban areas are not only important for individuals, but also for local biodiversity and the health of the urban ecosystem as a whole. The sharing economy is, in turn, an economic model that emphasizes collaboration and resource sharing among people, rather than individualistic consumption, and the urban commons can be considered a form of the sharing economy.

Within social psychology, the social behavioral perspective provides insights into how social norms can be built and maintained to guarantee the sustainability of urban commons. According to Ostrom, from the perspective of information and knowledge management, knowledge commons is any shared body of information that numerous members of a community extract and contribute with. An example of this is are the electronic government (e-Gov) platforms, which can function as an instrument for the co-production of public goods, knowledge sharing and the promotion of transparency, participation, efficiency among other principles of open government. This is based on the articulation of citizens, policymakers and organizations operating in the public sphere. Furthermore, e-government and open government platforms can mediate innovation processes, the search for solutions to meet the needs and solve the problems of cities, enabling governance and interested parties' participation.

The commons, as Ostrom envisioned them, offer communities the opportunity to self-govern and decide how to share and use information. In this sense, the commons are presented as an institutional arrangement that determines how and where community members (citizens, government officials and organiza-

tions) will interact, their responsibilities and roles, how they will be organized, and how the state of public and related resources will be monitored and assessed.

Looking ahead into the future and taking into account the evolution of sociotechnical-ecological systems¹⁴, the concept of Society 6.0 is a vision of a future that entails a highly technological and humanized society in which humans and machines work together to achieve a common good. Although there is no consensus on the definition of Society 6.0, it can be said that it refers to a future society that seeks to integrate advanced technology and human values to promote human happiness and well-being.

The co-production of knowledge and innovation is one of the key elements of this vision, as it requires collective action to create solutions to global challenges. In this context, the development of social capital can be triggered by advanced technologies that facilitate interaction and communication between people, such as artificial intelligence, virtual reality and the Internet of Things. The use of these technologies can help overcome geographical and cultural barriers, allowing people to connect and collaborate on common projects, creating spaces for experimentation and co-production of social innovation, in the pursuit of developing new forms of production, participation in decision-making processes, consumption, and coexistence that are fairer and more sustainable.

CO-PRODUCTION OF KNOWLEDGE AND INNOVATION

The co-production of knowledge and innovation is an interactive and iterative process of collaboration between actors from different organizations and sectors of society, including individuals. When integrating non-academic knowledge, co-pro-

14. The concept of a sociotechnical-ecological system can be described as the set of elements that make up the environment (human beings, natural and constructed elements) and their various interrelations.

duction is considered transdisciplinary. The term co-production was firstly introduced by Elinor Ostrom in the early 1980s as “processes through which supplies used to produce a good or service are provided by individuals who do not belong to the same organization.” She referred to the co-production of public services with citizens’ participation and the development of social capital. Recently, co-production has been analyzed from the perspective of the co-production of innovation, as a process of interaction between actors in innovation ecosystems.

In this sense, understanding the context is crucial as co-production refers to a collaborative and dynamic process of producing knowledge in a relevant social, cultural, and political context. In an innovation ecosystem, there are different types of interaction between the system’s actors and the degree of interaction among them is dynamic and nonlinear. This means that a given actor may exhibit different modes of interaction depending on their objectives (desired outcomes) and the context. The complexity of relationships and governance systems, therefore, is greater in co-production.

Many co-production processes are described as collaborative, as they refer to the act of engagement across domains and disciplines, which is just as important as production of knowledge. Compared to disciplinary processes, knowledge co-production ranges from a collaborative phase of problem structuring and trust building, through production of knowledge, to a phase of exploring the practical implications of the process.

It should be noted that, in the context of innovation ecosystems, the scale of interaction is dynamic, and each actor in the ecosystem may have different types of interactions with different actors. It is also worth highlighting the importance of governance in the coproduction perspective. Elinor Ostrom’s contribution on the common good brought important aspects of governance to coproduction to understand the structure and

function of complex governance systems. Co-productive governance articulates context, knowledge, process and vision of governance. The mode of governance is essential for addressing complex challenges and problems, redistributing power by building and strengthening social capital, trust processes, common goals, access to resources, and the ability to manage conflict.

From the perspective of more human, smart and sustainable cities, it is essential to create and build mechanisms and spaces that foster and stimulate knowledge co-production and innovation processes geared toward urban sustainability. In this context, the development of social capital is essential to creating a more connected, collaborative, and resilient society that seeks the co-production of urban commons.

The co-production of innovation focused on urban commons has developed innovative solutions to face common urban challenges. These commons can include public spaces, transportation, utilities, housing and other areas of the city that affect residents' quality of life. One example is the development of technological solutions to improve urban mobility. This may include ride-sharing apps, bike and electric cars -sharing systems, and other technologies that help make transportation more efficient and accessible. Similarly, we could also mention technologies targeting sanitation, soil and air pollution, more energy-efficient buildings, or cheaper and more inclusive solutions.

As technologies have evolved, many urban commons have been updated and improved to meet the demands of modern cities. Smart public transport represents a successful example of the co-production of innovation in technology-enabled urban commons. Many cities around the world are investing in smart public transport systems, which use advanced technologies to improve efficiency, safety and passenger comfort. This includes real-time control systems, public transport apps, traffic sensors and even autonomous vehicles in some cities. To achieve this,

open public data and citizen participation in the co-production of these services are critical.

Another example is energy management systems. With the increase in energy production from homes, such as solar energy, the co-production of energy management and distribution services requires innovative co-production systems. Some cities are investing in smart energy management systems that use advanced technology to monitor and manage energy generation and distribution, reducing waste and saving money.

Some cities have developed mechanisms and spaces for co-producing innovation, resulting in improved air and water quality, climate change mitigation, biodiversity promotion, increased resilience, health and well-being, public safety, and inclusive education, among other things.

Urban sustainability implies the efficient use of natural resources and the creation of a healthy and safe urban environment for all inhabitants. This includes an integrated approach to waste management, renewable energy, sustainable transportation and land use. As stated in the first chapter, a sustainable city is the one that seeks to reduce the negative environmental impact of its activities and increases its resilience to climate change.

Thus, urban sustainability, urban commons, and innovation co-production are interdependent and complementary. Urban sustainability is a goal to be achieved through the appropriate use of resources and urban commons. Co-production of innovation is one way to achieve this goal, which involves the participation of city residents and the creation of innovative solutions that take urban commons into account. Acknowledging the interdependence of these concepts and promoting collaboration among different actors to achieve a more sustainable, fair, and innovative city is a way towards the society advocated by Society 6.0.

Society 6.0 is an evolution of the Information Society and the Knowledge Society, and is characterized by the interconnec-

tion of people, technologies and infrastructure to create a more advanced and intelligent society, based on several concepts, including Chesbrough's "*Open Innovation*," which highlights the importance of collaboration between different organizations and individuals in developing new ideas and solutions. In Society 6.0, open innovation is key to promoting the co-production of innovation, allowing organizations and individuals to share knowledge and resources to create more advanced and efficient solutions.

Another key concept is the "open science" movement, which aims at making science more accessible, transparent, and collaborative, enabling diverse interested parties (researchers, businesses, and citizens) to work together to create innovative solutions for society's problems. Emerging technologies, such as artificial intelligence, the Internet of Things, *blockchain*, and advanced robotics, drive the co-production of innovations, allowing different organizations and individuals to collaborate in new and more efficient ways. In turn, citizen participation involves citizens in the innovation process and it is important to guarantee that innovation be ethically and socially responsible.

There are several examples of successful co-production processes of various types and scales, developed within a single urban development, neighborhood, or region of the city, but the generated benefits have an impact over the whole city. An emblematic example, which required solutions co-produced with citizens in relation to social conflict, was the case of the city of Medellín in Colombia, which faced a serious problem of urban violence in the 1980s and 1990s as a result of drug trafficking and the presence of armed groups. The city was once considered one of the most violent ones in the world. To address this situation, the municipal government of Medellín adopted an innovative approach that involved citizen's participation in formulating solutions. Spaces for dialogue and listening were created,

in which residents could express their demands and co-produce proposals to improve security and quality of life in the city.

Several initiatives stand out within this process. The “Safe Neighborhood” program is one of these, which involved the creation of urban commons, such as parks and libraries, and the provision of cultural and sports activities aimed at social inclusion and violence reduction. Another one is the “Metrocable” program, which involves the installation of cable cars to connect poor and isolated areas of the city with the urban center, fostering social and economic integration. The “House of Justice” program is another one also worth mentioning, which offers legal and conflict mediation services to the population. The “Medellín, the Most Educated” program, launched in 2004 to improve the quality of education in the city, involved a partnership between the public and private sectors, and local communities to co-produce innovations that led to solutions such as the construction of schools and libraries in poor areas, the implementation of vocational training programs and the creation of a quality public transportation system.

As a result, the city of Medellín has undergone a significant transformation, becoming a model of urban resilience. The homicide rate has dropped dramatically, from 381 per 100,000 inhabitants in 1991 to 24 per 100,000 inhabitants in 2018. Furthermore, the city has become a hub for innovation and development, attracting investment and tourists from around the world.

Medellín’s acknowledgment for its transformation and innovative city planning, design, and development stems from a set of interrelated factors, from civil society mobilization, to urban governance reforms, to investments in urban commons in the poorest neighborhoods, all of which combine to help transform Medellín’s built, social, natural, political, and economic environment.

Today, Medellín is an example of how the co-production of urban innovation and the commons has given rise to a popu-

lar city that survives, resists and transcends imposed limitations, drawing on the possibilities of everyday life.

Likewise, the Ruta N initiative, a public organization, is leading the transformation of Medellín's innovation district, known as the *Medellinováción* District. This organization's mission is to support companies, public institutions and universities in fostering technological innovation and transforming Medellín into a knowledge-based city. By bridging the gap between residents and emerging knowledge workers, the Ruta N innovation district team aims at building an inclusive innovation district that does not exclude residents from participating in the knowledge economy, seeking to develop Medellín's science, technology and innovation ecosystem through disruptive transformations of social processes. It seeks to connect organizations and attract foreign and local capital to use as donations or seed capital for social impact initiatives. According to data from the Ruta N District 2020 management report, only in 2019, they raised approximately \$515,000 in capital to fund entrepreneurship and social innovation initiatives.

Medellín's experience illustrates how co-producing solutions, with the active participation of citizens, can be an effective strategy for addressing social conflicts and promoting urban resilience. Furthermore, by involving citizens in the co-production of solutions, it is possible to create a sense of belonging and responsibility toward the city, strengthening social cohesion and contributing to a more just and sustainable future.

Another outstanding example is Florianópolis, a city in southern Brazil and the capital city of the state of Santa Catarina, which developed a set of strategies within the framework of a public policy for the co-production of public services for the management of organic waste. The city's geography, its land use and occupation, and the "vocation" of its inhabitants make it an ideal city for urban agriculture. The Semear Network, comprised

by municipal departments, civil organizations and self-organized groups, developed the Municipal Urban Agriculture Program, by decree enacted in June 2017. The program seeks to promote agroecological practices that involve safe production, agro-extractivism, harvesting, processing, and service provision to generate products for personal consumption, exchange, donations or marketing, reusing local resources and supplies efficiently and sustainably. It also advocates that agroecological practices in urban environments should consider improving nutritional and health conditions, leisure activities, sanitation, cultural appreciation, community interaction, environmental education, environmental stewardship, the social function of land use, job and income generation, agro-ecotourism, urban improvement of the city and sustainability.

A final example is Mexico City, which in 2013 launched the “My Smart City” program, as part of the KLIMA project of the Friedrich Naumann-FNF Foundation. Its objective is to implement the best practices of *Smart Cities* in municipalities and towns in Central America and Mexico, promoting innovation through market economy tools. The program included the participation of technology companies, universities and citizens, and co-produced solutions such as an application that helps identify bus stops with shorter waiting times, an air quality monitoring system and an electric *car sharing system*.

FINAL CONSIDERATIONS

Movements calling for collectively produced cities in pursuit of socio-spatial justice and improved quality of life geared toward urban sustainability are becoming increasingly common. Many of these urban co-production practices continue to operate on the basis of informal agreements based on the voluntary work of citizens and activists, although public policies to pro-

mote and innovate the co-production of urban commons have increasingly been developed and implemented, as shown in the examples mentioned above.

The use of smart technologies such as sensors, geographic information systems (GIS) and the Internet of Things (IoT), can help cities collect and analyze real-time data to monitor and manage risks and provide early warnings to citizens. At the same time, it would enable participation in the development of innovative solutions through collaborative governance focused on the city's real problems and demands.

The digital revolution can provide tools for the co-production of urban commons, reducing the costs of collective action and connecting with urban social movements and network effects, thereby increasing the dynamics of collaboration supported by digital platforms, especially in cities.

Society 6.0 is a futuristic concept. Many contexts, especially in Latin America, are still far from this future due to various reasons such as structural, political, technological, or environmental. It is necessary to reflect on and question the development models adopted, since co-production is a tool for coordinating public policies when the vision of society's development is not linear. From this perspective, it is necessary to create institutional and political conditions so that co-produced projects and solutions achieve their objectives, gain long-term traction and are not exclusive to one administration or political party.

Furthermore, it is important to keep in mind that community engagement is critical to developing resilient solutions. Effective communication with engagement can help build trust, raise awareness and guarantee that solutions address citizens' needs and concerns, since co-production involves citizen participation with a focus on active construction, not just public consultation. Often, the emphasis on the need for certain skills for participation leads to the systematic exclusion of citizens without the necessary cultural capital.

Finally, it is important to consider the sociotechnical-ecological environment or system in question, its complexities and, in particular, power asymmetries, identifying the actions necessary to overcome barriers and build bridges of trust. Many politicians and professionals consider co-production to be somewhat risky, either due to the risk or the reluctance to lose status, power or control. In this sense, the importance of the third sector in empowering, facilitating and promoting civic engagement in the process is highlighted. For citizens to be included in these innovative practices, it is necessary to reduce or even break down boundaries and generate a sense of belonging and ownership, as Ostrom advocates, and truly create spaces for co-production, where collaborative interaction generates empowerment and interdependence, and everyone feels free to contribute.

IMPLEMENTATION CASES IN CITIES

Yanina Nemirovsky

ECOCUR

Today, in Paraguay, there are more underused tires than people. This represents a serious environmental problem, as in countless cases, these tires end up in landfills, vacant lots and even on the streets. They are often burned, releasing toxic gases that damage air quality. They also pose a health problem, as discarded tires represent an ideal breeding ground for diseases vectors such as dengue, Zika, and chikungunya fever, which are now classified as endemic in Paraguay. Moreover, these problems are exacerbated by the lack of a tire collection and reuse system that allows these materials to be reused beyond their useful life.

For this reason, innovative approaches are required and, in this sense, Ecocur is a startup that proposes a solution to prevent car tires from ending up in rivers, natural environments, and streets.

Ecocur's proposal, based on a circular economy model, consists of generating a business that provides a dual solution: on the one hand, offering an alternative for the recovery of the rubber and steel used in tires and, on the other, designing an innovative, low-impact material for the construction sector. This is how Ecocur uses the rubber it recovers from tires to create tiles that can be installed in parks, gyms, pedestrian paths, patios and even in industrial work areas.

The material is recovered through a tire shredding process that produces a new granulated material to be used when making tiles. Thus, the project integrates the complete recovery process: it takes used tires off the streets and gives them a second life as flooring. The project has yielded positive results: tiles made from reclaimed rubber are resistant, they can last for many decades and they are suitable for a wide variety of spaces.

Ecocur was founded in 2020 as a family business based on a dual concern: designing a productive project that was both sustainable and beneficial to society. After analyzing the idea of recovering tires and designing a process for recovering and re-using the material, the entrepreneurs acquired their first machinery and began working. At first, they collected the tires themselves by visiting tire sales and repair shops in Asunción. The project soon grew, and Ecocur began to establish partnerships with these stores, which were its main suppliers of raw materials. Today, Ecocur holds an environmental license from the General Secretary of Environmental Quality and Natural Resources Control, which reports to the Ministry of Environment and Sustainable Development of Paraguay. It grants its suppliers a final disposal certificate that allows them to certify compliance with their environmental obligations to public institutions.

In its nearly three years of existence, Ecocur has recycled more than 20,000 tires, more than 207 tons of rubber, and nearly 40 tons of steel. At the same time, it has managed to position on the market the tiles made from the resulting material. This was not easy, given that it was a novel product and often competed with other tile manufacturers from abroad.

But the entrepreneurs are foreseeing other possibilities beyond tiles. They are looking to expand their product catalog and begin designing other objects made from recycled rubber, and even become suppliers of this material to other industries that can use it as a raw material.

Along the way, Ecocur represents a case that illustrates the importance of innovation in achieving efficient use of resources by recovering materials that typically remain on the streets and in rivers, polluting cities and increasing the spread of disease.

Ecocur is a model based on the circular economy that has the potential to transform the life cycle of rubber products by impacting the value chain of various productive sectors. Ecocur's model allows for shortening material supply chains, generating positive impacts on the resilience of cities and the natural environment through resource decoupling, which means creating new products and using fewer resources.

BOA VISTA ACOLHEDORA

Roraima is one of the Brazilian states that has undergone the greatest demographic transformation in the last decade. Since 1970, through financial incentives, infrastructure investment and the creation of agricultural production projects, programs began to be implemented to occupy a territory that had a very low population density compared to the rest of the country.

In the following decades, Roraima underwent major population transformations due to a wide variety of factors, which led to an increase in its population from approximately 79,000 inhabitants in the early 1980s to 290,741 in 2011 and 463,591 in 2021. This latter major population increase was mainly due to migration from Venezuela and led to changes in the city's dynamics and the provision of public services.

Within this context, Boa Vista Acolhedora emerged as a response to the need to open spaces of inclusion for the migrant population and, at the same time, to incorporate a circular and regenerative economy perspective linked to the value chain of family farming and the production and consumption of local food.

The city of Boa Vista, capital of the state of Roraima, is located in the heart of the Amazon, just over 200 kilometers from the border with Venezuela. Both in the urban area and its surroundings, Boa Vista boasts traditional agricultural production and extractive industries, with little waste treatment. Therefore, this initiative appears as a solution to the need to establish a circular, agroecological production model that protects biodiversity and produces healthy food sustainably and under a fair economy.

The Boa Vista Acolhedora initiative began to forge multisectoral alliances, resulting in the creation of the Boa Vista Circular Economy and Agroecology Network (RECA BV), a network of organizations seeking to implement these perspectives in the city. It is made up of more than 30 local organizations, including

peasant groups, indigenous communities, migrants, social and academic organizations, and public and private entities. Network members interact and share experiences to produce knowledge so as to create new business models within the framework of agroecology and the circular economy.

RECA BV members defined the network's action in five lines of work: ensuring the sustainability of circular economy projects and proposals; transforming local business models; conducting effective communication to raise awareness of the network's activities and facilitate access to financing that enables long-term sustainability; and promoting advocacy for public policy proposals in coordination with local governments.

Furthermore, to support the city's transformation toward a circular model, a composting plant is being developed complying with local waste management regulations, providing a comprehensive solution for organic waste management.

On the other hand, Boa Vista Acolhedora works to support and strengthen local entrepreneurs dedicated to family farming. The goal is to initiate a transition toward agroecology and develop business models based on the circular economy by recovering materials to extend their useful life and bridging gaps between urban and rural environments through the marketing of products handcrafted by local communities.

Boa Vista Acolhedora was born from the Operation Welcome initiative, a coordinated strategy between the Brazilian government and the United Nations High Commissioner for Refugees (UNHCR) to facilitate the reception, accommodation, and integration of Venezuelan migrants arriving from Roraima. This strategy has benefited more than 100,000 people, representing a quarter of the Venezuelan migrant population in Brazil.

Boa Vista Acolhedora is proposed as an approach to this context, which leads to changes in social and economic dynamics and requires building resilience so the city can adapt to them.

PONCEANO ALTO

Ponceano Alto is one of four industrial parks located in the Quito metropolitan area. An industrial park is an area where various industries are located and where other activities develop around it, driven by the need of workers to live close to their jobs.

Ponceano Alto is home to a wide variety of industrial activities, ranging from paint factories to multinational automotive companies. Over the years, it has evolved into a small town as working people moved there to be closer to their workplaces. Thus, a residential area began to emerge, bringing with it the growth of small businesses and commercial spaces for this new local population. Currently, Ponceano Alto accounts for 11% of the companies based in Quito and employs 57,000 people.

Among this variety of actors sharing the same territory, some difficulties for coexistence began to emerge, particularly related to environmental issues. Some of the main problems—typical of industrial areas—were noise disturbance, pollution, mobility problems and a high environmental footprint related to the lack of incorporation of new technologies. Besides, there were limited job opportunities and poor ties and communication between businesses, academia, and the public.

In response, the local government issued a series of regulations establishing the need to relocate some of the industrial estate's facilities. However, many of them had great difficulty relocating, so the only viable option was to restrict the entry of new industries into the area.

In this context, a consortium consisting of Conquito, the Economic Promotion Corporation linked to the municipality of Quito, the Avina Foundation, IDB Lab, and the Resilient Cities Network began developing strategies to foster virtuous dynamics of coexistence among the various actors living in the area,

taking into account the inclusion of an environmental perspective in their work with industries.

As a first step, communication channels were created with several companies in the industrial zone to establish new relationships of trust and strengthen existing ones. A diagnostic assessment of production practices was conducted to obtain information on the environmental aspects of industrial production and identify the main problems. A detailed characterization of the solid waste generated by the various industries was also conducted. Once the diagnosis was completed, cleaner production agreements were reached in conjunction with the Municipality of Quito. These agreements have the potential to generate positive environmental impacts through reduced emissions, improved water resource management, optimized electricity use, and the generation of new opportunities to foster the circular and collaborative economy. In coordination with the University Hub, innovation and incubation processes were carried out to promote the circular economy. These included, for example, the production of packaging made out of banana peels and the recovery of tanks containing chemicals.

As part of the initiative, we also worked with local businesses, which are the source of income for many families, as they provide services to both residential homes and the industries located there.

When the pandemic hit in 2020, new needs arose for small businesses, ranging from how to adapt to virtual environments to how to develop new strategies to improve sales. In this regard, the consortium expanded to include the National Network of Recyclers of Ecuador (RENAREC) and the CITI Foundation in a new collaboration agreement aimed at supporting economic recovery and job reintegration processes. Thus, work was done with more than 150 businesses on topics related to economic recovery (related to financial management, inventory manage-

ment, customer service, and the incorporation of electronic payments), leadership and partnership, biosafety protocols, and waste management. The latter was carried out in collaboration with recyclers from the National Network of Recyclers of Ecuador, which was in charge of the training. This process, which generated new forms of partnership, resulted in the forging of alliances between small businesses to enhance their activities. In addition, recyclers working independently in the area were able to join RENAREC or form their own organizations.

In Ponceano Alto, work was also carried out on a neighborhood revitalization project, strengthening community ties as families were able to reunite in public spaces following the pandemic lockdowns. Additionally, families of migrants from Venezuela and Colombia, who arrived in the area, were integrated. Public space, understood as a public good, was restored in a participatory manner, based on *mingas* (a community gathering), an ancient form of community and solidarity work. Thus, plazas and parks were restored, furniture was installed, pedestrian crossings were improved, and common spaces were refurbished for the enjoyment of the population. The improvement of public spaces brought greater safety to the neighborhood, greater inclusion and, above all, a new perspective on the future, revealing the area's tourism potential and the possibility of generating productive activities.

In this way, the work in Ponceano Alto has contributed to the integration of the various sectors that coexist in the region, fostering virtuous dynamics, new forms of partnerships, and best practices for moving toward a common goal of sustainability.

WOMEN BUILDERS

The city of Lima has historically been the epicenter of enormous social, demographic, economic, and cultural transformations, while simultaneously embracing the most diverse geographies: desert landscapes, hills, rivers, all on the shores of the Pacific Ocean. Home of ten million inhabitants, it is also marked by inequality, encompassing both residential neighborhoods with large houses and low population density, as well as human settlements that house hundreds of thousands of people in highly vulnerable situations.

Puente Piedra is one of the districts where this geographic diversity is evident. Combined with precarious housing and a lack of access to public services and spaces, this presents unique challenges that must be addressed in order to strengthen the city's resilience. Urbanization has grown unevenly there and much of the hillsides have been taken over for housing. In neighborhoods like La Ensenada de Chillón—home to a population of nearly 40,000—many hillside communities face problems common to human settlements, compounded by those related to the unique geography of the territory, which is prone to landslides. This is especially dangerous in a city like Lima, which is at high risk of seismic activity.

In this context, the *Mano a Mano* collective was formed. This group of women, mostly heads of households, organized themselves to find solutions to the problems they were facing in their community, the Vista Alegre Human Settlement in La Ensenada. The first group of fifteen women organized in 2007 with the goal of generating income for their families and carrying out work in the neighborhood that would contribute to the community. The group trained in the fields of construction, design and safety and began working on improving some areas of the neighborhood that were deteriorated, at risk of collapse

or abandonment. One of their first projects was to rehabilitate a weak and difficult-to-access hillside by building sidewalks. These sidewalks not only allowed traffic from one side to the other and at different heights, but also functioned as retaining walls against potential landslides. In addition, the terraces were used to create a community garden, which is tended by the neighborhood's residents themselves.

Initially, the women had to overcome some gender barriers due to prejudices related to the profession. The construction sector is typically associated with men's work. But after 16 years of work, the Mano a Mano women's group has established itself as a benchmark in the neighborhood, attracting not only the residents but also civil society organizations and public institutions to work collaboratively on infrastructure projects to improve the area's resilience, inclusion and sustainability.

The Mano a Mano community has built nearly 6,000 square meters of public spaces over these past years. This has improved communication between the different groups in the La Enseñada neighborhood, which was often hampered by the uneven terrain of the hillsides and the lack of public urban infrastructure for public transit.

They also collaborated on the construction of two green public parks, which represent the first step toward addressing the shortage of public green spaces. The goal is for them to be enjoyed by people and also to serve as the lungs of the neighborhood.

Throughout their history, the women builders also began to see other benefits from their work. Given their acknowledgment in the neighborhood, they are gradually starting to find work such as building homes in the community. Their extensive knowledge on construction and safety issues has made them leaders, to the extent that people from other neighborhoods come to them to work on their homes. Some of them have also

been able to access funds to improve their own homes through programs like *Techo Propio*, which through the Ministry of Housing, Construction and Sanitation provides financing to families seeking to build or improve their homes.

At present, the work of this group of women has strengthened the communities of La Ensenada in multiple ways that go far beyond the building process itself. Over these 16 years of hard work these women have succeeded in facilitating interconnection between neighborhoods, installing terraced gardens that produce local food, reducing the risk of landslides, installing new streetlights and building paths for people with reduced mobility but, above all, in strengthening community ties. They constitute a linchpin of civil society in the defense of their rights, which begins with the improvement of the land they inhabit and the urban commons they share.

They are also an inspiration to neighboring communities. Currently, plans are underway to train new groups of women from other neighborhoods in the city to carry out the same work in their communities. Along the way, they will forge new bonds of trust that will translate into organizational forms that promote a more collaborative, safe, fair and resilient city.

CÓRDOBA CHAMBER OF METALLURGICAL AND COMPONENT MANUFACTURERS

Industry 4.0 has come to stay. This concept refers to a transformation in production methods through the incorporation of new technologies that provide solutions in terms of connectivity, automation and the generation of information about what is happening in an industry. In many cases, companies (usually SMBs) do not keep updated, real-time records of their production processes, which translates into a series of problems that may be related to the increase in industrial waste generation and inefficient use of both machinery and raw materials.

Therefore, a first step on the path to improving production processes involves this knowledge: producing a map of the factory, its dynamics and processes and, from there, identifying the main problems and designing the specific solutions required.

In line with the adoption of Industry 4.0 technologies, the Córdoba Chamber of Metallurgical and Component Manufacturers, as part of its strategy to improve the productivity and resource efficiency of its member companies, began coordinating collaborative actions with a group of companies that had identified those problems. This agenda raised the possibility of incorporating a system designed to collect real-time data on everything that happens in a production plant. This system, designed by Wiidem, represents a solution to the challenge Argentine industry is facing regarding the need for modernization. The global trend toward Industry 4.0 was confronting Argentine companies with challenges that forced them to improve their processes to maintain their competitiveness, both locally and internationally.

In a first experiment, the system was installed in four auto parts companies in Córdoba. Based on an initial survey, the productivity of these companies was analyzed in terms of the

efficiency of their production lines, product quality, machinery performance and facility availability, among other factors. This survey also made it possible to identify the types of technological innovations required by each specific plant to improve the use of resources, supplies and equipment, and also to achieve greater efficiency in the time of the plant's workers.

Real-time data capture allows for increased awareness of what is happening in a plant and detects problems as they occur, which also facilitates identifying their causes. Having data enables effective problem-solving actions and facilitates their prediction, as well as helping to organize production. Also, stored historical data provides vital information for diagnosing and comparing processes over time, as it sets the basis for decision-making regarding the improvements needed to increase productivity and optimize costs and machine utilization.

The transformation toward Industry 4.0 and the use of technological innovations aimed at improving productive capacity and resource use entails social and environmental consequences. First, it implies defending local industry, to the extent that the implementation of technological solutions allows companies to be competitive and strengthens local value chains. It also makes local companies competitive abroad and able to meet the demand of higher-level companies that require their products and services. Furthermore, it entails protecting local employment, as it increases the capacity of industries to develop and expand the increasingly technologically advanced workforce and prevents people from migrating to other industries and sectors outside the region.

The efficient use of materials reduces the need of raw materials and waste production. By simply increasing the efficiency of their processes, industries require fewer supplies and reduce the amount of *scrap* or industrial waste. In turn, this also lengthens the useful life of their tools, as improving the process is related

to reducing the number of resources used and also improving machine utilization. This implies, once again, reducing the use of other supplies necessary to operate the tools and increasing the time between repairs.

Argentine industry has great potential to improve its processes in terms of efficiency, and real-time information represents a key factor to achieve this. Initiatives such as those of the Córdoba Chamber of Metallurgical and Component Manufacturers, aimed at reducing resource use in production, contribute to urban resilience from both economic and environmental perspectives. On the one hand, increased efficiency allows for improved production processes, increases the competitiveness of local companies, and improves industrial environments, with the consequent improvement in employment in terms of both quality and quantity. On the other hand, it is a necessary step in response to the need to reduce pressure on the environment by using fewer resources and also by adapting to the timescales required for regeneration.

BEE GREEN

In 2020, when the pandemic hit Argentina and the harshest lockdown measures and restrictions were established, the city center of the Autonomous City of Buenos Aires (CABA), which everyday bustles with people working in offices, retail stores or restaurants, became practically deserted. In this context, many businesses were unable to operate normally, including parking lots. Similarly, those who owned buildings and private spaces for offices and workspaces also ceased operations, leaving people without income and buildings completely empty.

Thus, Bee Green was born in response to a specific need: to convert empty spaces that had previously served commercial purposes. The project is made up of a consortium of owners supported by professionals from the fields of Social Sciences and Biology, who proposed taking the conversion a step further: their goal was to ensure that these unused spaces would also contribute to incorporating nature into the city.

In the City of Buenos Aires there are nearly 15 million square meters of public green space, which are open-air green spaces larger than one hectare, according to the “Atlas of Green Spaces in Argentine Cities” prepared by the Bunge & Born Foundation. This translates to an average of 5.13 square meters of green space per capita for residents of Buenos Aires. This figure is far below other large cities, such as New York, where there are 13.6 square meters per inhabitant, or Brussels, that reaches 30.

Bee Green’s proposal, then, is to incorporate green spaces into an area of the city with high building density and limited public spaces. The group’s goal is to generate a source of income from a productive activity that allows for incorporating biodiversity into the city. But these terraces cannot just be gardens; they

can also turn into a cultivated area with the potential to produce vegetables that supply both local residents and restaurants. This entails a series of benefits for the city: beautifying the space, reducing buildings' energy consumption, promoting carbon capture, and producing seasonal vegetables for local consumption. These innovations are linked to the installation of green infrastructure and urban agriculture, proposed through nature-based solutions as measures for resilience and adaptation to climate change and for the sustainability of urban food systems.

This design can be replicated and implemented in many other buildings throughout the city. Furthermore, terraced gardens and cultivated areas also allow spaces to be re-occupied by people, visitors looking for a place where to eat, take a break, or simply relax.

Furthermore, the implementation of green roofs also allows for the creation of what are known as "green jobs," which are those that contribute to reducing the impact of productive activities on the environment, whether by capturing atmospheric carbon, making resource use more efficient, or restoring, rebuilding or regenerating nature. Therefore, Bee Green contemplates working with cooperatives and social organizations that can provide the materials needed to build the necessary infrastructure, thereby reusing end-of-life materials and contributing to a circular economy model. In this way, the business model contributes to sustainability in three major aspects: environmental, social and economic.

Given the lack of public policies and incentives for implementing these types of solutions in cities, Bee Green offers the possibility and opportunity, through knowledge and innovation, to implement a model that can be promoted through multi-sector alliances, local regulations and effective communication that contributes to the model's recognition and replication on other terraces in the city and even in other cities.

Bee Green does not emerge solely from resilience and the need to adapt to an adverse context; but it contributes to the city's resilience through nature-based solutions. Its ultimate goal is to extend its solution far beyond its team and inspire other ventures with the same vision of resilience and sustainability.

ARCA TIERRA

Mexico City is an epicenter where a diversity of peoples, historical times and landscapes converge. Xochimilco is one of the territories where this diversity is more evident. It is a territorial area whose origins date back to pre-Hispanic times, when around the 10th century, the indigenous Xochimilca people settled in what is now known as Santa Cruz Acalpixca and, from there, expanded to the lower lands and occupied the lake. This occupation was carried out using chinampas, a word of Nahuatl origin that designates a cultivation system specifically designed for flooded areas, lakes or territories with abundant water. Today, Xochimilco is one of the few places in the world where this technology survives, which has been a pillar of food security for the people of the region for centuries.

In this context, Arca Tierra emerged as an enterprise aimed at recovering chinampa agriculture to produce and market agroecological foods in Mexico City. Together with the Xochimilco Agroecological Initiative, Arca Tierra works with farming families dedicated to growing food in chinampas to recover this ancient technique through various initiatives: training, water and soil remediation and the creation of commercial networks to, among other things, sell products at fair prices.

Chinampa farming is the most productive agricultural technique in the Mesoamerican region. It can produce food year-round and make use of all the resources in this type of land, which are abundant in organic matter and minerals.

Currently, there are around 20,000 chinampas in Mexico City, occupying an area of more than 30,000 hectares, out of less than 2,500 are used for agriculture. Yet, chinampa agriculture produces nearly 19,000 tons of food each year.

Apart from being a historic site, Xochimilco is a fundamental ecological pillar for the city and the region. It is an important

source of fresh water, home to a wide variety of animal and plant species, allows for the capture of atmospheric carbon and constitutes a public good that, as such, offers cultural, social, and recreational benefits to the entire community. Due to these qualities, which make it unique in the world, Xochimilco was declared a World Heritage Site by UNESCO in 1987. It is also a Ramsar site, designating it as a wetland of international importance. Since 2017, the chinampas have been listed as Globally Important Agricultural Heritage Systems (GIAHS) by the Food and Agriculture Organization of the United Nations (FAO).

Despite this, the area faces significant challenges to its conservation. One of the main challenges is urban expansion, which threatens to destroy this environment of incalculable natural and cultural wealth. Therefore, Arca Tierra and the Xochimilco Agroecological Initiative have designed a viable model that allows for the conservation and care of the territory and a sustainable form of production that benefits society. By producing quality food, it restores ancestral traditions and the cultural identity of the area, generates employment and allows for the development of collaborative networks between producers and consumers.

Arca Tierra works with five farming families on chinampas that occupy an area of four hectares and produce two tons of food per month. The initiative has successfully rescued these areas, which were vulnerable to urbanization and aims at increasing the number of hectares used for chinampa agriculture, which in Xochimilco totals 2,200.

But alongside the city's growth, the chinampas in Xochimilco face other major challenges, particularly social and cultural. The main one is that fewer and fewer young people are pursuing work in chinampa agriculture, because it is undervalued, considered excessively burdensome and unattractive compared to the opportunities Mexico City could offer. For this reason, Arca

Tierra is working on developing strategies to revalue this activity from an educational perspective.

All of these challenges present significant opportunities to strengthen sustainable agriculture and biodiversity conservation in an environment of immense cultural and natural value. Chinampa agriculture has been a source of food for ancient societies and has shown its ability to integrate a production model into a landscape whose care is increasingly urgent.

But to reach its full potential, it requires the intervention of all sectors of society, public and private organizations, academia and individuals who choose foods that are not only of high nutritional quality and free of agrochemicals but are also produced by local workers, under decent conditions and at fair prices.

Arca Tierra and Agroecological Initiative Xochimilco are the proof that it is possible to implement a sustainable production model that, through the recovery of the chinampa technique and ecosystem restoration, proposes nature-based solutions, linking the natural environment with the city.

On the other hand, it is a permanent source of employment capable of generating peasant autonomy, in which food production is geared toward providing social benefits. But agriculture is much more than production; it is also all the wisdom that such production entails: knowledge of the animal species that inhabit the area, the type of climate and its cycles, the phases of the Moon, and every natural phenomenon that impacts the environment and production.

For all these reasons, Xochimilco offers an enormous opportunity to implement highly efficient and productive agriculture on a large scale, but also to build an alternative model that exemplifies how caring for nature in an urban environment is not only a possibility, but, increasingly, a necessity.

CHAPTER 4: THE FUTURE OF CITIES

What is the future of cities? What changes are currently being proposed in terms of urban planning? Which are the new city models? Are they designed in systemic, resilient and sustainable terms? This last chapter of the book aims at providing a path forward towards the transformation of urban ecosystems.

First, there is a brief description of the new city models currently being implemented; models that are being tested especially in developed countries and are tentatively expanding to the “Global South.” But, as it usually happens, it is necessary to ask whether this expansion and the possibility of replicating northern models are the best option for southern cities.

This is followed by a discussion on the advantages and disadvantages of these models, their potential replicability and the benefits they may imply to cities.

Finally, there is a proposal that includes the aspects shared throughout all the chapters of this book, focusing on the path forward for building sustainable and resilient cities based on the ideas of sustainable development, urban metabolism and collaboration.

NEW CITY MODELS

Florencia Rojas

In recent years, in response to the environmental impacts that severely affect society and the economic development of cities, new urban models have been emerging with the common goal of achieving more efficient operation and more orderly planning to guarantee citizens access to infrastructure and services.

New city models embrace an innovative and sustainable approach to urban design and planning, aiming at improving residents' quality of life and reducing environmental impact. These models incorporate new technologies, infrastructure, services and policies to promote energy efficiency, sustainable mobility, waste management, responsible use of natural resources and citizen participation.

Curitiba, Medellín, Buenos Aires, and Santiago de Chile, among others, are cities that have begun implementing new sustainable urban transportation models. Even though this does not imply a systemic transformation of the urban ecosystem, it represents the first step towards resilience and sustainability.

The new city models have one aspect in common: they consider the idea that the most efficient cities are the compact ones.

Compact cities are those with high population densities and an urban planning that prioritizes efficient land use and the promotion of sustainable transportation. In a compact city, buildings and urban infrastructure are designed to be taller and closer to each other, thus reducing the need to travel long distances and facilitating access to services and workplaces. Besides, these

cities typically have a well-developed public transportation network, which decreases car dependence and reduces air and noise pollution. Compact cities also promote social interaction and co-existence, as public spaces are more accessible.

There are no references in the literature to a specific author who is credited with the idea and concept of the compact city, but rather it is identified that this term arises from the evolution of urban planning and management in the search for more efficient and sustainable cities.

THE 15-MINUTE CITY

The “15-minute city” is an urban planning concept that promotes the creation of communities where residents can meet all their daily needs—such as work, shopping, education, exercise and socializing—within a 15-minute walk or bike ride from their homes. This concept establishes a decentralization of cities, enabling a better quality of life and a better and greater distribution of infrastructure and services within neighborhoods, improving social relationships between residents and visitors.

As explained by Carlos Moreno -the driving force behind this model and scientific director of the Sorbonne University of Paris- in a conference held in Buenos Aires in February 2022, the concept of the 15-minute city proposes the search for compact cities where interconnections can occur and value can be created from elements that are usually ignored, thus leading to a better quality of life. The idea behind 15-minute cities is to create more sustainable communities, to reduce traffic congestion, to decrease pollution and to improve citizens’ quality of life by reducing the time they spend traveling from one place to another.

This model tries to identify six minimum functions for a dignified life: housing, work, services, health, education, and recreation, connecting them to achieve individual well-being for

city residents, integration and social well-being for the community and, ultimately, environmental sustainability and ecological well-being. The model aims at building social circularity, an urban planning oriented toward human beings and the social functions that exist in a city.

This concept has become a major topic for discussion in urban planning and public policy in many cities around the world, emerging in Paris and extending as far away as Buenos Aires.

SMART CITIES

“Smart cities” implies a city model that uses technology and data to improve the quality of life of its inhabitants. Its main objectives are to increase the efficient use of resource and reduce environmental impact, to improve the quality of life of its citizens, to foster innovation and economic growth and to improve the safety and security of its citizens.

The term “*Smart City*” began to be used in the 1990s, although there is no author found in the literature to whom the term can be attributed. Some authors attribute it to IBM technology company, which launched its Smart City initiative in 2008. However, others point out that the term was already in use in some academic and urban planning circles before then.

Some of the most relevant characteristics of smart cities are: 1) the use of advanced technologies to collect, analyze and use data in real time to improve the quality of life of their citizens; 2) intelligent transportation systems; 3) smart buildings; 4) sensor networks to monitor traffic, air, and water quality; 5) efficient and sustainable public services and advanced communications infrastructure.

The benefits of this urban model can be significant, both for citizens and for governments and businesses, as its implementation leads to greater energy efficiency and reduces operating costs in the use of urban infrastructure and services.

CIRCULAR CITIES AND THE “DONUT” MODEL

From an urban planning perspective, circular cities are, as proposed by British urban planner Ebenezer Howard, a design concept that proposes creating human settlements in the shape of a circle or ring. In these types of cities, buildings, streets, and parks are organized around a common center, which can be designed as a central park or plaza. The idea behind circular cities is that this type of urban design can help improve the efficiency of space use, reduce the need for transportation and foster community and a sense of belonging among residents. Some examples of circular cities around the world include Radburn in New Jersey, USA; Pienza in Italy; and Almere in the Netherlands.

However, this circular city concept also applies to the metabolic functioning of the urban environment and the analysis of material and energy flows along the value chain. A clear example of this is the public policy implemented in Amsterdam through a project that seeks to create a more sustainable and circular city in economic and ecological terms.

The project is based on the principles of the circular economy and its main features include:

- Fostering local production and the collaborative economy.
- Designing buildings and public spaces that maximize energy efficiency and reduce greenhouse gas emissions.
- Creating a more efficient and sustainable transportation and logistics network, including the use of electric vehicles and bicycles.
- Promoting innovation and the development of sustainable and circular technologies.
- Reducing and managing waste sustainably, promoting recycling and reuse of materials.

SUPERBLOCKS

Superblocks are an urban planning concept that seeks to improve the quality of life in cities by reducing traffic and promoting sustainable mobility. The term was coined by the Spanish architect and urban engineer Salvador Rueda in the 1990s, founder and director of the Barcelona Urban Ecology Agency.

A superblock is a group of urban blocks (usually between three and nine) that are closed to passing by traffic and transformed into areas of coexistence where pedestrians and cyclists have priority over vehicles.

In an interview with Rueda by the Inter-American Development Bank in 2015, the architect explained that the concept re-values public space, since a city is one in which, in addition to housing, there is a space for citizens to socialize. Rueda also explained that this public space, which aims at allowing for citizen dispersion, participation, and recreation, among other things, has been lost due to traffic and other infrastructure that had reduced it.

In his own words, Salvador Rueda states the following:

Superblocks are new urban cells, each measuring about 400 or 500 meters on each side, where the outskirts are articulated like main roads. Connected to each other, they create a network designed for transit vehicles, for those who want to get from one side of the city to the other as quickly as possible. But we are transforming the interior. They are 10 km/h speed zones, where, for example, children can play or people with disabilities can roam safely, where we can engage in all the uses the city allows and where motorization, at present, is restricting us from doing that. In Barcelona, superblocks have allowed us to free up 70% of the space currently occupied by motorization.

Superblocks seek to improve road safety, air and environmental quality, reduce noise and pollution while encouraging social interaction among residents. This idea has already been imple-

mented in various cities around the world, such as the aforementioned Barcelona, Madrid, New York, and Vitoria-Gasteiz, Spain. In 2022, the latter shared its model with more than other 20 Latin American cities, including Cali, Medellín, Cusco, Arequipa, Curitiba, Rosario, Santa Cruz, and San José in Costa Rica. Will it be possible for cities in the region to implement this sustainable mobility model?

GREEN CITY

Although there is no formal concept that accurately describes what a “green city” is, the term is currently being used by a large number of cities that implement one or more sustainability measures, generally linked to the comprehensive management of urban solid waste, the use of renewable energy sources or the installation of efficient and intelligent buildings.

But in this chapter, the term is used to describe an urban model replicated in neighborhoods in German cities. The objective of including this model is to identify how sustainability can be built through innovation.

The most outstanding example is the “green district” of Freiburg, in southwest Germany, considered a global example of sustainable urban development. The project began in the 1990s and has involved the creation of buildings and public spaces that use renewable energy sources and are designed to minimize their environmental impact. Among its most relevant features are:

- The use of solar energy for the generation of electricity and hot water.
- Buildings with high energy efficiency and thermal insulation.
- Efficient and environmentally friendly public transportation systems, such as trams and bicycles.
- Green areas and public spaces that encourage cycling and walking.

**WHICH IS THE MOST APPROPRIATE MODEL FOR A
RESILIENT AND SUSTAINABLE CITY?**

Although there is no single answer to this question, we propose the following: the model that best adapts to the local reality and allows a city resemble a natural ecosystem (which works perfectly), ensuring its persistence and adaptability to impacts and collaborating with neighboring ecosystems and the larger ecosystems where it is settled.

It is clear that there is no single model for a sustainable city and that, among the different models currently proposed, there are many common components: the design of compact cities, the reduction and/or elimination of waste, the promotion of sustainable means of transportation and the consequent reduction of emissions, fostering proximity for access to shops, infrastructure, and services (short, local value chains) and the installation of smart buildings that allow for efficient use of resources. These aspects, as described in the first chapter, determine an efficient, circular, resilient and sustainable metabolic functioning of cities.

A NEW WAY OF ARTICULATING URBAN CHALLENGES

Andrés Borthagaray

IN SEARCH OF SIMPLE IDEAS TO EXPLAIN COMPLEX PHENOMENA

The evolution of cities depends on a set of economic, social, technological, and institutional factors in diverse natural contexts, based on decisions made in the built environment. Within this diversity, widespread changes have taken place, such as industrialization, the introduction of alternating current, railroads, elevators, automobiles, massive destruction and reconstruction resulting from natural phenomena or wars, and environmental and health crises. Faced with each new reality, new responses and lessons have been tested, whose interpretations—through direct observation, image recording and spheres of political, academic, and cultural exchange—travel from one city to another.

Thus, in response to various spatial trends, solutions have been proposed, which summaries can be expressed in a series of suggestive titles, which will be mentioned later. Specifically, solutions must be sought to the social and economic needs of an unequal society.

In this regard, a series of responses have been developed under different names. For example, a charter for public space has been proposed and partially incorporated into the so-called New Urban Agenda (adopted by the last UN-Habitat General Assembly) or into specific principles of the Charter of the Educating City. With a more general approach, a rights agenda has been

proposed, starting with the right to the city, which is also developed into more specific rights: to decent housing, education, landscape, and mobility. And with a more restricted approach, we can mention types of urban development, such as public transport-oriented development or *transport-oriented development* (TOD), something that existed in some cities before the name was adopted.

In relation to this, in recent years, the global COVID-19 pandemic has tested the ability to respond, particularly in the most vulnerable societies, where inequality and poverty are a defining feature.

On the one hand, the temporary restriction on movement has led to innovative solutions: available technology has been leveraged in a digital transition with new uses of various platforms for education, healthcare, work, administrative and even judicial procedures. At the same time, nearby public spaces have been revalued, a precious asset that allowed for the continued development of outdoor activities, in many cases with temporary solutions to take advantage of parking or traffic spaces to design outdoor dining areas, school playgrounds, and more space for pedestrians and cyclists, which in some cities were planned over time.

But the pandemic has also shown a dark side. Inequalities between manual and intellectual labor, between educational levels, and between household connectivity options have tended to become more pronounced. Also, new geopolitical tensions and armed conflicts have generated a global rise in energy prices which, at first, puts greater pressure on more efficient use of existing resources and the development of alternative solutions.

Given all these structural challenges, the intention here is to provide a perspective and try to identify some references in the strategies to overcome them. For example, a frequently recurring phenomenon in certain cities is unbounded sprawl, which has generated very low-density peripheries, difficult to reach with infrastructure networks and highly consuming land and resources.

As a counterpoint to this idea, a compact city model has been proposed, which appears in public and sometimes private discourse. Like several other terms, it can be used to think of a utopian metropolitan organization based on the general interest or, somewhat cynically, to justify greater heights where they are not allowed.

On the other hand, the management of increasingly complex networks, together with the generation of ever-increasing data in a context of digitalization, has given rise to unprecedented sophistication in measurement and observation mechanisms. On this basis, the concept of a *smart city* was developed. Despite the initial enthusiasm, it also proved to have inaccurate and contradictory uses. Part of the ambiguity stems from a linear association with the adoption of certain technologies, especially those associated with information, sometimes as a turnkey product offered by providers of those products and services. Even though the field is very broad, it remains a tool. As it has happened with terms that at one point became central to public debate, it has had several meanings simultaneously, moments of rise and fall. A more lasting definition of a smart city is based on the resources available, at different levels: financial, spatial, energy or water. Of course, digitalization together with information technology and the development of *Big Data* and artificial intelligence, which are currently undergoing a rapid growth, are tools for more efficient use of resources. Like any liberating tool, it also deserves a critical reserve in terms of society.

Indeed, the benefits of these transformations are reaching different sectors very unevenly. When it comes to technology and connectivity, access to quality services is not equal for everyone, not to mention the widening gap between manual and intellectual work. From an urban perspective, the growth of teleworking has changed parameters of office occupancy and demand schedules for public transport networks and traffic flows, although it

still represents a relatively small share of total jobs, according to ILO statistics. Regarding the impact of teleworking on the emancipation, measurements have been made in terms of scientific publications by gender during the pandemic, or studies such as those by Hue-Tam Jame from Arizona State University, which show a regressive effect. Thus, there is a technological potential with great transformative capacity, whose effects are not linear and require all our institutional ability to capitalize on them in an inclusive manner.

The current concept of a “proximity revolution,” or the fifteen-minute city, identifies a problem: the distance resulting from the artificial division of functions, a mode of city production that leads to more difficulties than solutions. While in some respects the concept is not new—in the 1920s, people were already talking about neighborhoods as a unit; in the 1960s, Jane Jacobs had advocated for neighborhoods with activity throughout the day, the coexistence of functions, and eyes on the street as a vital factor for cities—in the current context, it has acquired a reformulation and particular relevance. Indeed, the idea developed a few years ago with the argumentative skill of Carlos Moreno, entered public debate in the midst of a pandemic and had a powerful impact on international city networks, such as the C40.

Thus, as a consequence of the concept’s popularity, a 15-minute city observatory has been created. The mayor of Rome, shortly after being elected, proposed it as his model and the topic is part of the international urban agenda. The concept has provided fodder for discussion in cities, both in political, academic and professional circles.

As with every successful and widespread concept, this one also has its observations. For example, it is pointed out that it is an excellent idea for central areas of cities or for certain neighborhoods, but that in large metropolises—or even in the outskirts of medium-sized cities—the alternatives available at

that distance will not be possible. Or that the ideal model exists in neighborhoods whose population tends to have a higher income, but that it does not necessarily reach those who come to work from distant outskirts. Or that, like any other successful concept in terms of communication, it implicitly simplifies a complex phenomenon, in this case the city, the citizens and their diverse situations.

Of course, there are counterarguments. For example, that a focus on proximity can be a factor of change precisely by creating multiple centralities in severely deprived peripheries. On the other hand, the mere fact that this controversy is taking place means a positive contribution to the urban discussion. The idea of a more walkable city, accessible by bicycle, with shopping opportunities in the neighborhood, more age- and gender-friendly and articulated with sustainable mass public transportation, is a concept directly related to urban mobility policies and offers.

The transition from an urban planning concept to politics is a significant event in itself. But in this particular case, in the context of the lockdowns during the first half of 2020, had acquired particular relevance. Even more when the restrictions on movements were applied if you moved more than one kilometer away. The urban issue became the most forceful response from a society hypersensitive to health issues. More generally, faced with a strict functional division, often promoted by planning or *zoning regulations*, but also by ways of production in the city—large commercial areas with equally extensive parking areas, commercial districts exclusively restricted to offices, strictly residential neighborhoods, among other examples—the mixed city has been vindicated, in which the concept of the fifteen-minute city represents an organizing idea for an alternative mode of organization.

Other ideas, such as the experimentation at the neighborhood's main school—the playgrounds of twelve schools open to the entire community on Saturdays from 10 a.m. to 5 p.m.,

with a surveillance and cleaning system afterward—were added as a complement to this proposal.

Buenos Aires has formally announced the adoption of the so-called fifteen-minute city. This idea can reinforce some of the city's already existing attributes, which are sometimes undervalued in certain production models that tend to concentrate functions or frame specific cases of successful interventions developed with other pre-existing ideas in neighborhoods. In other cases, it can revalue certain characteristics of urbanity, generated by its grid- and park-based growth pattern, as properly described by Adrián Gorelik, in the railroad, tram and subway, through a comprehensive system, with careful consideration in the treatment of infrastructure, trees and regulations.

Nevertheless, it is worth clarifying what we are talking about, given that in some cases the fifteen-minute concept is used to promote gated communities, projects that may have very interesting explanations, but which clearly reflect a very different idea. Or sometimes the mix of uses within the city itself is lost.

The successions of ideas that gain traction in city networks gradually replace one another, sometimes with overlapping periods, without the previous frameworks of interpretation necessarily having completely disappeared. As seen in previous chapters, the idea of a resilient city gained some traction with the introduction of the term, originally derived from other disciplines. For example, Boris Cirulnyk, a renowned French neurologist, psychiatrist, and psychoanalyst, attributes the condition of resilience to a way of coping with adversity and to the ability for new development after a trauma.

This idea can also be applied to a territorial and urban level. There have always been resilient cities, although they haven't always been called that. When Venice opened its canals and defense system, when Mendoza created its irrigation system, when Tenochtitlán developed its urbanization system on water; they

developed an ability to adapt and face threats, each of them in its own way. When cities became spaces of freedom by the end of the Middle Ages, unprecedented capacities for collaboration and exchange were woven. When plagues, overcrowding, and the pressures of rapid growth—as a result of industrialization—hit cities, resources were mobilized, efforts were combined and innovation was generated.

Of course, there are problems that never found adequate solutions. And at present, they are complemented by new challenges, particularly in our region that is marked by the highest levels of urbanization according to the level of development and by a combination of dynamism and inequality that exacerbates vulnerabilities. In this sense, there is concern about insecurity, worsened by the emergence of parallel economies and addictions. Public strategies to prevent these problems have several facets. One, that is very important, is related to justice and the security system. Another one relates to the resilience of cities, education and social inclusion.

The Resilient Cities Network identifies nearly twenty resilient cities in Latin America and the Caribbean. It is worth mentioning a few of them to identify the priority issues and areas of focus in each case.

In Santiago de Chile (metropolitan city), regional governance. A historical moment of reform of the regional form of government. According to the official in charge of the resilience strategy, the strategy's development is divided into: Mobility, Environment, Security, Risk Management, Economic Development and Competitiveness and Social Equity.

The city of Santa Fe, Argentina, has suffered extreme situations of vulnerability, including floods with serious social consequences. The resilience strategy is based on four basic objectives: adopt the metropolitan scale; growing with equity and ensuring access to basic services; cultivating a sense of belonging, social

cohesion and the right to the city; and managing knowledge and leveraging new technologies for local development.

Mexico City (CDMX) experiences multiple risks, both at a natural and human level. According to the local report, some of the most frequent impacts are of hydrometeorological origin; however, geological phenomena, such as the 1985 earthquake, have generated the greatest human and economic losses. Thus, aquifer overexploitation is not only one of the most significant chronic pressures for the future water supply of the region's inhabitants, but is also a determining factor in seismic exposure due to its relationship with the differential subsidence it produces. Climate change can exacerbate these risks due to the potential increase in the intensity of events such as heat waves, extreme rainfall and prolonged droughts, which may exceed historical records.

Other synthesizing concepts are more specific, for example, the healthy city. There has always been a concern for hygiene in contemporary urban planning. Cross-referencing geographic information made it possible, as early as the mid-19th century, to identify a tap in London from which a cholera outbreak started. The development of sanitation networks was considered as the most important advance in health in 150 years.

Once again, at present, health has become a central concern for cities, especially since the pandemic. There was already a growing concern due to problems associated with the quality of the air we breathe in cities, sedentary habits, diabetes, cardiovascular diseases associated with lifestyles based on car use, road safety, especially for pedestrians, and so on. What is more interesting, and has in fact led to a series of publications in the *Lancet* journal, is the way in which health is becoming an explicit objective of urban policies, including urban design. It is not only about the ability to provide adequate and quality services through specific equipment,

but also about the way in which the city fosters and enables healthy lifestyle habits.

Cities, in their educational role—or educating cities—are also a topic of special attention. The International Association of Educating Cities, for example, proposes an initiative that allows for the multiplication of reflections and contributions from cities through a network with an international headquarters in Barcelona and a Latin American headquarters in Rosario. In its charter, public space is the main topic of a special chapter. Once again, during the pandemic, with the quarantine and lack of in-person classes, public space acquired a more important role. It is true that there was innovation in digital platforms and distance education, even when there was not universal connectivity; as in the case of Mexico, with open television, or in Córdoba, with community radio stations for rural schools. But in some cases, there were also innovative experiences in the physical environment of schools. For example, longer time outside the classroom, more outdoor walking and pedagogical proposals, more green space in interior courtyards and a second courtyard over the sidewalk and part of the street.

Placing the school at the center is essential to revalue its role in society. Schoolyards, thus, take on a new dimension. As “urban oases,” they are transforming from a mineral space to a green space, open to the public after school hours; increasing, in turn, the city’s green spaces and offering a unique experience of interaction in the learning process.

One last point about the way the city educates is that when the city itself becomes an object of study. In various settings, such as the Rome Biennial of Public Space, the importance and potential of a study that does not wait until advanced university courses for such a elementary social topic has been emphasized.

THE POLITICAL DIMENSION OF CITIES: PARTICIPATION, GOVERNANCE AND ROLES OF THE PUBLIC SECTOR

The first democratic step faces challenges of scale—in some large metropolises, the dimension of proximity is lost, except for intermediate levels—of conflict—not everyone has the same dreams or the same representations—and of learning—when one city finds a solution, another one tries to imitate it, and when one fails, it tries to learn from the lessons and the causes. It is not just a matter of governments, but also of the respective local communities facing the urban future in each case. Public space has a dual dimension here: the physical one and that of a shared space for society, reflected in its institutions and decision-making mechanisms.

Participation is key to putting public policies in the urban agenda. It can be spontaneous or planned as a necessary step to produce them. For example, the Pedestrian League in Mexico, present in several cities, has championed action related to infrastructure policies—such as combating “anti-pedestrian” bridges, illustrating with examples from around the world how this is a counterproductive and regressive solution—and is emerging as a new player in public discussion. Cyclist associations, environmentalists, gender groups, heritage defenders, neighborhood associations, and civil society organizations contribute vitality to the debate and quality to decision-making. However, this is not always enough to change direction, especially if democratic bodies are not created at different levels in metropolitan areas.

Thanks to the introduction of formal public hearings and access to information regulations, participation becomes a necessary step. But sometimes, it also becomes a formality, with a frustrating result that leads to skepticism. Greater openness to information, a debate on various levels, with contributions from citizens, professional communities, associations and a variety of

sectors, will always represent a contribution. An example of this are the integration processes of vulnerable neighborhoods.

The challenge of articulating specific demands in an urban policy also leads to a reflection on how participation is integrated into political processes and into the democratic governance systems of cities. And something similar applies to the private sector. In many countries and cities, there has been a dramatic shift, in one sense or another, from the public to the private sector to provide public services based on cyclical processes. Perhaps a key issue, one that contributes most to the debate, is not how much of each sector participates, but rather the way each sector involves and its commitment to long-term objectives for society.

In a recent study of urban mobility in Tokyo, Paris, and Buenos Aires, a striking point is the changing role of each sector—public and private—that can serve to achieve long-term results. In Tokyo, rail public transport service providers are primarily private, urban developers with a broad portfolio of services. Unlike certain private providers elsewhere, they have a long-term vision and play a fundamental role in the planning and coordination of the world's most populous metropolitan region. The state, on the other hand, has intervened in sectors of the economy that in Western countries would, in theory, have been considered more strictly reserved for the market.

In Paris, the roles are partially reversed. The state is responsible for public transport at the regional level for certain services and, through a national state-owned company, for the new Grand Paris Express. It also has greater control over urban development, through urban planning regulations and successive plans.

In Buenos Aires, there has been a cyclical shift in recent periods from public to private roles and vice versa. However, unlike the other two cities—economic centers of highly industrialized countries—rail public transportation in Buenos Aires has tend-

ed to lose ground in the face of the rise of automobiles, even though the potential of a metropolitan rail network of more than 800 km remains.

In São Paulo, where the metro is undergoing a dynamic expansion, the way in which revaluation is appropriated could find new insights in light of international experience, in a city with a tradition of developing quality architecture in the public spaces of stations.

More generally, the way people get around, associated with public space, is a highly determining when analyzing how a city's and society's priorities are oriented. A city based on public transportation, walking, and cycling—what has been called “active mobility”—presents more vibrant, open, interactive and lower-emission streets. Even the widespread use of lighter motorized vehicles is not the same as using cars. In this context, Asian cities have a very unique development. For example, Ho Chi Minh City shows that there are many nuances when it comes to vehicles: they can be individual and lightweight and combined with busy streets. But as automobile motorization increases, new forms of interaction are emerging, requiring large parking areas, generally in closed spaces, far from the street and its points of interaction. Furthermore, infrastructures created for exclusive or priority use of cars tend to be used in a more biased way, either by income or gender. This type of bias is reflected in Latin America in statistics on vehicle ownership records and driver's licenses.

Access to housing clearly shows how these representations of the public and private evolve in different contexts. In Vienna, the public housing stock is dominant, in other cities it plays a leading role, while in others it is only allocated to certain sectors, representing a very small percentage of the total. In any case, beyond the public or private, the idea of community, at the metropolitan or neighborhood level, requires a set of intervention

dimensions associated with public transportation accessibility, land policies and environmental challenges, including ways to integrate migration trends in each case.

The sensitivity of city governments is reflected not only in major policies but also in small details, including banks and street furniture, and the relationship between plants and minerals. Medellín, with its river park system, intermodal transportation, social housing and quality infrastructure, has become a benchmark for successful urban restructuring. Curitiba, since a longer time, over several administrations, has also established itself as a prime location for innovation in urban policies and benchmarks in Latin America. In both cases, there have been connections between different sectors, with at least one public sector representing very high professional quality, both in city administration and in the public enterprise system. In these cases, the city's name becomes a metaphor for a complex urban program.

IN CONCLUSION: UNPRECEDENTED CHALLENGES, CONSTANTLY ADAPTING RESPONSES

Obviously, there are no one-size-fits-all solutions when facing with unprecedented urban challenges. Some proposals that may seem attractive at first glance prove difficult to implement in the real world. However, a look at a set of these strategies provides a basis for more intelligent use of available resources.

At first glance, the need to articulate territories into metropolitan regions clearly emerges. Adopting a long-term perspective on how to identify strategies when extraordinary challenges arise leads to a coordinated approach beyond the boundaries of an administration.

Another key issue is mobility, the way people move within a city or region, crossing jurisdictional boundaries on a daily basis.

This is where the ability to wisely use energy, spatial, economic and social resources can be put to the test.

Of course, education and learning at all levels, both for individuals and urban systems, clearly emerge as a central element of resilience.

Infrastructure and the relationship with nature are equally essential, especially from a perspective that includes the full assimilation of an increasingly digital world, with greater availability of real-time information and measurement possibilities that offer elements to improve the quality of decisions and public management. But the way in which this information is used, more than the information itself, represents our ability to overcome challenges.

Building narratives about the city is a way to join data and key aspects under a manageable concept, an understanding that allows us to share a complex reality, giving it meaning and perspective through a representation of the city. Generally, we know the neighborhoods and the daily routes, but the city itself often remains outside the collective imagination.

Every city is unique and has characteristics that differentiate it from the others. And each city can learn from the others, sharing common knowledge and offering a new model to enrich the range of possible alternatives.

SYSTEMIC CHANGE FOR CITIES

Marcela Mondino

CITIES AS PROTAGONISTS

Cities have existed for centuries and have played a crucial role in different cultures throughout history, like the Greek, the Roman, the Aztec and the Mayan ones. However, in recent decades, they have taken on an even greater role in the development of relationships between people and between them and the environment; dynamics increasingly influenced by technology.

This shift toward a central role for cities is explained, partly, by the fact that more than half of the world's population currently lives in urban areas, a figure that reaches 80% in Latin America. Furthermore, cities have become centers of economic, cultural, political, and innovative opportunities, positioning them as a key factor in development processes. However, this excessive focus on urban growth has neglected fundamental aspects such as planning and sustainable development, equitable access to quality public services, harmonious coexistence, and the relationship with natural and rural environments—all of them essential elements for the very existence of cities.

Statistics clearly demonstrate these transformations: in 1950, less than a third of the world's population lived in cities – approximately 800 million people; today, this figure is around 4.2 billion, and in the next generation, that proportion is expected to reach almost six billion. The UN predicts that this trend will intensify in the short and medium term, stating that by

2030, there will have been ten new megacities with more than 10 million inhabitants¹⁵. However, despite this urban growth, more than two-thirds of the world's population is at the mercy of income and wealth inequality, which is significantly undermining the prospects for sustainable development¹⁶. Given these challenges, the question is whether we will be able to create sustainable urban ecosystems that take into account existing backgrounds, trends, challenges and opportunities. Can we overcome the tensions between extreme poverty and wealth accumulation, between linear growth and the climate crisis? Will we be responsible enough to make decisions that value both ancestral knowledge and technological innovation to make our cities be more resilient?

SYSTEMIC PERSPECTIVE OF CITIES

Acknowledging these challenges represents a major step forward. For decades, proposals have been put forward to address housing, transportation, infrastructure, inequality, among many other issues. However, each of these aspects has been considered in isolation, without considering their interconnectedness with others. This has led to positive impacts which have been enough to achieve systemic change in urban development models. Systemic change is understood as a social change on a scale that alters the status quo—that is, the structures, hierarchies, and rules that dictate outcomes in a community or society¹⁷.

Generating changes that include these characteristics necessarily requires moving from a fragmented to a more systemic approach to urban space, and this involves considering at least

15. The World's Cities in 2018 – United Nations.

16. <https://www.un.org/en/un75/inequality-bridging-divide#:~:text=More generally, the prospects for sustainable development.>

17. ColobarAcción: A Practical Guide to Promoting Sustainability. Sean McKaughan, TEMAS Publishing. 2019. Page 25.

three fundamental concepts: sustainable development, urban metabolism, and collaboration.

The implementation of a systems approach in cities could represent the most powerful tool available to generate transformations that improve the quality of life of communities and preserve the natural environment. The proposals based on the new city models presented at the beginning of this chapter reflect systemic dynamics of urban life that aim at enhancing interrelation opportunities to achieve more efficient use of resources and resilience. This is not limited solely to economic considerations but encompasses other variables, such as time use, emissions reduction, enjoyment, security, and the strengthening of social cohesion, all of which affects the improvement of the population's quality of life.

It is encouraging that these urban planning and use proposals include a systemic perspective, combining already generated knowledge with the use of social and technological innovations in the search for new paths toward sustainable and equitable development, to guarantee access to basic human rights.

In Chapter 3, we looked at the case of the recovery of Xochimilco, which shows how different elements can be articulated in the urban ecosystem: the chinampas and their efficient metabolic functioning, the culture and identity of a community through a nature-based production model, the creation of a regenerative business model, and the production of local food. We also analyzed how this integration offers solutions related to access to quality food, improved air quality, biodiversity preservation, and soil and water recovery for a megacity like Mexico City.

Through real-life examples and cases like this one, in each chapter of this book we have attempted to highlight the challenges and opportunities cities face in moving toward a systemic approach that leads to sustainable development. However, to what extent does the urban system is able to see its relationship with other systems?

Cities have grown by building the utopia of an endogenous, self-sufficient, and ideal model of economic and social development. However, this model is crumbling in light of the reality of the climate crisis and the inequalities they face every day. For this reason, it is crucial to understand peri-urban and rural environments as an integral part of an urban-peri-urban-rural continuum.

These peri-urban and rural areas not only provide natural resources to urban populations but also play a fundamental role in improving air and water quality and regulating temperature. They also provide recreational and enjoyment spaces for the population and they are agricultural areas that provide fresh and healthy food. Therefore, it is important to emphasize that urban planning must consider the natural environment and create the conditions for a symbiotic relationship, inspired by the functioning of nature, in order to foster effective integration and collaboration between urban and natural ecosystems, thus contributing to more efficient use of resources and energy, urban resilience and greater sustainability.

City planning with a metabolic approach to its functioning allows for solutions that rethink the overvaluation of urbanization processes, putting the importance of nature into perspective, both in peri-urban and rural environments and in urban areas. The good news is that, from this new perspective, and through the implementation of nature-based solutions, for example, cities are rediscovering the value of their rivers, parks, green spaces, and urban production belts, aiming at recovering them from long periods of pollution and abandonment, based on an understanding of the benefits this provides to city resilience, economic development, and community building.

To reestablish this link, several priority agendas must be addressed, proposed in the new city models that are begin-

ning to be planned globally. Among the most relevant agendas are: the energy transition to use renewable energy sources, the fostering of clean mobility and sustainable transportation, the promotion of the circular economy, sustainable water management, the densification of green areas, the recovery of public spaces, the modification of production and consumption processes, valuing short production chains and the production of local food.

To guarantee that these solutions effectively have an impact on urban resilience, it is crucial to establish a direct connection with production processes, considering that they are the foundation of economic development, one of the main drivers of urban growth. In this sense, value chains and the subsequent consumption process present an opportunity to link the aforementioned elements: a systems approach, sustainable development and metabolism. They offer the possibility of addressing the design of transition processes toward a closed-loop economy that contributes to reducing the use of finite resources, minimizes waste and reduces negative environmental impacts. Adopting these practices leads to a positive integration of production processes with the resilience of the city and its surroundings.

This perspective complies to SDG 12, “Responsible Consumption and Production,” which aims at doing more and better with less, decoupling economic growth from environmental degradation, increasing resource efficiency and promoting sustainable lifestyles.

When production and consumption processes are developed along short value chains (taking into account the concepts of the circular economy, systemic functioning, metabolism and symbiosis discussed above), a virtuous cycle is created that fosters long-term sustainability. This involves adopting cleaner and more efficient production practices. It also promotes a responsi-

ble consumer mindset among citizens. It also requires the active participation of local governments in implementing policies and regulations that promote the transition to a more circular and sustainable economy.

Within the manufacturing industry and other industrial sectors, there are several regional and global cases that reflect these practices (some of which were presented in Chapter 3), in which production processes are modified or new business models are generated. The approach shifts toward efficient use of water and energy, reducing the use of polluting products, using organic or recycled fibers, recovering and reusing materials, proper waste management and building green roofs that promote the use of nature-based solutions.

In this sense, we see value chains as an opportunity to design processes that positively connect urban relationships with their natural environments based on the logic of the city's metabolic functioning.

To ensure that these identified opportunities contribute to the aforementioned systemic change, it is necessary to promote and accelerate joint efforts and collaboration across different sectors to address the planning of cities and their natural environments as an integrated system. This collaboration becomes even more urgent in the context of the global climate and social crisis we are facing, which is manifested in the increased risks and vulnerabilities experienced by cities and in the widening of the aforementioned inequalities, as discussed in Chapter 2.

COLLABORATING TO MAKE OUR CITIES MORE RESILIENT

When we talk about sustainable development and urban metabolism, it is essential to also talk about collaboration. To achieve urban planning that promotes sustainable development, it is mandatory to have collaborative processes in which we all work

together towards a common goal. We call this “ColobarAcción”—acting collaboratively to change things. This term, coined by the Avina Foundation and reflected in the book *“ColobarAcción: A Practical Guide to Promoting Sustainability,”* posits the basic principle that many hands are needed to create the systemic change that promotes sustainability. “A single organization, let alone a single individual, cannot execute this kind of change¹⁸.” Throughout the text, urban innovations such as superblocks, circular cities, and the 15-minute city have been mentioned. These innovations focus on integrating different aspects into urban planning, such as mobility, accessibility to resources and new production and consumption models. These models seek to break economic paradigms, protect the environment, foster culture and promote equity in society. Besides, technologies have enabled the development of designs such as smart cities, the Internet of Things and smart mobility. Both social and technological innovation are contributing to making cities more resilient, thanks to planning and organization that allows for more efficient use of available public goods. However, solutions implemented from sectoral perspectives or actions that do not articulate a diversity of interests fail to fully solve urban challenges.

To achieve systemic change in the functioning of cities, the collaboration and commitment of multiple actors is necessary, including the public sector, the private sector, academia and civil society. In the same way we are aware of the fact that cities are part of a system that extends beyond their territory, we also understand that we cannot find solutions to the climate and social crises without the active participation of the community, without understanding its needs and proposed solutions and without involving it in decision-making processes for the gov-

18. ColobarAcción: A Practical Guide to Promoting Sustainability. Sean McKaughan, TEMAS Publishing. 2019. Page 26.

ernance of public goods, defined as all those goods or services that contribute to human dignity and are available to all of society in equal quantity and quality.

It is necessary to foster effective governance and citizen participation in decision-making to achieve this. Local governments have the responsibility of facilitating governance processes that promote transparency, accountability and citizen participation. Furthermore, cities must promote gender equality, inclusion and equity for marginalized groups to guarantee that all voices are heard and considered in urban policy planning.

On the other hand, the private sector, as the main driver of the economy and production in cities, has the responsibility of using and managing resources sustainably. Private companies play a relevant role by adopting sustainable practices that not only contribute to the resilience of the city, but also strengthen their business model by meeting the demand of global markets that increasingly value the environmental and social responsibility of companies.

Collaboration among all these actors is essential for building a resilient and sustainable future. Likewise, collaboration between cities is a valuable resource for addressing common challenges, sharing resources and knowledge and promoting innovative solutions. Furthermore, collaboration between various civil society, philanthropy and international cooperation entities is of great importance, as it allows for pooling resources, both in terms of knowledge and financial resources.

A case that illustrates multisector collaboration and knowledge exchange between cities is the experience initiated in 2019 by IDB Lab, Resilient Cities Network and Fundación Avina, which, at present, continues in partnership with the Citi Foundation in the implementation process of the Regional Resilient Cities Initiative in nine Latin American countries. This initiative allows for the identification of innovative solutions to the challenges cities are facing, such as the need to generate opportunities for economic recovery, achieve gender equality goals, reduce the digital gap and increase the positive social and environmental impact of businesses. Added to this, there is the need to respond to the changes and emergencies caused by COVID-19.

For its implementation, it was necessary to build local partnerships between the private and public sectors, which allowed for the agreement on agendas to promote the development of open challenges related to the resilience priorities of the participating cities. From these calls, more than 500 innovations were identified, approximately 100 of which were preselected to participate in training sessions. Of these, more than 40 innovative ventures received seed capital and support for developing their business models, most of them linked to vulnerable sectors.

PRESENT TIMES, THE OPPORTUNITY FOR A SUSTAINABLE FUTURE

As we moved through the various chapters of this book, we encounter diverse perspectives that clearly highlight the constant evolution of cities and their fundamental role in human and environmental development. There is an emphasis on the importance of facing the challenges and seizing the multiple opportunities that arise as more people move to urban areas. To achieve significant change, the need to adopt a systemic approach to urban planning, encompassing economic, social, cultural and environmental aspects, is acknowledged. In this approach, the integration of nature-based solutions, the development of production processes based on the circular economy, and the promotion of common goods emerge as essential elements for

strengthening resilience and fostering sustainability in our cities. It is about finding a balance between tradition and innovation, leveraging ancestral knowledge and new technologies to build urban ecosystems.

In addition to these previously developed elements, there are other relevant factors that complement this vision and are essential for moving toward effective systemic change. These include the importance of scientific research, South-South collaboration and the need for adequate funding.

The role of technology and knowledge is fundamental in strengthening our cities. It is essential to establish a close relationship between scientific research, technological innovation, and decision-making in urban planning. All forms of innovation, whether social or technological, must guarantee that no one is left behind and that the commitments established in the 2030 Agenda are met.

As already mentioned, collaboration between cities becomes a relevant resource. By joining forces, it is possible to overcome barriers, share resources and knowledge, and, inspired by the concept of urban metabolism, promote innovative solutions. The similarities shared by cities in the “Global South” provide a favorable setting for fostering collaborations in the Global South. Key global agreements, such as the 2030 Agenda, the Sustainable Development Goals and the New Urban Agenda, provide a solid framework for fostering comprehensive and diverse collaboration. By joining and collaborating at all levels, from the local to the global, we can build cities prepared to face current and future challenges.

Accelerating positive transformation processes requires the effective implementation of sustainable innovations, as described above, which largely depends on adequate financing. It is essential to establish mechanisms that facilitate investment in sustainable projects and promote collaboration among dif-

ferent actors. Adequate financial resources will enable initiatives that promote sustainable urban development and contribute to achieving the goals established in the global agendas.

Together, we can transform the present and create a future where cities become examples of sustainable development, where people's quality of life is in harmony with the natural environment. This collaboration offers us a promising and sustainable path towards developing prosperous and equitable cities.

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Cities are ecosystems where the built and social environment coexist together with the natural one. They are spaces of great importance at a global level, as they home 50% of the population and it is where there are more opportunities for economic development. But the counterpart are the challenges in terms of risks and vulnerabilities they are exposed to, such as social inequality and climate change consequences, which affect specially those who are most vulnerable.

This is way it is fundamental to think about and implement new urban ecosystems that can offer an approach that complies with the Sustainable Development Goals so as to build sustainable, resilient, equal and safe cities. This can be achieved through an urban planning that is based on the efficient metabolic functioning of the city, as well as implementing certain tools such as circular economy, industrial symbiosis, nature-based solutions and urban commons.

With focus on the “Global South,” this book provides a revision of the context of cities, their impacts, challenges and possibilities. Besides, it presents successful cases based on implantation of existent tools and suggests a path to follow so as to achieve a systemic change to organize and plan urban environments and build resilient cities.

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