Csorba, P., Túri, Z. (2025): The presence and interpretation of climate change in Hungarian small-town urban development documents and local public thinking. CITY.HU Városstudományi Szemle. 5(2), 93–114.

The presence and interpretation of climate change in Hungarian small-town urban development documents and local public thinking

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Abstract

In Hungary, it took 25 years for extreme weather events to become commonly perceived by the public, as consequences of global climate change. Although the scientific explanation of these phenomena continues to generate professional debates, it does not impede practical efforts to plan for and mitigate the damages caused by increasingly frequent droughts, flash floods, heatwaves, windstorms, invasive species, pests, and even human diseases. The overarching objective, as defined by the Second National Climate Change Strategy (NÉS-2), is "to avoid the unmanageable and manage the avoidable" (NÉS-2).

The strategic programmes prepared by small towns comprise three interrelated main components addressing damage mitigation, adaptation, and the shaping of environmental awaraness (attitude and involvement). Of Hungary's 348 cities, 88 have a population between 10,000 and 25,000. From these, 34 small towns were selected for analysis, based on the availability of climate change-related documents published on municipal websites. A smaller subset of these programmes was designed using the results of online surveys assessing the local residents' climate awareness, adaptability, and willingness to act. In addition, a field survey conducted in Tiszaföldvár aimed to explore the local residents' attitudes toward climate change.

Keywords: small towns, Hungary, climatic change strategies, European Landscape Convention, local climate adaption, landscape identity

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Absztrakt

Magyarországon 25 év kellett ahhoz, hogy ma már a szélsőséges időjárási eseményeket a társadalmi közvélemény természetes módon a globális éghajlatváltozásnak tulajdonítsa. Az okok tudományos magyarázata ugyan még ma is szakmai vitákat generál, de a mind sűrűbben jelentkező aszály, villámárvíz, hőhullám, szélvihar, özönnövények, különféle kártevők, sőt emberi betegségek miatt jelentkező károk elhárításának gyakorlati tervezését ez már nem akadályozza. A cél a „kezelhetetlen károk elkerülése és az elkerülhető kezelése" (NÉS-2).

A kisvárosok által elkészített stratégiai programok egymásra épülő 3 fő fejezete a károk lehetséges csökkentésével (mitigation), az alkalmazkodással (adaptation) és a szemléletalakítással (attitude, involvement) foglalkozik. Magyarország 348 városa közül 88-nak a lakosságszáma esik 10 és 25 ezer közé. A 88 kisváros közül 34-et választottunk ki, amelyeknek megvizsgáltuk az önkormányzat honlapján megtalálható, klímaváltozással kapcsolatos elképzeléseit. A klímavédelmi programok egy kisebb része úgy készült el, hogy előtte online felmérés volt a helyi lakosok klímatudatosságáról, alkalmazkodó képességéről és hajlandóságáról. Személyesen lebonyolított felmérésünk során *Tiszaföldvár* lakóinak attitűdjét igyekeztünk megismerni.

Kulcsszavak: kisvárosok, Magyarország, éghajlatváltozási stratégiák, Európai Táj Egyezmény, helyi klímaalkalmazkodás, tájidentitás

Introduction

Although professional debates continue regarding the ultimate causes of global climate change, it is an established fact that extreme weather events are becoming increasingly frequent worldwide (IPCC 2023; Bartholy et al. 2022). The gradual shift in average annual temperature and precipitation often go unnoticed in our everyday life. However, unusually long heatwaves and torrential storms tend to remain vivid in collective memory and strongly influence societal perceptions (Szirmai 2009; Mezősi et al. 2017; Poortinga et al. 2018).

Urban residents experience weather phenomena differently due to the densely built environment. Several climatic features typical of large cities do not occur in rural areas. Common examples include the urban heat island effect that forms above paved city surfaces, stormwater flooding streets, underpasses, and subway tunnels, due to inadequate drainage systems and increased wind speeds resulting from the channel effect created between tall buildings (Lázár et al. 2024).

Although more than 70% of Hungary's population lives in urban areas, in 204 out of the 348 cities, fewer than 10,000 people reside, meaning they are unlikely to experience the aforementioned urban weather phenomena. Urban heat islands generally develop in cities with at least 150,000–200,000 inhabitants and densely built-up city centres with limited green space (Szegedi et al. 2013). The most vulnerable are historical large cities that retain their medieval compact urban structures, lack sufficient parks, and are often enclosed by city walls – such as Bologna, Zaragoza, or Dubrovnik. Conversely, green areas, rivers, and lakes mitigate the formation of heat islands, even in cities with populations exceeding one million.

In Hungary the climates of Budapest, Győr, and Szeged are moderated by the Danube and the Tisza. Even in Debrecen, studies have shown that the centre of the urban heat dome is not located around the more ventilated area of the Great Church, but near the Csokonai Theatre (Szegedi et al. 2013; Unger et al. 2010; Dezső et al. 2022).

In response to the intensified negative bioclimatic impacts of global climate change, several professional frameworks have emerged in Hungary over the past 20–25 years. Sectoral adaption strategies – such as those addressing water management, forestry, and nature conservation – have all based on the first and second National Climate Change Strategies (2008, 2013). Later, more comprehensive and integrated frameworks were introduced, such as the National Development and Territorial Development Concept, the National Sustainable Development Framework Strategy and the National Landscape Strategy.

At the same time, public interest in climate-related issues has grown significantly, and was accompanied by the rise of civil initiatives and various awareness-raising activities. Professional insights have gradually become part of social consciousness, though this process of societal learning takes time before such topics appear in everyday practices – such as selective waste collection or water conservation.

It is evident that in small towns the climatic consequences of dense urban development are still barely perceptible. However, because these settlements are closely connected to their surrounding natural environments, residents may be more directly aware of climatic extremes.

We suggest that one useful indicator of the slow transformation of public thinking is the extent to which small-town municipalities have addressed climate change – specifically whether they have prepared locally tailored strategies to prevent or mitigate its anticipated negative impacts. According to international literature, numerous studies argue that small towns are at a disadvantage in mitigating the harmful effects of climate change. This is partly due to their limited financial and institutional capacity, and partly to the more traditional mindset of their residents (Fila et al. 2023; Nazari et al. 2025; Olczak, Hanzl 2025).

Hungary's National Climate Change Strategies

After the turn of the century, increasingly detailed professional reports emerged in Hungary on the signs of climate change and on ways to reduce its adverse impacts. Between 2003 and 2006, the so-called VAHAVA group worked extensively on the topic (VAHAVA 2010), and in 2008, the Parliament adopted the country's first National Climate Change Strategy.

As the European Union complemented its continental climate policy with the Decarbonization Roadmap in the early 2010s, Hungary developed its second national programme by 2013 (NÉS-2 2013). The revision was necessary because experts recognized that vulnerability to climate change differs significantly across regions due to variations in land use and social conditions. Consequently, adaptive capacity is also uneven. Therefore, realistic objectives must be aligned with local adaptation potential. The ability to respond effectively depends largely on social factors – such as residents' financial situation, demographic characteristics, and overall social position. Together these factors determine an individual's so-called "coping ability".

The authors of the second Climate Change Strategy (NÉS-2) carried out their vulnerability assessment in three main steps:

1. *Assessing the spatial pattern of climate vulnerability arising from geographical exposure.*

   According to the climate models projections for 2050, Hungary lies on the boundary between the highly endangered Southern European region and the moderately endangered Central European zone. Within the country, regions, where climate vulnerability is expected to remain stable or only slightly worsen, include the south-western and mountainous areas (Vas, Zala, North Somogy, and the counties of Veszprém, Nógrád, Heves, and Borsod-Abaúj-Zemplén). Conversely, conditions are expected to deteriorate more severely in Baranya, Jász-Nagykun-Szolnok, Hajdú-Bihar, Békés, and Csongrád-Csanád counties (Bihari Z. et al. 2018).

2. *Evaluating the climate sensitivity of different land use types.*

   Forests, arable land, meadows and other land uses respond differently to climatic shifts. Urban areas – such as city centres, residential districts, industrial zones, and suburbs – also exhibit distinct sensitivities. The combination of these two components (exposure and sensitivity) determines the overall climate vulnerability of a given area. Forests, arable land, meadows, and other land uses respond differently to climatic shifts.

3. Assessing adaptive capacity.

Adaptability refers to the tools available to mitigate climate-related hazards – for example, irrigation in agricultural zones or the application of the "sponge city" concept for water retention. According to Malatinszky et al. (2018), the current agricultural and forestry structure shows the lowest adaptive capacity in the Marcal Basin, the Southern Transdanubian Hills, and the Danube Plain. Social indicators of adaptability, include residents' income levels, car ownership, educational attainment, and – given the health implications of climate change – the accessibility of primary healthcare and emergency services.

Based on these factors – driven primarily by non-climatic conditions – cities such as Székesfehérvár, Veszprém, Győr, Debrecen, and Tiszaújváros display relatively strong adaptive capacity, whereas scattered farmstead (tanya) areas represent the opposite extreme. When assessing individual coping options, considerations was given to whether people could afford air-conditioning, travel during periods of extreme heat, or relocate to more comfortable microclimatic environments.

According to data from 2013, 36% of the country is classified as highly vulnerable from a bioclimatic perspective, while only 26% of the population resides in these areas.

The Strategy highlights the importance of maintaining ventilation corridors that allow air circulation into city centres, as well as reducing transport-related paved surfaces, since asphalt and concrete streets contribute most to urban overheating. The most effective measure, of course, is the expansion of interconnected urban green networks wherever possible, alongside strengthening the so-called Smart City programmes – particularly in the field of sustainable transportation.

Among built structures, historic monuments generally exhibit higher climate sensitivity, providing shading, rainwater drainage, and wind-resistant reinforcement for them tends to be more costly. In contrast, modern buildings such as bank headquarters or shopping centres featuring large glass façades and flat roofs are inherently disadvantageous from a climatic perspective. Consequently, in an increasing number of large cities, energy demand for cooling, now exceeds that for winter heating.

The overarching conclusion drawn from the professional literature is that climate-conscious urban planning should place greater emphasis on the development of compact cities rather than on unlimited urban sprawl. The concept of the compact city appeared in this context for the first time.

The next phase of adaptation planning between 2015 and 2019 involved the formulation of county-level climate strategies. This step was deemed necessary because each geographical and administrative territorial unit – region, county, district, and city – possesses distinct environmental and socio-economic characteristics.

These climate strategies typically focus on three interrelated pillars:

- mitigation – reducing greenhouse gas (GHG) emissions
- adaptation – enhancing resilience to climate impacts and
- awareness-raising – promoting climate-conscious behaviour among residents.

This triple focus is consistently reflected throughout the documents: it informs the situational analyses, shapes the long-term visions, and provides the structural foundation for objectives and policy measures (Kovács et al. 2024).

In the case of Hajdú-Bihar County, for instance, the strategy highlights several key local characteristics: agricultural land use and the food economy (e.g., KITE), the health industry notably, pharmaceutical production), and innovative knowledge bases associated with higher education and research institutions (Hajdú-Bihar 2018).

The Hungarian National Landscape Strategy (2017-2026)

The first major milestone in European landscape protection occurred in the autumn of 2000, when the European Landscape Convention was opened for signature to member states at a meeting of the Council of Europe's Rural Development Committee in Florence (Council of Europe 2000). This convention also serves as a key reference point for Hungary's National Landscape Strategy adopted by the government on March 20, 2017 (Government Decree 1128/2017. [III. 20.]).

The Strategy focuses on the following five thematic areas:

- demographic restructuring and migration,
- the sustainability of economic development,
- energy security,
- climate change, and
- declining biological and landscape diversity.

One of the main priorities is addressing the landscape effects of climate change, including the specific challenges faced by urban environments.

According to the Strategy, the current condition of Hungary's landscapes is strongly influenced by several interrelated trends:

- Growing regional disparities in population distribution and density. Rural landscapes are increasingly depopulated, while the capital and the outskirts of several major provincial cities face intense agglomeration pressure. Each year, 4,000–7,000 hectares of arable land are converted for urban use on the peripheries of these rapidly expanding cities.
- Erosion of landscape identity due to intensive urbanization. The Strategy highlights that "the sense of responsibility of a person detached from the landscape weakens, and often they do not recognize their own personal responsibility. They do not feel their own and the community's responsibility for the disappearing landscape heritage."

Unfavourable trends have led to the blurring of historically distinct settlement types and structures. Traditional forms such as the tanya farms of the Great Plain, the market towns along the foothill zones, the small villages of Transdanubia, and the characteristic small towns are gradually losing their unique features. As a result, a kind of homogenization is taking place at both the landscape and settlement-structure levels. "In the future, there should be room for settlements to define their own character, combining traditions and new aesthetical functions. To achieve this, the 2016 LXXIV Act on the protection of the settlement character has introduced new tools for ensuring landscape protection – Municipal Regulations on Settlement Character and Landscape Design Manuals."

According to the Landscape Strategy, "the municipalities' adaptation to climate change has already gone beyond the recognition phase." However, the proposed directions for adaptation remain rather general; "the structure of municipalities must be reviewed, and during planning, wise and economical land use, providing new functions for abandoned areas, and integrating climate-friendly municipal models must be applied together. The climate adaptation interventions must be expanded to include urban planning, green space design, brownfield, and redevelopment of derelict areas."

In addition to expanding public green areas, an intriguing proposal of the Landscape Strategy is that non-municipal but privately owned (!) green spaces within settlements should also fall under professional supervision. Currently, regulation is limited primarily to the moderately effective control of highly allergenic common ragweed (Ambrosia artemisiifolia) on private property. In recent years, some municipalities have also issued local decrees prohibiting the planting of certain invasive ornamental plant species, such as Japanese knotweed or cherry laurel. Interestingly, these climate-tolerant plants are often preferred, precisely because they tolerate changing climatic conditions – yet this preference directly contradicts ecological and climate protection objectives.

The strategic document understandably places particular emphasis on urban development and the "transitional zone" where the nature-friendly, semi-natural rural landscape meets the transitional belt of the urban periphery. According to the Strategy, the urban fringes and "gateways" of Hungarian settlements are typically disordered both functionally and aesthetically, and as a result, towns and cities fail to blend harmoniously into the surrounding landscape.

A crucial factor shaping urban structure is transportation infrastructure. Increased mobility is identified as the primary driver of urban sprawl, which in turn stimulates further infrastructure development – creating a self-reinforcing cycle.

To improve the urban climate, the local retention of rainwater and the implementation of the "sponge city" concept are recommended. Through the creation of permeable surfaces and the development of green infrastructure, the first 20 mm of precipitation should be absorbed on-site, replenishing groundwater and soil moisture rather than being lost through surface runoff.

Evaluation of climate strategy programmes found on small town websites

As of 2025, Hungary has 348 settlements with town status, 88 of which have populations between 10,000 and 25,000. This settlement size represents the lower tier of urbanization, situated between the "barely cities" (below 10,000 inhabitants) and the medium-sized towns exceeding 20,000–25,000 residents (Kovács et al. 2022). From these 88 towns, 34 were randomly selected for analysis, ensuring representativeness in terms of economic type (agricultural, industrial, tourism-oriented), hierarchical position (capital agglomeration, areas with urban deficiency, micro-regional centres), and geographical location *(Table 1, Figure 1)*.

The reviewed documents reveal, that settlements have not addressed climate change challenges at the same pace. In some small towns, the topic appeared in environmental protection programmes 15–20 years ago, yet broader attention to climate issues primarily emerged following two national grant frameworks and policy obligations. Beginning in 2018, the KEHOP grant enabled municipalities to finance the development of a Climate Protection Strategies, while from 2020, under the European Covenant of Mayors, the preparation of Sustainable Energy and Climate Action Plans (SECAP) also commenced in Hungary.

Out of the 34 towns examined, 19 – more than half – possess professional documents, including situation analyses and recommended actions. Three towns (Dombóvár, Hajdúszoboszló, and Szarvas) have climate strategies of earlier or alternative structure, often prepared nearly a decade ago, and thus less comparable. The most comprehensive

materials were found among 11 strategies developed using the Methodological Guide prepared by the National Adaptation Center of the Geological and Mining Institute of Hungary, commissioned by the Association of Climate-Friendly Settlements (Taksz 2018). The Guide is structured around five main chapters: GHG inventory and mitigation, adaptation, mindset shaping, financing, and vision (Pongrácz et al. 2024).

In SECAP documents, the energy-related dimension of climate change understandably plays a more dominant role. The Methodological Guide itself functions as a highly detailed manual, providing numerous examples for describing and evaluating various climatic impacts. Consequently, local strategy developers were effectively offered a "menu" of adaptable options, enabling them to tailor measures to their town's specific characteristics.

However, the 19 strategies reviewed cannot be considered fully uniform. In several cases (e.g. Gárdony, Kapuvár, Komárom, Kőszeg, Mátészalka, and Sátoraljaújhely), municipalities supplemented their analyses with online surveys measuring residents' climate awareness, climate anxiety, and willingness to cooperate on climate-related issues. According to the Guide, the integration and alignment of these strategies with other local planning documents are essential. Yet, in practice, many Municipal Image Manuals, make little or no reference to climate change, despite the clear relevance of building shading, glass surfaces ratios, and green space network design for urban climate resilience.

A particularly interesting example appears in the strategy of Balatonfüred, which applies a Climate Index for Tourism (CIT) designed to assess various locations based on thermal comfort, precipitation levels, sunshine duration, and wind intensity (Dubois et al. 2016).

Of the 34 small towns surveyed, 10 experienced population growth, while 24 saw a decline between 2022 and 2024. The towns showing net in-migration almost exclusively belong to the broader metropolitan agglomeration of Budapest (e.g., Biatorbágy, Budakeszi, Monor, Ráckeve) or are tourism-oriented settlements (Gárdony, Balatonfüred). In contrast, smaller towns, located farther from county seats have experienced severe migration losses, with population decreases of around 1,000 people over two years – for example, Sárvár, Mátészalka, Szarvas, Dombóvár, Tapolca and Körmend.

The demographic situation significantly determines the capacity and flexibility of local governments to act. The establishment of dedicated climate protection working groups or the appointment of municipal climate officers appears mainly in the programmes of better-positioned municipalities such as Balatonfüred, Biatorbágy, Hajdúnánás, and Kapuvár. However, a closer look at the agendas of municipal council meetings reveals no evidence of such measures being implemented, despite the strategies outlining plans extending to 2030, with a "view to 2050."

While there is still ample time for progress, it is more concerning that in the two to three years since the completion of these strategies, the topic of climate protection has not appeared on council meeting agendas at all. This is particularly striking given that strategies explicitly prescribe a review of commitments every two to three years. Although it may still be premature to issue strong criticism, of the challenges of recent years – the Covid-19 pandemic, reduced municipal revenues, inflation and economic stagnation – suggest that there is currently little political or financial momentum to implement the measures outlined in these often campaign-like climate strategies.

It appears that among the climate protection objectives, only those connected to new central EU funding sources are being realized – such as energy efficiency retrofits of public buildings, or the replacement of municipal vehicle fleets with zero-emission alternatives.

It is notable that nearly all small towns with a currently up-to-date Climate Protection Strategy are located in North and West Transdanubia – including Kőszeg, Sárvár, Kapuvár, Komárom, Tata, Biatorbágy, Gárdony and Balatonfüred. The remaining two-thirds of the country is represented by only three towns: Balassagyarmat, Hajdúnánás, and Békés.

Among the 34 towns examined, 12 possess other professional planning documents – such as Integrated Urban Development Strategies or Sustainable Settlement Development Strategies – that contain only marginal or passing references to climate change. In three cases (Bátonyterenye, Kiskunmajsa, and Tapolca), the topic appears solely within Environmental or Urban Development Programmes, and even there, only in brief mention.

Table 1 summarizes the key issues addressed in each town's available documents. It becomes evident that natural, ecological, and economic contexts largely determine both the perceived threats and the focus of adaptation measures. For instance, droughts dominate in agricultural landscapes, flash floods in hilly areas, forest desiccation in mountainous regions, and urban heat islands in resort towns affected by dense traffic and building congestion.

Several municipalities propose locally grounded solutions based on their specific environmental assets. Balassagyarmat, for example, envisions channelling the fresher air of the nearby Ipoly River into the town, while Hatvan seeks to introduce the cooler air of the Zagyva River's floodplain forests into the city centre. Where such natural advantages are absent, towns often focus on establishing interconnected urban green networks and planting climate-tolerant vegetation. A recurring concern across nearly all strategies is the spread of invasive, often allergenic plant and animal species associated with changing climatic conditions.

In cities with a strong agricultural background, such as Balassagyarmat, local strategies emphasize that the bankruptcy of medium-sized agricultural enterprises due to recurring droughts may lead to undesirable social polarization and the expansion of impoverished social groups. In contrast, Mátészalka's assessment presents a more optimistic view, suggesting that local agricultural systems possess a relatively high adaptive capacity to climate change.

In small towns rich in historical monuments, the vulnerability of heritage buildings to extreme weather events – notably windstorms – has become a significant concern. This is highlighted in Kalocsa, Balatonfüred, and in the case of Sajószentpéter where the deteriorated building stock in segregated areas further compounds climate-related risks.

In mass tourism destinations, such as Sárvár, Hajdúszoboszló, and Gárdony, achieving reduction in water and energy consumption poses a particular challenge, as visitors tend to suspend environmentally conscious behaviour while on holiday. In Balatonfüred, however, "Green Hotel" regulations have been introduced as an attempt to curb the water and the excessive resource use commonly associated with tourism seasons.

In several small towns – such as Kőszeg and Paks – the aging of the local population is perceived as a greater-than-average climate vulnerability given that elderly residents are more exposed to heatwaves and extreme weather events. In contrast, Gárdony's strategy argues that strong social welfare systems and relatively high income levels mitigate these risks to a notable extent.

Overall, the responses to climate risks in small towns tend to be highly site-specific. For instance, Biatorbágy has adopted a "sustainability slowdown" policy emphasizing the limitation of new constructions to prevent excessive land consumption and urban heat accumulation. Elsewhere – such as Marcali, Tiszaújváros, Szarvas, Balatonfüred and Hajdúnánás – strategies prioritize decarbonization through the promotion of locally produced agricultural goods and efforts to reduce freight-related greenhouse gas (GHG) emissions.

A particularly self-reflective document is Tata's Climate Strategy, acknowledges that intensive industrialization has placed the town among the "climate-intensifying" localities, where high GHG emissions make the settlement more a source than a victim of climate change.

With few exceptions, transportation emerges the second largest greenhouse gas emitter after residential energy consumption. Consequently, the development of a traffic-free city centre and bicycle infrastructure are among the most frequently proposed interventions of many strategies (e.g., Komárom, Balassagyarmat). Some towns, such as Sajószentpéter, have already realized major improvements, including the construction of bypass roads that reduce through-traffic.

Komló presents a special case, as its complex topography sprawling urban structure, deindustrialization, and significant changing land use patterns have created both challenges and opportunities for comprehensive urban transformation (Csorba, Túri 2024). The town's Integrated Urban Development Strategy aims to address these through Smart City initiatives, linking technological innovation with sustainability.

Finally, several urban programmes emphasize that the designation of new industrial park locations represents a critical, long-term planning decision – one that will shape urban morphology and environmental performance for decades to come.

Table 1.

Climate–change related data from 34 Hungarian small towns

City	*Population number in 2024*	*Change 2022/24*	*Quality of climate change document +*	*Prominent topics*
Balassagyarmat	13,917	-579	+++	traffic through the city centre, water shortage, drought, drying forests
Balatonfüred	12,925	+193	+++	traffic congestion, stormwater drainage, vulnerable heritage buildings
Bátonyterenye	11,118	-371	– – –	-
Békés	17,526	-647	+++	drought, flood/inland water, heatwave, plants causing allergies
Biatorbágy	15,338	+889	+++	suburbanization, transportation, storm damage, flash flood, shading
Budakeszi	15,862	+988	– – –	energy efficiency of buildings, water shortage, invasive plants
Dombóvár	17,041	-883	++	transportation, increasing green areas, shading
Gárdony	13,750	+1,165	+++	through traffic, drought, storm damage, water shortage of Lake Velence
Hajdúnánás	16,087	-424	+++	drought, inland food, storm damages
Hajdúszoboszló	23,918	-220	++	mass tourism, energy demand, transportation, heatwaves, drought, storms
Hatvan	19,943	-69	–	energy efficiency of the buildings, industrial structure, afforestation
Kalocsa	14,433	-652	+	obsolete building stock, drought, lack of green spaces
Kapuvár	10,024	-160	+++	transportation, drought, heatwave, inland water, storm
Kiskunmajsa	11,127	+167	– – –	-
Komárom	20,391	+791	+++	heatwave, large industrial sites, flash flood, drought

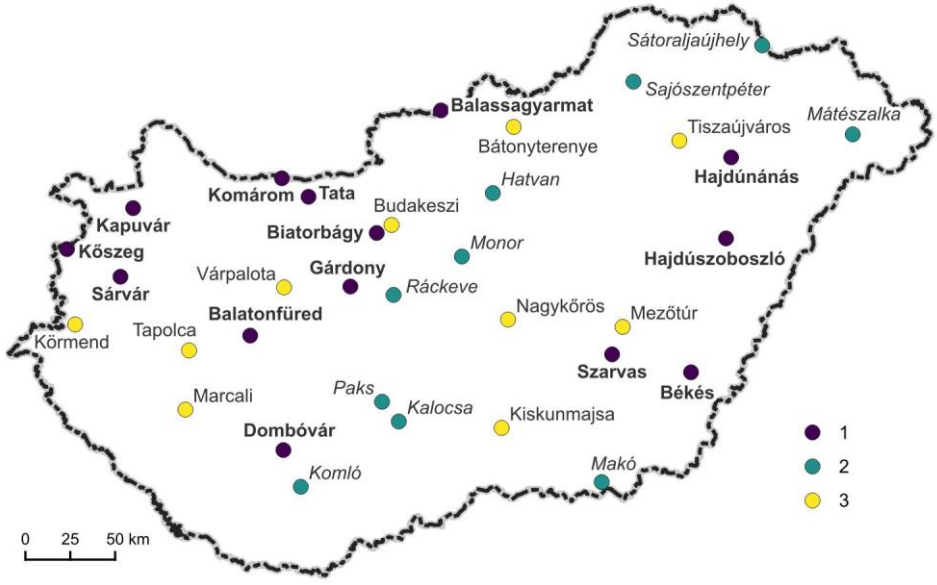
Komló	21,695	-770	–	flash flood, forest drought, outdated building energy efficiency, unfavourable urban structure
Körmend	10,177	-809	– –	-
Kőszeg	11,757	-209	+++	aging "sleeping city", thunderstorms, drainage, drying forests
Makó	21,753	-608	–	heatwaves, drought,
Marcali	10,502	-573	– – –	rainwater drainage, use of local agricultural products
Mátészalka	15,157	-995	+	heatwaves, thunderstorms, drought, drying forests
Mezőtúr	15,469	-466	– –	heatwaves, green area regeneration
Monor	19,743	+1,325	–	energy efficiency, thunderstorms, wind, drought
Nagykőrös	23,016	-522	– –	-
Paks	17,917	-572	–	extreme rainfall events, heatwaves, ageing population
Ráckeve	11,080	+280	+	flood/inland water, agricultural pests
Sajószentpéter	11,251	+118	+	flash flood, building energy, dry forests
Sárvár	14,200	-1,101	+++	heatwaves, drought, flash floods, health tourism sustainability
Sátoraljaújhely	12,973	-829	+	extreme rainfall events, drought, dry forests, heatwaves
Szarvas	14,464	-936	++	flooding, heatwave, use of local agricultural products, water retention
Tapolca	14,006	-855	– – –	-
Tata	23,549	+84	+++	industrial energy demand, drought, forest quality
Tiszaújváros	14,700	-212	– –	use of local agricultural products, transportation
Várpalota	19,395	-123	– –	-

Explanation: +++: Climate Protection Strategy prepared after 2019; ++: Climate Protection Strategy prepared before 2019, or less detailed; +: Sustainable Energy and Climate Action Plan (SECAP); –: Addressed within the Integrated/Sustainable Urban Development Strategy; – –: Possibly mentioned in an Integrated/Sustainable Urban Development Strategy before 2020; – – –: other cases, e.g. indirectly related references in Environmental or Urban Development Programmes.

Source: The authors' own compilation.

Figure 1.

Location of the 34 small towns included in the study and the quality of their municipal documents related to climate change



Explanation:
1: Small towns with municipal documents rated as excellent or good (+++ and ++) in Table 1.
2: Small towns with municipal documents rated as medium (+ and –) in Table 1.
3: Small towns with municipal documents rated as inadequate (– and – – –) in Table 1, or not possessing any such document

Source: The authors' own compilation.

The attitude of local residents towards climate change

The successful mitigation of the adverse impacts of climate change is strongly influenced by the mindset of local populations and the activity of municipal governance (Hallegatte 2009; Hoppe et al. 2016; Bautsch, Koziol 2020; Hügel, Davies 2020; Kiss et al. 2022). Contemporary approaches are already being applied to assess climate risks and enhance public awareness including machine learning, the dissemination of good practices, and learning-based knowledge development (Boehnke et al. 2019; Haggag et al. 2024; Orderud, Naustdalslid 2020).

Our review of municipal documents revealed several noteworthy observations regarding public attitudes and the quality of knowledge related to climate change. In Balassagyarmat, for instance, a strong willingness to adapt to climate-related challenges was reported, whereas in Kőszeg, local authorities noted widespread public indifference. Some small-town strategies (Sátoraljaújhely, Mátészalka) contextualize these encouraging or discouraging situations by referring to the so-called deprivation index which reflects the capacity for lifestyle adaptation. It indicates the extent to which individuals can maintain or improve their quality of life based on material well-being, health status, mental condition, and social position whether advantageous or disadvantageous (Koós 2015).

In Sátoraljaújhely, the deprivation index was estimated at 0.42 in 2011, projected to decrease to 0.31 by 2050. By contrast, the corresponding value for Tata was 0.67 in 2021, suggesting that residents there have approximately one-third greater potential to preserve their standard of living compared to those in Sátoraljaújhely. The low deprivation index n some towns also correlates in several respects with the feasibility of climate protection measures, such as the prevalence of winter heating with waste materials (as observed in Szarvas).

Socioeconomic conditions appear to influence individual perceptions of climate change. A national survey reported that respondents in poor or very poor financial situations were more likely to perceive significant changes in weather patterns since childhood, with 70% and 77%, respectively, acknowledging such changes (Baranyai, Varjú 2015).

In several small towns, attitudes towards climate change were assessed through online surveys. In Gárdony, for example, respondents indicated a low sense of local responsibility, with many perceiving that addressing major issues such as climate change is primarily the government's responsibility and that local initiatives would yield limited impact only. Consistent with this, the national survey found that 67.5% of respondents considered the government entirely responsible for managing climate change effects (Baranyai, Varjú 2015).

Conversely, in Kapuvár, the authors of the Climate Strategy reported satisfaction with public engagement, noting that residents demonstrated adequate climate awareness. In Komárom interest in climate change appeared relatively uniform across age groups, although respondents over 60 exhibited slightly lower levels of knowledge and engagement than younger participants. In Mátészalka, 80% of surveyed residents reported perceiving clear signs of climate change, particularly the increased frequency of heavy rainfall and windstorms. Notably, respondents expressed a willingness to assume personal financial burdens to mitigate climate threats. According to the same national survey, a decisive majority of respondents (70.8%) indicated that they would definitely

or likely be willing to make financial sacrifices to slow down climate change, for instance by paying higher prices for certain products or services (Baranyai, Varjú 2015).

More than half (54%) of respondents in Sátoraljaújhely reported perceiving the harmful effects of climate change, and 84% indicated that they strive to act in an environmentally conscious manner. For instance, many use only rainwater for garden irrigation, and prefer to purchase products at the local market. However, only 26% reported a willingness to engage in volunteer work. Residents expect the local government to undertake initiatives such as tree planting, installing lower energy-intensive street lighting (LED), and creating permeable street pavements.

The opinion of Tiszaföldvár residents on the locally visible consequences of climate change

Between 2016 and 2023, Tiszazug was included as one of the sample areas as one of the sample areas in a national landscape character research project (Konkoly-Gyuró et al. 2021; Csorba et al. 2024). Tiszaföldvár serves as the centre of the micro-region, with a population that fell below 10,000 between 2022 and 2024, therefore was not included in the previously described small-town overview. Nevertheless, data collected through online surveys, personal interviews, and workshops conducted in 2020–21 provide relevant insights into the opinions of small-town residents regarding climate change. The research primarily focused on landscape character. Accordingly, the questions were framed to explore which landscape features or locations participants had observed changes in over recent years, what unfavourable environmental changes they had experienced, the landscape environments with which they felt emotionally connected, and how they interpreted their own landscape identity.

Responses from 104 local residents were recorded, constituting a representative survey. While younger participants primarily completed the online questionnaire, older respondents were interviewed in person, ensuring balanced coverage across age groups (Csorba 2021).

In terms of social dynamism and economic potential, Tiszaföldvár is a small town lagging behind not only the national but also the county (Jász-Nagykun-Szolnok) average, and its decline is ongoing (Ditzendyné Frank, Szilágyi 2017). The population continues to decrease, accompanied by significant outmigration of young people. At the same time unskilled Roma families relocating from Szolnok and nearby villages have formed a sizeable segregated district in the southern part of the town, in the area of the former garden plots. Educational attainment data also show a downward trend,

a parallel society has become evident, and the number of residents exhibiting deviant or risk-related behaviour, including drug use is high.

The county ranks 17th among counties with GDP per capita representing 62–68% of the national average (2015), and Tiszaföldvár's economic performance does not improve this ratio. Within the Kunszentmárton micro-region, Tiszaföldvár ranked 125th out of 174 micro-regions in the country's competitiveness index. Employment is concentrated in agriculture and in small and medium-sized enterprises engaged in agricultural processing at a higher rate both exceeding the national average.

"In Tiszaföldvár, services are at a lower level than the county average; looking at the internal composition of services, trade is exceptionally high, while other sectors (financial, tourism, administrative, etc.) are at a lower level than the county average" (Ditzendyné Frank, Szilágyi 2017).

The natural assets of Tiszaföldvár associated with the nearby Tisza River and the oxbow lakes that formed in the 19th century. Respondents identified the living river, and the area surrounding the still near-natural oxbow lakes the most valuable landscape elements. They perceive climate change primarily through a decline in water levels and the expansion of reed beds *(Table 2)*. Almost all respondents expressed appreciation for the unspoiled scenery of oxbow lakes bordered by narrow reed belts and open water surfaces *(Photo 1)*. They are popular destinations for many visitors who frequently come individually, to listen to the rustling of reeds, the songs of birds, and to experience the tranquillity of nature. These landscapes represent core components of local landscape identity.

The perceived loss of such natural features would evoke emotional discomfort, which most respondents associate with water scarcity and climate change. Older respondents tend to assess the magnitude of climate change more realistically, whereas only a few younger participants articulated extreme views, such as that "the Tisza may dry up".

Table 2.
Favourite locations

Location type	*Percentage (%)*
the Tisza River's riverside	65
Oxbow lakes	30
Tisza River floodplain forests or oxbow lakes	40
Vineries and orchards	25
Grasslands	25
Swamps and wetlands	15
Parks and gardens within settlements	25
Other	10

Source: The authors' own compilation.

Photo 1.

Water surface, reed beds, floodplain forests, and the atmosphere of tranquillity—key natural features valued in the Tiszazug micro-region (oxbow lake near Cibakháza).

Source: The authors' photo.

Tiszaföldvár was an important centre of fruit and vegetable cultivation until the late 1960s. Between 1975 and 2010, greenhouses facilities were established for vegetable production, most of which have since been abandoned. Some attribute the decline of horticulture, as well as the cessation of meadow, and pasture use to the effects of climate change, however the main causes identified are outmigration, population aging, and a dramatic decline in economic activity (Csorba 2021). The oxbow lakes in the area are popular fishing sites, yet many locals complain about their neglect and the deterioration of natural environment. Some professional respondents – such as nature conservation rangers from the national park – associate the eutrophication of these lakes with climate change, as irregular water replenishment hinders regeneration processes. The lower floodplain of the Tisza River, once characterized by moist meadows, now dries out as early as early summer. In gardens on the outskirts of the town, invasive plant species have proliferated, such as giant goldenrod (Solidago gigantea). One of the town's best-known enterprises is a distillery, whose owner describes it as a peculiar paradox that, due to the scarcity of locally grown plums and peaches, raw materials must now be sourced from other regions. A few years ago, the company began establishing its own orchard; however, the traditional local fruit varieties have not developed as quickly as expected – possibly as a partial consequence of changing climatic conditions.

Summary

Global climate change poses a major environmental threat in Hungary as well. Extreme weather events such as heatwaves, droughts, flash floods, and windstorms already present serious challenges for agriculture, forestry, nature conservation, water and energy management, transportation, construction, and tourism, among others. To mitigate the expected damages, scientifically grounded sectoral and regional strategies have been developed over the past decade.

Among the 34 small towns examined, 19 have climate strategies created between 2018 and 2023, the others address the consequences of climate change to varying degrees within their urban planning programmes. The most comprehensive and up-to-date programmes have been prepared by economically developed small towns in the Northern Transdanubia region and in the broader agglomeration of the capital. Nevertheless, even in these favourable cases – economically active towns with stable or growing populations – there is little tangible evidence of the implementation of the objectives outlined in their strategies.

Although several national grant schemes support progress in climate protection, we found no indication of a coherent, systematically monitored implementation framework. In 6–7 of the most climate-conscious small towns, the local population was involved in the planning process, or at least an online survey was conducted to assess the local residents' knowledge and expectations on the issue. Local inhabitants generally perceive that climate change increasingly affects their own living conditions, and they are recognize their own responsibilities in adaptation. In areas where the most valued local sites – such as rivers, still waters, and wetlands – are highly climate-sensitive, residents also tend to feel that climate change threatens their personal and community identity. Nonetheless, the majority of the tasks are still expected to be addressed primarily through national environmental policy and municipal action.

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