ALTERNATIVES FOR DEVELOPMENT IN GREEN INFRASTRUCTURE PROJECTS

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Abstract

Green Infrastructure is a proven contribution instrument supporting the sustainable development of society. The approaches they apply help preserve biodiversity, adapt and mitigate the effects of climate change, preserve and provide so valuable ecosystem services. The benefits that society derives from the application of the Green Infrastructure concept are grouped on economic, social and environmental reasons due to its specific feature - multifunctionality. The alternatives for developing such types of objects are a suitable approach to meet the objectives and needs of a wider range of stakeholders and hence a wider range of benefits.

Keywords: *green infrastructure, projects, alternatives, development*

1. INTRODUCTION

The concept of building green infrastructure originated in the early 1990s in the United States to continue after its development in Europe. By formulating the concept and its content, this concept is enshrined in a number of documents of the European legislation and respectively of the legislations of the EU member states. Environmentally friendly or green infrastructure are two concepts used as synonymous with different strategic documents. Absolute and undeniable is the link between landscape planning in the construction of green infrastructure, which in turn requires the involvement of the landscape architect in setting up and managing environmentally friendly infrastructure. A challenge for the present study is to analyze all possible alternatives for building sites in green infrastructure directly related to landscape planning activities and the opportunities for investing in similar sites.

2. EXPOSITION

In order to formulate opportunities for investing in green infrastructure projects related to landscape planning, construction, maintenance and management, it is important to investigate which of the potential components of green infrastructure are the subject and work of the landscape architect. Given the specific subject of landscape related work, we are focusing our research on the spatial aspects of green infrastructure.

In a published edition of the European Commission (EK, 2010) the potential components of green infrastructure are:

- protected areas such as Natura 2000 sites;
- healthy ecosystems and high nature value areas that are outside protected areas such as floodplains, wetlands, coastal areas, natural forests, etc.;
- elements of the natural landscape such as small watercourses, groves, hedges, which can serve as ecological corridors or wildlife stories;
- restored parts of habitats that are associated with certain species;
- artificial elements such as ecopoints or ecopoints, the function of which is to facilitate the safe movement of species in areas where the areas are fragmented;
- multifunctional zones where several functions are combined in one territory. For example, land use, which combines maintaining or restoring healthy ecosystems with other activities such as recreation.

- areas where measures have been implemented to improve overall ecological quality and landscape permeability;
- urban elements such as green parks, green walls and green roofs that preserve and enhance biodiversity, support the functioning of ecosystems and link urban and outlying areas;
- adapting to climate change and reducing its impact? Conservation or restoration of existing marshes, forests in floodplains and bogs that naturally protect against flooding, retain and slowly take water into the river bed or absorb the harmful emissions, etc., thus allows species to adapt to change in the environment (EK, 2010).

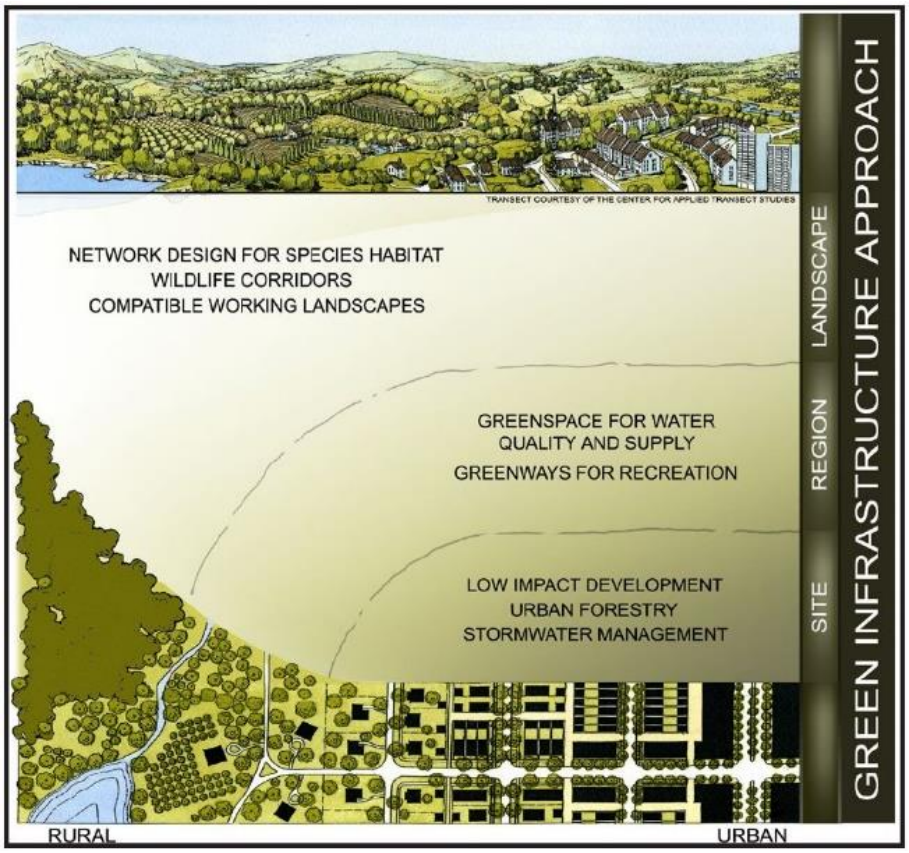


Figure 1. The scales of GI planning. Source: Allen (2014)

The Green Infrastructure concept is perceived as a different approach to landscape planning as it takes into account environmental and social values for the needs of different types of land use in the planning process (Aegisdyttir et al. 2009). Different types of landscape elements are a valuable tool of territorial planning (Collinge 1996, Mata et al., 2005), providing optimal conditions and relationship between habitat (Kindlmann & Burel 2008). In this context, different policies, strategies and plans are developed at local, regional and transnational levels, each of which should be linked to the next level. A document published by EEA (2011) identifies three spatial groups: 1) local, neighborhood and rural; 2) urban, urban and district dimensions; 3) Urban area, region and national scale.
The sustainable and healthy living environment is one of the main priorities in this concept. Considered as a critical part of the urban and peri-urban environment, green infrastructure enables conceptual planning of green spaces. Improving public awareness, bringing together the interests of different stakeholders and integrating them into space-making is one of the main tasks in the urban and regional environmental planning process. Achieves goals related to (Davies, 2015):

- Valuation of existing green areas and prevention of deterioration of their condition;

- Improving the quality and diversity of territories to meet local needs;
- Linking the different types of green spaces as part of a whole;
- Strategic management of all green areas, regardless of their ownership.

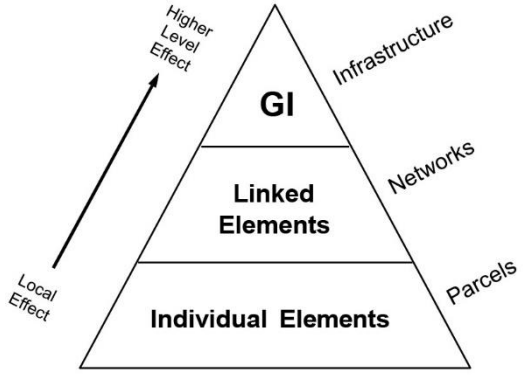


Figure 2. Parcels, Networks & Infrastructure (Davies, 2015)

Spatial planning is the most effective approach to building green infrastructure projects. This approach, on the one hand, provides opportunities for planning such sites on a local level, on the other hand planning a complex and guiding infrastructure for the development of the region, and third-party development of multifunctional zones to preserve and maintain ecosystems (Davies, 2015). And as an overall positive effect, to promote sustainable development at regional and local level, creating a balance between economic, environmental and social benefits [fig.2].

Green infrastructure plans are prepared in a variety of forms that can nevertheless be linked to each other. This is done through the use of available data, GIS systems, the digital framework of each country and, of course, the right approach to planning, implementation and monitoring. Different guides have been developed to help this process. Based on the best practices of the implemented projects, guidelines are given for the development of (Davies, 2015):

- Spatial Green Infrastructure Plans in City Regions;
- Strategic GI guidelines that steer decision making in the development control process;
- Supplementary planning documents;
- Policies embedded within Local Development Frameworks and Local Area Agreements;
- Statutory and non-statutory plans produced by organisations including Natural England, Forestry;
- Commission and Environment Agency;
- Proposals included within local Area Based Initiatives;
- Proposals included within regional strategic documents.

The main spatial parameters of building investment sites subject to landscape planning are in components such as healthy ecosystems and high nature value areas, natural landscape elements that can serve as ecological or wildlife stories, multifunctional zones where they combine several functions in one territory, areas where measures have been implemented to improve the overall ecological quality and landscape permeability and urban elements such as green parks, green walls and green roofs that support the functioning of ecosystems and connect the city with urban areas.

Landscape planning must be tailored to the desired ecosystem services, which in turn will lead to economic, social and environmental benefits. A widely accepted resource model for landscape planning

is the model of abiotic, biotic and cultural resources (Ndubisi, 2002; Ahern, 1995) [Table 1]. This model takes into account the landscape ecology that takes into account the negative influence of human activity on biotic and abiotic systems and processes. On the other hand, this resource model can be used to determine the basic environmental functions that green infrastructure performs in urban and extra urban environments. In this way, the various alternatives for building such objects can be defined.

Abiotic	**Biotic**	**Cultural**
Surface: groundwater interactions	Habitat for generalist species	Direct experience of natural ecosystems
Soil development process	Habitat for specialist species	Physical recreation
Maintenance of hydrological regime(s)	Species movement routes and corridors	Experience and interpretation of cultural history
Accommodation of disturbance regime(s)	Maintenance of disturbance and successional regimes	Provide a sense of solitude and inspiration
Buffering of nutrient cycling	Biomass production	Opportunities for healthy social interactions
Sequestration of carbon and (greenhouse gasses)	Provision of genetic reserves	Stimulus of artistic/abstract expression(s)
Modification and buffering of climatic extremes	Support of flora: fauna interactions	Environmental education

Table 1. Key abiotic, biotic and cultural functions of a green urban infrastructure

This figure articulates what a green urban infrastructure can explicitly do to contribute to sustainability. (PDF) Green infrastructure for cities: The spatial dimension. Available from: <https://www.researchgate.net/publication/237220404_Green_infrastructure_for_cities_The_spatial_dimension> [accessed Jun 23 2018].

Proper understanding of the functional interplay between the different types of green spaces is necessary for the proper construction of the surrounding environment. Diversity is quite large and uniting them, ensuring their smooth interaction enables the creation of an environment that improves quality of life, environmental health and habitat rich diversity. Different green spaces have a wide range of features that depend on their location and scale. Viewed in a local context, biodiversity-rich parks, gardens, hedges, green roofs, lakes, streams, meadows, restored territories provide many valuable ecosystem services that mobilize society to invest more in conservation and conservation. It is the same at regional, national and European level.

According to Green Surge (Hansen, 2017), the green spaces are divided into 44 elements, divided into 8 groups. Accordingly, the groups are natural, semi-natural and wild territories, river beds, water areas of various types such as lakes, rivers, streams and springs, urban areas for agricultural activities of the population, spaces for private, public, industrial and institutional landscaping as a natural connection with gray infrastructure, vertical and roof landscaping, parks of different uses and arable land.



Figure 3. Regional green ingrastructure

In order to correctly identify alternatives for greenfield development, it is more appropriate to focus the approach on identifying the different types of components, features, functions and services that result in a wide range of "green infrastructure" initiatives. Designation of project types can be grouped according to their main purpose, scale and types of components and activities they include. In a report to the European Commission from the Institute of Ecology and GHK Consulting, they publish their own typology of project types, depending on the initiatives. This approach proves to be successful as it allows the support of a number of objectives that can interact and complement each other.

The parameters used within this typology that are the subject of the landscape architect's work are (Naumann et all, 2011):

- Objectives

- Human health/quality of life/well-being - e.g. establishing recreational areas, installing green roofs to improve local climate and air quality, creating jobs and promoting rural and regional development
- Sustainable management - Taking actions specifically aiming to improve the ecological quality and permeability of landscapes, therein addressing multiple ecosystem services and functions and adopting a long-term perspective.

- Actions/ measures involved

- Identification/ mapping/ spatial planning - Assess existing green infrastructure features/ elements and its functionality in order to identify how it needs to be improved (e.g. where restoration or development is needed) and where there is a need to enhance connectivity
- Legal designation of green infrastructure areas/features - e.g. protection under the Natura 2000 network, national parks, nature reserves, etc.
- Maintenance/protection - Maintaining protected areas, corridors and stepping stones; taking actions specifically aiming to benefit a particular habitat or species (e.g. conservation of a breeding ground area for migrating birds)
- Restoration - Improving the health of or converting an area/ecosystem back to its natural state (e.g. bog and mire, wetland, fish stock, forest, peat bogs)

- Creating new green infrastructure components - Creation of connectivity features, green roofs, new green (urban) areas (e.g. parks), sustainable use areas, habitats (national forest area, etc.)
- Research/analysis - Aiming to increase the knowledge of a certain species, or of specific habitat/ecosystem functions or features; testing/ developing appropriate management practices (e.g. impact of cover crops on soil erosion)
- Increasing public awareness - Public awareness campaign, production of guidance documents, involvement of local stakeholders and populations.

➢ Green infrastructure elements

- Sustainable use areas - Areas for improved ecological quality and permeability of landscape; sustainable economic land uses and related restrictions (e.g. relevant to tourism activities) that help maintain or restore healthy ecosystems (e.g. IUCN categories V and VI, biosphere reserves)
- Green urban features - e.g. parks, gardens, grassy verges, green walls, green roofs
- Artificial connectivity features - Features designed specifically to assist species movement (e.g. green bridges, eco-ducts, wildlife passages, etc.), which can result from compensation measures to recreate a physical connection which has been lost or compromised as a result of grey infrastructure construction (e.g. a motorway)
- Multifunctional zones - Balance between various uses such as access, recreation and biodiversity; promote enhanced public access to the landscape particularly adjacent to existing and planned settlements (Cambridgeshire Horizons)

➢ Sectors affected - built environment, health, tourism, transport, urban & regional planning, water, cross-sectoral, nature protection

➢ Setting - Rural, urban, peri-urban, combined (containing elements of both rural and urban landscapes)

➢ Geographic scale - Local/regional, national, transnational (Transnational and EU focused projects may also involve non-EU countries), EU.

The European Union has a database that provides information on implemented green infrastructure projects. By 2011, their number has reached 127, with approximately 70% at the local and regional level. Other projects, again expressed in percentage terms, account for 20% at national level and 10% as cross-border cooperation. It is a positive fact that each country has at least one implemented project. Statistics from the point of view of their location in urban, suburban or rural areas show that rural and suburban territories are the predominant initiatives that have nevertheless embraced elements of the urban environment (Losarcos, L.).

Other analyzes were made, depending on the scope of the objectives, the sectors, the elements and the activities in the projects. For the purposes of this study, those of them, which are the object and subject of the work of the landscape architect, will be presented. In terms of objectives, projects related to the healthcare sector and sustainable land management account for 53% and 39%, respectively. The second and third places are ranked according to their importance / priority. With regard to the frequency of addressing of the elements, sustainable land use is set in 47% of the projects implemented, green urban areas - 28%, multifunctional zones - 28% and artificial connectivity features - 12%. The third analysis shows the degree of impact of different sectors - urban & regional planning 30%, built environment - 19%, tourism - 16%, health - 5%. Within this statistical sample of the database, it becomes clear that the role of the landscape architect occupies an important place in the planning and development of green infrastructure. Building a well-functioning network of green spaces is unthinkable without applying the landscape approach. It is for this reason that most of the implemented projects set a number of different sector-specific objectives (Naumann, 2011).

Examples of the development of green infrastructure related to landscape planning, construction, maintenance and management are most varied. Exploring ecological systems as a planning principle is

an example given by Portugal (Losarcos, L.). The country imposes legal regimes in favor of spatial planning tools to implement the concept of an ecological network at all levels of government. Is the aim to identify areas sensitive to human intervention, rural and urban areas, uniting them with another planning tool National Reserve Ecological Reserve (Reserva Ecologica Nacional). Although it is managed locally, this concept has an impact on the Lisbon Regional Plan of Territorial Planning in the Metropolitan Area of Lisbon. The result is the establishment of the Metropolitan Ecological Network (REM), which harmonizes the relationship between green spaces, corridors between them and the urban environment. This network aims at preserving the ecological link between the territories, ensuring a healthy urban environment that preserves nature and its elements (Losarcos, L.).

Madrid, Spain, also gives an example of a landscape approach to planning and developing green infrastructure. They create a network of environmental corridors that provide society with a healthy environment and preserved nature. Among the main goals is the unification of urban and suburban parks, forming a green ring to provide a number of ecosystem services and improve their sustainability (Losarcos, L.).

Providing green infrastructure through multifunctional forest and farmland management presents different approaches to each country implementing a project with such a focus. An example is Austria's National Policy Initiative, which is geared to the protection of natural disasters for certain types of landscapes within the country. Finland develops ecological landscape conservation plans that cover a much wider area of activity. On the one hand combat desertification, on the other restoration of habitats and their structural connectivity, and the Pumlumon project in Wales aims to improve forest habitats, peatlands and development of the tourism sector (Mazza et al., 2011).

Conservation and restoration of coastal ecosystems is another example of balanced management of valuable areas. The Latvian project to restore and manage coastal habitats shows an approach that provides cultural and recreational services that successfully overcome habitats degradation caused by increased tourist flow. The initiative is supported by the EU through the LIFE program. Mapping of the affected areas has been done; appropriate site management has been prepared with a wide range of stakeholders involved (Mazza et al., 2011).

The development of green infrastructure within an urban environment helps to adapt and mitigate the effects of climate change. It also contributes to improving the health and quality of life of the population as well as protecting biodiversity. Green spaces in the urban environment reduce the temperature amplitudes, which improves the thermal comfort; take large amounts of rainwater, reducing the risk of flooding; reduce air pollution levels and increase the amount of oxygen; and have a beneficial effect on the psycho-physical condition of the people, and hence the disease is reduced. (Ong, 2002).

As a good example of a greenfield infrastructure in an urban environment, Basel City can be given, which invests in building green roofs as a measure of energy saving. The source of funding for this campaign is the electricity tax (5% of all consumer energy bills) and the energy saving fund, which funds various energy saving campaigns and measures. The first campaign was in the 1990s, and in 2005-2006 has been re-launched by focusing on adapting to climate change.

3. CONCLUSIONS

Spatial development at all levels (local, regional, national, and international) is important for clarifying all intents and measures to achieve the goals set. A balanced development between progress and nature is necessary to recognize and realize the importance of the natural elements of the landscape. Successful planning and conservation require the intervention of responsible professionals because the creation, management and development of green infrastructure is unthinkable without landscape planning.

Promoting investment to build, develop and manage green infrastructure sites will contribute to the economic and social development of the community. There are many alternatives to develop objects of this type and give them a variety of options to be implemented. Formulating specific investment opportunities and, accordingly, their returns will contribute to the development of a competitive local economy, sustainable employment, lasting growth and stable incomes.

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