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Greenery and water structure before and after political system transformation. A Poznań city case study

Highlights:
- The key role in the conservation of urban green and water areas should play spatial policy
- Socio-economic changes affect the spatial structure of the city
- Misconceived democracy leads to the degradation and disruption of the city's green and water structure

Abstract: The greenery and water structure, in the form of wedges cutting into the city, is a characteristic and unique element of Poznań's urban model. Already before the Second World War, it became the matrix setting the framework for spatial and natural connections within and around the city. These areas were originally clearly demarcated and formed an organic network that permeated the built-up areas. It was this local network of linkages that was to have the greatest impact on the quality of urban living, climate improvement, biodiversity and the functional and spatial structure of the city.
In the idea of the socialist city, ensuring access to green spaces for the masses, was one of the essential policy elements of the time. However, over time, in the various models of the city proposed by successive planners, these interconnections began to disappear and the individual bands were narrowed and sometimes discontinued altogether.
This study aims to verify the urban planning models of the city of Poznań against the original idea of a wedge-ring system of greenery and water areas, before and after the political transformation in 1989.
How does this original structure function today and how have the socio-economic changes that followed the fall of communism affect the greenery and water solutions proposed in the new city model?
A comparative analysis of changes in green and water structure in the different spatial models of the city of Poznań, before and after the political transformation, makes it possible to observe the pace and directions of these changes. The analysis was based on the findings of the then-current master plans and on the studies of spatial development conditions and directions, which are an expression of the city's spatial policy. It can be used to verify the assumptions made or even to change the current model of the city.

Key words: greenery and water structure, political transformation, city resilience, urban development, model of the city

Introduction

Greenery and water structure can be defined as unrestricted, publicly accessible green and water areas, such as parks, forests, bodies of water, city rivers and lakes, sports grounds, community gardens and shared green areas in residential districts, and also greenery accompanying road and rail infrastructure. In the urban environment, the term greenery and water structure may also be used to refer to all undeveloped and unsurfaced areas which create a web of spatial and natural interrelations within the city and in the surrounding area, acting as its matrix. These areas should be marked out and should create an organic network of mutual relations, penetrating built-up areas (Sandström 2002). It is this local network of connections that has the greatest impact on the quality of inhabitation in the city, climate improvement (Chen, Jim 2008, Liu, Li 2012, Hesslerová et al. 2022), natural biodiversity (Kattwinkel et al. 2012) and spatial structure of the city (Kotus 2006).

Irrespective of the multitude of definitions, greenery and water structure in a sustainable city should be a multifunctional space, fulfilling a number of roles, including facilitation of social integration (Madureira, Andreson 2012, Ahern et al. 2014), and should be a fundamental component of public spaces in the city (James et al. 2009, Russo, Cirella 2018). Such greenery and water:

- has social value: impacts on the inhabitants' health and their interactions, is the place of leisure and entertainment,
- has economic value: locations with access to green and water areas are more attractive,
- has natural value: supports biodiversity, creates migration corridors for plants and animals,
- affects a climate in the city: reduces temperature, protects against wind, snow and sun, regulates water management,
- has visual value: defines and enhances the appearance of any space.

The importance of these benefits has been pointed out by the researchers of COSTC11 (European Cooperation in the field of Scientific and Technical Research) who also emphasised that the most important element of planning urban green and water spaces is their integration (Beer, COSTS11 2000, Halland, van den Bosch 2015, Anguluri, Narayanan 2017, Lidmo et al. 2020). This is because only an integrated system has a chance of becoming a core element of spatial structure, rather than a randomly scattered archipelago of green islands, illegible when looking at the city as a whole. Four main factors are listed that make a landscape attractive: coherence, legibility, complexity and mystery. Coherence and legibility make it easier to comprehend and read space, while complexity and mystery build its aura. Rhythm organises and diversity creates tension, arousing curiosity (Kaplan et al. 1998, Zachariasz 2006). All these effects can be achieved by greenery and water structure.

In Poznań, the existing public green spaces, uninhabited areas, areas of natural value, urban forests, and fortified circuits created a cross of four green wedges joined by two green rings (both based on an earlier project). The cross structure,

apart from the most valuable forest complexes and watercourses, also included urban parks, community gardens, zoological gardens, cemeteries, and open-air sports grounds (Parysek, Mierzejewska 2006, Urbański et al. 2009, Raszeja 2015). The city gained a regular shape, in which urban areas were connected with undeveloped space on the east bank of the Warta River (Ptaszycka 1950).

The paper attempts to link significant changes of a socio-economic nature with changes in the model of the city of Poznań in the context of their impact on the transformation of the structure of greenery and water areas. It is based here on the results of in-depth own research conducted on the spatial development of the city of Poznań after 1945 (Szejnfeld 2019).

This is a summary of research on green and water structure which shows how much it has changed as a result of the political system transformation in Poland after 1989. Like with other Polish cities, the example of Poznań, once regarded as a "green" city – with its unique wedge-ring green system (Fig. 1), illustrates the trend towards reducing this structure.

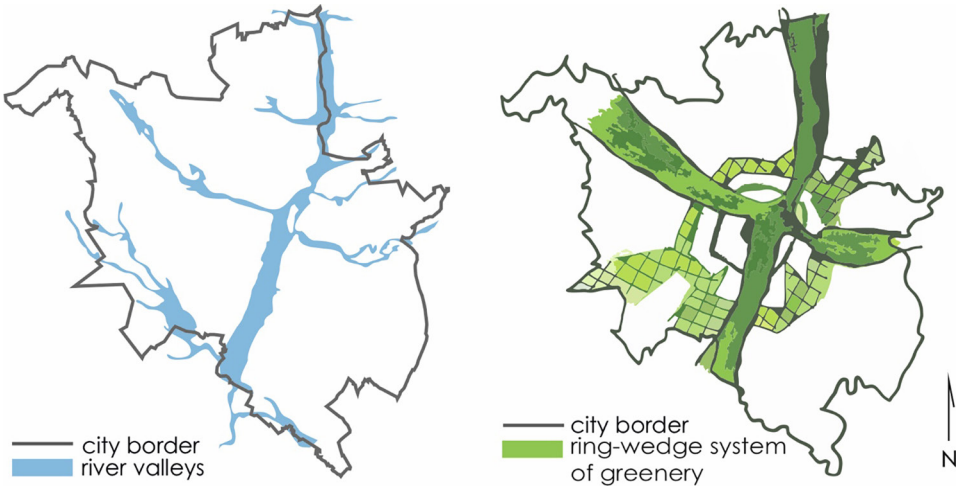

Fig. 1. Wedge-ring system of greenery designed by architect Władysław Czarnecki is a unique urban green and water composition
Source: Author's drawing.

Materials and methods

The analysis of changes in the structure of green areas was preceded by a detailed search for planning documents drawn up for the city of Poznań after World War II. Then, in order to unify the collected planning materials, i.e. general plans, drawn up for more than half a century in different techniques, scales and in varying degrees of detail, aggregates of these plans were developed using computer support, mainly GIS and CAD tools, which allowed their comparison with today's assumptions of the directions of development of the city of Poznań. It

was assumed that the method adopted would make it possible to carry out quantitative and spatial analyses of changes concerning the structure of green areas in individual urban models and the direction of these changes after the political transformation.

This analysis was carried out using GIS software in three steps:

- Developing vector versions of paper archived plans
- Developing uniform graphics to enable quantitative comparison of greenery and water changes
- Comparative studies presenting the differences in the city's green and water structures.

The aggregates produced may be subject to some error due to the different scales and techniques and detail of the master plans examined. Some imprecision may also have resulted from the manual vectoring of paper scans and photographs. At the same time, the plan text was used to establish the balances, except the descriptions of the master plans from the years 1946 and 1948, which could not be found.

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To track the changes in greenery structure in the new, democratic reality, analysis also included the most recent document on the spatial development strategy of the city, adopted in 2014 (MPU 2014).

The analysis excluded housing estate greenery and greenery accompanying infrastructure, and was limited to areas which, due to their size and significance, were marked out in the documents mentioned above. To study the degree of changes of green and water structures, a comparative analysis was conducted on those systems in master plans in three time periods: during the communist time, during the period of political transition, and to the current planning state. The comparison included data on quantitative and spatial changes in green and water structures taking place o in areas constituting the main natural matrix of the city. Examination of these accounts has revealed interesting phenomena.

Poznań's green and water structure in urban models during the communist period

At the beginning of the 20th century, the development of Poznań was limited because the city's territory was heavily fortified. Fortification causes many spatial, technical, and housing problems. The need to demolish the fortifications led to the preparation of a spatial plan which was the first example of spatial planning wherein the city was treated as one structure. The site plan was built around the rings following the shape of fort moat (Kodym-Kozaczko 2017).

In the interwar period the city's borders changed and expanded eastwards. The direction of city development changed. In the plans created at that time, for the first time the system of green wedges was connected with watercourses. The final form of greenery and water structure was defined by Władysław Czarnecki (Czarnecki 1961) in his spatial plan prepared in 1934 (Kodym-Kozaczko, Kozaczko 2009).

In the master plan from 1946, development sites were distributed around the inner city in the form of loosely designed housing estates divided by green wedges cutting into the planned development.

The next plan, from 1948, maintained the existing development layout, loosening it even further, in the principle of free colonies surrounded by green areas. This took into account and brought out the wedge-ring green layout of the town lying at the junction of two river valleys. The Warta River was the axis of development here.

The master plan from 1955 abandoned the previous arrangements. Instead of separate enclaves of build-up areas, a highly concentrated model was proposed, with even, ring-shaped development from the center. This reduced the green

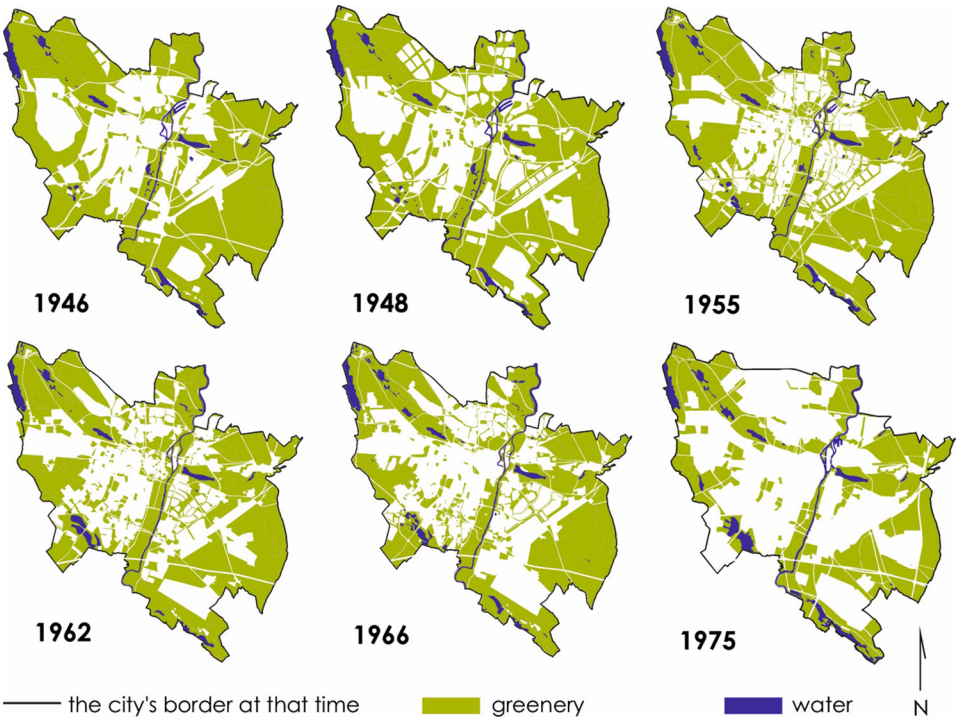

Fig. 2. Greenery structure following previous guidelines which were based on natural conditions. Areas along the river with high groundwater levels were unsuitable for development and were thus dedicated for flood retention. These natural conditions have dictated the green structure in Poznań for years

Source: own elaboration based on archival master plans.

wedges and partially interrupted the peripheral linkages. It is worth mentioning here that all of the above plans were not approved and the city developed unplanned until 1962. This development was in reality marginal and focused more on the reconstruction of inner-city areas from war damage than on the urbanisation of new urban areas.

The master plans of the 1960s preserved the city's centripetal structure, expanding it even further in the southern part and on the right bank of the Warta River. The green wedge areas were significantly reduced. The most painful changes, however, affected the city center: the reconstruction of the Poznań waterway junction devastated the historic urban composition of the city. The plans, the first to be enacted in the city's post-war history, contributed to the start of major housing developments and the first settlements of the new part of the city on the right bank of the Warta River.

The master plan from 1975, on the one hand, referred to the plan from 1948 by introducing a development band parallel to the river and, on the other hand, sanctioned the city's previous spatial policy, both in terms of the central areas and the continuation, in part, of estate investments already made. The spatial structure of the plan restored a new wedge-shaped green system of the city. However, its ring elements were lost, to which the findings of previous master plans had contributed. The Warta River has once again become the axis of the city's development.

Contemporary analyses of the potential of green spaces in Poznań, their distribution and accessibility for inhabitants have identified existing and exacerbating shortages in the system of Poznań's green wedges (Zwierzchowska et al. 2019). With increasing urban density, the entire city centre of Poznań is deprived of easy access to green spaces, which essentially cannot be remedied (Polyák 2017). The urban structure which has been in place for so long was perceived as 'everlasting', able to resist any change and adequately protected. According to the present research, unfortunately, this is not the case.

The comparative analyses carried out clearly showed that between 1945 and 1975, successive models of urban development increased the share of land designated for building at the expense of primarily green areas. In the first post-war master plan, the share of land excluded from development accounted for 64.9% of the city's area at the time. This proportion gradually decreased with the massive influx of people into the city, which was linked to the intensive development of housing and industrial areas. The master plan for Poznań, drawn up in 1975, was the last planning document adopted during the communist period. The planned share of land excluded from development was now only 45.4% of the city's area. This is a decrease of 19.5% compared to the assumptions of the master plan from 1946.

Political transformation – changing the city model

The change in political regime was accompanied by a change in the social and economic context, whereby the ever-present central planning by the state gave way to a neoliberal planning policy. The transformation brought with it a profit-oriented and market-dependent approach, and the role of spatial planning was "reduced mainly to facilitating economic growth and building the competitive advantage of regions" (Mierzejewska 2001, Polyák 2017). As already mentioned, the master plan from 1975 (WPU 1975) was the last planning document in legal force before the system transformation of 1989. It provided for a linear city model (Lynch 1984), with a distinct northward direction of growth. After the collapse of the regime, the city started working on a new master plan, which came into effect at the end of 1994 (MPU 1994), breaking away from the previous system and ideology. The concentric city model has been embraced again (Burgess 2000).

In a new reality, city space has become an arena for playing out the interests of different groups: investors, city governments and stakeholders: institutions, citizens, NGOs or urban aktivists. At the same time, the power of influence and impact on urban development between these groups is often unequal and limited (Harvey 2012). With it comes rivalry for space, which brings out spatial and environmental consequences (Waterhout et al. 2013). In this urban conflict, green areas tend to end up on the losing side, as an unprofitable element of urban space. In addition, in new spatial development plans, the issues related to green structure design in the cities tend to be addressed in brief, and the functions of greenery structures in the urban space are not sufficiently appreciated (Bielecki 1997, Bonenberg 2011).

Modern cities are no longer treated as an integrated composition, which fits into a broader structure of relations, including those of nature. Today, despite the strong trends towards sustainable urban design, we can observe processes leading to the disappearance of green areas within cities and disruption of the natural continuity system, which leads to the emergence of green "patches", creating "ecological islands" within the city (Sobczyńska 2014). These fragmentary structures destroy the continuity of city-wide ecosystems threatening the extinction of protected plants and animal species, as well as unique natural habitats. In urbanised areas, they undermine the quality, aesthetics, microclimatic and acoustic properties of space (Januchta-Szostak 2011).

Finding a golden mean between the treatment of special and naturally unique areas and the development of urban areas is extremely difficult and requires a series of analyses.

The linear model of the city was abandoned in 1994. Development from the northern areas was mainly moved to the southwestern and southern areas of the city. New districts were discontinued in the northern band. The compactness of development has further depleted the green wedge areas and some parts of these areas have disappeared, especially the eastern wedge. Depletion has also occurred in the outer ring of greenery surrounding the city (Fig. 3).

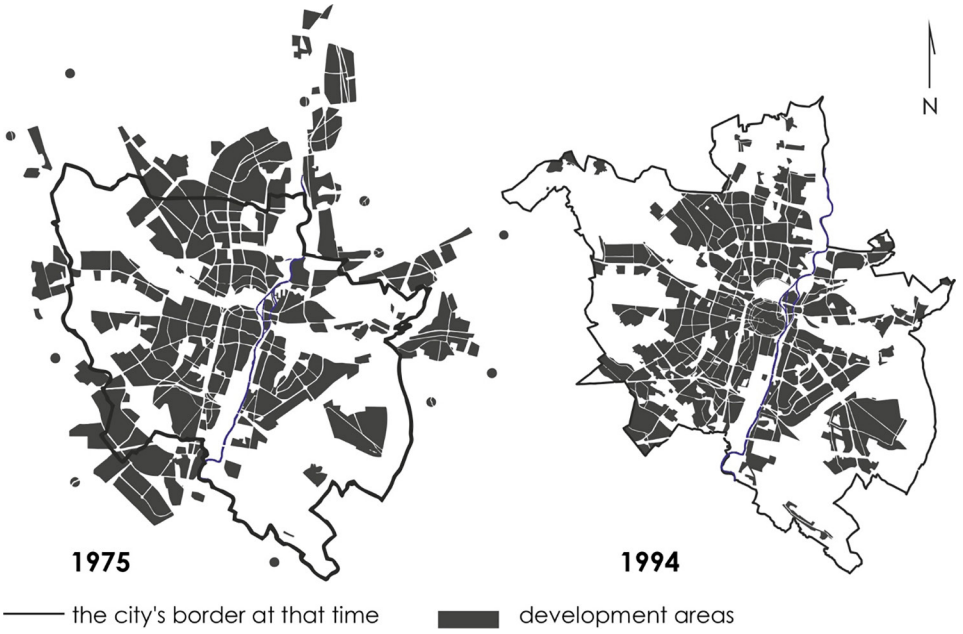

Fig. 3. The change in the city model after the 1989 political transformation. 1) Master plan 1975, 2) Master plan 1994
Source: own elaboration.

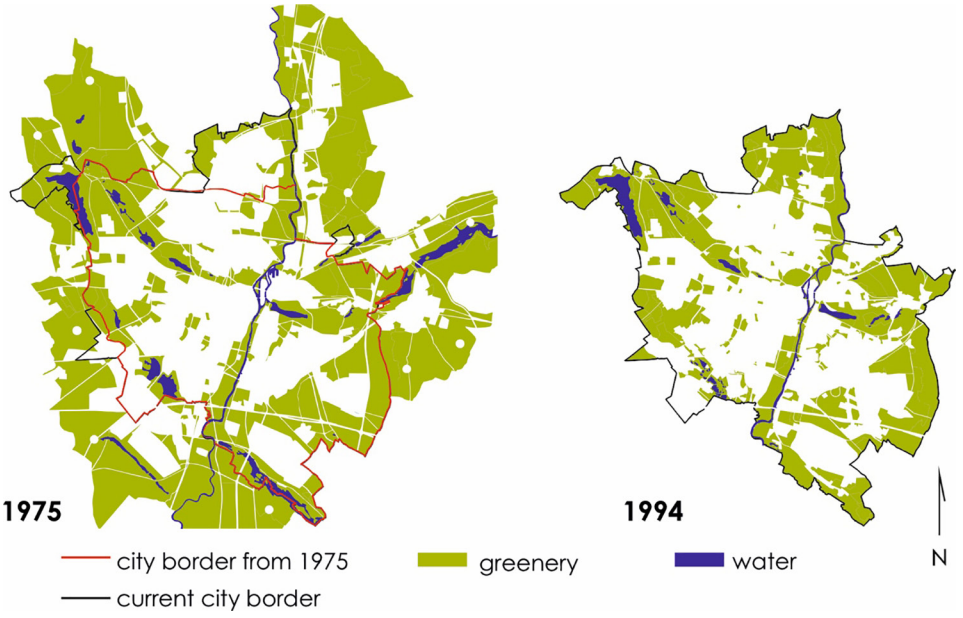

Fig. 4. Utilisation of green areas making up the greenery and water structure in Poznań. 1) Master plan from 1975, 2) Master plan from 1994
Source: own elaboration.

Contrary to the assumptions made in the master plan document, the new city model has not brought about significant changes regarding the preservation and protection of green areas. It is only due to the inclusion of significant areas within the city borders that the proportion of land excluded from development has increased from the previous 228.4 km^2 to 261.3 km^2 (an increase of 14.40%). At the same time, when looking at such a characteristic form of the wedge-ring green system, one can see their narrowing along the north-south direction in the axis of the Warta River and the defragmentation of the east-west greenery wedge, especially in the vicinity of the city center. More minor changes in the form of the disruption of local, residential ecological corridors in the area of the greenery rings surrounding the city (former fortification rings) are also of significance (Fig. 4). This has translated into a reduction in the quality of life for residents and access to green spaces, especially for those living in the central districts.

New model of the city

Negative changes took place after 1995, following the emergence of the extreme liberalism, private property, and competition. The development policy, aimed at profit maximisation and coupled with an absence of planning regulations in that time, led to an excessive build-up of open areas. The changes taking place in the green and water structure are highly alarming. The comparison of spatial data corresponding to the main green and water areas of the city, underlying the entire urban spatial arrangement 'crystallizing element' (Wejchert 2008), indicates that changes in this respect have been very dynamic. In the light of move towards polycentricity of the urban structure (Gzell 2013) consisting of smaller, multifunctional units and similar concepts: the Neighbourhood Unit (Perry 1939), the New Urbanism (The Charter of the New Urbanism 1993) or the current concepcion of the short-distance city: The 15-minute city (Moreno 2020), The 20-minute city (Capasso Da Silva et al. 2020) or even The one-minute city (O'Sullivan 2021), the lack of preservation or depletion of local ecological corridors or islands of greenery, providing proximity to recreation and leisure areas for residents of individual neighbourhoods, in subsequent city models should be considered as an extremely inappropriate development direction (Fig. 5).

The map presents green and water areas in the master plan from 1994 with the overlaid greenery structure from the most recent master plan from 2014. In the analysis of the above, it was found that over the past 20 years the amount of green and water structure in strategic documents, defining the directions for the city's development, dropped by 9.07% compared to the areas outlined in the master plan from 1994 and by 8.25 % compared to the green and water areas included in the master plan from 1975 (Fig. 6).

The most significant and highly unfavourable changes took place between 1994 and 2014. In the space of 20 years, 2433.3 ha of greenery and water structure disappeared from planning documents (Table 1). The unique greenery structure of Poznań became fragmented and divided. The green wedges which serve

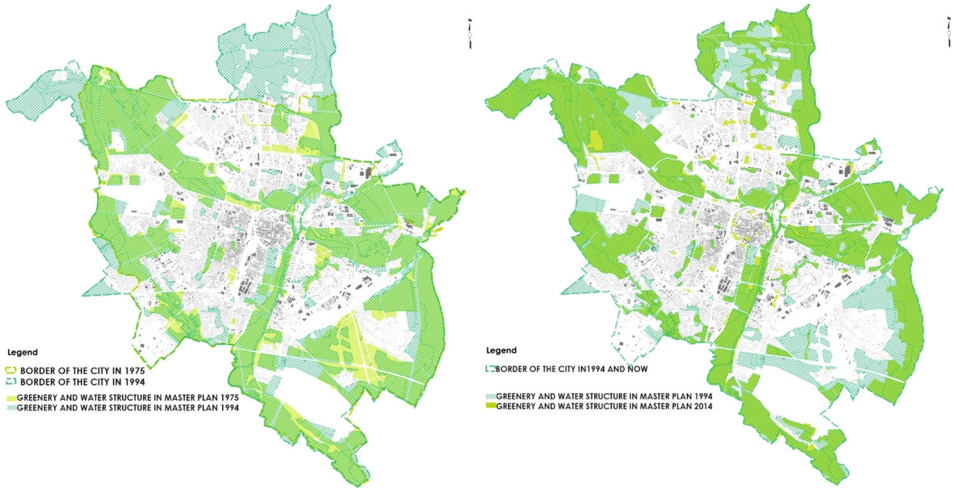

Fig. 5. Green and water structure. Master plan from 1994 versus master plan from 2014
Source: own elaboration based on Poznań master plans.

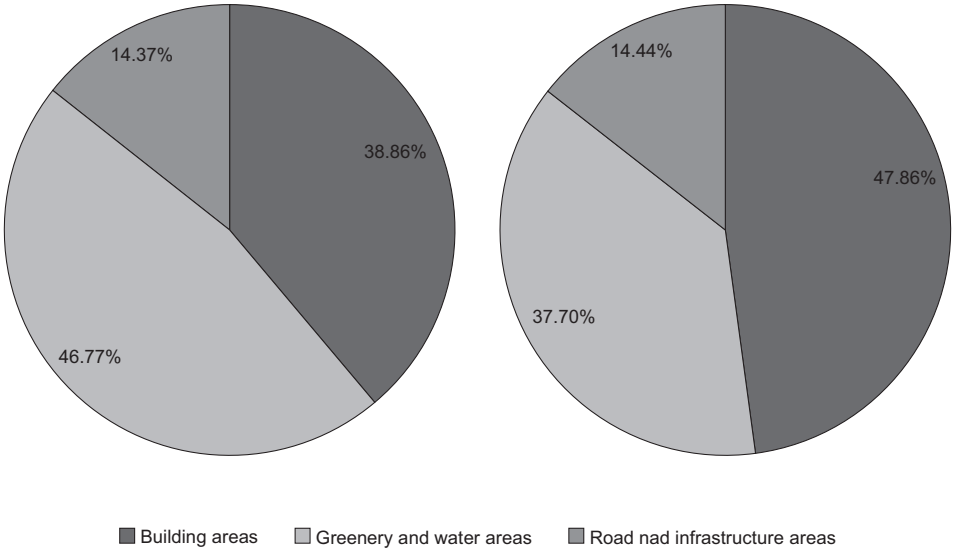

Fig. 6. Division of urban areas: 1) Master plan from 1994, 2) Master plan from 2014
Source: own elaboration based on Poznań master plans.

as extremely valuable ecological corridors and, at the same time, fresh-air corridors for the city became considerably reduced. The two rings of greenery surrounding the city have almost completely disappeared. All the components of the city's greenery and water structure were significantly diminished. Agricultural land ceased to exist and the residential function took over in its place: single- and multi-family housing. The current volume of residential areas seems to be completely unjustified and fails to take into account the demographic forecasts

Table 1. A comparison of data presenting quantitative changes in main green and water areas of Poznań over the past 40 years – before and after political transformation

Land area according to the master plans Green and water structure	1975		1994		2014	
	ha	%	ha	%	ha	%
Total green and water structure including:	10948.6	100	12278.4	100	9845.1	100
natural greenery (forests, meadows)	4413.7	40.3	5877.7	47.9	7211.5	73.2
surface waters (rivers, lakes)	1775.4	16.2	685.1	5.6	685.1	7.0
agricultural land	2093.8	19.2	3570.7	29.1	0.0	0.0
parks	512.9	4.7	420.7	3,4	545.5	5.6
community gardens	520.4	4.8	953.3	7.8	781.8	7.9
sports and leisure grounds	1340.1	12.2	525.2	4.3	373.6	3.8
cemeteries	292.3	2.7	245.7	2.0	247.5	2.5

Source: own statistics based on master plans. See maps (Fig. 4 and 5).

(demographic capacity), seen as their calculated occupancy is more than 800,000 residents (Mikuła, Maćkiewicz 2015), while the city's population continues to drop, amounting to 529 thousand inhabitants as of the end of 2021).

In comparison with the master plan created during the communist era, where the industry was considered to be of utmost importance and environmental issues were treated as marginal by the authorities, there is no justification for today's spatial policy which should be based on environmental sustainability and conservation of valuable natural areas. The New Athens Charter of 2003 (European Council of Town Planners 2003), defines that all inhabitants should have access to areas of natural value, where the quality of the environment is one of the fundamental factors underlying the city's fundamental success and also contributes to its social and cultural vitality. The scale of such far-reaching negative changes requires immediate action to protect such an important and valuable greenery and water system.

Research results

The trend of shrinking areas excluded from development – green and water areas – was exacerbated by 2014. The quantitative changes that have taken place between the investment and non-build areas designated in the master plans between 1946 and 2014 showed a significant increase of 265% in land allocated for development, compared to the 1946 plan baseline. The highest jump – by 42.3% – was recorded between master plans from the years 1966 and 1975. This increase was directly linked to the successive administrative reforms that connected new areas to the city of Poznań. The actual surface of the city is 261.9 km^2,

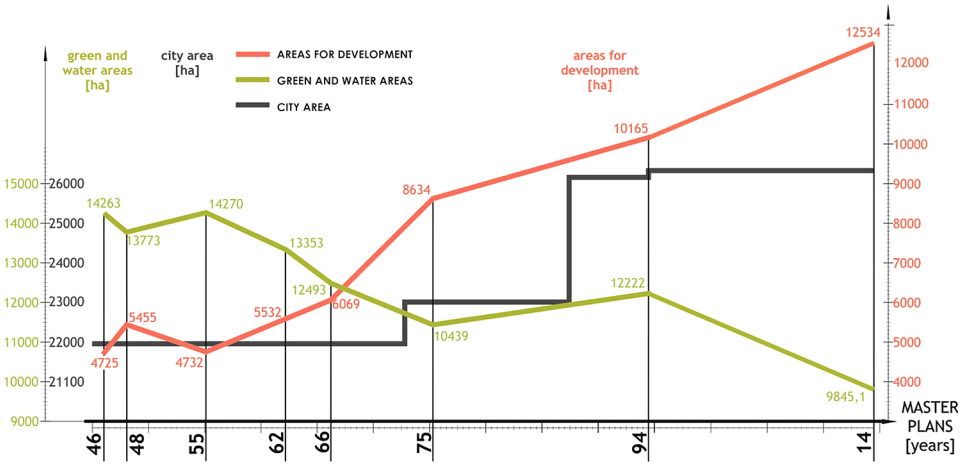

Fig. 7. Quantitative changes between investment areas and open areas within the administrative city boundaries in a given period
Source: own elaboration based on data from master plans.

while in 1946 it was 228 km^2. The increase in the area of development caused an understandable decrease in green and water areas, especially land used for agriculture, which in most master plans was designed for housing development. In almost 70 years, the surface of these areas indicated in the planning documents in question has decreased by 4417.9 ha.

It seems that the return to the concentric model of the city has brought far-reaching negative consequences. First of all, an abrupt change in the model was brought about, thereby interrupting the intentional continuity of planning. At the same time, the effectiveness of the proposed city model, in the context of leg-

Table 2. The share of investment and undeveloped areas to the total surface of the city of Poznań (within the then boundaries). The reserve defines the percentage share of areas not covered by the provisions of the respective master plans and later incorporated into the city border of Poznań. The remaining areas not included in the table include places for transport and technical infrastructure, and so-called "other" areas (military areas et al.)

Master plans	Areas for development [in %]	Green and water areas [in %]
1946	21.5	64.9
1948	24.8	62.7
1955	21.5	64.9
1962	25.2	60.8
1966	27.6	56.8
1975	37.5	45.4
1994	38.7	46.6
2014	47.8	37.7

Source: own elaboration.

islative changes and liberalization of urban planning law in the capitalist economy, has been severely limited. The overlap of these two elements has led to a situation in which the unique wedge-ring green system is not sufficiently protected.

The analysis revealed another important conclusion: the development model of the city of Poznań did not determine the compactness of its functional and spatial structure. The linear model proposed in the master plan from 1975, differs minimally in the ratio of investment to undeveloped land from the compact city model adopted in the master plan from 1994 (Table 2).

Conclusions

Cities, as highly urbanized units with often dispersed natural resource systems, are valuable spoils for development policies. In Poznań due to the lack of comprehensive planning protection of the unique green system, there have been many negative phenomena, including numerous intrusions on naturally valuable areas. The area of biologically active areas constituting the system of natural continuity has significantly decreased, due to which valuable green areas have become the prey of the free-market economy and acquisitions by developers.

The lack of coordinated action in the sphere of urban planning may be a response to the situation of diminishing green areas in the city, which is not seen as a valuable resource. Establishing comprehensive protection of the green and water structure calls for the participation of many entities: naturalists, urbanists, local authorities and the residents themselves. This kind of cooperation needs to go beyond the rigid confines of public administration.

Our response to the escalating deterioration of naturally valuable areas should be a coordinated and sustained spatial policy, grounded in the continuity of intention in the planning process (Gawlikowski 1988) as well as a transparent and comprehensible management system, inspired by the message "common goal, joint action, axiological framework, constant interaction and a desire to achieve collective benefits which cannot be realised through independent action" (Swyngedouw 2005).

A city is a human habitat, where one can satisfy their fundamental needs and functions, and public greenery areas are of particular importance for the fulfilment of those needs. In Poznań, the allure of the capitalist economy and the collapse of the spatial planning system have led to unfavourable changes in the quality of public space (Sepioł 2014). The concept of greenery and water structure is absent from legislation, nor are there any clearly defined criteria for designating such areas. Greenery is not treated as a whole (unlike e.g. transport infrastructure). This leads us to the conclusion that this term refers to one of the least precise concepts in Polish spatial planning. This loophole means that greenery structure has become an informal instrument in spatial planning, which affects the shape of contemporary urban space in Poland. The comparative analyses carried out indicate that the unique greenery structure in Poznań is a less and

less important element of the urban composition on a city-wide scale and that its protection is insufficient.

A new strategic document – a new master plan – is currently being developed. This document has not yet been presented to the public. It is to be hoped that in times of climate crisis, and the huge role of green spaces and waters in cities for the quality of living or public health (in the context of the Covid-19 pandemic), it will seek to preserve and protect all green spaces and waters, valuable at both the city and the smaller – neighbourhood – scale.

This research forms part of comprehensive studies on the city's spatial structure aimed at obtaining a more complete take on the situation.

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Struktura terenów zieleni i wód przed i po transformacji ustrojowej. Poznań jako studium przypadku

Zarys treści: Struktura terenów zieleni i wód w postaci klinów wcinających się w miasto jest charakterystycznym i unikalnym elementem krajobrazu miejskiego Poznania. Już przed II wojną światową stała się ona matrycą wyznaczającą ramy dla przestrzennych i przyrodniczych powiązań w obrębie miasta i wokół niego. Tereny te pierwotnie były wyraźnie wydzielone i tworzyły organiczną sieć powiązań, która przenikała obszary zabudowane. To właśnie ta lokalna sieć powiązań miała mieć największy wpływ na jakość zamieszkiwania w mieście, poprawę klimatu, bioróżnorodność i strukturę funkcjonalno-przestrzenną miasta.
W idei miasta socjalistycznego zapewnienie dostępu do terenów zieleni dla mas stanowiło jeden z istotnych elementów ówczesnej polityki. Jednak z biegiem czasu, w poszczególnych modelach miasta proponowanych przez kolejnych planistów te wzajemne powiązania zaczęły zanikać, a poszczególne pasma zostały zawężone, niekiedy zaś całkowicie przerwane.
Celem opracowania jest weryfikacja modeli urbanistycznych miasta Poznania wobec pierwotnej idei klinowo-pierścieniowego układu zieleni i terenów wodnych przed transformacją ustrojową w 1989 r. i po oraz pokazanie, jak ta pierwotna struktura funkcjonuje obecnie oraz w jaki sposób zmiany społeczno-gospodarcze, które nastąpiły po upadku komunizmu, wpłynęły na rozwiązania w zakresie terenów zieleni i wód zaproponowane w nowym modelu miasta.
Analiza porównawcza zmian dotyczących terenów zieleni i wód w poszczególnych modelach przestrzennych miasta Poznania przed transformacją ustrojową i po pozwala zaobserwować tempo oraz kierunki tych zmian. Analiza ta została sporządzona w oparciu o ustalenia ówczesnych planów ogólnych i o studia uwarunkowań i kierunków zagospodarowania przestrzennego, które są wyrazem prowadzonej polityki przestrzennej miasta. Może ona posłużyć do weryfikacji przyjętych założeń czy wręcz do zmiany obecnego modelu miasta.

Słowa kluczowe: struktura terenów zieleni i wód, transformacja ustrojowa, odporność miasta, rozwój miasta, model miasta