

Anna JANUCHTA-SZOSTAK\*, Julia ZIELENIEWSKA\*\*,  
Monika KUBACKA\*\*\*

## **FAMILY ALLOTMENT GARDENS IN THE STRUCTURE OF POZNAN CITY AND THEIR ROLE IN ADAPTATION TO CLIMATE CHANGE**

The aim of this study was to analyse the location and current condition of the Family Allotment Gardens (FAGs) in Poznań city (Poland) and the changes that occurred between 2011 and 2021. The authors verified 98 gardens, of which only 85 still exists. The subject of the analysis were: the context and location of FAGs in the city structure, including the connection with Poznań's green wedges, and the hydrographic structure. As the result, the conditions and problems of FAGs in Poznan were identified, furthermore the possibilities of better use of their potential were indicated.

The results of the research confirm that FAGs are integral part of the structure of Poznan green wedges and are of great social, natural and climatic importance, but due to the modus of arrangement (parcelling of plots, fences) they disturb the continuity and accessibility of urban green areas and are poorly integrated with the city's surface waters.

The proposed changes in spatial arrangement and organization of FAGs (increasing the public accessibility) would enable the inclusion of some gardens into the structures of green wedges or the creation of new connectors between the wedges. In addition, the improvement of connections with waterbodies (daylighting of canalized sections of streams, improving accessibility of banks) would increase their ecosystem value and the retention capacity of urban catchments.

**Keywords:** adaptation to climate change, family allotment gardens (FAG), blue & green infrastructure, green wedges, Poznan city

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\* Poznan University of Technology, Faculty of Architecture, Institute of Architecture and Spatial Planning. ORCID: 0000-0001-7411-9280.

\*\* Poznan University of Technology, Faculty of Architecture, graduate.

\*\*\* Poznan University of Technology, Faculty of Architecture, graduate.

## 1. INTRODUCTION

Contemporary trends in urban planning indicate the direction of nature-positive urban development, in which allotment gardens can play an important role in the reintegration of urban and natural structures [World Economic Forum 2022]. The diversity and continuity of urban greenery structures are crucial for adaptation to anthropogenic climate change, and allotment gardens are also an important element of the recreation structure, environmental education and circular economy as urban gardening [Lewandowski 2019; Pawlikowska-Piechotka 2009; Chojecka 2014]. The benefits of green infrastructure – not only environmental, but social and compositional as well [Borysiak et al. 2015; Borysiak et al. 2017; Witczak, Macias 2016; Bańka 2015; Bartłomiejski, Kowalewski 2019] – may also improve the quality of life by providing recreational space [Pawlikowska-Piechotka 2012] and the effectiveness of mitigation and adaptation processes in cities.

In Polish legislation, the name "Family Allotment Garden" is understood as a separate area intended for individual plots and a common area, with appropriate infrastructure for allotment owners (Polish Legislation Act: Ustawa z dnia 13.12.2013 r. o rodzinnych ogrodach działkowych).

As public utility areas, Family Allotment Gardens favourably complement public greenery structures, providing various ecosystem services [Borysiak et al. 2017], including cultural ones, as a place for integration and recreation of residents – a substitute for a backyard garden, and in times of a pandemic – a place of safe contact with nature. At the same time, however, gardens are under a strong pressure of urbanization and their area is constantly decreasing [Witczak, Macias 2016].

The research undertaken in Poznań was aimed at analysing and assessing changes in the functioning of FAGs in the years 2011-2021 and their connections with the structural wedges of greenery in the city. The hypothesis that was tested was meant to prove that FAGs indeed co-create in some parts green wedges of Poznań and complement the capacity of urban greenery. If changes implemented, FAGs could undoubtedly affect green structures, by strengthening and preserving continuity, as well as enriching biodiversity [Borysiak et al. 2017]. They may be considered as multifunctional element of green and blue urban infrastructure which is crucial for adaptation to anthropogenic climate change.

To achieve the results, an inventory documentation was prepared (legal status, including gardens closed in the last 10 years) coupled with detailed map revealing exact locations of Poznań's FAGs. The current situation of selected gardens was also analysed, especially those threatened with transformation or decommissioning, or ones which have been already eliminated. The analysis was contrived to present tendencies (developmental or degenerative) of these structures, as well as to investigate reasons of mentioned changes and cancelations.

This study examined research thesis' pointing at problems, barriers and the potential of reconnecting Family Allotment Gardens with hydrographic structure of the city of Poznan (in order to increase the retention capacity of small watercourses).

## 2. METHODS AND MATERIALS

Various methods were included into this research, including reviewing a considerable volume of literature and documents, which have been published on FAGs. The data from scientific papers (2010-2021), Polish Central Statistical Office (GUS), Development Strategies for the City of Poznan 2020 and Polish Allotment Association (PZD), department of city of Poznan were gathered and providently analysed.

In the first place a literature and cartography sources review was performed (there were used different cartographical websites, like spatial information system, map portal, historical and current planning documents of Poznan). Particular data included in legislation act (Polish Legislation Act: Ustawa z dnia 13.12.2013 r. o rodzinnych ogrodach działkowych) were used, as well as unofficial data contained in common spatial information (Ukosne.pl, Google Maps, SIP, e-poznanski-mapa-net, historical maps on mapster.pl). During undertaking this study, measurements were taken of the location, context, and state of particular FAGs. The additional help to confirm precise information (e.g. about date of liquidation) were press reports from years 2010 to 2021.

The second part was focused on creating a map, where the features of the gardens were marked (graphically – location in correlation with Poznan's green wedges, and correlation with watercourses' scheme).

For the purpose of the research, all gardens were strictly analysed and classified according to various criteria:

- Location (with relation to green wedges and the possibility of including FAGs in these structures);
- Neighbourhood (type, features);
- State: existing / annihilated / transformed into habitat/ endangered) and Correlation with waterbodies.

An overlay map method was also used to find the correlation between the location of the FAGs and the urban heat island.

Third stage contained determination of threats of the gardens if the city policy and plots development would remain unchanged and chances following changes of these factors.

Data for this study were retrospectively collected from surveys of plots' users, scientific researches and interviews, as well as from analysing trends and good practices [Bartłomiejski, Kowalewski 2019; Škamlová et al. 2020], all to indicate

directions of changes – changes in structure and formal organization of FAGs, to increase social inclusiveness and environmental and climate productivity.

### 3. RESULTS

#### 3.1. Family Allotment Gardens in the structure of city Poznan

Before 2010 there were more than 95 existing Family Allotment Gardens in the city of Poznan [Informacja o wynikach kontroli... 2010]. Unfortunately they were gradually erased or transformed into habitats (while maintaining the original layout). In 2014 they were counted – as the result – authors of that calculation, Szczepańska, Krzyżaniak [2016] specified the amount of 90 existing gardens (occupying total area 819,7 ha, which accounted for 3% of Poznan's area). The following study, carried out in 2021 revealed that the amount of FAGs decreased to 85. Moreover, the number of gardens is decreasing (in 2013, a decision was made to close down more gardens, and 6 more gardens were destined for complete liquidation).

Authors analysed 98 FAGs (95 administratively belonging in Poznan and three gardens adjoining to city's borders) of various purposes, with different status (including liquidated ones) The study aimed to focus particularly on the changes that have occurred in past 10 years. The division into 4 categories was introduced: existing / annihilated / transformed into habitat (maintaining the form and layout)<sup>1</sup> / endangered.

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<sup>1</sup> E.g. Habitat named after Skorupka Priest, located in Górczyn District. The conversion into housing site was legally completed. Maltanskie Habitat, even though is in fact housing estate – still is denied to be recognized as a habitat, although it contains all the features characterizing habitat (this situation was caused by the conflict between residents of the place and the rightful owner of the site – Poznań Curia). Residents of the FAG named after Masłowski Priest have similar problem – since 2014 (when the legislation act about FAGs was passed, claiming that it is forbidden to inhabit FAG's plot) there are debates about changing this site into housing area, contrary to the local spatial development plans of Poznan city, where the industrial area has been planned. Till 2014 the city's policy was in fact liberal. ("Głos Wielkopolski", Anna Jarmuż press report, 14.04.2014 r.). The fate of this garden/habitat is still unknown.

Table 1. Detailed analysis of current situation of Family Allotment Gardens in Poznan in 2021. Signs: ZD – Allotment Greenery; MW/U – multi family housing with/ or facilities; MN – single family housing; U/P – facilities, magazines, industrial area; MN/U – single family housing with facilities; ZO – unmanaged greenery; MN/MW – single-family housing and/or low-rise multi family housing; U/US – facilities or/and sport and recreation area; wedges: NW– Northern Wedge; SW – Southern Wedge; EW – Eastern Wedge; WW – Western Wedge; JW – Junikowski Stream’s Wedge

No	District and address	Name	Type	Status	Acc. To Spatial Studium 2014	Location in Green Wedge	Rivers/ streams and reservoirs
1	Old Town, Serbska, Wilczak, Lechicka Streets	„Urodzaj”	FAG	existing	ZD	Near NW	No
2	Old Town, Lechicka, Umultowska Streets	„23 Lutego”	Old FAG	removed/nomadic liar	MW / U	No	No
3	Old Town, Lechicka Street 105	„F. Roosevelta”	FAG	existing	ZD	No	No
4	Old Town Umultowska, Madziarska Streets	„Budowlani”	FAG	existing	ZD	Near NW	No
5	Old Town Madziarska Street	„Tramwajarz”	FAG	existing	ZD	Near NW	no
6	Old Town Miętowa Street 36	„Relax”	FAG	existing	ZD	Near NW	no
7	Old Town Czarnucha	„Czarnuszka”	FAG	Newly formed in 2017	ZD	Near NW	Not now, upcoming part near Warta
8	Old Town Rzepeckiej Street	„Słonecznik”	FAG	Removed	MN	No	Wierzbak
9	New Town Bałtycka, Syrenia Streets	„ks. Masłowskiego”	All – year, habitat	To remove	U/P	No	No
10	New Town Pusta Street 16a	„Cybinka”	FAG	existing	ZD	In EW	Szklarka
11	New Town Majakowskiego Street 356	„Darzynka”	FAG	existing	ZD	Near EW	Darzynka
12	New Town Sandomierska Street 30	„Minikowo”	FAG	existing	ZD	No	No
13	New Town, św. Wincentego Street	„Energetyk I”	FAG	Existing, endangered	MW/U	Near NW	Warta River
14	New Town Nieszawska Street 2	„Pomet”	FAG	existing	ZD	No	No
15	New Town Wrzesińska Street 2	„Międzyzlesie”	FAG	existing	ZD	In EW	No
16	New Town Wrzesińska Street 11	„Kajka”	Allotment Organisation	existing	ZD	In EW	Kajka Pond

17	New Town Sypniewo Street 41	„Sypniewo”	FAG	existing	No data	In SW	Głuszynka
18	New Town Reknicka Street 1a	„Kolejarz-Kobylepole”	FAG	existing	ZD	Near EW	No
19	New Town Głuszyna Street	„Głuszynka”	FAG	existing	ZD	Near SW	No
20	New Town Jarosławska Street (Krzesiny)	„Pod lipami”	FAG	existing	ZD	No	Krzesinka
21	New Town Browarna Street 39	„Nowy Młyn”	FAG	existing	ZD	In EW	Browarny Pond Młyński Pond Cybina River
22	New Town Rudzka, Rymanowska Streets (Krzesiny)	„Reklas 27”	FAG	existing	ZD	No	No
23	New Town Silniki Street	„Pod Kasztanami”	FAG	existing	ZD	No	No
24	New Town Skłodowa Street 15 (Żerniki)	„Rodzinne Ogrody Działkowe im. Profesora Stanisława Żalińskiego w Jaryszkach”	FAG	existing	MN/U, beyond Poznan	Near EW	Krzesinka
25	New Town Jarosławska Street (Krzesiny)	„Koninko”	FAG	existing	ZD, beyond Poznan	No	Krzesinka
26	New Town Ruggijska Street 60	„M.C. Skłodowskiej”	FAG	existing	ZD	In EW	No
27	New Town Sandomierska Street	„Euro 2012”	FAG + open garden	existing	ZD	No	No
28	New Town Krańcowa Street	MALTANSKIE HABITAT/ FORMERELY Workers Allotment Garden „Wolność”	ALL – YEAR, HABITAT	Transformed into illegal habitat	MW/U	Near EW	No
29	New Town, Przy Lotnisku Street	„Przy Lotnisku”	FAG	Newly formed, July 2021	ZO	No	No
30	New Town Katowicka Street	„Drzymały”	FAG	Removed (moved in 2016/17)	MW/U	No	No
31	New Town S11, Żerniki	„Okran Jaryszki”	FAG	existing	beyond Poznan	Near EW	Stream flowing into Michałówka
32	Wilda, Opolska Street 151	„Wilda”	FAG	existing	ZD	Connects SW and JW	No
33	Wilda, Opolska Street 149	„St. Gintrowskiego”	FAG	existing	ZD	Connects SW and JW	No

34	Wilda, Opolska Street	„Seneka”	FAG	existing	ZD	Connects SW and JW	Górczynka
35	Wilda, Opolska Street 148, Leszczyńska Street 190	„Świerczewo”	FAG	existing	ZD	Connects SW and JW	No
36	Wilda, Leszczyńska Street 58	„Piotra Skargi”	FAG	existing	ZD	Near JW	Śmierduch Pond
37	Wilda, Wspólna Street 58	„M. Jackowskiego”	FAG	existing	ZD	Near SW	No
38	Wilda, Wspólna Street 65	„A. Mickiewicza”	FAG	existing	ZD	Near SW	No
39	Wilda, Dolna Wilda Street 91	„T. Kościuszki”	FAG	existing	ZD	In SW	No
40	Wilda, Jałowcowa Street	„Kolejarz – Dębiec”	FAG	Existing, to remove	Road area	No	No
41	Wilda, Dolna Wilda Street, Droga Dębińska	„A. Paszkowiaka” (HCP-2)	FAG	existing	ZD	In SW	No
42	Wilda, Dolna Wilda Street 16	„Mazurek” (HCP – 3)	FAG	existing	ZD	In SW	No
43	Wilda, Droga Dębińska	„Bielniki”	FAG	existing	ZD	In SW	Unknown pond
44	Wilda, Droga Dębińska	„Dębinka”	FAG	existing	ZD	In SW	No
45	Wilda, Samotna Street	„HCP-4”	FAG	existing	ZD	Connects SW and JW	Eventually Górczynka
46	Wilda, Żabikowska, Świerczewska Streets	„Pokój”	FAG	existing	ZD beyond Poznan	Connects SW and JW	Near Eda Pond
47	Wilda, Opolska Street	„Górczynka”	FAG	existing	ZD	Connects SW and JW	Górczynka
48	Wilda, Dolna Wilda / Orzechowa Street	„T. Wejnerta”	FAG	removed	MW	Near SW	Near Słoneczny Pond
49	Grunwald, Górnicza, Street Górczyn	ks. Skorupki habitat	habitat	Transformed into housing estate	MN/U	No	No
50	Grunwald, Bukowska Street 236	„1000-lecia Państwa Polskiego”	FAG	existing	ZD	Near JW	No
51	Grunwald, Bukowska Street 440	„Leśna Polana”	FAG	existing	ZD	JW	Junikowski Stream
52	Grunwald, Jana Brzechwy Street 1	„Kolejarz – Edwardowo”	FAG	existing	ZD	In JW	Unknown pond
53	Grunwald, Jana Brzechwy Street 3	„Wypoczynek”	FAG	existing	ZD	In JW	No
54	Grunwald, Złotowska Street 102	„Camping”	FAG	existing	ZD	In JW	Junikowski Stream, Ławica

55	Grunwald, Złotowska Street 67 a	„Złotowska II”	FAG	existing	ZD	In JW	Junikowski Stream
56	Grunwald, Złotowska Street 67	„Przylesie”	FAG	existing	ZD	In JW	No
57	Grunwald, Węgorka Street	„Stokrotka”	FAG	existing	ZD	Near JW	No
58	Grunwald, Reymonta Street	„Wł. Reymonta”	FAG	existing	ZD	No	No
59	Grunwald, Arciszewskiego, Grochowska Streets	„J. Chociszewskiego”	FAG	existing	ZD	No	No
60	Grunwald, Palacza Street 67	„M. Palacza”	FAG	existing	ZD	No	No
61	Grunwald, Czechosłowacka Street	„M. Kopernika”	FAG	existing	ZD	No	No
62	Grunwald, Kludyny Potockiej Street	„M. Curie-Skłodowskiej”	FAG	existing	ZD	No	No
63	Grunwald, Dmowskiego Street	„Hanki Sawickiej”	FAG	existing	U/P	No	No
64	Grunwald, corner of Hetmańskiej and Dmowskiego Streets	„Kopczyńskiego”	FAG	endangered, partially removed	ZD	No	No
65	Grunwald, Ptasia Street	„Ustronie”	FAG	removed	U or US	Near JW	No
66	Jeżyce, Dąbrowskiego Street	„Zjednoczeni”	FAG	existing? / removed; (2017/18)	MN/MW	No	No
67	Jeżyce, Bukowska Street	„Dąbrowskiej”	FAG	existing? / to remove; (supposed to be removed in 2018/19)	U	Not far away from JW	No
68	Jeżyce, Engeströma Street 15	„Jutrzenka”	FAG	existing	ZD	No	No
69	Jeżyce, Bukowska Street 169	„Ubezpieczeniowiec	FAG	existing	ZD	Not far away from JW	No
70	Jeżyce, Bukowska Street	„Energetyk II”	FAG	endangered	3rd communication frame	Not far away from JW	No
71	Jeżyce, Bukowska Street 281	„Nad Stawem”	FAG	existing	ZD	Near JW	POND
72	Jeżyce, Bukowska Street 170	„Żwirki i Wigury”	FAG	endangered (supposed to be removed in 2018/19)	U	Near JW	No
73	Jeżyce, Bukowska Street 237	„Lotnictwa Polskiego”	FAG	existing	ZD	Near JW	No



74	Jezyce, Bukowska Street 235	„Żwirki i Wigury II”	FAG	Existing, but endangered (plans of third communication frame)	ZD / 3rd communication frame	Near JW	No
75	Jezyce, Gorajska Street	„Wiepofama”	FAG	existing	ZD	No	No
76	Jezyce, Gorajska Street 9	„Zacisze”	FAG	existing	ZD	No	No
77	Jezyce, Gorajska Street	„Szafirek”	FAG	existing	ZD	No	No
78	Jezyce, Puławskiego Street	„Bogdanka”	FAG	Endangered/ partially removed	ZD	In WW, connects WW with Stubben Ring	Bogdanka
79	Jezyce, Piątkowska Street	„gen. H. Dąbrowskiego”	Workers Allotment Garden	endangered	ZD	No	No
80	Jezyce, Lutycka, Dojazd Streets	„Relaks”	FAG	existing	ZD	No	Wierzbak
81	Jezyce, Lutycka, Dojazd Streets	„Mostostal”	FAG	existing	ZD	No	No
82	Jezyce, Lutycka Street	„Gaj”	FAG	existing	ZD	No	No
83	Jezyce, Lutycka, Dojazd Streets	„ks. L. Przyłuskiego”	FAG	existing	ZD	No	Wierzbak
84	Jezyce, Litewska, Grudzieniec Streets	„St. Moniuszki”	FAG	existing	ZD	In WW	No
85	Jezyce, Bukowska Street 171	„Nowa Przyroda”	FAG	existing	ZD	Near JW	No
86	Jezyce, Słupska Street 90	„Camping pod Lasem”	FAG	existing	ZD	In WW	No
87	Jezyce, Bukowska Street 175	„2 Armii Wojska Polskiego”	FAG	existing	ZD	Near JW	No
88	Jezyce, Dojazd Street	„Akademia Rolnicza II”	FAG	existing	ZD	No	Wierzbak
89	Jezyce, Stobnicka Street 2a	„Zagajnik”	FAG	existing	ZD	In WW	No
90	Jezyce, (wrong data: Wejherowska Str.) Polanowska Street	„Zakątek”	FAG	existing	ZD	In WW	No
91	Jezyce, Biskupińska Street 19	„Strzeszyn”	FAG	existing	ZD	In WW	Ponds and Strzeszyński Stream
92	Jezyce, Wańkowicza Str. 43	„Armii Poznań”	FAG	existing	ZD	Near WW	No
93	Jezyce, Koszlińska Street	„C. Ratajskiego”	FAG	existing	ZD	Near wW	No
94	Jezyce, Wichrowa Street 9	„Wichrowa”	FAG	existing	ZD	No	No

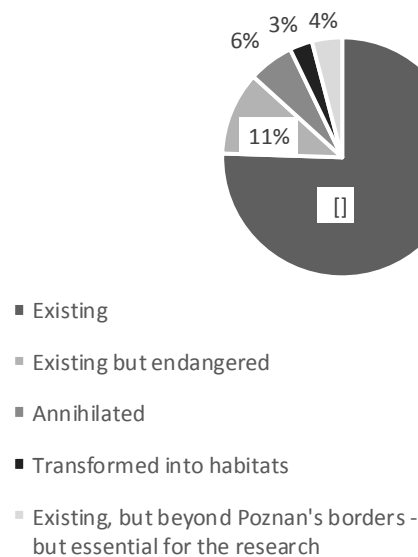
95	Jeżyce, Lutycka, Koszalińska Streets	„Rusalka”	FAG	existing	ZD	In WW	Reservoir, partially dried
96	Jeżyce, Sianowska Street	„Olszynka”	FAG	supposed to be removed in 2018/19	MN/MW	No	No
97	Jeżyce, Strzeszyńska Str.	„S. Strugarka”	FAG	existing	ZD	Near WW	No
98	Jeżyce, Wichrowa Street	„Karola Marcinkowskieg”	FAG	existing	ZD	No	Krzyżanka

Table 2. Comparing the results of Szczepańska & Krzyżaniak’s research made for 2014 and current analysis in 2021

District	Number of FAGs in 2014	Number of FAGs in 2021	Forecast for the future <sup>2</sup>	Notes
Old Town	6	6	6	Annihilated: FAG „23 Lutego”, Created: “Czarnuszka” FAG. Before 2013 – annihilated “Słonecznik” FAG
New Town	17	17	13	Created: FAG „Przy Lotnisku”, annihilated: FAG “Drzymały”, endangered: FAG “Energetyk I”. In this district there are two post-garden habitats.
Jeżyce	34	32	25	Annihilated: „Zjednoczeni”, partially annihilated: 4 gardens. For removal: 3 gardens
Grunwald	17	15	13	Still existing, but in acts and literature documented as annihilated – „Kopczyńskiego” FAG, another garden intended to removal. Before 2013: annihilation of “Ustronie” FAG. In this district there is one post-garden habitat.
Wilda	16	15	14	One garden annihilated, another one to go

<sup>2</sup> Predictions made based on spatial documents and press reports.

### Family Allotment Gardens in Poznan in 2021



Graph 1. Current structure of the Family Allotment Gardens' Quantity – including annihilated gardens and transformed into habitats

The analysis of the quantities, as well as documents and literature show that despite of certain need for gardens (seen in citizens' requests), more and more gardens are annihilated comparing to the need of creating new ones. Recently – only two gardens were established (see Table 1, no. 7, 29) – and they were founded to place all the users from removed gardens. The data from the analysis of Table 2 and Graf 1 shows that in 2011-2021, 9% of gardens were liquidated or transformed into housing estates, 4% of the still existing gardens are at risk of changing their status.

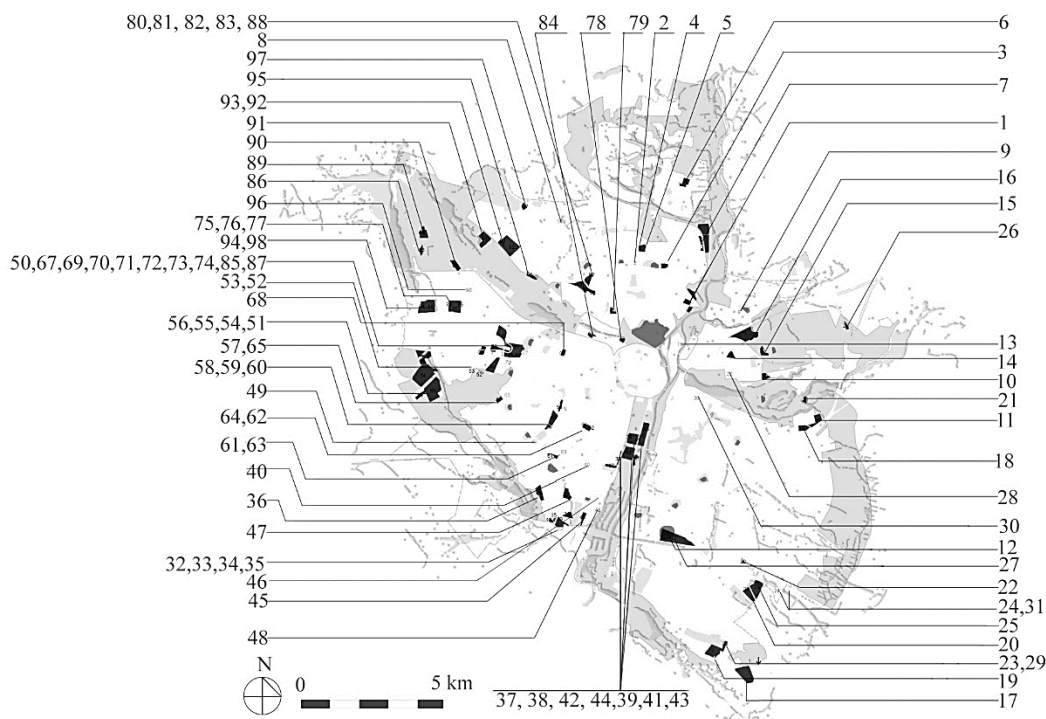


Fig. 1. Exact location of each of Poznan Family Allotment Gardens. A number contains information (table 1) about every garden (with different status and situation)

### 3.2. Family Allotment Gardens and Poznan green wedges – law and ownership issues

Only 27% (23 gardens) of all existing 85 have the advantage of being incorporated into Poznan green wedges. Question has been raised about the safety of FAGs existence, as some of the gardens are located in the areas attractive for investment (like partially annihilated “Bogdanka” FAG, see Table 1 point 78), while at the same time they have such legal status that allows for their liquidation or relocation into less “attractive” place, following – with using valuable land for another, more profitable function [Lewandowski 2019; Ustawa o ogrodach działkowych 2013]. As previously stated, the legal status and hence the ownership structure pose a significant problem. The area which have been used for years by the plot enjoyers – often has a private owner (e.g. “Bogdanka” and “23 Lutego” FAGs – see Table 1, no. 2, 78). The ownership wouldn’t be such a problem, if the area was secured by law (Studium...), that is, in the local spatial management plans should figure as

“ZD”, i.e. the allotment greenery. If this condition haven’t been fulfilled on such level – the rightful owners may, as they please – treat the area as “free” and unused space, perfect for future investments [Szczepańska, Krzyżaniak 2016], such as building new housing estates (see table 1 point 78, 79 and other “endangered” gardens). In case of “Bogdanka” (table 1, no. 78) – recently 13 plots have been removed (0,4458ha) (Press reports).

Table 3. Family Allotment Gardens existing in Poznan green wedges

WEDGES	No. in table 1	Quantity
Southern Wedge	17, 39, 41, 42, 43, 44	6
Northern Wedge	–	0
Eastern Wedge	10, 15, 16, 21, 26	5
Western Wedge	78, 84, 86, 89, 90, 91, 95	7
Junikowski Stream Wedge	52, 53, 54, 55, 56	5
Sum	10, 15, 16, 21, 26, 17, 39, 41, 42, 43, 44, 78, 84, 86, 89, 90, 91, 95, 52, 53, 54, 55, 56	23

### 3.3. FAGs in the Poznan’s greenery and water structure

The Poznan wedge-ring system of greenery was developed by Władysław Czarnecki (and his team) in 1934. He had proposed 10 green wedges and rings of greenery on post-military area, inspired by Josef Stübben ideas about city surrounding rings [Urbański et al. 2008]. The system is based on the hydrographic structure – Northern and Southern follow the Warta river, Eastern Wedge is situated in the valley of Cybina river, the Western Wedge – in Bogdanka’s valley. Fifth wedge spreads along Junikowski Stream. Some of the smaller watercourses (like Wierzbak) have been canalised underground, preventing them from serving environmental role. It is extremely important to understand how open watercourses and reservoirs (especially in preserved green structures) can serve to adapt to anthropogenic climate change. By creating natural ventilation corridors for the city, they reduce the nuisance of heat waves and the urban heat island phenomenon. Additionally, they are used to buffer extreme rainfall [Januchta-Szostak 2019], but only when their retention capacity allows for the reception of sudden storm discharges. Further advantage allows to clean rainwater runoff if the ecosystems of river valleys have been preserved. In addition, river valleys should and could constitute animal migration corridors, ensuring continuity of walking routes for animals. This potential of green structures is not fully used in Poznan.

Of the 85 FAGs existing, only 23 are closely related to the city's hydrographic structure. Prior to understanding the issue of unused water-related potential, several gardens were analysed to see the correlation with the watercourses.

Table 4. Coexistence between hydrographic structure and Family Allotment Gardens

Correlation with the watercourses	No. from table 1	Quantity
Stream, river or reservoir within FAG's structure	16, 43, 51, 52, 71, 95	5
FAGs enclosed by canalised Wierzbak Stream	80, 83, 88	3
FAG adjoining with the watercourse / reservoir	10, 11, 13, 20, 21, 34, 36, 45, 47, 52, 54, 55, 78, 91, 95, 98	16
Sum	16, 43, 51, 52, 71, 95, 80, 83, 88, 10, 11, 13, 20, 21, 34, 36, 45, 47, 52, 54, 55, 78, 91, 95, 98	23 (52th FAG – see table 1 – is bordering with reservoir, but there is also a small, pond on the wasteland, within garden's structure).

As shown in the Table 4, 16 gardens border on blue infrastructure (whether it is a stream, river, pond or another kind of waterbody). Only 5 FAGs include open river or pond within its structure (individual plots are often distributed around the water, not across it). The Wierzbak Stream (channeled underground) flows within 3 gardens. Despite the fact that its course is located within open allotments, the stream has not been opened and renatured so far.

In the studied gardens, no public zone (commonly accessible) was observed along the banks of the watercourses (the exception may be No. 43 in Table 1, see: Photo 1). Only in three cases it was observed that the shores were accessible to outsiders.

Despite the connection with water structures, spatial organization of the FAGs makes it almost entirely impossible to use the potential of the vicinity of water. The landscape, natural, recreational, climatic and retention values of the watercourses (and reservoirs) are ignored. Enclosed FAGs have become strongholds that neither animals nor other people can pass through. In cases where watercourses appear to be adjacent to the FAG, a centripetal tendency in the organization and development of plots is noticeable, leading to concentration of activities within the central area of the garden and neglecting river bank development.

Garden development activities are not aimed at creating common spaces on the shores of watercourses or reservoirs. In most cases, the water structures constitute a border, a barrier rather than an area of recreation and users' integration. The fencing of the FAGs and the lack of access to the streams flowing through them (or at

the gardens' borders) also hinder the shaping of ecological corridors. The valleys of streams have been maximally narrowed, the channels have been regulated, which limits their ecosystem functions, despite their courses through green areas.



Photo 1. Pond within FAG's structure – “Bielniki” FAG (Table 1 No. 43). (Source: UKOSNE.PL providing aerial photos). The beginning of common spaces (the northern side of the pond) is visible here. The southern side of was cut off by the private plots



Photo 2. FAGs enclosed by canalsised Wierzbak Stream – “Relaks” oraz “Akademia Rolnicza II” FAGs, seen from aerial perspective (Source – website UKOSNE.PL). The black arrows indicate the hypothetical course of the Wierzbak underground. (See table 1 No. 80, 88) The paradox here seems to be the fact that a canalsised Wierzbak's watercourse flows under the green areas and, as proved in many scientific papers [Gołdyn et al. 2019] – open water has great value in the blue and green urban infrastructure. The restoration of Wierzbak would have a positive impact not only on the urban climate, but also on the development of FAGs No. 88 and 80 itself

## 4. DISCUSSION AND CONCLUSIONS

### Family Allotment Gardens in Poznan green wedges

What are the barriers to incorporation of FAGs into green wedge structures? As stated in part 3.3 of this research, one of the barriers is the way of landscaping allotment gardens [Dymek & Bednorz 2017, Informacje o wynikach kontroli... 2010 and author's analysis], which prevents the migration of animals. The solution may be to promote the idea of "Open for hedgehogs" gardens (this idea would make it possible for smaller animals to migrate through these areas). There are several conditions that a place users have to fulfill. The example may be, among others: no hermetic fence (there should be holes / passages / gaps, or there should be proper gap at the bottom provided).

Another suggestion is to change the method of parcelling the land; transforming FAGs into more into open gardens, with paths and common spaces between plots. That would allow both pedestrians and animals move through the FAG, between the plots (creation of "ecological corridors"). Unfortunately, this solution requires interfering with the ownership structure and reducing the area of fenced private plots, which is opposed by their users.

Table 5. Existing FAGs located near green wedges, but not included into their structures (but with such potential)

WEDGES	No. From Table 1	Quantity
Southern Wedge	19, 23, 29, 37, 38	4
Northern Wedge	1, 4, 5, 6, 7, 13	6
Eastern Wedge	11, 18	2
Western Wedge	92, 93, 97	3
Junikowski Stream Wedge	32, 33, 34, 35, 36, 45, 47, 50, 57, 67, 69, 70, 71, 72, 73, 74, 85, 87	18
Sum		33

The inclusion of 33 gardens located beside the wedges (or the clusters of gardens which have a potential to connect the wedges) – would bring the green structure of Poznań closer to the vision of Władysław Czarnecki from 1934. Family Allotment Gardens positioned in wedges would account for 66% of the total number of FAGs in Poznań. The total area of green wedges would increase from 8051,07 ha [Witczak, Macias 2016] to 8317,3 ha.





Fig. 2. Scheme shows the gardens located near green wedges, which makes it possible to connect within their structures and incorporate them into the structure. The circles indicate large groups of wedges, making them important element of city greenery's structure

It is possible to enrich the Wedge-Ring arrangement of the green structure with other elements (e.g. connecting the green ring of forts and creating smaller wedges, reaching up to the Stubben Ring). Thanks to the presence of FAGs in certain places, it is possible to make attempts to at least partially implement this vision.

#### **Connector between FAGs and Eastern Wedge via Jarzyski / Żerniki area**

Further investigations were carried out, needed to estimate the values of the FAGs beyond the Poznan borders. By analysing the gardens located in the New Town District, on the northern-east of Krzesiny Airport, new potential was discovered. The vicinity of the ROD "Pod Lipami" (see Table 1, item 20) and the FAGs located outside Poznań, but directly adjoining to it (see Fig 3 and Table 1, items 24,

25, 31) creates an opportunity to make another, valuable connection with the Eastern Wedge of Poznan. If the changes would appear in the spatial study of the Jaryszki (concerning the above-mentioned areas) – perhaps it would be possible to create a connection between the FAGs and the Cybiński Wedge – using the valleys of the watercourses: Krzesinka, Świątnica, Kopel, Michałowka, Spławko. At the moment, without changes in the spatial study (as well as transforming existing areas), this idea is a daydreaming situation – due to the existing and planned industrial development.

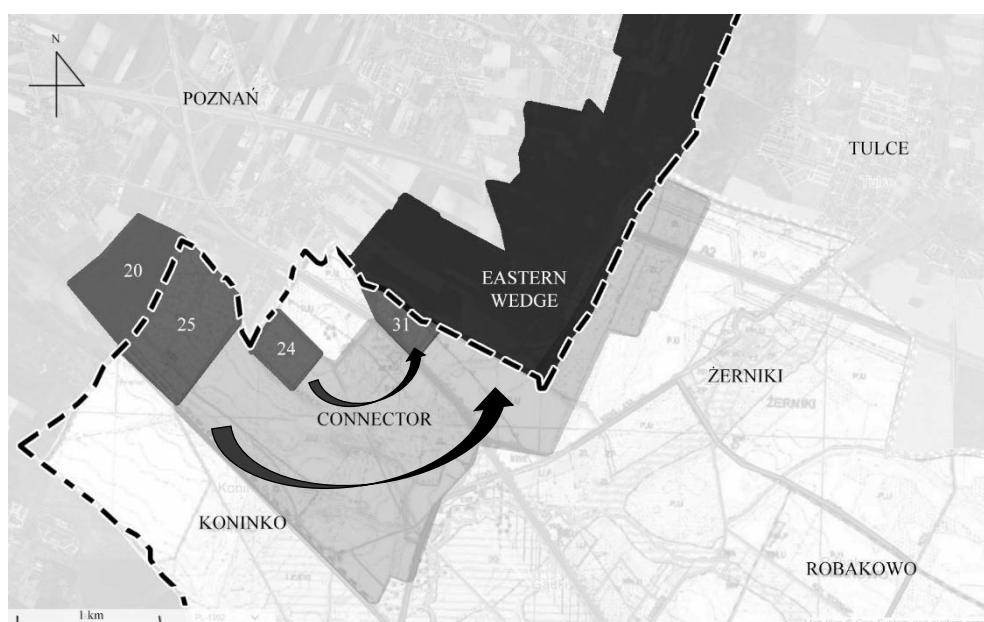


Fig. 3. The scheme shows FAGs no. 20, 25, 24, 31 (GREY colour, see table 1., no. 20, 25, 24, 31) corresponding with Eastern Wedge (Black colour). The perfect connection would appear on the grey area (see arrows). To achieve this venture, the cooperation between cities' governments should be established

### Family Allotment Gardens and water structures

The result of the study about FAGs connections with water structures were disappointing, mainly due to the situation of the Wierzbak watercourse and the lack of connections with the gardens: “Gaj”, “Przyłuski”, “Agricultural Academy II” (see table 1, points: 80, 83, 88, photo 2). In the area that is an important element of the city's green structure (the so-called “Winiary Wedge” consisting of Family Allotment Gardens located between Bałtycka and Droga Streets), the watercourse is canalized and serves also as a rainwater drainage collector. This negative phenom-

enon is common in cities and contributes to the impoverishment of the natural environment, landscape values and retention possibilities [Januchta-Szostak 2019]. Wierzbak currently flows under the allotment gardens, which contain only temporary garden arbors (not buildings nor durable, valuable infrastructure). Due to the key role of blue and green infrastructure in the processes of adaptation to climate change, it should be considered that the discovery and restoration of such watercourses in cities should be a public purpose investment.

## 5. SUMMARY

Currently, only 23 out of 85 existing Family Allotment Gardens are located within Poznan green wedges, and the same number of gardens links with the hydrographic structure. Most of them are under pressure from developers seeking investment areas. Including the major part of the Family Allotment Gardens in the structures of Poznan green wedges (as well as changing their legal status in local spatial management plans) would allow them to be legally protected by law. Presumably, to become enriching part of the wedges, the gardens should be modified within their structures in order to serve not only their users, but also the environment, climate protection and adaptation measures. FAGs may contribute to the enrichment of biodiversity, regulation of hydrological and biochemical processes, along with the improvement of air quality. In order to achieve that, significant spatial and organizational transformations (related to the reduction of private property for the common good) are required. One of the most crucial, upcoming tasks is the discovery and restoration of the canalised watercourses (especially Wierzbak Stream), flowing under the gardens, coupled with the restoration of biodiversity and connectivity of ecosystems.

Today the Family Allotment Gardens represent closed, fenced structures, available only to users (FAG “2012”, no. 27 in table 1 is an exception). Although the gardens serve social and psychological purposes (comfort of being outdoors, having own garden, a sense of privacy, the possibility of producing healthy food, and during a pandemic – ensuring a minimum recreational level), they require some changes. Such actions include changing the form, reducing fences and increasing accessibility for people and animals. Indubitably, the existence of private plots is the basis for the organization of these structures, but the idea of reorganizing the FAGs to increase the share of public spaces (currently limited to the so-called “allotment house” as the only public structure in the gardens) is worth considering. It would be a virtue to extend the functional program with common spaces like: mini parks, squares, playgrounds, walking paths, beaches/piers at water reservoirs. This conversion would improve the FAGs usability, as structures designated for more than individual leisure and urban gardening, but also for community purposes. It is

worth emphasizing on environmental education among residents and suggest changes in the structure of individual plots, along with differentiating the types and methods of cultivation, the selection of plant species and methods of water management, biological recycling of waste, so that the allotment gardens become a refuge for people, animals and plants. The additional but equally important goal is to create an effective tool for adaptation to climate change. Further work needs to be performed to establish the guide of specific changes required from individual gardens.

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## RODZINNE OGRODY DZIAŁKOWE W STRUKTURZE MIASTA POZNANIA I ICH ROLA W ADAPTACJI DO ZMIAN KLIMATYCZNYCH

### Streszczenie

Celem pracy była analiza lokalizacji i aktualnego stanu zagospodarowania Rodzinnych Ogrodów Działkowych (ROD) w Poznaniu oraz zmian, jakie zaszły w latach 2011-2021. Autorki zweryfikowały 98 ogrodów, z których tylko 85 nadal istnieje. Przedmiotem analizy były: kontekst i lokalizacja ROD-ów w strukturze miasta, w tym powiązania z klinami zieleni Poznania oraz układem hydrograficznym. W rezultacie zidentyfikowano uwarunkowania i problemy ROD-ów w Poznaniu, a także wskazano możliwości lepszego wykorzystania ich potencjału.

Wyniki badań potwierdzają, że ROD-y stanowią integralną część struktury poznańskich klinów zieleni i mają duże znaczenie społeczne, przyrodnicze i klimatyczne, jednak ze względu na sposób aranżacji (podział działek, ogrodzenia) zakłócają ciągłość i dostępność terenów zieleni miejskiej i są słabo zintegrowane z wodami powierzchniowymi miasta.

Proponowane zmiany w układzie przestrzennym i organizacji ROD-ów (zwiększenie dostępności publicznej) umożliwiłyby włączenie niektórych ogrodów w struktury klinów zieleni lub utworzenie nowych łączników pomiędzy klinami. Ponadto poprawa powiązań ze zbiornikami wodnymi (odkrycie skanalizowanych odcinków potoków, poprawa dostępności brzegów) podniosłaby ich wartość ekosystemową i pojemność retencyjną zlewni miejskich.

**Słowa kluczowe:** adaptacja do zmian klimatu, rodzinne ogrody działkowe (ROD), niebiesko-zielona infrastruktura, kliny zieleni, miasto Poznań