



MAPPING OF ECOSYSTEM SERVICES IN THE METROPOLITAN REGION OF LONDRINA

A TOOL IN DEFENSE OF BIODIVERSITY AND METROPOLITAN DIALOGUES

This case study aims to present the actions undertaken by the Municipality of Londrina, Brazil, and by ICLEI South America within the scope of the INTERACT-Bio Project. Initially, the process of mapping ecosystem services (ESs) of the Metropolitan Region of Londrina (RML) will be described, considered the guiding thread and main action of the project. For this, the adopted participatory methodology, the agents involved, the results, the innovative aspects and the challenges and opportunities arising from this process will be addressed. Then, the actions and products that resulted later from the same project and that, together, complemented

and highlighted the importance of mapping ecosystem services will be presented. The first and main challenge encountered in implementing the project was the absence of a metropolitan agency designed to bring together the municipalities of RML and to develop policies and planning for this regional scale. On the other hand, in addition to the measurable technical results of the project, it can be said that one of the greatest innovations of INTERACT-Bio was to make the mapping of ecosystem services an important and necessary tool for intermunicipal dialogue on environmental issues common to the entire Metropolitan Region of Londrina.



Biodiversity: threats and challenges in brazilian cities

If Brazil is one of the most biologically diverse countries in the world, on the other hand, it has also experienced high rates of urbanization associated with economic inequalities and a weak environmental policy, especially in small and medium-sized cities. This scenario, characteristic of the countries of Latin America and the Caribbean, makes the cities in expansion demand more ecosystem services (ESs) than they are able to produce, which commonly makes them seek these services beyond their administrative and geographical limits (Cohen, 2006; Dobbs et al., 2019; Günerlap and Seto, 2013). According to MEA (2005), the challenge of transforming this situation and, at the same time, meeting the growing demand for ESs involves significant changes in institutions, practices, policies and decision making. For this reason, the INTERACT-Bio project in Londrina had as its starting point and its main action the identification and mapping of ecosystem services in its metropolitan region. Furthermore, it has made this process a driving force in the promotion of dialogues at the metropolitan level, in the construction of public policies aligned with global sustainability frameworks and in the development of products that are fundamental tools for the planning and integrated management of municipalities in the territory of RML.

Metropolitan Region of Londrina in Context

The RML is located in the South of Brazil, in the north of the State of Paraná. It was legally constituted in 1998 and today comprises 25 municipalities. Although Paraná's first urban occupations date back to the 16th century, the northern part of the state began its urbanization process only in the first half of the 20th century. It was only in the 1970s that RML had its urban network organized and dynamized - the result of a set of political-economic and social transformations that made Londrina stand out in the state's urban hierarchy (Ferreira, 2011). With only 85 years of municipality, Londrina has a current population estimated at 569.733 inhabitants, where 96.94% live in an urban area.

Londrina is part of a network of cities in the north of Paraná that was born in the first half of the 20th century as a real estate product - the result of land parceling and the sale of lots of land by a private company with British capital. This network of cities was purposely implemented following a line of ridges, therefore far from the valley bottoms. However, the territorial expansion resulting from the accelerated urbanization has meant that many of these cities have incorporated valley bottoms into their urban area (Rego, 2009). Londrina, for example, has today more than 80 water courses that cut out the city and give its landscape a peculiar appearance.

Facts and figures

Local Government Name

Metropolitan Region of Londrina

Country and province

Brazil, Paraná

Population (2018)

1.1 million, annual growth - 4.05 % [1]

Total Area

9.068,077 km² [2]

Municipal Budget

R\$ 2.124.045.000,00 [3]

GHG inventory available since:

2013 [4]

GHG emissions indicator

1,349,293.21 t CO₂e [5]

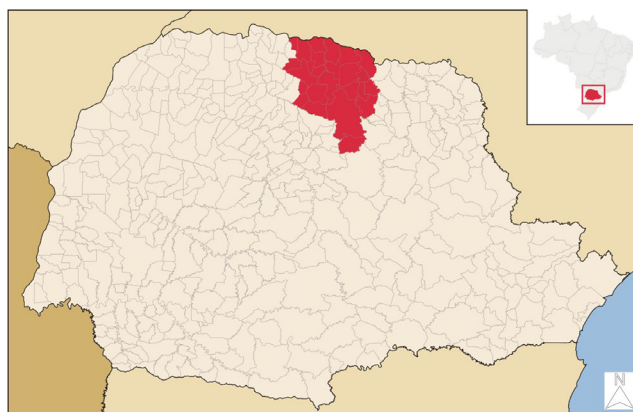


Figure 1: Larger picture: location of the RML (in red) in the State of Paraná. Smaller picture: location of the State of Paraná in the Brazilian territory. Author: Pedro C. C. Freitas.



INTERACT-BIO LONDRINA: EXPLAINING THE INITIATIVE

The project context

In recent years, discussions on sustainability have been increasingly intrinsic to city planning and management. And if in urban planning in the 20th century, valley bottoms (as well as floodplains) were seen as an obstacle to what was understood as progress, today we understand the infinity of ecosystem services they have to offer us. These green areas are responsible for air purification, regulation of humidity and temperature in the urban environment, protection of soil against erosion, maintenance of biodiversity and mobility of fauna and flora, and the supply of clean water. In addition, the integrity of riparian vegetation makes it possible to regulate the hydrological cycle, controlling floods and contributing to the reduction of flood risks. There is also the potential for landscape and cultural use of these spaces, which directly reflect on the quality of life of citizens. In short, it is a set of ecosystem services that allows cities to have sufficient resilience to face events arising from climate

change. And this is the initial challenge that motivated local action in the city of Londrina.

What motivates the initiative

In recent years, severe climatic events of high rainfall have become increasingly recurrent in the cities of RML, causing flooding, structural damage, risks of landslides in certain areas and, above all, threatening the lives of the population in a vulnerable situation. . A set of factors related to urbanization of cities - soil waterproofing, diffuse pollution, silting, insufficient conventional rainwater drainage system, etc. - has undermined the performance of the ecosystem services. In addition, the sources of public water supplies, in their majority, are in neighboring cities, which receive financial resources for their preservation (ICMS Ecológico), without the supplied city having any monitoring or knowledge of the conservation actions and improvements undertaken.

This whole scenario helped to define the scope of the INTERACT-Bio project,

which focused on dealing with the abundant water resources of RML. In this sense, the first objective was to identify strategic areas for the provision of Ecosystem Services to, then, enable cities in the metropolitan region to be able to support and promote the connectivity of forest fragments, map critical drainage points and recover degraded areas through adoption of Nature Based Solutions.

This approach on a metropolitan scale understands that environmental structures are not subordinated to the political-administrative limits of the municipalities and that the commitment to the preservation and management of these natural resources must be shared by all.

Goals and objectives

The process of mapping ecosystem services aimed to introduce a conceptual leveling on ESs, train the technical staff of civil servants from different agencies and municipalities, collect data for regional diagnosis and promote intersectoral and inter-governmental integration.

In a broader perspective, the mapping of ecosystem services aimed to promote debates and outline intervention strategies on a metropolitan scale, support RML to understand the potential of nature, especially in relation to the provision of essential environmental services for the daily lives of cities and, at the same time, to improve the conservation of biodiversity, generating new or better economic opportunities.

Methodology and working process

The identification and evaluation of RML's ecosystem services was done in a participatory way, through a practical exercise adapted by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) from the Institution of Environmental Sciences (IES) manual. According to TEEB (2018), collaborative mapping is a good way to collect information when there is no data about land use. This was the case with RML. The cities did not have enough human and technical resources to collect and systematize this kind of information.

The first step was the organization of the event "Conference and Workshop: Biodiversity, Ecosystem Services and Metropolitan Management", which took place in person at the city hall of Londrina, in March 2018. With 82 people present, the conference aimed to present ICLEI South America and also present the concepts that would support the practical activity that would follow. The Helmholtz Center for Environmental Research (UFZ) consultant spoke about "Ecosystem Services and Urban Context" and the environmental analyst from the Brazilian Ministry of Environment (Ministério do Meio Ambiente - MMA) presented "Perspectives and Actions for Municipal Environmental Zoning". There was also a presentation of experiences in the metropolitan regions of Campinas and Belo Horizonte within the scope of the INTERACT-Bio Project.

The following day was dedicated to the workshop and was attended by 37 representatives from secretariats and

entities. The objective was to identify ecosystem services in the region, as well as to point out the pressures suffered by them. Participants started by raising priority ESs in the context of their regions. After listing the most important ESs, an analysis was made as to their origin, current condition (quality / quantity), main beneficiaries, supply and demand trends and factors of change. From this activity, there were four activities that appeared most frequently by the municipalities: soil drainage, pressure under areas of environmental interest, soil erosion and solid waste destination. Then, the participants moved through these four themes to try to answer the following question: "What actions can

be developed within the project (with 2020 as the horizon) for the theme in question?" And as the reflections were shared, the responses were being collectively refined.

Agents involved

The Municipal Secretary of the Environment of Londrina (SEMA) was the first actor in this project, since the decision to apply for RML to INTERACT-Bio came from this body. Regarding that stage, it is important to acknowledge the support of the Paraná State Secretariat for the Environment, which did so officially at the time of the selection process.



Figure 2: Historic downtown (in orange) and the valley bottoms in the urban área os Londrina.

After the municipality was approved, other agents were added to the process. Firstly, ICLEI South America itself, which was (and has been) the main driver of the project and of the processes that are part of it. It should be noted that RML does not have a metropolitan agency and that there is also no working group formed to act on the development of INTERACT-Bio in Londrina. In this context, the performance of ICLEI was essential to connect the parts that would be developed throughout the project.

Together with the City Hall of Londrina, the ICLEI South America and the Cities Biodiversity Center - ICLEI Africa (CBC) organized the conference and workshop that culminated in the map of ecosystem services - and which would later unfold into other complementary products and actions. In this same opportunity, it should be highlighted the UFZ's role in training participants on the concept of systemic services and their relationship with the urban context.

Right at the beginning of INTERACT-Bio, the Secretariat for Urban Development and Public Works (SEDU) also entered as a strategic actor. The agency acts in the formulation of urban development policies in the State of Paraná and provides technical assistance to municipalities and associations of municipalities for the development and improvement of their services and solutions to their common problems. The articulation with the SEDU was important so that ICLEI had the opportunity to contribute in the elaboration of the Term of Reference of hiring the company that would make the Integrated Urban Development Plan (PDUI) of RML, improving the aspects related to sustainability. In addition

to being responsible for the PDUI, SEDU also monitors the North Paraná Metropolis Plan (Plano da Metrópole Paraná Norte).

Innovative aspects

The integration of sustainability values in RML's public policies is an action that should guarantee the assimilation of environmental values within the scope of public management at its various levels. Throughout the INTERACT-Bio Project, ICLEI had the opportunity to contribute to the review of the 2018-2028 Master Plan and to the elaboration of the Term of Reference for the contracting of the company that would prepare the RML PDUI. The purpose is for the environmental agenda to be incorporated in a transversal way in the municipal and regional public policies, so it can really become a posture of the municipality, guaranteeing its permanence, regardless of the successive administrations.

The technical legacy left by the actions and products is perhaps one of the most comprehensive and significant results. The satellite image (Product 2), for example, was the most important cartographic and data support used in the Master Plan review work, which was later adopted in the preparation of the Londrina Mobility Plan. Currently, the image is being used in the preparation of the Municipal Environmental Zoning (ZAM) and in the review of the Complementary Laws of the Master Plan. Later on, it will also contribute to the Drainage Master Plan, which will be developed in the coming years. Although these contributions are not immediately visible, they will have a



Figure 3: Opening of the Conference and Workshop: Biodiversity, Ecosystem Services and Metropolitan Management.

Photo: Rafael Porto / ICLEI South America

major impact on the decisions made in the coming decades.

Local actions guided by global values. Based on the principle of “thinking globally, acting locally”, INTERACT-Bio ends up connecting different scales - local and global - to support the needs of the municipality and, at the same time, move towards goals established by the most important environmental milestones in the world in the 21st century. At the municipal and regional scale, the INTERACT-Bio Project collaborates in the implementation of the Strategic Plan for Biodiversity 2011-2020, mainly pursuing the 1, 2 and 17 goals of the Aichi Biodiversity Targets. It also contributes to achieving the 11, 13, 14 and 15 goals from the Sustainable Development Goals (SDG) and to implement the New Urban Agenda (Habitat III, 2016). These global

commitments made by the Brazilian government and put into action by local governments are fundamental to encourage new policies and to endorse existing initiatives that are in synergy with the global biodiversity conservation agenda.

Challenges and opportunities

Metropolitan level dialogue. The absence of a metropolitan agency is a challenge that RML faces in its institutional arrangement, which makes it more difficult to deal with regional development policies in an integrated, consistent and continuous manner. In this context, the training of managers from different municipalities, the exchange of experiences and the mapping of ecosystem services

provided opportunities for a dialogue at the metropolitan level that provided an integral and, therefore, a real view of the territory. It was a rare opportunity to bring together the challenges and the potentials common to all in the environmental sphere. This approach on a metropolitan scale made it possible to deal with environmental structures, understanding that they are not subordinated to the political-administrative limits of municipalities and that the commitment to the preservation and management of natural resources and ecosystem services must be shared by all.

Georeferenced knowledge and training to manipulate the satellite image. The municipalities of RML are aware of the negative impacts of human activities on their ES's, but the instruments of command and control are scarce. In this sense, the satellite image provided by the Cities Biodiversity Center, through INTERACT-Bio, gave georeferenced knowledge about the use and occupation of land in the territory by municipal managers, although many municipalities do not have the necessary skills to work with tools such as QGIS or any geographic information system. This challenge makes us see an opportunity, which is to promote the technical training of servers in the small municipalities of RML so that they can manipulate the satellite image through the QGIS tool in order to plan and qualify their actions on the territory.

Linear parks as green infrastructures and multifunctional landscapes. Currently, the Londrina Urban Research and Planning Institute (IPPUL) is developing the project Londrina Linear

Parks, to be implemented in valley bottoms located in the urban area. The concepts presented under INTERACT-Bio context enabled managers to envision new ways of solving problems through the green infrastructure. It was possible to think about linear park projects considering the full potential of valley bottoms, understanding them as true multifunctional landscapes that, among many diverse ecosystem services, offer mobility for local fauna and flora, hydrological cycle regulation, temperature and air humidity regulation, natural drainage of rainwater, infrastructure for active mobility, sport, leisure, contemplation and, finally, the promotion of quality of life.

Urban and regional development associated with environmental conservation and its ecosystem services is a challenge for municipal administration, considering that, in Londrina (as well as in Brazilian cities in general), municipal urban policies have for a long time been restricted to topics such as education, health and safety that, in general, have a more immediate impact on reality. However, the opportunity brought by INTERACT-Bio to identify and value ecosystem services, causes this necessary and urgent challenge to make them become a component of regional planning from an integral view of the territory that conforms the RML.



The training of the technical staff carried out by UFZ was the first visible result of the project. It presented concepts that made it possible to see how natural resources relate to the urban and rural environment and, consequently, to the needs of human beings. This perspective is essential to develop plans and actions that, instead of taking a confronting position in the face of nature's challenges (typical of conventional engineering), adopt solutions based on the mechanisms and dynamics of nature itself, becoming aware of the wide range of services offered for her.

The identification and mapping of ecosystem services made it possible, first of all, to see the environmental structures in a more concrete way beyond the political-administrative limits of the municipalities. Then, they brought an unprecedented survey of the ecosystem services offered within the territory of RML, as well as the classification of these services and the pressures. This should be a starting point for the elaboration of public policies and for thinking about actions that seek to mitigate the impacts that put the offer of these ecosystem services at risk.

The sharing of information and concepts brought by the project has the capacity to improve the work that is already being done by organizations that work in the environmental area at a regional scale.

For example, considering INTERACT-Bio's focus on the water potential of the Londrina region, municipal managers presented the project products and the ES's and SbN concepts to the River Basin Committees (CBH) of the Tibagi River (State) and the Paranapanema River (Interstate / Federal). In addition to having access to accurate and updated information on land use, the committees saw the products as a potential tool for the reclassification of water bodies. The information and products of the project were also shared with the Association of Municipalities of the Middle Paranapanema (AMEPAR). Both CBHs and AMEPAR have different cuttings from RML, but they bring together several municipalities in common.

The in-depth and integrated knowledge of the territory itself was a legacy of the process of mapping ecosystem services, as Londrina did not have updated and integrated information on urban and rural land use in its metropolitan region. This knowledge has been deployed in high quality diagnoses that manage to outline plans and actions that affect the territory and reality in a more precise and concrete way. This integrated perspective of the territory implies more successful interventions not only in the environmental aspect, but also in the economic and social aspects.

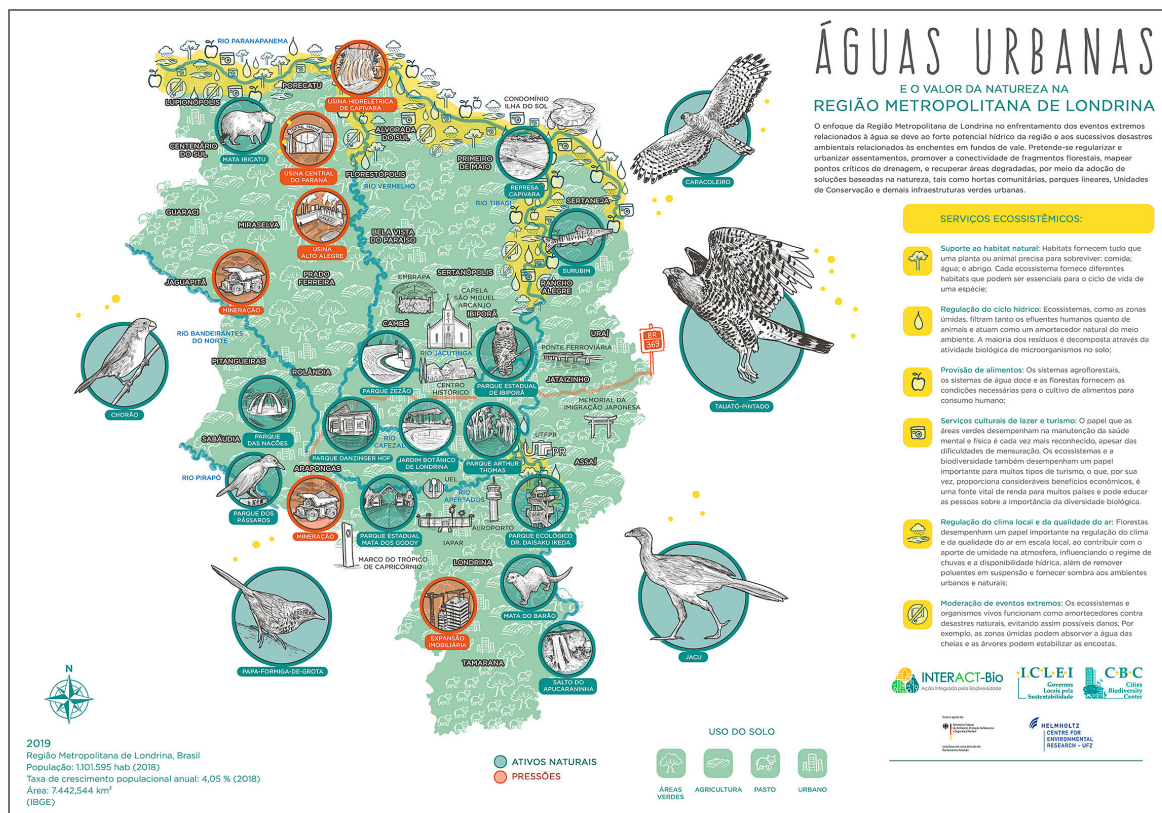


Figure 4: Illustrated Map of the Ecosystem Services provision areas in the metropolitan region of Londrina

The participatory process, the communication of results and the sharing of products were essential for municipal managers to take ownership of this material and incorporate it into their professional practice. The satellite image (Product 2), for example, served as a basis for the elaboration of diagnoses for the review of the Master Plan and its Complementary laws. Then, it was used in the development of the Londrina Mobility Plan and currently the image is being used in the elaboration of the Municipal Environmental Zoning (ZAM).

The friendly format and language of the illustrated map of the ESs allows it to be accessed by a diverse audience in their age group, school level, degree of organization and interests and goals. The publication of this material also makes it possible to know and qualify plans and actions for initiatives that take place outside public bodies. Therefore, the material can serve as an input and tool for both municipal managers and civil society - NGO's, associations, councils, educational institutions, etc. This also makes society, at its most diverse levels, assimilate concepts

from the environmental area (such as the notion of Ecosystem Services) in order to become more prepared to participate and intervene in the public policies of their own municipality.

- **The engagement of municipal employees should be encouraged and prioritized, and it is important that they are the real focal points of the project.** This means that the products, concepts and values mobilized throughout the project are more likely to be incorporated into the culture of the public agencies involved and that this guarantees its continuity even in times of management change. In the long run, the purpose is that sustainable urban planning has its practices consolidated so that it becomes, in fact, a posture incorporated by the municipality, independent of local management.
- **The lack of infrastructure should not be seen as an obstacle to the implementation of the project.** In the case of RML, not all municipalities had access to software or technology for territorial mapping, or were trained to deal with geographic information

systems, such as QGIS. Even so, the work map for the identification of ecosystem services was physically circulated among the municipalities, where the servers were also able to physically intervene - with pen notes, collages, etc. Despite the limitations in infrastructure, the mapping process had adherence among managers and, in the end, generated important products for all cities of RML.

- **The environment and regional planning on a metropolitan scale.** The mapping process promoted debates and became an input to outline intervention strategies on a metropolitan scale, supporting RML to understand the potential of nature, especially in relation to the provision of essential environmental services for the daily lives of cities and, at the same time, to improve the conservation of biodiversity, boosting new or better economic opportunities.



In addition to the engagement of public servants, it is important that mayors and secretaries are made aware of the importance of the projects that will be implemented in the cities, because according to the hierarchical arrangement in each of the institutions involved, they are the ones who will direct the work of these servants, which act at the end of the process. In general, the daily activities of municipal bodies are focused on more immediate results, whereas projects such as INTERACT-Bio work with goals and results in the longer term. In this sense, the engagement of municipal leaders is necessary so that the dedication - of time and human resources - is foreseen in the day to day of the employees, in order to guarantee the effective implementation and continuity of these projects.

It is necessary not to lose sight of the connection that local actions establish with global agendas, such as the Aichi Biodiversity Targets, the Sustainable Development Goals and the New Urban Agenda. In addition

to this connection being essential to establish the purpose of the project, municipalities and regions must, in fact, see themselves as members of a network of local governments, so that they can exchange experiences, share difficulties and thus strengthen their bond and their engagement with the goals and objectives that their country is as a signatory.

We believe that a large part of a project's success lies in its development based on the local reality - which should guarantee its maturity over the years, its consolidation and its perennial character. Therefore, before global connections are established, the project to be implemented in municipalities and regions must be properly connected with the local reality, with its historical context, with its particularities, with the existing actions and, above all, with the challenges facing in the present moment.

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Appendix

Related actions and initiatives

Type of action	Description
Policies / Strategies / Plans	<p>Integrated Development Master Plan Contribution of ICLEI South America in the elaboration of the Term of Reference for contracting a company that will prepare the PDML of RML, indicating the inclusion of ESs as a strategic variable to be considered during metropolitan environmental planning.</p> <p>Londrina Master Plan The mapping and classification of land allowed the collection of data on the territory, the development of diagnostics and the elaboration of environmental and land use and occupation guidelines.</p>
Regulation	<p>Interfederative Environmental Compensation Mechanisms Hiring specialists to prepare recommendations for inter-federative environmental compensation mechanisms, respecting the legislation and particularities of the RML and integrating biodiversity and ecosystem services in territorial planning, land use management, local development and infrastructure projects.</p>
Capacity building	<p>Workshop Training carried out by a UFZ consultant on "Ecosystem Services and Urban Context" and by an analyst at the Brazilian Ministry of the Environment on "Perspectives and Actions for Municipal Environmental Zoning". Actions had a preparatory character for the subsequent identification of the ES's in their mapping process.</p>
Stakeholder engagement	<p>Cities With Nature The city of Londrina has become a signatory to CitiesWithNature, a shared online platform where cities around the world can connect and exchange experiences related to the integration between nature and the city, in favor of a more sustainable urban environment.</p>
Technical and technological measures	<p>Land use map Delivery of ICLEI South America to all municipalities of RML with a georeferenced image of the entire territory containing the classification of urban and rural land use and also the classification of areas with potential for flooding.</p>

Type of action	Description
Awareness-raising	<p>Illustrated map of Ecosystem Services Illustrated map of the RML that identifies and describes ecosystem services classified according to the type of service offered, bringing natural assets and pressures, as well as land use throughout the metropolitan region. The illustrated format of the map allows it to be read and interpreted by different audiences, of different ages, without the need of technical training. The map has unrestricted public access.</p> <p>Events The public servants and managers who are focal points of INTERACT-Bio in Londrina represented the municipality and its RM in discussions of global importance, through participation in several events: 23rd session of the United Nations Climate Conference / COP 23 UN Climate Change Conference (Bonn, Germany, 2017); COP 14 UN Convention on Biological Diversity Conference (Sharm El Sheikh, Egypt, 2018), Seminar and Workshop "Metropolitan Policy: Metropolitan Governance, Instruments and Planning" and Workshop "Environment, Sanitation and Water Resources" (Brasília/DF, Brazil, 2019); BIO2020: Brazilian Perspectives on the Post-2020 Biodiversity Framework (São Paulo, Brazil, 2019).</p>

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Partners



ICLEI – Local Governments for Sustainability is a global network of more than 2500 local and regional governments committed to sustainable urban development. Active in 125+ countries, we influence sustainability policy and drive local action for low emission, nature-based, equitable, resilient and circular development. Our Members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.

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