Development of Green Areas of the Krakow Metropolitan Area as a Planning Problem

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Abstract. Spatial planning is one of the most important instruments that can ensure balance between developed areas and open spaces. Planning regulations define the quality standards of the living space for both people and nature. Creating green infrastructure inside strongly urbanised centres and connecting it with external areas is a problem in urban planning in terms of the integration of local activities and the regional level of spatial policy. The objective of the paper is the presentation, on the example of Krakow, of the problems that exist in the scope of creating a coherent system of green areas on the metropolitan scale, including both the given city and the surrounding, communities against the background of the current planning conditions. The analyses of the effective planning documents at the community level allowed the determining of the main barriers that restrict the continuity of greenery systems. These primarily include the assigning of large areas in neighbouring communities for development, mostly housing, located directly at the border of the city. This applies in particular to the communities located in the southern part of the analysed area. Studies regarding the current condition of the development of community areas in many places indicate potential possibilities of maintaining green corridors or restricting development intensity in a given area. However, the lack of economic benefits for communities and their residents from maintaining agricultural areas greatly affects the spatial policy of local authorities. The attractiveness of the suburban zone for inhabitants of Krakow as a place of residence, increasing prices of suburban properties are additional arguments. The development directions of the Lesser Poland voivodship on the regional scale are vague. They do not define specific rules for the system of connections between areas of greenery that feature varied intended use. The statutorily mandatory metropolitan study, developed as a consequence of the voivodship plan for the voivodship capital city and its functional area includes the components necessary for spatial, social, and economic coherence. These include areas precious in terms of natural qualities and landscapes covered by legal forms of protection resulting from the act on the protection of nature and supraregional and regional ecological corridors. There are no conclusions as to the effect of legally protected open areas on the quality of the condition of the environment in metropolitan centres. The attractiveness of Krakow, bringing in new residents, investors and tourists, is levelled by very unfavourable indicators in terms of environment quality. One of the factors that can improve this situation is the development of the greenery system on the metropolitan scale, combining various forms of use of its individual elements, ensuring better access to open areas and cleaner air for the inhabitants. This requires new methods of delineating green infrastructure and provisions in planning documents. The proposal of its implementation, open to broad consultations, will provide an opportunity for the effective carrying out of the plan.
1. Introduction

Green areas are an inseparable element of urban space. They fulfil biological, health-related and recreational functions. Their effect is a lowering of air pollution, an increase in surface runoff retention, local climate improvement, the possibility of regenerating strength and the recreation of residents. From the point of view of society, they constitute attractive public spaces. They are also a factor that co-creates the composition of urban complexes. They are perceived as a citygenic factor [1]. And finally, they have an economic role as agricultural areas. In large agglomerations, the intense urbanisation of suburban areas and the increasing densification of the built environment in urban areas worsen the living conditions of residents and cause the disappearance of natural systems. There arises the necessity to develop green areas not only inside structures featuring compact built-up areas, but also beyond them, as a task of spatial policy that is being conducted within the range of the influence of a large city.

Krakow, the second-largest city in Poland and at the same time belonging to the most polluted ones, requires an innovative manner of solving environmental problems, which undoubtedly include the provision of green infrastructure on the supralocal scale. [2] [3] In terms of spatial planning, the legal requirement of the special treatment of a voivodship capital city and its zone of influence as a functional area described as a "metropolitan region", for which a separate planning document is to be drafted, is a beneficial factor [4]. The factual content of this document is limited in terms of subject, but it can nevertheless constitute a basis for a discussion on the precepts of establishing green networks on this scale.

The research presented in the article is meant to provide an answer to the scope of the possibility of the development of such systems while taking into consideration the regulations contained in current planning documents at the local level, for all communities (gminy in Polish - transl. note) which make up the metropolitan area of Krakow.

2. Characteristic of the area covered by the research

The range of the impact of large cities upon their surroundings is constantly being monitored. Changes in terms of travel time to places of work and services, as well as the distribution of areas of economic and construction-related activity are being observed. The delineated area of mutual connections between the city and its supporting areas in the form of a "functional area", was defined for voivodship capital cities - with the purpose of conducting spatial policy in Poland - as a "metropolitan area". In the currently updated Lesser Poland Voivodship Spatial Development Plan, it was defined as the Krakow Metropolitan Area, abbreviated in Polish as KOM (Krakowski Obszar Metropolitalny - transl. note). It covers the city of Krakow along with 16 communities [5]. These include 5 urban communities: Skawina, Wieliczka, Niepolomice, Krzeszowice, Świątniki Górne, as well as 11 rural communities: Wielka Wieś, Zielonki, Zabierzów, Liszki, Jerzmanowice-Przeginia, Kocmyrzów-Luborzyca, Igołomia-Wawrzeńczyce, Michałowice, Czernichów, Biskupice and Mogilany. The area, which occupies 1 483 km² and constitutes 9.8% of the surface area of the voivodship, is inhabited by 1,1 million people.

Krakow - a voivodship capital city inhabited by around 767 thousand people, plays the part of a supraregional academic, cultural and tourism centre. It has the second-largest international airport in the country. At the same time, it belongs to the group of cities that suffer from very heavy air pollution, which significantly lowers its attractiveness as a place of residence.

From among the communities highlighted as the most intensely tied with the city, supraregional functions appear in Balice, which is in the vicinity of the airport, as well as the urban communities. Rural communities with mixed forms of use have been dominated by Krakow's vicinity and their development is primarily aimed at the expansion of housing and local entrepreneurship. Due to the qualities of the natural environment, they are, to a degree, functionally varied. The north-eastern and eastern communities feature intense horticultural production in relatively small farms. The average size of an agricultural farm for communities with the greatest horticultural production is: in the community of Igołomia-Wawrzeńczyce - 2.9 ha, while in Kocmyrzów-Luborzyca - 2.21 ha. The
south-western communities are becoming economically active, using their very good circulatory accessibility and the vicinity of the airport, while those located on the southern side of the city are dominated by the development of single-family housing. Agricultural areas are disappearing in all communities.

The research presented in the article refers to the Krakow Metropolitan Area. Planning work for the entirety of this area has not yet been undertaken by the voivodship authorities due to the lack of a basis in the form of the passing of an approval of a new voivodship plan.

3. The natural environment as the basis of the system of greenery on the metropolitan scale of the area of Krakow

The natural resources that are the basis for the shaping of the greenery system are comprised of: actively cultivated and unused farmland, forests, the recesses of river valleys and the greenery arranged for the purposes of the recreation of residents. The greenery of Krakow and its surroundings can be divided into:

a) areas of exceptional natural and landscape qualities. These are located to the west and south-east of Krakow, partially encroaching into its borders. The following areas among them have been placed under large-scale forms of environmental protection: the Ojców National Park, the Jurassic Complex of Landscape Parks: Bielany-Tyniec, Dłubnia, "Krakow Valleys", Rudna and Tenczyn parks; areas protected under the Nature 2000 programme: Czerna, the Prądnik River Valley, the Jurassic Valleys, Near Grobla, the Niepolomice Forest.

b) river valleys. The Vistula River Valley belongs to a group of ecological corridors of international significance. Small rivers flow into it in the area of Krakow: Sanka, Rudawa, Białucha - Prądnik, Dłubnia, the Suchy Jar (Kanar) canal, Potok Kościelnicki (Kościelnicki Stok), Sidoranka, Potok Kostrzecki, Potok Pychowicki, Wilga, Serafa, Podłężanka.

c) forest complexes. Larger forest complexes belong to areas placed under environmental protection. Forests are also present in the hilly areas located to the south of the city, but these are small complexes divided by built-up areas.

d) farmland belonging to the highest soil quality classes. They are located in the eastern and north-eastern part of the area under discussion. They are largely used by farms which conduct intensive horticultural production.

e) the greenery of Krakow. Open areas with different forms of development occupy, in total, around 55% of Krakow's surface area. This includes arranged greenery: parks, green squares and greenery in housing estates amount to 5.1%, while forests amount to 4.3%. Fortress greenery that accompanies the city's nineteenth and early twentieth-century fortifications (both historical and adjacent greenery) occupies 3.3% of the city's surface area. The city is crossed by the Vistula River Valley - which is connected with the valleys of its tributaries - along its east-west axis. It connects the Jurassic Landscape Parks Complex, which is an area featuring much natural beauty and enters the city from the west, with the Niepolomice Forest, which is located to the east and which partially covers the community of Niepolomice, which belongs to the KMA.

The potential of green areas, especially those under large-scale forms of nature protection, is a good basis for the development of mutually connected "green networks".

4. Green areas in spatial planning documents

4.1. The spatial planning system in Poland

According to the currently enforced legal state in Poland, the spatial planning systems includes the state level (national spatial development concept), the voivodship level (the voivodship spatial development plan), that of the metropolitan region (metropolitan union spatial development conditions and directions framework study, also called a "metropolitan study") and community level (community spatial development conditions and directions study, drafted mandatorily for an entire community, as well as local spatial development plans that can cover fragments of any size). The greatest legal force is that of the local spatial development plans, which have the status of local law. [4]
The requirement of providing protection to environmental resources exists at every level of planning. This primarily includes taking into consideration the accepted precepts of maintaining areas of the protection of nature, ecological pathways, soils of the highest quality classes, forests, waters and mining resources. The requirements of the protection of the landscape are also being taken into consideration to an increasingly greater extent. The degree of the precision of the regulations for these areas is associated with a plan's scale. One additional requirement at the level of the community is the determining of a minimum biologically active surface area ration for all areas assigned for construction. The standards required of areas of arranged greenery, as well as the ratio of biologically active surfaces for each form of use is determined individually when preparing specific planning documents.

The planning of systems of greenery within the metropolitan area defined for Krakow requires the taking of regulations for these areas featured in plans of various levels into consideration.

4.2 Development directions of green areas in national-level and regional planning

The National Spatial Development Concept approved in 2011 [6] considers the main natural system to be areas covered by the Nature 2000 programme, national parks, national and international ecological corridors and areas which concentrate within them the greatest natural qualities. It also features the establishment of "urban green ring systems for the functional areas of metropolitan and regional centres" for cities with over 100 thousand inhabitants. This is an indication for the establishment of such a ring for the Krakow Metropolitan Area.

The still-enforced Lesser Poland Voivodship Spatial Development Plan was adopted in 2004. Due to some of its provisions being no longer up-to-date, a new plan has been drafted, which is currently in the final stages of proceedings [5]. The directions of the protection of natural resources contained within it focus on the expansion of legally protected areas and their proper development. The continuity of natural systems is to be ensured by connections using ecological pathways, delineated along river valleys. Concerning areas outlined in the aforementioned plan of the Krakow Metropolitan Area, the necessity of establishing interconnected arranged green areas, which are meant to lead to the solving of the problems of air pollution, providing conditions for the city's cross-ventilation, was adopted. The basic role here is to be played by the appropriate distribution of built-up areas and the protection of greenery. The "metropolitan study" that is to be developed on the basis of the Lesser Poland Spatial Development Plan is primarily meant to determine the precepts of the development of the transport network and point to the maximum need for new areas of development in its provisions, however, systemic pro-environmental efforts, particularly a regime of the securing of an appropriate amount of green areas, could become necessary in the planning of the development of this area in the near future.

4.3. Spatial regulations for the shaping of open areas at the community level

4.3.1 The City of Krakow. The Spatial Development Conditions and Directions Study for Krakow was drafted in 2014. [7] The document defines the line that separates areas assigned for construction from open areas. Open areas include two categories of areas of greenery: arranged and unarranged. Areas of arranged greenery, apart from different forms of park greenery, also include didactic, historical and allotment gardens. Unarranged greenery includes forests, farmland, as well as meadows and the biological envelope of rivers. The basic objective for the layout of Krakow's greenery is the preservation of the corridors of river valleys supported by mixed-use open areas. The Vistula - the main river that flows through Krakow, creates a green belt supplemented by the wedges of the valleys of its tributaries that connect with it.

The study is the basis for the development of local plans. Due to the need to protect open areas from being built up, important greenery complexes, including parts of river valleys, have had plans developed for them. However, the long completion time of local spatial development plans, their reach and staging has resulted in the fact that developments leading to the fragmentation of larger, non-built-up fragments of the city could not have been constrained.
The increasing problem arising from the processes of environmental degradation that are typical for large cities (air pollution, limited surface runoff retention capacity, the heat island effect, noise) places the requirement of constraining the pressure of development on areas of greenery. Threats to the city's cross-ventilation corridors caused by excessively liberal provisions in the study have contributed to initiating another amendment of this document.

The sizeable document prepared in order to address the city's needs called "Directions of the development and management of areas of greenery in Krakow for the years 2017-2030" [8] is meant to point out methods of greenery management as a part of existing systems. It also has the character of a recommendation for specific solutions in the successive edition of the study.

4.3.2. The communities surrounding Krakow. Spatial policy belongs to a community's own individual tasks and community authorities make decisions regarding the manner of its development. Planning documents for communities are updated primarily in terms of development activation which ensures economic progress. Changes that are meant to provide adaptation to new needs are often made only in fragments of a community. There is no requirement to coordinate documents with neighbouring areas in terms of time. In the majority of communities, when preparing designs for the purposes of spatial planning, the main, overarching task is the shaping of the structure of areas assigned for construction.

Open areas outlined in spatial development conditions and directions studies of individual communities are mainly the result of the characteristics of the natural environment that differentiates land use conditions. These include the shape of the terrain, river networks and forests. They are determined by requirements of preserving the most valuable elements of the natural environment, as well as providing safety from flooding and landslides. Agricultural areas are not being effectively used. The departure from agriculture-related professions among the residents of the communities surrounding Krakow is the argument that community authorities give for their transformation into buildable land. The most durable elements of green areas are forests, as well as river valleys. Some communities decide to introduce additional afforestation in order to supplement pre-existing forest complexes. This phenomenon can be observed in areas of landscape parks and their buffer zones. Areas that have been exempted from construction in the spatial planning documents of communities, listed together, constituted the main subject of the research.

5. Research scope
In order to verify the possibilities of the establishment of a green infrastructure system, open areas for the entirety of the KMA outlined in the plan of the voivodship (for 17 communities) were compared against each other. They included all the areas that had been defined in planning documents as exempted from construction. They included: forests, farmland, river valleys, arranged greenery, historical parks, allotment gardens, recreational areas. Water reservoirs and currently unexploited deposits of natural resources were also taken into consideration. The planning documentation that was the basis for the analysis included local spatial development plans, provided that they encompassed the entire area of a community. The spatial development conditions and directions study was taken into consideration when plans were fragmentary or had lost their validity. It should be mentioned that 10 of the communities under discussion had local plans in effect. Most of these documents were prepared or amended in the years 2013-2016. However, there were those which were conducting a plan amendment procedure during the time of the study. If the stage of the procedure had indicated an adoption of the document in the immediate future, the draft of said document was included in the research - the condition was that the consultation stage by all the institutions outlined in the procedure had to have ended, assuming that any possible supplementation would not significantly breach the accepted development principles. The approach to the searching of future possibilities of shaping systems of open areas through verifying the target state of development is essential as the communities being discussed are characterised by high development dynamics. Currently, open areas, especially those featuring agricultural forms of use, are more expansive, however, in a future perspective, they will be built up in accordance with the spatial policy adopted by community authorities, expressed in
spatial planning acts. While the carrying out of these projects will take many years, due to the continuity of the planning process, the possibility of having areas assigned for construction purposes being exempted from a plan is very limited.

The verification of all areas available for the establishment of greenery systems provides an overview of their size, distribution and accessibility. Pointing the target-planned state as the main subject of the research was based on rational assumptions that these areas, at least in the long term, could still be available for use. Particular attention was paid to areas of the border between Krakow and its surrounding communities as the points of egress of open areas outside of the city, as well as of their further continuation.

6. Results and discussions

![Image](image-url)

**Figure 1.** Structure of the open areas of the Krakow Metropolitan Area,

1- the boundaries of the communities, 2- open areas in planning documents of the communities, 3- radius of access from the city centre 10 km, 20 km, 4- areas covered by legal forms of nature protection, 4- parts of areas covered by legal forms of nature protection- Ojcowski National Park, 6- protective buffer zones of Landscape Parks

The spatial planning documents for the area under analysis showed the differing forms of the expectations of communities regarding their future development, resulting from both the conditions of the natural environment and the spatial policy of local authorities. Their comparison in terms of expected sizes of areas excluded from construction has been shown on figure 1. It also features an indication of the borders of the most naturally precious areas covered by legal forms of protection, as
well as the scope of their accessibility to the residents of Krakow expressed by a length radius of 10, 20 and 30 km from the Main Market Square - the central point of the city. Because open areas are the main place of rest for the residents of Krakow, this radius shows the reach of the zone in which green pathways, in the form of pedestrian and bicycle tourism trails, should appear. It also shows where larger areas of greenery will be located and what size they will have. In general, the greatest measure of protection of existing non-built-up areas is constituted by forests and river valleys. Unfortunately, a portion of the valleys in the central areas of localities has been greatly narrowed, as is the case in, for instance, the communities of Zielonki, Czernichów or Krzeszowice.

There is also an observable link between the fragmentation of the structure of use, expressed in the proportions between areas assigned for construction and open areas, and the distance from a large city. Communities located "in the second row" relative to Krakow already show a lower intensity of planned urbanisation. The greatest fragmentation of the areas assigned for construction and open areas occurs on the southern side of the KMA, where it is difficult to point to larger areas for recreational use. This is why we should ensure the possibility of the maintenance of available corridors which exit the Carpathian Foothills in the direction of the Beskidy Mountains. We can assume that the belt of intense urban pressure exerted by Krakow ends at a distance of around 20 km from its centre (for the south-eastern communities it is slightly larger, while for the north-western ones, due to the limitations associated with areas of nature protection, it is narrower in some places). For this reason, providing access to larger complexes of green areas requires - from the north and south - the consideration of those communities that are located outside of the KMA. The analyses that are being conducted to this end, as well as guidelines for the system of green areas on the supralocal scale, should be performed at least on the scale of a powiat (equiv. of county - transl. note). One large problem is the narrowing or disappearance of the continuity of green areas at the point of contact between Krakow and its surrounding communities. Such a situation will take place in communities such as Wielka Wieś, Zabierzów, Niepołomice and Wieliczka. The narrowed links to these places are a problem that needs to be discussed with their holders regarding the principles of the establishment of passages, their width and rules of use.

Currently, Krakow and its surroundings are being viewed as an area of environmental catastrophe in terms of air pollution. This problem applies not only to densely built up cities, but also urbanised rural areas. The planned belt in the form of a "green ring" stopping the further stretching of built-up areas can form itself inside the KMA, partially including the second row of communities located to the west. [10] In communities that are adjacent to Krakow it is possible to outline a belt, in which open areas supplemented by buildings with a high biologically active surface area ratio can provide a mixed-use area with a large share of greenery. However, it will not have a continuous character. The effects of the analysis of open areas maintained in current community documents are the basis for the determining of the possible variants of the network of green areas on the metropolitan scale.

7. Conclusions
In order to provide the possibility of the implementation of open systems it is necessary to ground them in spatial planning documents. The comparison of the spatial policies of individual communities showed a lack of systemic thinking on the supralocal scale. Because the essence of the development of plans for metropolitan areas is making it possible for them to cooperate in territorial terms, there exists a need to define the main principles of their functioning. These also include the provision of the best possible living conditions for residents, within a healthy environment. In current times, this can also constitute an essential competitive advantage for a region.

In order to create a system of green areas - which is indispensable for the urbanised structures of Krakow - the following actions are postulated during the design of the metropolitan framework study:
- for the purposes of shaping open areas, expand the scope of the documentation to include at least one additional belt of surrounding communities, because the current territorial scope does not make it possible to create large-scale areas of greenery and green belts. Increasing the amount of forested areas within them should be pursued.
outlining a network of green infrastructure within the draft of the metropolitan study, despite the lack of a legal requirement of doing so (it is only required to consider the areas that have protected status). It will have the character of a recommendation for communities and constitute an object of discussion during the updating of planning documents. It is also desirable to undertake efforts to place a requirement of its delineation and of respecting it by communities in the legal system.

One very important factor in the establishment of systems of green areas is the interest of individual communities in the establishment of such systems. This requires the adoption of methods of negotiating the principles of cooperation with communities and the introduction of mechanisms of the profitability of their maintenance. One of the possible propositions could be the placement of "green projects" as a type of "integrated territorial development projects" which are currently being carried out in the Krakow Metropolitan Area.

References

[1] A. Zachariasz, „Green areas as a contemporary citygenic factor with a particular focus on the role of public parks" (original: „Zieleń jako współczesny czynnik miastotwórczy ze szczególnym uwzględnieniem roli parków publicznych”) Monografia 336, Politechnika Krakowska, Kraków 2006

[2] B. Suleczewska, “Green Infrastructure Plan – a new Fashion or an Actual Need?” (original: „Plan zielonej infrastruktury: nowa moda czy rzeczywista potrzeba?”) Nature in Management of Metropolitan Areas (original System przyrodniczy w zarządzaniu rozwojem obszarów metropolitalnych). Studia KPZK PAN Vol. CXXIII, Warszawa, p. 89-96

[3] “Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Green Infrastructure (GI) — Enhancing Europe’s Natural Capital” http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0249 (retrieved on 12.02.2018)

[4] Spatial Planning and Development Act of the 27th of March 2003 (original: Ustawa o planowaniu i zagospodarowaniu przestrzennym) Resolution Nr CXII / 1700/14 Council of the City of Kraków dated 9 July 2014

[5] “Voivodship Spatial Development Plan” – project 2017 (original: Plan Zagospodarowania Przestrzennego Województwa Małopolskiego) projekt zmiany 2017 https://bip.malopolska.pl/umwm,m,2981,projekt-planu-zagospodarowania-przestrzennego.html (retrieved on 08.02.2018)

[6] “National Spatial Development Concept” (original: Koncepcja Przestrzennego Zagospodarowania Kraju Ministerstwo Rozwoju Regionalnego Warszawa 2012

[7] Directions of the Development and Management of Areas of Greenery in Krakow for the Years 2017-2030. (original: Kierunki rozwoju i zarządzania terenami zieleni w krakowie na lata 2017-2030) Wydział Kształtowania Środowiska Urzędu Miasta Krakowa 05/04/2017 https://dialogspoleczny.krakow.pl/wp-content/uploads/2017/04/1_OPIS-05_04_17.pdf (retrieved on 08.02.2018)

[8] Own study based on the maps of space planning documentations of communes

[9] Spatial Development Directions and Conditions Study of Cracow (orginal:”Studium uwarunkowań i kierunków zagospodarowania przestrzennego Miasta Krakowa”). Resolution Nr CXII / 1700/14 Council of the City of Kraków dated 9 July 2014, https://www.bip.krakow.pl/?bip_id=1&mmi=48 (retrieved on 20.02.2018)

[10] A. Ciszewska, “Greenbelt as a tool to open space management within metropolitan areas” (original: „Greenbelt jako narzędzie zarządzania terenami otwartymi w obszarach metropolitalnych”) Problemy Ekologii Krajobrazu, vol. XXXIII, pp.193-201, 2014.