

## The Concept of Sustainability in Cities as a Spatial Management Paradigm

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**Stawomira Hajduk\***

An important component of planning activities of the city self-government is the implementation of the concept of sustainable development through the preparation and implementation of arrangements contained in studies on spatial planning. The paper attempts to evaluate ways to implement the idea of sustainability in spatial management of cities using the correspondence analysis. It has identified the cities which are characterised by a low degree of implementation of the concept of sustainability based on the criterion of planning coverage. The results of the investigation include such cities as Hel, Krynica Morska, Łeba and Nieszawa.

**Keywords:** territorial management, city management, sustainable development, correspondence analysis.

## Koncepcja zrównoważonego rozwoju w miastach jako paradygmat zarządzania przestrzennego

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Istotnym elementem działań planistycznych samorządu miejskiego jest wdrażanie koncepcji zrównoważonego rozwoju poprzez sporządzanie i realizację ustaleń zawartych w opracowaniach dotyczących zagospodarowania przestrzennego. W artykule podjęto próbę oceny sposobów wdrażania idei zrównoważonego rozwoju w zarządzaniu przestrzennym miast z wykorzystaniem analizy korespondencji. Bazując na kryterium pokrycia planistycznego, zidentyfikowano miasta charakteryzujące się niskim stopniem realizacji koncepcji zrównoważonego rozwoju, jak Hel, Krynica Morska, Łeba, Nieszawa.

**Słowa kluczowe:** zarządzanie terytorialne, zarządzanie miastem, zrównoważony rozwój, analiza korespondencji.

**JEL:** D73, O21, R32, R58

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\* **Stawomira Hajduk** – dr inż., Faculty of Management Engineering, Białystok University of Technology.

Correspondence address: Białystok University of Technology, Wiejska 45A, 15-001 Białystok; e-mail: s.hajduk@pb.edu.pl.



## 1. Introduction

Contemporary cities play an essential role in urbanised Europe. They are a venue for creative ideas and a driving force of innovation. At the same time, they face disturbing challenges related to demographic processes, pollution of the environment and climate change as well as social inequalities and pressure on spatial mobility of inhabitants. It is becoming necessary to improve urban management with the use of civic engagement mechanisms. It will allow for creating urban areas with a high quality of life and access to a wide range of public services for inhabitants.

European cities consume 80% of energy, and CO<sub>2</sub> emissions stand at 280 million tons per year (Dobbs et al., 2012). Figures confirm immense population density and intensification of economic processes. World trends show an ongoing rapid increase in urban population, as in 1900 only 10% of the world's inhabitants resided in urban areas, in 1950 – 30% of the population, and currently 54%. However, the United Nations projects (2015) a growth up to 66% in 2050. In Poland, 60.24% of the population lives in urban centres. The number of city dwellers in the world is constantly on the rise – from 2.6 billion in 2010 up to 5.2 billion in 2050. A multitude of theories and assumptions concerning urban development mechanisms have been advanced in recent years. One of them is the concept of sustainable development along with the associated idea of a smart city. Sustainable development is a paradigm of spatial management.

The paper discusses the issues related to the recognition of mechanisms of implementation of sustainable development in spatial management and attempts to identify cities performing poorly as regards the implementation of the sustainability concept. The aim of the paper is to assess the state of implementation of the concept of sustainable development in Polish cities taking into account the criterion of spatial planning coverage and the number of inhabitants. The paper puts forward the following hypothesis: Rationally using appropriate spatial management mechanisms, Polish cities are implementing the concept of sustainable development. The following research methods were used: a cognitive-critical analysis of secondary sources and a statistical multidimensional comparative analysis. The theoretical part of the study reviews the literature on the subject, international publications and national strategic documents. The empirical part of the paper analyses statistical data of the Local Data Bank of the Central Statistical Office [Główny Urząd Statystyczny – GUS] concerning local spatial development plans. The scope of the conducted research comprised the following stages: (I) identification of authors of scientific papers and post-conference publications on theoretical aspects of sustainable development related to cities based on a search of the content of the Web of Science and EBSCO databases; (II) classification of Polish municipalities according to spatial

planning coverage and the number of inhabitants as a determinant of the degree of implementation of the sustainable development concept, using the correspondence analysis for statistical data of the Local Data Bank of the Central Statistical Office.

## 2. Literature Review

The concept of sustainable development has found a permanent place in the considerations of numerous academic disciplines and management practitioners. This concept is legitimised in a vast number of acts of international law (Brundtland Report, i.e. the Report of the World Commission on Environment and Development: *Our Common Future* (1987); *Future We Want* declaration of the 2012 World Summit in Rio de Janeiro; Europe 2020 strategy; 2030 Sustainable Development Agenda) and of the Polish law (Article 5 of the Constitution of the Republic of Poland, Article 3.50 of the Act of 2001 “Environmental Protection Law”, Strategy for Sustainable Development of Poland until 2025, National Spatial Development Concept from 2011). The notion of sustainable development is defined in various ways in many items of foreign (Colby, 1991; Dasputa, 2007) and Polish literature (Kassenberg, 2007; Poskrobko & Poskrobko, 2012; Szelągowska, 2017). This term is ambiguous; it lacks an unequivocal definition although certain assumptions are common. Some definitions make reference to public management, including territorial management (Drabczyk, 2013). The concept of sustainable development is frequently narrowed to eco-development. Forward-looking actions providing the right balance between the three types of capital to improve the quality of life are proposed. Sustainable development refers to an evolutionary process that requires an individual to reach unattainable perfection. Corporate social responsibility and the introduction of standardised organisation management systems play a crucial role in enterprises (Borys, 2011). An interesting approach to the process of evolution of the sustainable development concept was presented by T. Borys and S. Czaja (2009) in the form of five stages which include inspiration, maturation, fascination, implementation and doubts. A. Graczyk (2013) presented the mechanism of creating the Polish market for tradable permits for the discharge of carbon dioxide. B. Fiedor (2006) specified a full classification of economic instruments for environmental protection in Poland and in selected European Union countries.

The system of spatial management of the city is based on the Deming cycle: Plan-Do-Check-Act (Hajduk, 2008). Guided by the principle of sustainable development, city authorities ensure the effecting of the idea of a compact and low-carbon city (Rzeńca, 2016). Kowalewski et al. (2014) state that during the preparation of the study of conditions and directions of spatial development the city self-government must analyse the development potential and needs. Valorisation activities that involve inventorying

the strengths and limitations of the environment and an overview of areas intended for investments should be used. Solutions adopted in the study of conditions and directions of spatial development must be consistent with the city development strategy and elaborated with the participation of citizens (Zachariasz, 2016). An active attitude of the city self-government should be reflected in the adoption of good-quality local spatial development plans with reliable economic and environmental forecasts (Bajerowski, 2008). Such measures will undoubtedly protect the land of significant natural or cultural value, with beautiful landscape, or areas with major risk of flooding against development (Najwyższa Izba Kontroli [NIK], 2016). The issue of administrative decisions regarding land development, i.e. decisions on land development conditions and decisions on the site location of a public-purpose line-investment project, is disadvantageous from the point of view of the implementation of the sustainable development concept by cities. According to Olbrysz and Koziński (2015), this is conducive to the construction of scattered buildings despite the principle of good neighbourly relations and leads to the implementation and financing of costly social and technical infrastructure resulting in an increase in expenditure from city budgets. Figure 1 depicts the system of spatial management in a city.

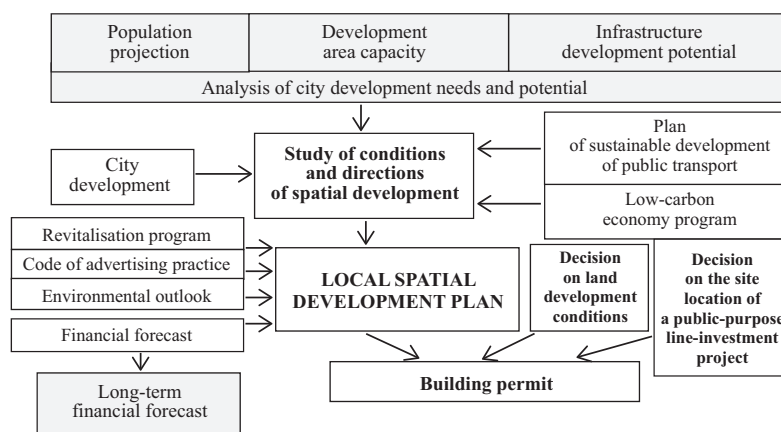


Fig. 1. Integrated spatial management system in a city. Source: Author's own work.

The overriding principle of spatial management is sustainable development; and its equivalent in urban development is spatial order integrated with other orders (Act, 2003). The new Charter of Athens, adopted in 1998, promotes the idea of sustainable development in the construction of urban structure (European Council of Town Planners, 2003). The issue of territorial cohesion in the development of cities has also found its place in the Leipzig Charter on Sustainable European Cities adopted by the ministers of European Union member states (Leipzig Charter, 2007). The principles

of effective spatial management of cities in the long-term through sustainable economic development and counteracting threats form the basis of the urban policy (Ministerstwo Infrastruktury i Rozwoju, 2015).

Contemporary challenges faced by urban centres change the manner in which cities are managed (Fertner et al., 2016). The New Public Management model promotes a managerial style of management in the public sector. The Public Governance model builds a civil society and treats citizens as co-decision makers. The Excellence Quality Management model is based on increasing the competitiveness of cities in the pursuit of excellence. The Smart City model creates the conditions of a city friendly to its inhabitants by using the ICT infrastructure that improves the quality of life and accessibility of public services (Nam & Pardo, 2011).

Numerous unfavourable phenomena occur in the urban space, leading to an inconsistent development of city centres and suburban areas. The former are subject to degradation, and the latter are plagued by uncontrolled urbanisation. This results in the depopulation of city centres and produces expansive suburbs with a substandard infrastructure and poor access to public services (Lorens, 2013). Noworól (2011) distinguished several trends in urban development that relate to the re-urbanisation of extensive city areas and the revitalisation of urban post-industrial and post-railway sites along with economic & social renewal of degraded city centres and pauperising post-war housing estates. Development-oriented activities, focusing on already used areas, bring a number of benefits, including: (1) reducing environmental interference, (2) increasing city compactness, (3) integrating and equalising living standards (Noworól, 2013). Cities struggle with many challenges, such as the ageing society, shrinking cities, gentrification, and intense suburban sprawl (Guziejewska, 2015). City self-governments should promote mixed-use projects. Multifunctional spaces limit the occurrence of city areas that are full of life only at certain times of the day, e.g. office estates that are deserted in the afternoon (Piasecka, 2015). For such projects, it is necessary to increase the percentage of population living in the center, which will contribute to the improvement of the efficiency of public spending on infrastructure and public services (Damurski, 2016). It is vital to contain the pressure to invest biologically active urban areas and to ensure accessibility of the green infrastructure for city dwellers (Pęski, 1999).

The implementation of the concept of sustainable development in urban areas is conducive to the creation of sustainable cities, which are characterised by the minimum consumption of electricity and the maximum use of renewable energy and closed substance cycles (Zygiaris, 2013). A harmonious development of social, economic and environmental conditions of the city ensures intergenerational justice and improves the quality of life in an infinite time horizon. The cities whose development supported by modern technologies helps meet residents' needs without diminishing the opportunities for the development of future generations are referred to as intelligent

sustainable cities (Hojer & Wangel, 2014). Hence the need to factor in the planning coverage ratio in considerations regarding the implementation of the sustainable development concept (Fogel, 2012).

### 3. Research Materials and Methods

The basic source of information was statistical data downloaded from the Local Data Bank of the Central Statistical Office on 20 January 2018 from the website <https://bdl.stat.gov.pl/BDL/start>, from the category: Local government<sup>1</sup>. The analysis and evaluation of the state of implementation of the sustainable development concept took into account two criteria, i.e. planning coverage and the number of inhabitants. The research covered all Polish municipalities. Figures related to city population and planning coverage are presented in Table 1. Only 17% of all cities have full planning coverage. Seven cities, i.e. Jelenia Góra, Nieszawa, Radziejów, Łaskarzew, Łaziska Górne, Sulmierzyce and Obrzycko, lack a local spatial development plan. This group is dominated by cities with a population of 20 to 100 thousand which account for almost 50% of all municipalities. The research tools used comprised the Excel spreadsheet and the Statistica 13.1 software.

Number of inhabitants	Number of cities	Share	Planning coverage	Number of cities	Share
below 5 thousand	25	8.28	below 20.00%	102	33.78
5–20 thousand	91	30.14	20–40.00%	65	21.52
20–100 thousand	147	48.67	40–60.00%	31	10.26
100–200 thousand	23	7.62	60–80.00%	12	3.97
200–500 thousand	11	3.62	80–99.99%	39	12.91
above 500 thousand	5	1.65	full	53	17.55

Tab. 1. Number of cities and their share in population and planning coverage. Source: Prepared by the author based on the Local Data Bank of the Central Statistical Office [online] <https://bdl.stat.gov.pl/BDL/dane/podgrup/teryt> [accessed on: 20.04.2018].

The research procedure comprised the following stages: (I) selecting diagnostic variables from the Local Data Bank of the Central Statistical Office; (II) calculating the planning coverage ratio in the Excel spreadsheet; (III) showing, on a two variable graph, the relationship between planning coverage and investment pressure for voivodeship cities in the Excel spreadsheet; (IV) determining the number of dimensions of the space sought using the scree test criterion; (V) plotting the structure of relationships between planning coverage and the number of inhabitants of municipalities on a perceptual map by using the correspondence analysis in the Statistica software.

Statistical data aggregated at the level of municipalities for 2016 were analysed. The following statistical data were selected as diagnostic variables for determining planning coverage: (a) city area [ha], (b) number of city inhabitants, (c) area covered by the local spatial development plan [ha]. The planning coverage ratio for the city (share of the area covered by the local spatial development plan in the city area [%]) was calculated on the basis of selected diagnostic variables.

Studies with the use of a correspondence analysis were conducted in order to identify the cities that perform poorly in terms of implementation of the sustainable development concept. The scree test criterion helped determine the number of dimensions of the space sought (Panek, 2009). A point was found where the decrease in eigenvalues levels off. The scree started from the second dimension, which suggested that a two-dimensional space should be accepted for the correspondence analysis. After establishing the number of dimensions, the coordinates of column profiles were calculated in the coordinate system defined by singular vectors. In order to interpret the coordinates of column points, a row and column profile standardisation method was used, where coordinates are calculated from the matrix of column profiles (Stanimir, 2005).

#### 4. Results and Discussion

The correspondence analysis allowed for grouping the cities, taking into account two attributes: the number of inhabitants and planning coverage. It also made it possible to identify the cities that poorly implement the concept of sustainable development and are characterised by a low (below 20%) share of the area of the local spatial development plan in the total area of the city. Two dimensions explain almost 94% of the inertia. The first factor allows for capturing 71.44% of the diversity of elements in the output data matrix, and the other factor – the remaining 22.55%. Poor planning coverage is reported for the municipalities with a population below 5 thousand, while the municipalities with a population of 5–20 thousand have full coverage. The 2D column chart for the structure of connections between planning coverage and the number of inhabitants of municipalities is shown in Figure 2.

On the perceptual map, the municipalities were divided into four classes based on two attributes: planning coverage and the number of inhabitants. The designated classes are interpreted as follows:

- Class I includes the municipalities with a population of over 100 thousand, which are characterised by 20–60% planning coverage, e.g. Lublin, Katowice, Białystok, Opole;
- Class II comprises the municipalities with a population of 20–100 thousand with planning coverage of 60–100%, e.g. Ostrów Mazowiecka, Ostrołęka, Pruszków, Marki, Piastów, Oświęcim, Nowy Dwór Mazowiecki, Mrągowo, Kętrzyn;



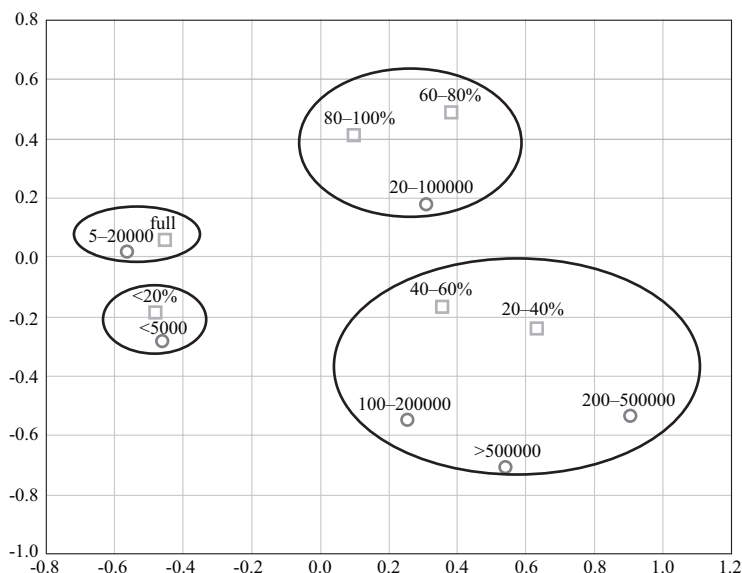


Fig. 2. Perceptual map. Source: Author's own work.

- Class III consists of the municipalities with a population below 5 thousand, which are characterised by poor planning coverage of below 20%, e.g. Hel, Krynica Morska, Łeba, Nieszawa;
- Class IV includes the municipalities with a population of 5–20 thousand with full planning coverage, e.g. Wysokie Mazowieckie, Sejny, Kowary, Złotoryja, Chojnów, Puck, Kudowa-Zdrój.

Table 2 presents coordinate values of point factors representing the number of inhabitants of the municipalities and the values of measures to assess the quality of the mapping of original configurations of points in the factorial space. Among all the columns, the most important was the one representing the municipalities with a population of 20–100 thousand, because the mass of this column is the largest. These municipalities are also best represented in the two-dimensional space since the quality of this column is close to one. The analysis of the relative inertia column shows that the largest share in the creation of a two-dimensional factorial space was contributed by the municipalities with a population of 5–20 thousand and 20–100 thousand. In contrast, the inertia Dimension 1 and inertia Dimension 2 columns present the shares of respective municipalities in the creation of a one-dimensional factorial space defined by the first and the second factor, respectively. The municipalities with a population of 5–20 thousand have the most substantial share in creating the first dimension. On the other hand, the municipalities with a population of 100–200 thousand contributed most in defining the second dimension.



Name of row	Coordinates Dimension1	Coordinates Dimension2	Mass	Quality	Relative inertia	Inertia Dimension1	Cos ^ 2 Dimension1	Inertia Dimension2	Cos ^ 2 Dimension2
5-20 thous.	-0.566859	0.019587	0.305921	0.993979	0.353405	0.491120	0.992793	0.001857	0.001185
20-100 thous.	0.307194	0.181199	0.486842	0.999291	0.221187	0.229532	0.741356	0.252960	0.257935
>500 thous.	0.535400	-0.705225	0.016447	0.553176	0.083199	0.023555	0.202259	0.129451	0.350918
<5 thous.	-0.463991	-0.280363	0.078947	0.922668	0.089753	0.084915	0.675893	0.098205	0.246775
200-500 thous.	0.901328	-0.532897	0.036184	0.980482	0.144414	0.146863	0.726520	0.162615	0.253962
100-200 thous.	0.252054	-0.544447	0.075658	0.899670	0.108041	0.024014	0.158790	0.354911	0.740880

Tab. 2. Values of coordinates representing the number of city inhabitants (rows) in the factorial space and solution quality statistics. Source: Author's own work.

According to Komornicki (2014), voivodship cities are characterised by a higher advancement of planning works compared to lower-ranking urban centres. Due to the huge scale of needs, there are substantial deficiencies in this area. The progress in performing planning works is highly differentiated. In the last three years, the expansion of the area covered by local spatial development plans has slowed down, which indicates a focus on updating activities. The high share of decisions on land development conditions is worrying, despite good advancement of planning works (Mickiewicz, 2015). This is confirmed by the fact that local spatial development plans are adopted for areas that do not necessarily come under the greatest investment pressure, which should be considered as pathology. A serious problem is that local spatial development plans are adopted for the purposes of exclusion of arable land from agricultural production (Śleszyński, 2011).

## 5. Conclusion

Polish cities should implement the concept of sustainable development using the inventory of strengths and limitations of the environment for the study of conditions and directions of spatial development and the environmental outlook for local spatial development plans.

The assessment of planning coverage of Polish voivodship cities allowed for defining urban centres which should intensify planning works. These cities include Zielona Góra, Kraków and Łódź. The most favourable situation in terms of planning coverage occurs in the cities of Gdańsk, Gorzów Wielkopolski, Lublin, Olsztyn, Toruń and Wrocław. The analysed municipalities vary significantly in terms of progress in the implementation of planning works, which is also confirmed by the research conducted by Komornicki (2014). In addition, it was found that voivodship cities were distinguished by a higher level of advancement of planning works compared to other urban centres.

The correspondence analysis identified municipalities in terms of the number of inhabitants characterised by good planning coverage and provided a lot of information about the structure of connections. The conducted study revealed that the configurations of points representing the studied variables were presented without distortions in the two-dimensional space. Poor planning coverage is shown by the municipalities with a population below 5 thousand, such as Hel, Krynica Morska, Łeba and Nieszawa. In contrast, the municipalities with a population of 5–20 thousand, such as Wysokie Mazowieckie, Sejny, Kowary, Złotoryja, Chojnów, Puck, and Kudowa-Zdrój, have full coverage.

### Endnotes

<sup>1</sup> Group: Spatial planning, subgroup: (I) Valid local spatial development plans issued under the Act of 7 July 1994 and the Act of 27 March 2003, (II) Decisions on land development and management conditions issued under the Act of 27 March 2003 on spatial planning and land management.

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