



The Morphology of the Urban Sprawl Phenomenon in the Poznan Metropolitan Area

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Abstract. The aim of the article is to assess the development of the Poznań metropolis from the perspective of urban development. This applies to the compactness of buildings, spatial and landscape diversity. The observed increase in urban sprawl can be interpreted as a weakness of the spatial planning system. The results of our study suggest that there is a lack of understanding of the causes of uncontrolled spatial development, the causes of unplanned expansion on a metropolitan scale, and of effective concepts to counteract this phenomenon. These results show a significant relationship between the loss of arable land and growing urban sprawl. The results of the conducted research provide evidence explaining the process of suburban development and indicate tools preventing uncontrolled development.

Keywords: Poznań metropolis · Urban sprawl · Suburban areas · Quantitative analysis

1 Introduction

The spatial problems of modern cities take on a new face in the era of globalization, technological and demographic changes, and functional and social connections in urbanized areas.

It applies in particular to metropolises made up of large cities and their surrounding areas. The development of cities is an undoubted technical and organizational achievement, it is the object of admiration and fascination, and it attracts more and more new residents, investors, and clients. It is an opportunity for economic development, it gives the opportunity to improve the quality of life of the inhabitants. On the other hand, criticism of complex urban structures is growing, as well as criticism undertaken from the point of view of human needs and aspirations, which, contrary to hopes, have not been satisfactorily solved. Newly emerging conflicts arise from the necessity to reconcile the conflicting interests of various user groups: property owners, investors and developers, local communities, pressure groups that in an institutionalized form represent specific interests (protection of landscape and cultural goods, ecology, etc.), local government authorities responsible for local spatial policy and economic development of individual communes. These groups pursue their own goals in the agglomeration area and exert a specific influence on the form of spatial

development. In this approach, the urbanized area is a place where the interests of many users clash, competing for resources located in the agglomeration. These resources are of different nature and value for each user. These can be a convenient transport connection, access to the existing technical infrastructure, an attractive location associated with a beautiful landscape, a stabilized social environment. One of the most valuable resources of the agglomeration is the area. Changes in land use are considered a manifestation of competitive competition for space. These changes cause characteristic spatial and environmental effects leading to the so-called suburbanization. Suburbanization (urban sprawl) is a common phenomenon in large cities and is most often associated with the dependence of residents on the car. In environmental terms, urban sprawl can be considered the opposite of sustainable development and is the dominant form of spatial evolution in most urban agglomerations.

The article presents the scale of this phenomenon in the Poznań agglomeration and the impact of this phenomenon on the spatial order. Research in this area was carried out as part of the Polish-Chinese project “Future City Lab” at the Faculty of Architecture of the Poznań University of Technology in 2019 and 2020.

In the analyses of the existing urbanization, data from satellite images were used, field studies were carried out in the form of urban and architectural queries, and the results of existing specialist studies were used [1–3]. These publications concern general issues of suburbanization and its specificity, including urbanization, as well as its spatial and socio-economic effects for the Poznań metropolis. Churski [4] considers urban expansion to be one of the most important development challenges for the Poznań metropolis.

This article presents the specificity of the urbanization phenomenon around the city of Poznań and an assessment of the spatial effects it causes. In particular, the purpose of the article is:

- a) Identification of development trends on the basis of the direction of spatial development of municipalities included in the Poznań metropolitan area.
- b) Recognition of the dynamics of suburbanization around the city of Poznań in the aspect of sustainable development of the metropolitan area.
- c) Analysis of losses and benefits for the inhabitants caused by urban sprawl in the Poznań metropolis.
- d) Formulating recommendations and recommendations for the spatial development plan of the Poznań metropolis.

2 Materials and Methods

The research concerned the communes around Poznań that are part of the Poznań Province. The research was carried out in the Polish-Chinese experimental research studio “Future City Lab” at the Faculty of Architecture of the Poznań University of Technology in 2019 and 2020. The aim of the research was to identify the phenomenon of urban sprawl in the quantitative aspect, to capture the features specific to the Poznań metropolis. Problems with obtaining detailed empirical data were a significant limitation. The research was based on the imaging of planning documents. It should be noted

that the imaging method is used as a standard in spatial planning for analyzes covering the issues of land use, physiography, cartography and landscape assessments. Imaging in urban planning has a well-established tradition. Modern techniques make it possible to combine visualizations with databases about space and virtual reality. Imaging includes all components of the planning procedure, which consists of: diagnosis, measurement, data analysis, coordination and control.

The conducted tests included:

- diagnosis of resources and the condition of planning documents in the surveyed communes,
- comparative analyzes of the records of studies on the conditions and directions of spatial development in the surveyed communes.

In the course of the research, we found that:

- a) Used graphic signs do not fulfill their function as a tool for creating spatial policy in communes.
- b) The scales used, the detail of the record, and graphic symbols make it impossible to directly compare the town planning plans of individual communes.
- c) Urban plans make limited use of digital graphic imaging techniques. There are no problem analyzes applied to cartographic maps.
- d) The inconsistency of the graphic record hampers planning coordination, prevents direct comparative analyzes in the analyzed communes.
- e) Graphical signs are not parametrically linked with space databases.
- f) The imaging of data on town planning drawings makes it difficult to recognize the dynamics of urbanization processes, changes in land use and the assessment of suburbanization in the Poznań metropolis.

As can be seen, we encountered a significant problem in the direct use of existing urban plans. For this reason, the graphic imaging method has been supplemented with: field inquiries and inventories in the surveyed communes, satellite image analysis, standardization of municipal plans for the purpose of comparison.

The field queries were conducted by students of the Faculty of Writing of the Poznań University of Technology as part of the summer research internship in 2020. For each commune, changes in the manner of land use were identified in the period 2010–2020, broken down into:

- arable land, (area loss - increase),
- built-up area, (area loss - increase),
- green, (area loss - increase),
- road transport roads (surface loss - increase).

These indicators are partial criteria for assessing the urban sprawl phenomenon in municipalities. As a supplement to the above-mentioned quantitative criteria, a qualitative assessment was carried out in the field of: typology of buildings and the standard of public spaces in communes. We have aggregated the obtained data. As a result, we

got an image of the scale and dynamics of the urban sprawl phenomenon in the entire Poznań metropolis. The results were presented on maps and diagrams.

3 Results

The research led to the determination of the scale of the urban sprawl phenomenon in the communes of the Poznań metropolis. The results are presented in the diagrams divided into the following sub-criteria:

In order to synthetically assess the urban sprawl phenomenon in the communes of the Poznań metropolis, the results were aggregated according to the following formula:

$$SP_n = [A_n(a_n) + G_n(g_n) + B_n(b_n) + R_n(r_n)] \text{dist}_n$$

SP_n - size of urban sprawl in the commune n ,

A_n - conversion of agricultural land into land intended for development in the commune n ,

G_n - changes in the area of green areas in the commune n ,

B_n - changes in the area for development in the commune n ,

R_n - road surface changes in the commune n ,

a_n, g_n, b_n, r_n - weighting factors for parameters A_n, G_n, B_n, R_n ,

dist_n - correction factor taking into account the distance of the commune n from the center of the Poznań metropolis (Figs. 1, 2, 3, 4 and 5).

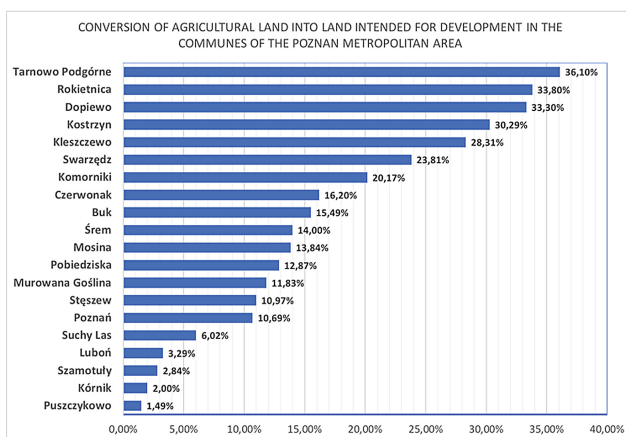


Fig. 1. Converting the area of agricultural land to land intended for development in the communes of the Poznań metropolitan area in 2010–2020.

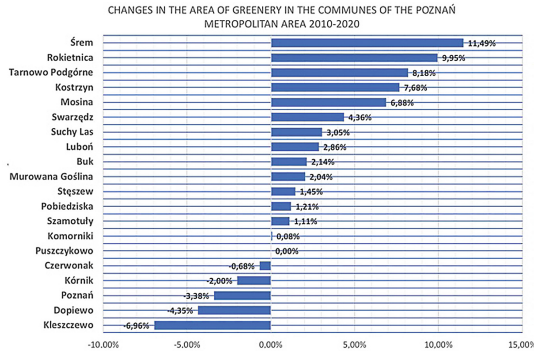


Fig. 2. Changes in the area of green areas in the communes of the Poznań metropolitan area in 2010–2020.

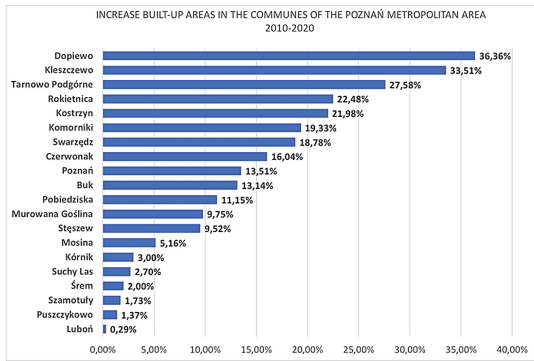


Fig. 3. Changes in the area for development in the communes of the Poznań metropolitan area in 2010–2020.

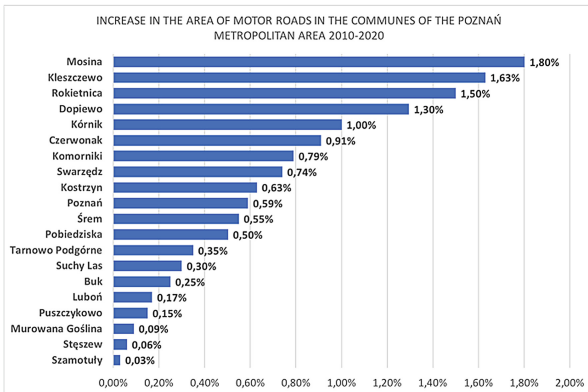


Fig. 4. Changes in the area of motor roads in the communes of the Poznań metropolitan area in 2010–2020.

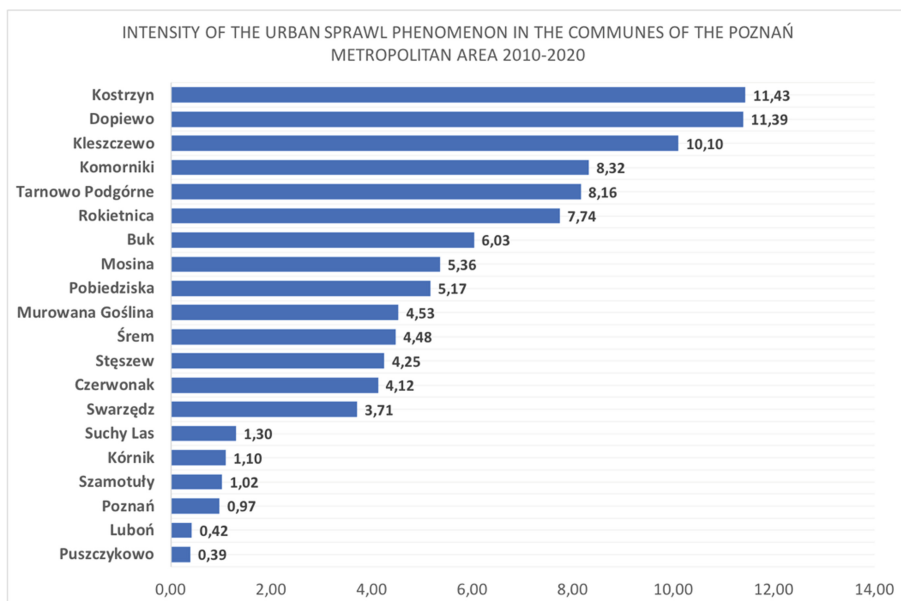


Fig. 5. Intensity of the urban sprawl phenomenon in the communes of the Poznań metropolitan area 2010–2020. Synthetic assessment.

4 Discussion

Research has confirmed that the urban sprawl phenomenon negatively affects the quality of urbanized space, and causes environmental and landscape problems. From an environmental perspective, urban sprawl can be regarded as the opposite of sustainable development, yet it is the dominant form of spatial evolution in the Poznań metropolis.

The negative features of this phenomenon include:

- the disappearance of the physical, readable city limits (destruction of the suburban landscape),
- clusters of chaotic buildings occupying suburban areas,
- building development into rural areas, violating traditional forms of rural architecture by foreign forms, disappearance of identity and cultural tradition.
- too low intensity of development, no elements crystallizing the urban structure,
- increasing chaotic development, lack of coherent compositional formations, urbanization characterized by expressionless vagueness,
- irrational functional structure, limited availability of services (trade, culture, education, health), accessible through the use of a car,
- loss of community ties, anonymity of residence,
- a disproportionately high crime rate (hence the tendency to build monitored gated communities),
- depreciation of public spaces,

- negative impact on the health of residents, increased amount of air pollution, - road blockage,
- loss of greenery, threat to natural structures, defragmentation of forest biocenoses,
- disappearance of species diversity of vegetation.

As a result, negative trends overlap in suburban areas: the ability to sustainably regulate land use ceases, and irreversible damage to the landscape is caused by uncontrolled settlement activity.

The greatest negative changes were diagnosed in the communes of Kostrzyn, Dopiewo, Kleszczewo, Komorniki, Tarnowo Podgórne, Rokietnica. The average size of changes occurred in the municipalities of Buk, Mosina, Pobiedziska, Murowana Goślina, Śrem, Stęszew, Czerwonak, and Swarzędz. The smallest extent of the urban sprawl phenomenon was diagnosed in the communes of Suchy Las, Kórnik, Szamotuły, Luboń, Puszczykowo and Poznań. A disturbing phenomenon is the consent of local governments to conduct such spatial policy. The analysis of planning documents shows that by 2030 the local governments of communes plan to enlarge the areas for development by 31,827 ha. This figure describes the dynamics of the urban sprawl phenomenon in the Poznań metropolis. Built-up areas increase the surface area at the expense of arable land. The overall decrease in arable land by 2030 will amount to 395.79 km², which is 15.50% of the area of the entire Poznań metropolis. Other forms of land use show a slight increase: greenery by 61.45 km², and the area of motor roads and communication by 26.07 km².

On this basis, it is possible to characterize the specific features of the urban sprawl phenomenon in the Poznań metropolis.

- a) There has been a degradation of local, historically shaped settlement centers (small towns and villages) as elements crystallizing the spatial structure of the agglomeration area. Śrem, Buk, Stęszew, Szamotuły, Pobiedziska (mostly Murowana Goślina and Kostrzyn) also play such a role.
- b) The old, historically shaped spatial module (approx. 10 km) characteristic of the Poznań County, based on a network of small towns and manor and manor farms, was destroyed.
- c) The spatial form of the suburbanization process in Poznań takes on specific features. The typical urban sprawl development along the main roads (national and provincial) is transformed into a wedge-shaped model - filling the space between roads leading to the center of the agglomeration. This phenomenon is most noticed in the communes of Tarnowo Podgórne, Rokietnica, Komorniki, Dopiewo, and Kleszczewo.
- d) The structure of suburban buildings shows characteristic zoning regularities: The areas located directly next to the exit roads from Poznań are occupied by light industry, business services and the service sector (including large-area trade). The area between the exit roads is intended for residential development.

5 Conclusions

The results of our research are diagnostic. The results can be used to reduce urban sprawl in the Poznań metropolis. In further research, it is necessary to answer the following questions:

Can you find effective planning tools, strategic concepts and spatial policy instruments for stopping the urban sprawl phenomenon around Poznań?

Can new “urban junctions” crystallizing and concentrating the development be formed in the buildings spreading around Poznań?

Can a higher intensity compact building with more attractive free space be offered in place of low intensity, overflow buildings?

What should the model of the compact (coherent) structure of the Poznań metropolis look like?

In the interest of which user groups is urban sprawl developing, and how could these users benefit from the compact structure of the Poznań metropolis?

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