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# CHANGES IN THE CITY SPACE AGAINST THE BACKGROUND OF THE SUSTAINABLE DEVELOPMENT CONCEPT: THE CASE OF OPOLE

## ZMIANY W PRZESTRZENI MIASTA NA TLE KONCEPCJI ZRÓWNOWAŻONEGO ROZWOJU (PRZYKŁAD OPOŁA)

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### Abstract

The concept of sustainable development is gaining popularity both in science and practice. It provides a basis for implementing actions and initiatives aimed at improving the living conditions of the urban population while respecting the natural environment. Decisions made by city managers regarding new projects should take into account economic and environmental effects as well as the voice of the local community. This is an extremely difficult task and its results may meet with approval or criticism. Nevertheless, the actions taken should reduce the problems faced by the city and its inhabitants. The conducted research was based on a descriptive case study as a qualitative research methodology and the method of observation and desk research as well as analysis of public statistics sources. The aim of this paper is to identify changes in urban space and to determine their importance in shaping sustainable urban development. The research scope included the elements of urban space and the directions of its changes from 2004 to 2020 in Opole city. The investment activities undertaken in Opole are to a large extent justified and follow the principles of urban sustainable development. However, more attention should be paid to the management of public squares and the construction of new housing.

**Keywords:** sustainable urban development, public space transformation, urban space modernization, Opole city

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## Streszczenie

Koncepcja zrównoważonego rozwoju zyskuje coraz większą popularność zarówno w nauce, jak i w praktyce. Jest ona podstawą do realizacji działań i inicjatyw mających na celu poprawę warunków życia ludności miejskiej przy jednoczesnym poszanowaniu środowiska naturalnego. Decyzje podejmowane przez zarządzających miastami dotyczące nowych projektów powinny uwzględniać efekty ekonomiczne i środowiskowe oraz głos społeczności lokalnej. Jest to zadanie niezwykle trudne, a jego wyniki mogą spotkać się z aprobatą lub krytyką. Niemniej jednak podejmowane działania powinny zmniejszać problemy, z jakimi boryka się miasto i jego mieszkańcy. Badania oparte zostały na opisowym studium przypadku jako metodologii badań jakościowych oraz metodzie obserwacji i *desk research*, a także analizie źródeł statystyki publicznej. Celem pracy jest identyfikacja zmian o charakterze przestrzennym oraz określenie ich znaczenia w kształtowaniu zrównoważonego rozwoju miasta. Zakresem badań objęto elementy przestrzeni miejskiej oraz kierunki jej zmian w latach 2004–2020 w mieście Opolu. Podjęte w mieście działania o charakterze inwestycyjnym w dużym stopniu znajdują uzasadnienie w zasadach zrównoważonego rozwoju i realizują je. Należy jednak zwracać uwagę na sposób zagospodarowania placów publicznych oraz wznoszenia nowego budownictwa mieszkaniowego, które ma możliwości korzystania z nowych technologii, odnawialnych źródeł energii.

**Słowa kluczowe:** zrównoważony rozwój miast, przekształcenia przestrzeni publicznej, modernizacja przestrzeni miejskiej, miasto Opole

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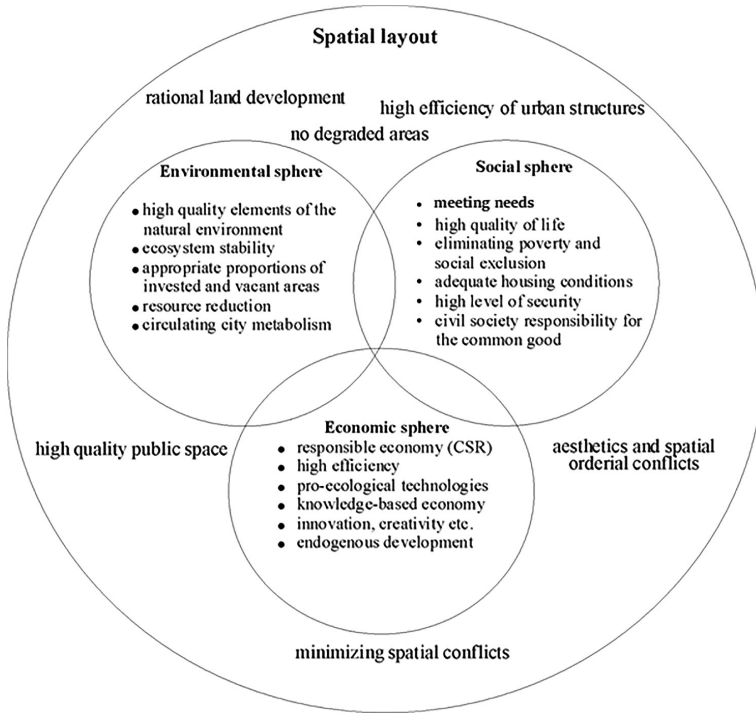
## INTRODUCTION

Cities are the main living area of the population and their development affects the creation of socio-economic potential. This process requires the use of natural capital and impact on the environment. Cities are an expression of the highest level of civilization. Currently, more than half of humanity lives in cities. It is in cities that people, economic activity, resource consumption and energy consumption, and emissions are concentrated. What is important are the transformations occurring in urban space, which directly and indirectly affect the functioning of the entire city as a coherent ecosystem. The development of a city depends on the implemented planning processes designed to coordinate this development, but also on bottom-up processes, which are the actions and decisions of various market participants (Stangel, 2013, p. 7). Whether a city is struggling with social, spatial or environmental problems and on what scale, depends on the implemented solutions and factors that determine its development. The aim of the paper is to identify changes of spatial nature in accordance with the assumptions of the concept of sustainable urban development. The research scope included the elements of urban space and the directions of its changes from 2004 to 2020 in Opole city.

A concept that is gaining in importance and whose implementation is aimed, among other things, at improving the quality of life in cities and protecting the

environment is that of sustainable development. The Brundtland Report published in 1987 by the World Commission on Environment and Development is considered to be the beginning of its popularization. The content of this document indicated, among others, the need to maintain the global socio-economic and environmental order, because only in this way development could meet the needs of the present without depriving future generations of the possibility of satisfying their needs (*Report of the World...*). The approach to the concept of sustainable development has evolved; nevertheless the concept implies the need to strive for balanced and sustainable development through economical and rational management of resources. For a city, the term “resources” means space, raw materials, energy and capital, but also so-called human resources, social capital or time (of inhabitants) (Stangel, 2013, p. 8). In the literature, it is often pointed out that there are three main dimensions of sustainability, or capitals: economic, social and natural also called environmental, or environmental-spatial (Elkington, 1994, p. 23; Moffatt, 2000, p. 359; Harris, 2003, p. 657; Ciegis et al., 2009, p. 28). In recent years, there has been a growing interest in environmental issues as well as in the principles of sustainable development, which stems from the need to respond to emerging problems of urban functioning. These territorial units currently require an interdisciplinary approach to the actions taken, because they significantly influence the transformation of the natural environment and are a significant source of pollution emissions. In addition, cities are also the largest consumers of energy, which makes it necessary to take a special approach to the topic of implementing technologies based on renewable energy sources.

Because cities develop on many levels, at different rates and with different characteristics, it is difficult to point to one universal concept of a sustainable city. There are many approaches to this issue in the literature. Their review indicates some common features: effective and economical use of environmental resources and broadly defined limitation and inhibition of undesirable human activities (Burton, 2000, p. 1969–2006; Bithas, Christofakis, 2006, pp. 177–189; Jencks, Jones, 2009; Jencks, 2019). The indication of some leading characteristics of a sustainable city should be individually determined taking into account the condition of the city, its character, the functions it performs and the needs of its inhabitants. The analysis of the subject literature (Mierzejewska, 2010; Rzeńca, 2016) also prompts to distinguish the characteristic features of a sustainable city attributed to the relevant spheres: natural, social, economic. Since cities do not function in a vacuum, but in space, it is important to distinguish a certain spatial system within which there are three other spheres of sustainable development (Fig. 1). Changes in particular spheres or dimensions of sustainable development influence the shape of the spatial system. For example, revitalization of degraded areas and giving them a new function simultaneously transforms the city space and the functioning of the space changed. Thus, it affects not only the socio-eco-



**Fig. 1.** Model of a sustainable city taking into account the spheres of functioning and spatial layout

Source: own elaboration based on literature (Mierzejewska, 2010; Indicators for Sustainable Cities, 2015; Rzeńca, 2016).

conomic sphere but also the spatial layout of the city. Bringing a degraded space back to life also changes the direction of movement of the urban population (the well-known example of Manufaktura in Łódź), thus influencing the functioning of the city and its ecosystem.

Selected concepts of sustainable city development consider to a large extent the spatial aspect. Examples of such concepts are the following: eco-city, compact city, green city, redesigning a city, external dependent city, new urbanism, smart city, ecosystem services, urban resilience, adaptative management. Each of these concepts emphasizes a different issue, the development of which should make the city function at its best. For the concept of sustainable development, it seems to be a kind of “bridge” between the other concepts, taking into account the needs of humans but respecting the limits of nature’s resilience.

The present predatory economies of many cities and the shift towards more consumerist lifestyles are making environmental changes more significant and have a major impact on climate change. Increasing levels of air pollution, inefficient rainwater management and many other factors mean that cities are faced

with the challenge of creating new urban structures. Against this background, new approaches to urban spatial management are gaining importance. City models based on an ecological approach become crucial in solving problems occurring in urban areas. The solutions proposed in the eco-city concept are also important here, as they involve a maximum reduction in the impact of urban structures on the natural landscape, a reduction in the consumption of materials and energy, as well as time and land (Matusik, 2017, p. 53). For the latter two elements, the concept of “walking distance” is important, which assumes that a sustainable urban space is one that contains all the necessary services and workplaces with cultural and recreation facilities, inside or in a close proximity to housing projects (Kronenberg, Bergier, 2010, p. 254). This is consistent with another theory of the compact city which assumes sustainable transport based also on smaller travel distances and reduced pedestrian traffic. The compact city suggests open space protection, high urban density, mixed land uses, revitalizing downtowns, central business districts with residential uses and high use of the public transit system (Kotharkar et al., 2012, pp. 7–9). A convergent model for these assumptions is the smart city model which supports ecological assumptions (Matusik, 2017, p. 52). The smart city concept assumes that a city should be a creative, sustainable area that positively improves the quality of life, creates a friendlier environment, and strengthens opportunities for future economic development (Winkowska et al., 2019, p. 2). There is no formal and widely accepted definition of a “smart city”, but it supports ecological and social principles and the improvement of the quality of services offered to citizens, while reducing operational costs of public administration (Zanella et al., 2014, p. 23).

Another concept of urban development is the concept of redesigning a city which is based on the remodeling of city space. There is a need to plan ahead and take into account the impact of today’s urban design on the experience of future generations (futurity). It is important to manage the environment appropriately by implementing projects that would improve the existing conditions and create manageable places people will want to care for (Carmona, 2001, p. 165). The literature also highlights the independence of cities from external flows and being more self-sufficient. Cities can decide to implement a policy of rebuilding their own natural capital stock and promoting the use of the local resources (Rees, William, 1997; Folke, et al., 1998). What emerges, then, is a model of externally dependent cities that is based on “excessive externalization of environmental costs, open systems, linear metabolism, and buying additional ‘carrying capacity.’” This model treats the city as a node extracting resources from an ever-increasing hinterland to satisfy its internal urban consumption, with little regard to the quality of waste produced by the city (Guy, Marvin, 1999).

Among urban development concepts, three of them – smart growth, new urbanism, and ecological city – are directly associated with sustainable development.

Smart growth and new urbanism have been adopted and are being implemented into development and planning goals and policies mainly in the US. In contrast, the green urban approach has been endorsed especially in Europe and is treated as desirable to urban development (Jepson, Edwards, 2010).

The main aim of the paper was to identify changes in the city space and analyze them in terms of the most desirable measures for a sustainable city, as well as to assess and determine the degree of their importance.

## **METHODS AND MATERIALS**

In order to achieve the aim of the study, the literature and concepts related to sustainable urban development were analyzed first. It was based on the subject literature, source documents and desk research. This provided the basis for identifying the assumptions of a sustainable city. The analysis of the assumptions of the concepts allows indicating the most desirable measures in the pursuit of sustainable city development. These are (Mierzejewska, 2015, pp. 5–11):

- increasing the density of the population and buildings,
- revitalizing degraded and dysfunctional areas,
- improving accessibility of high-quality public areas,
- increasing urban diversity (primarily social, but also in land use and a natural sphere),
- mixing different forms of land use,
- developing sustainable forms of transport (public, bicycle, and pedestrian)
- developing urban greenery,
- shaping the spatial order, including the order of urban arrangements and architecture of the city.
- recycling and introducing a modern system of collecting and utilizing waste,
- effective energy management, including the use of renewable energy sources and the reduction of heat losses

The measures taken in the city of Opole were analyzed and evaluated in terms of the mentioned assumptions. The last two specified assumptions were not analyzed due to lack of spatial context. Next, field research and observation of changes in selected urban spaces of the city under study were carried out in relation to the assumptions of the sustainable city concept. Field work was conducted based on two site visits (with descriptive recording of observations of selected elements of urban space), the preparation of photographic documentation and the identification of components identified for the purpose of individual analyses. The analyzed areas were visited before and after the investment. The individual observation method was adopted as the direct inventory method. The individual changes in space that have taken place as a result of infrastructure investments have been matched with particular assumptions of the sustainable city concept in the form



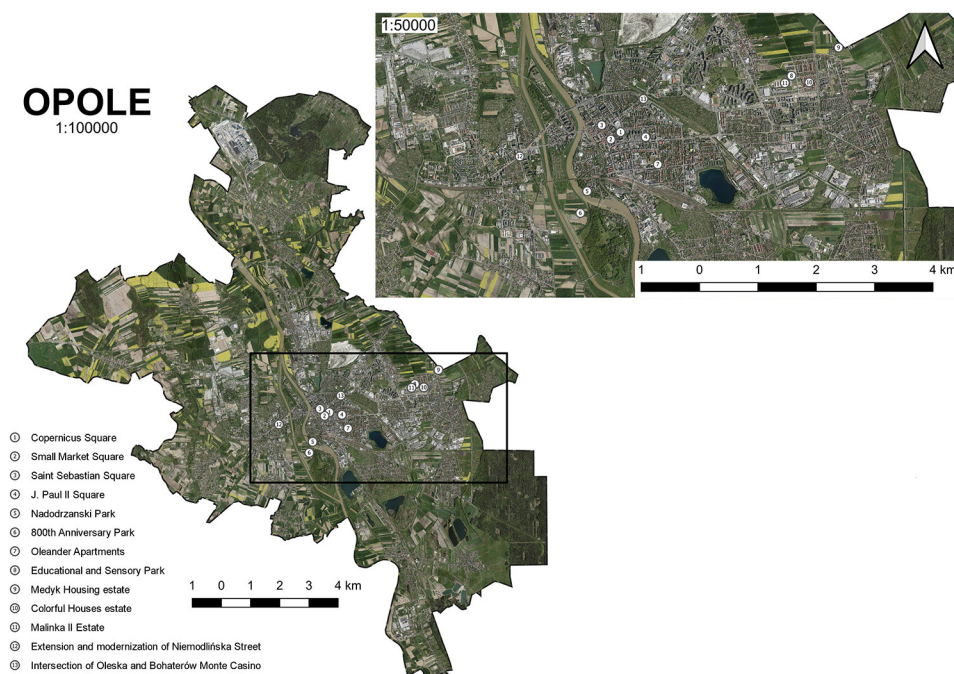
**Table 1.** Elements of space subject to transformation and the nature of changes

Element of space	Nature of change
public squares	modernization and change of function modernization only
residential substance	new buildings in city center new housing estates on outskirts of city
green areas	renovation of old parks (Bolko Park, Nadodrzański Park) establishment of new park (800th Anniversary Park)
transport infrastructure	increasing transport capacity, including implementation of bus lanes (expansion of transport nodes) building new network of bicycle paths

Source: own elaboration.

of a matrix. Next, the investments were assessed using the scale for implementing these assumptions.

Analysis of the measures introduced in the city allowed their classification in terms of their nature. A distinction was made between modernizing actions that were often based on renovating or refurbishing public spaces (squares in the city center and downtown). The appearance of new housing was also observed both

**Fig. 2.** Map of Opole city with analyzed elements of space

Source: Google Earth Map background (<https://earth.google.com/web/>, access: 11.10.2021)

in the center and on the outskirts of Opole. Moreover, one of the largest and most expensive investments in Opole is currently the reconstruction of the Opole-East road junction (not completed). The actions selected in this way (both completed and in progress) are considered to be among the most crucial for the city's development and changes in its space. These activities were grouped by space element and the nature of changes in Table 1. These elements are presented on the Fig. 2.

## **CHARACTERISTICS OF CHANGES IN URBAN SPACE IN OPOLE CITY**

Opole is a city where a number of investments have been carried out over the last 20 years to influence the spatial aspect of city development. These included revitalization and renovation projects aimed at improving the aesthetics of public spaces, as well as projects supporting the housing market. The latter concerned investments carried out mainly by private developer companies. Moreover, infrastructural investments were undertaken in order to increase the capacity of road traffic in the city. Some of them have not yet been completed.

### **Modernization, renewal of public spaces (public squares)**

The possibility of obtaining EU funds for revitalization enabled the city to undertake complex renovation of squares in its central part. Squares that had not been invested in for many years were not attractive public spaces. These areas are diverse. They differ in size, shape and surroundings. Regardless of this, their larger areas usually served as parking lots or access roads (Copernicus Square, St. Sebastian's Square, Small Market Square). Rarely did they serve as a meeting place for the city's residents or to organize cultural events. At this point, a brief description of them should be given.

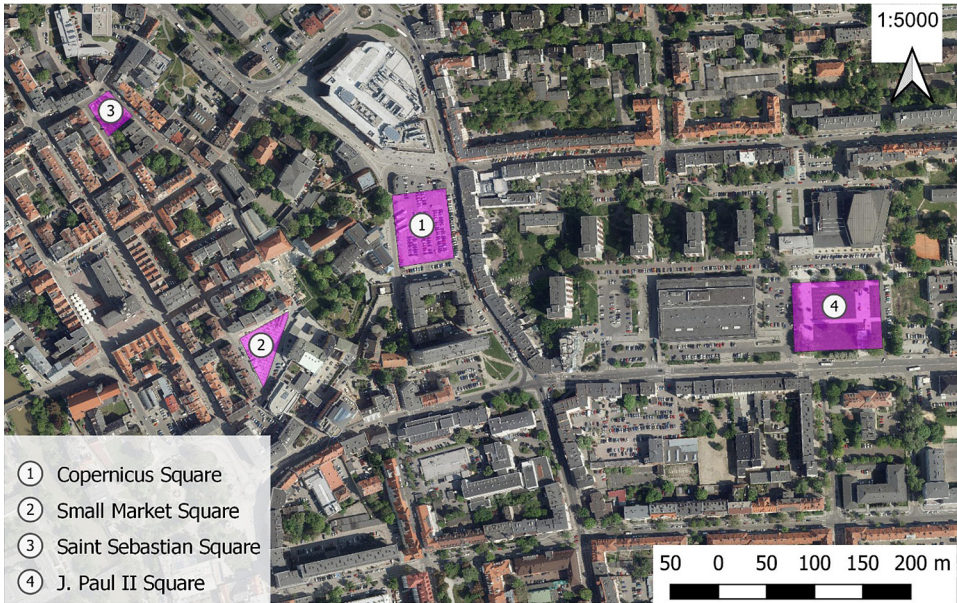
Analyzed elements of urban space are located in the city center and are located in close proximity to each other. The largest squares in terms of the surface area are John Paul II Square and Copernicus Square, which is clearly visible on the map (Fig. 3).

Copernicus Square is the largest of the analyzed squares and is located in the city center. In the past, it served as a marketplace and until 2019 as one of the larger municipal parking lots. The renovation of the square allowed for a new public space by constructing a two-level underground parking lot underneath (Fig. 4).

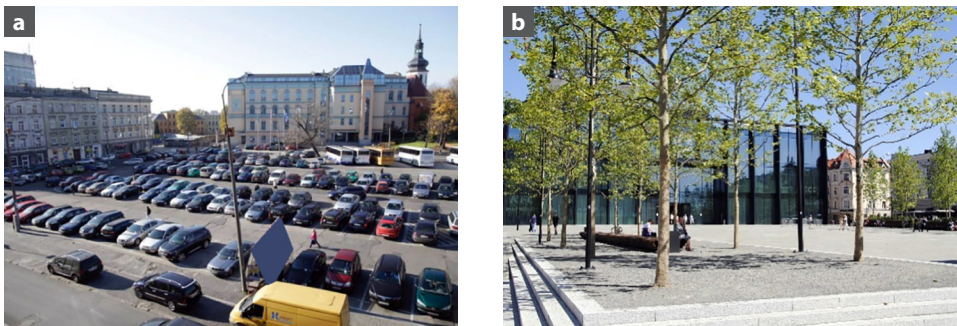
To make the place more attractive, sidewalk fountains were installed and new trees were planted. Currently, the square hosts cultural and entertainment events, and it is a place of leisure for people who visit the nearby shopping mall Solaris.

Opole has other squares located in the city center. These are Sebastian Square, John Paul II Square, and Small Martek Square. All of them were not renovated for many years until 2018. Activities consisted mainly in cleaning up the space by



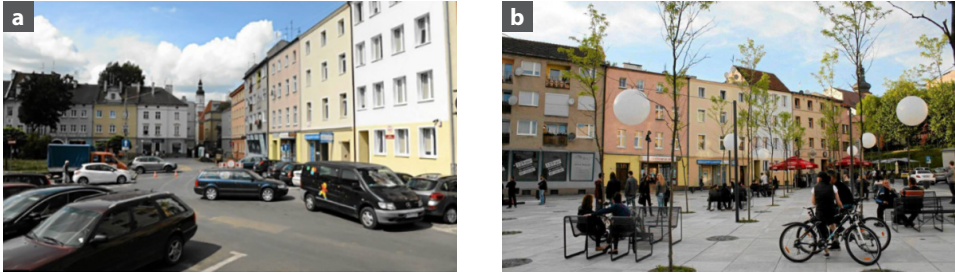


**Fig. 3.** Analyzed elements of space (public squares) in Opole city  
Source: Google Earth Map background (<https://earth.google.com/web/>, access: 11.10.2021)



**Fig. 4.** Copernicus square: (a) before renovation, (b) after renovation  
Source: photo a – [nto.pl](http://nto.pl), Sławomir Mielnik; photo b – Agnieszka Dembicka-Niemiec.

removing neglected greenery and laying concrete slabs with holes for plantings (Small Martek Square, St. Sebastian’s Square). In the case of Small Martek Square, there was a change in the function performed by this place. Before the renovation, Small Martek Square served as a city parking lot with a green area in the middle. Nowadays, it is a meeting place for residents of Opole, especially in the evenings, as the new investment has resulted in the location of pubs and clubs on the first floors of tenement houses, which display their beer gardens in the square area (Fig. 5).



**Fig. 5.** Small Market Square: (a) before renovation, (b) after renovation

Source: photo a – Marek Grocholski, [wyborcza.pl \(https://opole.wyborcza.pl/opole/1,35086,18523937,maly-rynek-to-centrum-nocnego-zycia-opola-jak-to-sie-stalo.html\)](https://opole.wyborcza.pl/opole/1,35086,18523937,maly-rynek-to-centrum-nocnego-zycia-opola-jak-to-sie-stalo.html); photo b – Jagoda Gorol, [wyborcza.pl \(https://opole.wyborcza.pl/opole/51,35086,18523937.html?i=3\)](https://opole.wyborcza.pl/opole/51,35086,18523937.html?i=3).

In close proximity to the Market Square in Opole is St. Sebastian's Square. The method of renovation of this place was quite similar to the method of modernization of the Small Market (Fig. 6).



**Fig. 6.** Saint Sebastian Square: (a) before renovation, (b) after renovation

Source: photo a – <https://opole7dni.pl/plac-sebastiana/>; photo b – Agnieszka Dembicka-Niemiec.

Analyzing the investment from the perspective of a sustainable city, one should pay attention to new elements that were not there before. Ground fountains have been located in the squares, which are an attraction for the youngest and add charm to the new space. However, they do not compensate for concreting the surface of the squares. Concrete surfaces contribute to the occurrence of heat island, which is considered a negative phenomenon. In summer, their heating is an additional source of heat, which is then not lacking in the city. The few introduced plantings, which are a source of shade, do not fully participate in the ecosystem of the city. Trees embedded in the concrete floor, under which there is hard, rocky ground, have no chance for proper growth of their root system, and their full participation in the ecosystem is limited.

In addition, the sealing of the area may contribute to an increase in the volume of rainwater runoff and its rapid concentration in other parts of the city. This is an adverse effect that has been occurring in many cities in recent years. Rainfall floods are often the result of heavy rains and rapid runoff from areas undergoing urbanization (Wojciechowska et. al, 2017).

A slightly different square that has also undergone a major metamorphosis in recent years is John Paul II Square formerly known as Theatre Square (Fig. 7).



**Fig. 7.** John Paul II Square: (a) before renovation, (b) after renovation

Source: photo a – <https://polska-org.pl/4788390,foto.html>; photo b – A. Dembicka-Niemiec.

Before the city authorities decided to renovate it, the area consisted of four green stretches of grass and flowers (Fig. 7a). Renovation of the Square took place while preserving the existing century-old trees (Fig. 7b). The space was cleaned up by separating the green area with fountains from the part of the square prepared for mass city events. Small infrastructure leaves much to be desired. Concrete, rounded shapes serving as benches do not seem to fulfill their function.

### **New housing development in the city center and on the outskirts**

The development of the city is also reflected in the emergence of new residential buildings. It is visible both in the inner city and on its outskirts. The appearance of new housing developments in the central part of the city is accomplished through the liquidation of old buildings that previously performed other functions (factory buildings, the House of the People's Movement) (Fig. 8).

This is a desirable action that should contribute to making the housing offer in the city center more attractive and have a positive influence on halting the urban sprawl process. Examples of such investments include Victoria House, George House and Oleander Apartments. There is no other investment of this type on the residential market in the city center. It is undoubtedly a response to the reported demand on the real estate market in Opole.

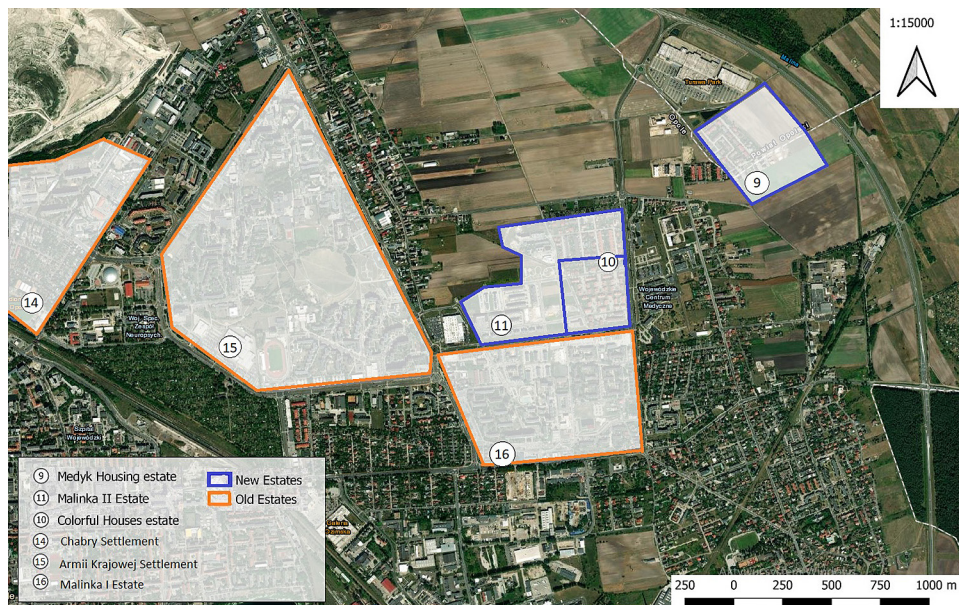




**Fig. 8.** Analyzed elements of space (new housing in the center of the city)  
Source: Google Earth Map background (<https://earth.google.com/web/>, access: 11.10.2021)

Another example of new housing development is the creation of the following estates: Medyk Estate, Kolorowe Estates and Malinka II (Fig. 9).

Former agricultural areas were turned into building areas. All these housing estates are located in the same part of the city and seem to be a well-thought-out planning decision, which resulted in new residential buildings, mainly up to four stories high, surrounded by service and commercial points, and green areas. As a result, car traffic between the new district and the city center has increased. The answer to this problem was the reconstruction of the main street connecting housing estates with the city center and the construction of two traffic lanes. While this solution was effective for a few years, it has recently become less efficient. The reconstruction of the street also included a bicycle path running almost



**Fig. 9.** Analyzed elements of space (new and old estates)

Source: Google Earth Map background (<https://earth.google.com/web/>, access: 11.10.2021)

from the central parts of the city to the newly built housing estates, which to some extent relieves the passenger car traffic.

What is disturbing is the phenomenon of cordoning off individual blocks of flats from one another, which is not conducive to integration of residents and creation of continuous public space. Such actions cause “space sectorization” and lack of possibility of free movement between blocks. There are few examples of desirable old quarter buildings. Actions consisting in demolition of old buildings and construction of new ones, as well as construction of compact housing estates contribute to the implementation of a compact city and, in a way, sustainable city. It is important that actions taken by cities are integrated and also cover new emerging needs connected, for example, with improving passageways.

### Renovation and creation of new green areas

Changes in park space were also identified during the study period. One of the oldest and largest parks in Opole was revalorized. This undertaking was appreciated and won the Opole Province Marshal’s Award in 2012. The award was granted for (<https://przestrzen.opolskie.pl/2018/07/rewaloryzacja-parku-nadodrzanckiego/>):

- very successful revalorization of an important area in the system of public green areas of Opole,



- model opening of the Odra river for city inhabitants, expected for many years,
- interesting and friendly design solutions adapted to the scale of public space, creating attractive places for meetings, recreation and leisure,
- diverse and creative solutions of small architecture adjusted to the needs of users,
- creating space for social and cultural activities.

Currently, it is a place of rest and recreation for city residents. The park is the largest coherent green area in the city and is called by the inhabitants the green lungs of the city.

Apart from the revalorization of old parks, Opole has also taken actions to create new green areas (Fig. 10a, b). An example of such measures is the creation of a new 800th Anniversary Park in the neighborhood of Nadodrzański Park



**Fig. 10.** Analyzed elements of space (public parks): (a) Nadodrzański Park and 800th Anniversary Park, (b) Educational and Sensory Park

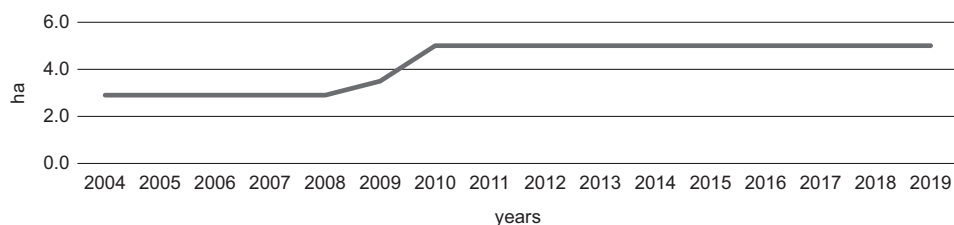
Source: Google Earth Map background (<https://earth.google.com/web/>, access: 11.10.2021)



(Fig. 10a). The effect of this investment is enlargement of the Green Lungs of Opole and the creation of new possibilities for spending free time (new playground, asphalt alleys for skaters and pedestrians, small infrastructure).

The second of the initiatives aimed at satisfying residents' needs for leisure and spending free time was to develop the area by creating an educational-sensory park integrated between new residential buildings of Malinka II and Kolorowy Settlement. Educational and Sensory Park was created for children and people with disabilities. Green area was constructed for social-educational and recreational needs. Designed vegetation fulfills primarily the didactic role as the source of knowledge about the various types of ornamental and utility plants and those in cultivation. This place allows you to learn and perceive the world with all your senses. The area is nearly one and a half hectares.

Of course, it is also worth noting the statistical data (Fig. 11) that indicate an increasing area of walking and recreational parks as well as an increasing trend in the share of green areas in the total area.



**Fig. 11.** The area of walking and recreational parks (ha) in Opole city in the years 2004–2019

Source: Statistics Poland: [stat.gov.pl](http://stat.gov.pl).

## Transport infrastructure

### Redevelopment of a transport hub and the creation of a transfer center

One of the most important roads in Opole used by heavy transport (trucks) and passengers is road 435, which connects the eastern part of the city with the south-western part. The crucial point is the Opole-East interchange. This place, due to the limitations of the old infrastructure (historic railroad station), forces the existence of only two lanes for vehicular traffic, creating the so-called “bottleneck” on Oleska Street. As a result, this street is notoriously jammed. The old historic railroad station is practically unused, as only freight trains run there. The redevelopment of this node is supposed to unblock an important intersection and improve the functioning of bus transport. A regional hospital is located in close proximity to the junction, and buses will be able to access it directly. The new transfer center is to include the construction of a bus interchange, Park&Ride, Park&Bike parking



**Fig. 12.** Analyzed elements of space (transport infrastructure) (a) scale 1:5000, (b) scale 1:3000

Source: Google Earth Map background (<https://earth.google.com/web/>, access: 11.10.2021)

lot, and an ITS system [[www.naszemiasto.opole.pl](http://www.naszemiasto.opole.pl)] (Fig. 12). The complexity of the project and its integration within various forms of transport should contribute to the use of new solutions by visitors as well as by residents. As a result, individual traffic should decrease. This investment changes the space to a great extent. Before the construction work could begin, the area had to be prepared by clearing it, which involved, among other things, cutting down old trees located along the tracks and traffic routes. Such an action was unavoidable with such a large-scale investment. Another negative effect is the reduction of some biologically active areas because of adopting concrete technical and construction solutions.

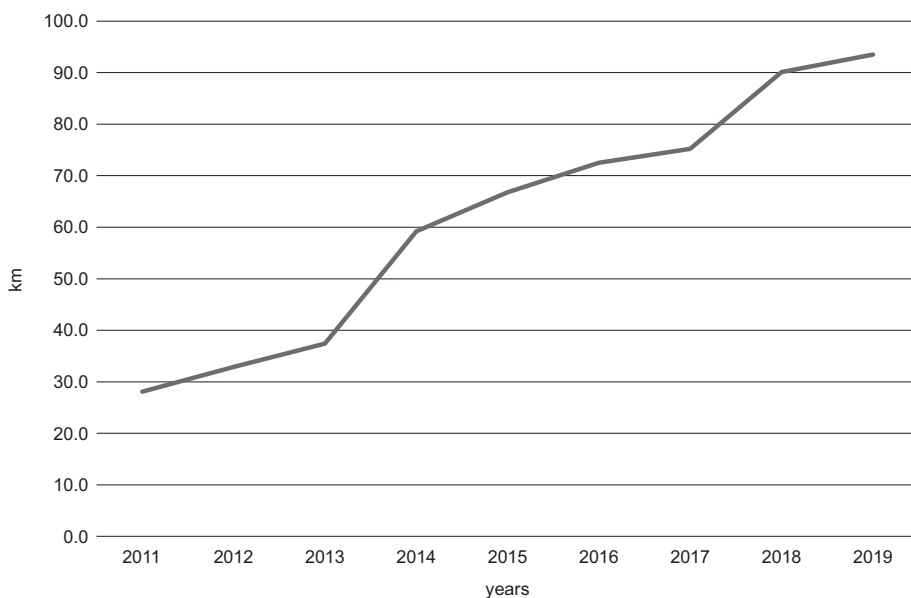
### Extension and modernization of Niemodlińska Street

The undertaking consisted in the reconstruction of Niemodlińska Street (Fig. 12a), demolition of the existing bridge and construction of the new one over the Ulga Canal in Opole. It is the main traffic route connecting the western part of the city. The main natural barrier in Opole is the Odra River, which makes movement difficult. The scope of the investment included the demolition of the existing and the construction of a new road bridge with a roadway, footpath and cycle path on

the south side, the construction of a new footbridge north of the new bridge with a pedestrian walkway and cycle path and the modernization of street lighting. The investment was part of the “Safe Transport in Opole” project co-financed by the European Union under the Opole Province Regional Operational Programme for 2014–2020. This investment is important in terms of organizing the traffic paths for cyclists, pedestrians, buses, and cars. A bus lane has also been planned to give priority to public transport. The action was to increase the attractiveness of public transport by reducing the travel time for city buses.

### Building a new network of bicycle paths

Every measure aimed at encouraging city dwellers to use bicycles as a means of transport is a desirable one. These actions include mainly the construction of road infrastructure in the form of bicycle paths that ensure safety and easy movement (Fig. 13).



**Fig. 13.** Length of the cycle paths (km) in Opole city

Source: Statistics Poland: [stat.gov.pl](http://stat.gov.pl).

It is therefore important to create a network of bicycle paths connecting different points in the city. In Opole, this policy is successively implemented, creating the possibility to communicate with an increasing number of places in the city by bike. The increasing length of bicycle paths are evidenced by statistical data which show that in 2011 there were about 30 km of bicycle paths in the city, now the length is 93.5 km. City residents are increasingly using bicycle transport.

## ASSESSMENT OF CHANGES IN THE URBAN SPACE

Actions taken in the city of Opole have been analyzed for their positive and negative impact as part of the implementation of sustainable development. The impact of each investment is summarized in Table 2 and the nature of the action is also included.

**Table 2.** Characteristics of actions taken and their impact on the background of sustainable development

	Action	Nature of action	Impact	
			Positive	Negative
Public squares	renovation of Copernicus Square	renovation of square, change of use function, revitalization of dysfunctional areas	higher level of aesthetics and attractiveness of place and city parking lot – enlarged and moved underground, new space for organization of events, new place for spending free time, fountains and place for children	increased water run-off
	Renovation of Saint Sebastian Square	revitalization of degraded and dysfunctional areas	higher level of aesthetics, new place to spend free time, increase in usefulness of place	reduction of green area
	Renovation of John Paul II Square	renovation of square, increasing city's diversity in terms of space use	renovation of space, meeting place for residents, increase of aesthetic level, increase in usefulness of place	
	Revitalization of Small Market Square	renovation of square, increasing city's diversity in terms of space use	successful revitalization of space, meeting place for residents, increase in usefulness of place	Roots of trees do not participate in the city's ecosystem because they are artificially planted into hollows in the hardened concrete ground.
Parks	renovation of Nadodrzanski Park	developing urban greenery, improving access to high quality public areas	successful revalorization of important area in system of public green areas in Opole, new planting	

	Action	Nature of action	Impact	
			Positive	Negative
Parks	Construction of 800th Anniversary Park	development of urban greenery, increase of green areas	new recreation and leisure space, increase in usefulness of place	
	Construction of Educational and Sensory Park	developing urban greenery, mixing different forms of land use	new green space to meet needs of residents in new housing developments, increase in usefulness of place	
Housing	Construction of Oleander Apartments		countering urban sprawl, no need to build new infrastructure	No renewable resources were used
	Construction of Victoria House and George House	increasing population and housing density, revitalization of degraded and dysfunctional areas		(solar panels, photovoltaic panels, heat pump).
	Construction of new housing developments on outskirts of city		diversified forms of housing, providing access to services for new residents and green areas	lack of school facilities
Transport infrastructure	construction of bicycle paths	increasing population and housing density, revitalization of degraded and dysfunctional areas	relieving car traffic	
	Extension and modernization of Niemodlinska Street	development of sustainable forms of transport	implementing two lanes, bicycle paths, space for pedestrians, increasing accessibility of Zaodrze District	possible downward spiral of mass transport
	Intersection of Oleska and Bohaterów Monte Casino	development of sustainable forms of transport	increasing capacity interchange to encourage use of public transport, eliminating traffic paralysis in area, encouraging people to leave their vehicle outside city center, reduce emissions by encouraging use of public transport	significant felling of century-old trees, significant landscape change, possible public transport, death loop phenomenon

Source: own elaboration.

## Evaluation of analyzed changes

The undertaken measures were evaluated in terms of their assumptions and the most desirable actions in pursuit of sustainable development of the city. The evaluation of the presented activities is shown in Table 3.

The analysis of the matrix was made in two ways. Firstly, in order to indicate the highest importance of individual investments in the implementation of a sustainable city (horizontal analysis) and secondly, to identify which assumptions of a sustainable city are implemented to the greatest extent (vertical analysis). The

**Table 3.** Matrix of the investments implemented and the assumption of city sustainable development (evaluation)

Action		Increasing density of population and buildings	Revitalising degraded and dysfunctional areas	Improving accessibility of high quality public areas	Increasing urban diversity (primarily social, but also in land use and natural sphere),	Mixing different forms of land use	Developing sustainable forms of transport	Developing urban greenery	Shaping spatial order, including order of urban arrangements and city architecture	Sum
Public squares	1.	0	2	4	2	0	0	0	2	10
	2.	0	4	4	2	0	0	0	2	12
	3.	0	4	4	2	0	0	0	2	12
	4.	0	4	4	2	0	0	0	2	12
Parks	5.	0	0	0	4	0	0	4	0	8
	6.	0	0	0	4	4	0	4	0	12
	7.	0	0	0	2	4	0	4	0	10
Housing	8.	4	4	0	2	0	0	0	0	10
	9.	4	4	0	2	0	0	0	0	10
	10.	2	0	0	2	2	0	0	2	8
Transport infrastructure	11.	0	0	0	0	0	4	0	0	4
	12.	0	0	0	0	0	2	0	0	2
	13.	0	0	0	0	0	4	0	0	4
sum		10	22	16	24	10	10	12	10	

Source: own elaboration.



Legend:

	high importance for the implementation of the concept of sustainable development (4 point)
	medium importance for the implementation of the concept of sustainable development (2 point)
	negligible importance for the implementation of the concept of sustainable development (0 point)

1. Renovation of Copernicus Square
2. Renovation of Saint Sebastiana Square
3. Renovation of John Paul II Square
4. Revitalization of Small Market Square
5. Renovation of Nadodrzanski Park
6. Construction of the 800th Anniversary Park
7. Construction of Educational and Sensory Park
8. Construction of Oleander Apartments
9. Construction of Victoria House and George House
10. Construction of new housing developments on the outskirts of the city
11. Construction of bicycle paths
12. Extension and modernization of Niemodlińska Street
13. Intersection of Oleska and Bohaterów Monte Cassino

results indicate that the most important investments were those related to public squares and newly created city parks. The creation of new green areas contributed to the satisfaction of the local community's needs for recreation and leisure, and allowed preserving and creating biologically active areas. This is a desirable action in the development of the city. In turn, the vertical analysis indicated the greatest impact related to increasing the diversity of the city (primarily social, but also in land use and a natural sphere). The different forms of land use and the varied offer of housing make it possible to diversify land use.

A sustainable city is one that enables a balanced lifestyle of its inhabitants and optimal choices in various aspects of life (both life decisions on important matters, such as choosing an apartment or a school for a child as well as choosing a store, a restaurant or a recreational or green area). In order to be sustainable, the city development should take into account the possibility of depletion of natural resources as well as the impact on the environment. The investments that have been carried out in Opole are, to a larger or smaller extent, in line with the assumptions of a sustainable city in the spatial aspect. When analyzing changes in the city space, it is necessary to take into account a holistic view and not only point investments. Therefore, the purpose of a particular investment should be kept in mind. If the renovation of public squares is aimed at increasing their use, improving their aesthetics, and revitalizing the space, then this space should be changed in accordance with the current canon, provided that there are green areas in the near vicinity that are important for the functioning of the city's ecosystems. In the

case of Opole, Small Square and St. Sebastian's Square are located in the vicinity of the market square and about 500 m from the Odra River boulevards which are green areas. Therefore, changes in the city space should take into account the economic, social and environmental aspects. Only then one can talk about the sustainable development of the city. By treating the environmental resources as the most important, dominating over meeting the social and economic needs of the city, we talk about urban eco-development.

Infrastructural investments, especially those connected to transport, are a natural element of the city's development. Opole is not a large city and does not suffer from hourly traffic jams compared to larger agglomerations. However, as a result of its development, the city authorities have decided to rebuild extensively one of the main intersections in the city center. The construction of an interchange center combining different forms of public and private transport is a welcome solution. And while the expected effects of easing congestion at this location will be satisfactory in the coming years, there is a risk of a downward spiral of mass transport. The construction of new roads makes them attractive for car users, so people are more willing to use this type of transport. As a result of an increase in the number of cars, road congestion is increasing again and we are constantly faced with the challenge of building new roads. At the same time public transport is losing its attractiveness (Kronenberg, Bergier, 2010, p. 256). Of course, this threat may or may not occur as long as, in addition to the new city interchange, public transport connections are well organized.

The transformation of the city space included green areas aimed at satisfying the recreational needs of the residents, but also at increasing the biologically active surface area and increasing the diversity of green area forms. The renovation of public squares revitalized the city center economically and socially, raised the quality of public areas, and increased the usability of public spaces. In the case of residential areas, new land development is usually chaotic and results from investors' activity who occasionally buy up land. In Opole, housing developments are pre-planned and included in planning documents, and with the development of new housing estates an urban structure is created that is spatially, functionally, and socially appropriate. Even if it is not possible to meet all the needs of the new residents, they can use the social infrastructure of the neighboring settlement. Therefore, the creation of new housing estates with planned green areas, transport infrastructure, bicycle paths connecting with the city center, and service facilities should be treated as the establishment of a sustainable and "permanent" urban structure. It is important that the construction of new housing substance also takes into account the use of renewable energy sources. Unfortunately, at present, these solutions are not implemented by developers. We should think about legal and organizational solutions that can be proposed by the local government in the form of incentives for developers to consider sustainable construction.

The analysis shows that investment activities undertaken in the analyzed city often have the right direction. Nevertheless, more attention should be paid to the possibilities of using new solutions in the field of, for example, renewable energy sources or greater greening of public squares.

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