GREEN INFRASTRUCTURE DEVELOPMENT PLANNING SYSTEM AS A TOOL FOR PROMOTING SUSTAINABLE DEVELOPMENT

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ABSTRACT

Modern approaches to urban planning assume the dualistic nature of urban green infrastructure. On the other hand, green infrastructure (GI) is as an integrated network of natural and semi-natural areas, featuring a delivery of various benefits to humans' .Green infrastructure programs and strategies are regarded as planning opportunities to promote sustainable and resilient urban development. However, the discourse about green infrastructure policy and its effectiveness has pointed to the limited success in practical implementation. Since the green infrastructure has no planning status in its own right, it depends on being embedded in comprehensive urban and regional planning approaches if it is to have an impact on sustainable and resilient urban development. At the same time spatial planning may contribute in providing a platform for its institutionalization. The need for this paper was as a result of poor urban infrastructural development. The paper first looks at the contents of urban resilience. The paper also discussed the principles for planning resilient cities. The ways green infrastructure initiatives can foster the principles contributing to building urban and regional resilience were emphasized. There are challenges facing the institutionalization of green infrastructure initiatives. In conclusion, there should be future role of spatial planning in the process of institutionalizing green infrastructure strategies.

KEYWORDS: ***Planning system, Urban Development, Green infrastructure Master plan amendment GIS, Sustainable Development.***

1.0 INTRODUCTION

Cities are an important habitat for an array of physical, economic, social, political and cultural capital. Given this importance, it is significant to think carefully about the nature, operation and form of cities particularly in respect to the challenging issue of sustainability. Cities however, today stand in the face of grave danger in the form of uncurbed urbanization and climate change. As a result of this phenomenon, they are facing problems like biodiversity and natural habitat loss, air pollution exceeding safe limits, and urban flooding.

Climate change is inextricably linked to the process of urbanization where traditional problems like rapid population growth, increasing demand for housing space, need for support infrastructure (especially transport and sanitation)are exacerbated by the demand to accommodate the impacts of climate

change in the planning process (Clark, 2009). Responding to these challenges such as unprecedented urban growth lies in innovative development of green infrastructure, which not only ensures resilience, but also includes environmental and well-being benefits. However it is equally significant to manage the development of green infrastructure in order to deliver effective and efficient transition to sustainable urban form that further enhances urban resilience to multiple social, economic and environmental stressors.

Urbanization of megacities meets a lot of different environmental, economic and social problems and risks (Kötter et al. 2009). As a remedy to some of these negative consequences of urbanization, the installation of green infrastructure as opposed to grey infrastructure is identified as an alternative nature-based and cost-effective solution for improving the sustainability of the urban development (Ahern 2013; Alberti 2008).

According to a report by Forest Research (2010), Green Infrastructure (GI) can mitigate risks from climate change by protecting urban regions against floods and other negative effects of changing weather patterns (Krause et al., 2011). In addition to the environmental benefits, there are also potential well-being benefits of GI like increased life expectancy, better mental and sychological health (Nordh et al., 2009).

Green infrastructure is defined generally by the scientist and planners as the physical green environment within and between our cities, towns and villages. It is a network of multi-functional open spaces, including formal parks, gardens, woodlands, green corridors, waterways, street trees and open countryside. It comprises all environmental resources, and thus a green infrastructure approach also contributes towards sustainable resources management and highlights the importance of the natural environment in decisions about land use planning.

From a planning perspective the GI approach makes use of the natural environment in a way that it maximizes its functions and seeks to put in place, either through regulatory or planning policy, mechanisms that ensure protection of natural environment, and proposes how these can be put in place through landscaped and/or engineered activities (Benedict and McMahon, 2006). However the planning approach differs from region to region. The concept of GI in European countries refers to the new or existing interlinked networks or corridors of green routes and hubs of biodiversity (Murphy, 2009), which is recognised as a valuable approach for spatial planning and is now seen in national, regional and local planning and policy documents and strategies (Lafortezza et al., 2013).

In recent years, “green infrastructure planning” (Benedict and McMahon, 2006; Kambites and Owen, 2006; Mell, 2009; Hansen and Pauleit, 2014) has been recognized as a tool for safeguarding sustainable development on the basis of a holistic understanding of combining ecological, social and economic benefits. The literature dealing with green infrastructure planning – as opposed to that on the green infrastructure as such – is not extensive. We highlight the contribution by Ahern (2007), who classifies green infrastructure as an “opportunistic” planning strategy.

2.0 LITERATURE REVIEW

2.1 Importance of Urban Green Spaces

Urban green spaces with trees as the major component play role in every aspect of sustainability issue: (social, economic and environmental) (konijnendijk et al., 2005). Urban green space has a range of values to urban society. Social include the positive impact on people's physical and mental health (providing settings for physical exercise, reducing ultraviolet radiation and air pollution, lowering stress levels). The connection between public health and the provision of free, accessible, open green space – particularly in towns and cities – is obvious to most people (Ward and Traylor, 2007). Besides, by being actively involved in tree planting and management local communities can be strengthened and crime rates can be reduced. Greening improves the urban image and quality of life. Economic values of urban green include the urban agriculture production and positive impact on real estate prices and business development (attractive environments for business to settle in and people to live in).

Environmental values of urban green are: water management, protection of soils, moderating harsh urban climate (cooling the air, reducing wind speeds, giving shade), intercepting particles and gaseous pollutants (reducing air pollution), contributing to the cost-effective sustainable urban drainage systems, preserving and enhancing the ecological diversity of the environment of urban places, increasing biodiversity through the conservation and enhancement of the distinctive range of urban habitats (Konijnenedijk et al., 2005).

Green infrastructure is today one of the most important terms when we think about planning the contemporary city. It is an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations (Benedict and Mcmahon, 2002). It contributes to a very high level of achieving the sustainable urban form (Rafeq, 2006) and supports the natural life system (Benedict and Mcmahon, 2002). The term 'green infrastructure' relates itself to the meaning of the term 'built infrastructure', this is critical to the continuance and growth of the community as the essential part of the city (Benedict and Mcmahon, 2002).

2.2 Green space management as a planning tool for sustainable development

System of the Green and Open Spaces is defined as a part of the functional structure of the city. It includes: river valleys with surrounding green areas, large urban forestry areas, Botanical Garden and Zoological Garden, areas protected because of delivering water and sewage drainage, parks, squares, sport, recreational areas, cemeteries, airport, military areas, agriculture areas (City of Wroclaw, 2010].

The city plans to gradually transform the areas of private allotment gardens into the public open spaces. This process will decrease the today's distance between green areas (>2 ha) and settlements, which is very often more than 500 m. The reason for that transformation is the current location of allotment gardens - close by the heavy traffic roads, industry areas or historical sites. The same process of replacement regards the agriculture areas in the city - 12 900 ha is covered by arable lands, meadows, orchards – gradually being transformed to sport, recreation or park areas.

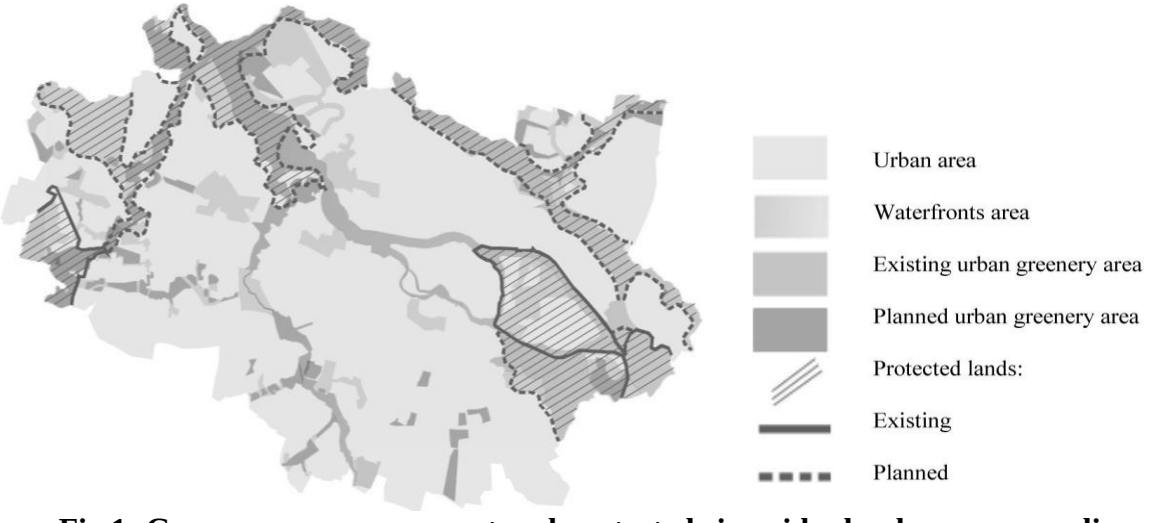

Fig.1: Green space management and protected riversides landscapes according to the Urban Master plan, 2010.

2.3 Principles for planning resilient city regions

Biggs, Schlüter and Schoon (2015) have identified seven principles for fostering resilience. On this basis, we will discuss in the following how spatial planning can enhance the resilience of the city region. The planning principles to enhance the urban resilience are:

Promote diversity: Promoting and sustaining diversity in all forms, e.g. related to biological, land use, social and economic issues, and encouraging multiple resources to balance current homogenising trends, is essential for building resilience (Walker and Salt, 2006). Diversity also means to embrace a range of management strategies (scenarios) to face uncertainties.

Manage connectivity: Spatial connectivity is important to understand the relationship between inhabitants, species and their surrounding landscapes (Auffret et al., 2015). Spatial biotic (organisms) and abiotic (water, electricity) connectivity have both structural and functional dimensions in urban systems. Structural connectivity describes the physical relationship or distance between areas (i.e. neighbourhoods, squares, landscapes, and patches of ecological habitat) while functional connectivity is the degree to which these areas facilitate or impede the movement of organisms and processes of ecosystems. Structural connectivity is often used as a proxy for functional connectivity, although the movements of people and species are not necessarily correlated with the physical connections among areas. Connectivity can have positive or adverse effects on building resilience. For instance, local failures in highly connected systems might lead to a systemic collapse (e.g. disease spread, water quality).

Manage control variables: Control variables are those that govern the role and impacts of inhabitants within the city region, and can be planned or modified to achieve certain objectives, like building resilience. Thus, land use zoning, strategic master plans, norms and legal systems are control variables that can influence the preparation for and reaction to uncertainties (Herrfahrdt-Pähle and Pahl-Wostl, 2012). With regard to choosing the level of control of the variable (e.g. incentives, penalties and compensation measures), each strategy will produce different patterns of spatial interaction.

Foster urban complex system thinking: The city region is a complex system of interrelated stakeholders where multiple interactions occur at the same time on different spatial levels. System thinking helps to anticipate rather than react to events, and better prepare for emerging disruptions. In practice, system thinking means to build and obtain knowledge, to accept and prepare for uncertainties and change (Table 1), and to recognize diverse development perspectives or trajectories (e.g. transformation, adaptation).

Encourage learning practices and knowledge-building: Because city regions are in constant change, it is necessary regularly to revise existing knowledge about disruptions and management strategies to enable adaptation to change and to prepare for transformation. Building up knowledge involves learning from other experiences, adding to codified knowledge and proposing future actions (Miranda and Bau, 2014). Sharing learning approaches helps to establish or strengthen networking among different stakeholders at different spatial scales. However, this may face considerable challenges – political, institutional, environmental – in which the nature and value of building urban resilience is contested (Orleans Reed et al., 2013).

Encourage participation and partnership: Incorporating all stakeholders in decision making improves legitimacy, expands the depth and diversity of knowledge and helps to detect and interpret change and disruptions. Resilience grows as the network of stakeholders strengthens linkages in the system. These linkages promote dialogue and collaboration to address emerging problems or crises.

Deal with multi-level governance: Multi-level governance refers to an organisational structure where multiple, independent actors mutually order their relationships under general systems of rules (Araral and Hartley, 2013). Institutions and organisations have to be connected through a set of strategies, plans and norms that interact across hierarchies and spatial levels. Formal and informal planning instruments can overlap in objectives, providing a diversity of responses of differing strength. Additionally, urban regions often comprise a multiple administrative subdivision which might complicate the management of ecological, social and economic dynamics in terms of avoiding mismatches (Puckett et al., 2001 in Bergsten et al., 2014). Not infrequently, management organisations do not match with the spatial scales they deal with (Garmenstani and Harm Benson, 2013).

Urban green infrastructure (UGI) is progressively claimed as an essential structural part of cities (Lafortezza et al., 2013) playing a key role in the sustainable development (SD) of planet Earth, because most of the human population is now living in urban zones. The UGI of a city is made up of different types of systems more or less connected

with each other. The essential components of UGI are natural elements (plants, animals, water, soil and micro-organisms etc.) structured in a variety of forms (e.g., urban squares, street tree lines, parks and horticultural gardens). These are the same components structuring natural ecosystems and making them perform ecological functions, and thus provide ecosystem services (ES). However, the urban oriented design and construction of UGI and the occupation and use of natural ecosystems for urban purposes incorporate artificial components to the UGI. This causes a decrease in the provision of regulating services but an increase of recreational services, which are respectively related to the fulfillment and the limitations of natural ecological functions. In other words, UGI can contribute substantially to the SD of cities through the provision of ES and avoid disservices (Chen and Jim, 2008).

The connectivity between UGI sites is essential to provide benefits for persons in a city. In fact the network of UGI and its distribution in the urban zone is an important aspect of urban planning (Rusche et al., 2019).The growth of the cities is frequently a dilemma between the conservation and the urbanization of natural environments. As far as new natural areas are urbanized, loss of ES takes place while urban living facilities for humans increases. As a consequence of the increasing interest in SD, urban green infrastructure design, provision, maintenance, conservation and restoration are being more recognized as critical components of any holistic and realistic strategy for urban sustainability (Breuste et al., 2015).

3.0 THE CHALLENGES

In an urban context, mounting levels of urbanization creates a network of barriers that result in a patchwork of land uses and isolated open space areas. Consequently natural ecosystems become scattered across the landscape and displaced by new land-use developments (Geneletti, 2004; Lafortezza et al., 2008). Improving the functional and spatial connectivity of these landscapes is a prerequisite to its ability to mitigate and adapt to climate change and in turn to increase the value of the goods and services that ecosystems provide (Grimm et al., 2008; Hodgson et al., 2009) thereby moving towards achieving urban sustainability. A solution to this challenge lies in developing GI approach that considers the landscape as an overall blanket of inter-related ecosystems in which single components interact with each other through a multitude of elements (Weber et al., 2006).

Planning of green infrastructure here refers to policies and planning activity affecting urban GI, in particular through processes of land use and management and development of nature areas and elements. As mentioned previously, there is a variety of national and local planning cultures and needs present, due to which no single definition of green infrastructure planning exists, but instead a set of shared principles have been developed as guidance for different contexts (Pauleit et al., 2011), which makes it increasingly difficult for experts to come up with a consistent strategy towards managing urban GI.

Green infrastructure plays a key role in a formation of a comfortable urban environment, but at the same time it is affected by intense processes of urbanization, like surface sealing and active

building, transport and industrial activity. However, cities are not only the cause of negative influence, but also the main decision-making centers for green infrastructure improvement.

4.0 THE SOLUTION

The development of green infrastructure is a necessary measure for keeping urban sustainability, particularly in the context of the global environment change. Sustainable cities and communities are among the priority UN sustainable development goals (Sustainable Development Goals 2015). Cities are often considered to be centers of knowledge and innovation and the challenge in building resilient cities lies in how they are managed and developed.

Similarly, the effective development of GI approaches takes place through a co- ordinated action between decision-makers and other relevant stakeholders ensuring the proper translation of policy (usually formulated at national level) into practice (implemented at regional or local level) (Mell, 2013).

5.0 CONCLUSION

Green infrastructure is a concept that entered the sustainability and resilience discourses across a wide range of organisations and planners. Initiatives appear to be a good tool for building resilience since, in theory; they address the dynamic interplay of ecological and social urban systems, incorporating common driving forces (connectivity, adaptation, participation and cooperation).

Green infrastructure strategies constitute an opportunity to be "grasped in practice and sustained" for sustainable and resilient cities (Kambites and Owen 2006). Although its implementation still faces many challenges, planners need to concentrate their efforts on developing a compelling vision of the concept, on initiating extensive outreach and on promoting interdisciplinary and inter-sectorial cooperation.

6.0 RECOMMENDATION

The planning system of the country must make use urban green infrastructure in the master plan of the cities. Government policy should enhance sustainable development for the future urban centers. Green infrastructure should be used as innovation to the existing cities and megacities.

Landscape and planning of new land-use development should have spatial connectivity in the urban land regulation.

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