

# BIODIVERCITY PLANNING: STRATEGIES FOR INCORPORATING URBAN BIODIVERSITY AND ITS ECOSYSTEM SERVICES

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Urbanization is advancing progressively and rapidly throughout the world, particularly in countries considered to be developing. These growing urbanization trends since the mid-20th century have been marked by the generation of significant opportunities and the emergence of critical social, economic, and environmental challenges. Human agglomerations facilitated by urban areas have led to substantial economies of scale at local and regional levels and considerable global progress in indicators of human well-being (Chen et al., 2014; Van Zanden et al., 2014). However, at the same time, urban growth has produced high costs and externalities at local and regional scales associated with the loss of natural cover, air and water pollution, or phenomena such as heat islands. Climate change or the depletion of natural resources are precisely the results of these urbanization phenomena, which ultimately affect the quality of life of a growing

urban population that is directly benefited or affected by the environmental conditions that cities generate at different scales (Grimm et al., 2008; Seto et al., 2012).

In response to the challenges posed by urbanization, different approaches to the proper planning of these spaces have been tested and implemented worldwide. Such planning is usually oriented to achieve economic, social, cultural, and environmental objectives by developing spatial visions, strategies and plans and applying a set of principles, tools, mechanisms, and instruments in institutional or regulatory aspects (Raven et al., 2018). Urban planning has thus become a powerful instrument to reshape the forms and functions of cities and their surrounding regions. Not only to generate economic growth, prosperity, or employment but also to ensure social and environmental conditions that comprehensively address the quality of life

demands of the human groups living there (Barton & Grant, 2013).

The spectrum of planning tools, mechanisms, and instruments that cities worldwide employ to respond to these challenges has been growing and changing, reflecting an evolving continuum (Oliveira & Pinho, 2010). This growth and change, in recent decades, has shown the need to address the effects that the processes of loss and transformation of natural ecosystems resulting from urban growth can have on the quality of urban life. Such phenomena are directly linked to the loss of fundamental ecological functions to maintain the provision of regulatory, provisioning, and cultural ecosystem services that determine human well-being in all cities (Niemelä, 1999; Nilon et al., 2017). In this context, urban planning has become a fundamental strategy for maintaining the growth dynamics of cities. Doing so by providing the necessary elements for their develop-

ment, preventing the environmental degradation that this may generate, promoting their resilience, and guaranteeing the well-being and quality of life of the people who live in them.

Urban planning that incorporates ecosystems and biodiversity has made it possible to recover cities' importance and comprehensive view and break paradigms around management based exclusively on the urban gray. This perspective highlights the value of the natural capital of cities in human well-being and the quality of life they can offer, as well as the challenges that may lie behind their explicit inclusion in mechanisms, tools, and instruments that address planning in both urban and urban-regional contexts.

## BIODIVERSITY IN URBAN PLANNING?

Urban planning is currently conceived as a participatory, technical,

and political process led by the State, which involves all stakeholders in its development. In a new vision that incorporates the regional dimension and recognizes the importance of ecosystems and biodiversity as structuring elements of a functional landscape, these processes must be oriented to support and articulate decision-making and action on the territory at different scales, including the urban scale. This approach will make it possible to prevent, solve and more effectively mitigate the conflicts that affect the balance between biodiversity conservation, ecosystem services, their resilience, and the development of socio-economic activities and dynamics (Nilon et al., 2017).

Incorporating these dimensions implies understanding that they must be integrated as fundamental, inescapable, and inseparable components of these processes. Planning thus makes it possible to understand the territory and, to this

extent, provides a synthesis of the structure and dynamics of ecosystems and their biodiversity at the regional scale. It also provides an assessment of the problems in the face of urban transformation trends and recognizes the territorial potentialities that support their functioning and sustainability (Ahern et al., 2014). Thus, comprehensive management of biodiversity and its ecosystem services in urban-regional contexts becomes relevant to "promote sustainable development processes based on land use and occupation patterns in accordance with biodiversity, its ecosystem and social services, the population, culture, and the development potential of each one" (Ahern et al., 2014). (Márquez, 1997).

In this context, the structuring character of ecosystems, biodiversity, and their ecosystem services in planning processes becomes evident, elements traditionally incor-

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BiodiverCity Planning: Strategies for Incorporating Urban Biodiversity and Its Ecosystem Services. P. 80-87. In: Mejía, M.A., Amaya-Espinel, J.D. (eds.). *BiodiverCities by 2030: Transforming Cities with Biodiversity*. Bogotá. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. 2022. 288 pages.

porated in rural components under planning instruments but which have been little recognized in urban environments as integrating elements of territorial occupation models. It's worth emphasizing that as the more fine-grained scale—such as the urban—becomes more detailed, the more representative elements of ecosystem functionality at the rural level become less noticeable. And the social functionality of biodiversity and its impact and benefits on the well-being of the population becomes more important (Cilliers, 2010).

Beyond its biological attributes, urban biodiversity thus reflects historical processes of territorial transformation that have been conditioned by geographic, political, and economic characteristics and specific social and cultural values. This set of factors, materialized in a territorial occupation model, recreates the landscape at different spatial and temporal scales (Alberti et al., 2003). Therefore, the models of territorial occupation at the urban level that are designed and projected from territorial planning must be built based on ecosystems, which usually go beyond the limits of a city. This landscape perspective establishes the need to structure a model that integrates elements at urban-rural and urban-regional scales. This urban-regional planning model (see the chapter "BiodiverCity and region: a unitary system. The paradigm shift in urban development in the 21st century" in this book) will make it possible to manage the ecosystem services demanded by the city more efficiently and comprehensively. It also ensures the conservation of a mosaic of coverages that allow their provision at the regional scale (Norton et al., 2016).

From a global perspective, fundamental challenges have been identified in the generation of knowledge on the biodiversity-ecosystem services relationship in urban-regional settings and its importance

in planning processes at that scale. For example, issues such as the benefits of ecological restoration in urban environments are still poorly understood (Gómez-Baggethum et al., 2013). This lack of understanding also applies to urban biodiversity's role in generating benefits for citizens and the objectives that should be managed around these relationships in aspects such as the protection of green areas and their connectivity, integration, and multifunctionality. From a management perspective, although the relationships between natural dynamics and physical-spatial, sociocultural, and political dynamics are significant (supply of ecosystem services, the concurrence of natural disasters, for example), these interactions and flows have been poorly understood and included in an urban-regional planning perspective. (Forman, 2010).

On a global scale, there is evidence of efforts to incorporate ecosystems and biodiversity in urban-regional planning processes, which are usually based on public administration and, on other occasions, on the initiative of social organizations or driven by international cooperation agencies. Two cases in the Latin American region well represent and exemplify the possible global panorama around these efforts.

In Brazil, in the last 50 years, the urban population increased from 45% to 85%. This phenomenon has brought severe environmental impacts, especially related to the degradation and reduction of green areas, thus contributing to an increase in flooding, landslides, and other persistent risk situations in Brazil's urban environments (Da Mata et al., 2007). In response to this problem, the country has begun to focus on integrated territorial management to reconcile its demands for economic growth with the conservation of natural resources and the quality of life in cities. In this context, innovative

planning instruments are emerging, such as ecological-economic zoning as the basis for land use planning in the country's cities. It is also worth mentioning programs such as Greener Cities (*Ciudades + Verde*), created by the Brazilian Ministry of the Environment. It is one of the axes of the National Urban Environmental Quality Agenda, whose objective is to increase the quantity and quality of urban green areas and improve the quality of life in cities. In addition to this, the integration of areas of great ecological value, such as the São Paulo City Green Belt Biosphere Reserve, created in 1994, has been integrated into planning. This area, which has more than 600,000 hectares of forest, offers city residents numerous essential benefits to ensure their well-being, mainly because of its role in food security, air quality, water supply, cultural heritage, and climate stabilization.

Meanwhile, in Colombia, addressing the relationship between the phenomenon of urbanization, ecosystem transformation, and biodiversity loss represents a great challenge, both for the research agenda and for incorporating this knowledge into territorial planning schemes and processes at all scales (national, regional, and local). However, this trend has been changing through methods developed by organizations such as the Alexander von Humboldt Institute. These processes have begun to include conceptual approaches, methodological approaches, indicators, and strategies focused on biodiversity, such as using nature-based solutions (NbS), thus recognizing the dynamics of ecosystems at urban-regional scales. This is coupled with the development made by institutions such as the Ministry of Environment and Sustainable Development (2015). This development is evidenced in exercises for the identification and regulatory recognition of ecological networks—called main

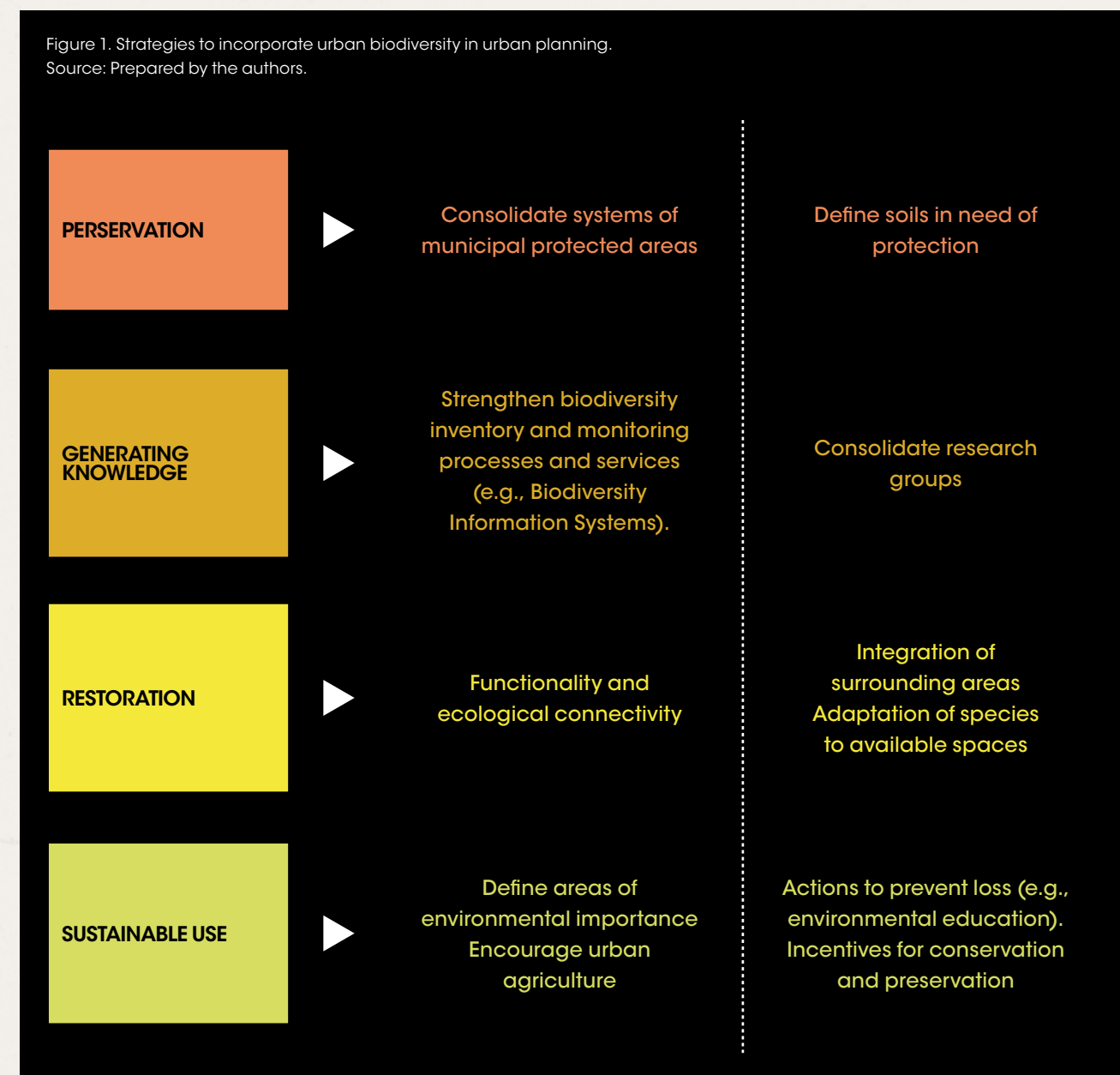
ecological structures (EEP, for its Spanish acronym)—in urban-regional environments, the development and use of effective urban green area indicators, and the conceptualization and implementation of frameworks such as green infrastructure. The latter allows glimpsing significant advances in linking ecosystems and biodiversity in territorial planning within this country's regions and urban areas.

## HOW TO INCORPORATE BIODIVERSITY IN URBAN PLANNING?

There are various strategies for planning urban biodiversity on a global scale. They range from preserving existing natural elements, restoring those under conditions of degradation or fragmentation, generating knowledge to have more details for decision-making, and establishing

conditions that allow their sustainable use (Figure 1). These strategies, which can be complementary, contribute to the construction of possible biodiversity and local ecosystem services action plans. The latter can be developed considering the need for different tactics for each scale at which biodiversity is manifested, or urban ecosystem services are configured (Dearborn & Kark, 2010; Kowarik, 2011; Nilon, 2011).

Figure 1. Strategies to incorporate urban biodiversity in urban planning.  
Source: Prepared by the authors.



The **preservation** of urban biodiversity refers to those actions that seek to maintain the structure and natural functioning of ecosystems and biodiversity and its ecosystem services by limiting or eliminating human intervention in them. Within this framework, it is worth highlighting those processes leading to:

- ➔ Consolidate urban protected area systems based on the identification, declaration, and effective management of urban and peri-urban areas.
- ➔ Develop systematic planning processes to identify conservation gaps and use them to guide legal and practical protection processes in priority sites.
- ➔ Identify protected soils with restricted possibilities for urbanization due to their geographic, landscape, environmental characteristics or because they are part of public utility zones for the provision of public utilities or areas of threat and unmitigable risk for the location of human settlements.
- ➔ Manage urban green areas, considering important aspects such as the resilience of these spaces and the development of actions aimed at maintaining native species, controlling invasive plants and animals, recovering nutrient cycles, or increasing landscape connectivity.

**Information and knowledge management** refers to obtaining and compiling data that, when integrated and analyzed, allow us to understand the structure and functioning of urban areas, their biodiversity, and the ecosystem services they provide. It also seeks to feed and guide decision-making that ensures the maintenance of this biodiversity while reducing the pressures that affect it at the urban scale. These objectives can be achieved through actions such as:

- ➔ Strengthen urban biodiversity inventory processes, including

collecting information on functional groups and traits, composition patterns, ecological structure and function, and mapping of ecosystem services and their connection with indicators of urban human well-being.

- ➔ Consolidate networks for the generation, collection, and analysis of information related to biodiversity and ecosystem services at the urban scale.
- ➔ Identify criteria, references, and baselines that allow regular monitoring of biodiversity and urban ecosystem services and the effectiveness of those actions focused on their maintenance and persistence.

**Restoration** describes the processes aimed at the rehabilitation, remediation, or recreation of ecosystems, their components, functions, or services to increase the coverage of habitats and ecosystems, mitigate the effects of fragmentation, reestablish landscape connectivity and ensure the provision of vital ecosystem services for the well-being of the urban population. Among the actions contemplated are:

- ➔ Rehabilitate, remediate or restore spaces with ecological and social criteria that contribute to maintaining urban biodiversity, including remnants of native vegetation or bodies of water such as rivers and urban wetlands.
- ➔ Renaturalize or recreate attributes or functions of nature in cities through landscape design and eco urbanism approaches.
- ➔ Generate follow-up and monitoring processes to evaluate the effectiveness of the restoration objectives.
- ➔ Develop initiatives to generate a change in the social, economic, or political practices that led to the degradation of the ecosystems to be restored.

**Sustainable use** refers to the actions of direct or indirect use that humans make of the biodiversity present in or around urban areas and the services it provides to produce a benefit for present generations while maintaining its potential to meet the needs and aspirations of future generations. In the framework of truly sustainable use, such actions must involve all stakeholders: from all urban dwellers to policymakers, urban planners, scientists, and decision-makers, to define guidelines, strategies, and tools to preserve and restore biodiversity, the services it provides, and reduce natural risks in the urban environment.

Usually, planning instruments that can incorporate this type of strategy are developed at different scales (national, regional, local). This same logic is followed in urban-regional settings, generally with interactions at different planning scales. It is vital to include tools that allow the management of ecosystems and biodiversity to their functional capacity to provide ecosystem services from beginning to end. Among the instruments that usually present more significant opportunities for this purpose are those that define land-use planning at national scales and planning tools that address intermediate scales (e.g., partial plans, urban development treatments, urban planning units, etc.). Programs at regional scales such as metropolitan strategic land-use plans are usually linked to these mechanisms, along with socio-economic planning instruments that become an important way to manage biodiversity. The latter is because they are used to plan the development of cities, develop projects and allocate resources (Ahern, 2013; Heymans et al., 2019).

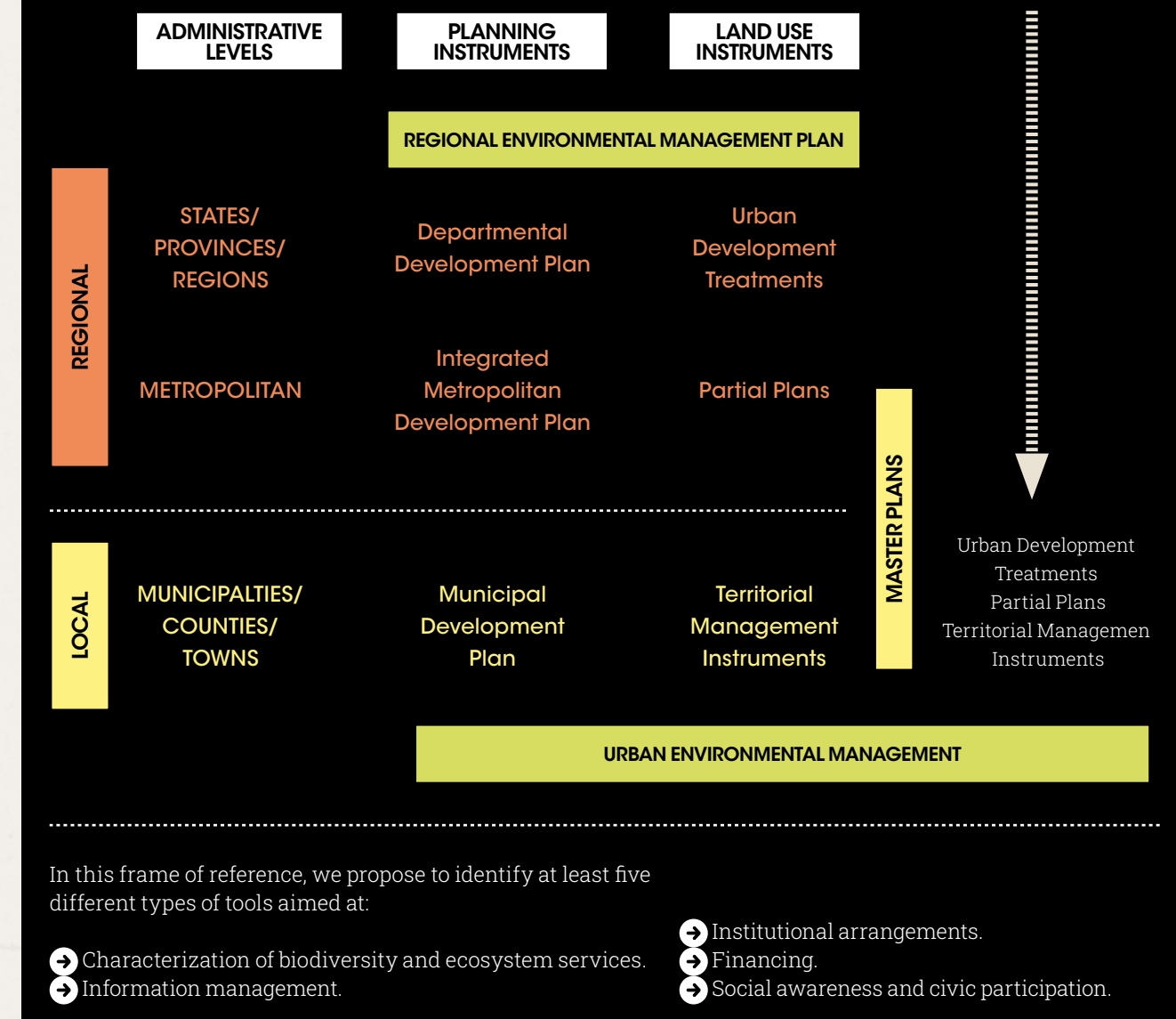
An example of this joint work is presented in Colombia. As shown in Figure 2, in this case, the relationship and interaction between various tools and instruments that

define urban planning and the possibility of incorporating biodiversity into them are evident (Ministry of Environment and Sustainable Development, 2015). To achieve in-

clusion adequately, tools that facilitate this task are necessary. In this sense, they should focus on different planning moments or be transversal to them and be designed to be used

both by the actors who carry out this task and by those who contribute in one way or another to the development and application practice of these processes.

Figure 2. Planning and land use instruments that incorporate ecosystems, biodiversity, and ecosystem services at regional and local levels in Colombia.  
Source: Prepared by the authors.

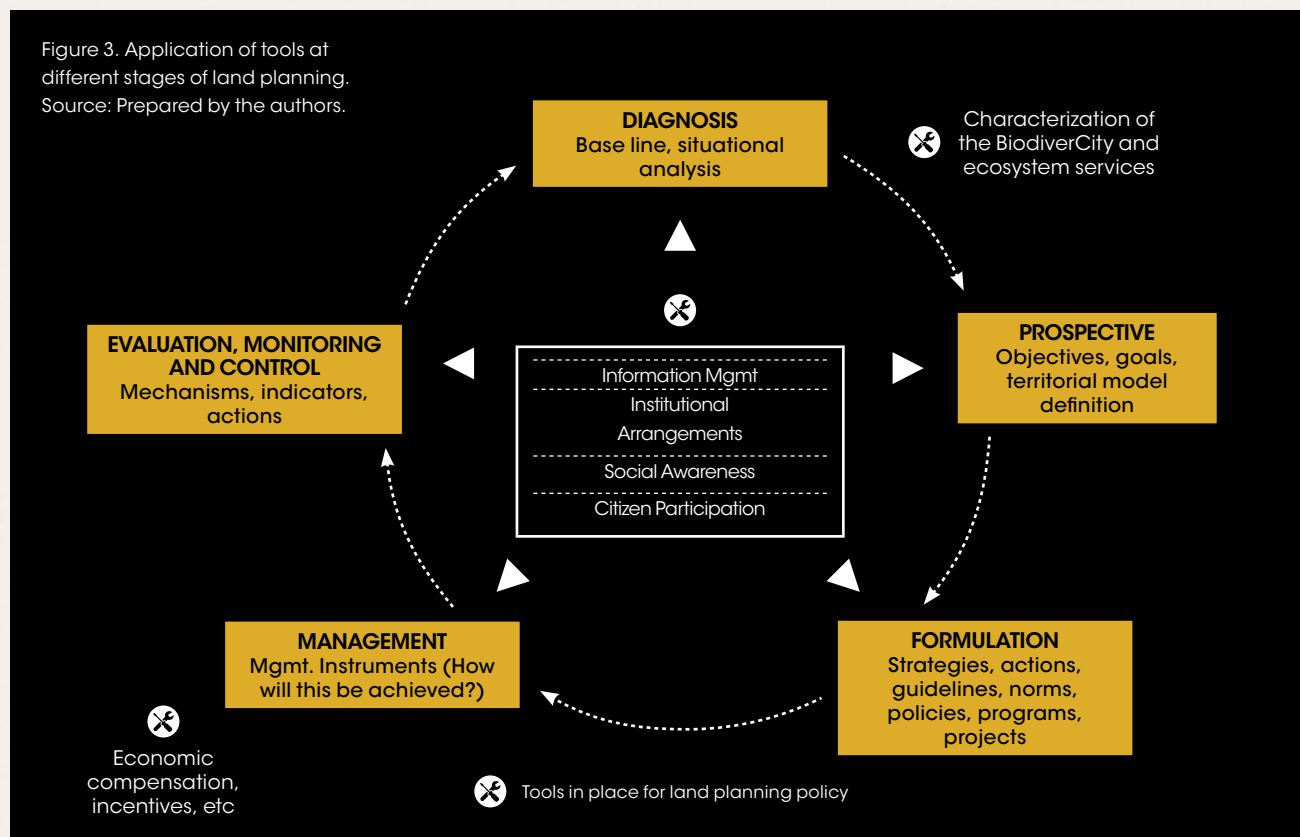


Tools related to the characterization of biodiversity and ecosystem services are technical processes that are generally developed in the diag-

nostic stages of planning. These processes make it possible, on the one hand, to approach knowledge of the urban territory using available infor-

mation and, on the other, to prioritize the collection of information that is essential to guide decision-making in planning processes (Figure 3).

Figure 3. Application of tools at different stages of land planning. Source: Prepared by the authors.



Financing tools are usually associated with the formulation and implementation stages of the planning processes since they are called to guarantee the actual application in the territory of the proposed proposals. The occupation model agreed upon with stakeholders is also partly managed through them (see chapter "Towards the financing of the BiodiverCity" in this book). Thus, these tools are essential to complement territorial management and make the guidelines and strategies proposed in the action plans and other programmatic components a reality (Figure 3).

The tools aimed at institutional management and social ownership constitute cross-cutting elements in the planning and management processes to the extent that they are fundamental for carrying out the procedures in a coordinated and collaborative manner. Likewise, these tools help ensure that the processes are carried out inclusively and that the decisions made in the planning framework

are consistent with the territorial reality and social demands (Figure 3).

### PLANNING RECIPROCAL AND POSITIVE RELATIONS BETWEEN THE CITY AND REGION

Societies must think and manage cities beyond the political-administrative boundaries of urban areas but recognize that there is biodiversity and, therefore, ecosystem services within and outside these spaces (Anthopoulos & Vakali, 2012; Norton et al., 2016). This implies recognizing the relationship and joint work that should always exist between the different scales of biodiversity and its roles in various urban, peri-urban, and rural contexts, considering their implications for the provision of ecosystem services and benefits.

The city needs the services of ecosystems outside the city, such as water and food, which are generally provided by rural areas or contiguous regions, and urban biodiversity, which

provides more specific services typically associated with the population's well-being. Thus, biodiversity management in urban environments must consider strategic ecosystems. Although not necessarily found within the city, these ecosystems are essential for their inhabitants' quality of life (see the chapter "BiodiverCity and region: a unitary system. The paradigm shift in urban development in the 21st century" in this book). To this end, ways must be established to structure the connectivity of urban-rural and urban-regional elements to maintain and manage multiple ecosystem services demanded by cities in a more efficient, comprehensive, and sustainable way (Kim & Kwon, 2021).

There are cases where the continuity of urban trees, for example, allows structural connectivity between ecosystems or can even generate functional connectivity by facilitating the transit of particular species or flows of ecosystem services between different areas. There

are also cases in which forest areas protecting urban water flows, with proper management, promote connectivity between important rural and urban ecosystems. It is here where the identification of urban ecological networks and green infrastructure strategies, together with other structures at supra-urban and regional scales, can be vital elements for managing urban ecosystem services and quality of life in cities (Ignatieva et al., 2011; Van Oijstaeijen et al., 2020).

### REALITIES AND CHALLENGES IN THE PLANNING OF BIODIVERCITIES

Territorial planning has been the subject of countless challenges on the road to building more resilient territories, better adapted to social and environmental changes, friendlier, and capable of offering better living conditions to their inhabitants. In this context, territorial planning has enabled the incorporation of tools that allow cities and regions to know and manage their territory programmatically and prospectively, considering their particularities. For this purpose, installed capacities, information, technical knowledge, and instruments are required to help develop these processes most accurately and efficiently. Likewise, tools are needed to learn about and strengthen the understanding of biodiversity's role and the services derived from it to sustain the development of their territories and their socio-economic dynamics.

The institutions that support planning processes at the territorial scale need tools that allow them to jointly and in a coordinated manner address the challenges above, providing them with the necessary elements to generate institutional strategies per specific territorial realities and specific social and ecological demands. Cities, being complex, highly transformed territories with unique dynamics, require a differential approach to their planning and man-

agement, recognizing that they are both demanders and generators of ecosystem services and social benefits provided by their ecosystems and urban biodiversity.

One of the most important strategies for linking biodiversity and its services in urban planning has been the development of the concepts of ecological networks, green infrastructure, and environmental structures (Andrade et al., 2013; Ignatieva et al., 2011; Minor et al., 2017). The implementation of these concepts in planning has facilitated the development of processes aimed at maintaining, recovering, and sustainably using functional networks of green elements that constitute the basis that articulates the urban-regional system, from biodiversity and ecosystem services, as support for territorial development. In practice, these efforts have gathered different elements to guide the work with the regions and territorial entities in the planning and management processes since they allow knowing the organization and functionality of the natural and semi-natural areas in the territory, including the urban-regional environments. These networks that define a territorial functional ecological structure are then constituted as a determining element of territorial planning and an opportunity to:

- ➔ Recognize the structuring nature of biodiversity as a basis for land-use planning.
- ➔ Serve as a valuable framework for land-use planning and natural resource management. It does not replace land-use planning instruments.
- ➔ Support decision-making on land use, zoning, and land conservation strategies.
- ➔ Promote complementarity between different land uses to maintain ecological integrity and connectivity.
- ➔ Sustain a framework that guarantees the articulation with territorial planning processes at different spatial and temporal scales.

### KEY MESSAGES

➔ **Mainstream biodiversity as a critical element to achieve urban sustainability.** As fundamental strategies for maintaining the dynamics of urban growth throughout the world, territorial planning and management must expand a field of action based exclusively on urban gray and incorporate the actual value that biodiversity and its ecosystem services have on the quality of life in cities.

➔ **Move towards integrated management of urban biodiversity.**

Planning processes should comprehensively address the links between social and ecological systems that converge in a city. They should promote strategies that incorporate land use and occupation patterns, cultural practices, social demands with biodiversity, ecosystem services, and their role in urban areas' resilience and adaptive capacity.

➔ **Articulating planning instruments at various spatial scales.**

For cities seeking to face a transformation that will drive them towards sustainability based on their urban biodiversity, developing planning processes that transcend established political-administrative boundaries is a priority. And they should be doing so by recognizing and incorporating the links and flows that cities and their demands for services have at a spatial and temporal level with ecosystems, biodiversity, and ecosystem services found at the regional level.

➔ **Develop complementary strategies for biodiversity-based planning and managing.**

The explicit incorporation of biodiversity in cities should start with complementary use of preservation, restoration, and sustainable use strategies. These should be coordinated through knowledge management that feeds and guides decision-making processes that ensure the maintenance of biodiversity, reduce the pressures that affect it, and promote adaptive strategies based on learning.