From regional planning to local projects: designing green infrastructures

Session: **The evolution of the tiering concept: Connecting IA and planning levels**

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Abstract

The promotion of urban resilience as opposed to the negative impacts promoted by the usual urbanization processes has been increasingly stimulated. In this sense, the complementation of the use of grey infrastructures by green infrastructures has been debated and expanded. Green infrastructures can fulfill various functions (environmental, social and economic) being also related to the provision of ecosystem services. One of the main characteristics it must present is connectivity. In Brazil, isolated green infrastructure projects have been developed, lacking the promotion of connectivity. It is understood here that, in this context, the Municipal Master Plan, by establishing guidelines for municipal land uses (urban and rural), has the potential to outline instruments that enable the implementation of green infrastructures. However, for the design of this large network to be effective, it is recognized that the Ecologic-Economic Zoning (EEZ), an environmental policy tool of regional scale, based on environmental and economic potentialities and vulnerabilities of the territory, has great potential to assist in the design of local green infrastructures. In this sense, it is highlighted the potential that tiering brings to the process of integrating the different levels of planning. Thus, the present work seeks, through a bibliographic review, to identify in the guidelines for the elaboration of the EEZ, the criteria and factors capable of supporting the design of green infrastructures and, through tiering, to establish the relationship between regional and municipal planning, leading to the design of a connected network as a green infrastructure must be.

Key-words: Municipal Master Plan; Ecologic-economic Zoning; tiering.

Introduction

The need of the promotion of urban resilience and climate change adaptation to built up areas, as opposed to the negative impacts promoted by the usual urbanization processes, has been increasingly evidenced and stimulated. In this sense, concepts and alternative solutions to daily needs and problems have emerged, reflecting ecosystem-based approaches, such as: nature based solutions (NBS), ecosystem based disaster risk reduction (eco-DRR), ecosystem based adaptation (EBA) and green infrastructure (GI), in a way to provide biodiversity benefits and human well-being (OPPLA, 2021, IUCN, 2021).

All these ecosystem-based approaches deal, at some point, with the provision of ecosystem services of: supporting (nutrient cycling, soil formation, …); provisioning (food, water, wood and fiber, fuel, …); regulating (climate, food, diseases, water purification, …); and cultural services (aesthetic, spiritual, educational, recreational, …) (UNEP, 2005).

Defined by Benedict and McMahon in 2002 as "an interconnected network of green spaces that conserves natural ecosystem values and functions and provides associated benefits to human

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populations", the term GI presents various definitions, including "a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings" (EC, 2013).

From a practical perspective, mainly when we consider the challenge of stablishing an interconnected network including rural and built up areas, GI can be designed combining natural and restored ecosystems, with man-made infrastructure, including green roofs, green walls, constructed wetlands, working in a complementary way to the grey infrastructure. The main difference between green and grey infrastructures is that the first performs multiple functions while the second usually attends one single objective (EC, 2013).

Beyond being an interconnected multifunctional network, according to Benedict and McMahon (2006), GI should also attend some principles, which are:

1. Connectivity is the key
2. Context matters
3. GI should be grounded in sound science and land use planning theory and practice
4. GI can and should function as the framework for conservation and development
5. GI should be planned and protected before development
6. GI is a critical public investment that should be funded up front
7. GI affords benefits to nature and people
8. GI respects the needs and desires of landowners and other stakeholders
9. GI requires making connections to activities within and beyond the community
10. GI requires long-term commitment

In resume, it is understood that GI should be designed in a strategic way, considering different scales, jurisdictions, and topics of planning, being linked to land use guidelines for future developments, but also, to conservation targets. It should offer environmental services in a way that different stakeholders get benefits of it, but also, feel responsible for its implementation, together with public management bodies.

Integrating the design of green infrastructures in strategic plans is already a practice in some countries, most commonly in Europe (GRĂDINARU; HERSPERGER, 2019), where the Habitats and Birds Directives reflect on Natura 2000 Network, which must be considered by the European Union Countries in their policies and plans (ČIVIĆ; JONES-WALTERS, 2014). Starting from Natura 2000, some countries enlarge their protected areas and the connection between them, as it is seen in the Netherlands and its National Ecological Network, a big green infrastructure that the country designed and put a lot of effort to establish and keep.

Considering another context, where urban areas have spread without proper planning and most part of the people live in cities in a similar situation comparing to Brazil, Mexico, in a partnership with the German GIZ (BENÍTEZ, 2018), developed a report presenting green infrastructure as a strategy to mitigate and adapt to climate change, including guidelines in how to implement it in urban public policies.

In Brazil, although there are theoretical proposals (HERZOG; ROSA, 2010; VASCONCELOS, 2015), a recently published guide for GI implementation (IPT, 2020) and some initiatives of isolated projects of landscape designers or specific drainage systems solutions using GI, it is not yet usual to design GI as an integrated network or even integrate GI in strategic planning or in public policies.

Objectives and methods

This paper discusses the opportunity of integrating GI promotion and design as part of the Municipal Master Plan, linking urban and rural areas, based on factors and criteria utilized by Ecologic-economic zoning, through a tiering process. It is worth to highlight that Brazil does not present formal regulation for applying Strategic Environmental Assessment to policies, plans and programs.

This paper was based on literature review in papers, institutional publications and pieces of legislation, searching for factors and criteria used in the process of preparing EEZ, able to be translated to MMP and then in the design of GI, ensuring that its principles are attended.

Municipal Master Plan (MMP)

In the Brazilian context, the Municipal Master Plan is the basic and most important instrument containing land use guidelines and restrictions for new developments, including urban and rural areas. It is also able to define other instruments (financial or not) to put these guidelines in practice.

The 1988 Federal Constitution set that every municipality with more than 20.000 inhabitants must have a Master Plan prepared and, in 2001, the Urban Policy included a few other characteristics in this category and established that public participation would be fundamental in the plan preparation process.

Historically speaking, Master Plans are built under an urban perspective, giving more attention to urban areas and problems, and leaving the rural aside, even if new approaches, including the environmental perspective, have been discussed and a few practices already found (SANTOS; RANIERI, 2019). This is another challenge and opportunity if we consider the design of GI crossing these two areas including all the social and natural benefits, already in the municipal plan.

Ecologic-economic zoning (EEZ)

Included among other twelve instruments by the Brazilian Environmental Policy in 1981, and regulated in 2002 by Decree n. 4.297, EEZ is an instrument of spatial planning to be followed by plans and projects. The goal of EEZ is to organize and guide decisions on activities that make use of natural resources, ensuring the maintenance of the natural capital and the environmental services of the ecosystems. To do so, EEZ shall consider the ecological relevance, the limitations, and the weaknesses of the ecosystems, setting restrictions and opportunities for better strategies of economic developments and natural resources protection.

With focus on ensuring social, ecologic and economic sustainability for new activities and developments, EEZ shall be prepared considering public participation in different levels of public management and also, be based on multidisciplinary scientific knowledge.

Something to highlight regarding EEZ is the fact that it is prepared covering different areas (i.e. municipalities, regions or the states) and using different scales, considering the regional characteristics and specificities of social, economic and natural aspects, establishing guidelines in accordance with the context, including the institutional structure.

According to the methodological guidelines for EEZ, written by the Environmental Ministry (BRASIL, 2006), in relation to technical aspects, EEZ is supposed to be prepared using the systemic approach, to find solutions to complex problems integrating social, economic and

environmental variables, preferably using some Geographic Information System (GIS). The idea of using GIS is to organize and combine all the raised information using algorithms for creating different scenarios and maps.

The diagnosis shall involve the raise of specific information related to the goals of the EEZ, but there is a basic pattern to be followed (BRASIL, 2006).

Regarding the physical-biotic environment, some basic attributes must be considered, such as: soil, climate, slope, lithology, hydrography, and vegetation.

In relation to the socioeconomic dynamics, it shall be considered information on economic activities and development, social aspects, population, presence of traditional communities and cultures, land uses for different ends (urbanization, crops, industries, livestock).

EEZ must also consider other policies and regulations, including water resources management plans and conservation guidelines and rules, for instance: conservation units and corridors (protected areas defined by the National System of Conservation Units), Legal Reserve (a type of protected area defined by the Forest Code placed in rural properties), Permanent Preservation Areas (another type of protected area related to water bodies, steep slopes, and other specific natural conditions).

By the end, the EEZ results in maps based on the crossing analysis of all these factors using stablished criteria and defines guidelines for future land uses and economic developments, including the systemic view of the territory, which brings a more robust perspective for designing developments connected to conservation and ensuring the provision of ecosystem services.

Tiering

As it is seen in Europe, for instance, that GI is designed and implemented in various levels (supra-national, national, regional, municipal and local) (ČIVIĆ; JONES-WALTERS, 2014), it is suggested and expected that the same idea could guide the design of green infrastructures in Brazil, at least, from regional to municipal levels.

Although there is EEZ as a potential robust environmental plan that should give guidelines to the Municipal Master Plans, taking them out of the strict urban perspective to a more environmentally open view, there is absence of integration and SEA is not a practice in these strategic levels in Brazil.

Going further, looking at the opportunity of implementing GI in smaller pieces of a bigger plan, which means, if this interconnected network were designed considering the multiple information and criteria that EEZ already uses and organizes, linked to the land use guidelines established by the Municipal Master Plans, the planning system would be better arranged and the learning process and advantages of applying Impact Assessment for future developments would be more effective.

Discussion and final considerations

Considering the principles highlighted by Benedict and McMahon (2006) for an efficient and multifunctional GI, and the opportunity of using the EEZ guidelines, attending the criteria and factors as defined by Brasil (2006), integrated in the MMP preparation, it is possible to confirm that: connectivity would be provided; the context and regional specificities would be considered; scientific and land use planning practices would be applied; development and

conservation would be promoted; benefits for people and nature would be provided, specially when it comes to the protection of natural resources; people would be involved in the process of planning GI; plans could define goals with specific deadlines. These would directly reflect on the GI projects implementation.

Besides this, the promotion of tiering would allow the integration of the regional and systemic view of the territory, based on characteristics, specificities, weaknesses, and potentialities considered by EEZ in the MMP development.

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References

BENEDICT, M. A.; McMAHON, E. T. (2002). Green infrastructure: smart conservation for the 21st century. Renewable Resources Journal, V. 20, n.3, Autumn 2002, pp.12-17.

BENEDICT, M. A.; McMAHON, E. T. (2006). Green Infrastructure: Linking Landscapes and Communities. Washington, DC : Island Press.

BENÍTEZ, D. E. Q. (2018). Implementación de Infraestructura Verde como estrategia para la mitigación y adaptación al cambio climático em ciudades mexicanas, hoja de ruta. Ciudad de México: SEDATU / SEMARNAT / GIZ.

BRASIL. MINISTÉRIO DO MEIO AMBIENTE. (2006). Programa Zoneamento Ecológico-Econômico: diretrizes metodológicas para o Zoneamento Ecológico-Econômico. Brasília: MMS/SDS.

ČIVIĆ, K.; JONES-WALTERS, L. M. (2014). Implementing Green Infrastructure and Ecological Networks in Europe: Lessons Learned and Future Perspectives. Journal of Green Engineering, V. 4, Issue 4, pp. 307-324. https://doi.org/10.13052/jge1904-4720.444

EC. EUROPEAN COMISSION. (2013). Building a green infrastructure for Europe. Belgium: European Union.

GRĂDINARU, S. R.; HERSPERGER, A. M. (2019). Green infrastructure in strategic spatial plans: Evidence from European urban regions. Urban Forestry & Urban Greening, 40, pp. 17-28. https://doi.org/10.1016/j.ufug.2018.04.018

HERZOG, C. P.; ROSA, L. Z. (2010). Infraestrutura Verde: Sustentabilidade e resiliência para paisagem urbana. Revista LABVERDE, São Paulo, n. 1, p 92-115, sep. 2010.

IPT. INSTITUTO DE PESQUISAS TECNOLÓGICAS DO ESTADO DE SÃO PAULO. 2020. Guia metodológico para implantação de infraestrutura verde (livro eletrônico). Org. Maria Lucia Solera. São Paulo: Fundação de Apoio ao Instituto de Pesquisas Tecnológicas – FIPT.

IUCN. INTERNATIONAL UNION FOR CONSERVATION OF NATURE. (2021). Available at: https://www.iucn.org/theme/nature-based-solutions/about Visit in: May 2021.

OPPLA (2021). Available at: <https://oppla.eu/case-studies/existing-ecosystem-based-initiatives-eu-level> Visit in: May 2021.

SANTOS, M. R. R.; RANIERI, V. E. L. (2019). Rural areas in planning: proposal of a basic framework to prepare Municipal Master Plans. Revista Rural & Urbano. Recife, V. 04, n. 01, pp. 15-37.

UNEP. UNITED NATIONS ENVIRONMENTAL PROGRAMMEE. (2005). Living beyond our means: natural assets and human well-being (English). Washington, D.C.: World Bank Group.

VASCONCELLOS, A. (2015). Infraestrutura Verde: Aplicada ao Planejamento da Ocupação Urbana. 20 ed. Curitiba.