CHALLANGES AND OPPORTUNITIES NATURE-BASED SOLUTIONS FOR URBAN ADAPTATION IN THE ECONOMIC ENVIRONMENT

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In an increasingly urbanised economic environment, with more and more cities, there is a strong incentive for people to seek innovative local solutions to reduce their exposure to the risks of climate change. Accelerating urbanisation affects people in different ways, increasing exposure to the impacts of climate change. Air and surface temperatures in urban built-up areas are higher than in surrounding rural areas, leading to increasing urban heat islands. The more favourable economic environment has led people to move from rural to urban areas, and urbanisation has resulted in a mix of agricultural land, commercial and transport centres, industrial estates, industrial parks, transport hubs and coherent residential communities, housing estates, health and education facilities. The need to develop urban living space and its feasibility within a framework of sustainability requires a systemic, historical approach. In this article, we present the results of our survey in the parks of residential areas in Debrecen and the impact of contiguous green space on the microclimate. Through our computational methodology, we illustrate the influence of green space rehabilitation and innovative park developments adaptable to the urban environment on property value growth in a booming economic environment.

Keywords:
environment, urbanisation, green space, urban areas, sustainability

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1 Introduction

Due to the urbanisation trend of the 21st century, the level of built-up areas is constantly increasing, so the qualitative and quantitative analysis and sustainable development of the urban environment is a priority. The role of green spaces in the functioning of the urban ecosystem is nowadays the focus of attention (Dzifa, 2021). In our country, urbanised areas suffer from a serious deficit in green space - water management, and it can be noted that the proportion of urban green space is much lower in many municipalities compared to the built-up areas. In an increasingly urbanised and booming economic environment, the urban population is gradually increasing in proportion to the size of the cities. The process of urbanisation can thus be understood as a global and multidimensional process, which is manifested in rapid changes in the population density and environmental quality of urban populations (Elmqvist, 2008). The exposure of populations to climate change risks (Hashem, 2016) can be mitigated through innovative solutions at local level, through ecologically oriented green space development. The aim of this study was to investigate the relationship between housing prices and green space characteristics. The value of urban green spaces is not only known to reduce the urban heat island effect (Park, 1999; Zhang et al. 2017), improve air quality (De Ridder et al.2004; Smith & Huang, 1995), promote people's mental health (Beyer et al. 2014; Chen &Jones 2019; Nutsford et al. 2013), well-being (Groenewegen et al. 2012), but also increase property values (Jim & Chen, 2006; Chen et al. 2023).

2 Theoretical Background / Literature review

The evolution of temperature extremes and humidity in urban environments is related to the degree of built-up area (Elmqvist et al. 2015), the proportion of paved surfaces and the per capita availability of biologically active green areas. In February 2021, the European Commission adopted a new strategy for adapting to the impacts of climate change (COM(2021) 82 final), which highlights the need for immediate action to tackle the consequences of a changing climate. The adaptation measures will be implemented together with the measures published in the framework of the European Green Deal (COM(2019) 640 final). The new strategy sets out three main objectives: smarter adaptation, more systematic adaptation and faster adaptation. Sustainable ecological urban greening can be implemented in urban environments in a number of ways, such as mown lawns/hedgerows, annual green spaces, tree-

lined streets, perennial beds, biodiverse green spaces. Knowledge of environmental information is essential for effective climate adaptation. We measured the impact of green spaces on microclimate in a sample area of a housing estate in Debrecen, and the potential and ways of adaptation in an urbanised environment, which expresses the preparation for current or near future changes.

3 Methodology

Based on statistical data (ingatlan.com/debrecen), we compared the average apartment and house prices per square metre for non-new build properties in Debrecen over the past five years. We also looked at the popularity of each neighbourhood in terms of home sales. Debrecen is the second largest city in Hungary. The most popular districts of the city are the Belváros, the Nagyerdő area. The younger age group is more attracted to the Belváros, where properties are also an excellent rental option. Families tend to prefer neighbourhoods with a quieter environment and an excellent infrastructure, such as condominiums and housing estates. Looking at the five years from February 2019 to February 2024, the average price per square metre of non-new housing is up 172% and the average price per square metre of non-new housing is up nearly 202%. Given the fact that Debrecen is an industrial and university city, the increase in property values has been boosted by industrial development (international companies, pharmaceuticals, logistics services, car parts, IT, telecommunications, etc.) and the development of the city's infrastructure (motorway, airport). The available statistics show that more and more people are moving to the agglomeration from Debrecen, despite the steady increase in the price of real estate in the county capital. Within the city, low-residential, energy-efficient properties are popular, as well as stand-alone properties or those with green space in the immediate vicinity of the property. The location of the study was chosen to be an urban residential park in Debrecen where condominium/apartment buildings are popular and valuable due to the green space available and usable for recreational/leisure purposes. The "Újkert" housing estate was built in the mid-1970s in the north-east of Debrecen on an area of 810700 m^2 , with a green area coverage of 47.92% and a built-up area of 52.08% (Figure 1). The green area coverage per inhabitant in the area is 26.85 m^2 /person. The residential area is characterised by 4-14 storey buildings, with several large green spaces.

Figure 1: Presentation of the sample area
Source: Fülöp 2020

The measuring instruments used in the chosen sample area were the following: temperature and humidity meter TESTO 610 (With this instrument we are able to determine dew point, relative humidity, humid air temperature in addition to air temperature. The accuracy of the instrument is in tenths of km/h), Windtronic 2 - wind speed meter (The instrument is able to determine the maximum average and instantaneous wind speed. The instrument is compact and accurate to tenths of km/h).

Maxwell MT 25 901 infrared thermometer (The instrument obtains information on the surface temperature from the reflection of infrared light rays between 800 and 1400 nm with an accuracy of 4 digits). Eight sampling points were selected across the cross-section of the sample area (park), and temperature and humidity were measured at each point between June and September.

4 Results

The variation of temperature across the park cross-section for eight sampling points from 17.06.2019 to 02.09.2019 is shown in Figure 2. The graphs show the temperature results from sampling points 1 to 8 from left to right.

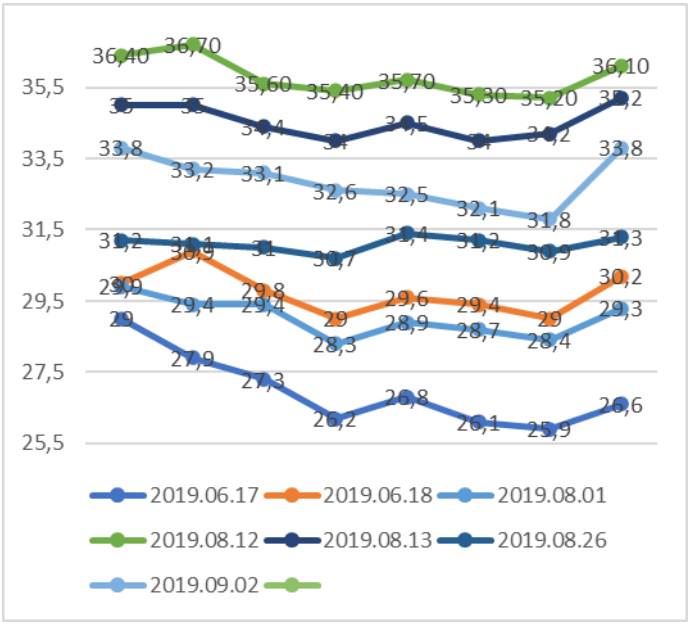

Figure 2: Temperature measurements in the sample area
Source: Fülöp 2020, Czédli et al. 2021

Measurement points 3, 4, 6 are located in the heart of the park, measurement points 2, 5, and 7 are located on the border of green areas, while points 1 and 8 are located in built-up areas. Our results confirm that the temperature decreases as one moves inwards in the green area. The average temperature difference between the edge of the park (measurement point 1) and the centre of the park (measurement point 3) was found to be 14.32° C. Moving across the cross-section of the park, the average surface temperatures ranged from 30.51 to 44.83 C. The lowest average temperature, at measurement point 3, was 30.51 °C in the interior of the park, and the highest average temperature, 44.83 °C, was measured in the built-up area. The intensity of the humidity variation in the sample area is illustrated in Figure 3.

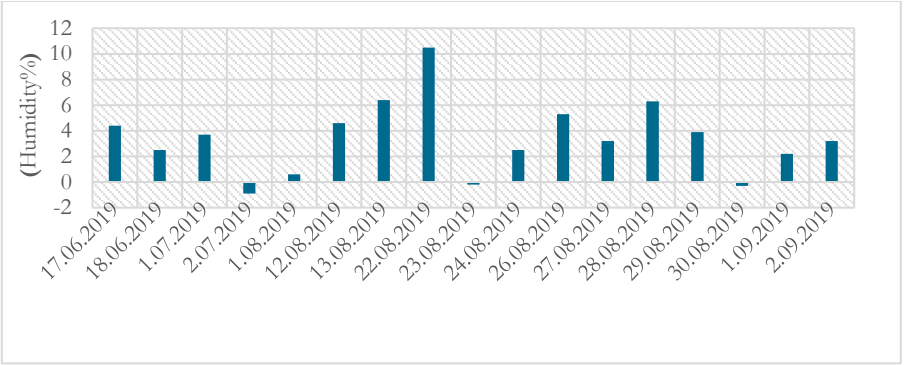

Figure 3: Intensity of change of the cushion column in the sample area
Source: Fülöp 2020, Czédli et al. 2021

5 Discussion

In order to compare the value and the conditioning effect of different urban green spaces for the urban population, we need indicators that allow us to carry out monitoring on a regular basis, since by carrying out the same studies several times, we can identify positive or negative trends by including quantitative and qualitative indicators. Rapid urbanisation is leading to the loss and fragmentation of urban green spaces, due to the rapid expansion of built-up areas at the expense of green spaces (Nazombe& Nambazo 2023). The marginal value of parks in terms of property prices depends on the type of green space, its protected status and its distance from the park (Lutzenhiser & Netusil 2001). Statistical results show that the impact of semi-natural green areas (Debrecen Nagyerdő zone) on property values is always higher than that of areas created by green space development (residential green areas).

6 Conclusions

Nature-based solutions offer a long-term opportunity for urban adaptation in a vibrant economic environment: they provide a cost-effective solution to modern urban challenges and contribute to making cities more sustainable and liveable with a range of positive environmental, social and economic impacts. The design and implementation of green infrastructure projects that provide ecological services and nature-based solutions with lower long-term maintenance costs are good for

municipal budgets. The development of green spaces in urban neighbourhoods contributes to improving the mental and physical health of the population, supports recreation, cools urban surfaces in summer, and supports the improvement of local social relations and community development. The need to develop urban living space and its feasibility within a framework of sustainability requires a systems approach and a historical approach. Green space development has a direct impact on the development of the city, influencing the quality and typology of the built environment.

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