

## Sustainable Development of a City: Systemic Approach

### Rozwój zrównoważony miasta: Podejście systemowe

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#### **Abstract**

Today the concept of sustainable development has been adopted as a basis for promoting development at all levels of territorial organisation. While generally worked out for the global level, this conception has also attained a local dimension, after the local *Agenda 21* had been drawn up at the Rio conference in 1992. However, each level of development planning has its own specific features, and so have individual territorial units at that level. This also, or perhaps primarily, concerns cities because of wide differences in their sizes, the complexity of relations occurring there, the accumulation of development problems, the special role they play in the settlement system and difficulties with transferring the assumptions of a conception worked out for the global scale to the local level. This paper seeks to find a way of understanding sustainable development appropriate to the specificity of a city, with special attention paid to a systemic conception, and more specifically that of a territorial social system. Also, an analysis is made of selected conceptions and models indicating concrete measures that should be taken to make urban development more balanced, especially in its spatial aspect. The reflections lead to the conclusion that sustainable urban development can hardly be associated with the sustainability presented in the report *Our Common Future*; rather, it should involve a search for conditions of a city's intra- and inter-system balance and relations with its immediate and farther vicinity.

**Key words:** city, urban system, sustainable development, territorial social system, sustainable development model and conceptions

#### **Streszczenie**

Koncepcja zrównoważonego rozwoju przyjmowana jest współcześnie jako podstawa wszelkich działań na wszystkich poziomach organizacji terytorialnej. Choć generalnie wypracowana została dla skali globalnej, po przyjęciu na konferencji w Rio w 1992 roku programu *Agenda 21* uzyskała dodatkowo wymiar lokalny. Jednakże, każdy poziom planowania rozwoju ma swoją specyfikę, podobnie zresztą jak poszczególne jednostki terytorialne w ramach tego samego szczebla. Specyfiką taką charakteryzują się także miasta, w szczególności miasta duże, w odniesieniu do których, ze względu na złożoność występujących relacji, nagromadzenie problemów rozwojowych oraz ponadlokalną rolę, jaką pełnią te jednostki w systemie osadniczym, rozwój zrównoważony musi być rozumiany nieco inaczej, niż ma to miejsce w przypadku jednostek terytorialnych wyższego szczebla. Celem niniejszego artykułu jest wskazanie na sposób pojmowania rozwoju zrównoważonego, który odpowiadać będzie specyfice miasta, traktowanego jako system, a konkretnie jako terytorialny system społeczny. Dokonany też zostanie przegląd wybranych koncepcji i modeli wskazujących na konkretne działania, które należy podjąć, aby rozwój obszarów miejskich uczynić bardziej zrównoważonym, zwłaszcza w aspekcie przestrzennym. Przeprowadzone w artykule rozważania prowadzą do wniosku, że zrównoważony rozwój obszarów miejskich trudno jest wiązać z koncepcją podtrzymalności, na której opiera się raport *Nasza Wspólna Przyszłość*, ale raczej powinien być

rozumiany jako poszukiwanie warunków równowagi w systemie miasta. Chodzi zarówno o równowagę wewnątrz, jak i między-systemową oraz o kształtowanie właściwych relacji z bliższym i dalszym otoczeniem miasta

**Słowa kluczowe:** miasto, system miasta, rozwój zrównoważony, terytorialny system społeczny, modele i koncepcje rozwoju zrównoważonego

## 1. Introduction

Since the popularisation of the concept of sustainable development, this kind of development has been adopted at various levels of territorial organisation, also that of a city, as a basis for all measures taken. A special role is assigned to measures adopted at the local level, since this rung of organisation is thought to be best suited for the implementation of the principle of sustainable development. The problem is that communes tend to vary greatly, even within a single country: the situation of a small rural commune is certainly different from that of a town, especially a large city – the core of an agglomeration or a metropolitan centre. The multiplicity of development factors and determinants in communes and problems they have to face forces them to adopt various sustainable development policies. Cities, in particular large ones, stand apart here, performing a special role of high-ranking central places in a settlement system and characterised by highly complicated systems of functional links, both internal and external, i.e. with the nearest and farther suburban zones with which they make up a functional region. It is because of this uniqueness that their sustainable development programmes cannot accommodate only the basic goals, or pillars, of this type of development described in the report *Our Common Future* and largely assuming a high level of self-reliance of the spatial units concerned; they must also reflect problems specific to a city and the complexity of functional links occurring there (Mierzejewska, 2015).

This paper seeks to find a way of understanding sustainable development appropriate to the specificity of a city, with special attention paid to a systemic conception, and more specifically that of a territorial social system. Also, an analysis is made of selected conceptions and models indicating concrete measures that should be taken to make urban development more balanced, especially in its spatial aspect.

## 2. Understanding sustainable development

Sustainable development as an idea or conception was made popular in 1987 by the report *Our Common Future*, where it was defined rather laconically as *the development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (WCED, 1987). As follows from this definition and the report as a whole, this type of development rests on a few basic notions (pillars), namely: (1) needs and the necessity

to satisfy them, (2) an intra- and inter-generational type of social justice, and (3) limitations imposed on the economy by the natural environment. Thus, it should involve deliberate building of proper relations between economic growth, care for the environment (first of all natural), and the satisfaction of various human needs that significantly determine the quality of life (Koglin, 2009; Petrișor, Petrișor, 2013). It is not supposed to be a deterrent to economic development, but to be a new approach to it, opposing the traditional understanding of economic development while still maintaining a high level of wealth (Domański, 2006). There is no doubt, therefore, that such development has to be well-thought-out and planned, although one should be aware of problems involved in the operationalisation of this conception, also at various rungs of territorial organisation (Mierzejewska, 2009).

Even this general approach to sustainable development can raise some doubts as to how the concepts of needs and social justice should be understood with reference to a city, and in particular, how to accommodate limitations imposed on its economy by the natural environment (Table 1). After all, a city satisfies not only the needs of a local community, but also of residents of its suburban zone, while requiring a steady, everyday supply of matter and energy (in particular food), hence it heavily depends on this very zone for it. In turn, the level of the economic development of cities performing the role of growth drivers in the age of globalisation greatly exceeds their ecological capacity as determined by the quantity and quality of their natural resources, thus making it necessary for them to rely on the ecological capacity of their suburban zones. It seems, therefore, that it is impossible to fully accommodate limitations that the natural environment imposes on the economic development of a city, and hence to apply the conception of sustainable development formulated in *Our Common Future* to it (Mierzejewska, 2015). Thus, the city requires a different approach to the issue of sustainable development, for example a generally accepted integrated approach embracing its social, economic and ecological aspects, and often also spatial and institutional ones. Such an approach is presented by a variety of authors, including Norgaard (1989), Sneddon, Howarth and Norgaard (2006), Bugge and Watters (2003), Mierzejewska (2009), Koglin (2009), Jenks (2010), Petrișor and Petrișor (2013), and others. This understanding of sustainable development means that none of the fields of human activity (social, economic and ecological) will develop at the cost of the other ones (Borys, 1999). However, one should be aware that it

Table 1. Problems with the operationalisation of the conception of sustainable development presented in *Our Common Future* with reference to a city (Mierzejewska, 2015)

Sustainable development pillars	Problems
concept of <i>needs</i>	- no elucidation of what concrete needs are meant - structure and hierarchy of needs of residents of individual cities differ considerably
social justice (intra- and inter-generational)	- can be treated as a synonym of distributive justice giving rise to much controversy, disputes and emotions, referring to division of highly appreciated goods in society (Hayek, 1993; Szewczak, 2011) - division of goods is one of basic functions of policy, but it is hard to determine when this division can be regarded as just
concept of limitations	- based on conceptions of carrying capacity, environmental space and ecological footprint allowing economy to be run within limitations imposed by the quantity and quality of environmental resources, which is very hard to determine - economic development of a city (especially a large one) is impossible within limits imposed by its natural environment (in order to develop, the city has to rely on the ecological capacity of its immediate and farther hinterland)

Table 2. Model of relations holding in an urban system, own compilation on the basis of Chojnicki (1989)

Aspects		Human community	Territory	
			natural environment (nature)	artificial elements (economy)
Human community		X <sub>11</sub>	X <sub>12</sub>	X <sub>13</sub>
Territory	natural environment (nature)	X <sub>21</sub>	X <sub>22</sub>	X <sub>23</sub>
	artificial elements (economy)	X <sub>31</sub>	X <sub>32</sub>	X <sub>33</sub>

is very hard to meet this condition because practically every human activity produces smaller or greater changes in the natural environment. It is therefore assumed that when one of the spheres has suffered as a result of development processes, suitable compensatory measures should be taken. On this understanding, this type of urban development is identified not so much with the sustainability discussed in *Our Common Future*, but rather with certain relations, a balance, between the individual aspects or spheres of development (social, economic, ecological), closely associated with a city's spatial form (Jenks, 2010). However, it also follows from this approach that such development will not appear of itself; it has to be planned and implemented by all entities active in a city (local authorities, residents, economic entities, non-governmental organisations, associations, etc.). In its planning, in turn, it is advisable to adopt a systems conception of a city (Mierzejewska, 2009; Jenks, 2010).

### 3. Sustainable urban development: a systems approach

A city as a unit composed of a variety of elements connected by all kinds of relations and operating in a specified area and in a specified surroundings, should be treated as a dynamic, functional whole, that is, as a system, and more precisely, a territorial social system. What makes the conception of a territorial social system especially useful with reference

to a unit like a city is that it implies efficient control of its territory by the population living in it, which is also a necessary condition for sustainable development (Chojnicki, 1989; Satterwaite, 1997; Mierzejewska, 2009; Vojnovic, 2014).

The basic components of the territorial social system of a city include a social layer, or a community of people together with their needs, endeavours and aspirations, and a material layer together with all its natural and artificial elements, or a territory. Those are not simple components but ones displaying a high level of complexity and numerous internal links. Therefore they can be treated as separate systems (though not territorial ones) while also being social, natural and economic sub-systems of the territorial system of the city. Its structure is formed by relations holding among those sub-systems and their elements, and by their relations with the surroundings. Assuming that the sustainable development of the urban system is intended to ensure it a certain level of balance, putting this conception into practice will mean establishing proper relations in the system. Three types of relations can be distinguished here (cf. Table 2):

- ✓ relations holding within the individual sub-systems (social, economic and natural), i.e. intra-system relations described in Table 2 as  $x_{11}$ ,  $x_{22}$  and  $x_{33}$  (the principal diagonal of the matrix);
- ✓ relations between the individual sub-systems (social and economic, social and natural, and economic and natural), i.e. inter-system rela-

- ✓ tions described as  $x_{12}$ ,  $x_{13}$ ,  $x_{21}$ ,  $x_{23}$ ,  $x_{31}$ , and  $x_{32}$ ; and
- ✓ relations with the surroundings, not included in the table because they affect, to a larger or smaller extent, all the other relations listed above.

The causative factor in moulding all those relations, and hence in determining the operation, efficiency and stability (balance) of the entire system, is man, who generates all kinds of economic, cultural and political relations (Chojnicki, 1989, 1999). A key role is played here by people's managerial-organisational work as determined by both, specific political relations and the knowledge of the laws, rules and mechanisms governing the social, economic and natural sub-systems, and relations holding among them. However, people's influence on some of those relations, especially with the surroundings, is only limited, being outside the possibility of direct intervention of persons (including political authorities) controlling the given territorial urban social system, especially in the conditions of a market economy.

Thus, sustainable urban development implies giving a proper form to all the relations mentioned above while accommodating the dynamic nature of the urban system, which is certainly no easy task. What may prove helpful in this respect are various models and conceptions of sustainable urban development presenting concrete measures intended to bring the urban system closer to the state of a balance, although it will always be a dynamic type of balance.

#### 4. Models and conceptions of a sustainable city

There are many positions in the literature on the subject describing conceptions or models intended to find proper ways of attaining sustainable urban development, which is perhaps due to the many aspects of this kind of development. When systematising them, however, it is hard to keep to the division into the three types of relations occurring in the territorial social system of a city described in the theoretical part of this paper.

In the output on sustainable urban development most attention is paid to creating an intra-system balance, especially in its economic and ecological aspects. There are also many works dealing with spatial aspects of urban development. Less attention is given to questions of a social and an inter-system balance. Besides, they often do not offer any theoretical approaches to sustainable urban development; rather, they tend to focus on the identification of urban development problems and on how to solve them (Koglin, 2009). While this does not detract from their usefulness, they hardly contribute to a better understanding of the causes underlying the processes that take place in cities and do not indicate long-term goals cities should strive to achieve.

In very general terms, the models and conceptions of sustainable urban development found in the litera-

ture can be divided into two groups (cf. Table 3a). The first embraces those that refer primarily to the spatial form of a city in its local and regional aspects, including also an approach combining those two aspects: an eco-city, a compact city, a green city, redesigning a city, an externally dependent city, a Fair Shares (equitable balance) city, MILU (Multi-Functional and Intensive Land Use), new urbanism, and smart growth. Here the discussion is primarily about which spatial-functional structure of a city is the more balanced one: a compact or a more dispersed one, and about ways of attaining such a balanced form.

The other group includes those models and conceptions that basically concern the quality of urban life, in particular in terms of social justice and a balanced urban economy. Here we can find concepts of a self-reliant city, a community garden, a just city, and an XXQ city. Those models, worked out by various authors, e.g. Roseland (1997), Haughton (1997), Nijkamp (2008), etc., are described at length in Mierzejewska (2009).

As follows from a survey of the models and conceptions worked out by the mentioned research streams, the presented classification is not fully disjoint. While the classification criteria are disjoint, what is problematic is an unequivocal assignment of certain models and conceptions to individual classes, mostly because some of them, e.g. those of new urbanism or smart growth, are more universal.

A classification can also be made on the basis of yet another criterion that also yields two groups of models. Those are research streams dealing with: (1) the internal structure of a city, both spatial-functional and socio-economic, and (2) relations between the city and its region (Table 3b).

The first stream is represented by those models and conceptions which focus on intra-urban issues and in which more emphasis is put either on: (1) the spatial-functional structure of a city, including intra-urban ecology, the role of greenery in it, reclamation and renewal of intra-urban areas, etc. (an eco-city, a compact city, a green city, redesigning a city, MILU, and smart growth), or on (2) the quality of life of city residents, social development, and sustainable economic development (a self-reliant city, a Slow City, a community garden, an XXQ city, a just city, and smart growth again).

The other stream includes models and conceptions intended to sort out relations between a city and its suburban zone, mostly by managing its uncontrolled outward expansion, i.e. stopping urban sprawl, and by making relations (links) between the city and its suburban zone more fair. To this group belong the conceptions of a compact city and new urbanism as well as models of an externally dependent city, a Fair Shares (equitable balance) city, and to some extent also smart growth.

The other of the presented approaches is close to two tendencies discernible in the spatial policies of cities,

Table 3a. Classification of selected models and conceptions of sustainable development, own compilation

Criterion	Models and conceptions
Spatial form of a city	- eco-city - compact city - green city - redesigning a city - externally dependent city - Fair Shares (equitable balance) city - MILU (Multi-Functional and Intensive Land Use) - new urbanism - smart growth
Quality of life and urban economy	- self-reliant city - community garden - just city - XXQ city

Table 3b. Classification of selected models and conceptions of sustainable development, own compilation

Criterion		Models and conceptions
proper internal structure	spatial structure	- eco-city - compact city - green city - redesigning a city - MILU (Multi-Functional and Intensive Land Use) - smart growth
	socio-economic structure	- self-reliant - slow city - community garden - XXQ city - just city - smart growth
proper relations between city and its region		- externally dependent city - Fair Shares (equitable balance) city - smart growth

sometimes termed *ecology within a city* and *the city in ecology* in the literature (Næss, 2001). One refers primarily to the traditionally understood protection of the urban environment and embraces such issues as care for a high quality of the air, the quantity of drinking water supplied to residents, and green areas in a city, which of course are still very important. In the other the city is perceived as part of a larger ecosystem, hence what is taken into consideration when planning its development are its relations with both, the immediate and a farther vicinity, and in the case of large metropolises, even international and global influences (Fig. 1).

A look at a city from a broader perspective than a local one has attracted the interest of many scholars, like Wong and Tang (2005), Kowalewski (2005), Olewiler (2006), Pincetl (2012), or Cobbinach et al. (2015). Naturally, those two approaches (*ecology within a city* and *the city in ecology*) are not mutually exclusive. What is more, it seems that the assumptions of sustainable urban development require a simultaneous adoption of both.

The perception of ecological relations in an urban system has consequences in its compact or dispersed building pattern and its spatial-functional structure resulting from the development model adopted. Each

of the models considered sets different directions in the planning of the spatial structure of newly built-up urban and suburban areas, which in turn crucially influences the sustainability conditions of the city (see Jenks, 2010). Each also has advantages and disadvantages that should always be considered in terms of the basic goals of sustainable development. In general, those goals are often reduced to the following (Næss, 2001; Mierzejewska 2006):

- 1) reducing per capita energy consumption in an area (e.g. a city) to a level meeting the criteria of the division of the Earth's ecological capacity at the global scale,
- 2) reducing the transformation of natural ecosystems and agricultural production spaces into investment areas,
- 3) minimising the consumption of materials detrimental to the environment,
- 4) replacing open cycles (linear metabolism) by closed cycles (circular metabolism), additionally designed to rely on local resources (Girardet 1992, 1993),
- 5) creating a healthy living environment for city residents (without pollution, noise, with a suitable number of green areas to help them keep emotional links with nature), and

- 6) creating a suitable social environment ensuring social development and affecting moral-ethical attitudes.

However, authors differ in what they see as goals or principles of sustainable urban development. According to Gibbs (2000), the chief principles of sustainable development are:

- ✓ quality of life (including and linking social, economic and environmental aspects),
- ✓ care for the environment,
- ✓ thought for the future and the precautionary principle,
- ✓ fairness and equity, and
- ✓ participation and partnership.

A slightly different, more ecologically oriented approach is taken by Heinberg (2010), who lays down five *axioms of sustainability*:

- 1) any society that continues to use critical resources unsustainably will collapse,
- 2) population growth and/or growth in the rates of consumption of resources cannot be sustained,
- 3) to be sustainable, the use of renewable resources must proceed at a rate that is less than or equal to the rate of natural replenishment,
- 4) to be sustainable, the use of non-renewable resources must proceed at a rate that is declining, and the rate of decline must be greater than or equal to the rate of depletion,
- 5) sustainability requires that substances introduced into environment from human activity be minimised and rendered harmless to biosphere functions.

However, this approach refers primarily to the sustainability of development which, as has already been mentioned, is a concept hard to use with reference to a unit like a city (Satterhwaite, 1997; Mierzejewska, 2015). A similar opinion is expressed by Koglin (2009), who claims that it is the global system that should be sustainable, which means that its individual parts need not be sustainable. What should be established are proper relations both within the system of a city and between the city and its surroundings, as treated more broadly by, e.g. Næss (2001).

The presented models and conceptions determine concrete measures that have to be taken in order to ensure each city a sustainable /balanced type of development. They involve:

- ✓ increasing the density of the population and buildings, but only to a level that would still guarantee its residents a high quality of life,
- ✓ mixing various land uses, naturally only up to a point when an excessive accumulation of various functions in an area could produce spatial chaos,
- ✓ revitalising degraded and dysfunctional areas,
- ✓ expanding urban greenery,
- ✓ moulding the city's spatial order, including its design and architecture,
- ✓ developing balanced forms of transport (public,

bicycle, pedestrian traffic),

- ✓ a modern system of waste collection, management and recycling,
- ✓ efficient energy management, including the use of renewable sources of energy and reducing heat losses (e.g. via thermal modernisation of buildings, the replacement of window frames), and
- ✓ increasing a city's diversity (primarily social, but also in its land-use pattern and in the natural sphere),
- ✓ the planning process accommodating the needs and opinions of all social groups, especially those that are weaker, poorer, etc.,
- ✓ better access of residents to high-quality public areas,
- ✓ increasing the city's self-reliance and its endogenous growth,
- ✓ supporting the local market, local products, traditions, etc.,
- ✓ developing social infrastructure favourable to the cultural development, innovativeness, creativity and entrepreneurship of residents, and
- ✓ developing an innovative economy based on knowledge and using modern computer techniques.

The above measures should help to improve the quality of life of city dwellers and ecological conditions in the city, and to reduce its transport needs and the dependence of the urban economy on its surroundings.

Among the above measures for the sustainable development of a city there is a high proportion of those concerning its spatial form. Making the spatial-functional structure of a city conform to sustainable development standards requires the adoption of a suitable development policy which, however, cannot be restricted to the planning of proper intra-urban relations, but should also see the city as an element of a larger ecosystem. Generally, the target is a compact city, but one that would guarantee a high share of green areas in the urban structure, easy access of inhabitants to physical and social infrastructure, and efficient transport networks, primarily public.

Giving a city a balanced form requires its authorities to work out a spatial development policy that will allow (Mierzejewska, 2007):

- ✓ increasing the height of buildings in the suburban zone and the population density in the city centre;
- ✓ giving existing buildings new users,
- ✓ regulating transport issues, especially giving priority to public transport, reducing transport-related areas (especially car parks), and constructing more walking and biking paths,
- ✓ changing the rules of developing suburban areas (e.g. by giving fewer permissions for building free-standing houses on individual lots, reduced funding of physical infrastructure, reducing transport-related areas, especially car parks),

and

- ✓ introducing public spaces to housing estates, primarily parks and recreation grounds that will allow their residents to engage in active and passive forms of recreation and establish social contacts.

Those are measures that will simultaneously boost the city's social productivity and economic efficiency while taking care of its natural environment and spatial order. However, what is crucial in sustainable development is not only setting proper development objectives, but also obtaining social acceptance for them, which may turn out to be very difficult (Mierzejewska, 2009). For many inhabitants of modern cities the ideal is often still a house with a garden in the suburbs and the freedom of going to places of goal attainment in a private car (Koglin, 2009).

## 5. Conclusions

The most popular way of understanding sustainable development is that given in *Our Common Future* (WCED, 1987). It seems hard, however, to apply it to a city, especially its management within limitations imposed by the natural environment. In the modern world, a city, especially a large one, is a supra-local central place performing the function of a driver of economic growth, and as such it has to rely on the ecological capacity of its immediate and farther hinterland. For this reason it is advisable to treat a city as a complex territorial social system in which the key role is played by a community controlling the territory it inhabits and the sustainable development of which is determined by a dynamic intra- and inter-system balance and a balance in its relations with the surroundings.

Some suggestions as to how to approach relations occurring within an urban system can be found in various models and conceptions of its sustainable development. Their abundance shows that there is no single, universal, correct model of urban development, a consequence of which is the necessity to seek a sustainable development path for each city separately.

Planning the sustainable development of a city requires an exact knowledge of individual elements of the urban system and the network of relations holding among them, the adoption of some assumptions and goals designed to achieve a balance in it, and an adjustment of those assumptions to local conditions. Therefore it is impossible to replicate even the most successful solutions worked out for a different geographical, natural, political, or socio-economic reality. Even so, it seems worth making use of theoretical achievements and practical experiences of individual countries and cities, both in moulding the spatial form of a city and in improving the quality of life of its dwellers and its economic conditions. In the

first case, the chief aim is curbing its spatial expansion by building a compact city and organising multi-functional quarters and housing estates within it, and in the latter case the focus is on a high quality of life of its dwellers, and this mainly involves a high quality of the natural environment and access to various types of goods and services, including public spaces. Naturally, of no little importance in such a balanced city is the empowerment of its residents and concern for a high level of environment-friendly economic development. Still, one should keep it in mind that this will always be a dynamic equilibrium.

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