Green Urban Management in the Light of Ecological Challenges

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The number of people moving to cities has been growing steadily over the past decades, with the population of cities set to increase by around 350 million every five years over the next decades, while the absolute number of non-urban people is projected to fall. This also means that rural depopulation will begin in the less developed parts of the world, with the proportion of the urban population likely to exceed 65% by 2050. This process, combined with climate change, will place increasing pressure on cities and make them increasingly challenging to manage. Urban populations will be the ones to suffer. The latest IPCC (Intergovernmental Panel on Climate Change) report published in March 2023 summarises the projected impacts of climate change, with key findings for cities. Climate change is having a detrimental impact on critical infrastructure, and extreme weather events and heat waves are intensifying in cities, which is also worsening air quality. In this paper, I will outline the issue of sustainable urban development and a possible way forward in the context of ecological sustainability, taking into account the limits of scope.
Keywords: *climate change, green cities, sustainability, smart city*

The basics

The number of people moving to cities has been growing steadily over the past decades, with the population of cities set to increase by around 350 million every five years over the next decades, while the absolute number of non-urban people is projected to fall. This also means that rural depopulation will begin in the less developed parts of the world, with the proportion of the urban population likely to exceed 65% by 2050.[1] This process, combined with climate change, will place increasing pressure on cities and make them increasingly challenging to manage. Urban populations will be the ones to suffer.[2]

1 Kovács Kálmán, *Okos városok és az okos közszolgáltatás és városfejlesztés*, Dialóg Campus, 2019. 11–12.
2 Also related: Ádám Boóc, Megjegyzések a COVID-19 vírus hatásairól a magyar szerző-

According to a 2015 survey in Hungary, 72% of respondents feel that summers are getting hotter, 69% experience sudden temperature swings, while 57% experience increasingly violent thunderstorms and windstorms.[3]

The latest IPCC (Intergovernmental Panel on Climate Change) report[4] published in March 2023 summarises the projected impacts of climate change, with key findings for cities. Climate change is having a detrimental impact on critical infrastructure[5], and extreme weather events and heat waves are intensifying in cities, which is also worsening air quality.[6]

The structure of cities increases local warming, leading to urban heat islands, and urbanisation contributes to damaging rainfall and strong wind storms. The result of all this can be observed in the intensity of flash floods.[7]

Climate change impacts particularly affect economically and socially marginalised urban dwellers, such as those living in slums.[8] Research shows that climate change is adversely affecting people's physical and mental health worldwide and contributing to humanitarian crises where climate hazards interact with high levels of vulnerability among populations.[9]

In this paper, I will outline the issue of sustainable urban development and a possible way forward in the context of ecological sustainability, taking into account the limits of scope. The topic under consideration is the subject of further analysis, which this paper will serve as a basis for.

Sustainability and urban development

Sustainability can be understood as a resource management issue based on local conditions and characteristics - resources, opportunities, goals, urbanisation processes[10] etc. - in the service of intergenerational social well-

dési jogban, különös figyelemmel a vis maior fogalmára, *Glossa Iuridica* 7: különszám, 2020. 85–94.

3 Energy Club July 2015 survey of a nationally representative sample of 1600 people.

4 IPCC, Synthesis Report of The IPCC Sixth Assessment Report (hereafter AR6), available at: https://www.ipcc.ch/report/ar6/syr/ (7. 08. 2023).

5 Critical infrastructure is defined in the literature as those infrastructural elements that are essential for the functioning of a country and play a crucial role in maintaining an adequate level of national and international legal and public security, economic viability, environmental condition, health and administration, and other services (such as drinking water, wastewater services). Kovács [2019] 23–24.

6 AR6 15.

7 AR6 16.

8 AR6 16.

9 AR6 16.

10 Enyedi György, A városnövekedés szakaszai – újragondolva, *Tér és Társadalom,* 2011/1, 5–19.

being[11], while one of the keys to achieving it is the implementation of sustainable projects based on local initiatives.[12] Sustainable development requires resilient ecosystems and social and economic systems,[13] whose lack of resilience can easily lead to unsustainable conditions. Ecological resilience improves economic sustainability, but the reverse is rarely true.[14]

Once infrastructure, low-density urban form, institutional and social practices become familiar, accepted or difficult to change, they create lock-in phenomena.[15] The long-term effects of the lock-in process and urban growth are still poorly understood, but infrastructure development in cities continues without a detailed analysis of the interrelationships that may affect the achievement and feasibility of long-term sustainability goals.[16] At the same time, urban planning has the opportunity to develop synergies through careful planning of interventions and complex assessment of direct and indirect impacts.

Urban development policy is a multifaceted concept, with many different forms, from the objectives and strategies formulated, to the programmes and methods used, to the everyday development practices.[17]

Climate adaptation and urban sustainability are complementary concepts. Sustainable urban development separates green, blue and grey infrastructures, the long-term development of which can do much to prepare for ecological and economic challenges. These elements are considered below.

Green Infrastructure (GI) is primarily about the maintenance and use of natural areas and natural, near-natural infrastructure, which is not about repainting and transforming the built environment or covering it with artificial grass, but about sustainable, ecologically sound development. It also

11 Buzási Attila, Szalmáné Csete Mária, Fenntartható fejlődés és klímaváltozás – globális összefüggések lokális értelmezése, *Magyar Tudomány* 2018/9., 1349–1358.

12 Szlávik János, Lépések a fenntartható gazdálkodás irányába: Gondolatok Láng István és Kerekes Sándor Megalakult a Túlélés Szellemi Kör című vitairatához. *Magyar Tudomány* 2014/1., 99–108.

13 Also relates: Pónusz Mónika, Kolonics Patricia, Megosztásos gazdaság, *Glossa Iuridica*, 2020/1-2. 315–334.

14 Also related: Gyüre, Annamária Csilla, *Az éghajlatváltozás és a fenntarthatóság kapcsolatának jogi szempontú vizsgálata*, In: Csillik, Péter; Andó, Éva; Kovács, Róbert (szerk.) *Egymillió karakter a fenntarthatóságról* I. kötet, Budapest, Magyarország: Károli Gáspár Református Egyetem, Gazdaságtudományi, Egészségtudományi és Szociális Kar (2023) 237–275.

15 Romero-Lankao, Patricia et al, Urban Transformative Potential in a Changing Climate. *Nature Climate Change* 2014/9, 754–756.

16 Chester, Mikhail V. et al, Positioning infrastructure and technologies for low-carbon urbanisation, *Earth's Future* 2014/10, 533–547.

17 Árvai Anett, A városfejlesztési szakpolitikák terjedése: elméleti megközelítések, *Tér és Társadalom*, 2021/2, 7.

promotes multifunctionality, which means that the same piece of land can serve multiple functions and offer multiple benefits if its ecosystem system is in a healthy state.

The GI aims to improve nature's capacity to provide a range of valuable ecosystem goods and services, potentially offering a wide range of environmental, social, climate change adaptation and mitigation[18] and biodiversity benefits.[19]

Green infrastructure uses (or mimics) natural systems to manage stormwater run-off. The most typical elements are rain gardens, infiltration basins, stormwater green streets, blue roofs and green roofs,[20] permeable pavements, subsurface detention systems, and rainwater tanks and cisterns.

The EU's new biodiversity strategy to 2030 includes a plan to *„build a truly coherent trans-European nature network*", with a particular focus on helping to conserve and rebuild biodiversity. It builds in large part on the existing Natura 2000 network[21]. The strategy establishes a framework to prevent biodiversity loss.[22]

While green infrastructure focuses on natural and strategically planned and designed green spaces, *blue infrastructure focuses* on similar aquatic ecosystems.

The systems are interconnected. The design of urban green infrastructure as well as grey infrastructure (i.e. stormwater drainage, water networks and wastewater services) thus includes the design of vegetated and wet vegetated channels as designed aquatic ecosystems as habitats, the regeneration of urban water bodies and vice versa. In addition to helping to improve the ratio of natural areas to green spaces, a naturalised riverbed and grassed bank can also have significant ecological value, increasing the biodiversity of the area concerned.[23]

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18 Also related: Gyüre, Annamária Csilla, *Current Issues in Climate Change Legislation* - /megjelenés előtt/, In: Szabó, Imre (szerk.) *Central European Legal Studies - Vol 1.*- / megjelenés előtt/ : Selected essays on current legal issues from a comparative legal approach, Oradea, România : Partium Press, 2023, 135-146.

19 What is green infrastructure? - European Environment Agency (europa.eu) (16. 08. 2023.)

20 What is an extensive green roof - greenroof.hu (15.08.2023)

21 The Natura 2000 network The European Union's nature conservation programme. For more on this, see Gyüre Annamária Csilla, *Környezetjogi előadások*, Patrocinium Kiadó, Budapest, 2022. 125-127.

22 *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and The Committee of the Regions - EU Biodiversity for Strategy for 2030*, (COM(2020) 380 final, 20.5.2020.)

23 https://masfelfok.hu/2020/12/15/esztetikus-okologikus-gazdasagos-kek-zoldinfrastruktura-uj-szemlelet-a-varosi-csapadekviz-gazdalkodasban-i/ (2023. 08. 16.)

Grey infrastructure also includes transport (i.e. roads, railways) and general sewerage and utilities (electricity, transmission, oil, gas, water and sewerage).

The challenges of grey infrastructure in Hungary there is a significant difference in the proportion of the population connected to the water network and sewerage network, the water and sewerage network is outdated in many places and is not able to handle large amounts of rainwater. Classical urban stormwater management aims to collect the rainfall in the shortest possible time and deliver it to a nearby watercourse. Most urban surfaces are therefore paved and impervious to stormwater. High pavement cover therefore has the greatest impact on the water cycle: it prevents soil absorption and recharge of groundwater, which can increase runoff volumes severalfold. Stormwater runoff is conveyed by combined or separated sewer systems.

The combined system is mostly used in urban areas built until the mid-20th century. Here, rainwater is piped in with the wastewater, so it cannot be discharged into rivers without treatment.

Recognising the value of water, the principle of stormwater management should be used instead of stormwater drainage. The aim should be to restore the original balance of runoff, infiltration and evaporation, mimicking natural processes. A combined system of stormwater management and permeable green spaces forms the urban blue-green infrastructure. Multifunctional, aesthetic and ecological surfaces simultaneously reduce runoff, cool the environment, serve the health of residents and maintain habitats.

Sustainable blue infrastructure solutions include several activities. These include, for example, the use of blue-green infrastructure elements to model the natural hydrological cycle in order to retain rainfall. Their four main functions are the capture, storage, evaporation and treatment of rainwater.

The simplest means of silting up rainwater is a flat permeable surface. Permeable pavements can provide a solution. The role of plants is also crucial, because their roots densely permeate the top layer of soil and the millions of micro-organisms living in this tissue filter and cleanse rainfall before it reaches the groundwater. The easiest way to increase evapotranspiration is to plant green spaces, especially trees with large canopies. A mature oak tree can absorb and evaporate up to 400 litres of water per day, intensively cooling its environment.[24]

24 A toolbox for keeping rainfall in place. A new approach to urban stormwater management II | Másfélfok (masfelfok.hu) (17. 08. 2023.)

The green and blue areas discussed above are particularly beneficial for the health and quality of life of certain socio-economic groups. The benefits of urban green spaces can be observed in relation to the reduction of stress levels and mental health of residents. [25]

According to a 2018 survey of 38 EEA countries (excluding Liechtenstein), on average 42% of the urban area of EEA member states had green infrastructure.[26]

Smart city concept

Smart city planning goes back two decades. The concept of the smart city originated in the technology sector, there are no scientific criteria or standards for what can be called a smart city, nor is there a single definition even today.[27]

Since the 1990s, the main question has been how to reform urban governance systems within a framework of sustainability (sustainable development). Cities had then evolved into dynamic systems in which people increasingly need personalised and time-sensitive services. The concept of the smart city has been developed in response to this and is organised around three aspects: sustainability, efficiency and broad participation.[28]

Sustainability means economically self-sustaining. Efficiency focuses on improving the quality and efficiency of services (e.g. digital infrastructure development), while broad participation means involving citizens in decision-making processes.[29]

According to Government Decree No. 314/2012 (XI. 8.) on the settlement development concept, the integrated settlement development strategy and settlement planning instruments, as well as on certain specific legal measures for settlement planning , and Government Decree No. 419/2021 (VII. 15.) on the content, preparation and adoption of settlement plans, as well as on certain

25 Marselle, Melissa R., Bowler, Diana Er, Watzema Jan, Eichenberg, David, Toralf, Kirsten, Bohn, Aletta, Ubran Street Tree Biodiversity and Antidepressant Prescriptions, *Scientific Reports*, 2020/10, 1-11. Ward Thompson, Catharine, Aspinall, Peter, Roe, Jenny, Robertson, Lynette, Miller David, Mitigating Stress and Supporting Health in Deprived Urban Communities: The Importance of Green Space and The Social Environment. *Int. J. Environ. Res. Public Health* 2016/13, 440.

26 https://www.eea.europa.eu/publications/who-benefits-from-nature-in/who-benefits-from-nature-in (10/08/2023)

27 Gere László, Kocsis János Balázs, Az okosváros-tervezés fejlődéstörténete kritikai megközelítésben*, Tér és Társadalom* 2022/4. 108-129.

28 Egedy Tamás, Városfejlesztési paradigmák az új évezredben – kreatív város és az okos város. *Földrajzi Közlemények,* 2017/3. 256-257.

29 Egedy, [2017] 256-257.

specific legal measures for settlement planning, a smart city is a municipality (or a municipality participating in joint planning of municipalities) that prepares and implements its integrated settlement development strategy (development plan) on the basis of the smart city methodology, which is defined in the Government Decree of 2012 as a methodology for the development of settlements or a group of settlements that develops its natural and built environment, digital infrastructure, quality and economic efficiency of municipal services by applying modern and innovative information technologies in a sustainable manner with increased involvement of the population.

The integrated urban development strategy is a specific tool for achieving medium-term objectives. The smart city prepares its strategy on the basis of the smart city methodology provided by the Lechner Knowledge Centre.

The concept of a smart city can be found in the literature in many ways, but the common denominator is that it includes solutions that use the latest technologies and innovations to improve a particular municipality. A smart city will include IoT technologies[30], augmented and virtual reality and big data technologies[31]. The concept of a smart city includes elements that use „smart" technology[32] to make a municipality more liveable. In this sense, for example, mobile applications that show the attractions of the area, routes or the city itself can be included.

The two main characteristics of a smart city are technology and added value for stakeholders. The aim of city management is to ensure a high quality of life and to increase competitiveness in a given geographical area. The smart city concept is becoming increasingly complex and is defined as a system of six elements (economy, people, governance, mobility, environment and living conditions)[33] based on one of the most commonly used models.[34]

30 Internet of Things

31 The term Big Data refers to the continuous collection of large amounts of data from connected devices through technological means. Chua F, *Big Data: its power and perils - Accountancy Futures Academy,, The Association of Chartered Certified Accountants*, London, 2013. cited in Kalmár Péter, Adattudomány és „Big Data" technológia a controlling szolgálatában, *Contoller Info*, 2017/2. 2-3.

32 See also Boóc Ádám, *Az online szerződéskötés magánjogi problémái*, In: Homicskó Árpád Olivér (ed.), Egyes modern technológiák, etikai, jogi és szabályozási kihívásai, *Acta Caroliensia Conventorum Scientiarum Iuridico-Politicarum,* XXII. Károli Gáspár Református Egyetem, Budapest 2018. 37-48.

33 Giffinger, Rudolf, *Smart cities: ranking of European medium-sized cities*, Vienna University of Technology, University of Ljubljana and Delft University of Technology 2007. 1-26. http://www.smart-cities.eu/download/smart_cities_final_report.pdf (18/08/2023).

34 Sikos T. Tamás, Szendi Dóra, A hazai megyei jogú városok gazdasági és környezeti fenntarthatóságának mérése, 2020-2021, *Területi Statisztika*, 2023/1. 88-124.

The living conditions include the implementation of a liveable city, measures to improve personal safety and health conditions, active cultural and leisure programmes, processes to improve housing conditions and the ICT[35] solutions that support them.

The economy dimension includes services supporting businesses and innovation ecosystems, as well as ICT platforms. The smart environment includes sustainable management of environmental resources (renewable energy, water and waste management), increasing the adaptability of cities to climate change[36], energy efficiency of the built environment and its improvement.

Smart transport includes sustainable and service-oriented transport development, the promotion of non-motorised and public transport modes, the provision of multimodal access (system-level and space-specific connections between transport modes).

The dimensions of smart people are defined by their capacity for lifelong learning, social and ethnic pluralism, flexibility, creativity and participation in public life.

Finally, participation in decision-making, community, social services, transparent governance are the key elements of smart governance.[37]

Nowadays, the literature on smart cities has developed a sustainable smart city approach, which complements the elements of smart cities with indicators of optimal management of limited resources, such as environmental protection, waste and water management, and greener energy.[38]

Concluding thoughts, conclusion

„Perhaps the highest level of sustainable cities is the so-called resilient cities, characterised by adaptation to different socio-economic-environmental shocks."[39]

In practice, urban smart planning is the result of an automatic signalling system that helps business and municipalities to achieve sustainable urban

35 information and communication technology

36 For more on this, see Gyüre, Annamária Csilla, *Az Európai Unió klímapolitikájának elmúlt 15 éve és hatása a magyar jogra,* In: Miskolczi, Bodnár Péter (szerk.) *Az Európai Unióhoz történő csatlakozásunkat követő hazai és európai jogfejlődés*, Budapest, Magyarország: Wolters Kluwer Hungary Kft. 2020. 113-134.

37 Giffinger et. al [2007] 1-26.

38 Sikos, Szendi [2023] 91. cite Ahvenniuemi Hannele et. al, *What are the differences between sustainable and the smart cities*? Cities February 2017 Part A Volume 60 Volume 234-245.

39 Sikos, Szendi [2023] 91.

development goals through smart business solutions. A common platform provides the right opportunity to allocate resources in a sustainable way.[40]

Smart cities are the cities of the future, leading the way towards sustainability by aligning infrastructures and changing societal attitudes.

40 Szalmáné Csete Mária, Buzási Attila, A smart planning szerepe a fenntartható városfejlesztésben, *Területi Statisztika,* 2020/3. 386.