Green space at new housing estates. Flat price versus accessibility to good quality greenery

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Abstract: Green areas positively affect human health. It applies in particular to greenery in a direct neighbourhood of the housings. We analysed new housing estates in Poznan in Poland. The research included two stages. The first stage was to assess greenery quality according to developed factors, based on data about: 1) area of the greenery in comparison with the area covered by hardscapes within the site; 2) pre-existing greenery inventories; 3) new greenery inventories; 4) green area functions and accessibility. In the second stage of the research we compared data about greenery quality to information concerning economic value of the statistic flat in the estate. The research showed that the price of flats does not affect the quality of residential greenery. The quality of the greenery in the new estates is on a similar level notwithstanding the price. Developers do not take actual actions in the field of environmental compensation. Which leads to lowering the quality of greenery and public space.

Keywords: green housing estate; capitalization of urban green; residential greenery, sustainable cities / development

Introduction

Nowadays one of the most important driving forces in cities are developers, being one of the actors responsible for shaping the city form (Todes & Robinson, 2019), including open space between buildings. Thus, for some neighbourhoods, their role is decisive in

whether the space will be green and sustainable and adapt to climate change (Connolly, 2019). Many researchers focus on social approach when it comes to place of living and access to urban vegetation. It has been proved that inequalities in this area are increasing. Studies conducted in the cities of the developed Global North show that populations with higher socio-economic status have greater access to ecosystem services provided by vegetation (Tammaru *et al*., 2019). Statistical analysis of the socio-economic status of households and individuals shows differences in access to urban green space related to income, age, education and children in the household (Wüstemann *et al*., 2017). People living under different social conditions have different amounts of street greenery in their residential environment. Li *et al*. (2015) indicates that people with higher incomes tend to live in areas with more street greenery. This problem was analysed at spatial microscales (i.e. urban blocks of flats, individual buildings) by Łaszkiewicz *et al*. (2021) while studying residential segregation.

Many studies refer to existing residential areas, focusing on their sustainability and spatial arrangement, combining data about greenery with buildings type, age and its surroundings (Kilnarova & Wittmann, 2017; Battisti *et al.,* 2019). To date, little research has been devoted to differences in the availability and quality of residential greenery created as part of new housing developments, and relation between its quality and price of housing. The observations so far allow us to conclude that greenery is integral to current promotional campaigns for new housing. More precisely, it is greenery inside the housing estate – mostly inaccessible to the urban community and available only to a selected few, i.e. those who have incurred extra costs for a ‘green view’ or ‘access to a garden, green terrace or roof’. This can be considered as manifestation of greenwashing (Gałecka-Drozda *et al*., 2021) and capitalising on greenery or even creating a type of exclusionary green enclaves. Referring to the above

observation, it can be expected that more exclusive, more expensive residential complexes should offer more prestigious enclaves of greenery, intended for their residents. However, the presentation of investments in advertising materials as green is not always associated with the actual provision of high-quality greenery. Our study proposes that even expensive housing does not necessarily have access to good quality green space, as the price is not a factor in making a housing estate greener. Residents may not have close and direct contact with good quality greenery despite the comparatively high price of the flat. Moreover, residual, seminatural, informal vegetation that can provide an alternative to amenity greenery is rapidly disappearing in developing cities due to strong urban pressure (Sanesi *et al.* 2016; Jaworek-Jakubska *et al., 2020)*. Given that the current UGS resource is being over-exploited, including in marketing strategies and naming of development projects, we believe that this is an opportune time to argue for the integration of greenery of newly developed housing estates into local housing policies and urban spatial planning. Although sufficient and equitable access to UGS is a key aspect of adequate living conditions and a healthy environment in urban areas, research on providing urban greenery at the household and housing unit level is scarce.

This study aims to determine whether the quality and accessibility of greenery created as part of development projects increase with the prestige of the housing estate and the price of the flat. The area of greenery next to residential buildings partly results from the minimum requirements set by law, and above all from the developer's vision of the investment, guided by the preferences of users and the profitability of the implemented solutions. This study reviews the standards for greenery in multi-family housing developments. It also attempts to formulate indicators describing the quality of greenery. This study was conducted in Poznań, a large Polish city. It analyses 12 multi-

family housing developments built between 2019 and 2020. The study was divided into two stages. The first stage involved assessing the quality of the greenery, and the second stage compared this assessment to the economic value of an average flat. The effect of greenery on the price of housing has been shown in many studies (Tyrväinen & Miettinen 2000, Crompton 2001, Mansfield *et al.* 2005, Li *et al.* 2015, Mai *et al.* 2018), but how the price of housing determines the quality of residential greenery hasn't been subject of many research. More expensive housing is frequently built in the vicinity of public green areas (Checker, 2011), but how do developers shape the residential greenery in such locations? Is there a relationship between the high price of a flat and the high quality of residential greenery on a development plot? Our study fills a research gap in the subject of residential greenery quality, and its relationship with the price of flat.

Regulations and Shaping of Residential Greenery - commentary on Polish conditions

At present, Polish law does not oblige the provision of publicly accessible green and recreational areas within residential development sites in local plans. The applicable law refers only to the development area, i.e. the plot intended for multi-family housing development. The Ordinance of the Minister of Infrastructure of 12 April 2002 on technical conditions for buildings and their location (2002) (Journal of Laws 2002, No. 75, item 690) requires that plots earmarked for multi-family development should have at least 25% of the plot area arranged as biologically vital areas (Ratio of Biologically Vital Areas RBVA) if no other percentage results from the local spatial development plan (LSDP). According to the Ordinance, in a complex of multi-family buildings covered by a single building permit, playgrounds and accessible recreation areas should be provided, as appropriate to the use, with RBVA of at least 30%, unless otherwise

specified in separate regulations. At the same time, a RBVA is considered to be not only the native soil covered with vegetation and surface water within the building plot but also 50% of the sum of the surfaces of terraces and flat roofs covered with greenery with an area of not less than 10 m^2. The area of a building plot in a multi-family housing development is not linked to the legislation to either the number of residents or the intensity of the development (number of storeys, development area).

As mentioned above a RBVA is a very broad term. This legal situation implies an agreement to lower the quality standards of the residential environment. Consequently, green areas are often planned and created in a piecemeal form, limiting greenery to the statutory minimum. As a result, newly developed housing estates are increasingly devoid of concentrated green spaces. Although, as numerous studies have shown, the concentration of green spaces in larger areas has significant health benefits. The concept of superiority of concentrated green areas emerged in the 1960s in Poland and was popularised by W. Czarnecki. According to him, at least 50% of housing estates should be planned and designed to form a dense green area of more than 1 000 m^2 (Czarnecki, 1965). During the communist period, a state housing program was in force, at that time a record number of completed flats was reached. After 1990 the real estate market was dominated by private investors. The pursuit of profit contributed to the deterioration of the quality of public space, often to appropriation of greenery (Staszewska *et al.,* 2022).

Many cities are developing their own regulations when it comes to residential greenery. The authorities of individual cities in Poland are striving to develop guidelines and parameters for both existing and planned greenery. The Warsaw Housing Standard (WSM, 2018) defines the city's expectations of future investors and meets the needs of residents. It provides transparency in the city's housing policy. According to the

document, the protection of the natural environment should be treated as a priority during development.

An analogous document, Housing Policy of the City of Poznań for 2017–2027 (Gawron *et al.*, 2017), while noting the significant attachment of residents to green spaces (including the view that public green space should not be replaced by other types of RBVA, such as parking slabs with openings or green space on the roofs of buildings that is inaccessible to users), the guidelines for the design of green space accompanying housing development are very limited.

The answer could be top-down regulations related to the introduction of building standards and relevant LSDPs. An element supporting the improvement of the state of affairs in Poland is the 'Green House' certificate issued by the Polish Green Building Council (PLGBC, 2023). The evaluation criteria include 'landscaping'. In the certification process, it is necessary to carry out a wildlife survey (before the investment) and submit an ecologist's report. The guidelines for landscaping the areas around buildings include, among other things, refraining from introducing ornamental plants, introducing habitat-appropriate species, drought-tolerant species, melliferous plants, new tall greenery of native species, preserving the ecosystem and establishing meadow lawns. In contrast, there is no indication of the share of a green area on a development site.

The liberal tree removal law exacerbates the poor greenery situation in Poland. Article 83 of the Nature Conservation Act (2013) (Journal of Laws of 2013, item 627) expanded the circumstances allowing the removal of trees or shrubs without a felling permit in 2017. Additionally, fees for removing trees and shrubs during the construction of public roads were repealed.

Green Space and Housing Developments

The quality of green space has been the subject of numerous studies and considerations from different perspectives. Many publications address the correlation between good green space quality and the health of urban dwellers (Knobel *et al*., 2019; Knobel *et al*., 2021; Szulczewska *et al*., 2014). The quality of green space is influenced by many factors, such as area, accessibility, location in the city, surroundings, amenities, maintenance, land cover, plant and animal diversity and a sense of security. Urban dwellers interact with green spaces on three levels, according to Pretty (2004). These three levels relate particularly to residents of multi-family housing developments. The first level of contact refers to views of greenery (the views from windows developers extol in their advertisements). The second level is contact with greenery when doing other things, such as walking through the estate. The third deepest level is the deliberate seeking of contact with nature, e.g. using the common part of the housing estate such as a green square. From the city residents' mental health perspective, it is essential to provide contact with nature on these three levels.

The 3-30-300 rule by Konijnendijk (2022) has received a lot of publicity. It is a simple guideline that says everyone should see at least three trees from their home, have 30% tree canopy cover in their neighbourhood and not live more than 300 m away from the nearest public green space. Housing greenery standards in urban planning exist in many European countries especially in individual cities. For example German standards stipulate that, in addition to backyard recreation areas, a playground for older children should be provided if the number of dwellings exceeds 50. If the number exceeds 75, access to sports areas for young people and adults should be provided with an area equivalent to a ratio of 5 m^2 per dwelling (Dąbrowska-Milewska, 2010 after Amtsblatt für Berlin, 1990). In 2002, a local building law was passed in the city of Basel. It states

that all new and renovated flat roofs must be built as green roofs. This requirement was reinforced in 2010 by an ordinance that mandated green roofing for all flat roofs if part of a building retrofit and for all new buildings with flat roofs (Clime Adapt, 2023a; Stadtgärtnerei, 2023). In Copenhagen the access to close green areas is secured through high standards about the extent of open spaces for housing; typically 60 m^2 per 100 m^2 of housing for new multi-family dwellings (parking facilities are most often under the buildings and not above ground). In existing housing, green areas are created by clearing courtyards, demolishing garages and parking, etc. (Website of the European Union, 2023).

The increase in residents' expectations of residential greenery was accelerated by the Covid-19 pandemic when importance began to be attached to opportunities for outdoor sports close to home and to enjoy passive recreation in a green environment (Säumel & Sanft, 2022). Furthermore, green space next to high-density housing is particularly important for alleviating the stress of city life, a principle that works exceptionally well for older people (He *et al*., 2022). Although often green spaces in a residential environment are critical for less mobile people, after work recreation and children's healthy development, there has been relatively little research on them (Schmid & Säumel, 2021).

Study Methods

Study Area

Poznań is the fifth biggest city in Poland, with a population of 533 830 (GUS, 2021). The number of flats in Polish cities is rising steadily. This is linked to growing living space expectations, the development of metropolitan areas and a housing boom in the property market before 2022. These figures are confirmed for Wielkopolska, the region

whose capital is Poznań, which had the highest number of new housing developments completed in 2020, just after Mazovia, with the nation's capital Warsaw (SWAID, 2022). Poznań alone saw a record number of multi-family residential buildings completed in 2020 (PiNB, 2022).

The share of residential greenery in the total structure of green areas in Poznań is 13% (Fig 1), which lands it in 15th place among the 18 provincial cities in Poland in this respect. However, statistical data from 2010 to 2020 concerning the amount of residential greenery in Poznań indicate its reasonably stable situation in the city with a slight downward trend of this form of greenery (Tab. 1).

[Figure 1 near here]

[Table 1 near here]

In Poznań, as in other large Polish cities, fenced and monitored multi-family housing estates are often built, leading to space appropriation, including the green areas near these developments. Moreover, in recent years there has been a densification of housing estates created during the communist era. These housing estates were planned and built following functional, spatial and architectural standards, i.e. including common areas: playgrounds, sports fields and residential greenery. Due to the often unresolved ownership issues of the land on which the housing estates were built, it is a widespread practice for developers to encroach on the green areas of the housing estates with new developments (Zwierzchowska *et al*., 2021). For the last few years, grassroots social movements in favour of greenery have been growing in Poznań. NGOs oppose the development of green areas, the felling of trees and the renovation of public spaces involving the concreting of areas. There is a growing public expectation of the availability and quality of green spaces in the city. This is widely exploited by developers, advertising their estates as green. Which in reality involves pure

greenwashing. Greenery appears mainly in the names of new developments. The sellers use visualisations to communicate with buyers, showing new developments in a favourable light, with lush greenery in the background of the estate and inside it. However, the depicted green areas turn out to be impossible to create (Gałecka-Drozda *et al*., 2021).

Methods

Estate's Masterplans and Detailed Planting Design Analysis

The study considered newly built or under-construction multi-flat investments from the area of Poznań (Fig. 2). The study focuses on the detailed designs of greenery and landscaping projects. These materials are neither publicly available in full nor disclosed to investors – flat buyers. In order to obtain the design documents, we approached the developers directly, asking them to make them available for research on a fully anonymous basis. We have twelve greenery plans among 73 different development investments we applied for, which is a limitation of the study. We received design charts with landscaping designs, planting plans, detailed designs of landscaping elements and paving, sometimes also with a descriptive section. The design charts were sent in .pdf or .dwg format. We imported these files into Vectorworks, where calculations were made of the area occupied by the various types of greenery and paving in relation to the total development project (development area, paved area, area of common greenery, private greenery, lawns, perennials and shrubs, roof greenery). The number of projected plants of various taxa was also calculated based on the documentation. The number of trees cut down and retained was also determined. The analyses also included the residential part: the number of flats, the average flat area, the number of floors and the estimated target number of residents. Ten development

projects analysed were entirely commercial; two were social housing developments, subsidised on various terms with public funds. Due to varying data availability, it was not possible to calculate indicators for all developments (for this reason one from 12 was omitted in the statistical analyses). In addition, a research walk was carried out to find out how residents use the public green space and investigate its accessibility.

[Figure 2 near here]

Residential Greenery Quality Indicators

The first stage of the study determined the quality of the residential greenery, which is derived from the seven indicators we developed:

(1) 'Greening index' (WZ) compares the area of greenery on plots in relation to the size of those plots.

$$WZ = \frac{RBVA}{PZO} \quad (1)$$

RBVA – total ratio of biologically vital areas (i.e. low, medium, high green and green roofs)

PZO – housing estate area

(2) 'Accessibility index' (WDs) determines the area of green space available to residents and how much of it is per person.

$$WDs = \frac{PTZO}{LM} \quad (2)$$

PTZ – area of residential greenery

LM – number of residents

(3) ‘Compensation ratio’ (WK) shows how the area of greenery removed from the plot in preparation for the development compares to the greenery introduced after the development is completed.

$$WK = \frac{PZD}{PZU} \tag{3}$$

PZN – area of greenery added

PZU – area of greenery removed

(4) ‘Structural indicator’ (WS) assumes that the importance of tall greenery (trees, tall shrubs) is both environmentally and socially more important than low greenery (lawns, perennial and low shrub beds, ground cover plants), which plays a mainly ornamental role. The indicator shows the share of tall greenery in the total area of greenery on the plots surveyed for residential developments.

$$WS = \frac{ZW}{RBVA} \tag{4}$$

ZW – area occupied by tall greenery

RBVA – total ratio of biologically vital areas (i.e. low, medium, high green and green roofs)

(5) ‘Biodiversity index’ (WB) shows the species diversity of the planned planting related to the number of plants planted.

$$WB = \frac{LG}{LR} \tag{5}$$

LG – number of species

LR – number of plants

(6) ‘Socialisation rate’ (WU) indicates the proportion of green space that can be used to develop social contacts. The area of greenery arranged as recreation areas for residents (courtyards, playgrounds, outdoor gyms) is related to the ratio of biologically vital areas.

$$WU = \frac{PZW}{RBVA} \quad (6)$$

PZW – green area arranged as a recreation area

RBVA – total ratio of biologically vital areas (i.e. low, medium, high green and green roofs)

(7) ‘Democratic index’ (WD) indicates the accessibility of the greenery on the plot, as some of the greenery arrangements include private greenery (private gardens or terraces), inaccessible to every resident. The area of greenery along the pedestrian routes on the plot and related to recreation areas for residents is related to the area of ratio of biologically vital areas.

$$WD = \frac{ZD}{RBVA} \quad (7)$$

ZD – area of accessible greenery (transport + recreation areas)

RBVA – total ratio of biologically vital areas (i.e. low, medium, high green and green roofs)

Economic Value of the Housing Estate and Greenery

The second stage of the research compared data about greenery quality with information concerning the economic value of the statistic flat in the housing estate. It can be assumed that if an investment is more prestigious, one can expect to spend more on greenery.

The surveyed housing estates were divided into two groups: A – more prestigious with a higher standard and B – less prestigious with a lower standard. The criteria that determined the assignment to a particular group were: average price per 1 m^2 of flat, location and size of flats offered. The average price per m^2 of flats was of key importance. Flats with an average price per 1 m^2 up to PLN 7 000 were classified as less prestigious, while those with prices exceeding 7 000 per 1 m^2 were included in the more prestigious group. Group A covered flats of relatively large sizes – small ones (below 40 m^2) did not occur or occurred together with particularly large ones (above 100 m^2). Housing estates in prestigious locations such as the very centre of the city (11) and very close to a large green area (10 – Marceliński Forest, 4 and 7 – Malta Lake) were included in Group A. The quality of the architectural solutions offered was also arbitrarily assessed and taken into account. Two communal developments (6 and 9) were included in Group B, recognising that, by definition, they are aimed at residents with lower incomes.

Statistical analyses were carried out using Statistica 13.1 and MedCalc 20.115. Data were analysed in two groups for more prestigious investments (6 cases) and less prestigious investments (5 cases). Groups A and B variables did not show a normal distribution. The normal distribution was analysed using the Shapiro-Wilk test. The data were then analysed by the Mann-Whitney test.

Results

The greenery on the surveyed plots occupied 23% and over 55% of the area in percentage terms after the development (Tab. 2). The average for prestigious investments was 40.16% and 41.62% for less prestigious ones. On average, greenery occupied a larger area of the plots than development (the average area of development for prestige investments was 33.95% and 31.07% for less prestigious ones); only in

three prestige investments was the area of development on the plot larger than the area of greenery. Ornamental greenery along travel routes was predominant, occupying an average of 19.07% of plots in prestigious investments and 17.23% in less prestigious ones. Gathering spaces such as green courtyards, playgrounds and other recreation spaces, important for supporting social contacts, were not present on three properties, all from the prestige group. The average area of such green space was also lower in the prestigious investments, as it averaged 2.11% of the plot, while in the less prestigious ones, it averaged 9.5% of the plot. The area of private greenery (private gardens and terraces) varied considerably from plot to plot. One plot had no such greenery at all, while it ranged from 4.1% of the plot area to 41.5% in the other cases. The average percentage of plot area devoted to private greenery was the same for prestigious and less prestigious investments and was 14.7%. In relation to the total area of greenery in the group of prestigious investments, public greenery occupied an average of 51.1% of the greenery area, and private greenery, inaccessible to all residents, occupied an average of 41.1% of the greenery area; in the group of less prestigious investments, these were 68.8% and 31.2%, respectively.

The predominant form of greenery was lawn (Tab. 3). Lawns occupied between 12.6% and 41% of the plot area. On average, in the prestigious group, lawns occupied 22.8% of the plot area, which accounted for 61.6% of the total green space. In the less prestigious group, lawns occupied an average of 29.35% of the plot area and 70.6% of the total green space. Perennials and grasses covered an average of 5.27% of the plot area of prestigious developments (which averages 11.5% of the total green space) and an average of 1.6% of the plot area of less prestigious developments (averaging 3.4% of the total green space). This may indicate a desire to provide more ornamental vegetation, which requires more maintenance and therefore is more costly to maintain in

the case of the prestigious group. The most significant plants from the point of view of environmental impact, i.e. trees and shrubs, occupied a small area, ranging from 0.2% of the plot area to 16.4% of all investment. In the case of the prestigious group, trees and shrubs covered an average of 8.5% of the plot area (an average of 21.1% of the total green area) and an average of 8.1% of the plot area of the less prestigious group (19.9% of the total green area) (Tab. 3).

The potential associated with trees on the development plots prior to construction was not harnessed. Trees were present on all the plots surveyed, but in varying numbers from a few to over 300 specimens. As many as six developments, including five prestigious ones, had all their trees removed from the site (Tab. 4). Only one of the prestigious developments retained 25 of the original 48 trees. In the case of the less prestigious group, an average of 9.9% of the trees that existed on the plot prior to the development were retained. In this group, there was a project with 394 trees on the plot, of which only six were retained. In most cases (9), more trees were planted than felled. On average, in the case of prestigious developments, 19 trees were felled (which represented 94% of the existing trees), and 37 were planted. In one case, fewer trees were planted than fell, and in another case, no planting was carried out despite the felling. In the case of the less prestigious developments, an average of 92 trees (90.2% of existing trees) were removed and an average of 107 trees were planted. In one case, fewer trees were planted than removed. The area of RBVA prior to the development averaged 59.1% of the plot area for the prestige developments and was higher for the less prestigious developments, averaging 88.4%. As the compensation ratio (WK) shows for all but one development, the area of greenery removed far exceeds the area of greenery introduced after the development. Buildings and paved surfaces replaced the green spaces. The species diversity of new plantings was not high in the case of trees,

ranging from two to seven species; on average, three new tree species were introduced in the prestigious group and two in the less prestigious group. As for shrubs, five new species of shrubs were planned to be planted on average in the case of prestigious investments, with three species in the case of less prestigious investments. However, there were much higher numbers of shrubs per investment on average (366 shrubs on average, on an area of 446.3 m^2 per prestigious investment, and 1336 shrubs on an area of 918.8 m^2 per less prestigious investment). The perennial species diversity was similar, with an average of five new perennial species introduced and an average of 514 plants per plot in the case of the prestigious investments and an average of two new perennial species and an average of 1235 plants per plot in the case of the less prestigious investments (although the average area occupied by perennials on the plots, nominally and in percentage terms, was larger (an average of 472 m^2 and 5.24% of the plot area in the case of the prestigious investments versus an average of 123 m^2 and 1.6% of the plot area in the case of the less prestigious investments). Climbing plants and green roofs were rarely used design solutions in the cases analysed.

[Table 2 near here]

[Table 3 near here]

[Table 4 near here]

[Table 5 near here]

The statistical analyses showed that the differences between the average values of the indicators for the two groups of investments (prestigious and less prestigious) are statistically significant in the case of the 'socialisation rate' (WU) (Fig. 3, Tab. 5). It was higher in the case of the less prestigious investments, indicating fewer private green areas excluded from common use by all residents and better maintained public green space accessible to all.

[Figure 3 near here]

Also, the average WB, WD, WDs and WZ turned out to be higher for the less prestigious investments, but these differences were not statistically significant (Tab. 5,6,7). The statistical significance of the differences in the results for both groups for only one indicator is probably related to the small number of detailed greenery projects that were able to collect for development investments and analysed. This represents a limitation of the research conducted.

[Table 6 near here]

Discussion

While the topic of the mutual influence of real property and green space has been widely studied (Czembrowski & Kronenberg, 2016), there are few answers to the question of how developers shape the greenery inside their developments. Garcia-Lamarca *et al*. (2022) represent a breakthrough in this regard. Forty-two residential property developers from Europe and North America were interviewed for this purpose. The study differentiated between private and non-profit developers, which is consistent with our approach. Both groups were shown to use rent extraction from greenery. Investment in greenery is dictated by financial benefits, consumer demands and developers' aspirations of socio-environmental good. Greenery was an important element of all the investments we analysed, which confirms the above statement. The problem, however, turned out to be the low quality of the new greenery.

Greenery introduced in new housing estates is also an element that, in addition to the increasing attractiveness of the space, results in greater social acceptance of the dense housing developments being built, which developers eagerly exploit (Garcia-Lamarca *et al*., 2022). Also due to the importance of the social reception of the investment, in our research we focused, among others, on spaces that enable social

integration within the estate greenery. Study of Schmid and Säumel (2021) for Berlin shows that local residents surveyed by researchers visited parks not more often than once a week but benefited daily from residential greenery.

Green Estates in Poland

The problem of poor quality green space next to new residential development is significant. The scale of this problem is exacerbated by the manipulation of customers' image of their future place of residence. Studies conducted in Poland note the low share of greenery, particularly tall greenery, in the development of residential green areas. Bradecki & Twardoch (2015) revealed that in cities of the Upper Silesian Metropolitan Union (Poland), in 17% (from 41) of examined new housing estates, green areas occupy less than 20% of the investment area, and in 26% of cases there was no high greenery (trees). In some other cases, the only trees on the plot had grown there before the investment. For investments in our studies, the results were more favourable. The average area of greenery in relation to the area of the plot was 40.16% for prestigious investments, and 41.62% for less prestigious ones. There were some trees on every plot but there were not as many trees planted on any of the plots as had been cut down before the construction started. The liberal law in Poland allows easy removal of trees (Journal of Laws of 2013, item 627). Zwierzchowska *et al*. (2021) show that environmental conditions in socmodernist housing estates are more favourable than in new development sites in Poznań and Berlin. Socmodernist estates were richer in green spaces than new developments. Probably thanks to the more demanding legal regulations regarding greenery from the socialist period. This state of affairs is probably also due to the desire to use the land for development as intensively as possible by increasing the intensity of development (Podawca & Górecki, 2009). The potential of residential greenery to build urban resilience is untapped. A study for Wrocław showed

that only 32% of the developments surveyed used NBS, and as many as 17% of developments are devoid of trees (Dobrzańska *et al*., 2022). Green roofs have been a regular feature of the promotional campaigns of development estates (Gałecka-Drozda *et al*., 2021). In contrast, in 2017, green roofs were not used for promotional purposes, in response to customer needs, but as an opportunity to meet regulations related to the RBVA (Kronenberg *et al*., 2017).

Is Greenery Crucial for Polish Housing Investments or is it Just a Bonus?

Residential greenery in new developments is becoming an increasingly important element of their spatial structure. This is confirmed by the widespread use of green marketing by developers (Gałecka-Drozda *et al*., 2021) and the growing demands of customers related to increasing awareness of environmental issues, which is a worldwide trend, also noticeable in Poland, especially for consumers with higher incomes (Bryk, 2019; Rice *et al*., 2020). However, these elements do not yet translate into good quality greenery as evidenced by our research. The lack of good quality green space next to new development can be explained by the large housing shortage until a decade or so ago, which made the comfort of residents less important (Gyurkovich, 2002). Environmental benefits are still less important to buyers than other parameters of the development, including, for example, parking spaces. This is due to the car-oriented approach of most residents and poorly developed public transport. There is often a takeover of space planned as green space by cars (Bryk, 2019; Gyurkovich & Sotoca, 2019). The literature indicates a handful of development projects with carefully created green space and good-quality common areas. These estates are presented as positive examples, worthy of emulation and treated as innovative and pioneering (Fuhrmann, 2017; Gyurkovich & Sotoca, 2019) but not as the actual state of residential greenery, which was indicated in our research.

The approach to residential greenery among urban residents has changed due to the COVID-19 pandemic. Greenery near the residence has become more important for individuals from underprivileged residential areas in Berlin. Every fifth in 2018 and every fourth respondent in 2021 stated that they did not visit public parks outside their residential area, while all used residential greenery areas in some way (Säumel & Sanft, 2022). Residential greenery was all the more important during the pandemic as some recreational areas, including playgrounds and sports fields, were periodically closed, and city parks were perceived as crowded.

Approach to Existing Green Space in Development Projects

The deteriorating conditions of urban trees and the difficulties with planting new ones should force maximum protection of existing greenery. According to our observations, most of the trees were removed from construction sites. The potential of the existing greenery, i.e. the presence of mature trees on the development site at the time of its commissioning, which could have positively influenced prospective buyers' perception of the property, was not harnessed. Similar conclusions were drawn in the case of Wrocław (Dobrzańska *et al*., 2022) and Poznań (Gałecka-Drozda *et al*., 2021), where the existing greenery on development plots is mostly removed. Even if some of the greenery is preserved, its chances of survival are very slim. A survey conducted by Suchocka *et al*. (2019) among tree professionals involved in development projects indicates that trees are not sufficiently protected in most cases during development. In the context of our study, the low level of greenery compensation rates also seems worrying.

Flat Price and Quality of Green Space

Surprisingly, the results of the study indicate greater accessibility to common green

space in less prestigious estates than those identified as prestigious. This is due, among other things, to the separation of large areas of private gardens within prestigious estates. The creation of gardens next to ground-floor flats is a common practice of developers, whereas it is less common in communal and social housing developments. Private gardens in multi-family developments are seen as part of a sales strategy. It is also a method of ceding the costs of greenery maintenance to buyers. Ground-floor flats are less popular with consumers; they offer a poorer view and less sunlight, and their users feel less secure. A good incentive to buy a ground-floor flat is a garden ranging in size from a dozen to even several hundred square meters. By dedicating large sections to private greenery, there is no room for common space. Meeting places intended for recreation that are important for social interactions were not present in the three properties surveyed (all represented the prestigious group). A study of changes in residents' attitudes towards residential greenery in Berlin before and after the pandemic showed that these green spaces were important to many residents in terms of maintaining social contacts (Säumel & Sanft, 2022) and reducing feelings of loneliness. A study in Kraków (Gorzelany *et al*., 2022) indicated the same reason for visiting green spaces was cited by around 20% of respondents in different phases of the pandemic. Social contact was more frequently sought by the Berlin survey respondents than the opportunity to grow plants, for which private gardens may be used more than common spaces. And 65% of the respondents indicated meeting neighbours or other people in the residential greenery, and a majority stated that children used the residential greenery, but only 15% gardened (Säumel & Sanft, 2022) what could be a good activity for a private garden. A study of different uses of and attitudes towards urban greenery during the pandemic in different countries showed that respondents indicated 'meeting other people' as the thing they sorely lacked in terms of access to green spaces during the first

stage of the pandemic when the possibility to use urban greenery in many countries was limited or non-existent (Ugolini *et al*., 2020).

The limitation of the research is the difficulty in obtaining design documentation related to greenery, which results in a small number of cases examined by us. Another obstacle is the difficulty in separating greenery from other factors affecting the cost of flats. In Poland, attention is paid first to the accessibility, size of the apartment and price, rather than to attractive neighbourhoodss (Bartkowiak & Strączkowski 2019, Bryk 2019). Only 6.9% of flat buyers in 2005-18 indicated that green surroundings were important to them (Bryk 2019).

Appearing certificates for green buildings (PLGBC, 2023) may contribute to greater attention to the greenery of housing estates and its quality. One can hope that society will also start to expect it.

Conclusions

We were unable to prove that more expensive apartments translate to better residential greenery. Our research leads to the opposite conclusion, less prestigious (cheaper) apartments have the same or even better access and quality of greenery in the estate. Our study concludes that even expensive housing does not necessarily have access to good quality green space, as the price is not a factor in making a housing estate greener. Residents may not have close and direct contact with good quality greenery despite the comparatively high price of the flat.

In the development projects analysed, greenery is not derived from the price of the flats. The common spaces are larger in less prestigious developments. In some of the studied more prestigious investments, the green area is limited to the necessary minimum required by law and the opportunities of plot development with maximum build up area. Both prestigious and less prestigious development projects offer private

gardens. These gardens are separated from the potentially publicly accessible housing estate space. This is particularly noticeable in the more prestigious developments and exacerbates the problem of equitable access to green space. These gardens do not serve a residential and recreational role for the flat owner nor an ecological and social one for the city inhabitants. Thus, the prestige of the investment is artificial and relies on a higher price, leading to a segregated society.

The analysed greenery of the development estates, due to the modest composition of the plant cover of both the publicly accessible space and the private gardens (parts of housing estates), does not constitute a significant element for the biodiversity and natural values of UGS.

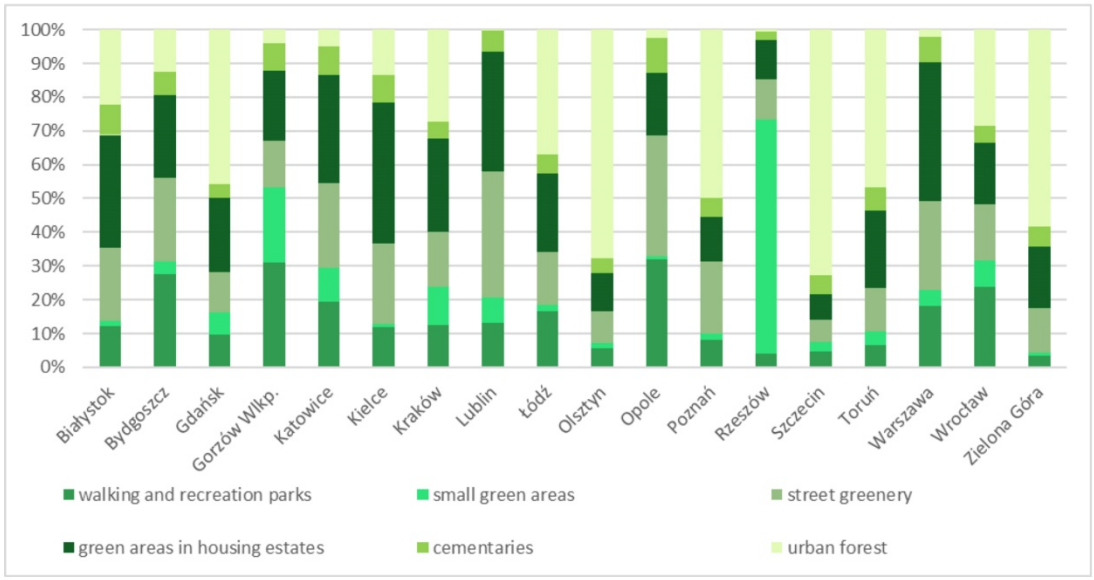

Fig. 1. Structure of green areas of large cities in Poland in 2020
Source: Statistics Poland (2021)

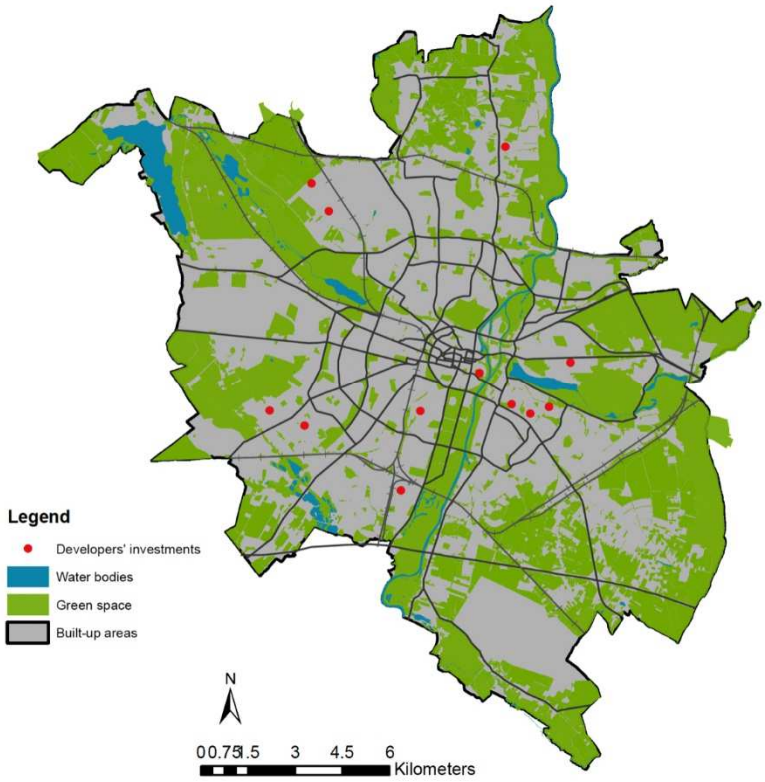

Fig. 2. Analysed developers' investments in Poznań.
Source: Author's elaboration

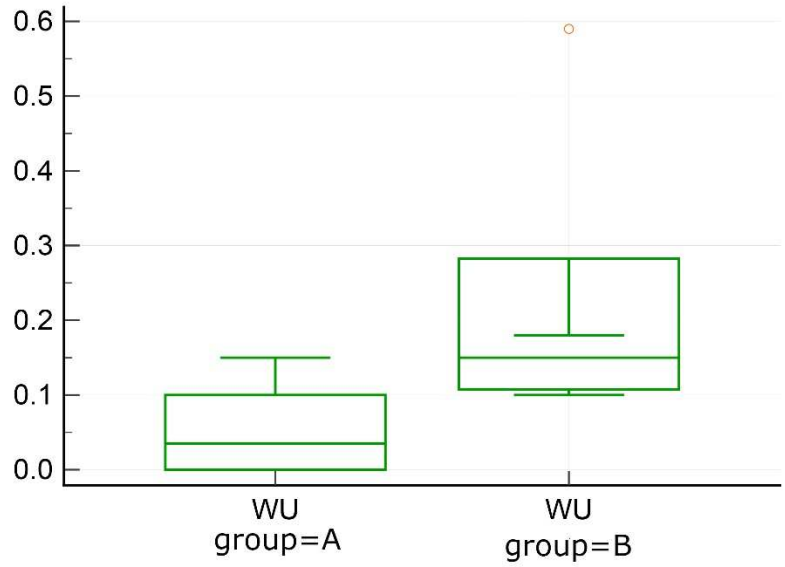

Fig. 3. Differences in median value for WU in two groups of investments: prestigious (Group A) and less prestigious (Group B)

Table 1. Residential green areas in Poznań between 2010 and 2020 [ha]

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Area [ha]	630.4	665.6	666.1	608.8	608.8	514.4	627.2	627.2	580.7	580.7	580.7

Source: Statistics Poland (2021)

Table 2. Summary of the different types of areas at the various developments

			Area					
Investment	**NR**		**Housing estates**	**Built-up**	**Paved**	**Greenery**	**Common greenery next to routes**	**Common green space as a meeting place**
A the prestigious investments	**1**	m2	3063	722.4	634.6	**1706**	1237	0
		%	100	23.59	20.72	**55.69**	40.38	0
	4	m2	16284	3927	5713	**9018**	3123	610
		%	100	24.11	35.09	**55.38**	19.18	3.75
	5	m2	3585	1214	826.7	**1087**	380.3	0
		%	100	33.87	23.06	**30.32**	10.61	0
	7	m2	5850	1659	1922	**2269**	829.7	236
		%	100	28.36	32.85	**38.79**	14.18	4.03
	10	m2	4343	1903	1032	**1408**	1019	211
		%	100	43.82	23.76	**32.42**	23.46	4.86
	11	m2	2449	1224	530.9	**694.2**	161.7	0
		%	100	49.97	21.68	**28.35**	6.605	0
average		**m2**	**5929**	**1775**	**1777**	**2697**	**1125**	**176**
		%	**100**	**33.95**	**26.19**	**40.16**	**19.07**	**2.11**
B the less prestigious investments	**2**	m2	5027	1944	806.6	**2485**	23.8	374
		%	100	38.68	16.05	**49.43**	0.473	7.44
	3	m2	11072	4107	2388	**4718**	550.2	2789
		%	100	37.09	21.57	**42.61**	4.969	25.2
	6	m2	25603	7064	7982	**10557**	5789	1873
		%	100	27.59	31.18	**41.23**	22.61	7.31
	8	m2	7779	2709	1059	**4011**	2907	391
		%	100	34.83	13.62	**51.56**	37.37	5.03
	9	m2	28144	4823	16776	**6546**	5833	713
		%	100	17.14	59.61	**23.26**	20.72	2.53
average		**m2**	**15525**	**4129**	**5802**	**5663**	**3021**	**1228**
		%	**100**	**31.07**	**28.41**	**41.62**	**17.23**	**9.5**

Table 3. Summary of the area of greenery of different types in the area of each development

			Area								
Investment	**NR**		**Lawns**	**Perennials and ornamental grasses**	**Shrubs and trees**	**Greenery on roofs**	**TOTAL planted cover**	**Greenery accessible**	**Greenery private gardens**	**RBVA before construction****	**Tree and shrub cover before construction**
A the prestigious investments	**1**	m2	926.1	277	502.5	0	779.5	1237	469	3063	2787
		%	30.24	9.04	16.41	0	25.452	40.4	15.3	100	91
	4	m2	2058	2186	848.6	3927	6960.8	3733	1080	723.2	723
		%	12.64	13.4	5.211	24.1	42.745	22.9	6.63	4.44	4.44
	5	m2	728.8	101	358	0	459.03	380	707	3585	26
		%	20.33	2.82	9.987	0	12.805	10.6	19.7	100	0.73
	7	m2	1516	0	753.3	0	753.3	1066	1204	3405	245
		%	25.91	0	12.88	0	33.2	18.2	20.6	58.21	4.19
	10	m2	1020	268	120	0	387.87	1230	178	3137	745
		%	23.49	6.17	2.763	0	8.9303	28.3	4.1	72.24	17.2
	11	m2	597.2	0	95.2	0	95.2	162	533	482.9	483
		%	24.39	0	3.888	0	3.8878	6.6	21.7	19.72	19.7
average		**m2**	**1141**	**472**	**446.3**	**654**	**1572.6**	**1301**	**695**	**2399**	**835**
		%	**22.83**	**5.24**	**8.522**	**4.02**	**21.17**	**21.2**	**14.7**	**59.1**	**22.9**
B the less prestigious investments	**2**	m2	1746	160	578.8	0	738.8	398	2087	4356	3879
		%	34.73	3.18	11.51	0	14.697	7.91	41.5	86.65	77.2
	3	m2	2160	256	869.5	0	1125.5	3447	1271	11072	1516
		%	19.51	2.31	7.853	0	10.165	31.1	11.5	100	13.7
	6	m2	10510	0	47	0	47	7662	2895	25603	160
		%	41.05	0	0.184	0	0.1836	29.9	11.3	100	0.62
	8	m2	2761	549	700,5	0	1249.5	3299	712	7544	1681
		%	35.49	13,69	17.47	0	16.063	42.4	9.15	96.98	21.6
	9	m2	4497	0	2049	0	2049	6546	0	16369	6454
		%	15.98	0	7.28	0	7.2803	23.3	0	58.16	22.9
average		**m2**	**4335**	**123**	**918.8**	**0**	**1042**	**4270**	**1393**	**12989**	**2738**
		%	**29.35**	**1.61**	**8.064**	**0**	**9.6776**	**26.9**	**14.7**	**88.36**	**27.2**

Table 4. Summary of greenery removed and newly designed

Investment	NR		Trees removed *	Trees retained	New tree species	Number of new trees	Shrub species	Number of new shrubs	Perennial and grass species	Quantity of perennials and grasses
A the prestigious investments	**1**	amt	48	25	7	36	10	542	13	1799
		%		34						
	4	amt	5	0	7	64	6	nd	12	nd
	5	amt	6	0	2	9	7	714	0	0
	7	amt	15	0	2	32	4	383	0	0
	10	amt	18	0	2	82	0	0	2	770
	11	amt	19	0	0	0	1	190	0	0
average		amt	**19**	**4.2**	**3**	**37**	**5**	**366**	**5**	**514**
		%	**0**	**5.7**						
B the less prestigious investments	**2**	amt	41	3	2	119	7	1166	2	1760
		%		6.8						
	3	amt	20	12	3	53	2	381	4	41
		%		38						
	6	amt	32	1	3	47	1	0	0	0
		%		3						
	8	amt	27	0	2	43	4	2005	3	4372
	9	amt	338	6	2	271	3	3128	0	0
		%		1.7						
average		amt	**92**	**4.4**	**2**	**107**	**3**	**1336**	**2**	**1235**
		%	**0**	**9.9**						

Table 5. Summary of indicators for individual investments, highlighting the highest values

Investment	NR	Indicator						
		1 WZ	2 WDs	3 WK	4 WS	5 WB	6 WU	7 WD
A the prestigious investments	1	**0.56**	**33.44**	0.01	0.29	0.01	0.00	0.73
	4	**0.55**	17.48	0.01	0.09	-	0.07	0.41
	5	0.30	3.70	**1.27**	**0.33**	0.01	0.00	0.35
	7	0.39	6.30	0.14	**0.33**	0.01	0.10	0.47
	10	0.32	5.32	0.01	0.09	0.00	0.15	**0.87**
	11	0.28	1.87	0.03	0.14	0.01	0.00	0.23
B the less prestigious investments	2	0.49	7.81	0.01	0.23	0.00	0.15	0.16
	3	0.43	19.41	0.01	0.18	0.02	**0.59**	0.71
	6	0.41	19.55	0.00	0.00	**0.09**	0.18	0.73
	8	**0.52**	2.50	0.01	0.17	0.00	0.10	0.82
	9	0.23	7.60	0.00	0.31	0.00	0.11	**1**

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