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Green conceptions for the development of cities in the light of a sustainable development paradigm

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Abstract

The concept of sustainable development is adopted at various levels of territorial organisation, including the city level as the basis for all the activities. Modern cities should provide efficient public services in order to eliminate the lack of comfort resulting from an excessive urban sprawl, which is why the importance of ecological conditions in socio-economic development is increasingly indicated. The purpose of this article is to present selected concepts and indicate the conditions for the implementation of the city's sustainable development assumptions. The econometric modelling was used in the research process.

Keywords: Green areas, sustainable development, city.

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1. Introduction

The issues related to the development of cities and the need to preserve a wide range of social, economic and environmental functions among residents is becoming a key issue from the point of view of the need to provide a better standard of living for the population. Currently, dynamic economic development is observed in many countries of the world with negative manifestations, such as violation of the natural balance of the environment, increase in the level of pollution, depletion of natural resources and climate change. Progressive urbanisation is not possible without natural resources. However, it is important that the dynamic development of urban agglomerations disturbs the valuable nature reserves as little as possible. Meeting this urgent challenge is now the responsibility of the authorities of the cities and municipalities. The aim of the article is to present the concept of city development and to indicate the conditions for the implementation of sustainable development. Additionally, Green European Capitals have been indicated, which should be a role model in the field of green and ecological solutions for city management. The city as a unit composed of many different elements, between which there are different types of relationships, functioning in a particular area, in a specific environment, should be treated as a dynamic, functional whole, and therefore as a system, and specifically a territorial social system.

2. Sustainable city development

The combination of social, economic and environmental aspects into one concept creates a paradigm of sustainable development. In recent years, the emphasis has been placed on problems related to environmental protection and ecology. The concept of sustainable development is very wide and popular both in the field of economics and management. However, it should be borne in mind that it is important to have a diversified relationship between the resources under consideration, which cannot be limited only to their purely economic dimension.

Sustainable urban development can be defined as improving the quality of life of residents within the limited resources of the Earth. It is the ability of cities to reduce the impact of urban activities on the environment, including improving social equity and viability in the urban areas. A sustainable city is designed with environmental protection in mind, with minimal use of water, food and energy, and minimal production of air pollution and waste, soil and water (Van Wee & Handy, 2016). The development of the city in accordance with the idea of sustainable development requires proper spatial management. In shaping the urban landscape, it is important to ensure proper proportions between natural and investment areas (Kulyk & Dubicki, 2018). Sustainable urban development improves and manages urban systems to ensure appropriate development conditions for future generations, by educating and participating residents in creating the quality of the environment in which they live (Nurul, 2015). Adopted in 2015 by the UN 2030 Agenda 2030 for sustainable development, provides for a plan of action to achieve universal prosperity, while protecting, restoring and promoting the sustainable use of ecosystems (Martin, 2019).

Adoption of plans and strategies to minimise energy consumption, reduce pollution, etc., are essential tasks to achieve sustainable urban development. Achieving the set goals of sustainable urban development is possible by designating and implementing three environmental, economic and social aspects (Figure 1).

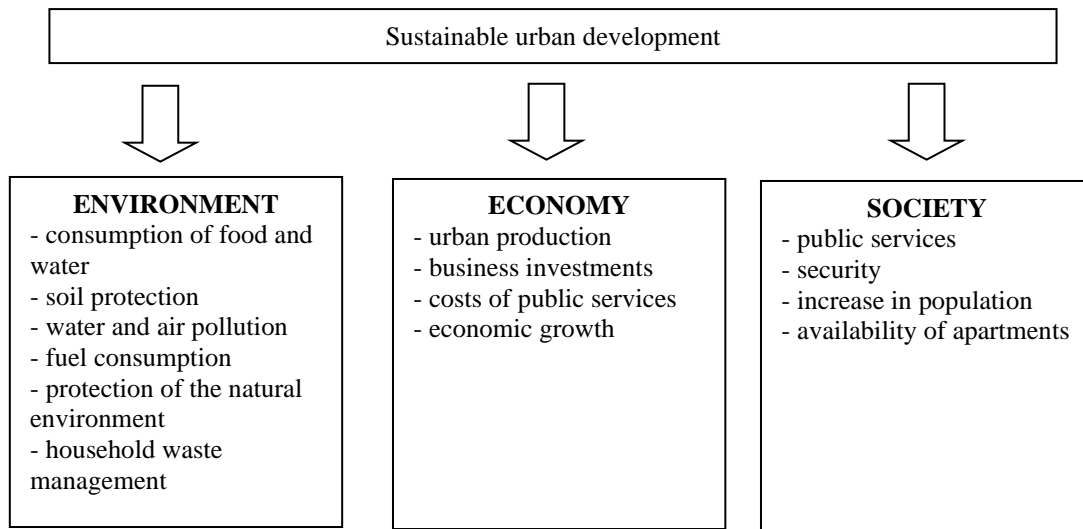


Figure 1. General aspects of sustainable urban development

Each element concerns a separate issue of the urban system based, among other things, on the protection of the natural environment, reduction of pollution, economic growth, and vitality and equality of society.

3. Concepts for the development of cities

Models and concepts of sustainable development can be divided into two groups (Table 1). The first one includes these models and concepts that refer primarily to issues of the spatial form of the city, both in local (within the city’s administrative boundaries) and regional (in the functional urban region), including approaches combining both these aspects (local and regional). The second group is those models and concepts that basically related to the issues of quality of life in the city, in particular in the context of social justice and a sustainable urban economy.

Table 1. Classification of selected models and concepts of sustainable development

Models and concepts	Organising the city’s internal structure		Organising the relationship between the city and its region
	Spatial	Socio-economic	
Eco-city		Self-reliant	
Compact city		Slow city	Externally dependent city
Green city		Community garden	Fair shares city
Redesigning a city		XXQ city	Smart growth
MILU (Multi-Functional and Intensive Land Use)		Just city	
smart growth		Smart growth	

The first trend is represented by these models and concepts in which attention is focused on inner-city issues, where greater emphasis is placed on the spatial and functional structure of the city, including urban ecology, the importance of reclamation and revitalisation of inner-city areas, the role of greenery in the city, quality of life of inhabitants and social development. The second trend includes models and concepts aiming at organising the relations between the city and its suburban area mainly by controlling uncontrolled expansion of the city outside, and making connections between the city and its suburban area (Mierzejewska, 2015). This approach refers to different approaches distinguished in the spatial policy of the city and it is sometimes referred to in literature as ‘ecology within a city’ and ‘city in ecology’. The first of these refers primarily to traditionally understood urban

environment protection, including among other things, care for the high quality of atmospheric air, the quantity and quality of drinking water supplied to residents as well as the layout of greenery in the city. In contrast, in the second approach, the city is perceived as a part of a larger ecosystem, therefore, when planning its development, the city’s relations are taken into account both with its near and distant surroundings, and in the case of large metropolises, international and global influences (Næss, 2001).

Green areas in the public space play an important role in cities, contributing to mitigating climate changes by absorbing coal from the atmosphere and providing areas for absorption of rainwater. On the other hand, green areas can influence social interaction and increase the lives of residents. The Green Capital of the European Union programme assesses how cities deal with the problem of noise, air pollution and waste management. The assessment also covers such aspects as biodiversity and green urban spaces. The European Commission has long recognised the important role that local authorities play in improving the environment and their high level of commitment to real progress. The ‘European Green Capital’ award (Table 2) has been conceived as an initiative to promote and reward these efforts, to encourage cities to engage in further activities and to present and encourage the exchange of best practices between European cities. The award has been granted since 2010, and nine cities have received the title so far.

Table 2. Green European Capitals in 2010–2019

.	City	Reason for the award
2019	Oslo (Norway)	The city aims to reduce emissions by 50% by 2020 and to neutralise carbon dioxide emission by 2050. The city has become the ‘World Capital of Electric Vehicles’ and 30% of all vehicles currently sold in the city are electric.
2018	Nijmegen (Netherlands)	Nijmegen intends to become energy neutral by 2045, wishing to achieve these goals together with local stakeholders, recognising residents, entrepreneurs and knowledge institutions as an integral part of their improvement of the environment.
2017	Essen (Germany)	Building green and blue corridors in the city and investing in green infrastructure. It is a city in transformation, overcoming difficult industrial history, to be transformed into a ‘green city’.
2016	Ljubljana (Slovenia)	The focus was from cars to public transport and pedestrian bicycle networks; progress in conservation and protection of green areas by planting more trees, building new parks and revitalising the Sava embankments.
2015	Bristol (Great Britain)	Committed to improving transport, energy efficiency and renewable energy initiatives; carbon dioxide emission has been steadily declining since 2005; despite the growing economy, it has the ambition to become a European centre for low-carbon industries.
2014	Copenhagen (Denmark)	Placing public-private partnerships at the centre of an approach to eco-innovation and sustainable employment; a pioneer of transport, striving to become the most practical city for cyclists in the world.
2013	Nantes (France)	Development of a sustainable transport policy with an emphasis on public transport and bicycles; the first city in France to successfully introduce electric trams.
2012	Vitoria-Gasteiz (Spain)	A large part of the green public areas, ensuring that the entire population lives within a radius of 300 m from the open green space; specific measures to support and enhance biodiversity and ecosystem services; the goal of reducing water consumption to less than 100 l per person per day.
2011	Hamburg (Germany)	Hamburg has set ambitious targets for climate protection, such as reducing CO ₂ emissions by 40% by 2020 by 80% by 2050. CO ₂ emissions per capita have been reduced by around 15% compared to 1990.
2010	Stockholm (Sweden)	Clear and effective measures to reduce noise pollution. A protection plan setting new standards for clean water. An innovative integrated waste management system. 95% of the population lives less than 300 m from green areas.

The title of the Green Capital of Europe is awarded to the city, which is at the forefront of environmentally friendly urban centres. The winner is an inspiration, and due to the recognition gained in this way, it becomes an attractive place to live, work and visit. All the cities applying for this title, however, have another common feature: they have coordinated their approach to spatial planning at the level of various administration departments, uniting them around a shared vision and thus improving their spatial planning process.

The implementation of the concept of sustainable development in cities requires a multi-criteria approach, and the weights and interactions of interdependent criteria are determined in an objective manner (Zhang, Xu, Yeh, Liu & Zhou, 2016). As a consequence, the same goal can be achieved in different ways and at different levels in individual criteria. In the current conditions, there is a large group of sustainable development indicators for cities. However, as the research shows, it is required to create a comprehensive measure that allows, above all, maintaining the sustainability of development and capturing external influences (Mori & Christodoulou, 2012; Pickett et al., 2013). On this basis, it can be unequivocally stated that there will be significant differences in various parts of the world in the implementation of the concept of a sustainable city. However, there are common and permanent assumptions and the areas required for the sustainability assessment that determine such development. The review of research in this matter allows concluding that there are many forms of development that will allow achieving durability in the development of cities (Ibrahim, Omar & Mohamad, 2015). It is also possible to notice the repeated recurrence of this concept, also at the operational level, with innovation, technology and business entrepreneurship (Haarstad, 2016). The multidimensionality of the concept of sustainability is also its significant weakness. As a consequence, the implementation of this idea may lead to the fragmentation of the city and the formation of many unrelated and non-adapted parts in terms of its functionality (Cugurullo, 2017). The results carried out in many countries show that, although planning ecosystem services and planning adaptations to climate change and attempts to implement the sustainable development path, they often lead to the implementation of separate and rarely comprehensive solutions (Wamsler, Luederitz & Brink, 2014).

The research carried out in this study drew attention to the implementation of the path of sustainable development based on its three basic dimensions: social, economic and environmental. The studies were carried out in voivodship cities of Poland on the basis of data from 2007 to 2017. The following indicators were taken into account: population density (social dimension), GDP per capita and the number of economic entities per 1,000 inhabitants (economic dimension) and area of forests and green areas (ha) per 1,000 inhabitants (environmental dimension). As a dependent variable, the level of greenhouse gas emissions was assumed. The analysed total greenhouse gas value included: CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, CO₂ in CO₂ equivalent, NF₃ in CO₂ equivalent). In order to assess the factors affecting the value of greenhouse gas emissions, panel regression was applied, and based on Breusch–Pagan and Hausmann tests, it was shown that the model with variable effects (Table 3) would be the best. In addition, a time shift was introduced for independent variables.

Table 3. Model explaining the implementation of the path of sustainable development in 2007–2017 in Poland

Variable	Coefficient	Standard error	t-student	p-value	Relevance
Const	3.35506e+07	1.60072e+07	2.096	0.0384	**
Population density	79,092.6	81,121.2	2.147	0.0341	**
GDP per capita	-135.161	65.0695	-2.077	0.0402	**
Number of economic entities per 1,000 inhabitants	230,217	64,903.1	3.547	0.0006	***
Forests and green areas per 1,000 inhabitants	-1.76878e+06	958,540	-1.850	0.0671	*
Assessment of matches and statistical tests					
LSDV R-square			0.790393		
Within R-square			0.138836		

* $p < 0,1$; ** $p < 0.05$; *** $p < 0.01$.

Source: own study based on Eurostat data, using the Gretl 2016d program.

The conducted panel regression analysis showed that in accordance with the assumptions and expectations, the number of green areas and forests had a positive effect on the reduction of CO₂ emissions. The same direction of impact was the size of GDP per capita. It should be combined with the so-called Kuznec's curve, which means that at the current level of transformation, a point of economic development has already been achieved, which encourages reduction of pollution along with further economic growth in cities. However, the high population density, as well as the increase in the number of economic entities per capita, adversely affected the level of greenhouse gas emissions. The indicated areas are determinants for the assessment of the implementation of the concept of sustainable development in cities.

4. Conclusion

Sustainable development means, above all, economical, effective and rational resource management. The model of sustainable urbanisation, expressed, among other things, in urban policies of the European Union, postulates rational development of urban areas with respect for naturally valuable areas. A sustainable city is one that enables a balanced lifestyle of residents and optimal choices in various aspects of life. A balanced model of functioning in a city is not about a revolution or imposing on people a single model of life, but on creating a choice of different options and conditions to choose more convenient, rational options suited to the needs and possibilities, and thus pro-ecological. Such action is to serve the rational and economical use of resources, including infrastructure and time and energy necessary to ensure transport. Social, economic, political and other factors shape the form of the city, and then the form of the city shapes the people living in it: their way of life, social interactions, development opportunities and satisfying their needs. In Polish cities, there has been already perceived an approach in line with the Kuznec's curve, which means a positive impact of the level of GDP per capita on the pollution in the form of greenhouse gases, but at the same time there are determinants of improving economic conditions affecting this aspect in a negative way.

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