

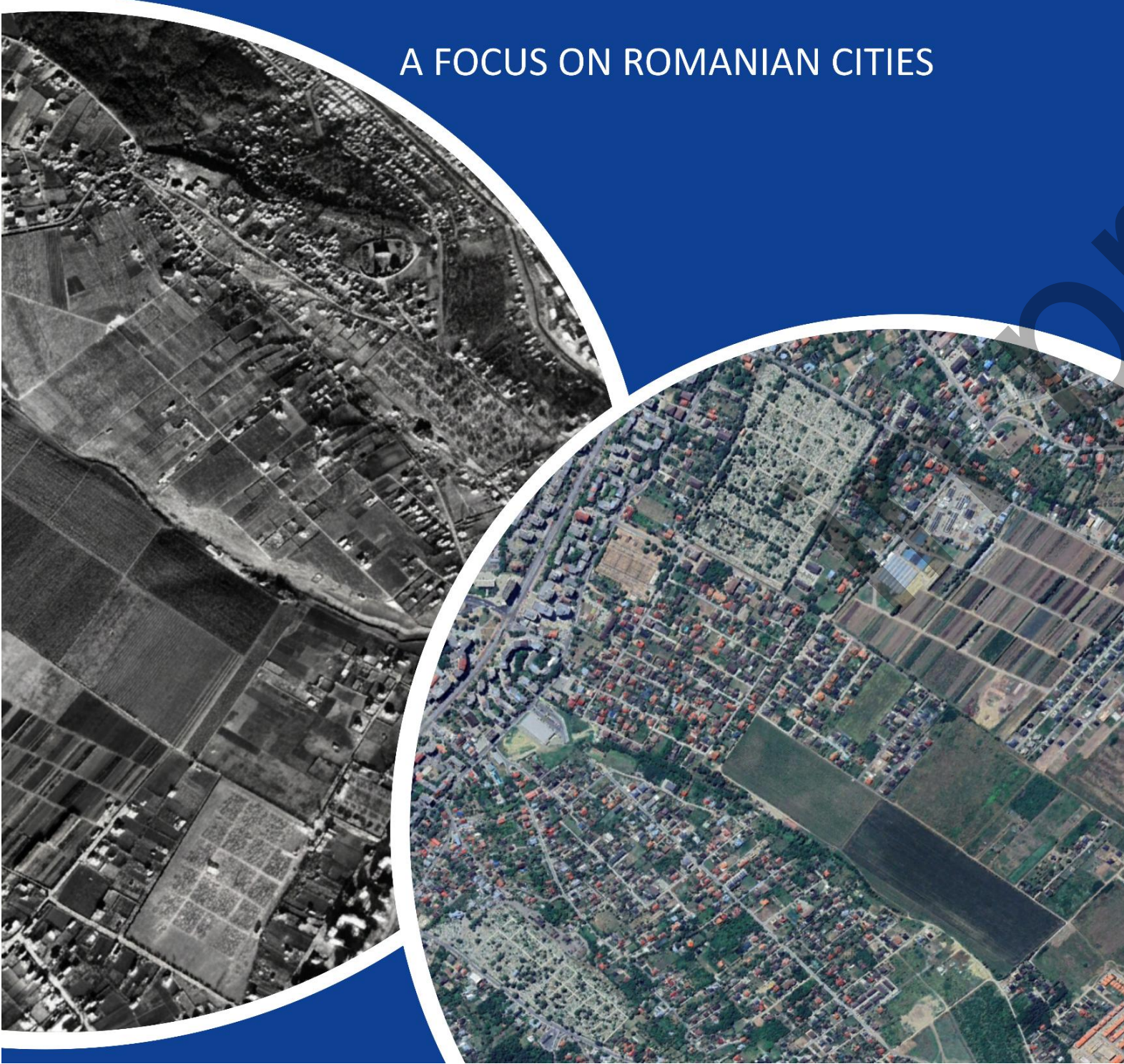
The Atlas of Transformative Urban Resilience

A FOCUS ON ROMANIAN CITIES



About the Atlas

The Atlas of Transformative Urban Resilience serves as a comprehensive strategic framework for understanding and navigating the complexities of modern city development. By integrating key pillars such as Environment and Climate Action, Economy, Health and Safety, and Social Equity, the atlas provides a holistic perspective on how urban systems can adapt and flourish. Through an in-depth exploration of Infrastructure and Mobility, Digitalisation and Big Data, and Governance and Institutional Capacity, this resource offers a multidimensional roadmap for building cities that are resilient, inclusive, and technologically advanced. It is an essential tool for policymakers and urban planners dedicated to fostering sustainable, transformative change in the urban landscape.



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This atlas is a result of various outcomes that emerged in the three years of implementation of City Focus. We thank all members of City Focus project for their contributions. We also thank Karima Kourtit for her valuable contribution and for coordinating the project in the proposal phase and in the first part of its implementation.

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THE ATLAS OF TRANSFORMATIVE URBAN RESILIENCE.

A FOCUS ON ROMANIAN CITIES

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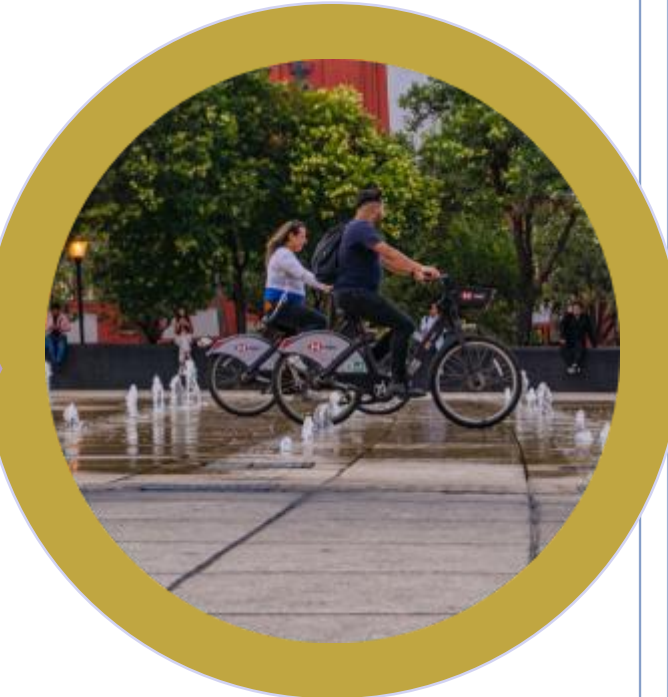
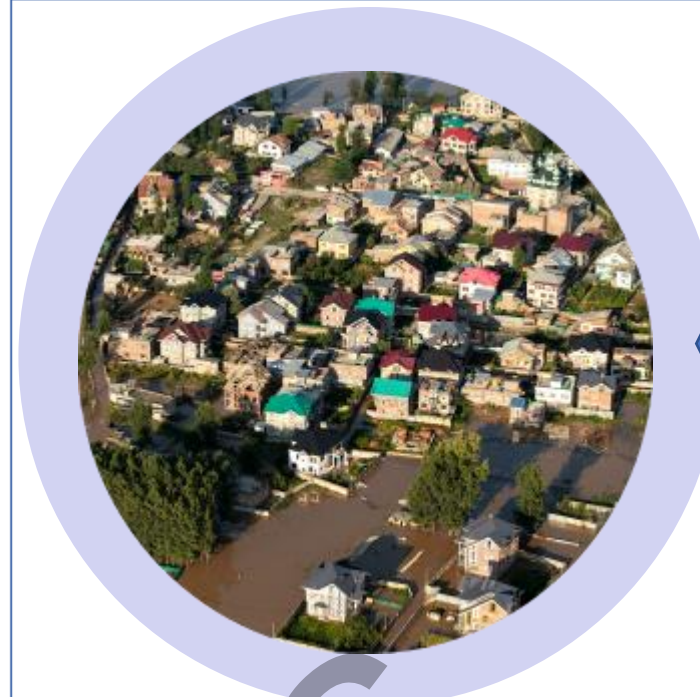
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Transformative Cities: Vulnerabilities and Opportunities

in press

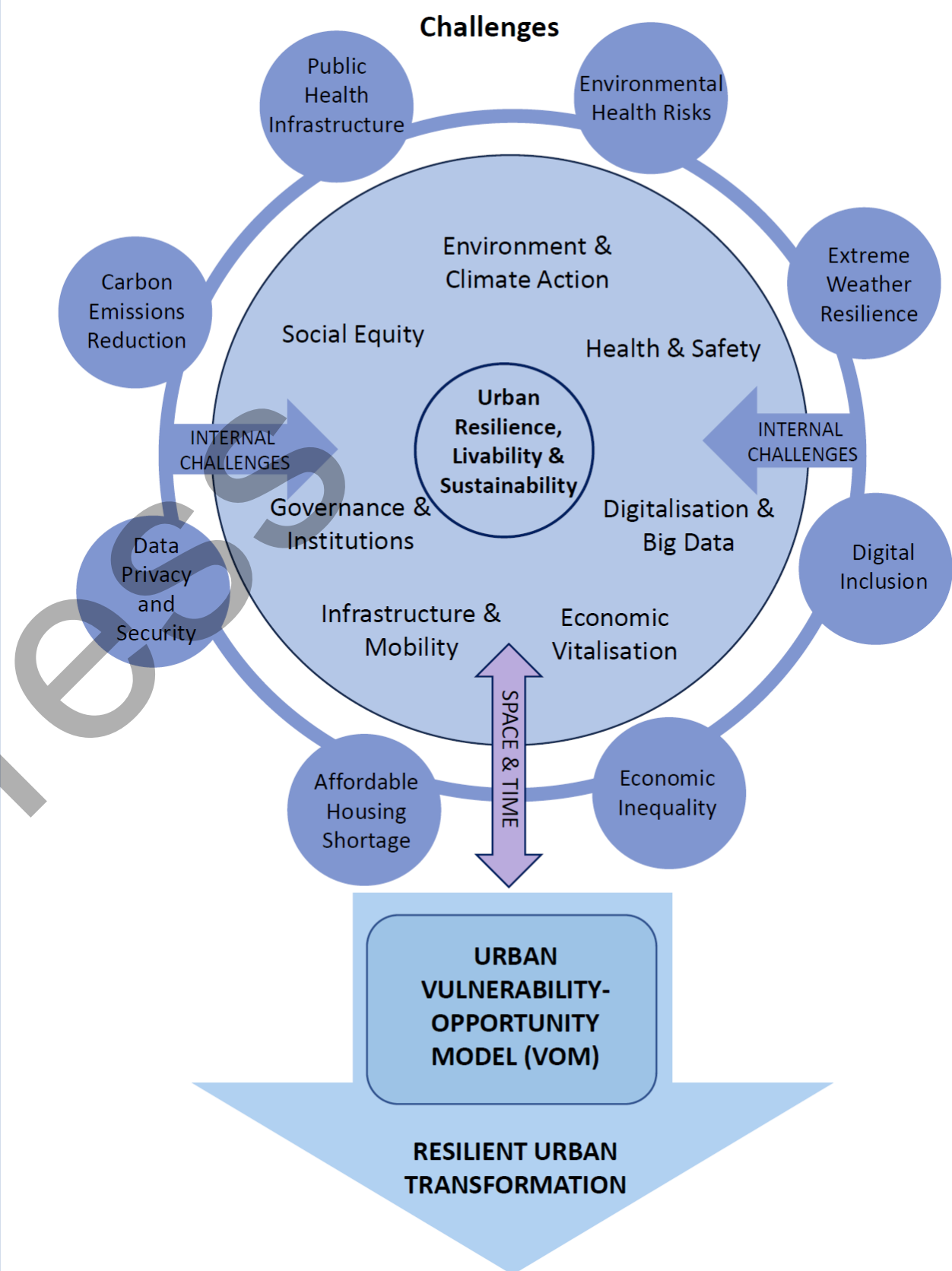
The CITY FOCUS proposed conceptual framework draws from an extensive body of literature spanning urban studies, environmental science, sociology, economics, and geography. Central to its development is the concept of urban resilience. The concept of urban resilience lies at the core of efforts to create sustainable and adaptable urban environments (Folke et al., 2010; Meerow et al., 2016). It emphasises the capacity of urban systems to absorb shocks, adapt to changing conditions, and catalyse transformative change.

Building upon this theoretical foundation, the framework integrates insights from resilience theory, governance models, and sustainability frameworks to offer a comprehensive understanding of urban dynamics. To enhance urban development, initiatives draw on resilience theory and governance models to strengthen cities against shocks such as economic downturns, natural disasters, and social disruptions. These models ensure effective decision-making and stakeholder engagement, fostering collaboration and inclusivity in urban planning, and employ smart solutions to support sustainable, high-quality urban environments. Efforts to enhance urban development and sustainability require focused interventions across key areas, including infrastructure, public services, health, digitalisation, and community engagement. Moreover, sustainability frameworks shape and faster efforts to support and stimulate environmentally responsible practices, resource efficiency, and long-term viability.

These frameworks reshape policies and strategies to create urban communities that are resilient, sustainable, and flourishing, capable of adapting and prospering amid uncertainty and change. Moreover, they underscore the importance of stakeholder collaboration, data-driven and evidence-based decision-making, and long-term planning to ensure the success and sustainability of urban development initiatives. Collaboration fosters inclusivity in urban planning and management, ensuring that diverse perspectives are considered. In summary, integrating insights from resilience theory, governance models, and sustainability frameworks offers a comprehensive understanding of urban dynamics.

This multidisciplinary approach acknowledges the interconnectedness of various factors shaping the urban environment and seeks to address them holistically. Through focused interventions and collaborative efforts, urban resilience and sustainability can be effectively fostered, creating more livable, resilient, and inclusive urban environments for residents and visitors alike.

The present atlas aims to be, in this context, a working tool that informs stakeholders regarding the long-term evolution of statistical and geostatistical parameters of undoubted importance and which indicate the transformability of cities either in the sense of making them vulnerable or in the sense of capitalising on existing opportunities.



The Atlas of Transformative Urban Resilience: A Holistic Sustainability-Based Approach

An atlas is a collection of maps with a uniform design and formal structure, intended to communicate spatial knowledge and foster a new perspective on geographical phenomena. An urban atlas is not a novelty in itself, but our approach is distinct from others in offering a perspective that is not only multidimensional and integrated but also focused on cities in motion, using long-term chronological datasets. What really distinguishes our approach, however, is the theoretical framework on which it is based. The intrinsic goal is to identify vulnerabilities in cities and their metropolitan areas and to analyse them through the prism of the opportunities they offer and their potential for sustainable development.

Thus, vulnerabilities are transformed into opportunities, and resilience, after numerous disruptions or shocks, becomes a chance for cities to metamorphose into better versions of themselves. Our analysis is focused first and foremost on the European urban context (including a substantial sample of 357 cities with over 250,000 inhabitants). Secondly, in the most consistent part of the atlas, the focus shifts to towns and cities in Romania, from the smallest to the largest, including their metropolitan areas. This option is natural given the fuzzy, increasingly difficult-to-delimit character of urban realities that evolve unhindered towards their hinterland.

Finally, case studies are selected that illustrate, at the microscale, the essential dynamics of urban transformability from a bottom-up perspective. All these aspects are highlighted from a systemic perspective. Cities are systems within urban supersystems, which comprise individualised and interconnected subsystems. This approach is supported by seven key areas: Environment and climate action; Health and Safety; Social Equity; Economy; Infrastructure and mobility; Digitalisation and Big Data; and Governance and Institutional Capacity, each comprising a package of relevant indicators. Their integration into a vulnerability-opportunity index yields results that allow comparisons between cities and also highlight distinct spatial features within cities and across the component units of their functional areas.

The Atlas includes 140 maps, numerous graphs and tables and explanatory text.

Overall, it is intended to be a tool for territorial diagnosis and for formulating strategic directions and urban and regional policies, capable of sustainably leveraging territorial capital and the opportunities that may emerge from current vulnerabilities. Transformative resilience thus becomes a new paradigm of spatial planning that should not only be able to withstand and recover from shocks and cope with existing pressures, but also capitalise on them to create a sustainable and livable urban environment.

DEFINITIONS

RESILIENCE Ability to withstand disturbance, to deal with shocks and crises in a coordinated way, to recover from decline (bounce-back) and to innovate and transform for the better (bounce-forward) (Folke, 2006).

URBAN RESILIENCE The competence of cities and functional urban areas to respond, recover, cope, adapt and even develop when facing an unexpected, sudden perturbation or stressor.

CHARACTERISTICS

The extent of change the system can undergo while still retaining the same controls over function and structure.

The degree to which the system is capable of self-organisation.

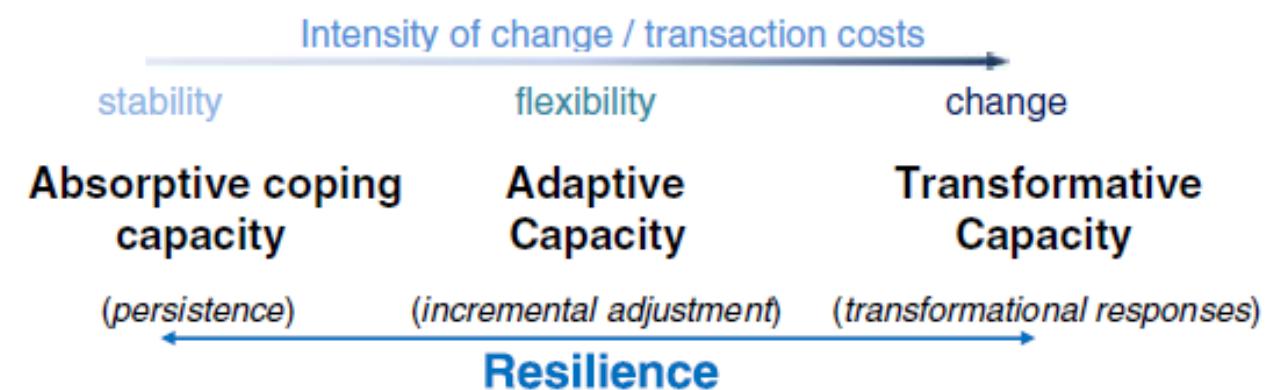
The ability to build and increase the capacity for learning and adaptation. (Holling & Walker, 2003).

PERSPECTIVES ON RESILIENCE

ENGINEERING – reactive resilience (bouncing back to former status);

ECOLOGIC – responsive resilience (learning and adjusting, adapting);

EVOLUTIONARY – transformative resilience radically changing [cities] according to modified context and circumstances” (Galderisi et al., 2020; Esposito, 2025).



(Bene, 2013)

GENERAL METHODOLOGICAL ISSUES (APPLIED TO BOTH EUROPEAN AND ROMANIAN LEVELS)

WORKFLOW (STAGES)

Stage 1: Reviewing the specialised literature to conceptually understand what is desired to be evaluated by developing an index— *particular aspects for each level*

Stage 2: Developing a conceptual framework on the basis of which the index will be created – *see project methodological framework*

Stage 3: Selecting indicators, according to the conceptual framework (taking into account the relevance of the indicators, the credibility and accessibility of the sources) – *particular aspects for each level*

Stage 4: Managing particular/extreme cases (outliers)

Stage 5: Normalising variables

Stage 6: Applying principal component analysis (PCA) or other methods for calculating weights

Stage 7: Developing the index – *the weighted sum of the indicators/subindexes*

Stage 8: Classifying units using quartiles, Jenks. Applying clustering methods (e.g. AHC) – *see the results.*

Stage 4: Handling particular/extreme cases (outliers)

4.1. Preliminary processing of indicators:

Using indicators to calculate rates -> favours comparison between units (avoiding indicators in absolute size)

4.2. Winsorization/censoring of variables to obtain a more uniform distribution and to avoid the unjustified influence of outliers/outliers:

4.2.1. Uniformisation of extreme values by taking the values of previous units;

4.2.2. Uniformisation of a similar percentage of values at both the upper and lower limits (for the first/last n% of units) -> after sorting, the first 2% of units will take the value of the unit from the 2nd percentile, and the last 2% of units will take the values corresponding to the 98th percentile.

Stage 5: Normalising variables

5.1. Variable normalization balances the importance of variables within the index, as differences in measurement units can be very large. Min-max normalization transforms values onto a 0-100 scale:

$$\text{Normalized indicator}_i = \left(\frac{x_i - \min(x)}{\max(x) - \min(x)} \right) \times 100$$

where x_i is the indicator value corresponding to unit i, and $\min(x)$ and $\max(x)$ are the minimum and maximum values of the indicator.

5.2. Z-score normalisation (standardization) transforms values into a function of the mean (value 0), with values greater than the mean being positive and those smaller than the mean being negative:

$$\text{Normalized indicator}_j = \left(\frac{x_j - \bar{x}}{sd(x)} \right)$$

Where x_j is the indicator value corresponding to unit j, $\bar{x}$ represents the mean, and $sd(x)$ the standard deviation.

The transformed units will have a mean of zero and a standard deviation of 1. for variables for which higher values indicate lower attractiveness -> reverse normalisation

Stage 6: Applying principal component analysis (PCA) or other methods (equal weights, Analytical Hierarchy Process - AHP *) for calculating weights

When using PCA analysis to calculate weights, Nardo et al. (2008) recommend the following criteria for factor extraction:

Choosing factors with eigenvalue >1 (Kaiser criterion)

Retaining factors that individually contribute to the overall variation by at least 10%;

The factors retained must cumulatively explain at least 60% of the overall variance.

Factor extraction was performed in the varimax variant.

*Equal weights and AHP were used as alternative methods to ensure robustness to the results, but the retained version of the index was PCA

Part 1



European Scale: Transforming European Cities

in press

EUROPEAN SCALE

559 towns, cities and urban agglomerations with more than 100,000

Transformative resilience in a European context. At the European scale, the Vulnerability-Opportunity model was applied to the above-mentioned sample, taking into account four subsystems of the city (natural, infrastructure, socio-economic and governance), each including one or more dimensions that will then be taken over for the model, more elaborately for Romania. The indicators, 15 in number, are mainly taken from the local OECD database. Thus, the indicators that capture the environmental dimension are linked to the share of green spaces, exposure to PM2.5 air pollution, and changes in the need to heat homes due to climate warming. Infrastructure is characterised by modifications to the built environment and population mobility through internal migration, as well as by the digital component, as reflected in mobile download speed. More diverse is the socio-economic component, as highlighted by total revenue and expenditure per capita, distance to pharmacies, share of the elderly population, dependency rate of the young population, and the share of the population born in other countries. Governance is reflected in a single indicator that shows the capacity of institutions to access projects funded by the EU or the national government.

City Population → Population data from 1990 to 2025 (city level, FUA level) (citypopulation.de; populstat.info)

VOM Model Indicators

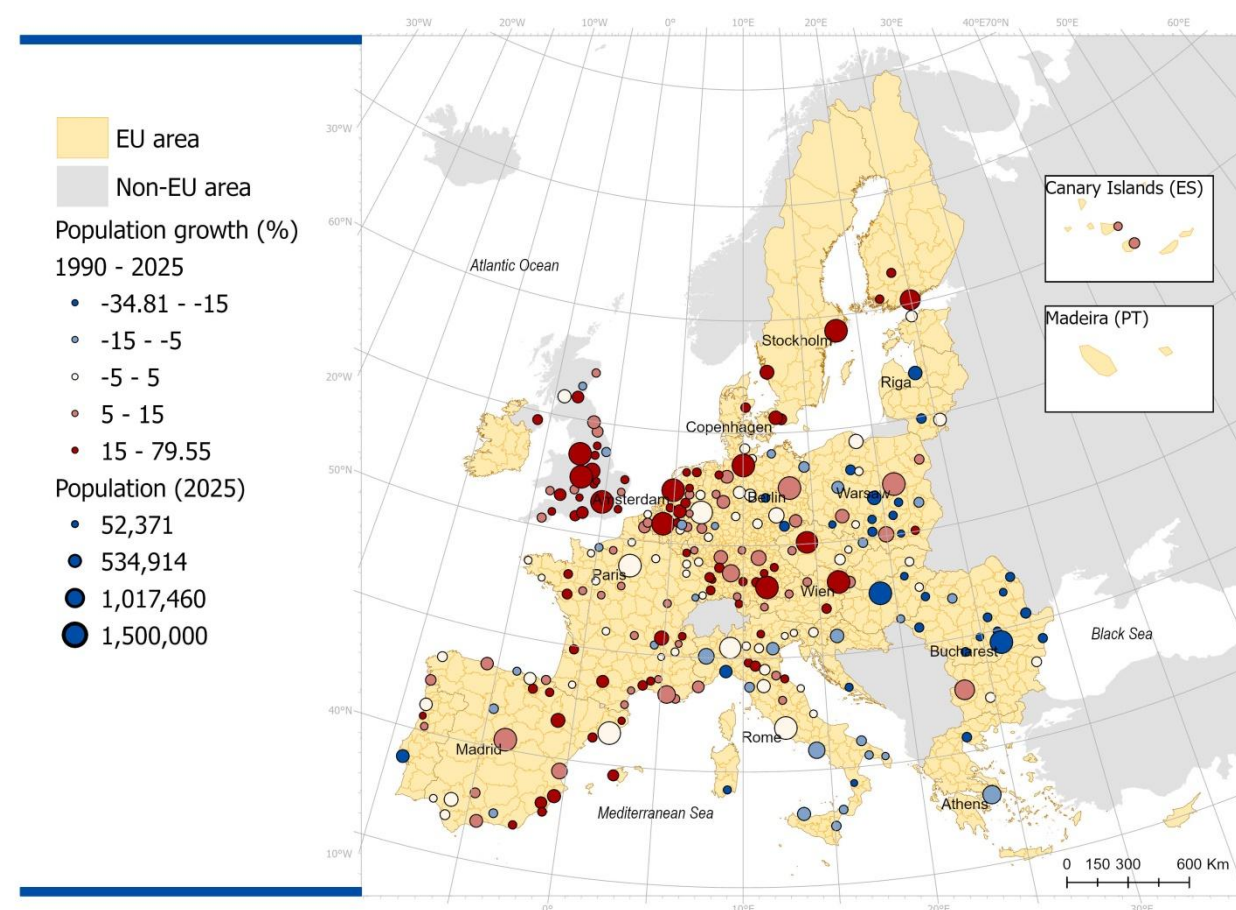
7 dimensions → 15 indicators



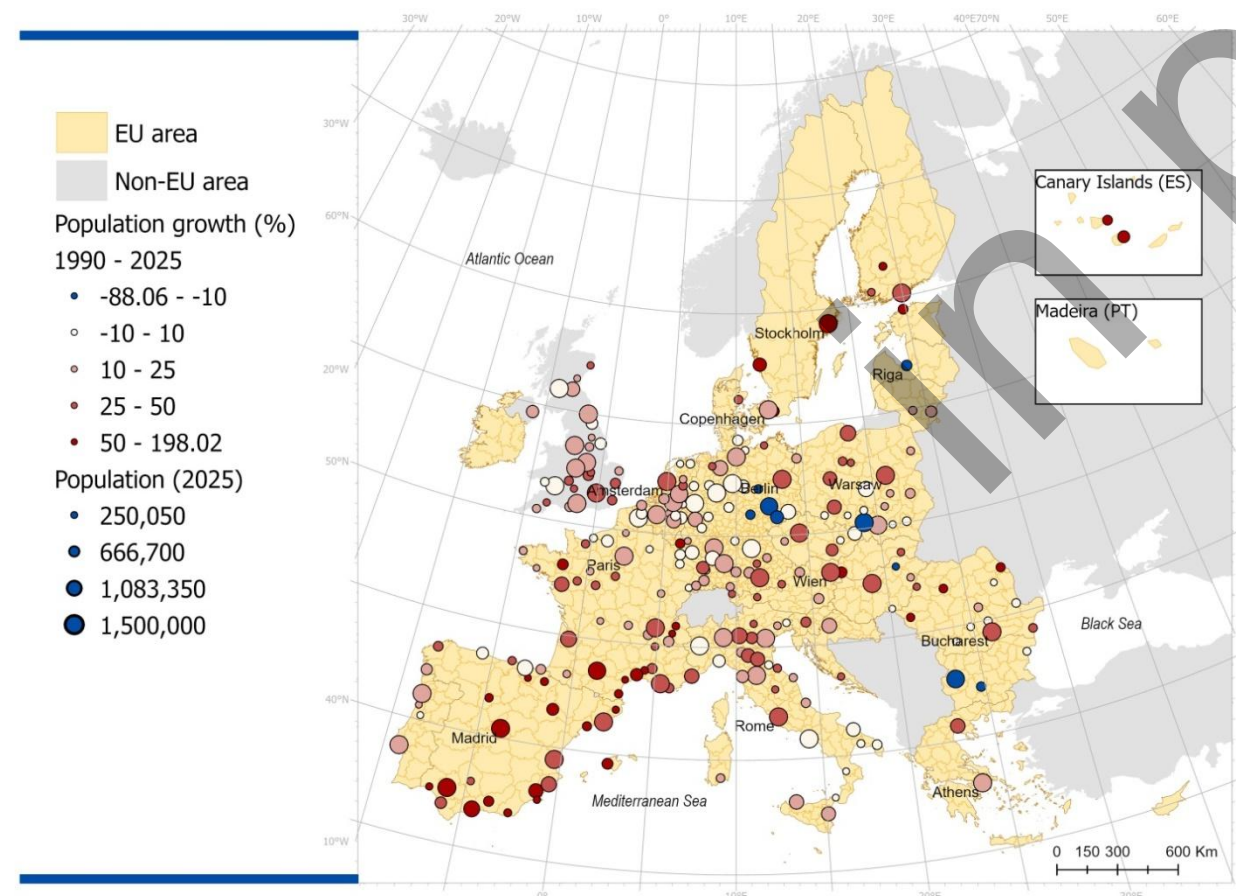
	Dimension	Indicator	Acronym	Period	MU	Polarity
Natural system	Environment & Climate Action	Green area per capita	GREENCAP	2021	sqm/cap	+
		Green area share from total area	GREENSH	2021	%	+
		Population exposure to PM2.5	PM2_5	2021-2023	µg/m³	-
		Change in heating degree days	HEAT_CH	from 1981-2010 to 2020-24	%	-
Infrastructure system	Infrastructure & Mobility	Change in built-up surface	BUILT_CH	2010-2020	%	+
		Built-up surface per capita	BUILTCAP	2020	sqm/cap	+
		Net migration rate (internal and international) in the last 5 years	NETMOB	2018-2023	%	-
	Digitalisation & Big Data management	Mobile download speed (deviation from national average)	MOBDOWN	2023	%	+
Social-economic-system	Economic vitality	Total revenue per capita	REVCAP	2021	USD PPP/capita	+
		Total expenditure per capita	EXPENDCAP	2021	USD PPP/capita	+
	Health & Safety	Distance to closest pharmacy	PHARMDIST	2023	m	-
	Social equity & inclusiveness	Share of old-age population (+65)	OLD_SH	2021	%	-
		Young-age dependency ratio (-14 over 15-64)	YOUTHDEP	2021	%	-
		Share of foreign-born population	MIGRANTS	2021	%	+
Governance system	Governance & institutional capacity	Grants as a share of total revenue	GRANTS	2021	%	+

(Source of data: Data extracted and aggregated by the authors from OECD Local Data Portal)

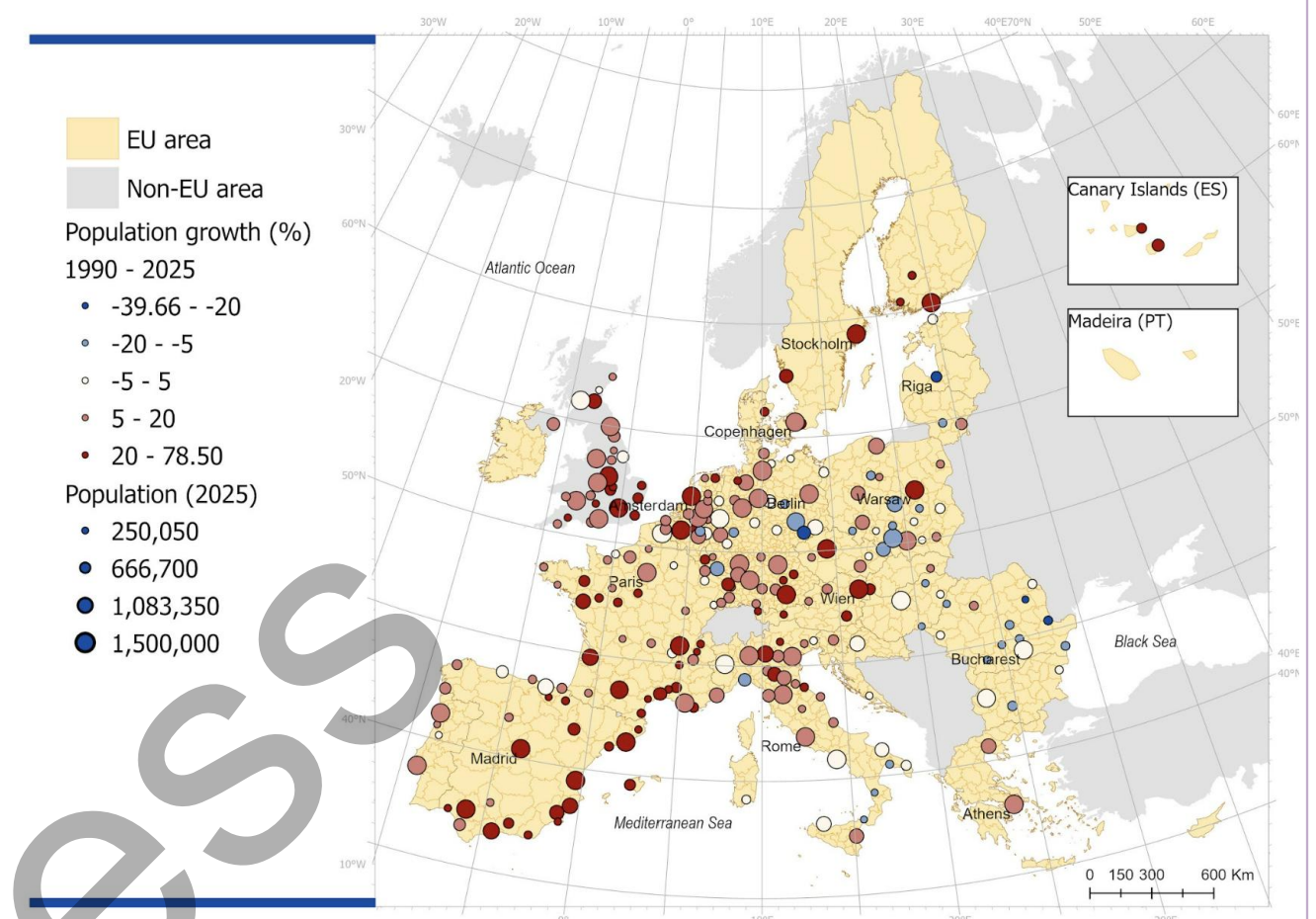
City Population



FUA Population



City & FUA Population



Population dynamics (1990-2025)

The population of cities decreased in the former communist countries, as well as in Greece, Southern Italy, and Portugal.

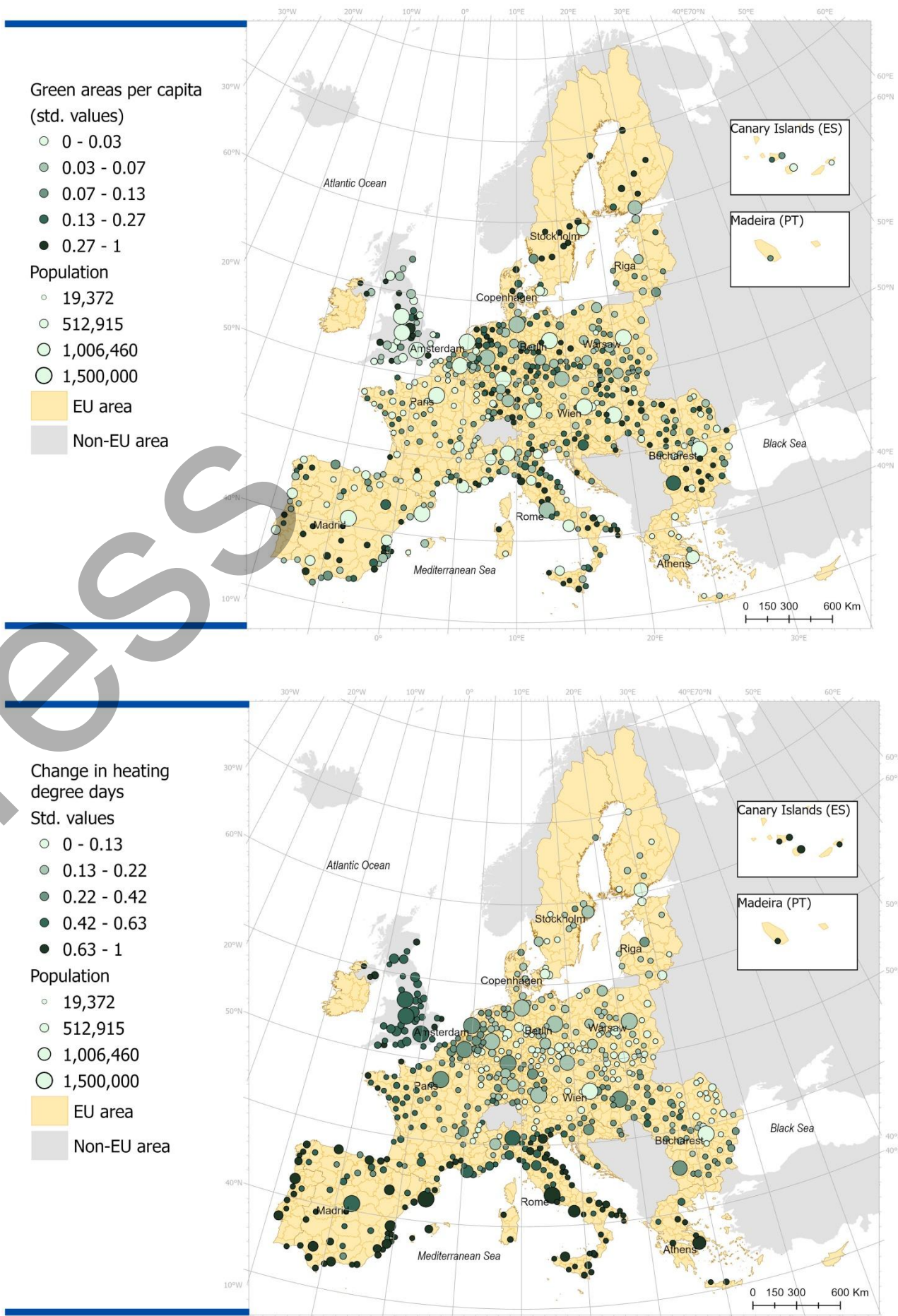
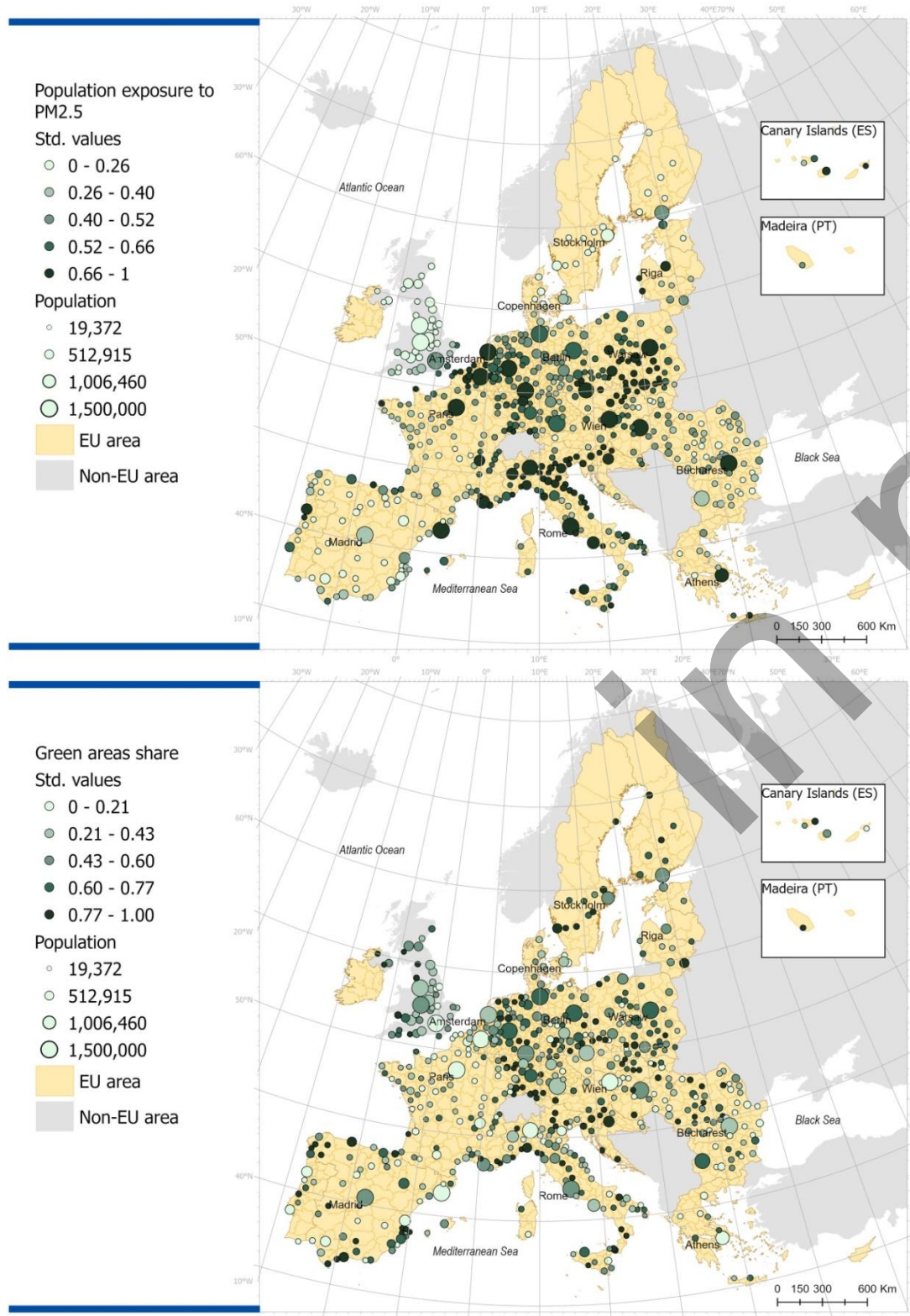
On the contrary, a positive evolution is visible in the North and North-Western Europe

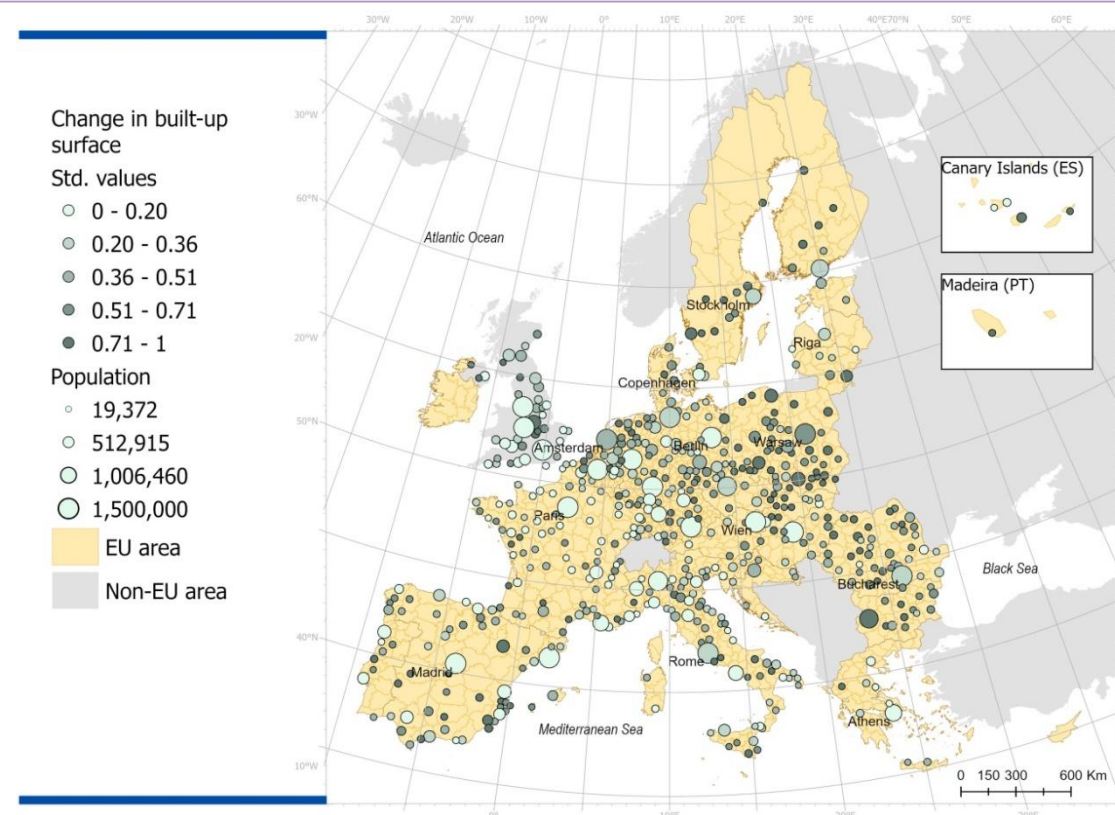
If one considers the Functional Urban Areas (FUA), one can notice an increase in population in most cities, except in Bulgaria and certain former industrial areas in Central Europe (Silesia), as well as in Latvia and Eastern Germany.

The East-West and North-South differences translate into gaps in the evolution of urban dynamics, with earlier periurbanization in the NW, an earlier decline of urban centres, flattened by the massive immigration of recent decades, a situation that has only recently been felt in the South and in the East, it is only in its early stages.

The strong concentration of coastal population along the Mediterranean coasts of Spain and France is noticeable and closely linked to tourism, which can be considered a factor of transformability. Especially since it manifests at both the city and FUA levels, as an organic dynamic.

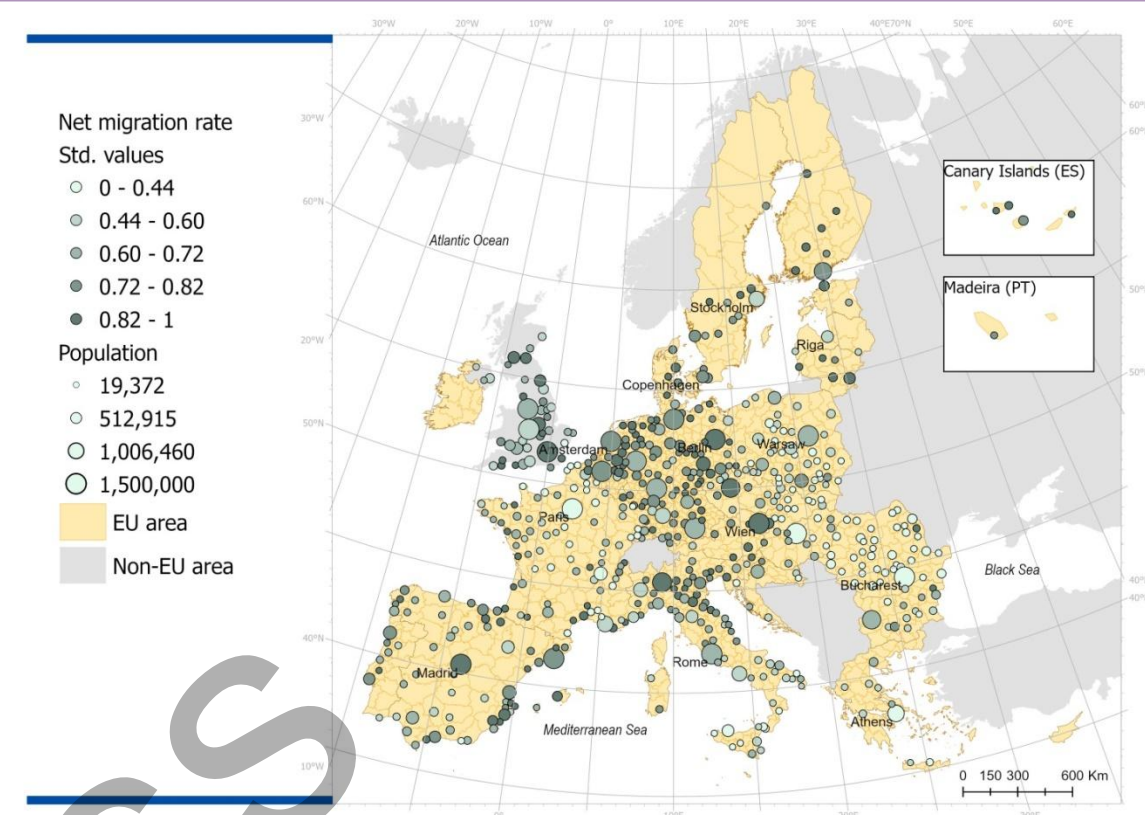
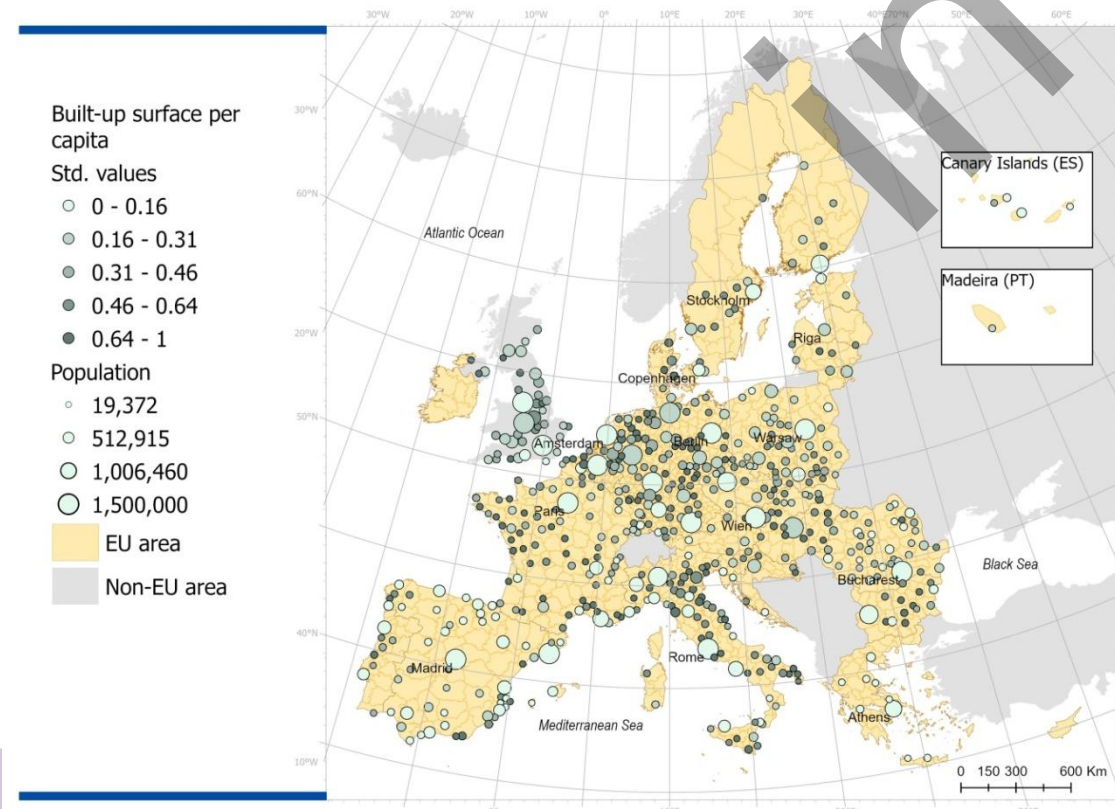
The exposure of the population of selected cities to PM2.5 reveals high values in Central and Eastern European countries (especially Poland, Czechia, Slovakia, Hungary), in the Mediterranean area (especially Italy), but also in the Benelux countries, as well as in large cities in most EU countries except the Nordic countries. Large cities are also characterised by a lower share of green spaces and a smaller surface area per capita. Regarding climate warming, Southern European countries experience a noticeable reduction in the number of days when homes need heating during the year. The correlation with population density and economic activities (Benelux, Italy) is evident, which seems to exceed the natural capacity to maintain an optimal level with all the green policies respected by these countries (especially Benelux); in former communist Central Europe, it may be an effect of intensive coal-based industrialisation (Poland, Czech Republic, Hungary).



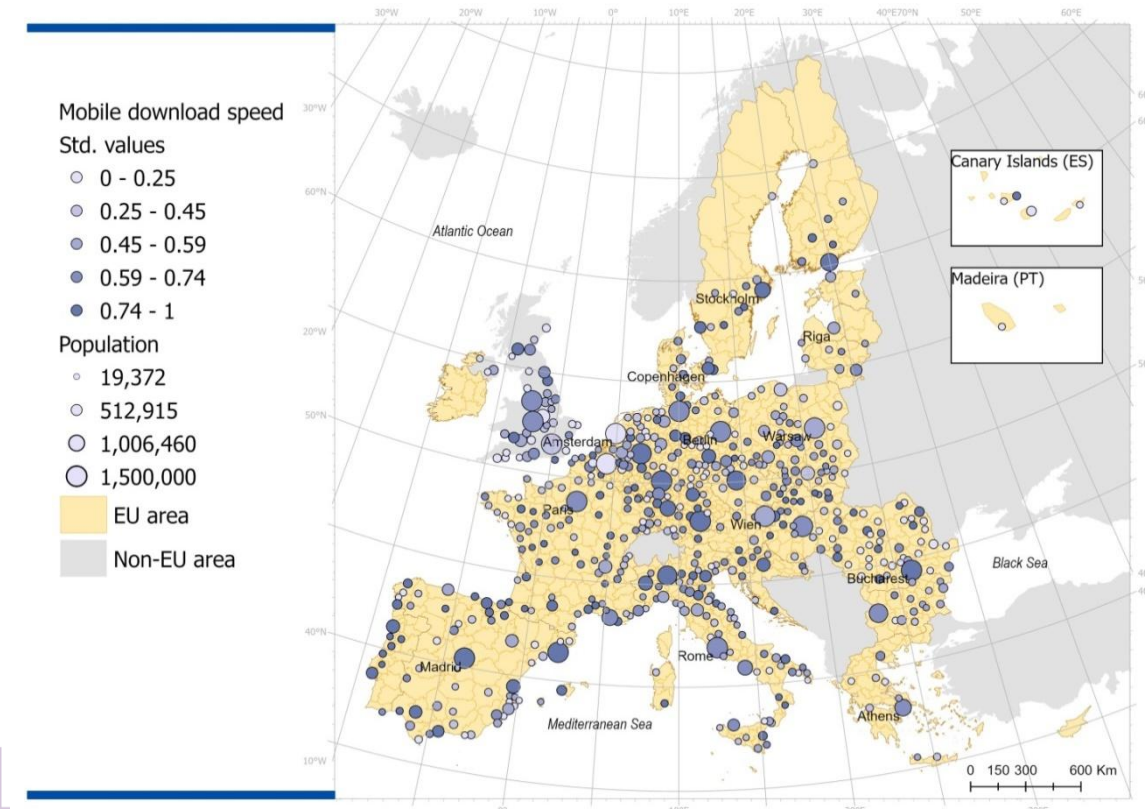


A consistent expansion of built space is specific to cities in Northern Europe (Finland, Sweden), where the reserves of space in urban areas are generous, but also to those in Poland, which have experienced accelerated dynamics (Rzeszów, Gdańsk-Gdynia, Lublin, Kraków). As for metropolitan areas, the most pronounced expansion of built space was experienced by cities such as Tampere, Szczecin, Poznań, and Bucharest. In terms of built area per capita, cities in Belgium, Denmark, and Hungary are notable for their high values, while Greece, Romania, and Spain have the lowest.

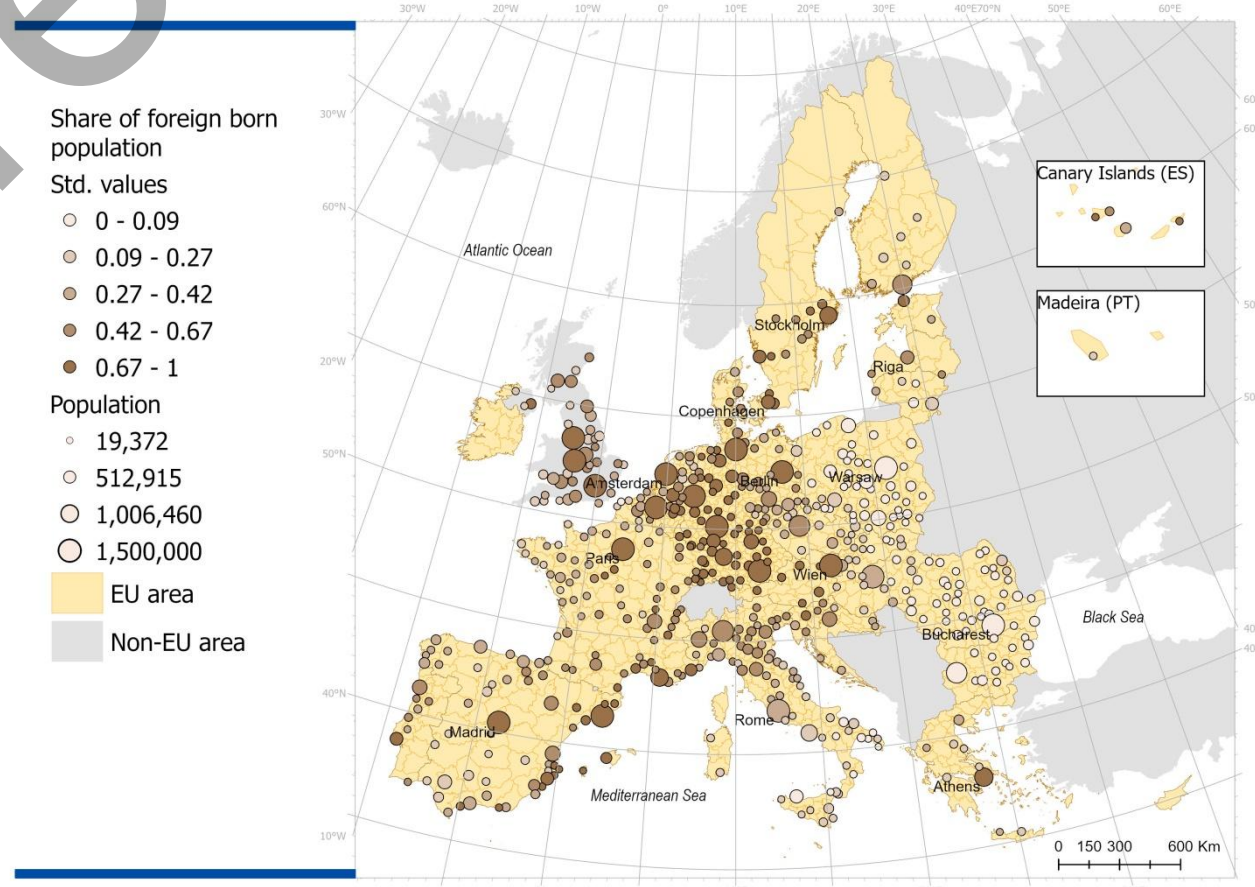
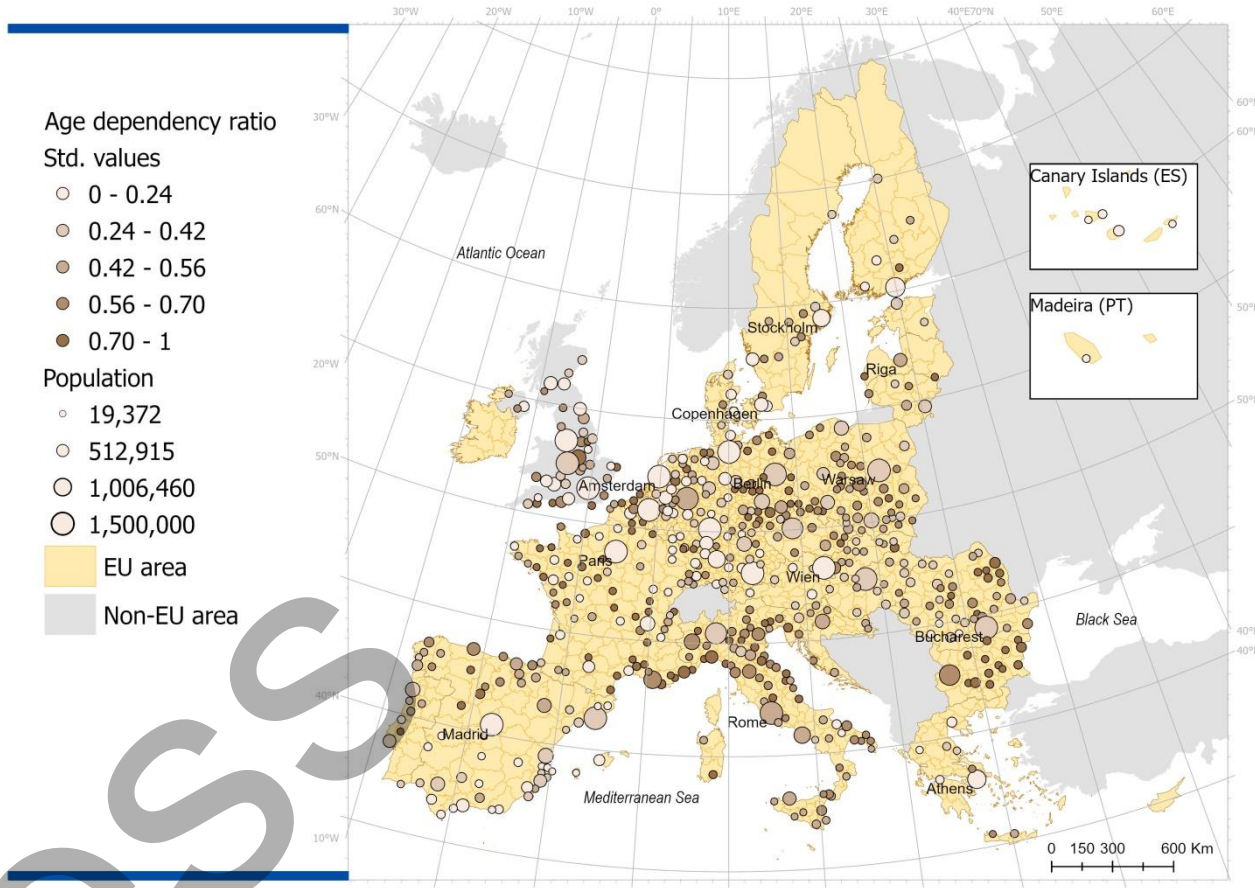
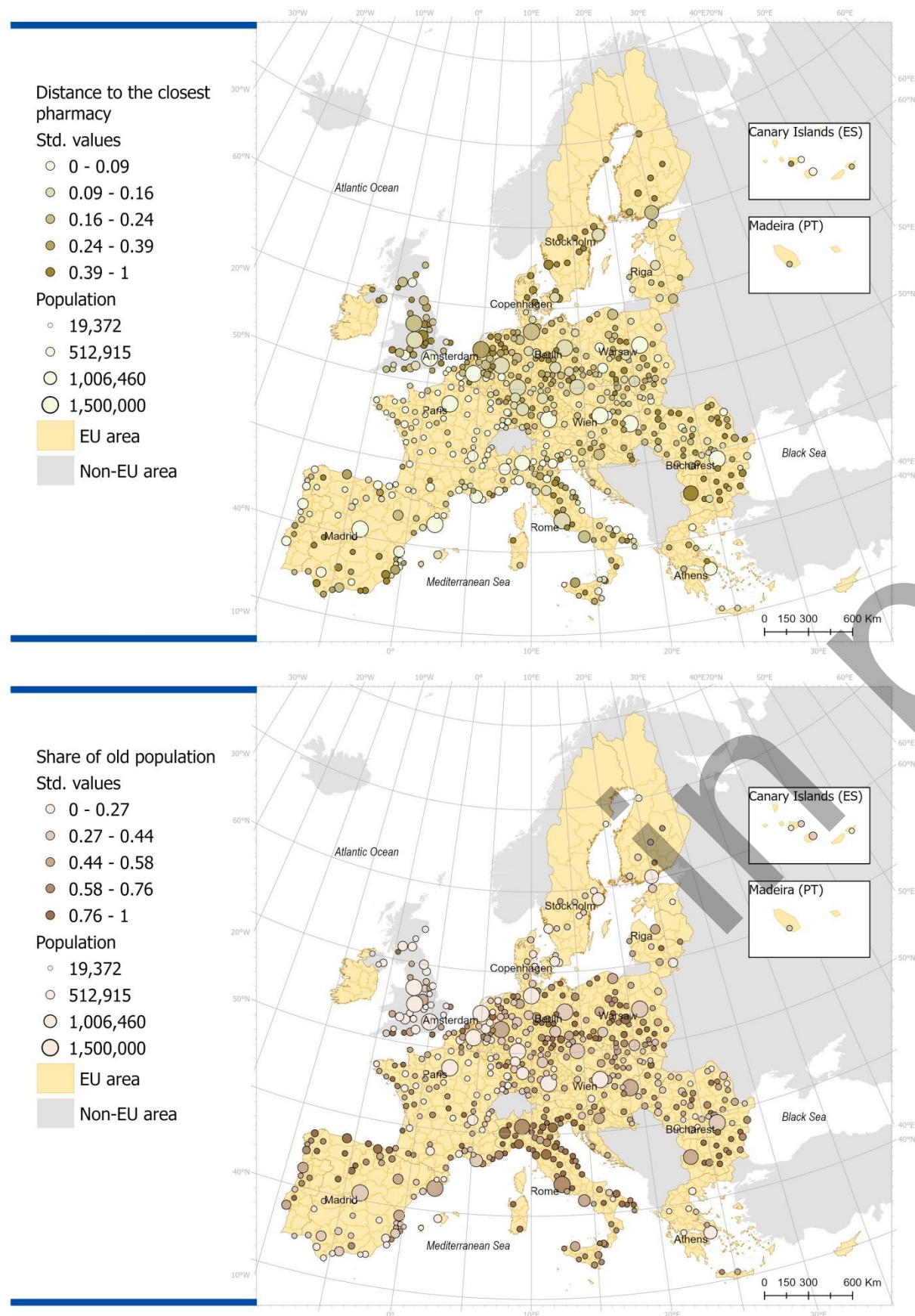
The high values in Eastern Europe, in contrast to demographic dynamics and other indicators, can also be seen as an effect of the limitations of the communist period, known for its concentrationist character and rigid urban planning.



An essential element of urban transformability, especially in recent times, is the share of immigrants who register high values in cities in Germany and Spain (Landshut, Vic, Torrevieja, Marbella, Arona), as well as in metropolises such as London, Vienna, and Brussels. The speed of the internet on mobile networks records the highest values in the countries of Northern and Western Europe (Germany, Sweden, Austria), but also in large cities in Mediterranean Europe (Madrid, Milan, but also Zagreb), while the most disadvantaged situation is experienced by smaller cities in Romania or Hungary (Petroșani, Tulcea, Reșița, Câmpina, Mediaș, Turnu Severin, Békéscsaba, Szolnok).

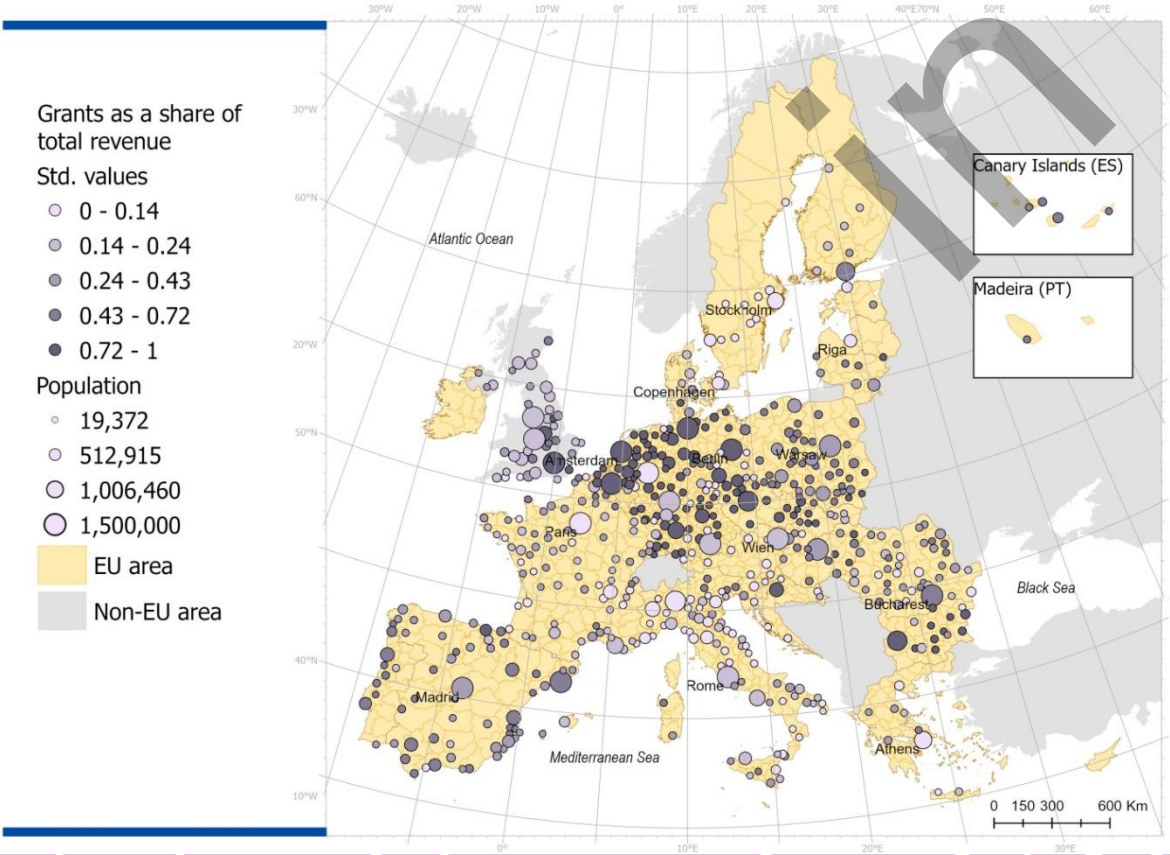
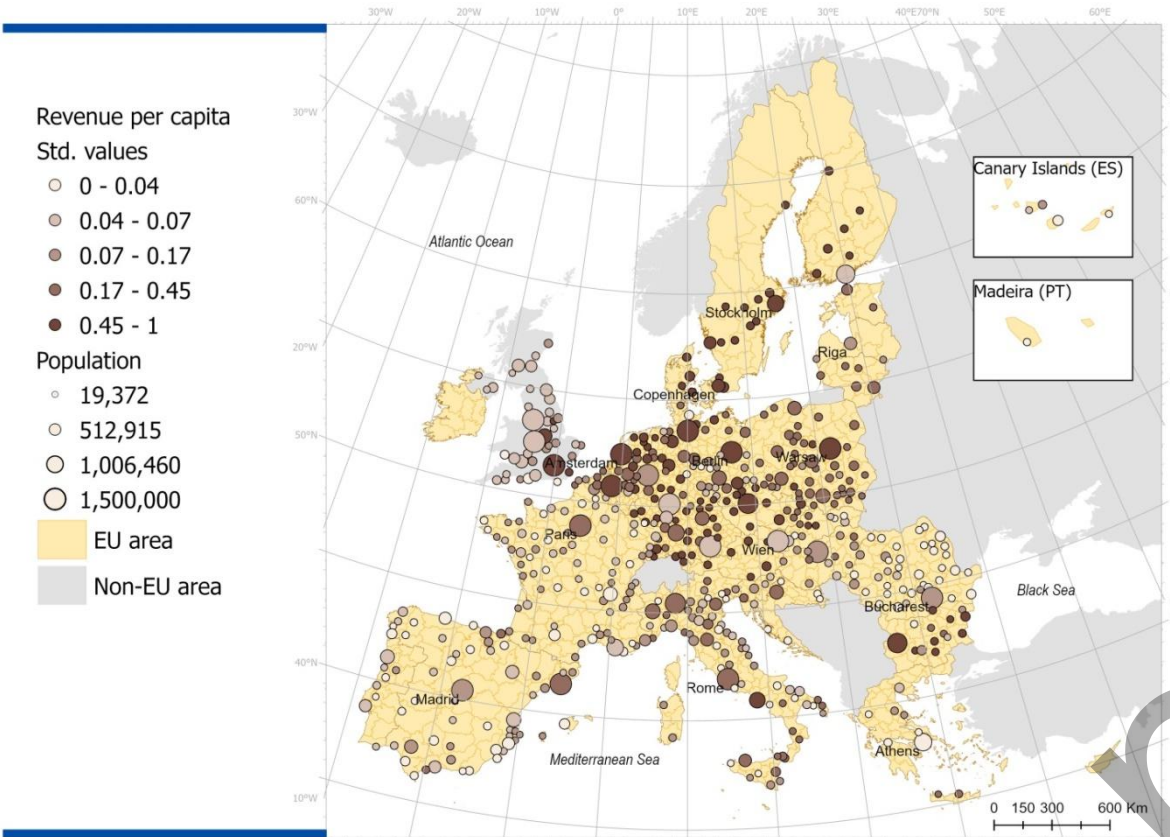


The accessibility of pharmacies remains lower in the cities of the Nordic countries, but also in Bulgaria and Romania. In Bulgaria this also overlaps with a significant presence of the elderly population in the cities. High shares are also found in Italy, while in Luxembourg, Estonia and Sweden the share of the elderly in the cities is much lower. At the same time, France, Germany and Spain have higher shares of the urban population born outside the country, which can be both a vulnerability and a relative opportunity.



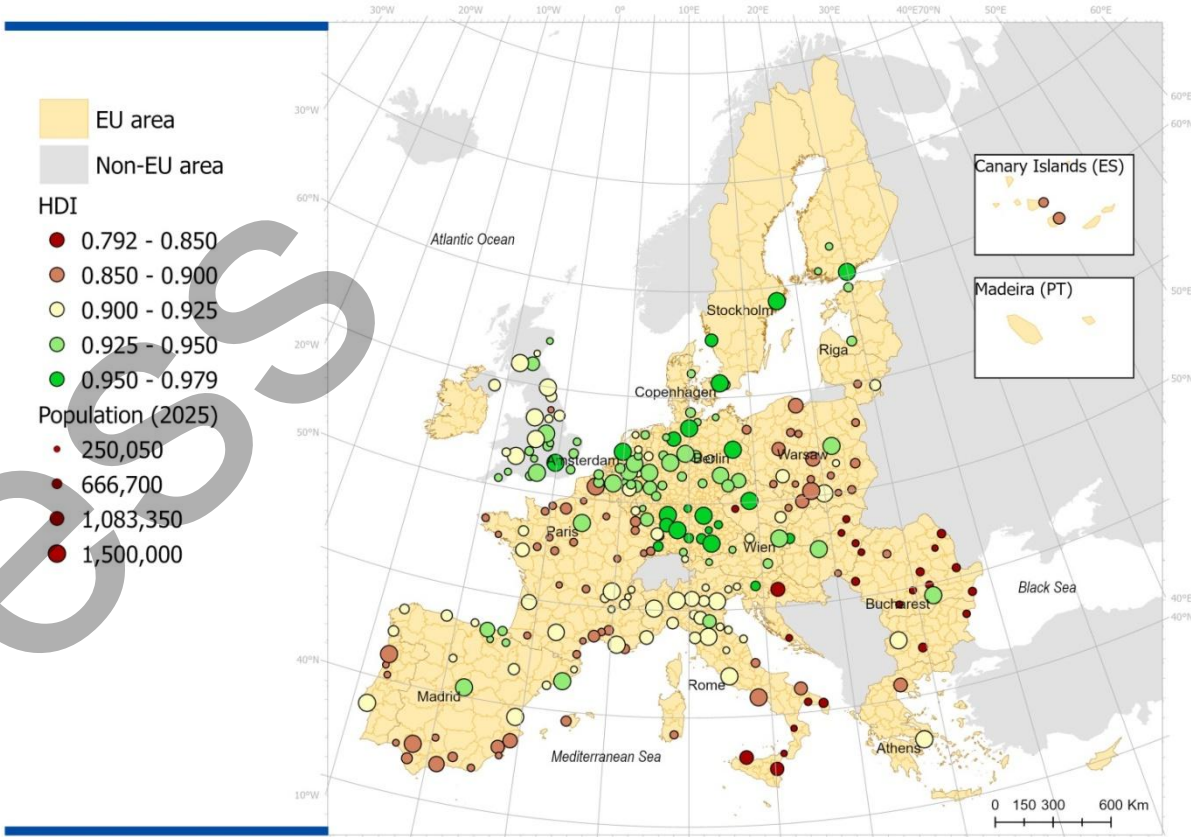
The total revenue per capita in cities shows steep west-east and north-south differentiations. The highest values in both the city and FUA are in the selected cities from Denmark, Sweden, Finland, and Austria, while the lowest values occur in Romania, Portugal and Croatia.

The capacity of governance, one of the main transformative factors of cities, is reflected by the share of grants in total revenues, where a good performance is observed in cities from the Netherlands, Belgium, but also the Czech Republic or Poland. At the opposite pole, lower values are recorded in Slovenia or Croatia.



All these indicators were weighted according to their correlation to the value of the Human Development Index (HDI) for each city. This broadly reflects the same N-S, E-W gradient while also highlighting specific situations. Thus, the highest values are found in the Nordic countries (Denmark, Sweden), Germany, Benelux, and Austria. At the same time, Central and Eastern Europe records the lowest values in Bulgaria (Iambol, Plevna) and Romania (Vaslui, Calarasi, Barlad).

Human Development Index (HDI)

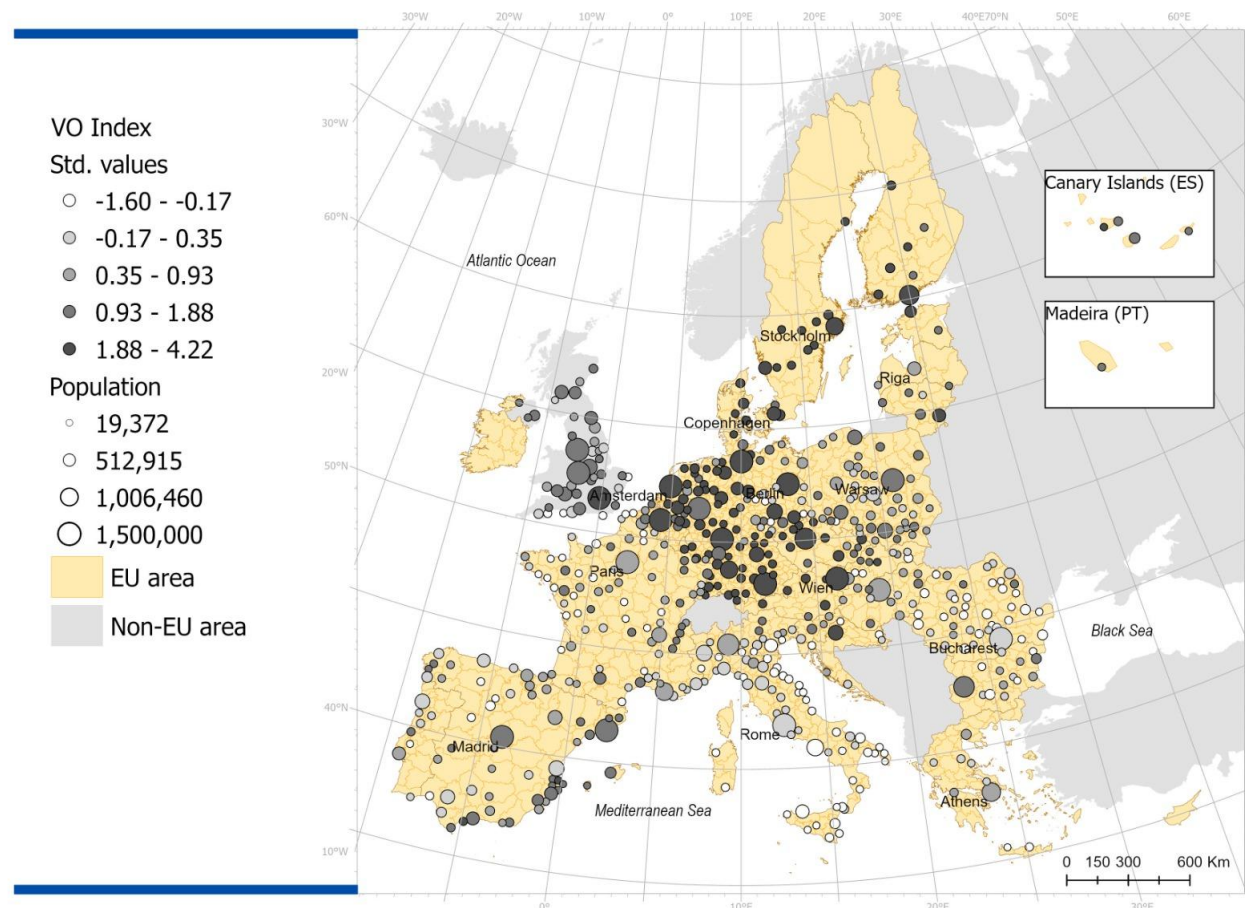


Correlation with HDI (Pearson)

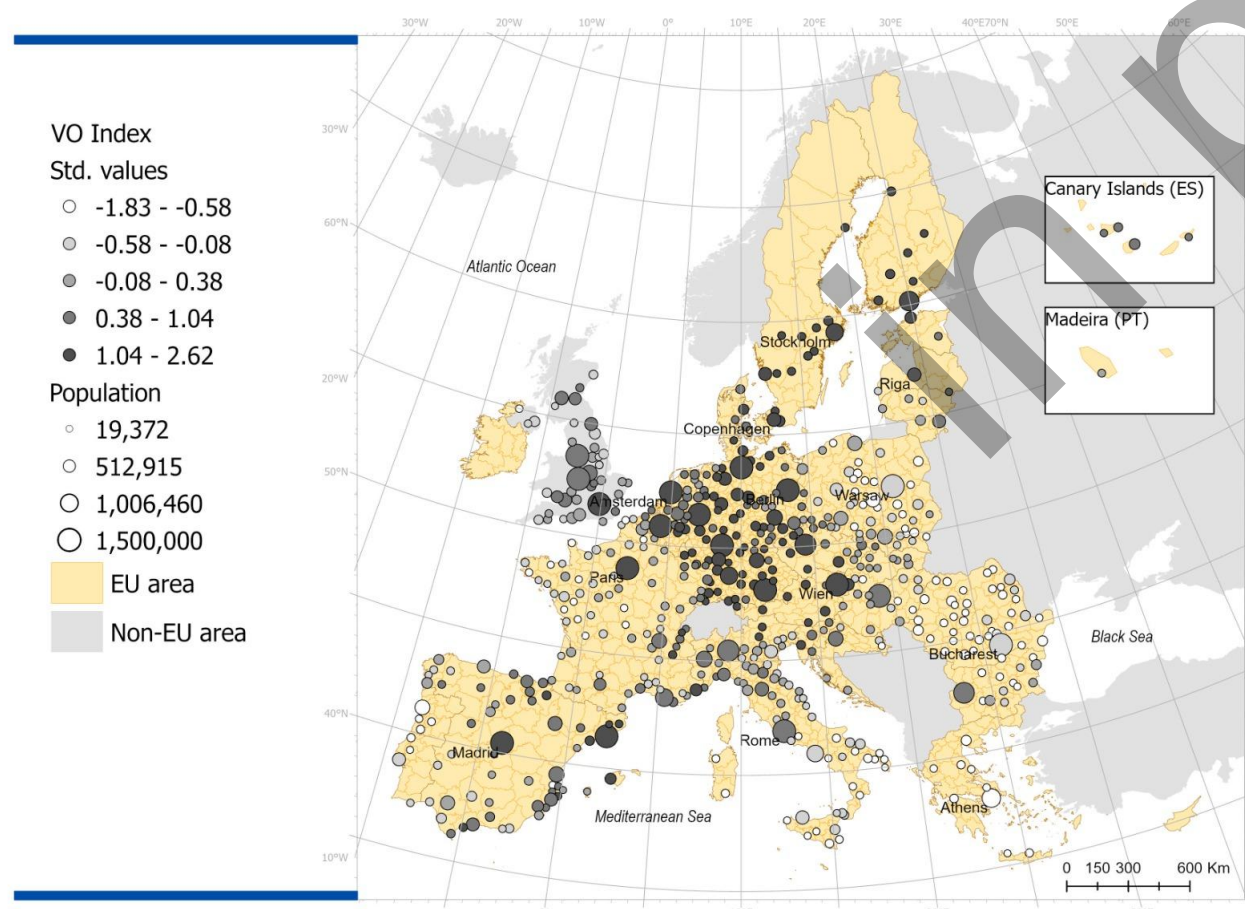
HDI (Pearson corelation)	CITIES	FUA
GREENCAP	0,011	-0,213
GREENSH	0,149	0,082
PM2_5	0,070	0,081
HEAT_CH	-0,224	-0,232
BUILTCAP	0,034	-0,198
BUILT_CH	-0,123	-0,181
NETMOB	0,541	0,610
MOBDOWN	0,016	0,118
REVCAP	0,396	0,394
EXPENDCAP	0,420	0,416
PHARMDIST	-0,054	-0,482
OLD_SH	-0,251	0,041
YOUTHDEP	-0,347	-0,026
MIGRANTS	0,643	0,637
GRANTS	0,245	0,099

Human development index, a proxy for quality of life and economic development, records high values in attractive cities and functional urban areas with large numbers of immigrants (internal and external). Also, proximity to daily facilities such as pharmacies is correlated with HDI especially in the case of FUAs.

Vulnerability-Opportunity Index (VOI) – Cities



Vulnerability-Opportunity Index (VOI) – Urban agglomerations



The Vulnerability-Opportunity Index, which cumulates the aspects analyzed by the partial indicators, through the statistically reflected contribution to the human development index, indicates an advantageous situation for the cities and functional urban areas in Austria, Denmark, Finland, Sweden, Luxembourg, Germany (Freiburg, Bonn, Hamburg, Marburg) or the Netherlands (Amsterdam, Groningen) while the most disadvantaged situation is found in Romania, Bulgaria (Iambol, Plevna), Greece, but also Portugal or Italy (Brindisi, Cagliari).

However, there is a major difference between the core city and the urban influence area that works either in the advantage of the latter (Salamanca, Valladolid, Burgos, Kosice, Haberstadt, Gera, Bautzen), or in favour of the main city (Patras, Groningen, Leiria).

Conclusions

- High diversity of cities across Europe, but North-South and East-West patterns remain visible despite common EU policies; persistent national and subnational peculiarities persist.
- The diversity of situations in Europe is also an effect of the opening of borders, which allowed the solving of the labour shortage (both qualified and unqualified) in the West, North, and South, but also of the employment problems (unemployment linked to deindustrialisation) in the East, on the principle of communicating vessels. The less favourable situation in southern and eastern Europe could be linked to the quality of governance, marked by sequelae such as endemic corruption, slow bureaucracy, and resistance to change.
- The contrast between Change in built-up surface and Net migration rate is so stark that it seems almost incomprehensible that this massive increase in built-up area is occurring while cities (sometimes agglomerations) are emptying. The capitals of the more important states in the East are often in an intermediate situation because they overcame these problems more quickly. The lag in the stages of urban dynamics was thus doubled by the overlap with the post-1990 demographic crisis, especially in the South and East (also of the economic transition).

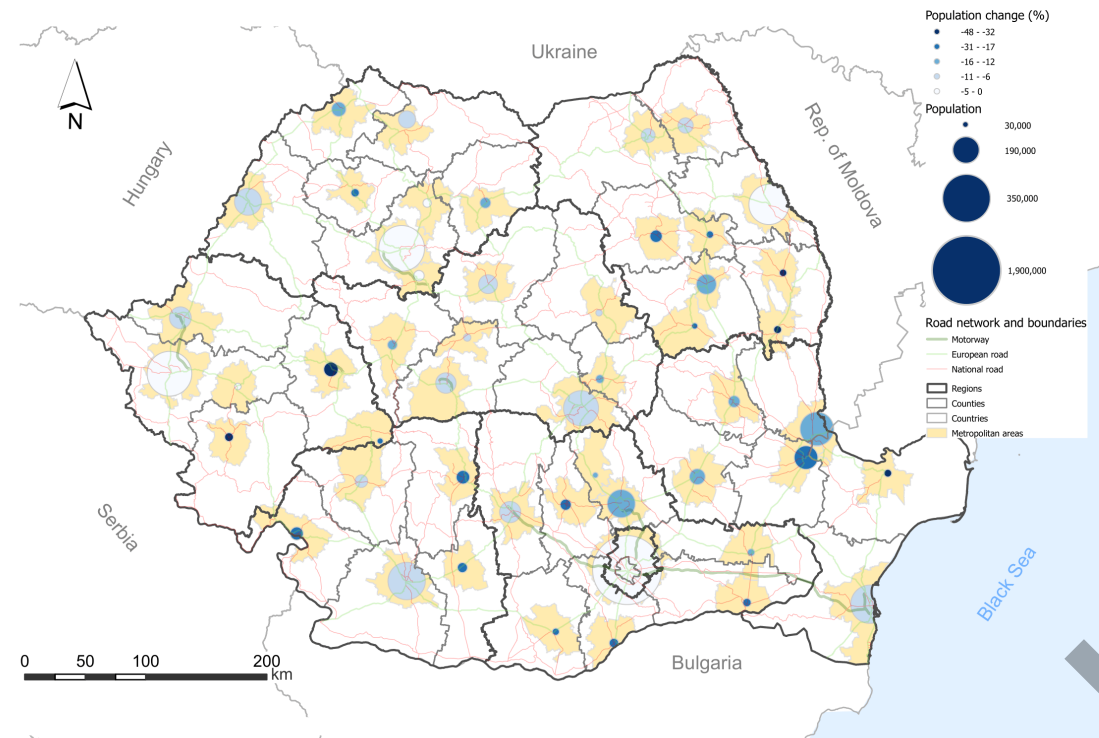
Romanian National Scale

in press

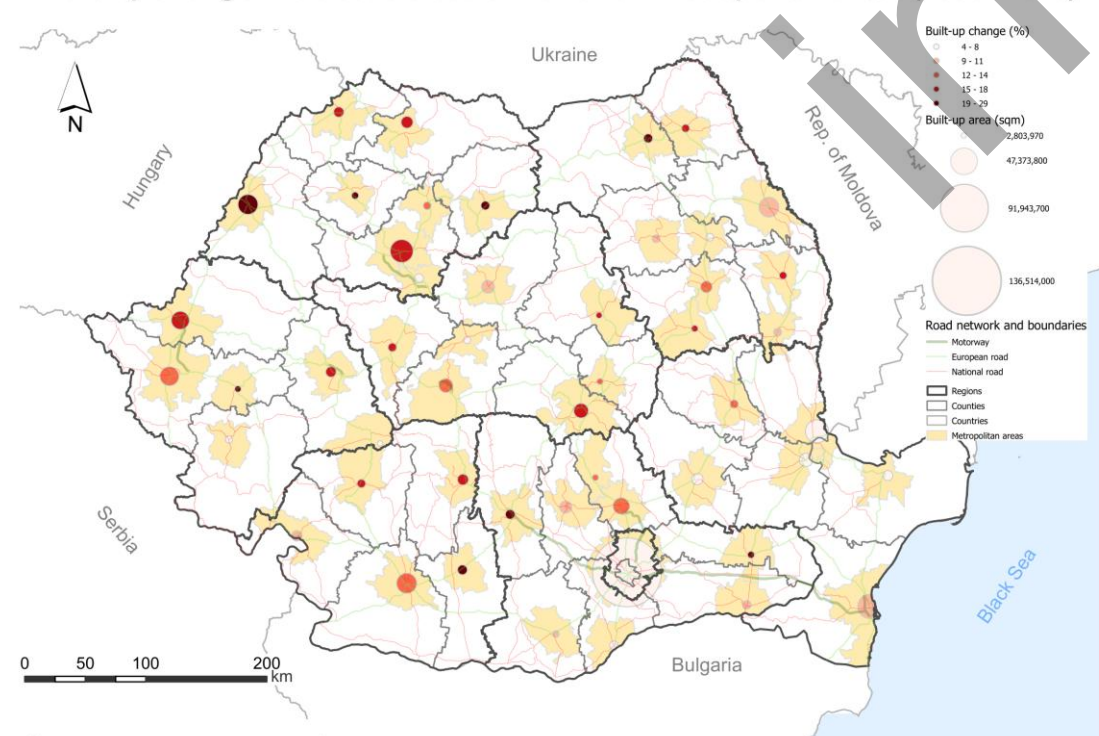
ROMANIAN SCALE

Cities are complex systems that continuously evolve, undergoing adaptive cycles shaped by political, social, and economic contexts, and sometimes radical changes originating within urban areas. They can contribute to increases or, conversely, decreases in pre-existing vulnerabilities or resilience capabilities of a social, economic, or environmental nature (Fingleton et al., 2012; Bănică et al., 2024). They can also influence population dynamics and structural changes in urban areas, affecting urban planning, functional area design, or city expansion, whether planned or through urban sprawl.

Population change in the core cities of Romanian metropolitan areas (2000 - 2020)

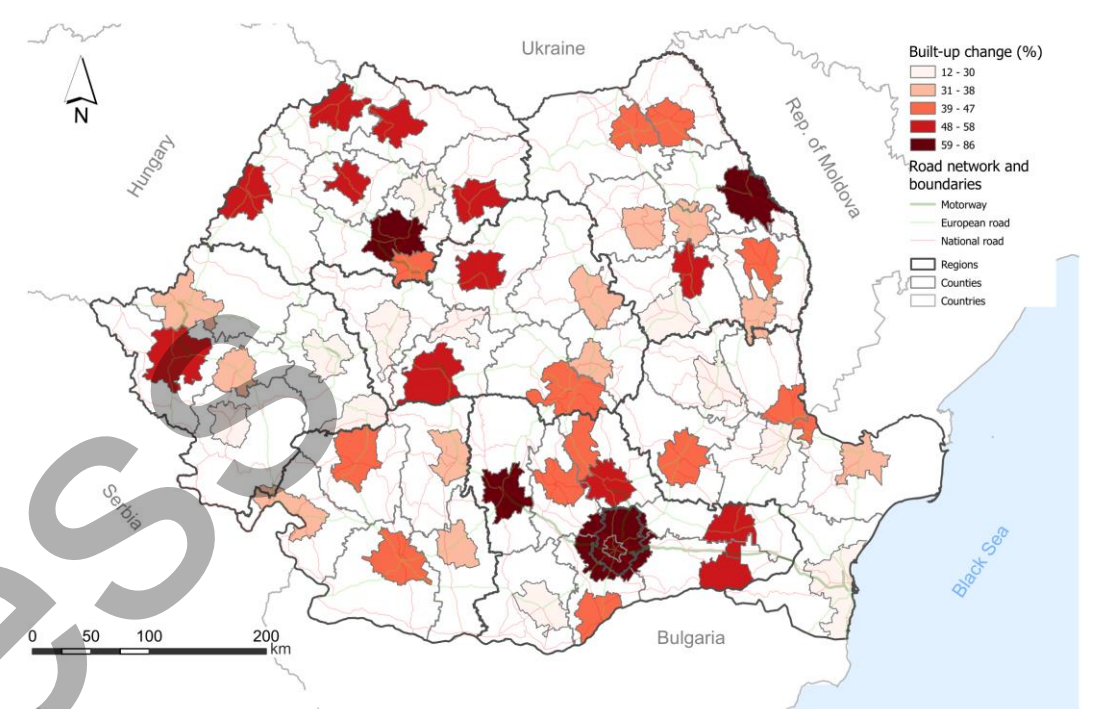


Built-up change in the core cities of Romanian metropolitan areas (2000 - 2020)



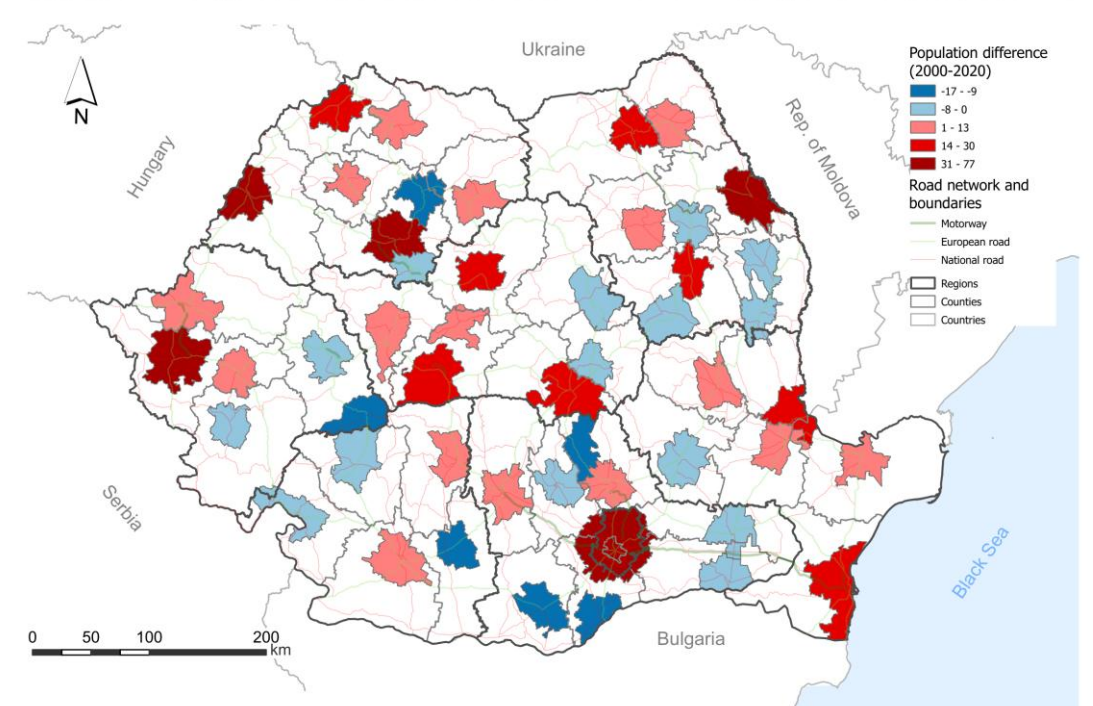
Between 2000 and 2020, Romania exhibited a clear demographic contrast between core cities and their metropolitan surroundings. All core cities experienced decline to various degrees, while many municipalities outside cores gained population, and others still declined. The contrast between cores and the rest of the metropolitan areas is most evident in second-tier cities, where peri-urbanisation is a key mechanism of metropolitan restructuring.

Built-up change outside the core cities of Romanian metropolitan areas (2000 - 2020)



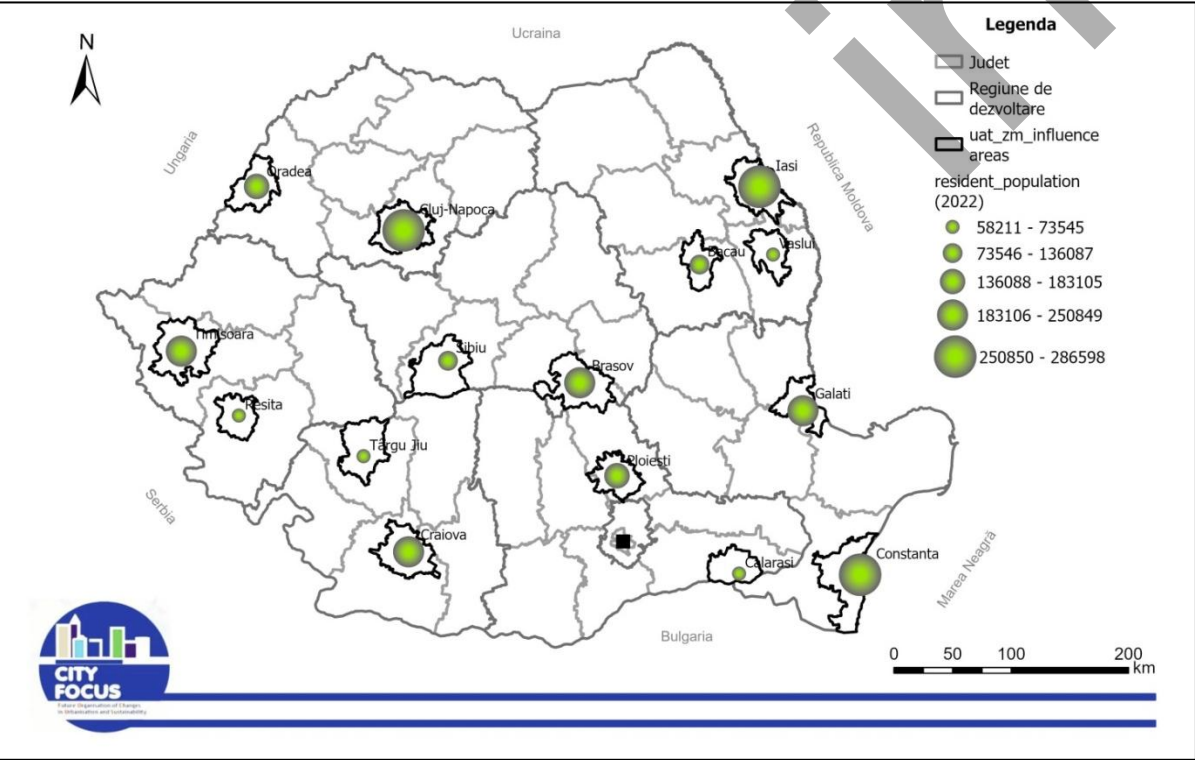
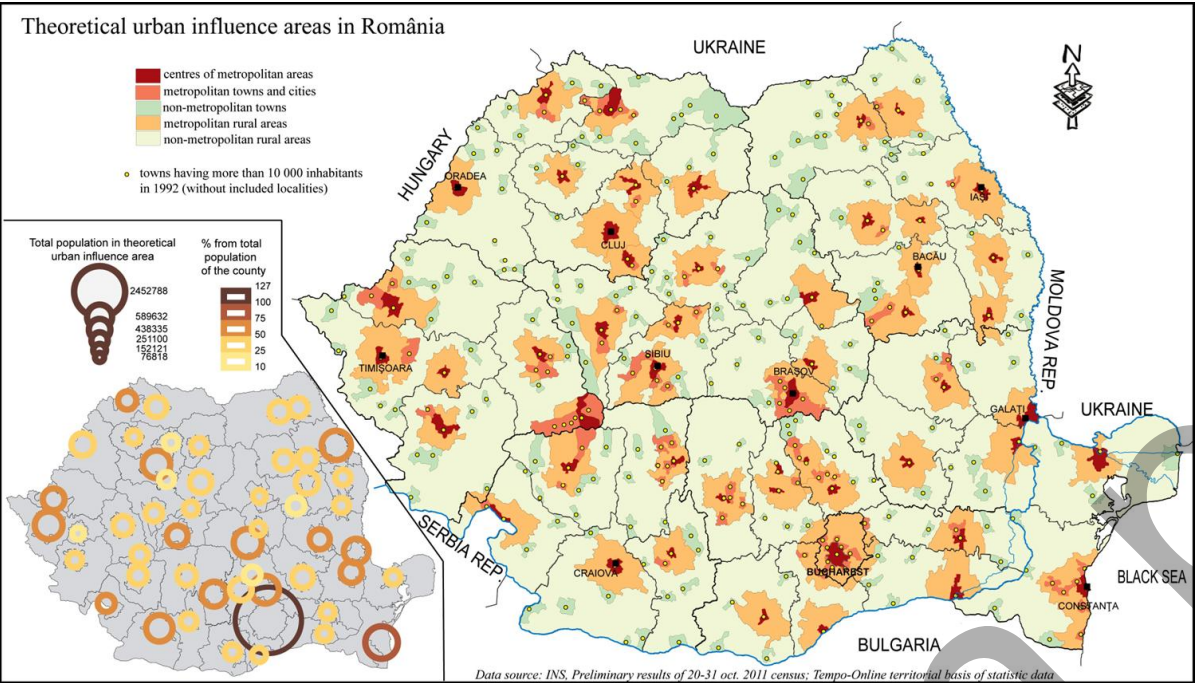
Similarly, the metropolitan areas recording the highest demographic increase also feature the strongest built-up expansion, often exceeding 40–50%. The comparison points to a spatial decoupling between demographic change and land consumption: even where core-city populations declined, built-up areas continued to expand, especially in peri-urban areas, indicating extensive suburbanisation and increasing pressure on land take.

Population change outside the core cities of Romanian metropolitan areas (2000 - 2020)



319 towns & cities and 50 (theoretical) metropolitan areas
15 selected cities

The analysis of urban transformability at the Romanian level targeted, on the one hand, all official urban units and, on the other hand, large cities and theoretical metropolitan areas (50 cities with over 50 inhabitants, at least once in their history) (Bănică & Muntele, 2013). A further subset of 15 cities and their urban influence areas was selected using the authors' methodology, which includes Regional Growth Poles but also cities that are marked either by major vulnerabilities or by a remarkable transformation capacity visible in recent decades (they often manage to transform their vulnerabilities into opportunities through processes of urban regeneration and morphological (urban) social and economic restructuring).



CITY	REGION	OBSERVATIONS
Timișoara	W	Regional Growth pole
Cluj-Napoca	NW	Regional Growth pole
Constanța	SE	Regional Growth pole
Sibiu	C	Selected (opportunities)
Brașov	C	Regional Growth pole
Craiova	SV	Regional Growth pole
Oradea	NW	Selected (opportunities)
Iași	NE	Regional Growth pole
Ploiești	S	Selected -former industrial city highly transformed (opportunity)
		Selected -former industrial city vulnerable (mining activities closed) but also highly transformed (opportunity) also for geographic homogeneity (the second selected city from W region)
Tîrgu Jiu	SV	
Reșița	W	Selected - contrasting city - some major vulnerabilities, also for geographic homogeneity (the second selected city from W region)
Galați	SE	Regional Growth pole
Bacău	NE	Selected (vulnerabilities)
Călărași	S	Selected (vulnerabilities)
Vaslui	NE	Selected (vulnerabilities)

TIMEFRAME

The data were averaged over four relevant periods, established according to the major disruptions experienced by Romanian territorial units in the last 25 years:
2000 – 2007 – pre-accession growth period,
2008 – 2012 – global economic crisis period,
2013 – 2020 – pre-pandemic expansion period,
2020 – 2026 – pandemic and post-pandemic period

DATA SOURCES:

- National Trade Register Office (ONRC)
- National Institute of Statistics (TEMPO / eDemos)
- European Environmental Agency, interpolated data
- Google Earth Engine
- Governmental data (DATA.GOV)



**For reasons of space, not all 43 individual indicators were represented cartographically, but two were selected for each dimension. However, all mentioned indicators were used to obtain the sub-indices and the final index.

DIMENSION	INDICATOR	ACRONYM	SOURCE	PERIOD	UNIT OF MEASURE	RATIO TO	PERIOD AVERAGES
Environment & Climate Action	Air quality — PM2.5 concentration	PM	EEA	2019–2022	µg/m³	—	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Normalised Difference Vegetation Index (NDVI)	NDVI	Google Earth Engine	2011 & 2021	Scale –1 to +1	—	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Flood risk index	FLOOD	Google Earth Engine	2011 & 2021	Scale 0–1 (Very Low → Very High)	—	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Local budget expenditure on env. protection per capita	rexp_env_pop	MRDPA	2011–2024	Lei / inhab.	pop	Avg 2011–2012; 2013–2019; 2020–2024
	Local budget investment in env. protection per capita	rexp_ienv_pop	INSSE eDemos	2013–2023	Lei / inhab.	pop	Avg 2013–2019; 2020–2023
	Recovered household waste per inhabitant	WASTE	INSSE eDemos	2013–2023	Kg / inhab.	pop	Avg 2013–2019; 2020–2023
Health & Safety	Circulatory disease deaths as % of total deaths	BCIRC	INS	2001–2023	Cases, % of total deaths	deaths	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Respiratory disease deaths as % of total deaths	BRESP	INS	2001–2023	Cases, % of total deaths	deaths	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Traumatic injuries & external causes as % of total deaths	VIOLENTD	INS	2001–2023	Cases, % of total deaths	deaths	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Hospital beds per 1,000 inhabitants	bedszz_pop	INSSE TEMPO	1992–2023	Beds / 1,000 inhab.	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Physicians per 1,000 inhabitants	doctorszz_pop	INSSE TEMPO	1992–2023	Physicians / 1,000 inhab.	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Local budget expenditure on health per capita	rexp_health_pop	MRDPA	2006–2024	Lei / inhab.	pop	Avg 2006; 2007–2012; 2013–2019; 2020–2024
	Reported crimes per 1,000 inhabitants	crimes	INSSE eDemos	2013–2023	Cases / 1,000 inhab.	pop	Avg 2013–2019; 2020–2023
Social Equity	Infant mortality rate (deaths under 1 year per 1,000 pop.)	lydz	INSSE TEMPO	2012–2024	No. of persons / 1,000 inhab.	pop	2012; avg 2013–2016; 2017–2019; 2020–2024
	School enrolment rate (population aged 0–24)	enrolledzz	INSSE TEMPO	1992–2023	Enrolled pop/pop 0–24	pop_0_24	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Share of population aged 65 and over	pop_65over	INSSE TEMPO	1992–2024	%	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Local budget expenditure on social assistance per capita	rexp_asist	MRDPA	2001–2024	Lei (const. 2023) / inhab.	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Local budget expenditure on education per capita	rexp_edu	MRDPA	2001–2024	Lei (const. 2023) / inhab.	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Living floor space per inhabitant	sup_inh_	INSSE TEMPO	1990–2023	m² / inhab.	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Teacher-to-student ratio	prof_stud	INSSE TEMPO	1992–2024	Teachers/pupils	pupils	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Local budget expenditure on culture per capita	rexp_cult	MRDPA	2001–2024	Lei (const. 2023) / inhab.	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024

Economic Vitalisation	Number of firms per inhabitant	firms_pop	ONRC/INS	2003–2023	<i>No. of firms/inhabitant</i>	pop	Avg 2003–2006; 2007–2012; 2013–2019; 2020–2023
	Employees per population aged 19–64	emp_pop	ONRC/INS	2003–2023	<i>Employees/pop 19–64</i>	pop	Avg 2003–2006; 2007–2012; 2013–2019; 2020–2023
	Total turnover per inhabitant (constant 2023 prices)	rturnover_pop	ONRC/INS	2003–2023	<i>Lei (const. 2023) / inhab.</i>	pop	Avg 2003–2006; 2007–2012; 2013–2019; 2020–2023
	Tourists arrived per 1,000 inhabitants	touristszpop	INSSE TEMPO	2001–2024	<i>Number / 1,000 inhab.</i>	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Net profit per capita (constant 2023 prices)	rnetprofit_pop	ONRC/INS	2003–2023	<i>Lei (const. 2023) / inhab.</i>	pop	Avg 2003–2006; 2007–2012; 2013–2019; 2020–2023
	Total local budget revenue per inhabitant	rincome_pop	MRDPA	2001–2024	<i>Lei (const. 2023) / inhab.</i>	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Registered unemployment rate (pop. 20–64)	unemploy	INSSE TEMPO	2010–2024	<i>% (0–100)</i>	pop_20_64	Avg 2010–2012; 2013–2019; 2020–2024
Digitalisation & Big Data	Share of local authorities with their own website	webpage	ONRC/INS	2013–2023	<i>Number</i>	metro_nr_uat	Avg 2013–2019; avg 2020–2023
	Share of ITC firms in total firms	firmsITC	ONRC/INS	2008–2023	<i>Proportion (0–1)</i>	nfirms_t	Avg 2008–2012; 2013–2019; 2020–2023
	Share of ITC turnover in total turnover	turnoverITC	ONRC/INS	2008–2023	<i>Proportion (0–1)</i>	nturnover_t	Avg 2008–2012; 2013–2019; 2020–2023
	Share of ITC employees in total employees	emplITC	ONRC/INS	2008–2023	<i>Proportion (0–1)</i>	nempl_t	Avg 2008–2012; 2013–2019; 2020–2023
	Share of ITC net profit in total net profit	netprofitITC	ONRC/INS	2008–2023	<i>Proportion (0–1)</i>	nnetprofit_t	Avg 2008–2012; 2013–2019; 2020–2023
Infrastructure & Mobility	Sewage network length per 1,000 inhabitants	SEWAGE	INSSE TEMPO	1990–2024	<i>Km / 1,000 inhab.</i>	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Private cars per 1,000 inhabitants	CAR	eDemos	2013–2023	<i>No. of cars / 1,000 inhab.</i>	pop	Avg 2013–2019; 2020–2023
	Permanent immigrants (residence change) per 1,000 inhabitants	EXT_IMIG	INSSE TEMPO	1994–2023	<i>Number / 1,000 inhab.</i>	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Internal in-migration (residence settlements) per 1,000 inhabitants	INT_IMIG	INSSE TEMPO	1994–2023	<i>Number / 1,000 inhab.</i>	pop	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
	Newly finished dwellings as share of existing housing stock	fin_dwell	INS	1990–2023	<i>Finished / existing (0–1)</i>	dwellings	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2023
Governance & Institutions	EU funds absorbed per capita	funds_inhab	Zenodo/MRDPA	2016–2022	<i>EUR (const. 2015) / inhab.</i>	pop	Avg 2016–2019; 2020–2022
	Total expenditure to total revenue ratio	rexp_rinc_r	MRDPA	2001–2024	<i>Ratio</i>	rincome_total_md	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Investment expenditure as share of total expenditure	exp_inv_sh	MRDPA	2001–2024	<i>Proportion (0–1)</i>	rexp_total_md	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Share of own income in total local budget income	income_own_share	MRDPA	2001–2024	<i>Ratio</i>	rincome_total_md	Avg 2001–2006; 2007–2012; 2013–2019; 2020–2024
	Community-based initiatives / civic NGOs per metropolitan area	CIVIC_NGOS	DATA.GOV	2008–2018	<i>Number</i>	metro_nr_uat	Avg 2008–2012; 2013–2018

INDEX COMPOSITION Sources: ONRC — National Trade Register Office; INS/INSSE — National Institute for Statistics; MRDPA — Ministry of Regional Development and Public Administration; EEA — European Environment Agency; DATA.GOV — Romanian Open Data Portal.

Environment and Climate action

This chapter examines Environment and Climate Action by correlating ecological indicators - **NDVI**, **flood risk**, and **air pollution**—with local governance efforts. The analysis evaluates financial commitment through **environmental protection expenditures and investments**, alongside waste management efficiency measured by recovered municipal waste per capita.



Air Pollution

Measures atmospheric pollutants and particulate matter to evaluate environmental quality and public health safety standards.



NDVI

Quantifies vegetation density and health to monitor ecosystem vitality, carbon sequestration, and urban greening efforts.



Flood Risk

Assesses topographical vulnerability and drainage capacity to predict, mitigate, and manage potential water-related disaster impacts.



Environmental Protection Expenditures

Environmental protection expenditures measure the local administration's financial commitment to sustainability. These include current spending for ongoing services and capital investments in infrastructure aimed at preventing pollution and environmental degradation.



Environmental Protection Investments

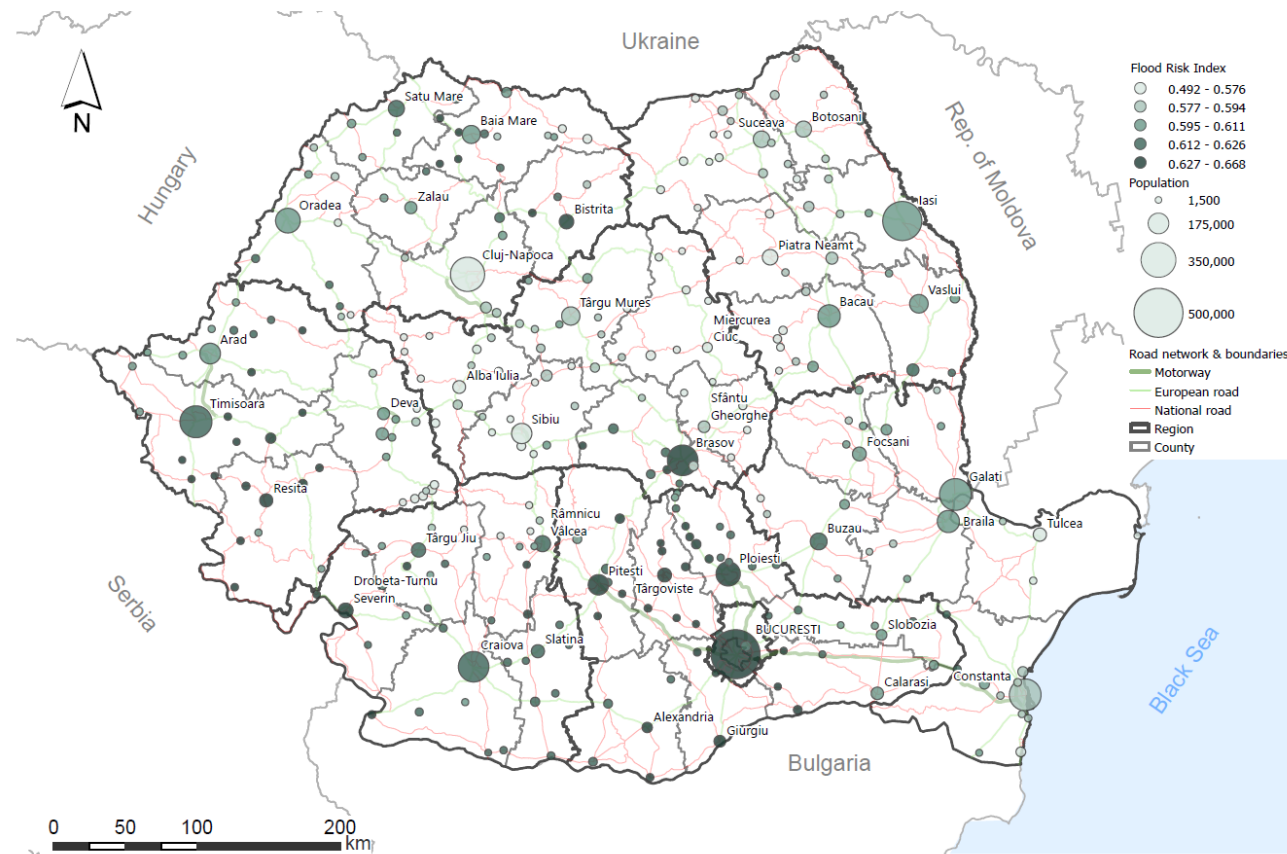
Environmental protection investments represent long-term capital funding dedicated to green infrastructure and technology. These resources are specifically allocated to modernize systems and build facilities that ensure sustainable resource management and pollution prevention.



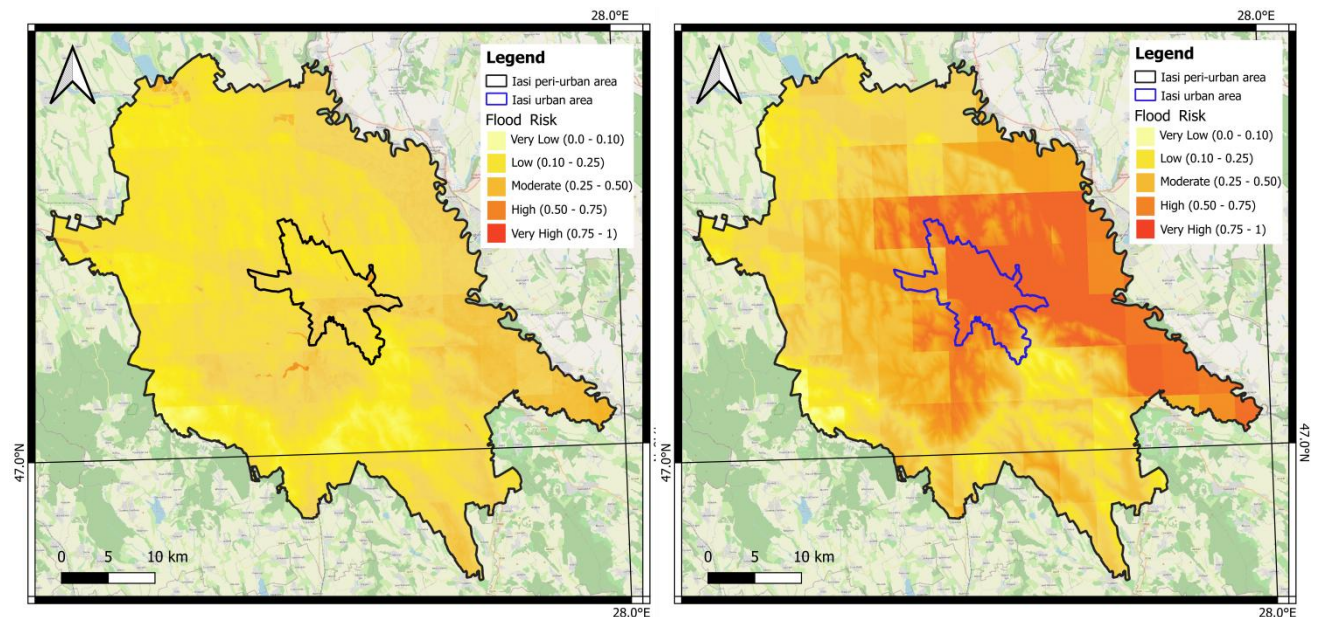
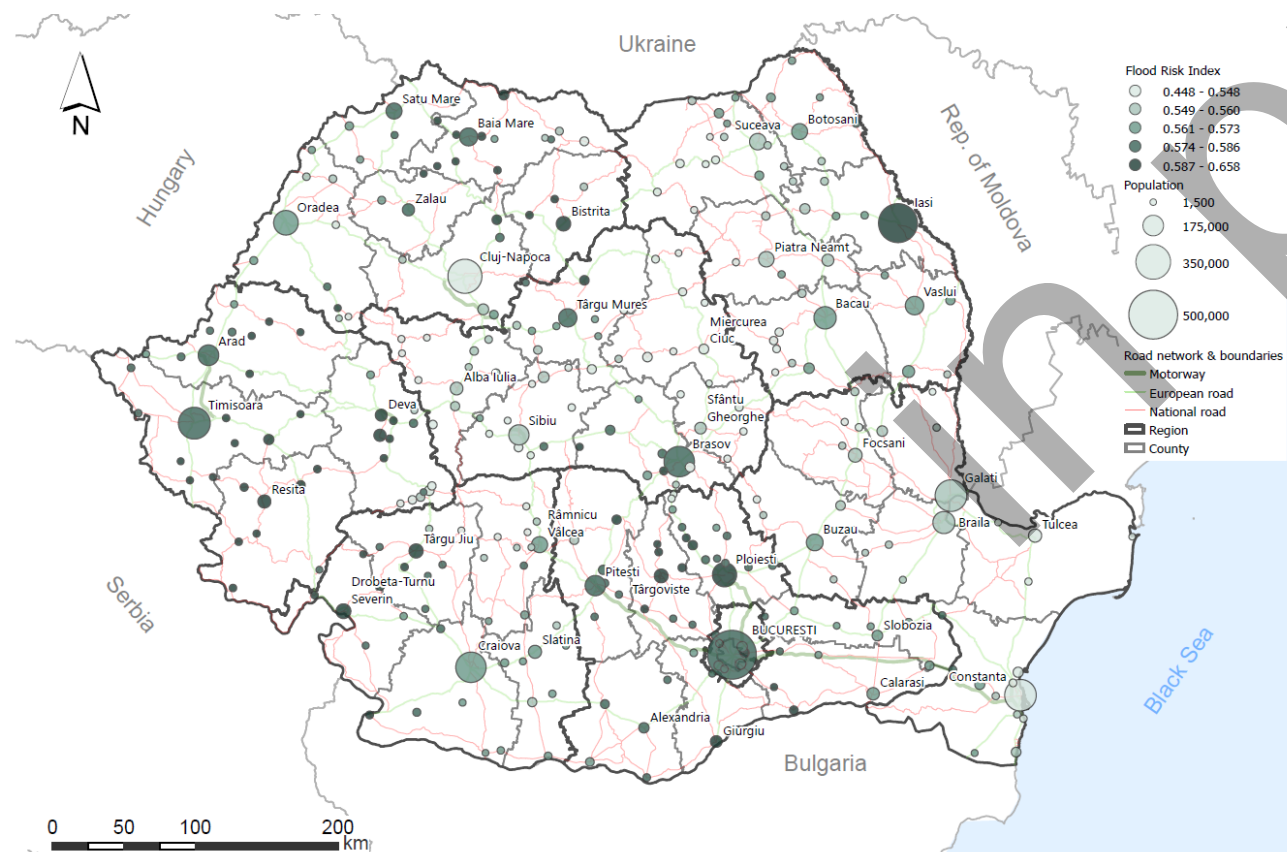
Recovered Municipal Waste per Capita

Recovered municipal waste per capita measures the efficiency of local recycling and recovery systems. It tracks the amount of household waste successfully diverted from landfills through recycling or energy recovery, serving as a key indicator of sustainable consumption and circular economy performance.

Flood Risk Index (2013-2019)



Flood Risk Index (2020-2024)



Flood Risk 2000

Flood Risk 2024

Urban flooding represents a critical threat to both human security and long-term economic stability (Miller and Hutchins 2017).

Urban flooding differs significantly from rural flooding. It occurs when the inflow of water (usually from intense, short-duration rainfall events) exceeds the capacity of an urban drainage system or natural water bodies within a city.

The Flood Risk Indicator is calculated by combining satellite-derived water indices (Landsat 7, Landsat 8), elevation data (SRTM), and total accumulated rainfall (CHIRPS) to map flood-prone areas.

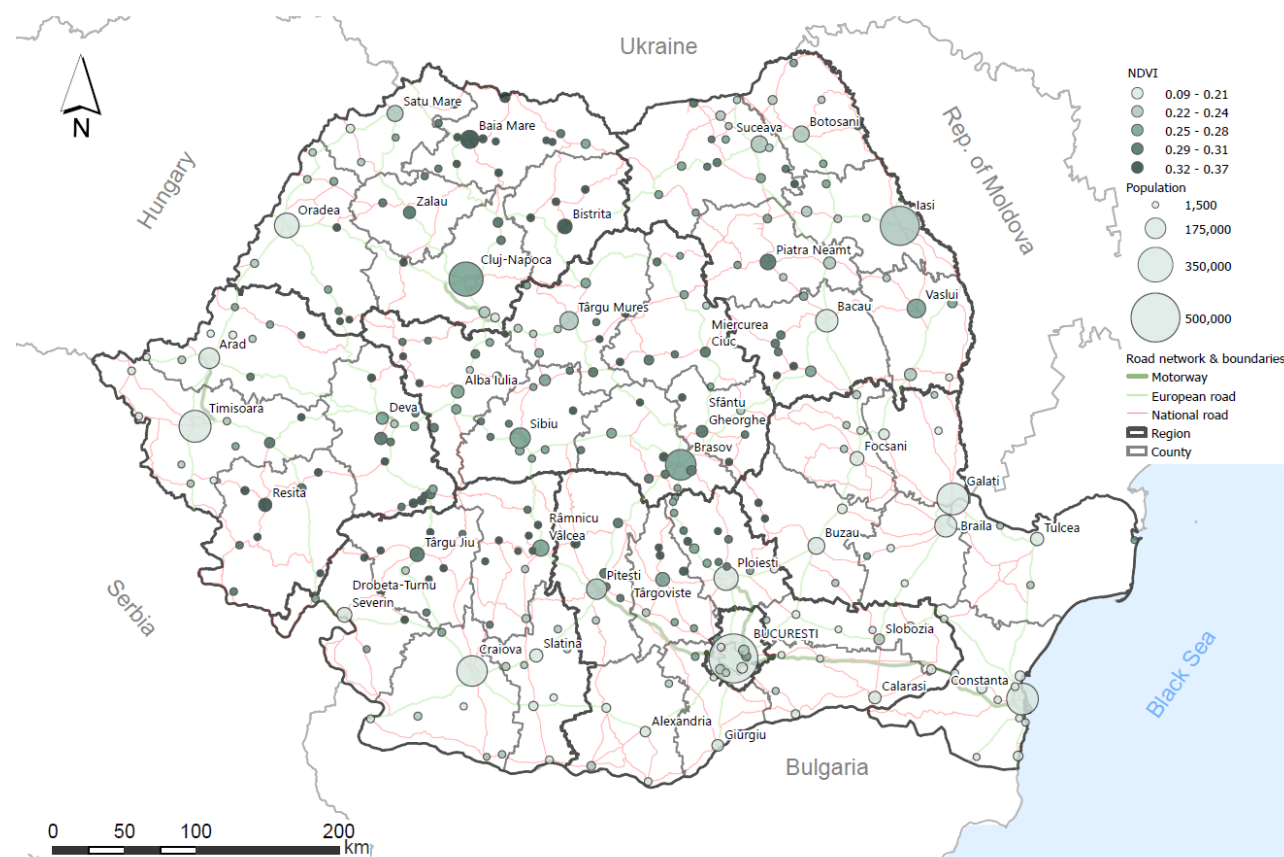
The Flood Risk indicator evaluates potential socio-economic loss by intersecting physical hazard, asset exposure, and systemic vulnerability.

Both maps reveal a consistent spatial structure of flood risk across Romania during the 2013–2019 and 2020–2024 period. Higher flood risk values are generally associated with lowland territories, major river corridors, and densely populated urban areas, particularly in the south and east of the country. In contrast, lower values are more frequent in the centre and upland regions.

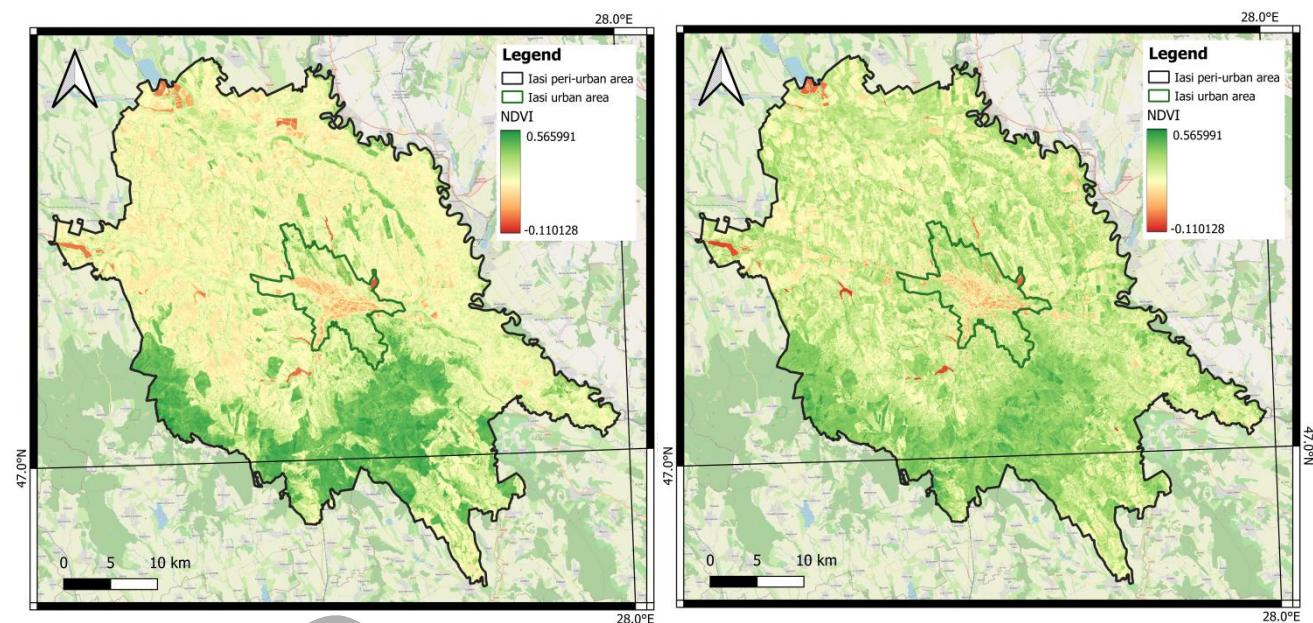
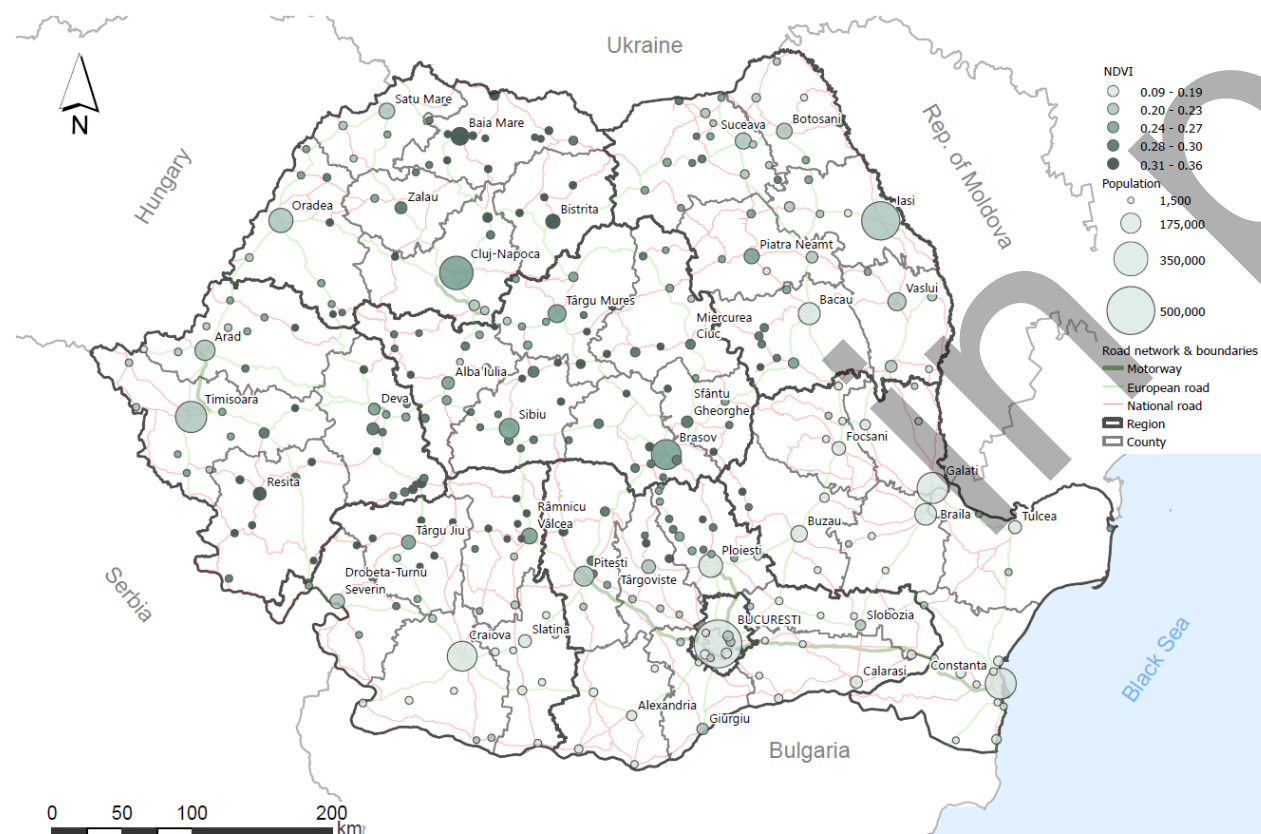
For Iasi, the transition from the 2000 scenario (left) to the 2024 scenario (right) demonstrates how a high-magnitude meteorological event interacts with highly urbanised, impermeable surfaces, maximising surface runoff, signalling a critical flash-flood vulnerability concentrated precisely over the dense infrastructure of the Iasi urban core.

Although the resolution is not very high, the distribution of Flood risk indicator values allows the identification of territorial units that are exposed to this hazard, and that should take measures to reduce possible losses in the event of extreme events (see at the top of the page the case of the Iasi metropolitan area).

Normalised Difference Vegetation Index (2013-2019)



Normalised Difference Vegetation Index (2020-2024)



NDVI 2000

NDVI 2024

Normalized difference vegetation index (NDVI) is known from literature as the most used vegetation index (Benedetti și Rossini, 1993; Maselli et al., 1992; Mkhabela et al., 2011; Rasmussen, 1992; Xue și Su, 2017; Yan et al., 2022), fiind being not just a proxy for vegetation health, but used also for land degradation assessment (Bai et al., 2008).

At the national scale, the NDVI pattern suggests a relatively heterogeneous landscape, in which vegetation quality is strongly influenced by relief, land cover, and regional environmental conditions.

The NDVI distribution for the 2013–2019 period shows a clear spatial differentiation in vegetation cover across Romania. Higher NDVI values are concentrated primarily in the north-western, central, and mountainous regions, which are generally associated with denser natural vegetation, forested areas, and lower human pressure. In contrast, lower values are more evident in the southern and south-eastern parts of the country, where the exposure to climatic stress may reduce vegetation vitality.

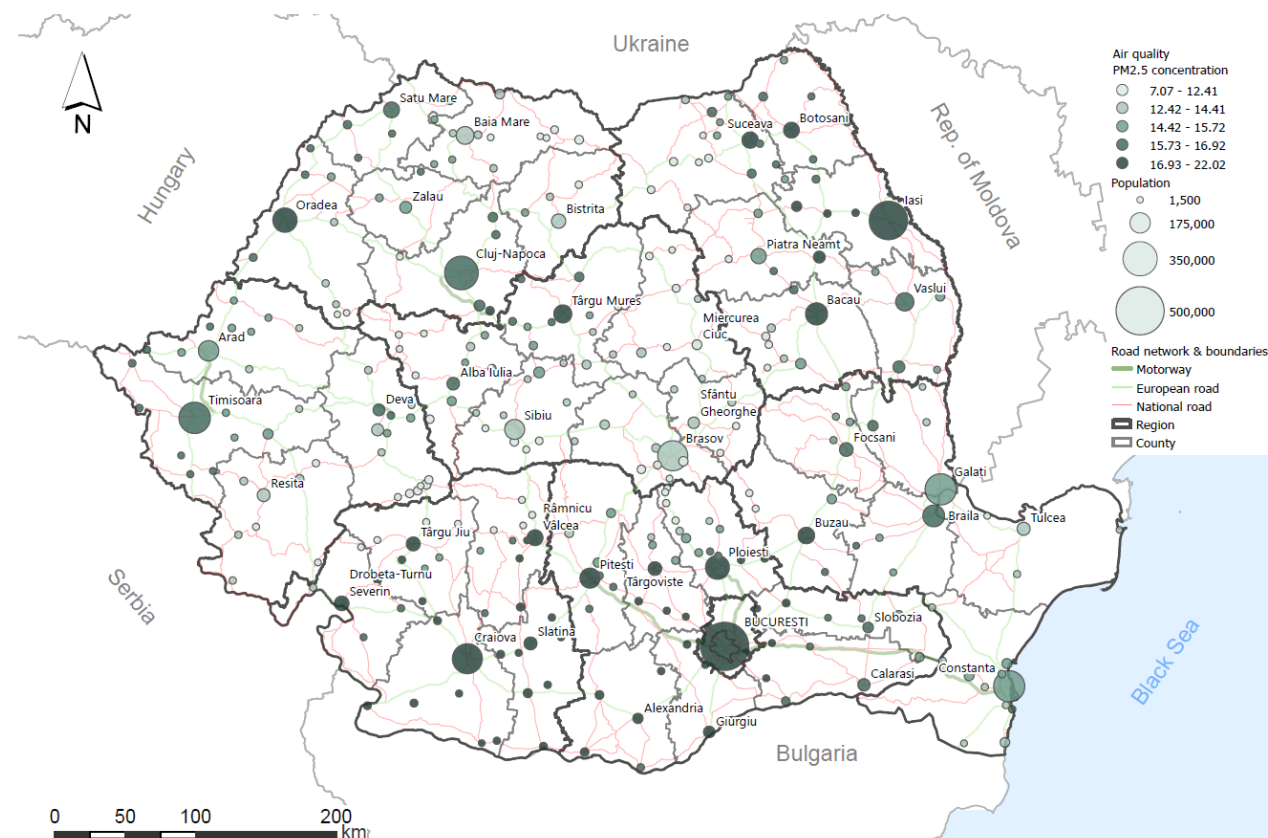
For the 2020–2024 period, the situation is quite similar: the overall vegetation pattern remains broadly stable, with no major restructuring of the national NDVI landscape.

From a spatial perspective, between the two periods, we register slight changes in greenness intensity.

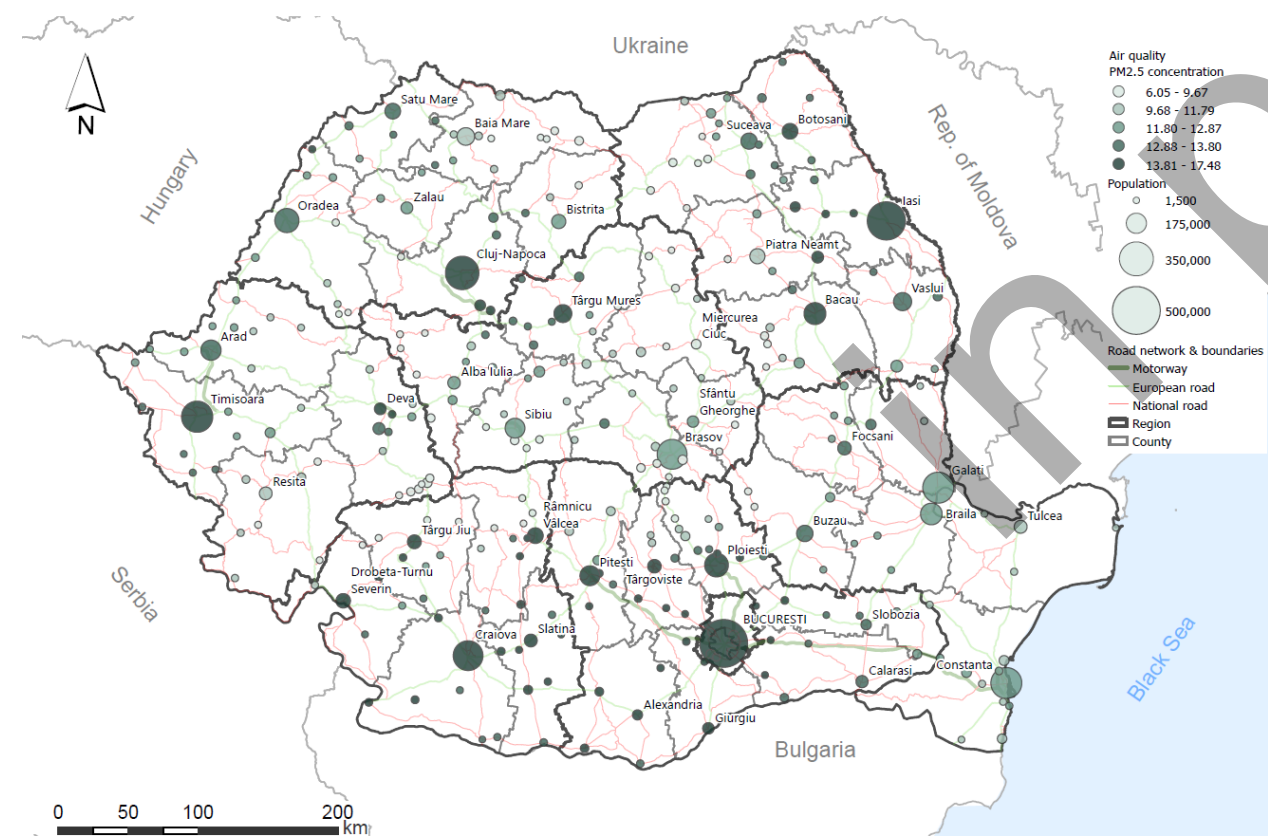
The second period appears to preserve the same general spatial gradients observed in the first, which implies that no major nationwide reconfiguration of vegetation cover occurred between the two time intervals.

In the urban and peri-urban areas of the Iași municipality, NDVI has increased in 2024 compared to 2000. From a climatic point of view, the trend remains stable, with slight local anthropogenic influences; the major changes are driven by the absence of snow during winters, which affects the general NDVI trend (see Case Study 1).

Air quality - Concentration of PM2.5 (2013-2019)

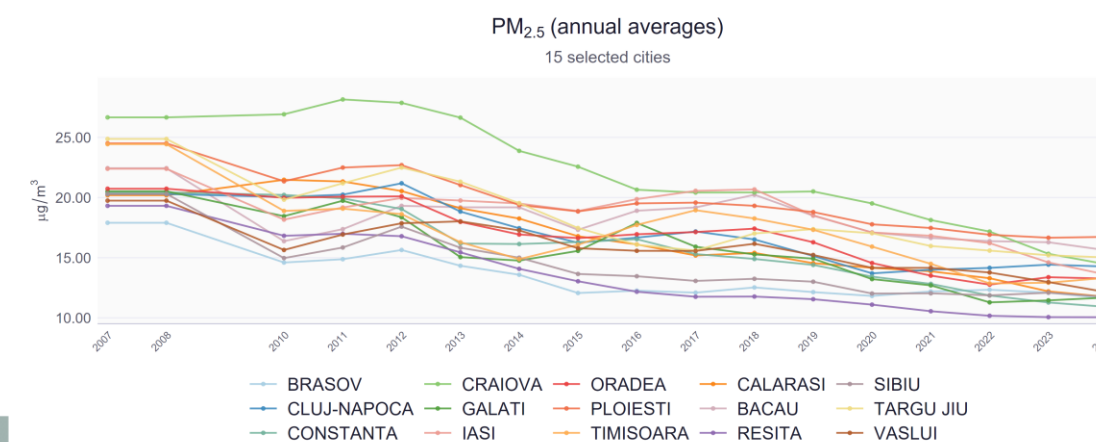
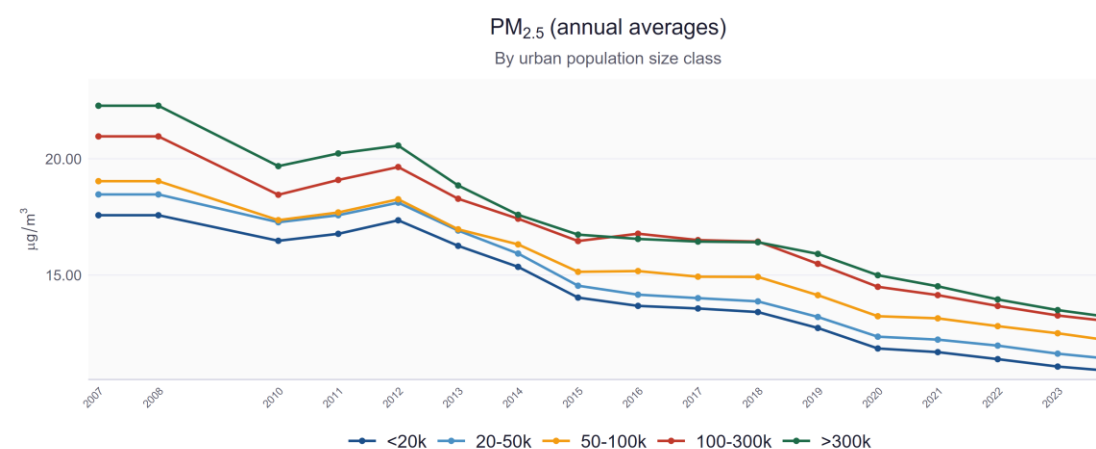
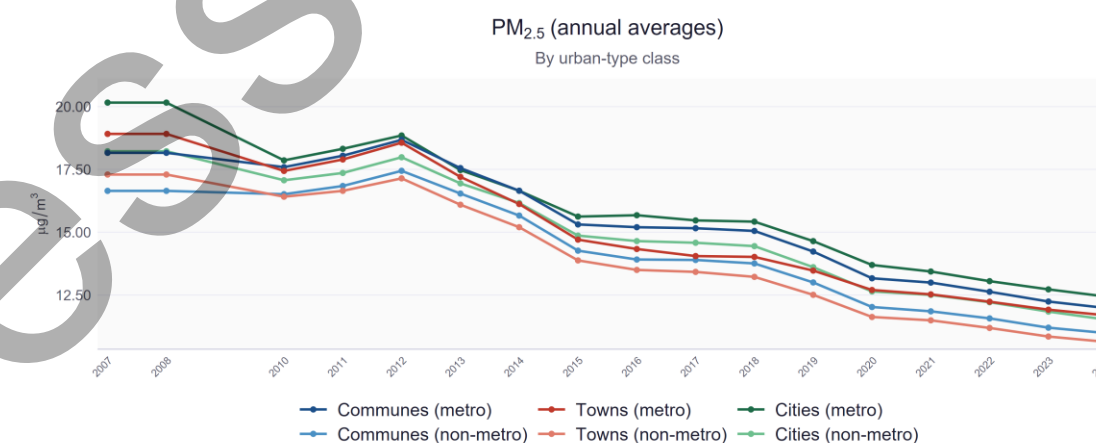


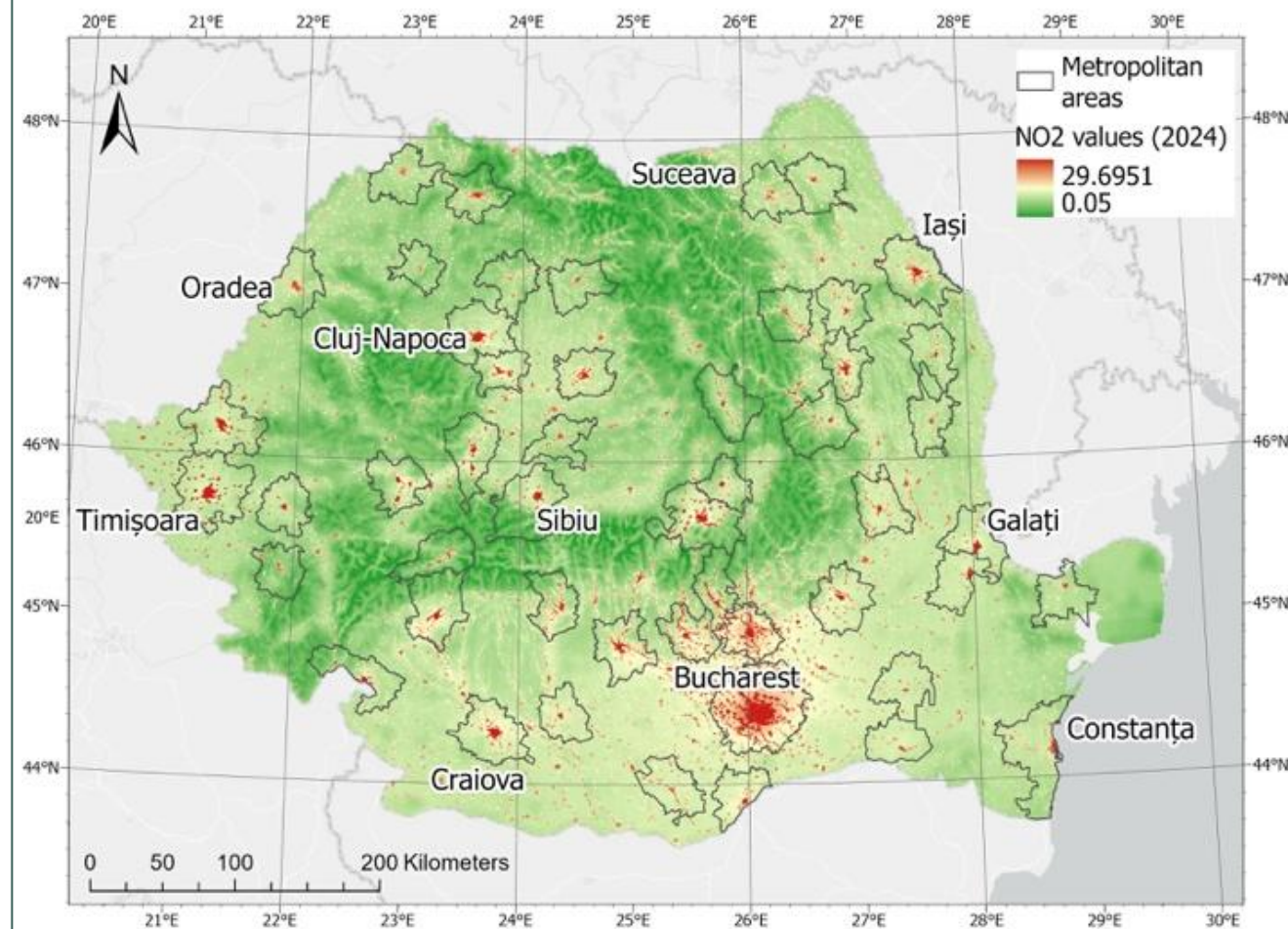
Air quality - Concentration of PM2.5 (2020-2024)



PM2.5 is a critical indicator of human health. Analysis of spatial distribution from 2013 to 2022 reveals elevated concentrations in core cities and densely populated regions. Consistent with topographical patterns, lower-altitude areas, especially in the Eastern and Southern regions, exhibit higher PM2.5 levels. Although the minimum average PM2.5 value recorded is $5 \mu\text{g}/\text{m}^3$, this concentration is still considered rather high by the World Health Organisation standards.

The Bucharest-Ploieşti axis is characterised by significant traffic volumes and industrial activity, including petrochemical production and thermal combustion, as part of the broader influence zone of Romania's capital. The use of solid fuels for residential heating further contributes to pollution. Topographical features exacerbate these effects by trapping pollutants in the Romanian and Western Plains. Similarly, Bacău and Iaşi experience pollutant stagnation in the Siret and Bahlui valleys. Timișoara faces challenges related to high vehicle ownership and cross-border transit traffic. These urban centres also serve as regional employment hubs, leading to increased commuter traffic from surrounding communes and concentrated pollution during peak hours.



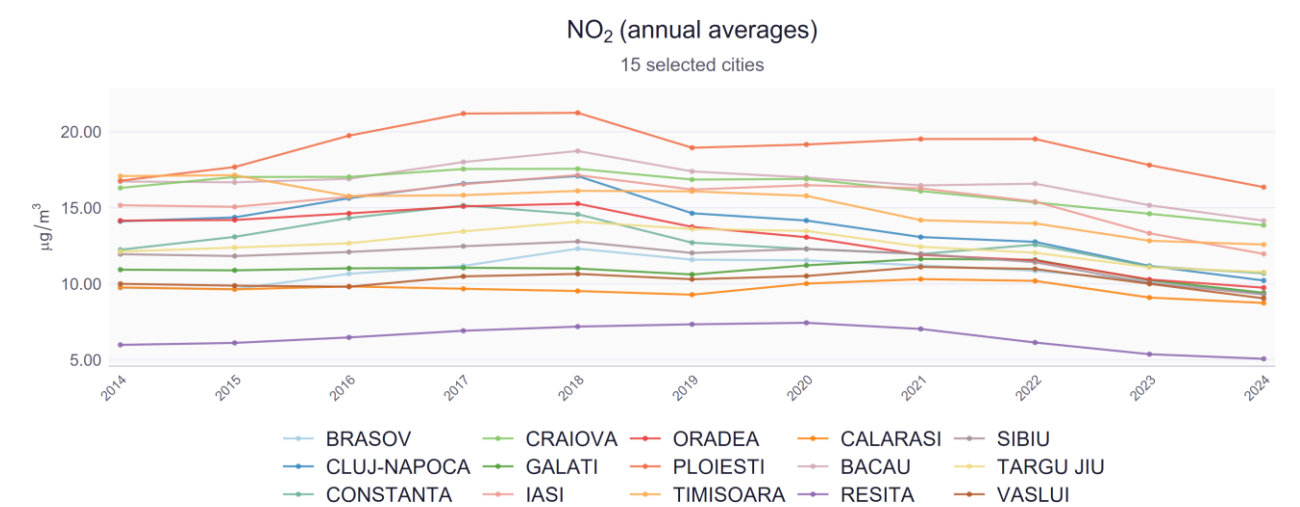
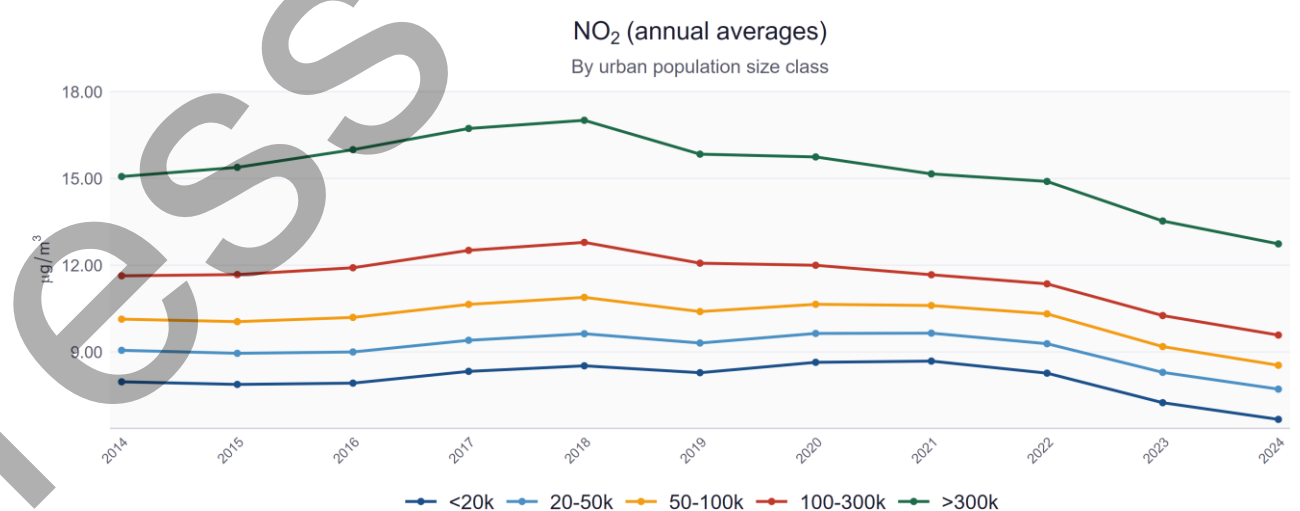
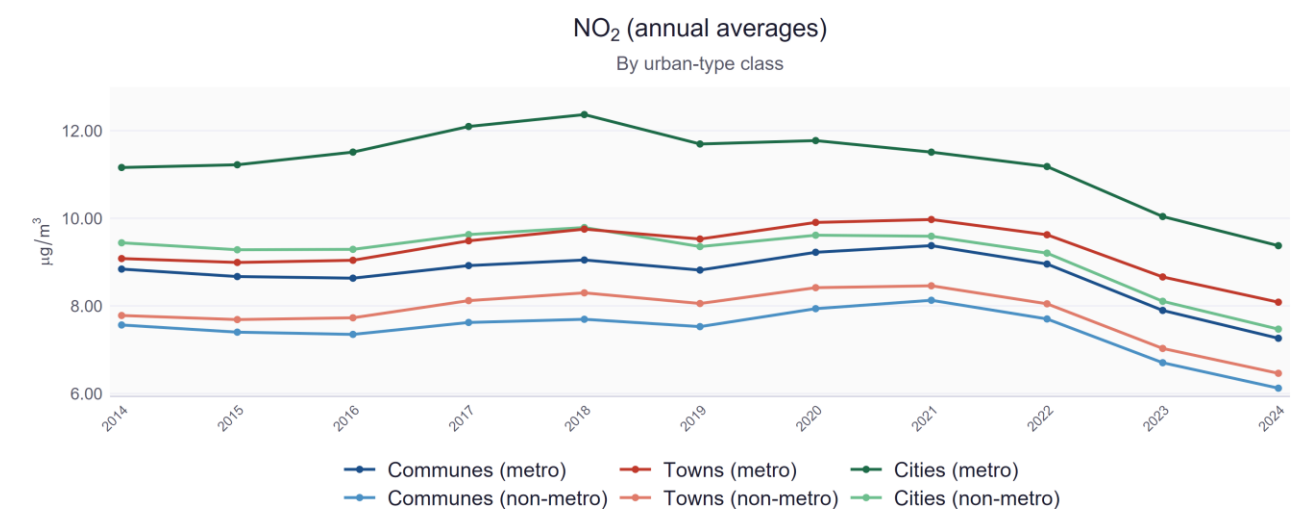


In contrast to PM_{2.5}, all cities show significantly higher NO₂ concentrations in urban cores than in peri-urban areas. This pattern results from NO₂ being generated primarily by vehicular traffic and concentrated combustion activities. Bucharest and Ploiești remain the most polluted cities overall, while Bacău, Brăila, Sibiu, and Piatra Neamț display the most pronounced urban-rural gradients.

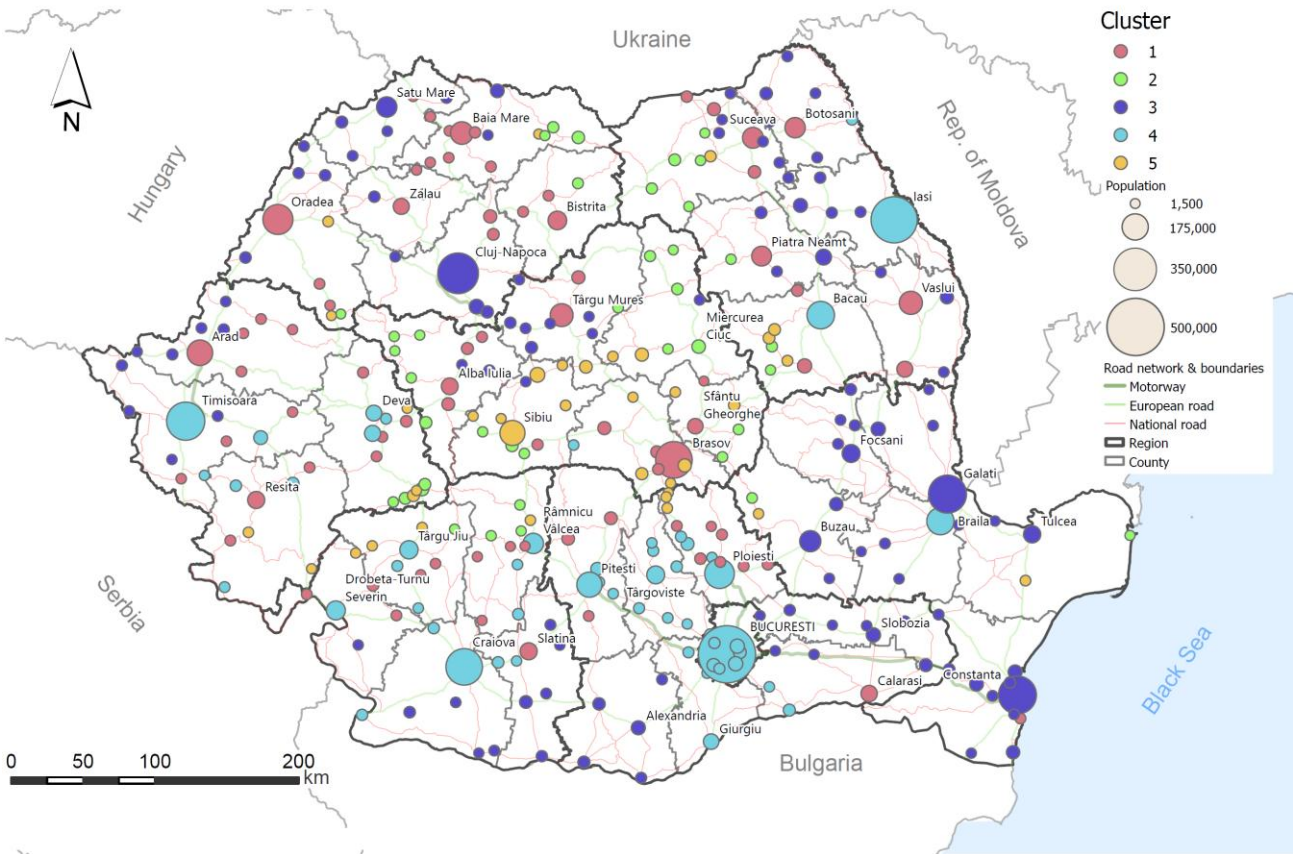
These cities serve as centralised employment and administrative centres within their respective counties, attracting substantial daily commuter flows that converge on compact historic cores with limited road capacity, creating traffic bottlenecks and elevated NO₂ hotspots.

The surrounding regions are predominantly agricultural or mountainous and experience minimal traffic. In contrast, Vaslui and Baia Mare exhibit nearly equivalent NO₂ levels in both urban and peri-urban areas, indicating more dispersed activity patterns.

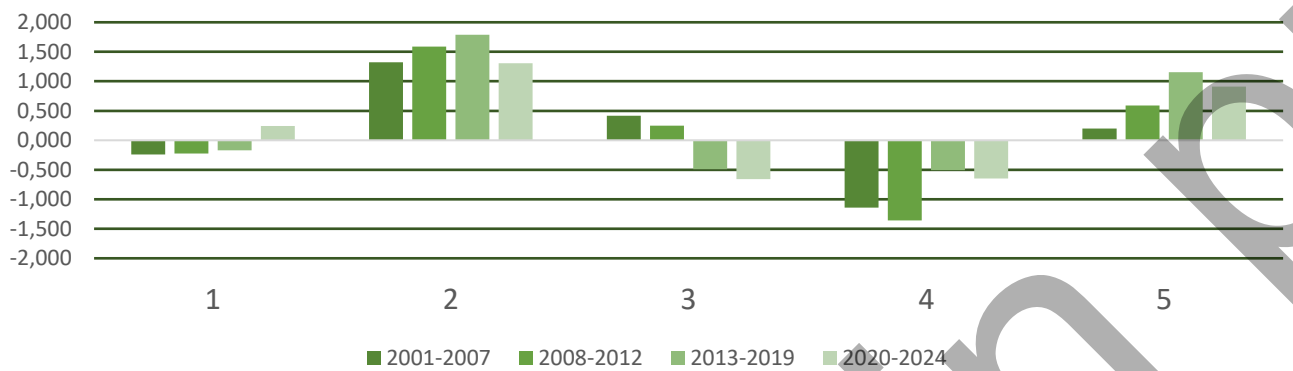
Vaslui's relatively unconvincing economic development correlates with reduced commuter pressure, whereas in Baia Mare, industrial facilities and transport corridors extend into peri-urban zones, resulting in a more even distribution of emissions across the metropolitan area rather than a concentration in the urban core (Fosalau et al, 2026).



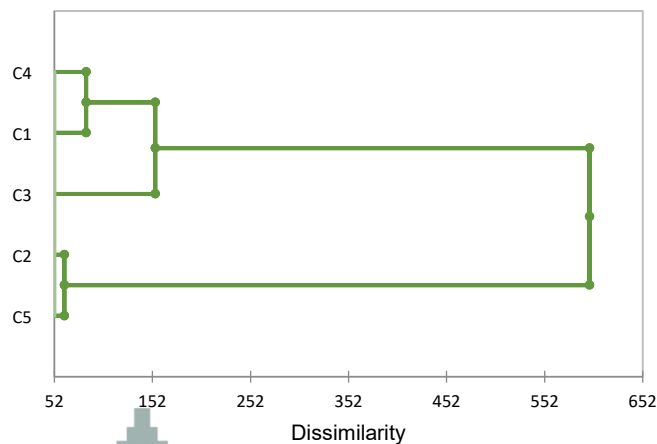
Environment & Climate Action Index Clusters



The profile of clusters

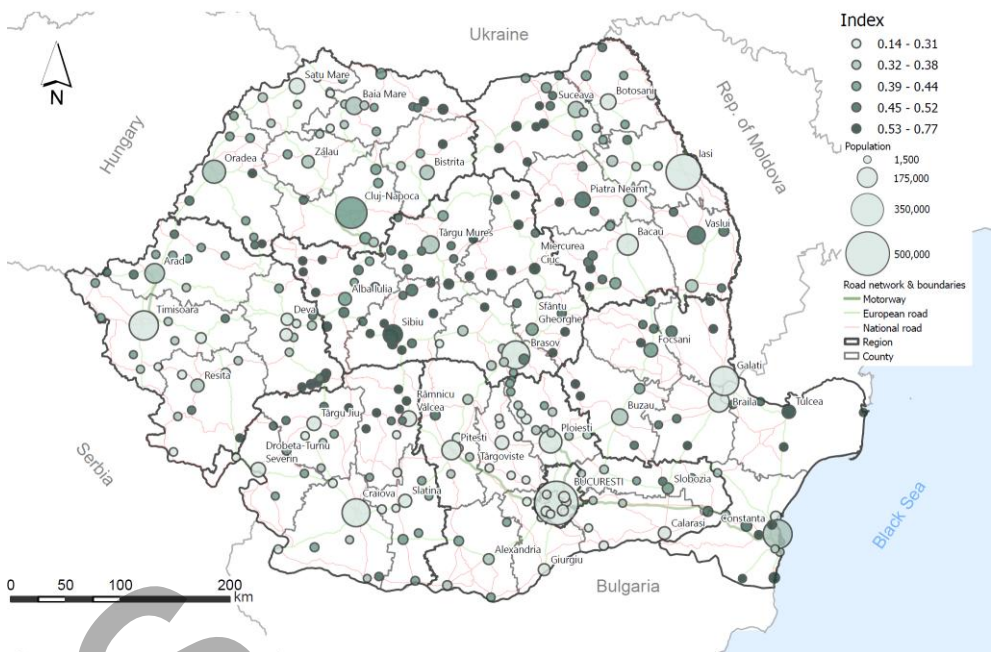


Dendrogram

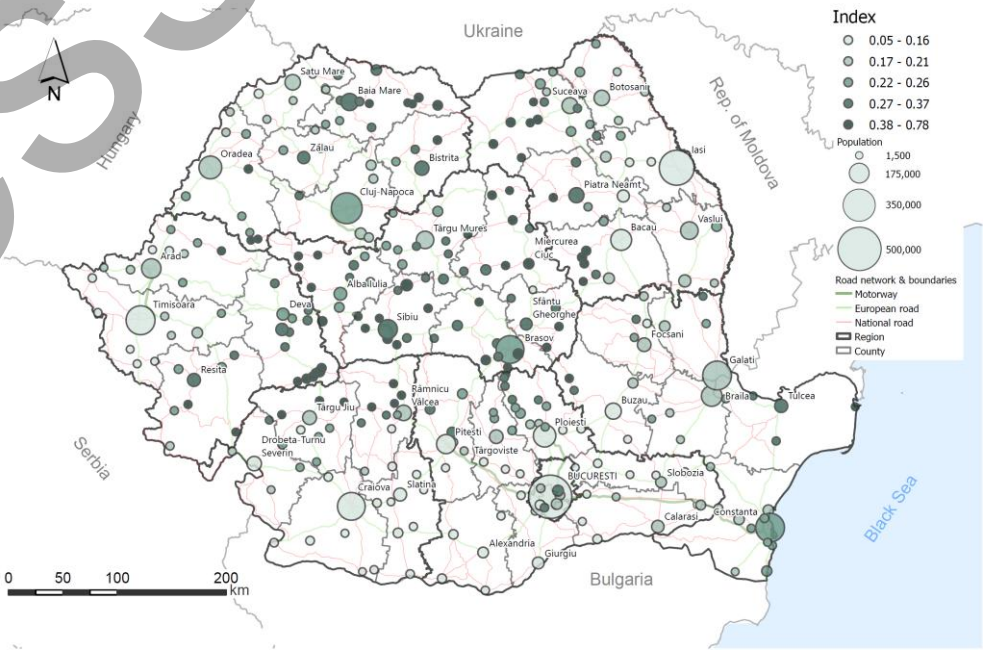


	Absolute	Percent
Within-cluster	373,057	29,33%
Between-clusters	898,943	70,67%
Total inertia	1272,000	100,00%

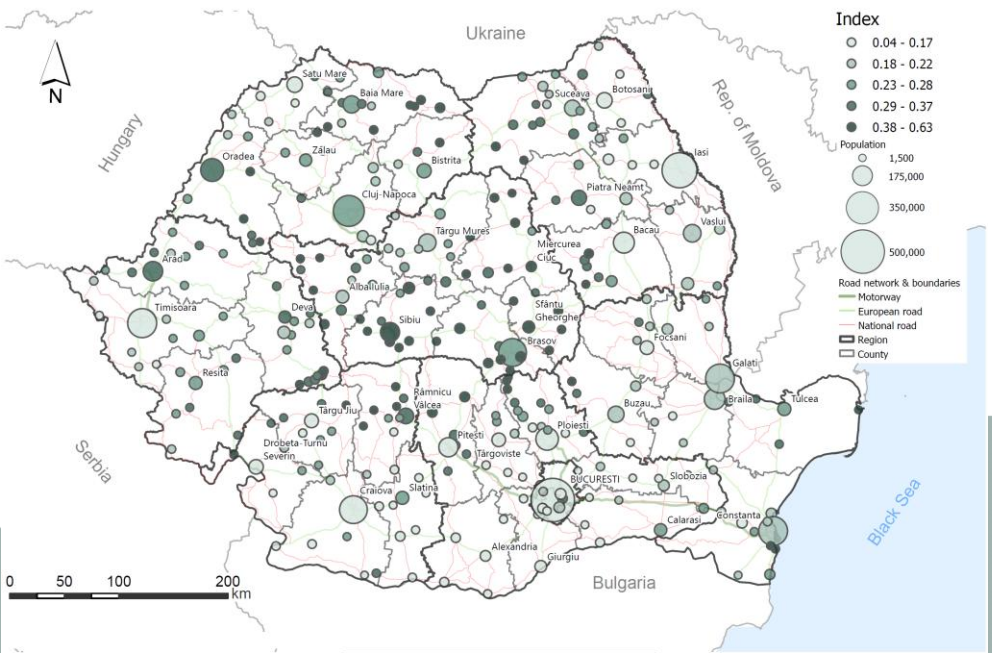
Environment & Climate Action Index (2007-2012)

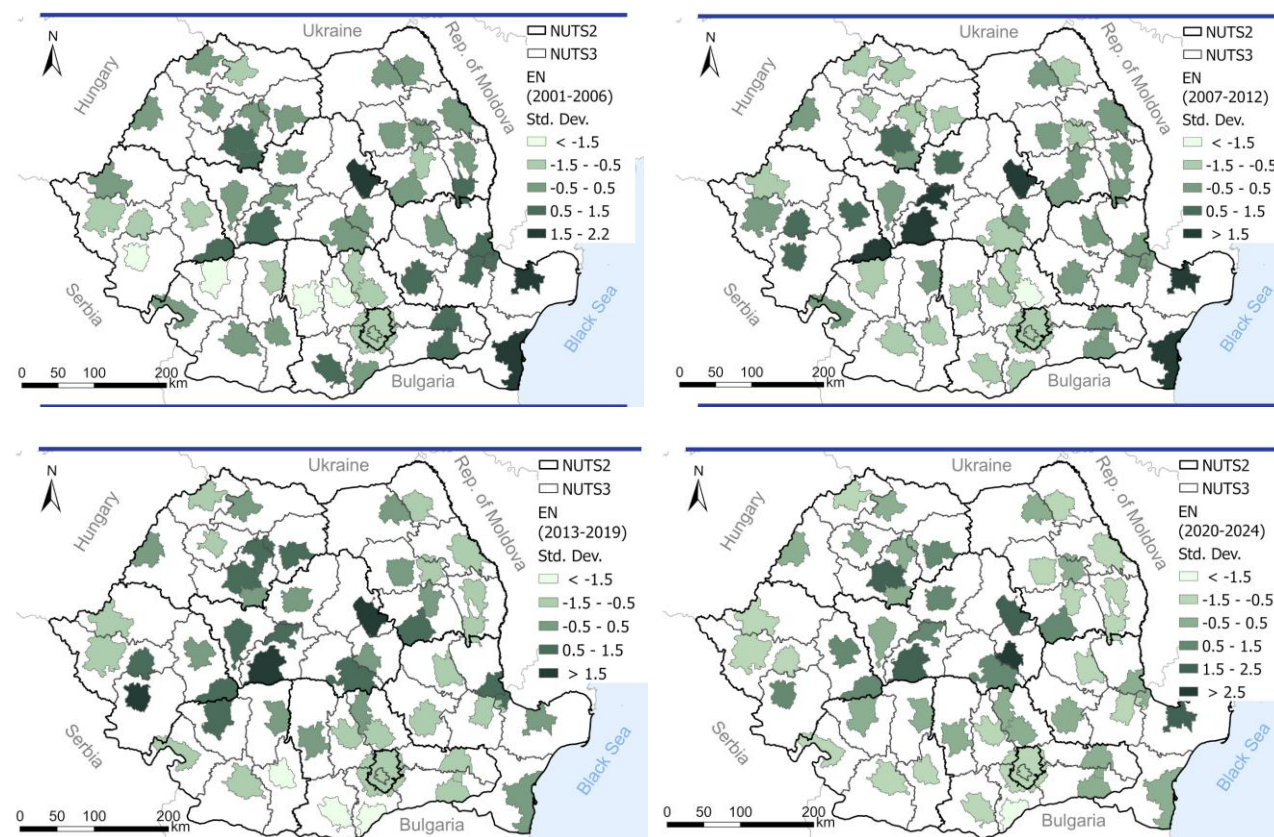


Environment & Climate Action Index (2013-2019)

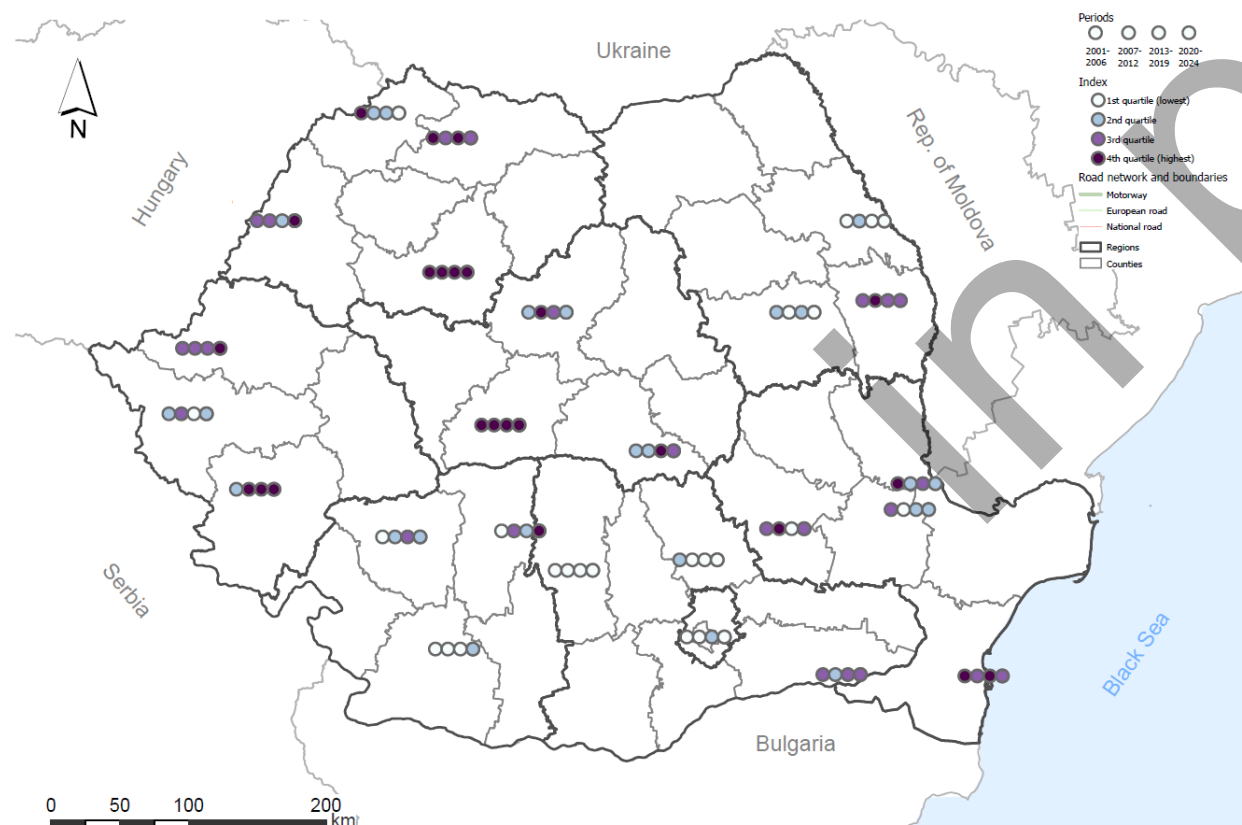


Environment & Climate Action Index (2020-2024)





Environment & Climate Action Index



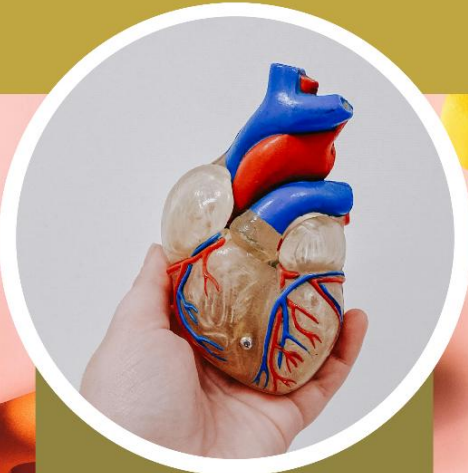
Regarding the evolution of the Environment & Climate Action index in the four periods considered, among the selected cities, there are several cases of positive dynamics in western Romania, but in general (Cluj, Arad, Oradea), the evolutions of the selected cities are rather fluctuating (Constanta, Calarasi, Bucharest), or even descending (Galati, Târgu Mureş).

Conclusions

- Indicators on air quality (PM_{2.5}; NO₂), NDVI and flood-risk index describe the “pressure” and “state” of the urban socio-ecological system, while local expenditures for environmental protection and recovered waste per inhabitant capture the institutional response.
- The fact that Romanian towns and cities still allocate a relatively small share of GDP to environmental protection, and that there are significant regional differences in local environmental spending, suggests highly uneven climate-related transformability across cities.
- Cities with higher NDVI values and consistent environmental investments (green spaces, water protection, waste management) possess ecological and institutional capital that can be leveraged toward a “green city” transformation pathway. Conversely, where air pollution, flood risk and environmental underfunding coexist, transformability is limited: any shock (heatwave, extreme rainfall) risks locking resources into emergency management and leaving little room for strategic change.
- The Urban Policy of Romania 2035 identifies green–blue infrastructures and adaptation to urban risks such as floods, heat-island effects, and pollution as crucial. In practice, we can see early nature-based initiatives, but they are still pilot-type and quite uneven across cities.

Health and Safety

This chapter evaluates public health and community safety by analyzing the prevalence of circulatory and respiratory diseases, alongside mortality rates and injuries from external causes. The assessment focuses on the capacity and efficiency of the healthcare system through metrics such as hospital bed availability, physician density, and per capita local healthcare expenditures. Furthermore, the analysis incorporates infant mortality rates as a key indicator of social well-being, while evaluating urban security through the rate of crimes investigated and solved by the police.



Diseases of the circulatory system

Tracks cardiovascular health prevalence, serving as a key metric for lifestyle-related risks and environmental stressors like heat.



Diseases of the respiratory system

Monitors lung and airway conditions, acting as a primary indicator of the health effects of urban air pollution.



Deaths under 1 year

A sensitive proxy for social well-being and the quality of prenatal and neonatal healthcare services.



Number of doctors

Measures the availability of medical professionals, directly impacting healthcare accessibility and the quality of patient care.



Injury, poisoning and consequences of external causes

Measures health impacts from accidents and external violence, reflecting environmental safety and emergency response efficiency.



Local budget healthcare expenditures per capita

Quantifies the local government's financial priority toward healthcare infrastructure, equipment, and public health programs.



Number of beds in hospitals

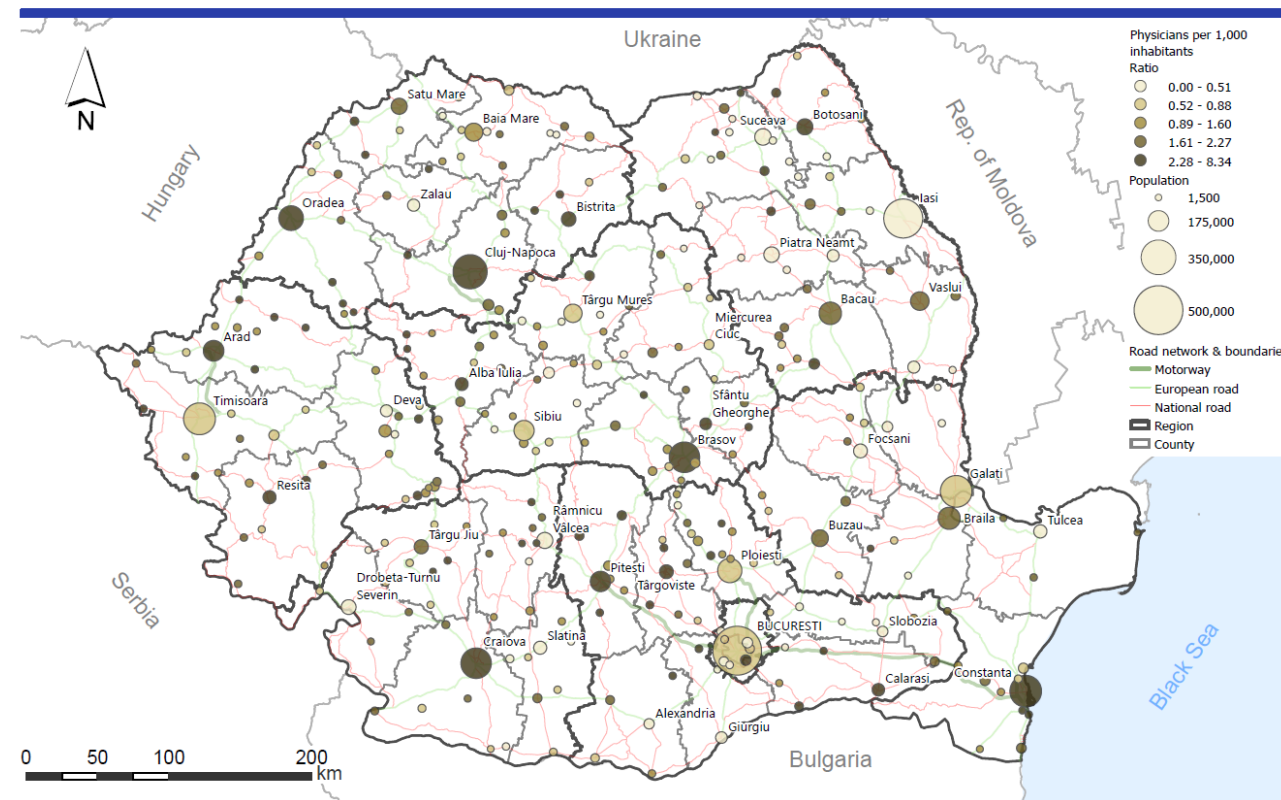
Indicates the physical capacity of the medical system to provide inpatient care and manage health emergencies.



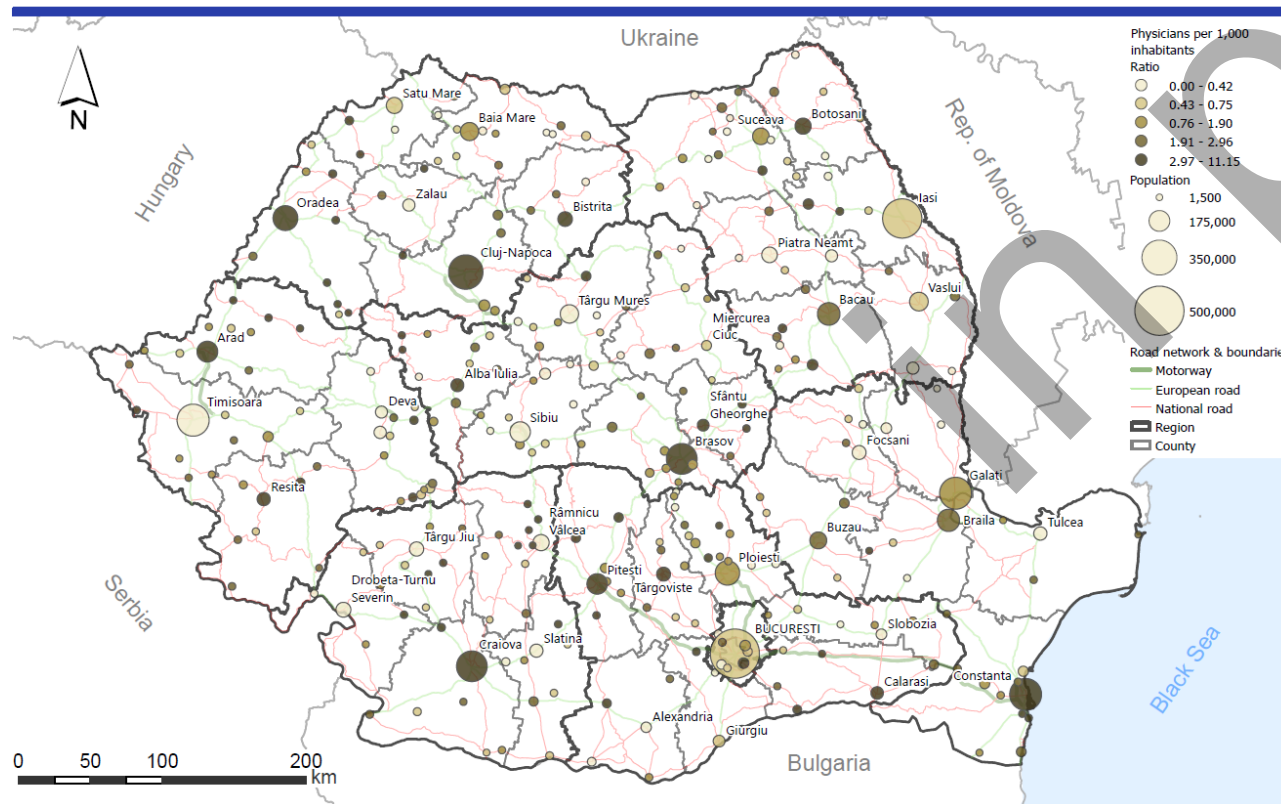
Crimes investigated and solved by the police

Evaluates urban security and law enforcement efficiency by tracking crime resolution rates within the community.

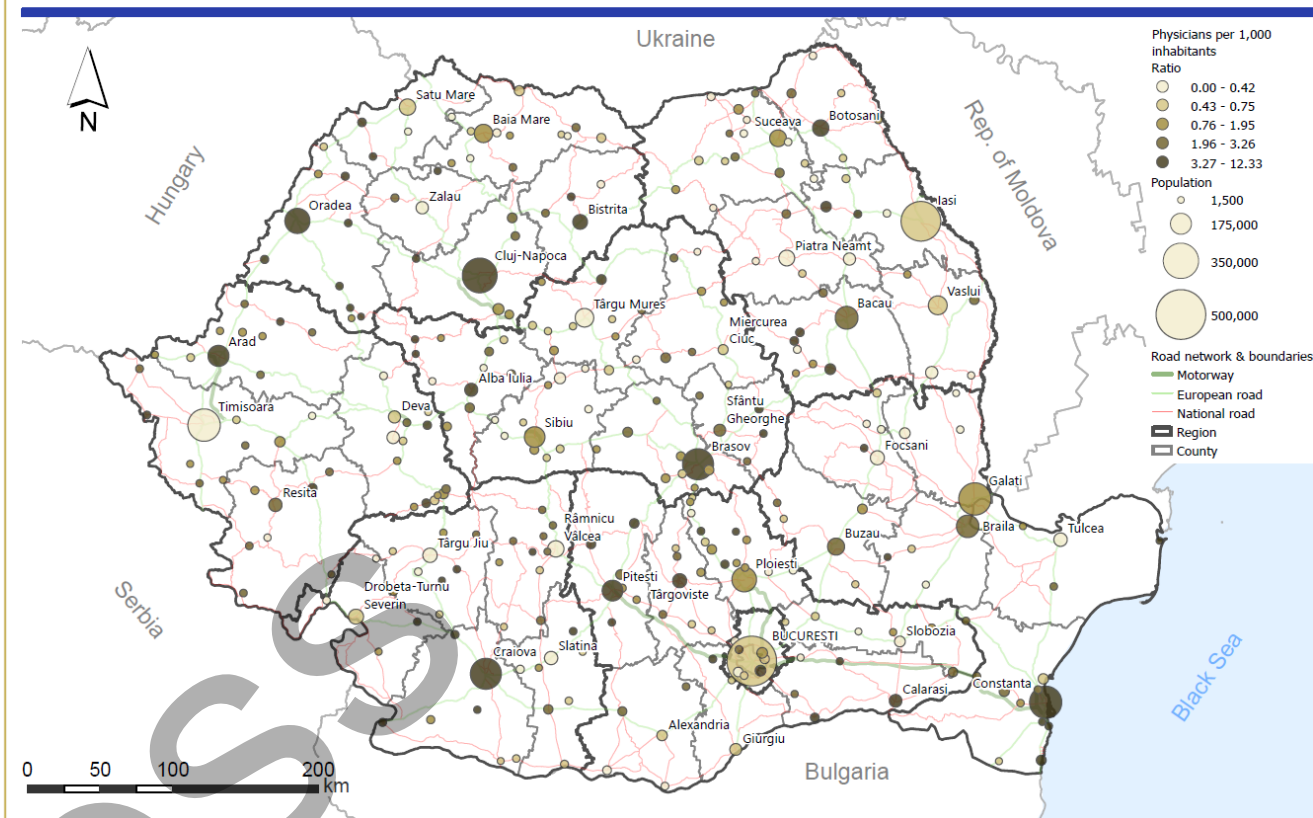
Physicians per 1,000 inhabitants (2007-2012)



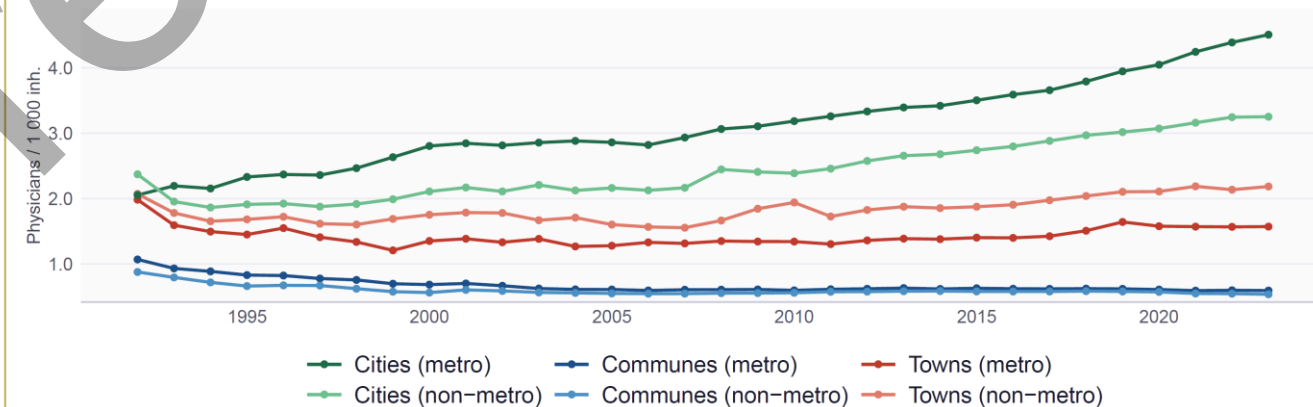
Physicians per 1,000 inhabitants (2013-2019)



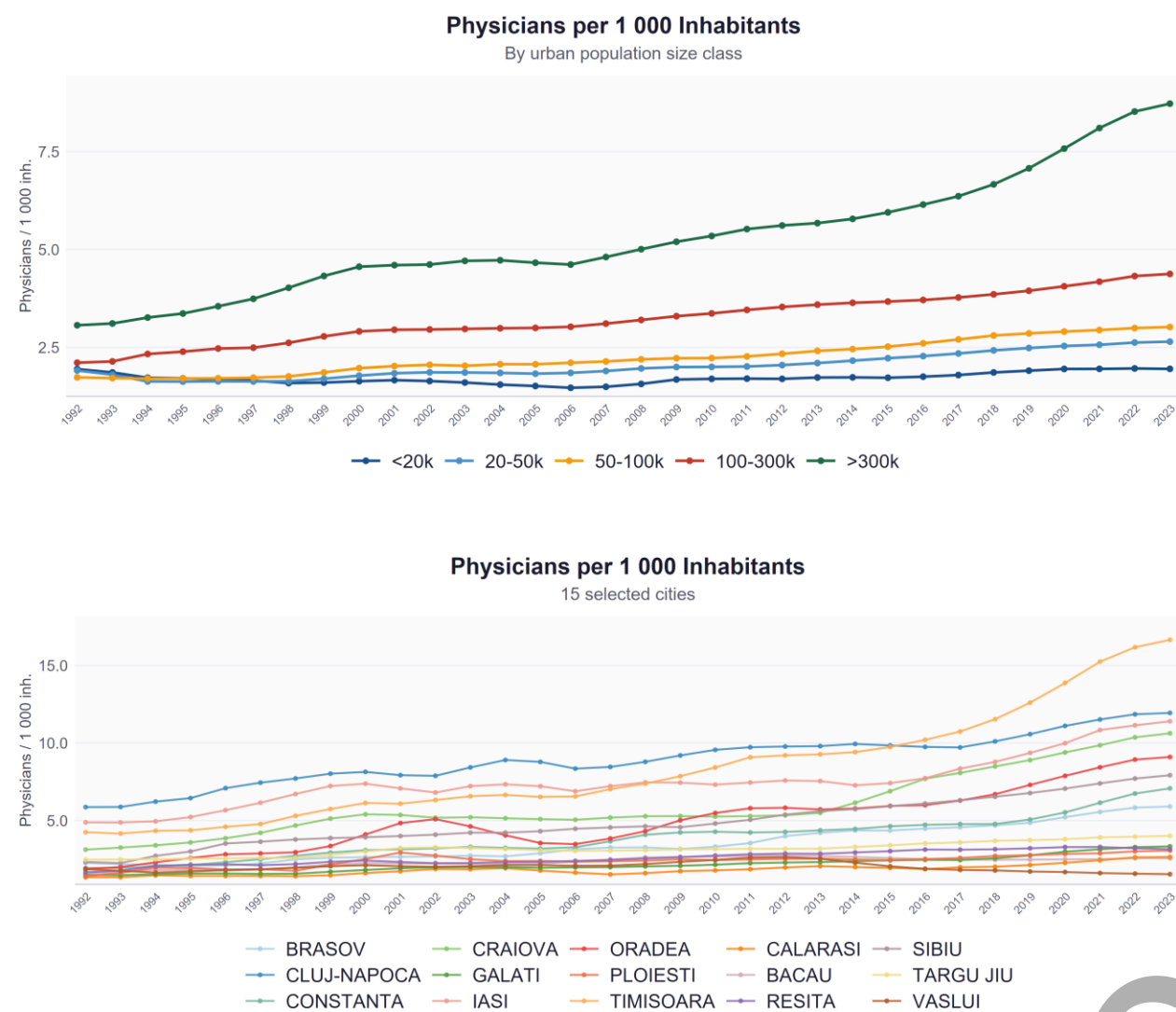
Physicians per 1,000 inhabitants (2020-2024)



Physicians per 1 000 Inhabitants
By urban-type class



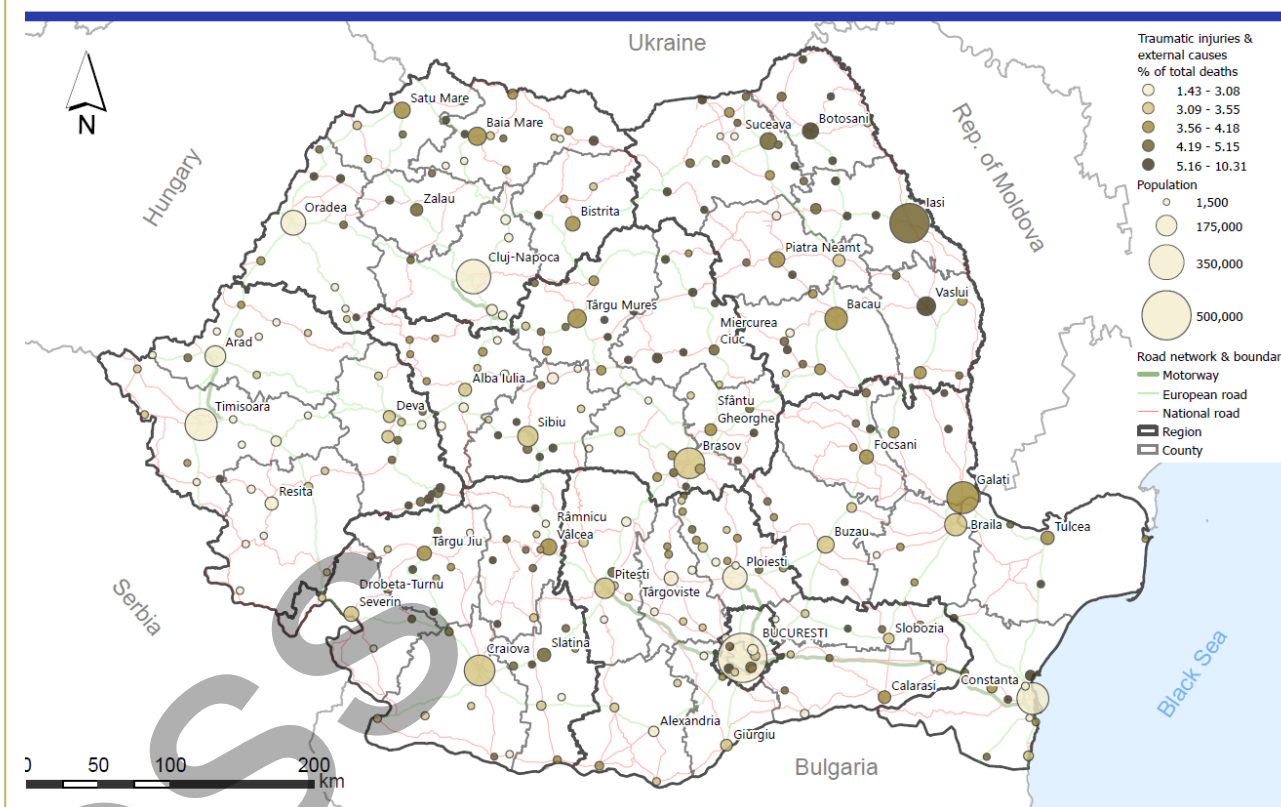
The ratio of doctors to population across Romania's cities highlights a strong concentration of medical resources in large urban centers, especially university cities. At the same time, there are major deficits in small towns and rural areas on the outskirts of metropolitan areas, as well as in non-metropolitan rural areas. This produces structural territorial inequities in access to health services. At the national level, Romania remains below the EU average in the number of doctors per thousand inhabitants, despite high university output. This situation indicates a mix of external migration, uneven spatial distribution, and insufficiently calibrated human resources policies.



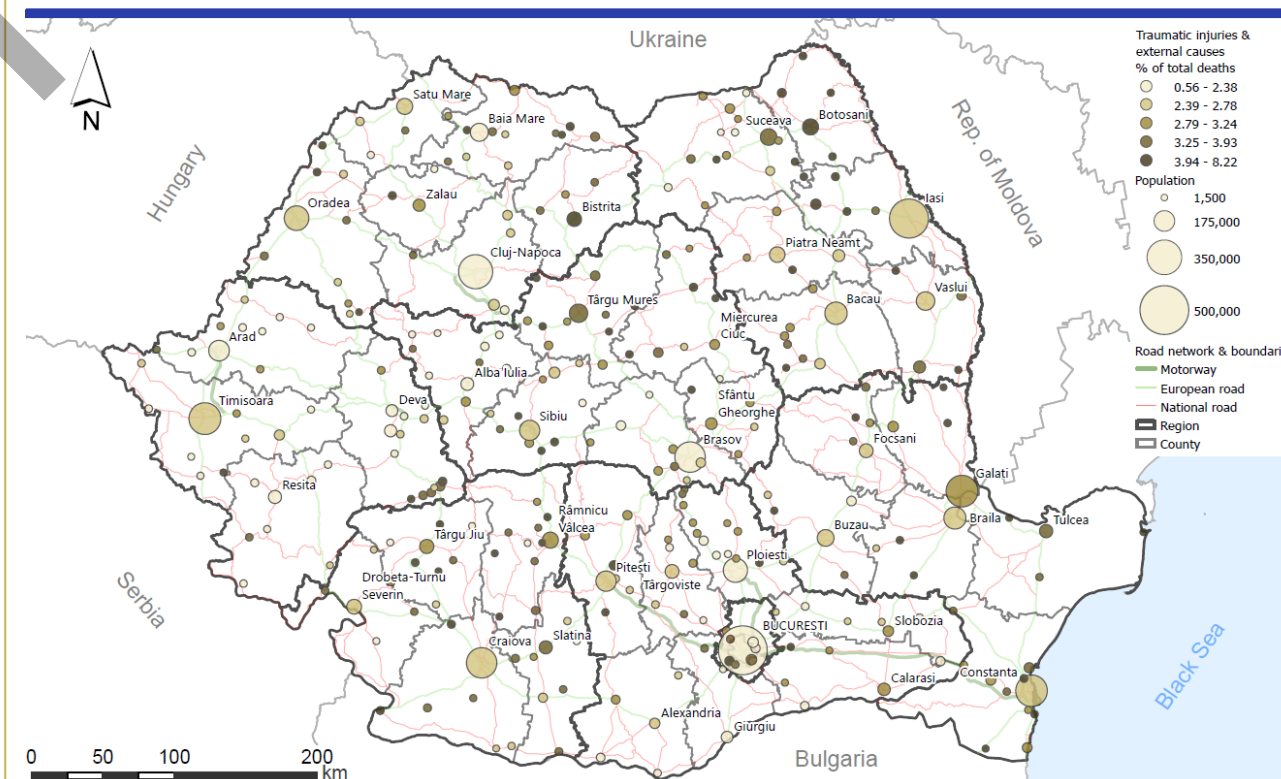
Large cities, as well as small ones with a predominant health function, have the highest ratios of doctors to the resident population. Overall, however, an advantageous situation is observed for large and very large cities, with a large and increasing number of doctors per 1000 inhabitants.

Traumatic injuries account for a relatively small but non-negligible share of all deaths in Romania overall (single-digit percentages), yet they are disproportionately important in younger age groups and strongly linked to urban patterns of mobility, work and violence. In cities and towns, road-traffic trauma, falls, and occupational injuries dominate this category, with road crashes remaining a major cause of injury-related mortality despite some improvements in traffic safety.

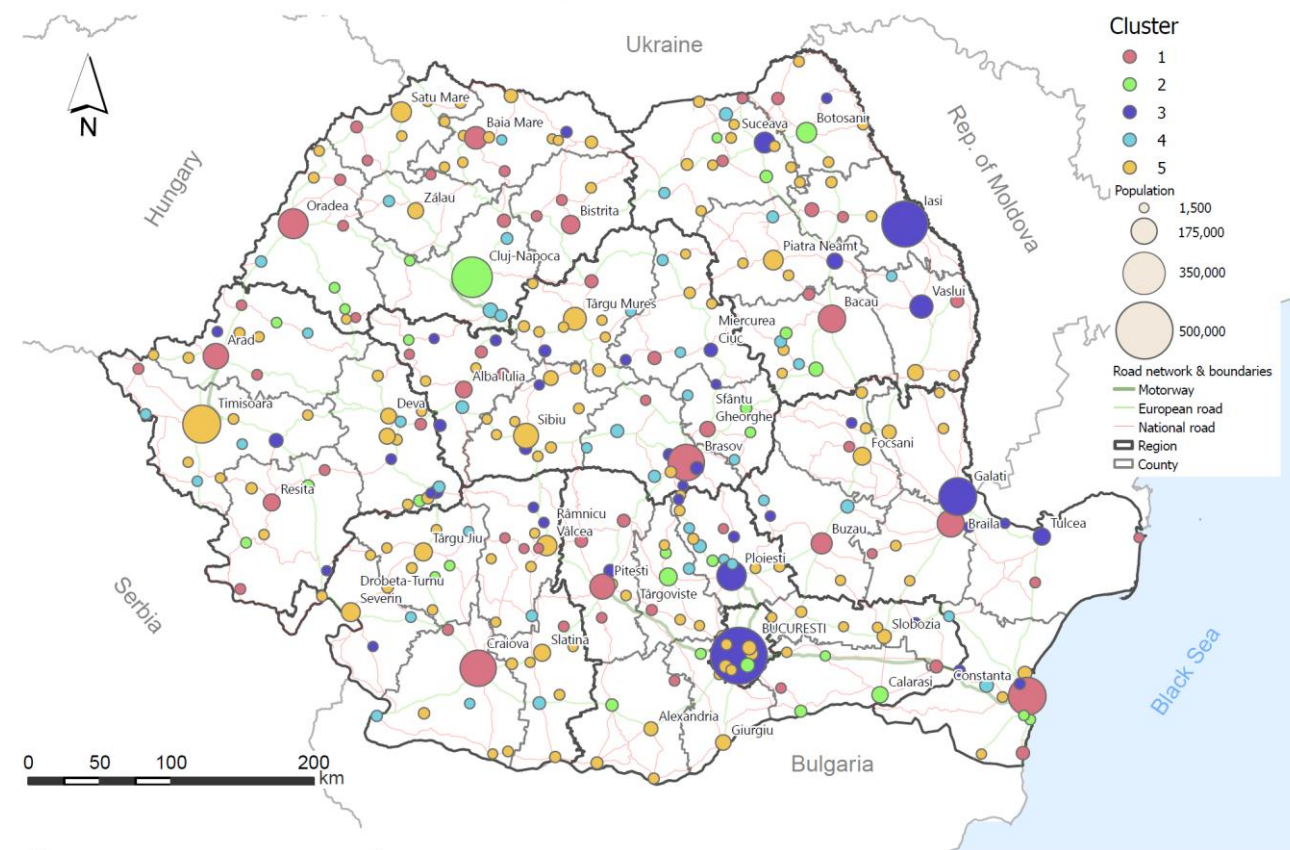
Traumatic injuries & external causes as % of total deaths (2013-2019)



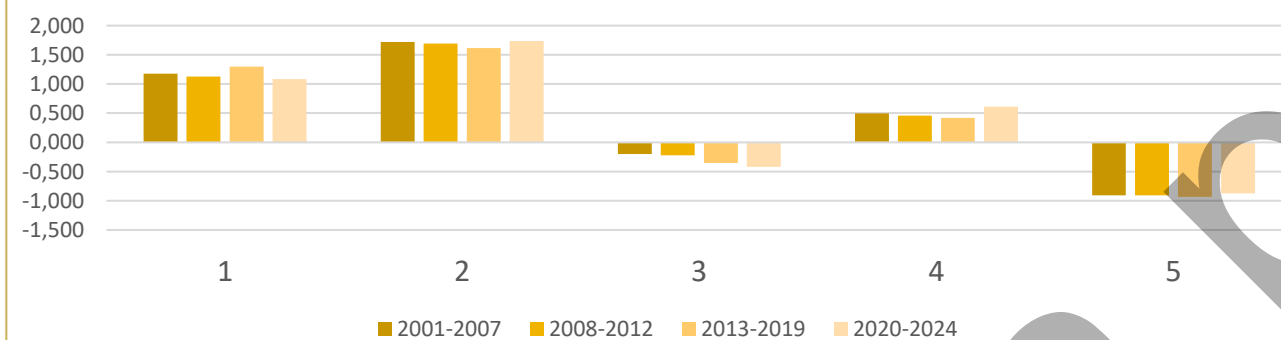
Traumatic injuries & external causes as % of total deaths (2020-2024)



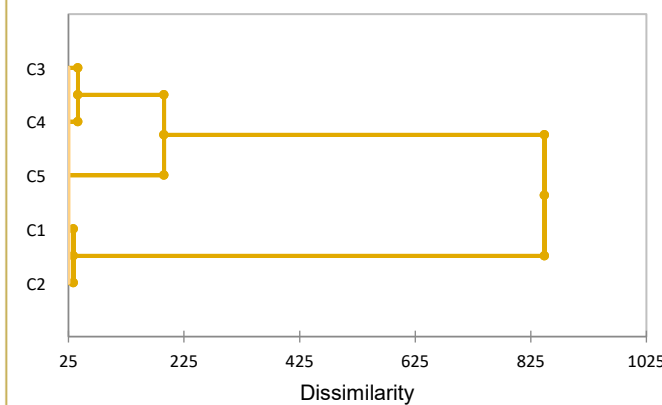
Health & Safety Index Clusters



The profile of clusters

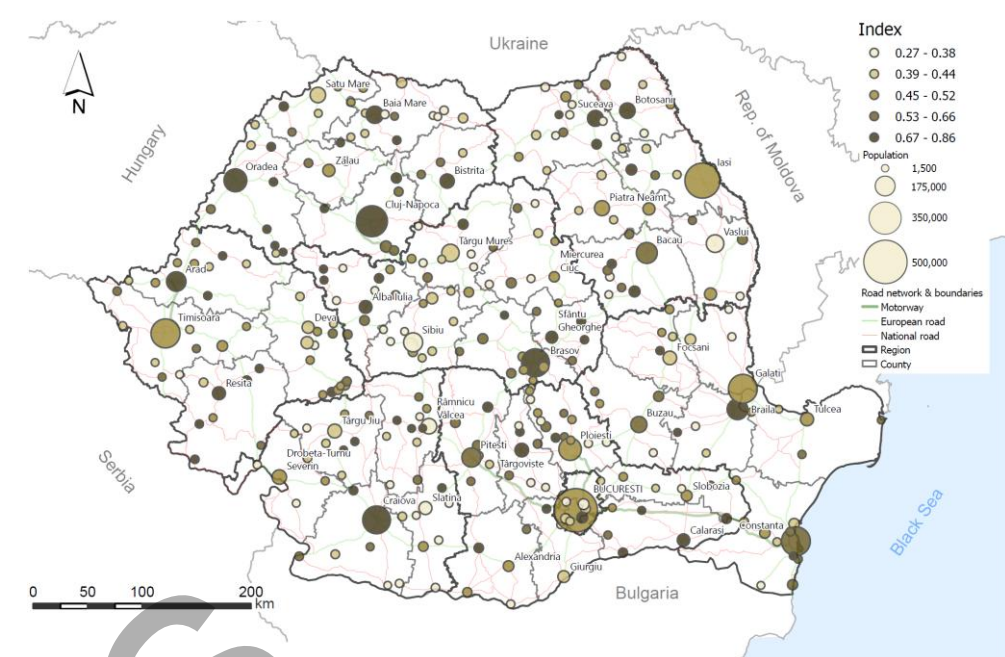


Dendrogram

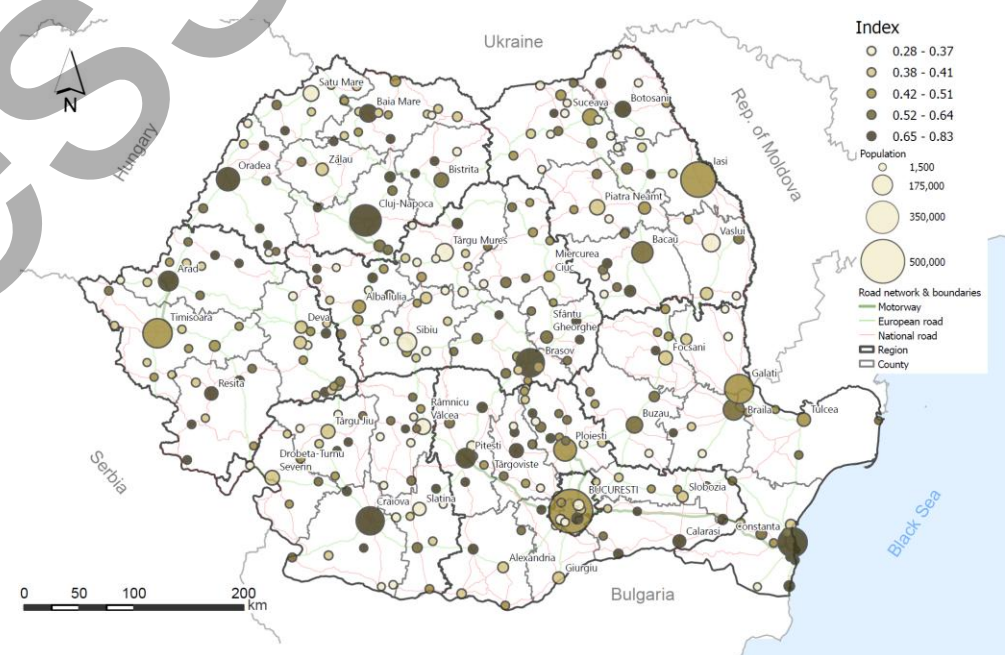


	Absolute	Percent
Within-cluster	158,140	12,43%
Between-clusters	1113,860	87,57%
Total inertia	1272,000	100,00%

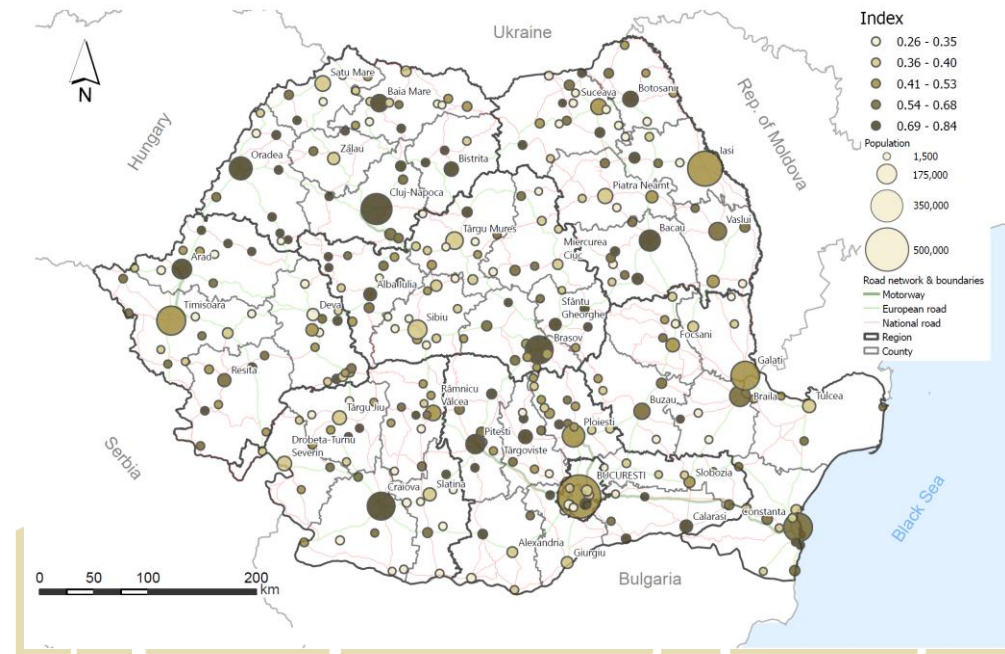
Health & Safety Index (2013-2019)



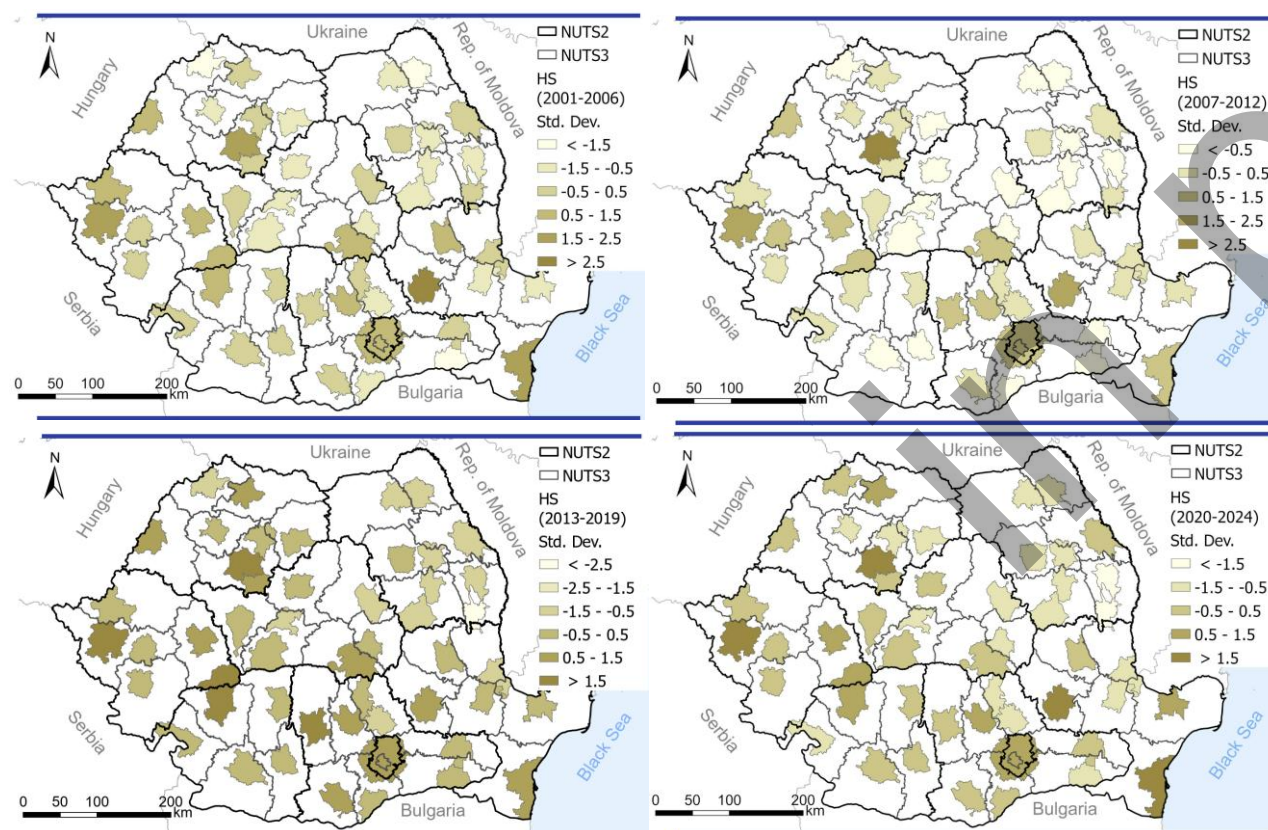
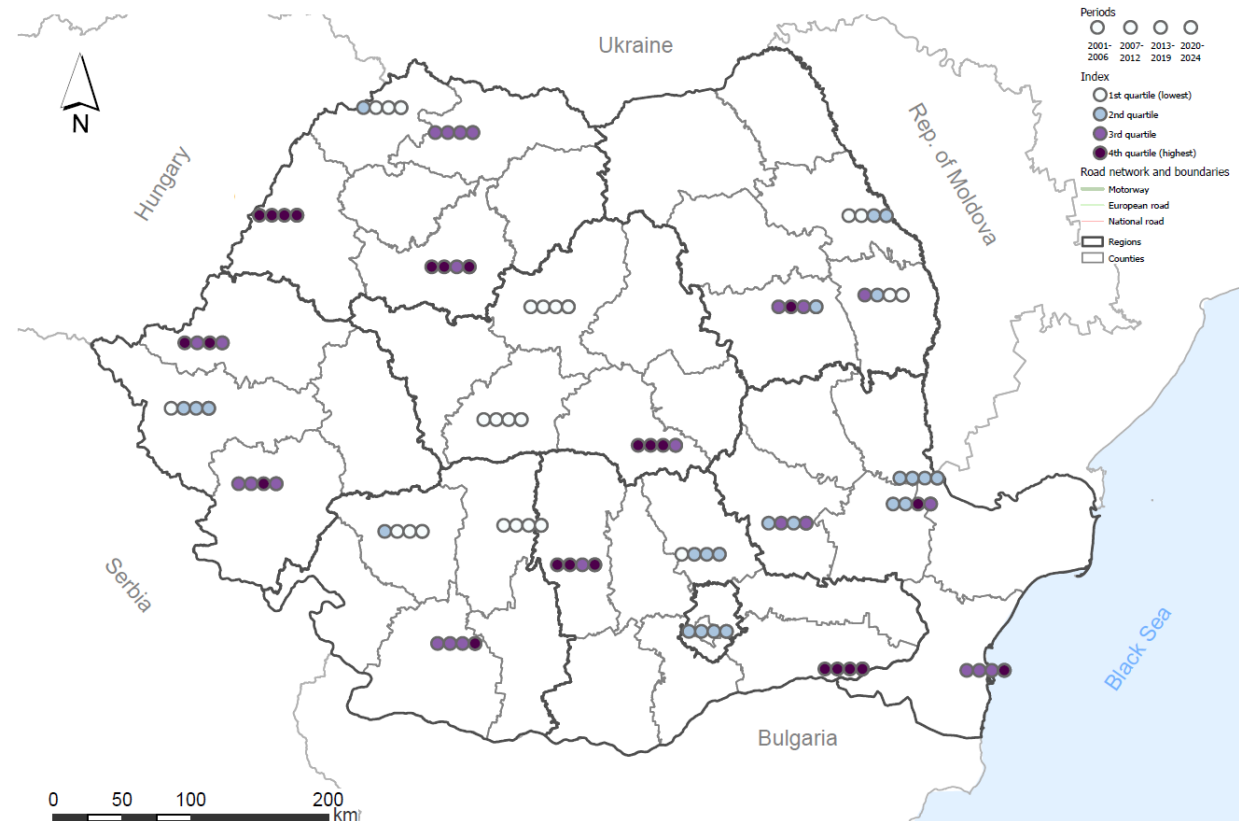
Health & Safety Index (2020-2024)



Health & Safety Index (2007-2012)



Health & Safety Index



Conclusions

- The three mortality indicators (circulatory, respiratory, traumatic/external causes as a share of total deaths) describe the structural health burden generated by long-term exposure to unhealthy urban environments, lifestyles and unsafe spaces. High circulatory and respiratory mortality in many Romanian towns and cities reflects persistent air pollution, limited preventive care and car-dependent, sedentary urban patterns; transformative resilience would therefore require changes in transport, housing quality and green space, not only more hospital capacity.
- Traumatic and external-cause mortality adds a lens on road safety, workplace accidents and violence, highlighting where public-space and safety policies must be part of any transformative agenda.
- Hospital beds and physicians per 1,000 inhabitants indicate the quantitative capacity of the health-care system at local or regional level, while local budget expenditure on health per capita shows to what extent municipalities treat health as a priority rather than a strictly national competence.
- Cities that combine higher local health spending with better staffing ratios are better positioned to pilot integrated “healthy city” approaches (linking health, mobility, environment and social policy), whereas places with low spending and structural shortages remain locked into reactive, curative models.
- Reported crimes per 1,000 inhabitants complete the picture: high crime rates can severely limit the use of parks, streets and public transport, making it politically and socially harder to shift towards walkable, mixed-use and night-time active urban environments that are central to transformative health and safety policies. The urban policy explicitly links health to access to *housing, public services, green spaces, and sustainable mobility*, not only to the health-care infrastructure.
- From a transformative-resilience perspective, recent crises (such as the COVID-19 pandemic) are treated as “shaping factors” for urban policy, justifying the reconfiguration of public-space networks and proximity-based services.

Part 2 - Chapter III

Social Equity



This chapter evaluates Social Equity by examining the balance between demographic dynamics, resource allocation, and quality of life. The analysis correlates youth and elderly population shares with public investments in education and social assistance, ensuring that the needs of all age groups are met. Furthermore, the chapter assesses equitable access to essential infrastructure—ranging from housing availability and living standards to educational participation and cultural engagement—to provide a comprehensive overview of social inclusion and the community's overall resilience.



School-enrolled population

Measures the educational coverage and participation rate of the young population in the formal schooling system.



Professor/student ratio

Reflects the potential quality of instruction and the level of personalized attention available to students in the education system.



Population aged 65 years and over

Indicates the degree of demographic aging and the resulting demand for specialized healthcare and elderly support systems.



Local budget expenditures for social assistance

Quantifies the local government's financial commitment to supporting vulnerable groups and maintaining social cohesion.



Local budget expenditure on culture per capita

Evaluates cultural engagement and the attractiveness of local heritage sites to both residents and tourists.



Living space per inhabitant

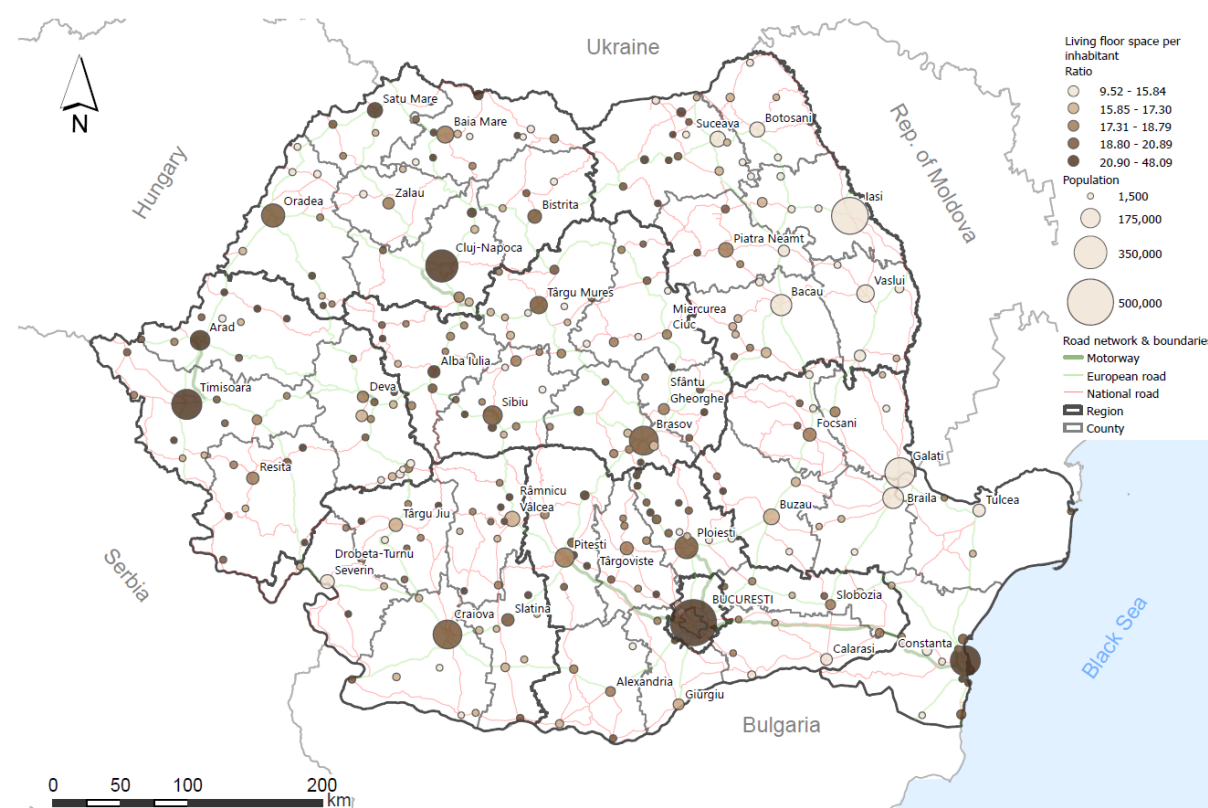
A key indicator of housing quality and comfort, measuring the average residential density and standard of living.



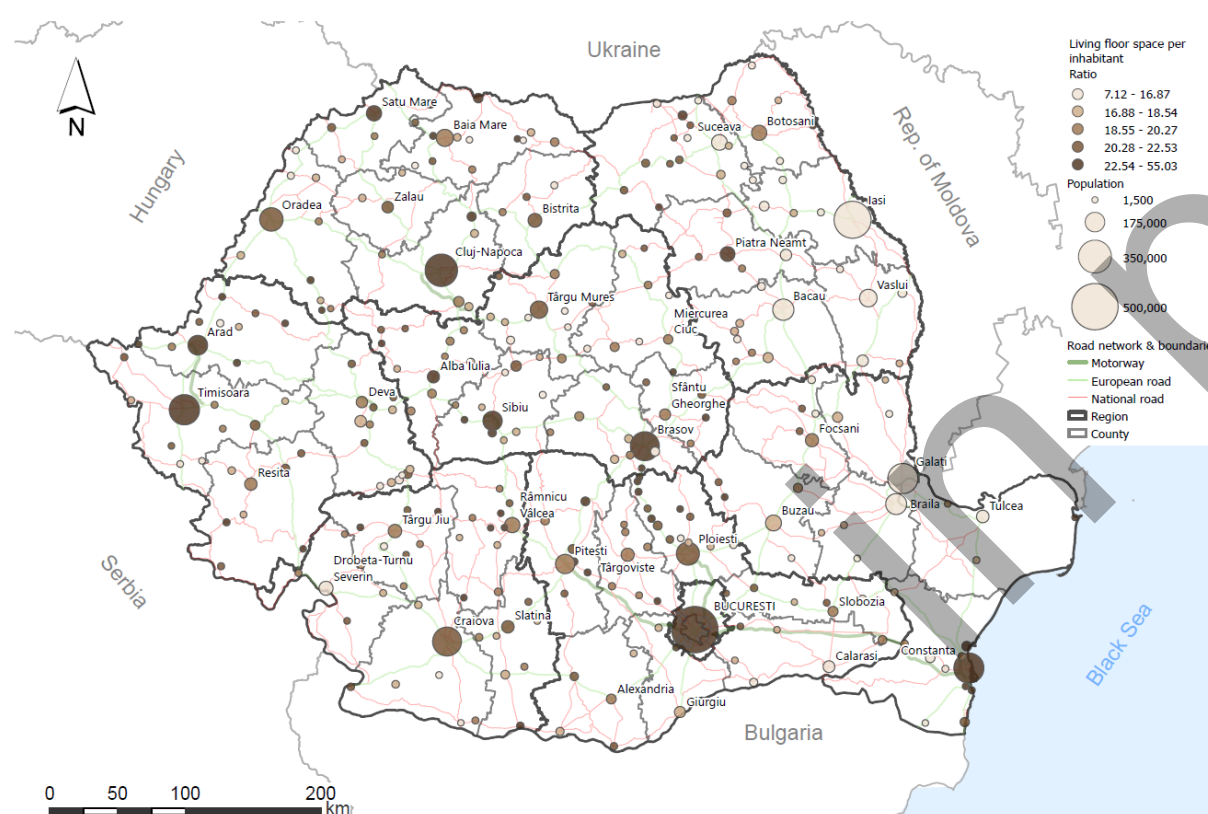
Local budget expenditures for education

Measures the level of public investment in school infrastructure and the quality of the local learning environment.

Living floor space per inhabitant (2013-2019)



Living floor space per inhabitant (2020-2024)



Living floor space per inhabitant measures the ratio between the total residential floor area and population and serves as an indicator of social equity that reveals access to adequate housing space and living standards. Higher values suggest more spacious dwellings and, consequently, better housing conditions; lower values point to crowded housing, often associated with lower-income populations and inadequate living standards. This metric captures not only material well-being but also fundamental dignity in housing, as adequate personal space is essential for health, privacy, and quality of life.

Beyond equity concerns, living floor space per inhabitant functions as a proxy for urban planning patterns and residential preferences. The indicator reflects choices between apartment-block living (typically offering smaller floor areas) and single-family housing, providing larger spaces. Settlement morphologies and the character of urban expansion can be shaped by different historical periods and development models. Cities with higher values often feature significant suburban growth, renovation of older stock into larger units, or strong tourism-driven construction of spacious accommodations. Conversely, cities with lower values tend to reflect dense, apartment-dominated development or housing shortages.

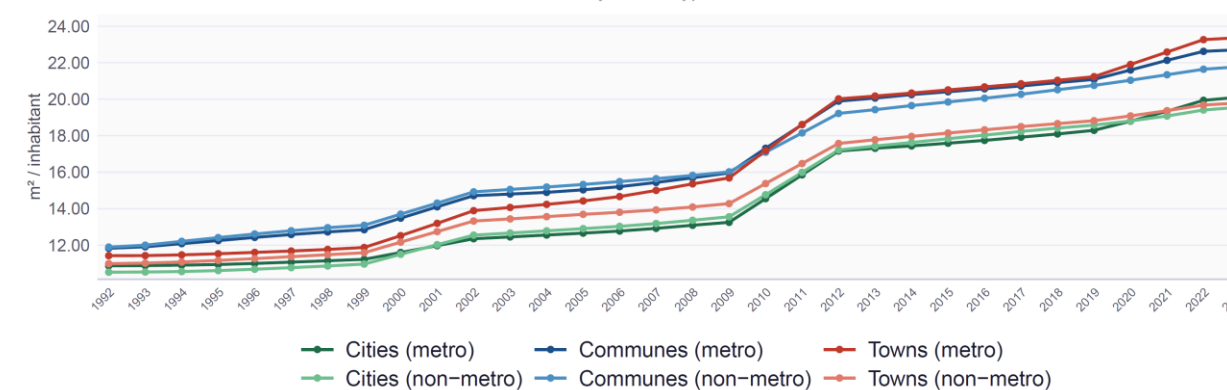
The maps do not reveal uniform spatial patterns, yet some regional tendencies emerge. High values are concentrated in Bucharest alongside major urban centres (Constanța, Cluj-Napoca, Timișoara, Arad, and Brașov) and in smaller cities such as Piatra Neamț, Satu Mare, Alba Iulia, and Sinaia. Notably, the historical region of Moldova, Tulcea County, and parts of the Carpathian uplands record consistently lower values, often due to denser historical settlement patterns, limited housing expansion, or persistent housing pressures in economically disadvantaged areas.

Between 2013-2019 and 2020-2024, the indicator showed modest improvement overall, with no dramatic shifts. However, localised increases are discernible: Brașov expanded substantially, as did the tourism-oriented Valea Prahovei corridor and coastal resorts. Sibiu similarly recorded gains, with multiple areas with new construction of larger-format dwellings. These gains, while positive, remain incremental rather than transformative, suggesting that housing standards remain a persistent challenge in many Romanian cities.

The exceptionally high values observed in cities such as Târgu Jiu and Reșița may be linked to Significant population decline following industrial restructuring.

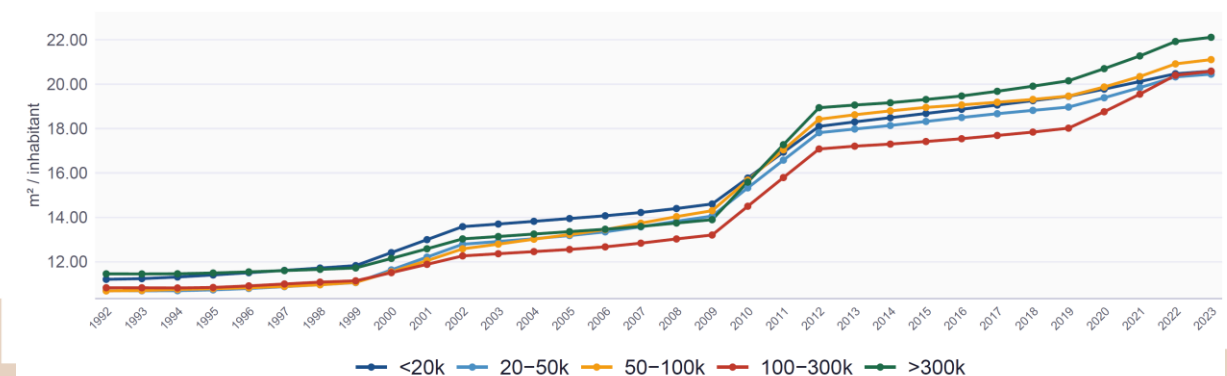
Living Floor Space per Inhabitant (m²)

By urban-type class



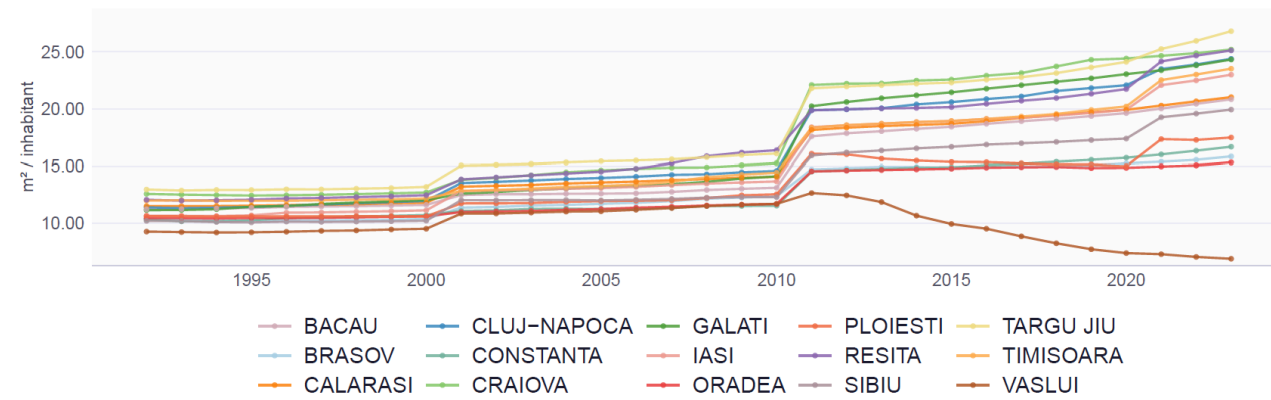
Living Floor Space per Inhabitant (m²)

By urban population size class



Living Floor Space per Inhabitant (m²)

15 selected cities

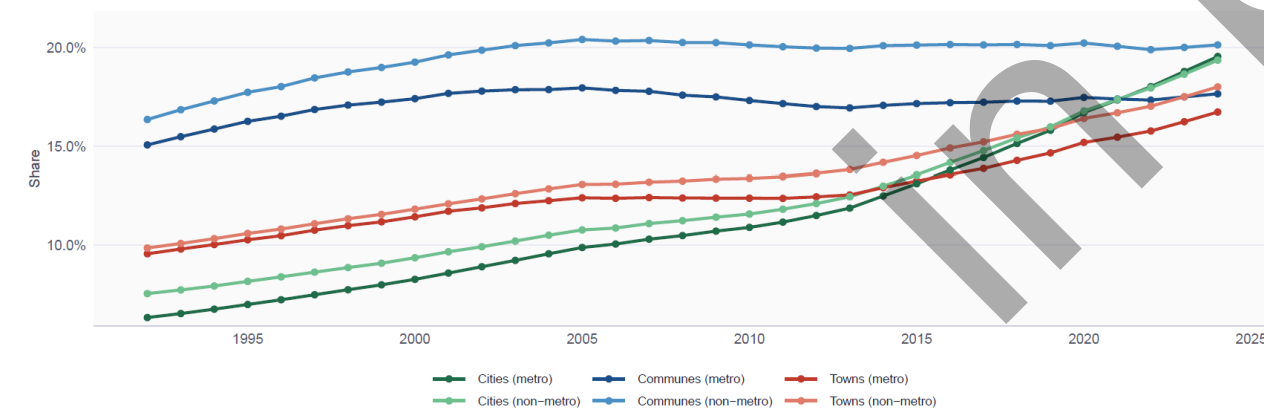


For the anomaly of Vaslui, the sharp decline after 2011 is likely a statistical rather than a physical housing phenomenon. If official population records included large numbers of residents who were actually living abroad, the denominator (population) would be artificially inflated, causing floor space per inhabitant to decrease. Reports of extremely high occupancy figures (dozens of registered residents in a single apartment) support this interpretation.

Aging population presents both challenges and opportunities. Aging increases vulnerability through greater care needs and reliance on fixed incomes. Meanwhile, it generates demand for new housing models, mobility solutions, and services. Strategically planned responses can harness this demand to support more inclusive and compact urban development. Population aging concentrates in rural and peripheral communes distant from cities, where the proportion of elderly residents remains highest. However, large cities within metropolitan areas have experienced the fastest growth in aging populations, reflecting both selective migration patterns and the aging-in-place of urban residents.

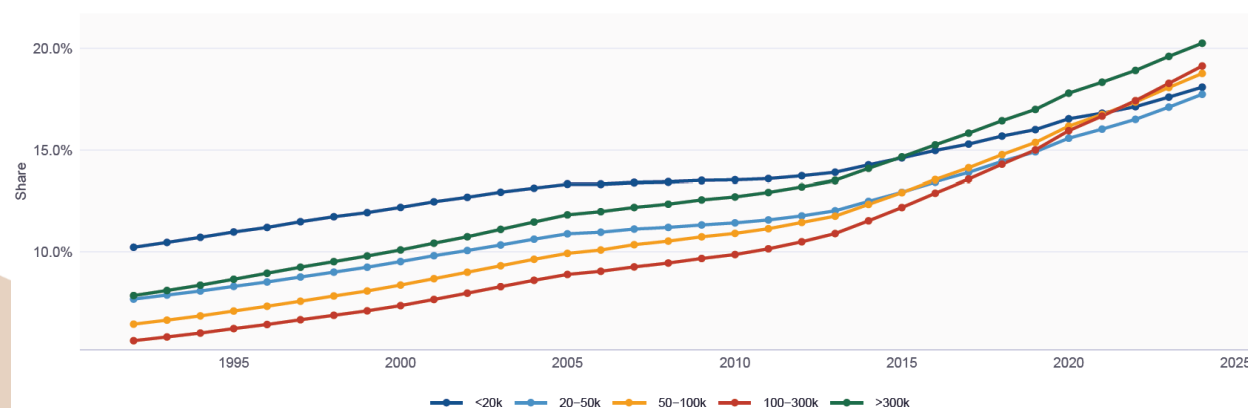
Share of Population Aged 65 and Over

By urban-type class



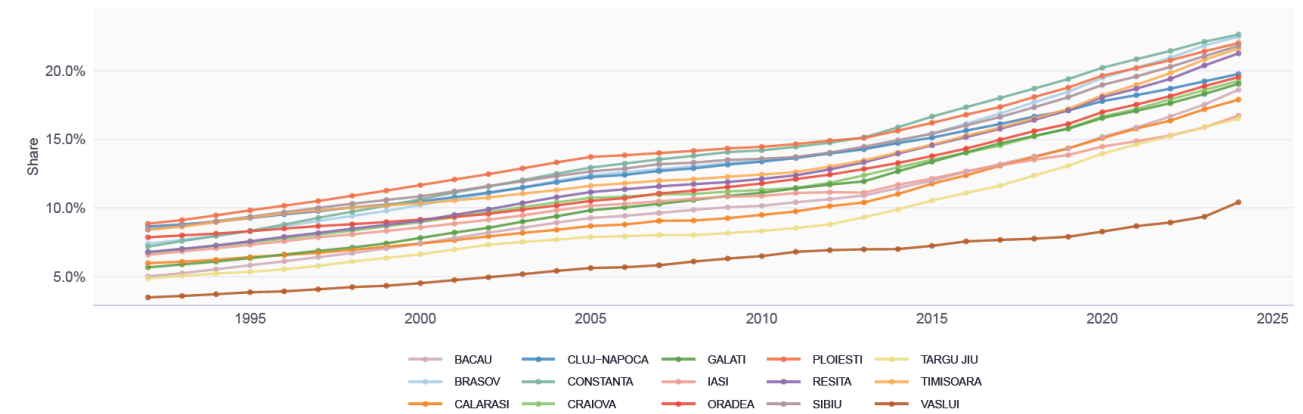
Share of Population Aged 65 and Over

By urban population size class

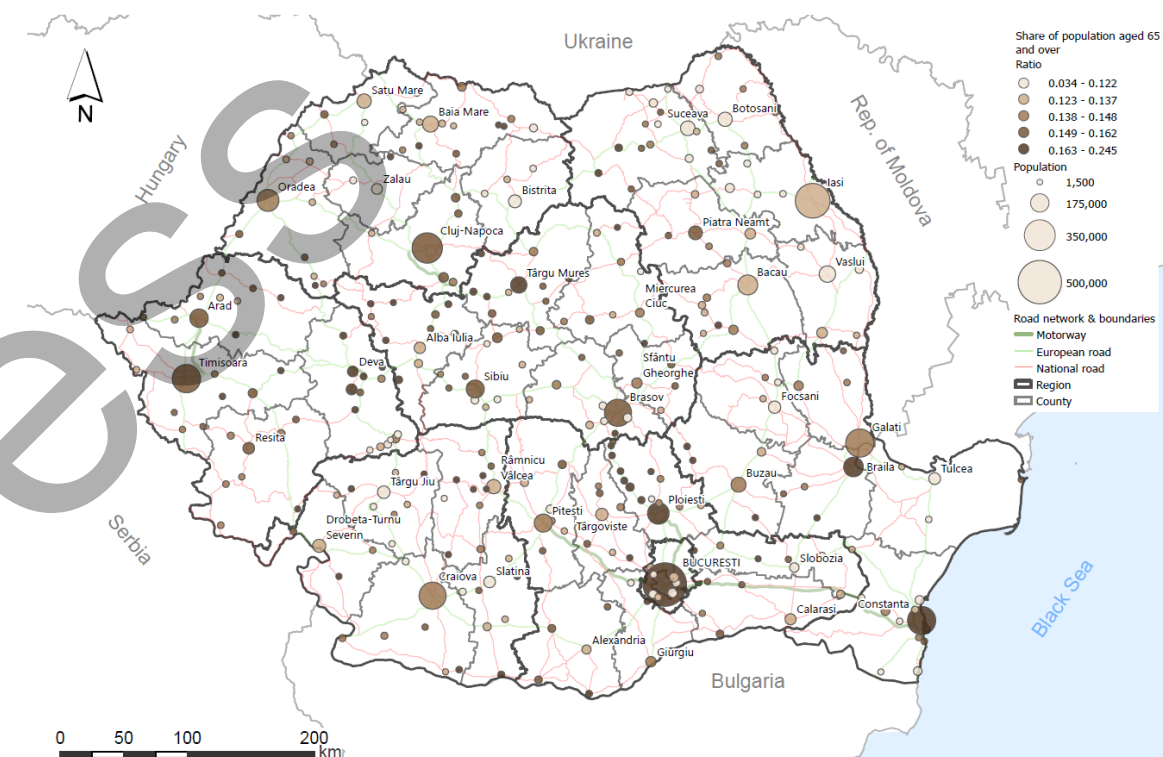


Share of Population Aged 65 and Over

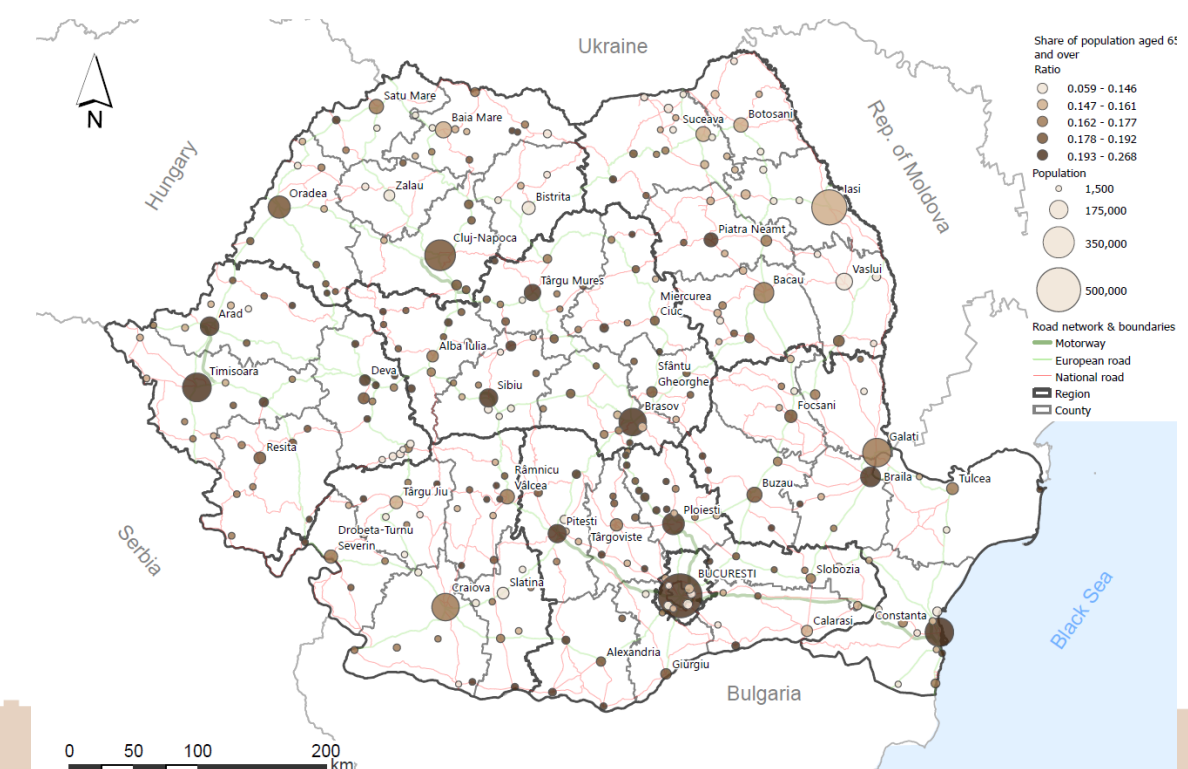
15 selected cities

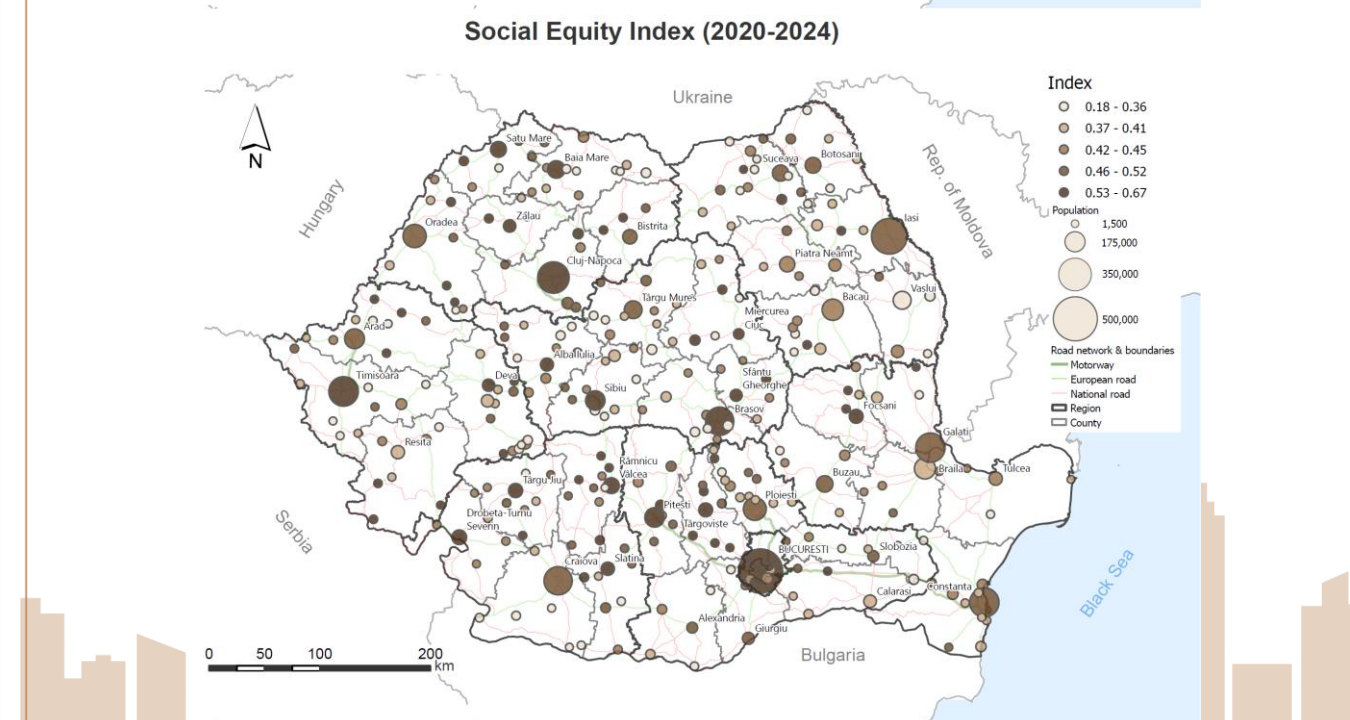
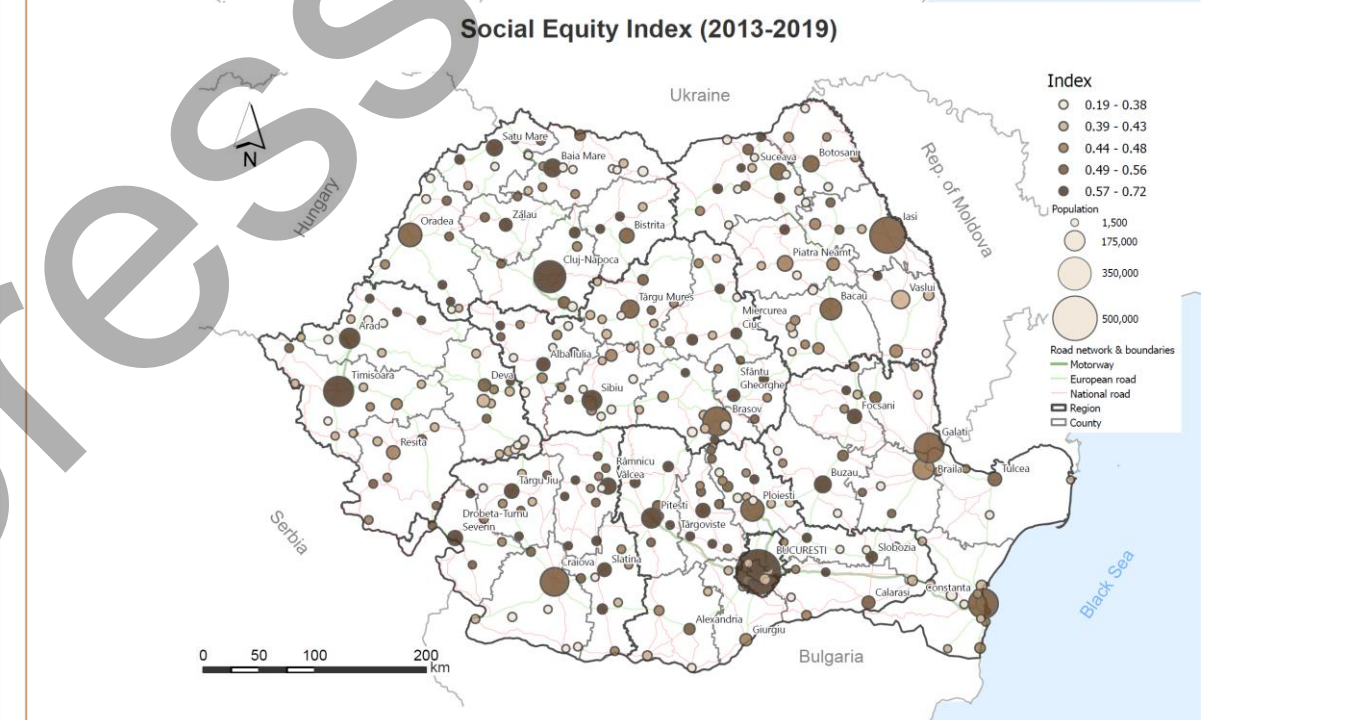
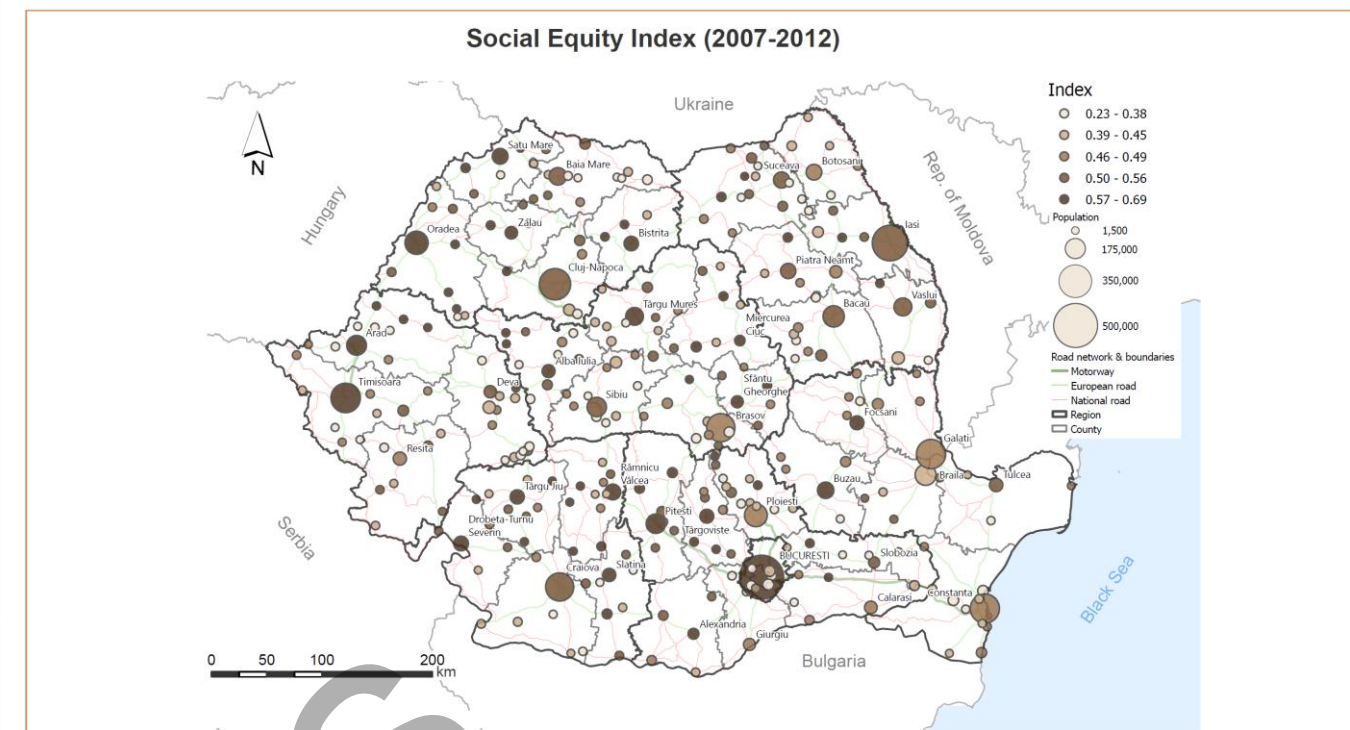
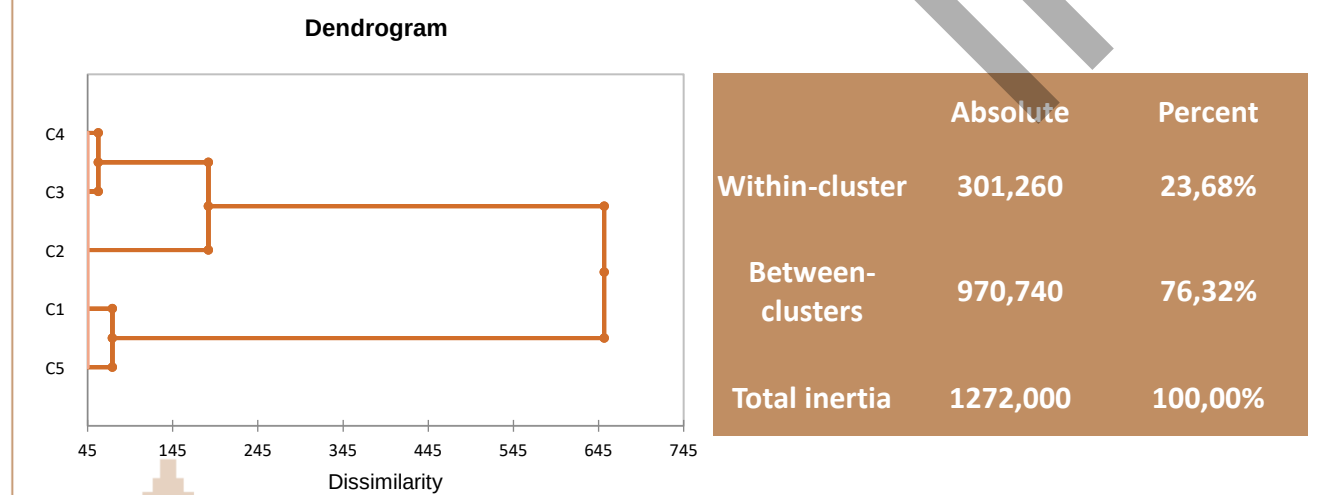
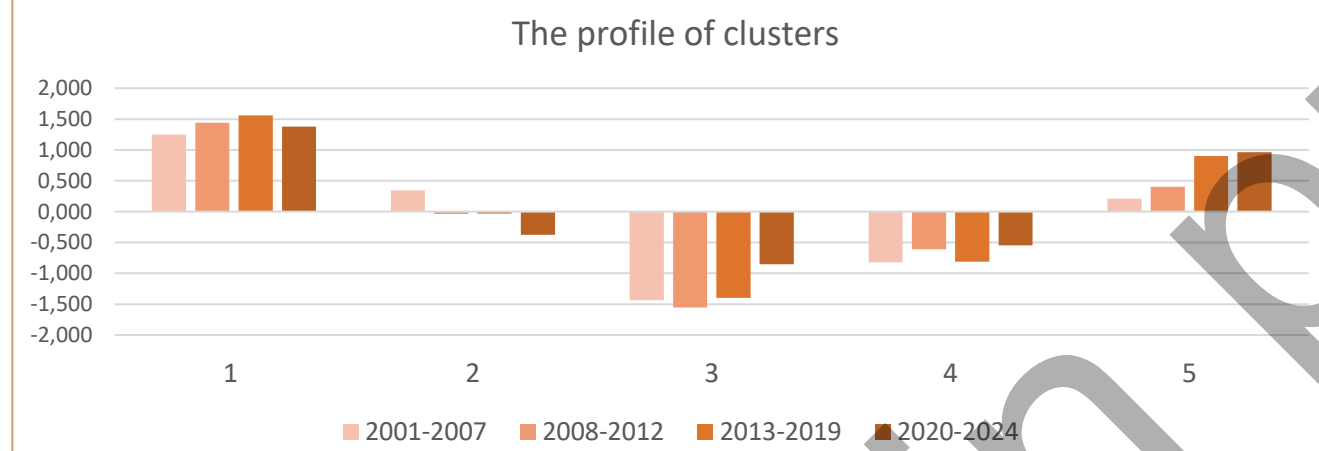
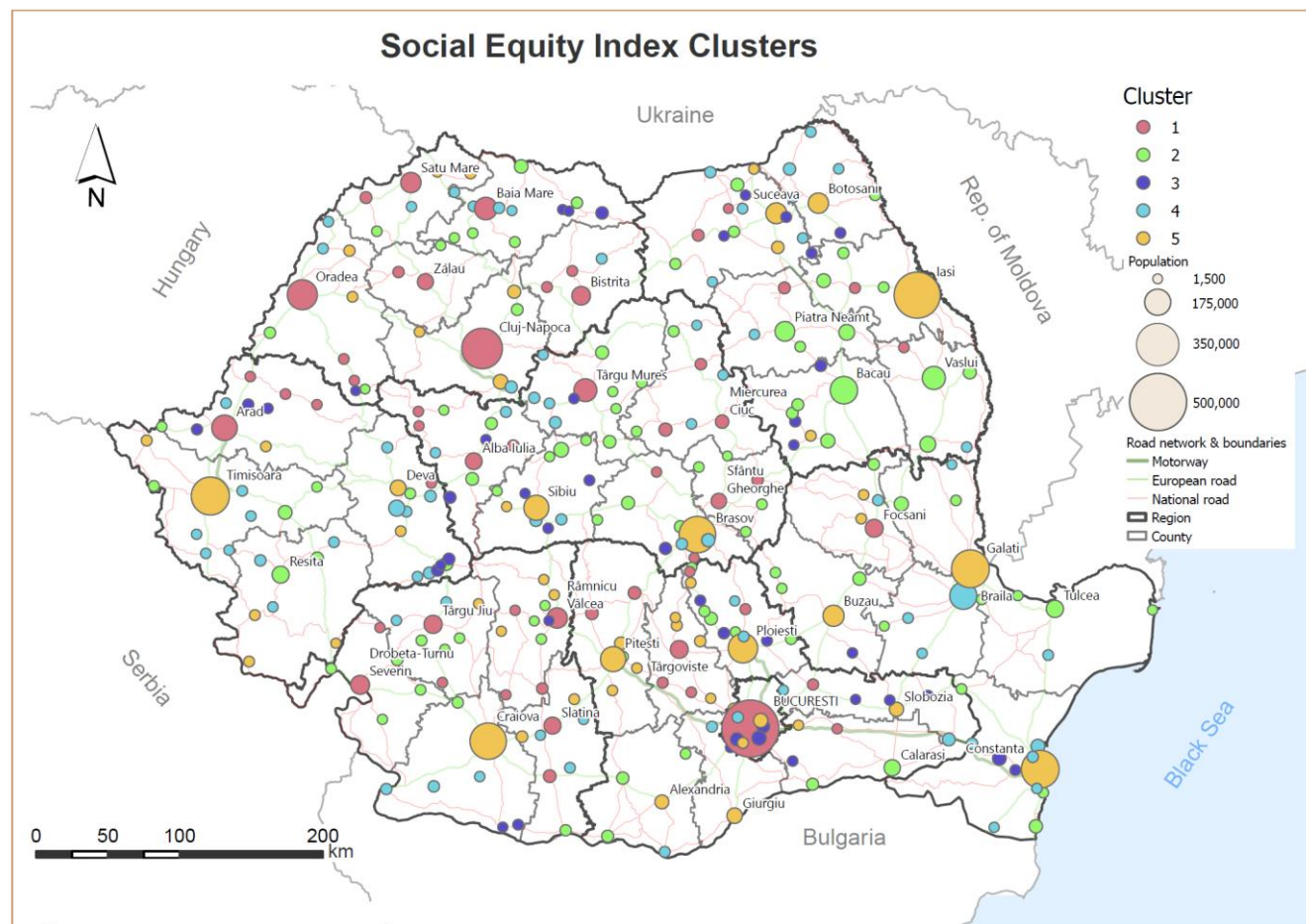


Share of population aged 65 and over (2013-2019)



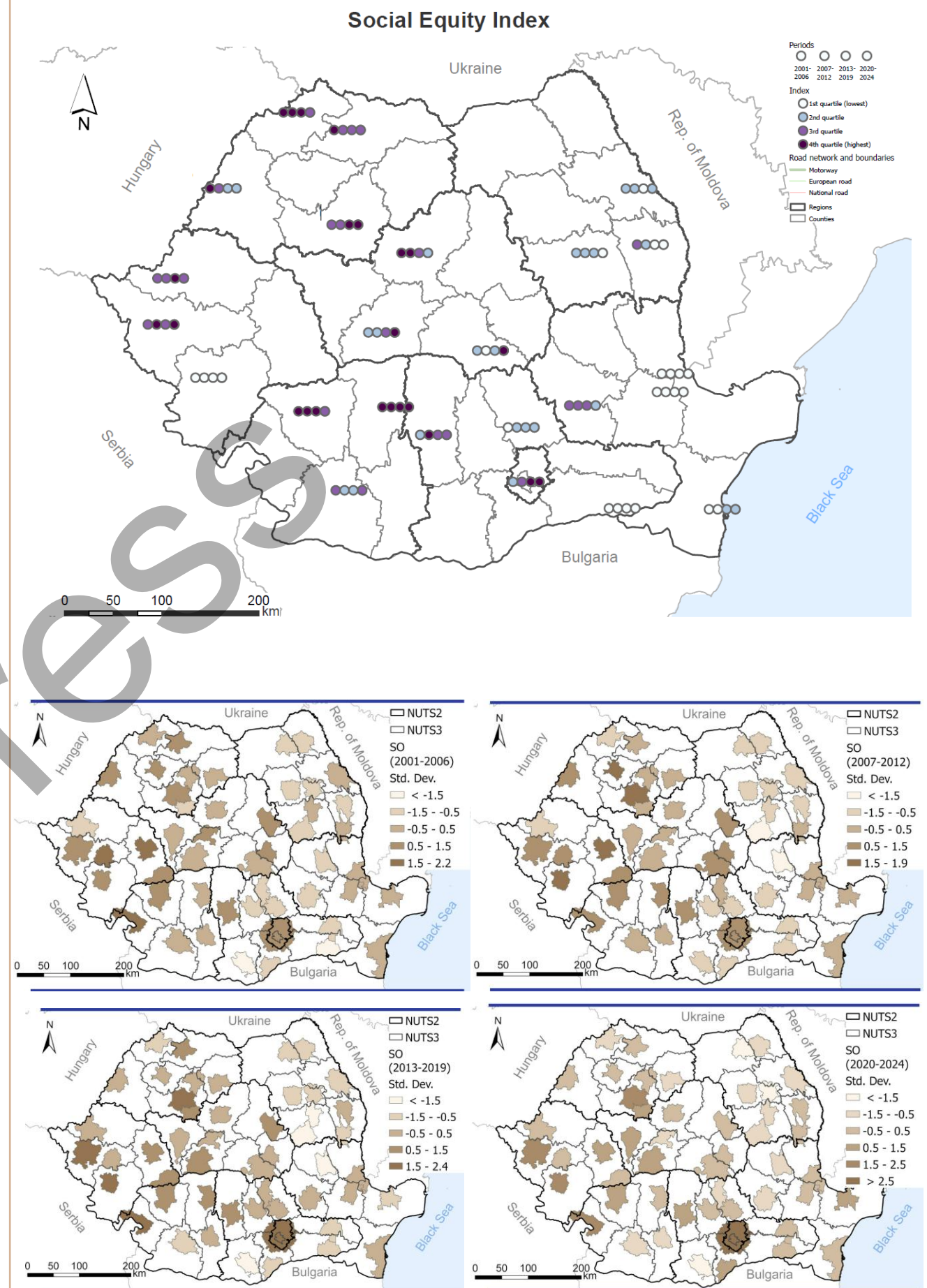
Share of population aged 65 and over (2020-2024)





Conclusions

- Major socio-economic disparities characterize Romanian urban hierarchies through large dynamic cities that diverge sharply from secondary centers and mono-industrial towns, with segregation trends intensifying within larger urban centers. Building resilience requires more than minimal social protection; it demands reconfiguring housing models and distributing public investment geographically such that disadvantaged peripheries and former industrial sites transform into viable socio-economic hubs.
- Progress in social equity varies considerably across Romanian cities. Bucharest, Cluj-Napoca, Sibiu, and Constanța recorded relative improvements, while Iași, Bacău, and Galați stagnated at low levels. Some cities, including Oradea, Satu Mare, and Târgu Jiu, experienced declines over the 2001-2024 period.
- Infant mortality and school enrollment rates (ages 0-24) serve as sensitive indicators of intergenerational inequality and basic social vulnerability, that can be taken into consideration. When high infant mortality coincides with low enrollment, local administrations become absorbed in coping strategies with minimum services and emergency response, leaving little capacity for forward-looking transformations in education, skills development, or neighbourhood quality.
- Per-capita expenditure on education and culture, particularly when paired with favourable teacher-to-student ratios, signals local commitment to human capital and civic life. Such cities navigate long, politically demanding green, digital and post-industrial transitions, more effectively because they require broader skills and civic engagement. Conversely, low spending and overcrowded schools, even where floor space per inhabitant is ample, often indicate segregation and spatial mismatch that undermine social equity-oriented transformation.
- The evolution of built-up area between 1990-2025 was highly influenced by various processes including the construction of new and larger dwellings after the socialist period; rising incomes and living standards; declining household size (fewer persons per dwelling); population decline in many localities, which increases floor space per inhabitant even when the housing stock remains unchanged; strong residential investment and expansion of suburban housing; construction of modern apartment complexes with larger units.
- The population share aged 65+, floor space per inhabitant, teacher-to-student ratios, and local spending on social assistance, education, and culture together constitute the social infrastructure that enables or constrains transformation. Among Romania's 50 theoretical metropolitan areas, only Bucharest, Focșani, and Constanța improved their social equity scores, while Suceava, Roman, and Miercurea Ciuc declined.



Economy

This chapter evaluates the locality's economic vitality by analyzing the synergy between business activity, labor market health, and public investment. It measures entrepreneurial density through the number of firms per inhabitant and overall market scale via total turnover. Labor dynamics are assessed by tracking employees (19-64 years) and the share of registered unemployed, highlighting the community's ability to provide stable livelihoods. Additionally, the number of tourists arrived indicates external attractiveness, while total investment expenditure reflects the infrastructure support provided by the local budget. Together, these indicators reveal the area's capacity to generate wealth and sustain long-term competitive growth.



Business density

Measured as the number of firms per inhabitant, this shows how active the local economy is. A higher value suggests more entrepreneurship and a stronger presence of private businesses.



Labour market participation (private sector)

This indicator shows the share of people aged 19-64 who work in the private sector. It reflects how much of the workforce is employed in market-based economic activities.



Economic strength of local businesses

Measured as business turnover per inhabitant (in Lei, constant 2023 prices), this indicator reflects the total value of goods and services sold by firms, indicating how much economic activity is generated locally.



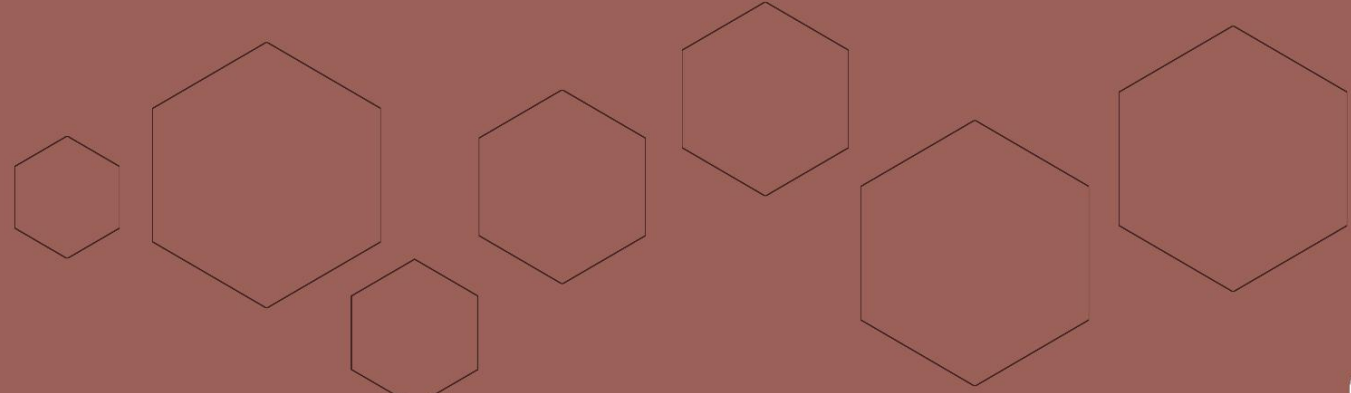
Tourism intensity

Measured as the number of tourist arrivals per 1,000 inhabitants, this reflects how attractive an area is for visitors and the importance of tourism in the local economy.

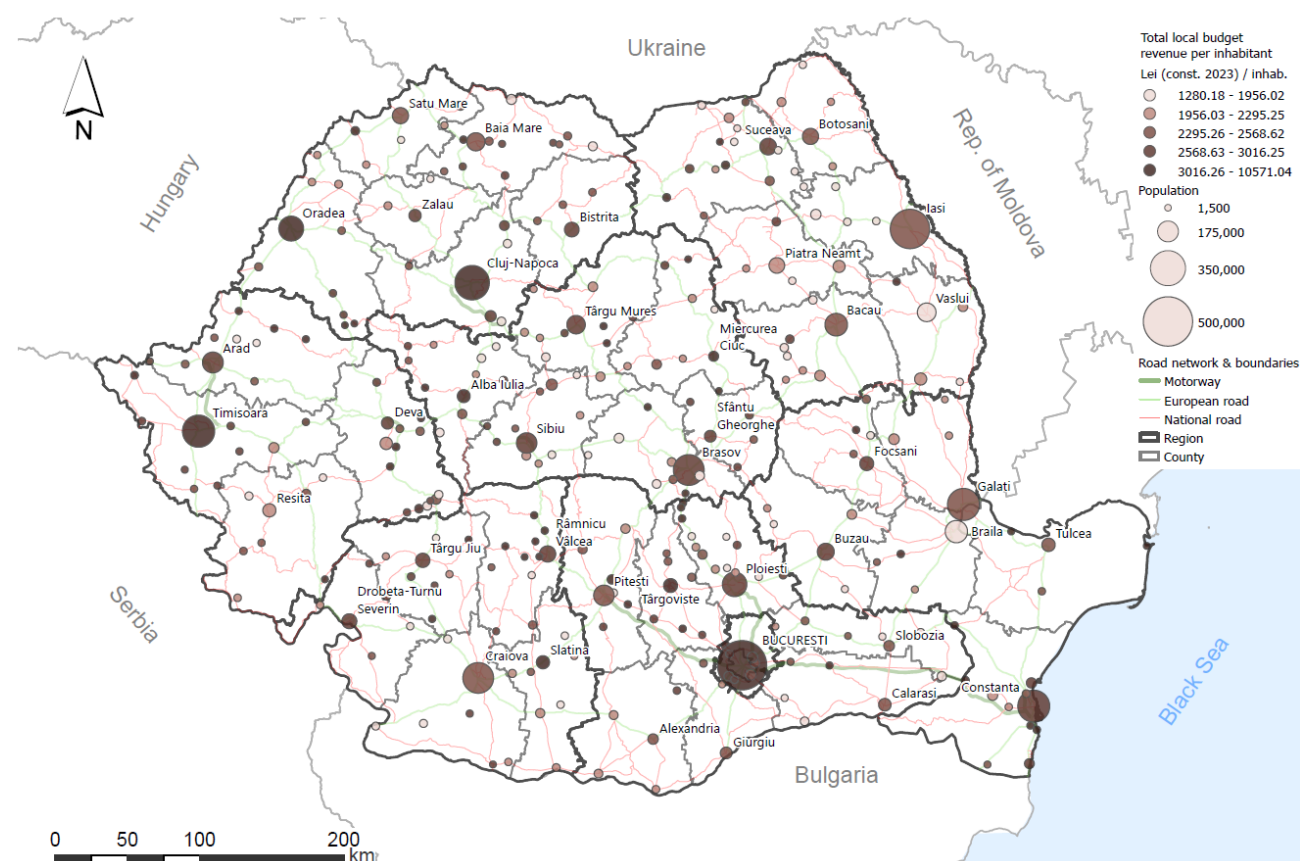


Labour market exclusion

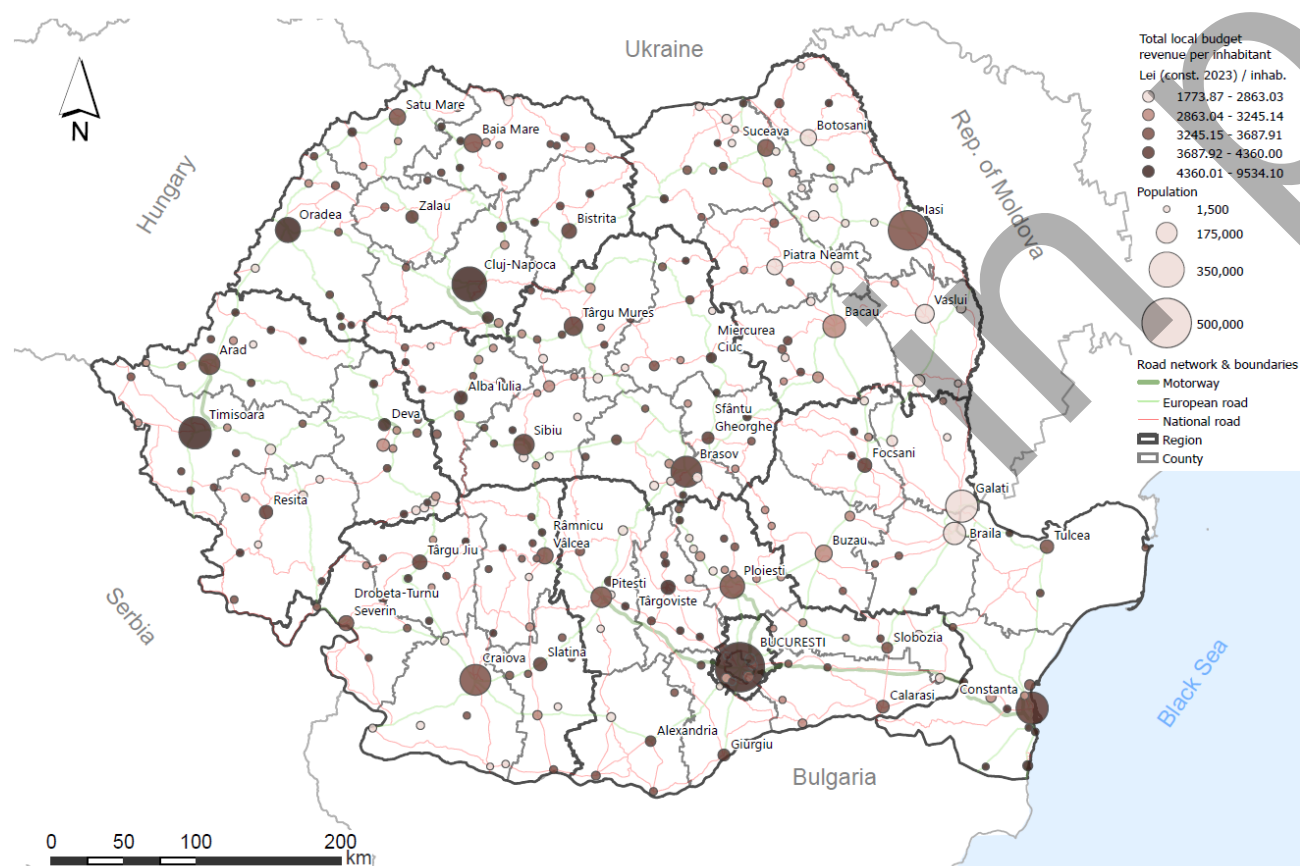
This indicator shows the share of people aged 20-64 who are unemployed. It reflects the difficulty of finding jobs and the overall health of the local labor market.



Total local budget revenue per inhabitant (2013-2019)



Total local budget revenue per inhabitant (2020-2024)

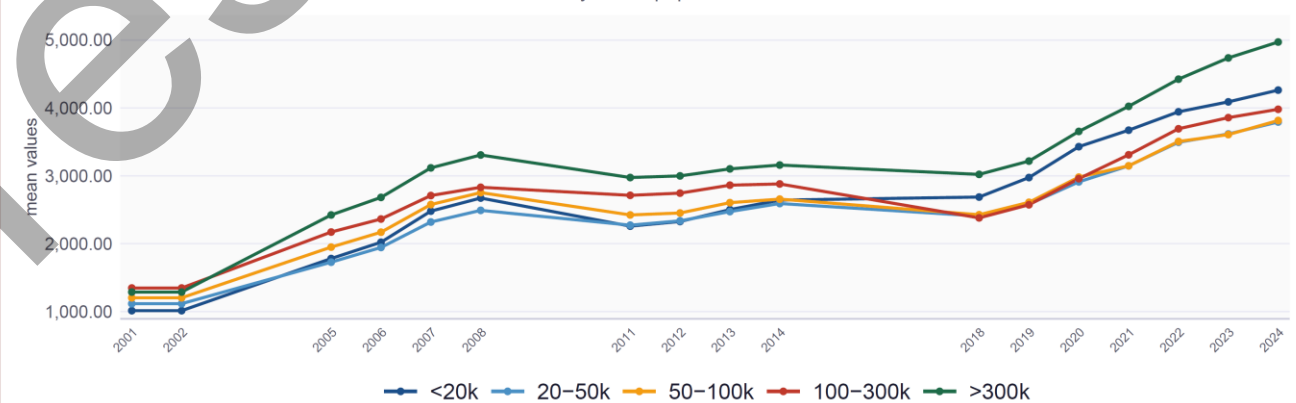


Romania experienced a significant growth in terms of local economic output over the last two decades (2003-2023). The sales of firms increased 78% over the 2010-period. This surge of local economic activity only faced reductions in 2013 and 2020, namely during the Euro Area Crisis and the COVID-19 associated recession.

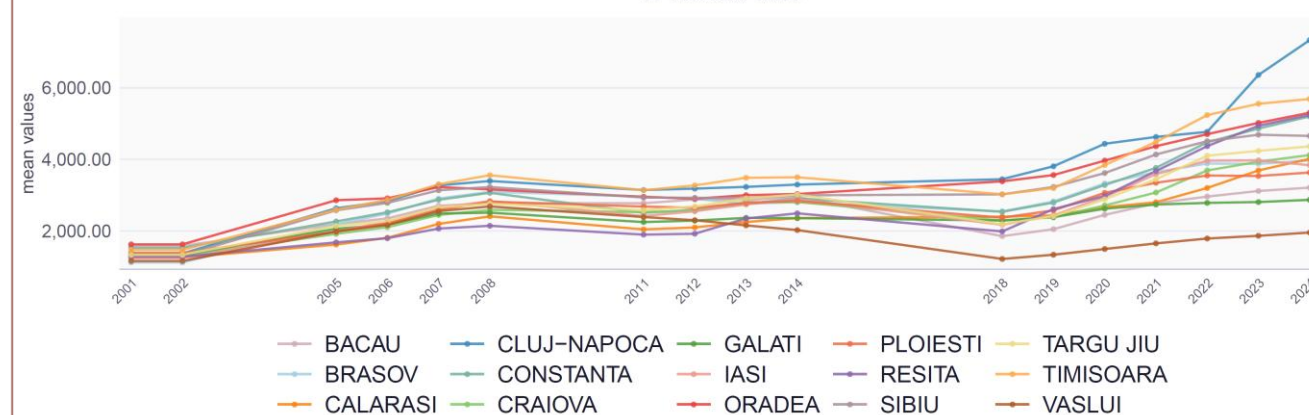
Total local government revenue (RON) per capita
By urban-type class



Total local government revenue (RON) per capita
By urban population size class



Total local government revenue (RON) per capita
15 selected cities

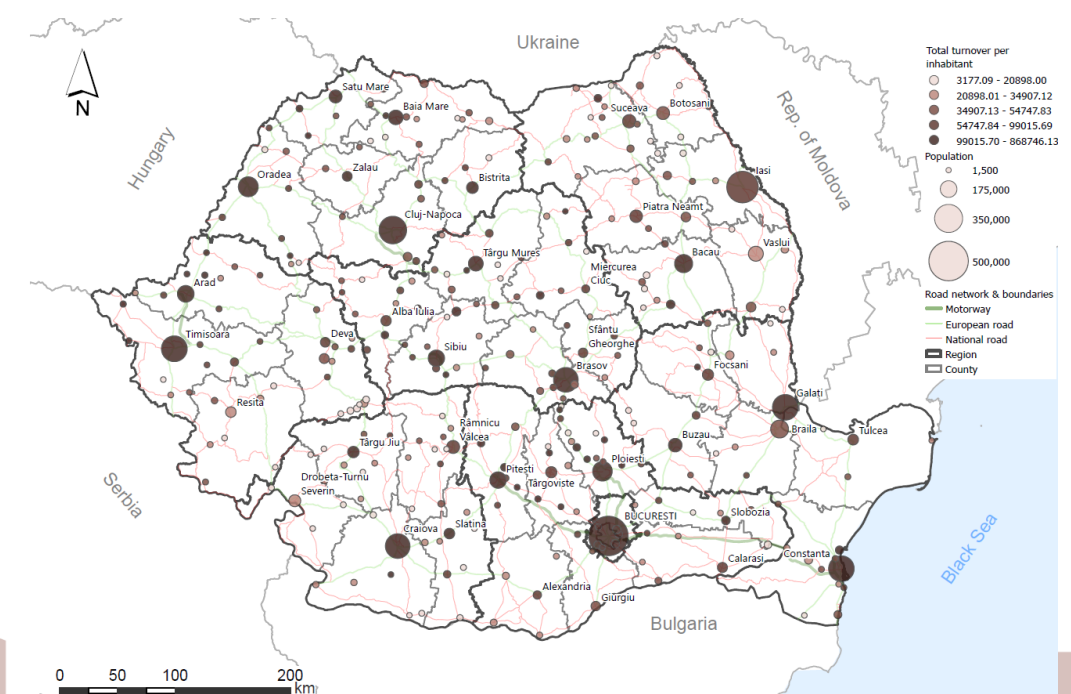
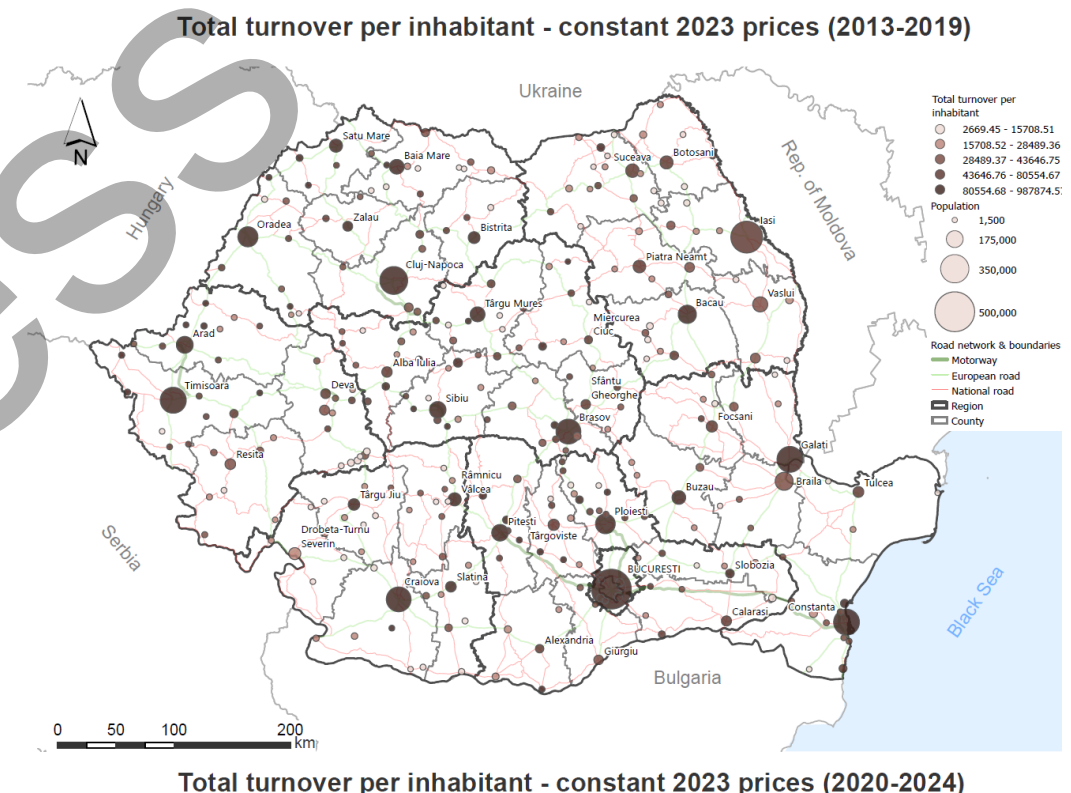


Clearly, the metropolitan areas are the main engines of growth. Both cities and municipalities exhibit the highest per-capita turnover rates over the entire interval. However, one needs to note that whilst the urban area reports the highest economic vitality, communes reported the fastest growth. In the last decade (2013-2023), the per capita turnover increased by 120% in communes outside the metropolitan areas and by 75% in communes inside the metropolitan areas. Conversely, towns and cities experienced growth rates between 29% and 45%, with slightly higher increases outside the metropolitan areas. Overall, although localities in metropolitan areas have the highest economic vitality, settlements outside metropolitan areas have displayed slightly higher growth rates, catching up (in line with a convergence pattern). The importance of cities is further confirmed when turnover per capita is analysed by population size. Large cities, with populations above 300,000, concentrate the highest level of economic activity. Smaller cities are competing for second place, whereas towns and communes with fewer than 20,000 inhabitants consistently rank last, displaying the lowest economic output.

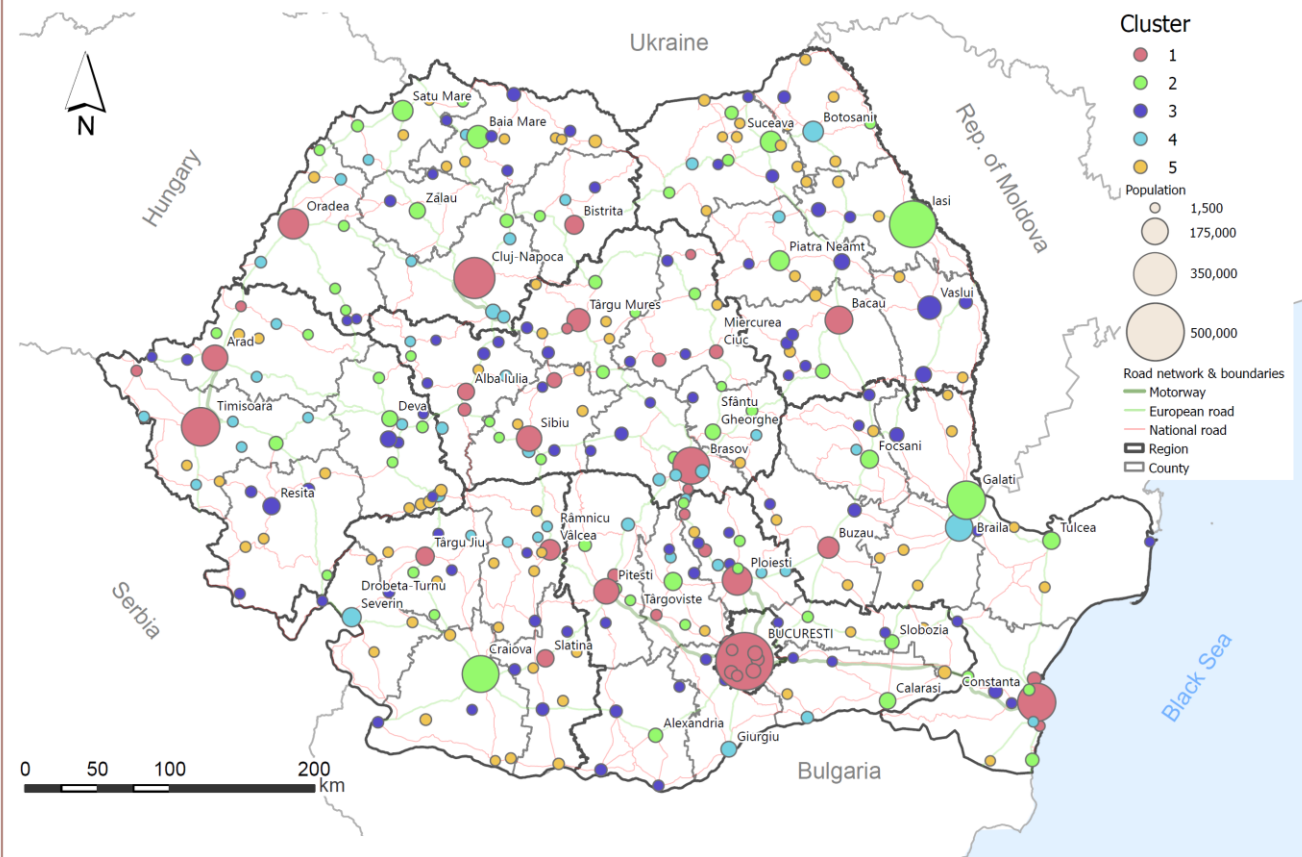


The role of cities is also suggested when looking at turnover per capita by population size. It is large cities (with a population of over 300,000 inhabitants) that show the highest concentration of economic activity. Next, while smaller cities are competing for the second position, the towns and communes with population below 20 000 remained on the last position, with lowest economic output.

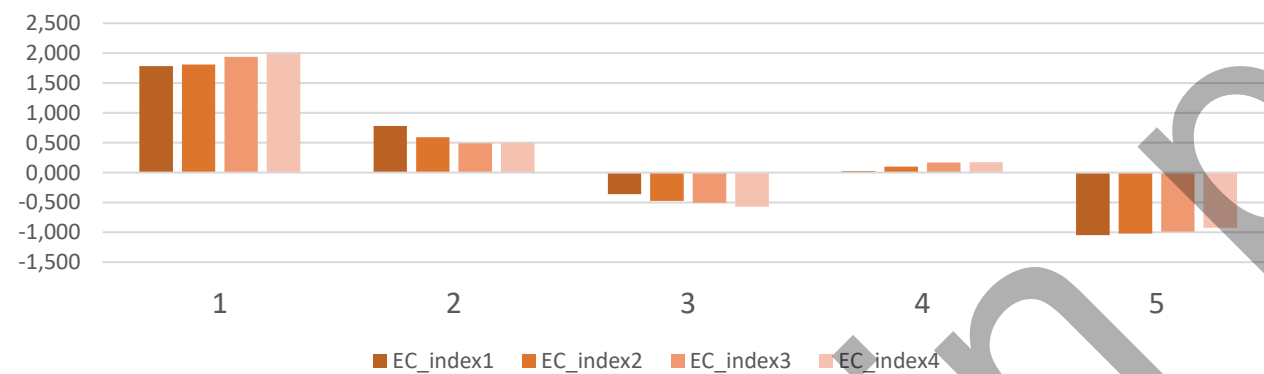
It is also important to note that, among the 15 selected cities, Cluj-Napoca, Timișoara, and Bacău exhibited the highest turnover per capita in 2023, exceeding 200,000 lei per capita. By contrast, Reșița and Vaslui were at the lower end of the distribution, with less than 27,000 lei per inhabitant. Regarding growth dynamics, Bacău showed the most pronounced increase, with turnover per capita rising by 162% since 2010, followed by Târgu Jiu and Craiova, both of which recorded growth rates of roughly 100%. The cities that experienced a decline in firm sales were Vaslui, with a 50% reduction, and Ploiești and Reșița, each with a contraction of 25%.



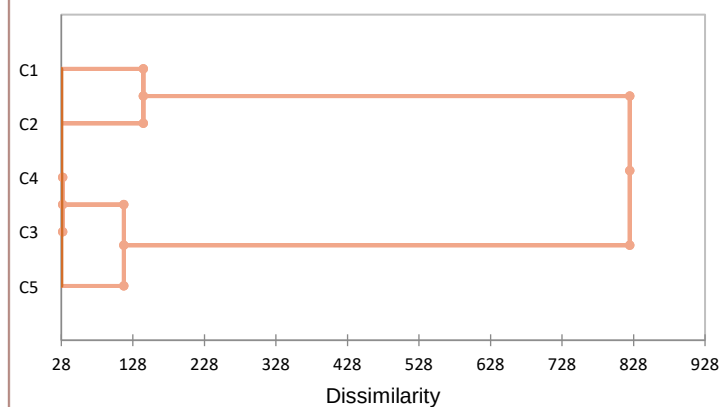
Economic Vitalisation Index Clusters



The profile of clusters



Dendrogram

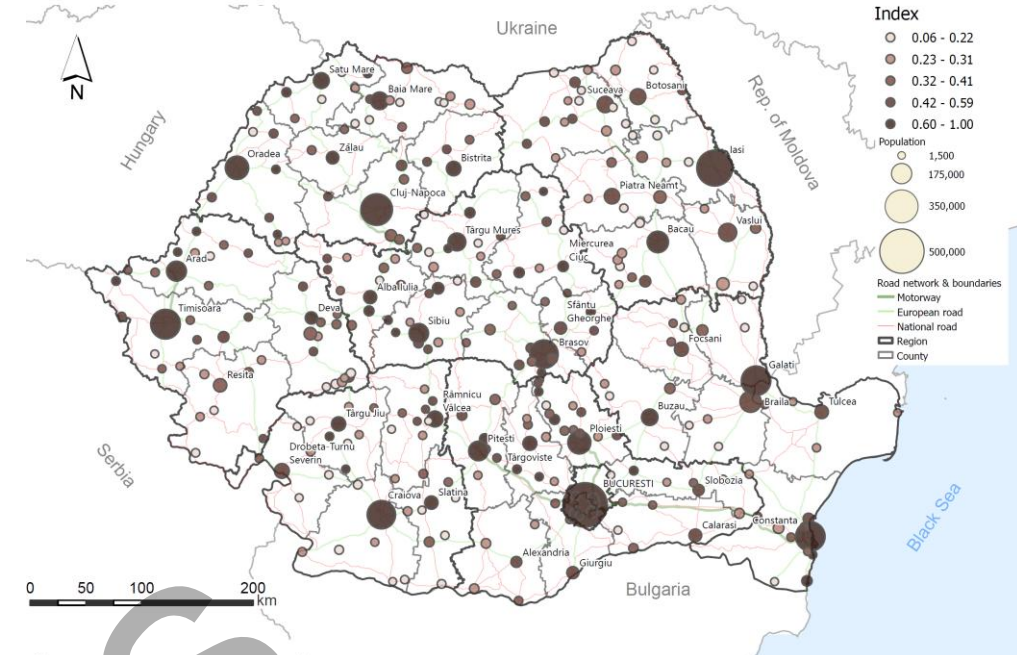


C1 – best performing, positive dynamics
C2 – well performing, but rather stagnant
C3 – bad performance, negative dynamics

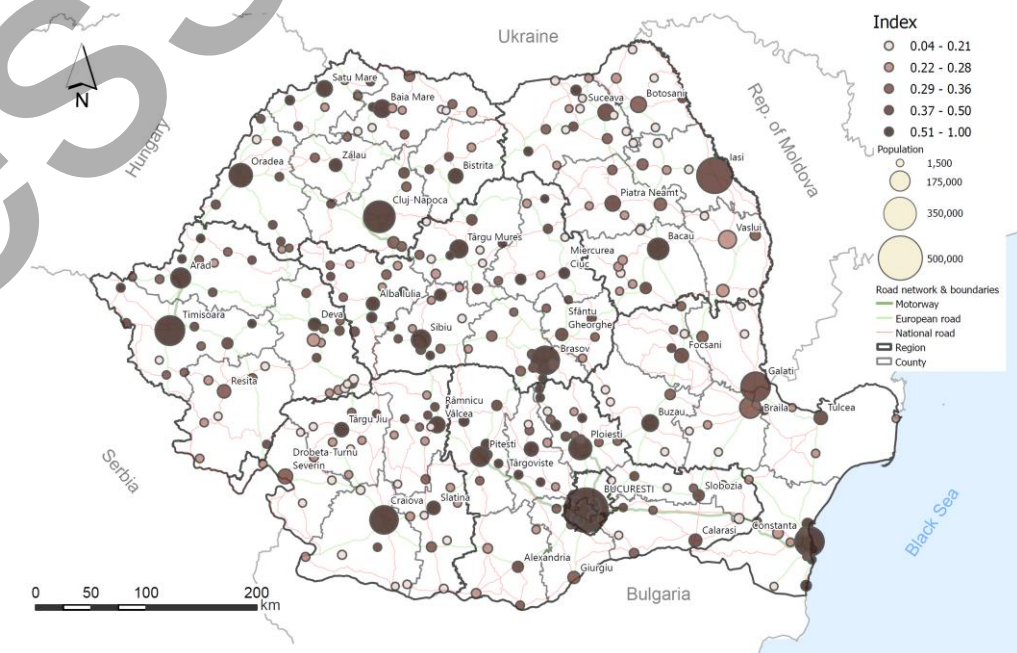
C4 – average performance
C5 – worst performing, slightly improving

	Absolute	Percent
Within-cluster	160,977	12,66%
Between-clusters	1111,023	87,34%
Total inertia	1272,000	100,00%

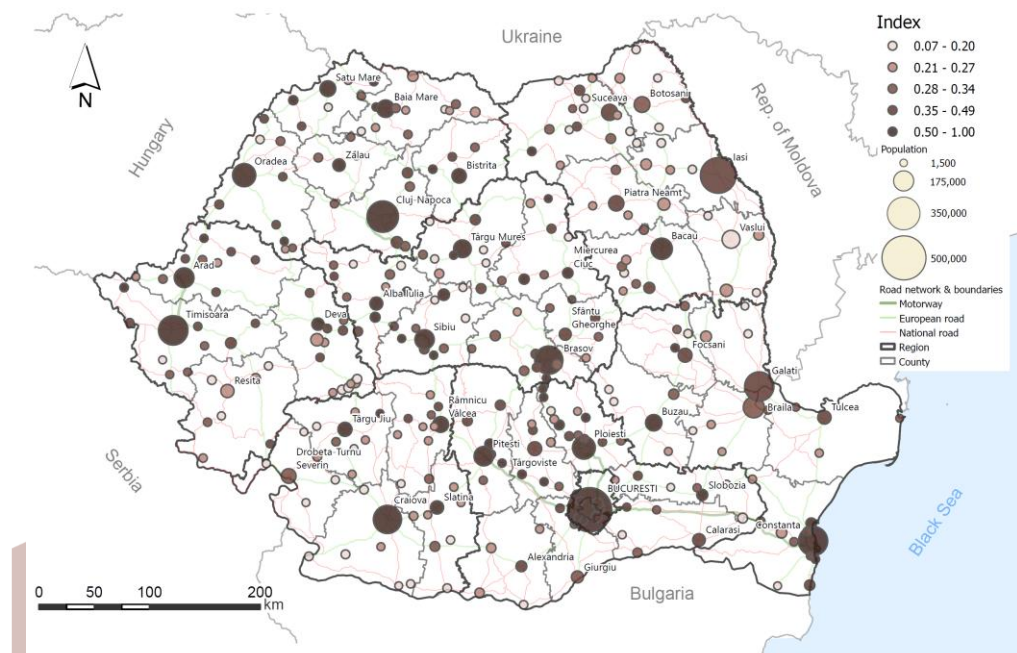
Economic Vitalisation Index (2007-2012)

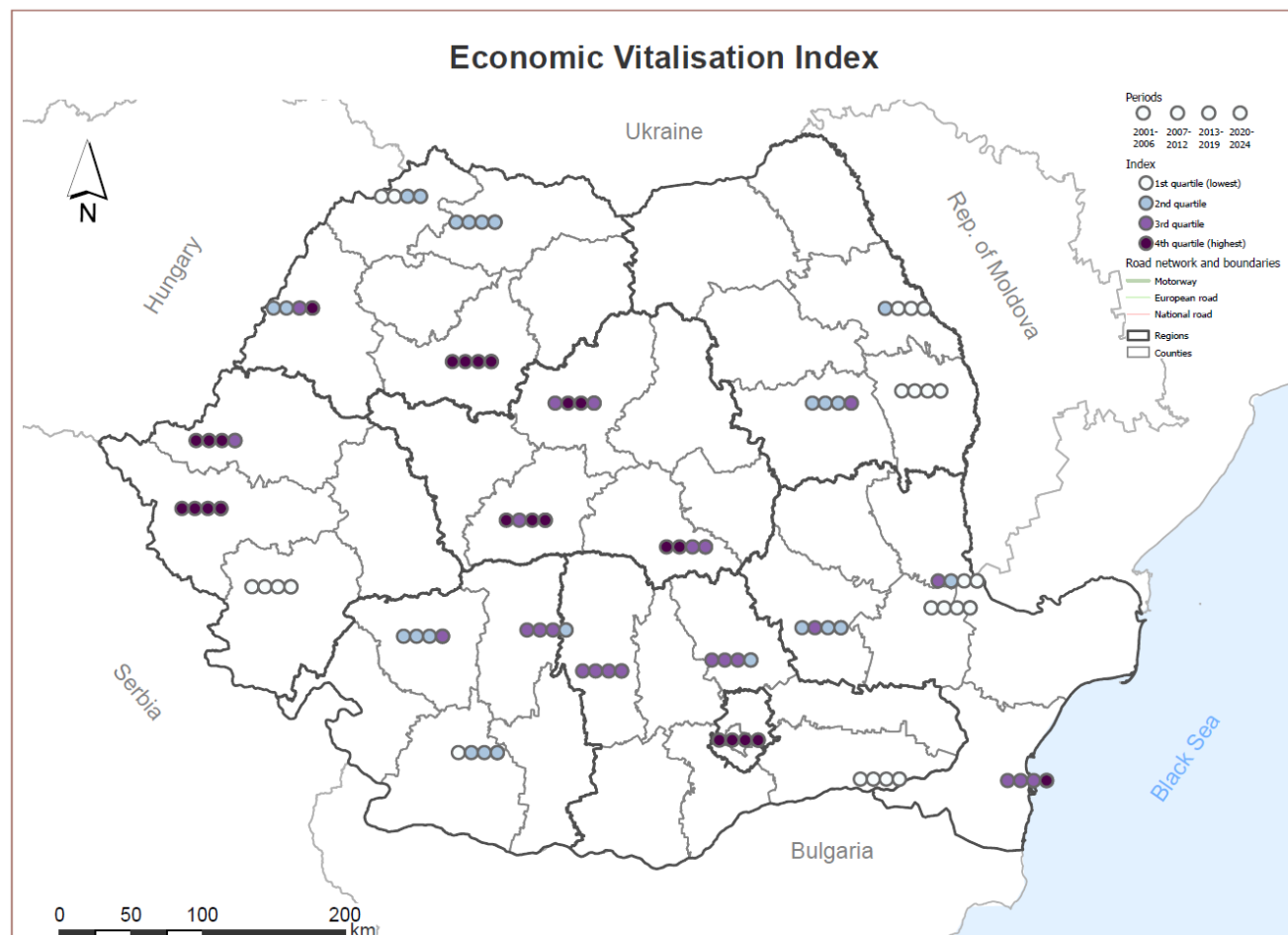


Economic Vitalisation Index (2013-2019)



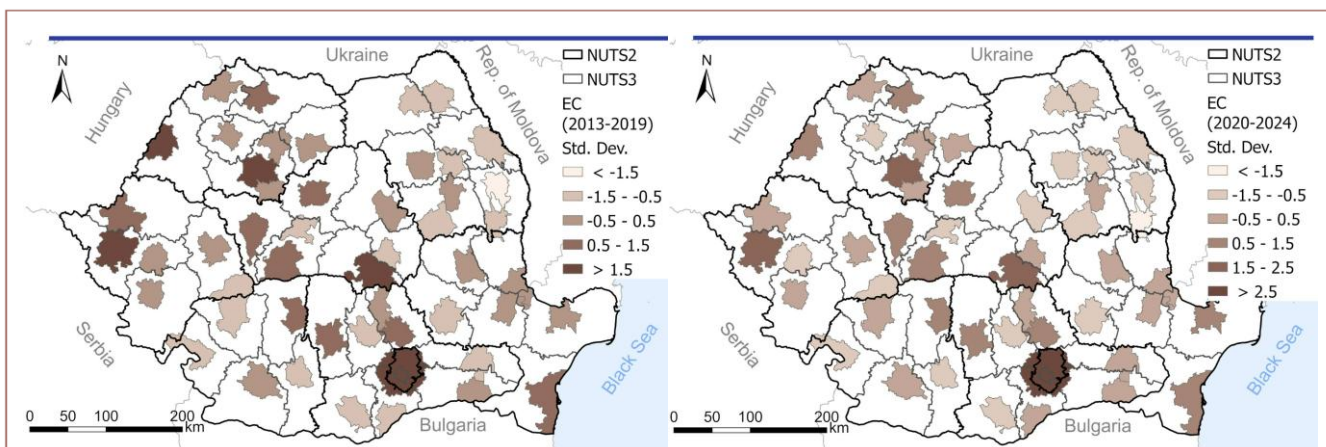
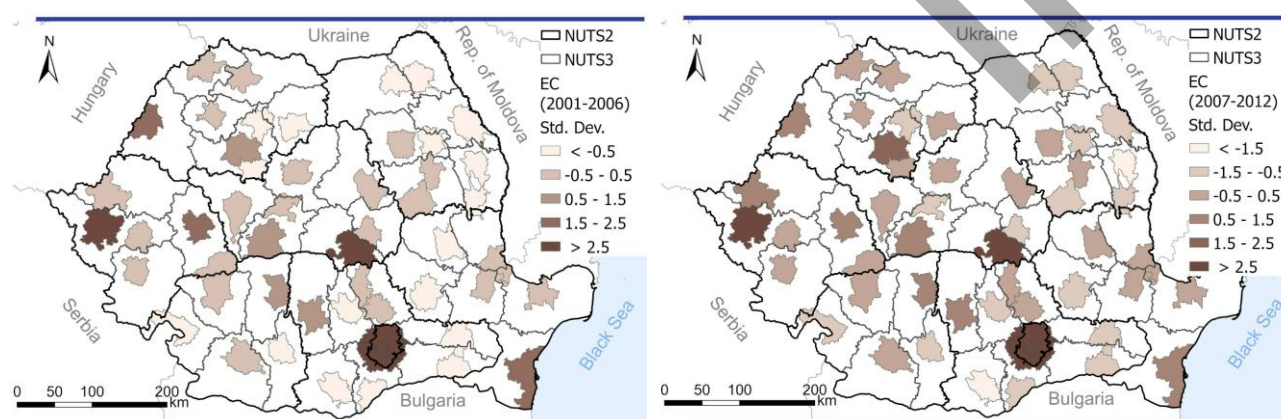
Economic Vitalisation Index (2020-2024)





Among large cities and metropolitan areas, București, Cluj-Napoca, and Timișoara currently exhibit the highest economic vitality at both the local and metropolitan levels. These cities have outperformed Constanța, Brașov, and Sibiu, while also improving their relative rankings. București and Timișoara have advanced at the local level, whereas Cluj-Napoca has strengthened economic activity at the metropolitan scale. At the opposite end of the distribution, Vaslui and Călărași record the weakest economic vitality.

While these maintained their position over the entire period of stability demonstrating remarkable economic strength.



Conclusions

- Boosting economic activity by improving living conditions, increasing employment, and enhancing access to well-served business centres. Vulnerability of small and mono-industrial towns and the need for economic reconversion and smart specialisation at the regional level.
- Urban economic transformation in Romania would involve a shift away from models based on low costs and speculative real estate towards innovative urban ecosystems (green economies, creative industries, IT, advanced services), organised in a more polycentric way.
- Indicators such as the number of firms, turnover per inhabitant, net profit per capita and local budget revenues per inhabitant measure the city's position in the national economic hierarchy and its capacity to generate its own resources for transformation. Moreover, the dynamics of firms and turnover over time (by comparing period averages) can reveal whether a city is surpassing its historical trajectory (a sign of transformation) or merely oscillating around an inertial economic model.
- The number of tourists per 1,000 inhabitants and the unemployment rate (20–64) demonstrate the opportunity-versus-vulnerability dimension: cities with tourism and diversified economies have more reconversion options, while those with high unemployment and mono-industrial structures follow much more rigid trajectories.
- Large cities and some regional poles score high and can initiate transformations (urban regeneration, investments in mobility, green spaces) without relying exclusively on central transfers or EU funds, whereas shrinking small towns display low economic transformability.

Digitalization and Big Data

This chapter explores the digital transformation of the local landscape by assessing both infrastructure and economic performance. It tracks the integration of technology in education and administration via standalone websites and IT equipment, while measuring the vitality of the ICT sector through its share of firms, employment, and profitability. Together, these indicators reflect the city's capacity to harness Big Data and digital tools to drive innovation and sustainable economic growth.



Existence of a standalone website

Indicates the level of digital transparency and the accessibility of public services and information for the community.



Share of ITC firms

Represents the density of the information and communication technology sector within the local business ecosystem.



Share of ITC firms turnover

Evaluates the economic weight and market importance of the tech sector relative to the total local business revenue.



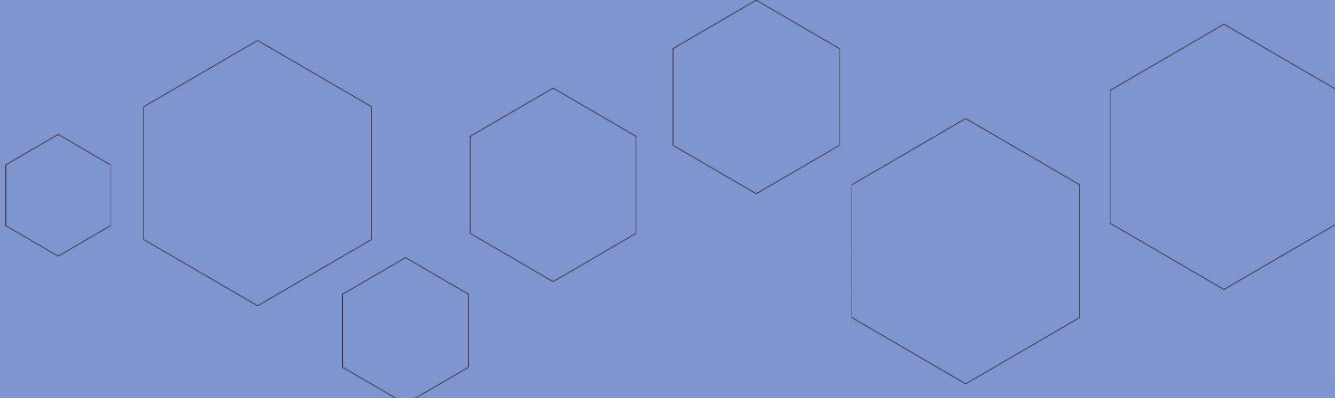
Share of ITC employees

Reflects the degree of specialization of the local labor force and the city's attractiveness for high-tech professionals.



Share of ITC net profit

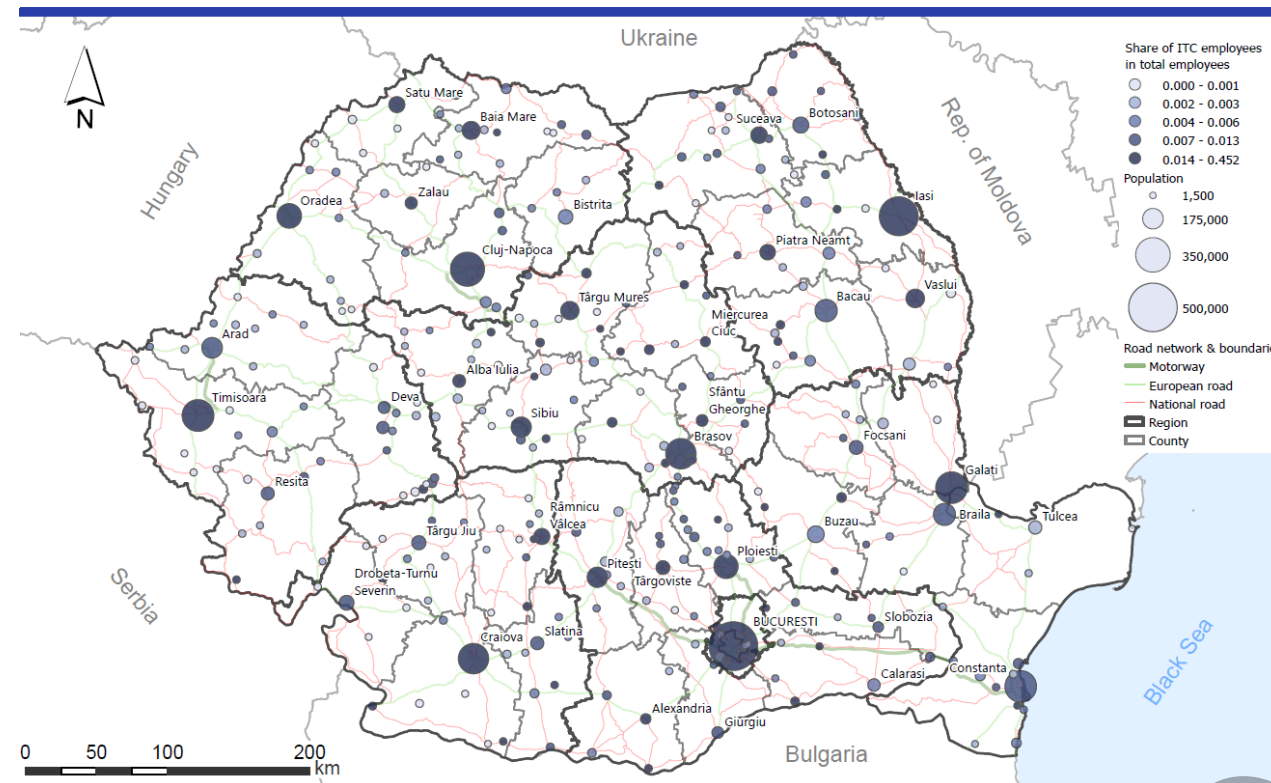
Indicates the profitability and financial health of the tech industry, serving as a proxy for the sector's local economic impact.



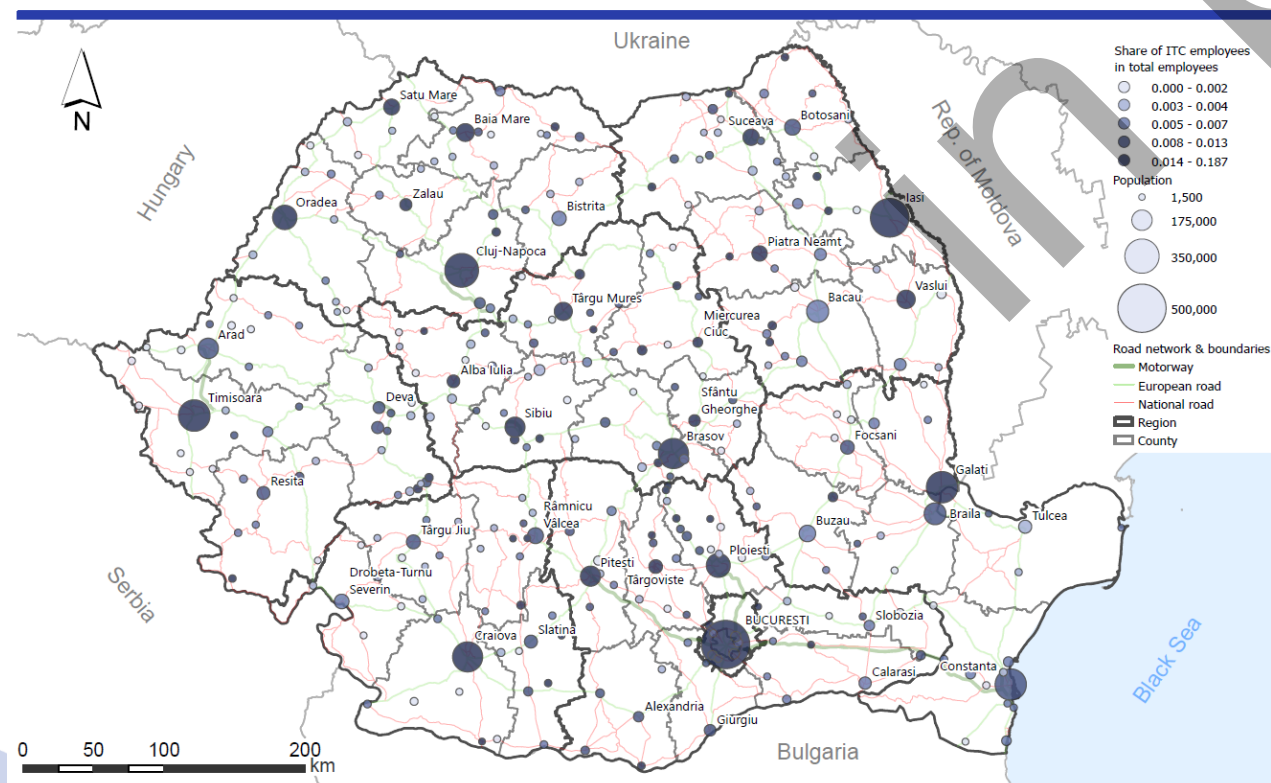
Share of ICT employees in total employees

ICT employment is strongly concentrated in Romania's main metropolitan and university centres, particularly Bucharest, Cluj-Napoca, Iași, Timișoara and Brașov.

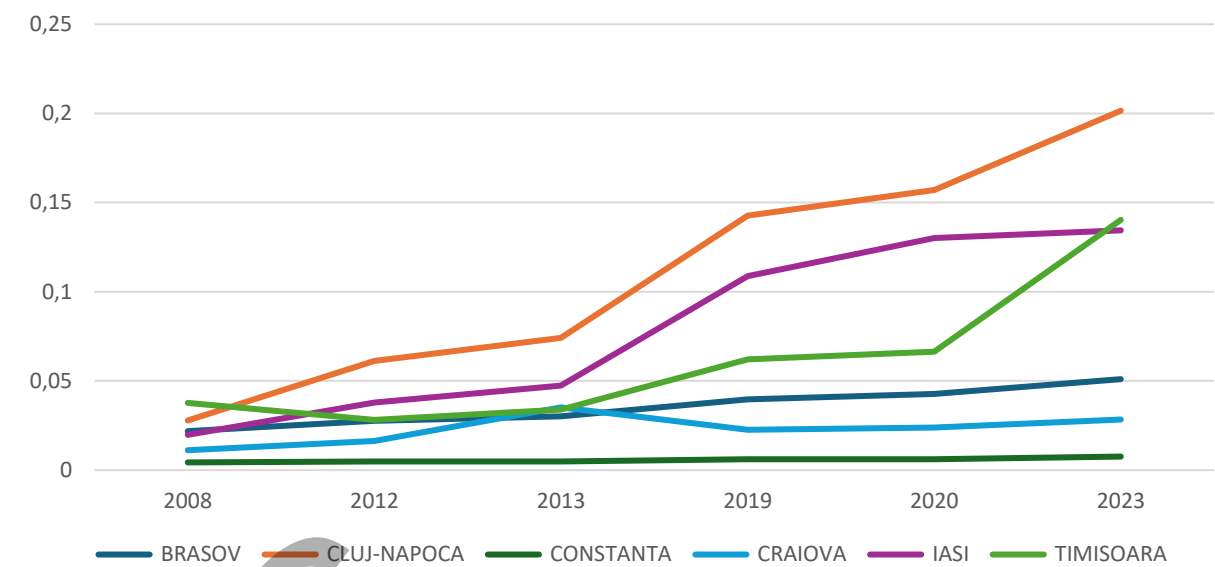
Share of ITC employees in total employees (2013-2019)



Share of ITC employees in total employees (2020-2024)

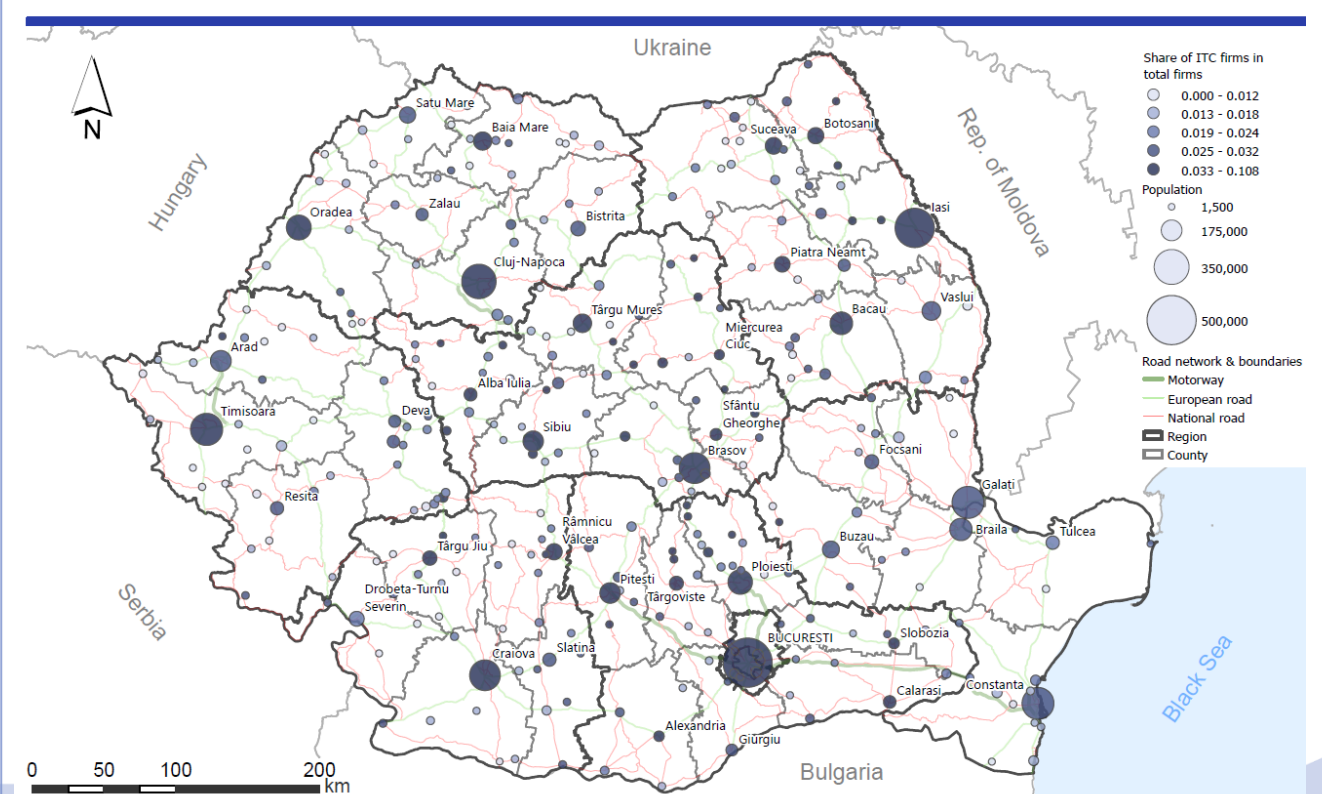


Share of IT employees (private sector)

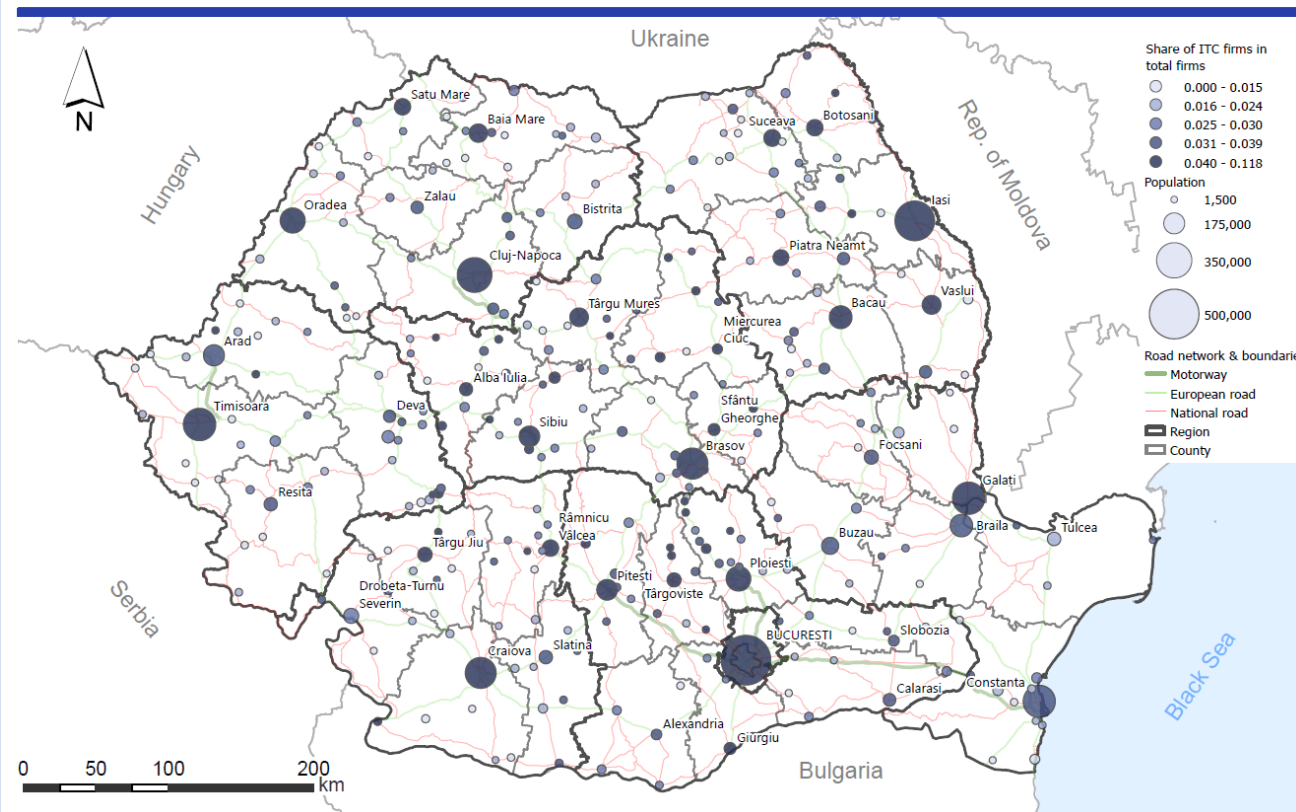


After the 2020 pandemic, digital growth became even more concentrated in cities that already had strong universities, skilled ICT workers, a diverse service economy and well-developed business networks. These cities are better able to use data and digital technology to improve public services and respond to changing urban needs. In contrast, the low share of ICT employment in many smaller towns points to a growing digital gap and a weaker ability to use digitalisation to support wider economic and social development.

Share of ITC firms in total firms (2013-2019)



Share of ITC firms in total firms (2020-2024)



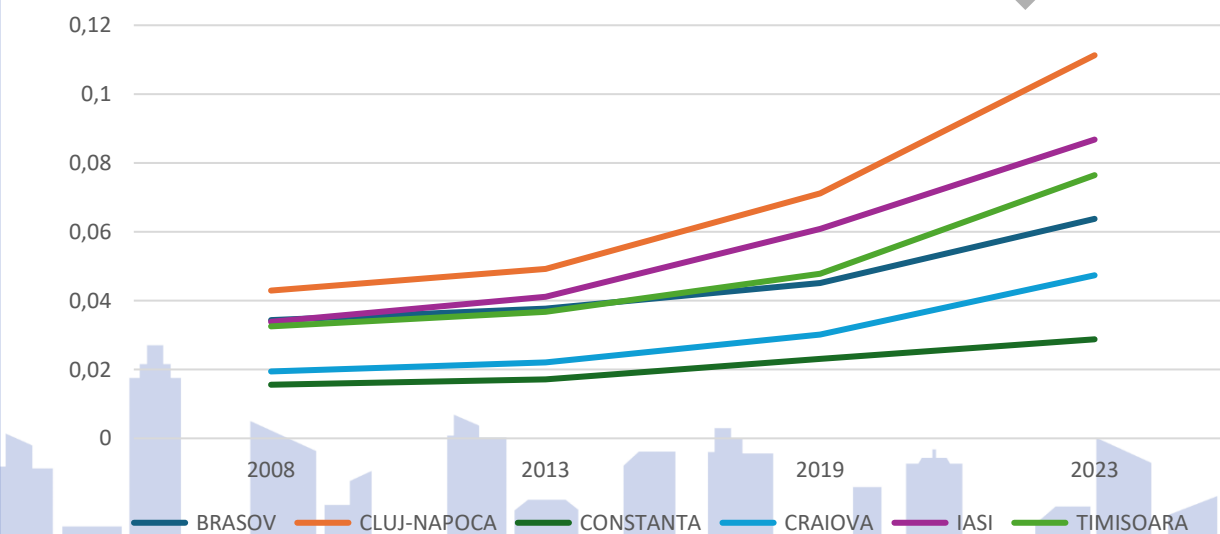
Share of ICT firms in total firms

ICT entrepreneurship is present across Romania's urban system, but remains most strongly concentrated in major metropolitan areas.

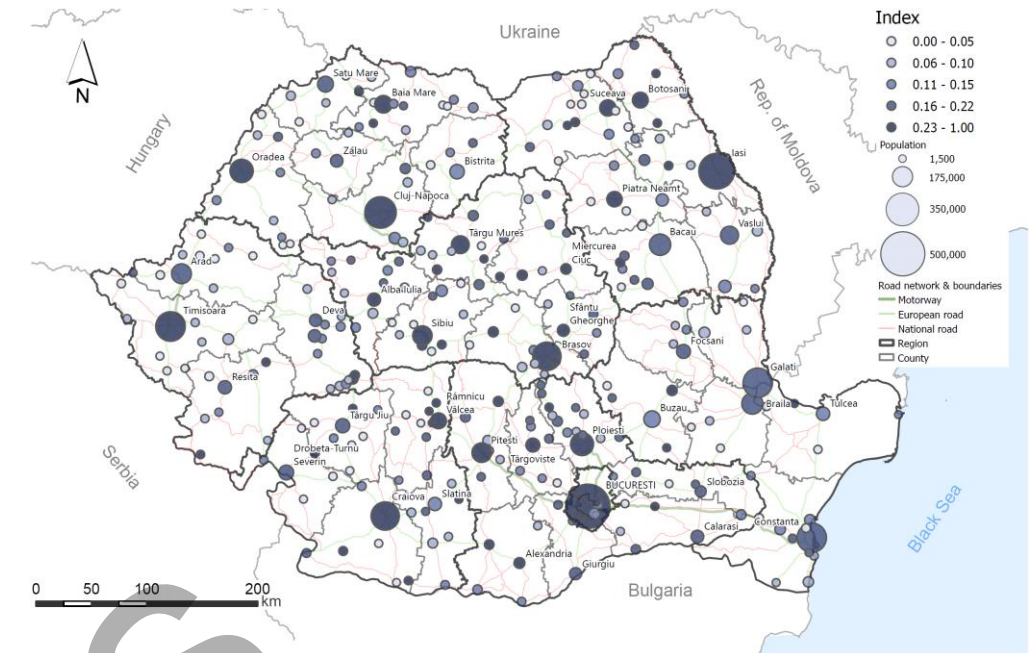
The post-2020 period indicates some diffusion of ICT firms beyond the largest cities, potentially supported by remote work, platform-based services and fewer obstacles to starting and running a digital business.

However, the presence of ICT firms does not necessarily imply a strong digital economy: transformative resilience depends on their scale, their links with other local businesses, and whether they help improve public services, strengthen local institutions and support economic diversification.

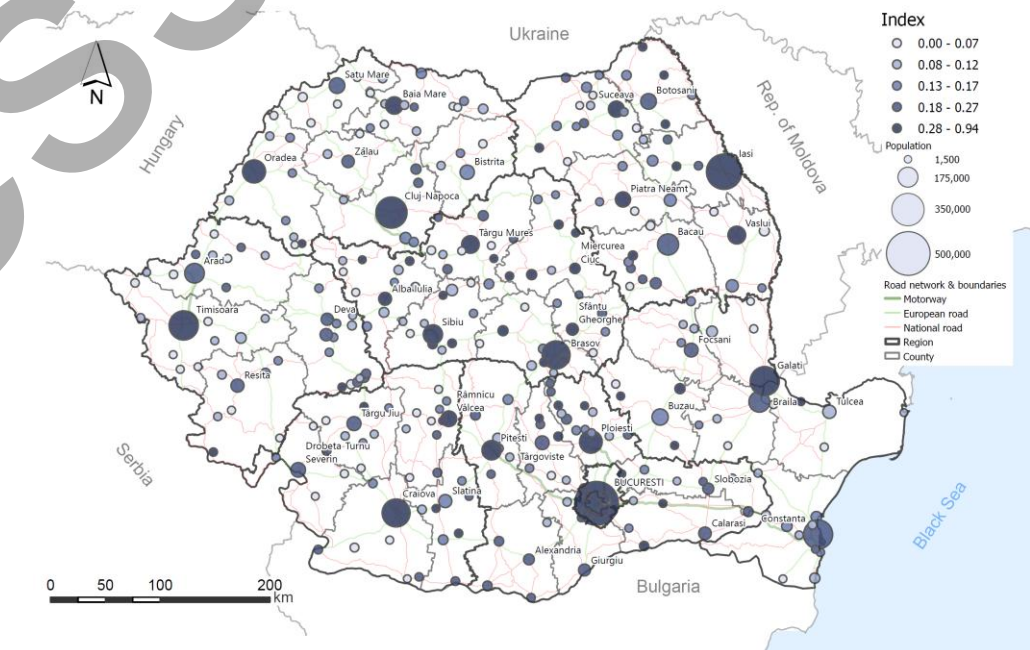
Share of IT firms (private sector)



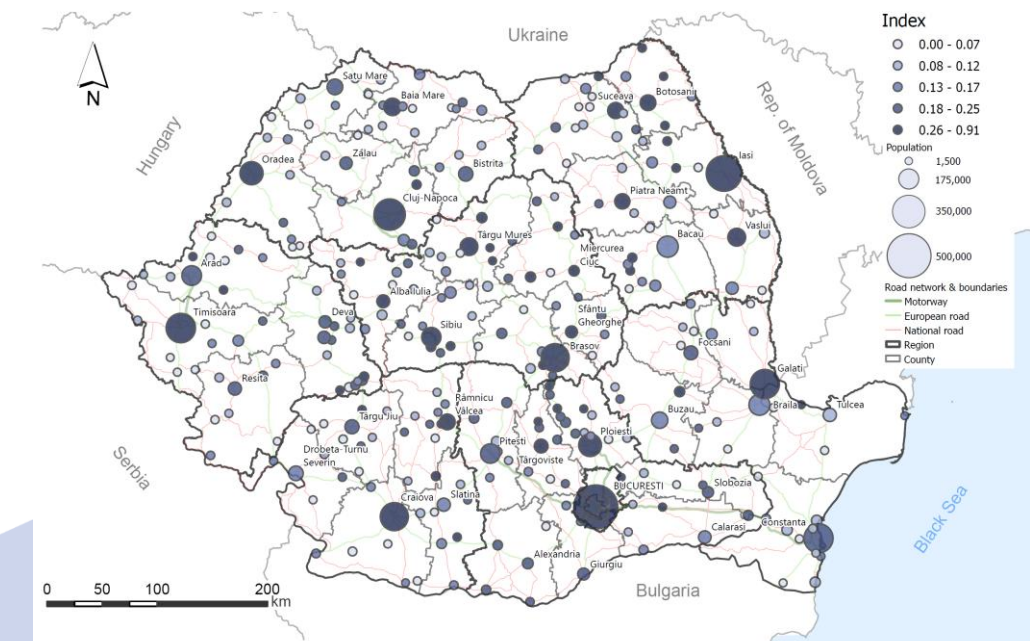
Digitalisation & Big Data Index (2007-2012)



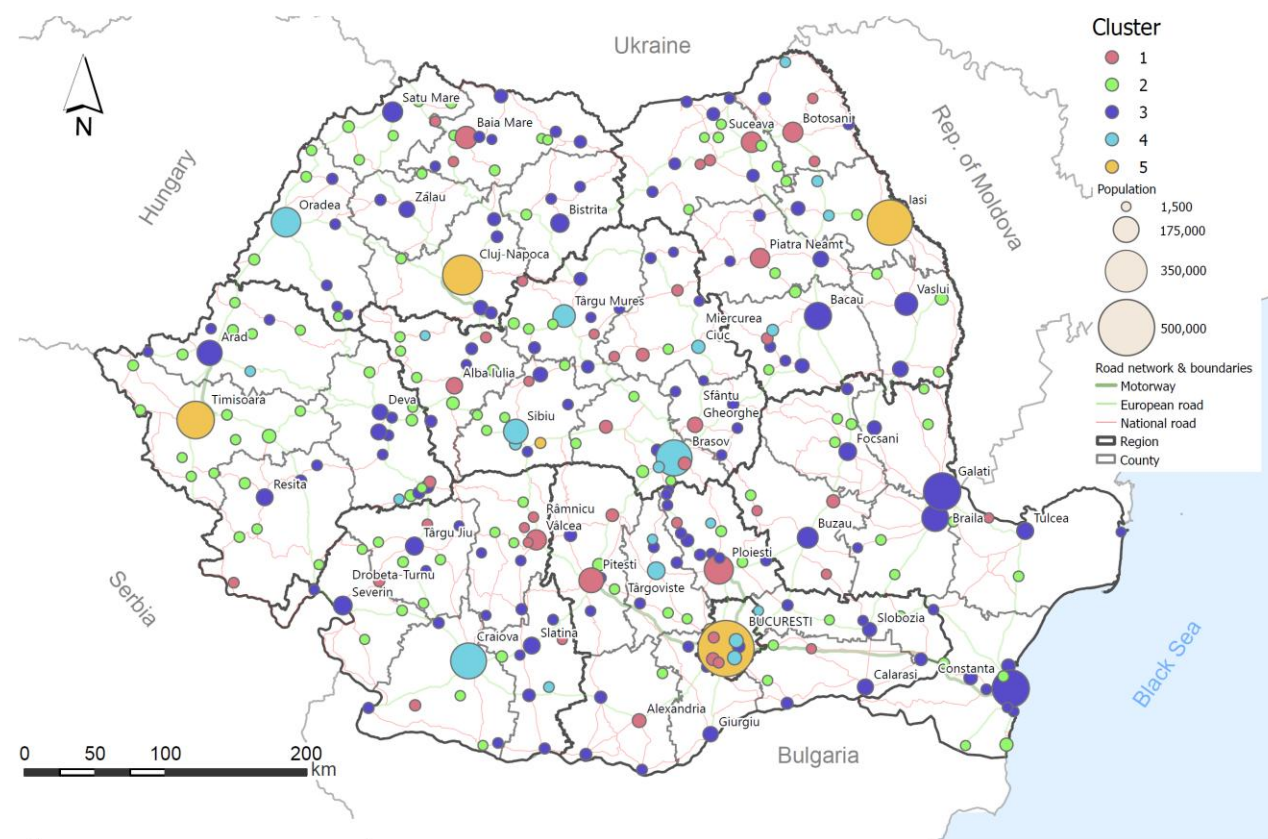
Digitalisation & Big Data Index (2013-2019)



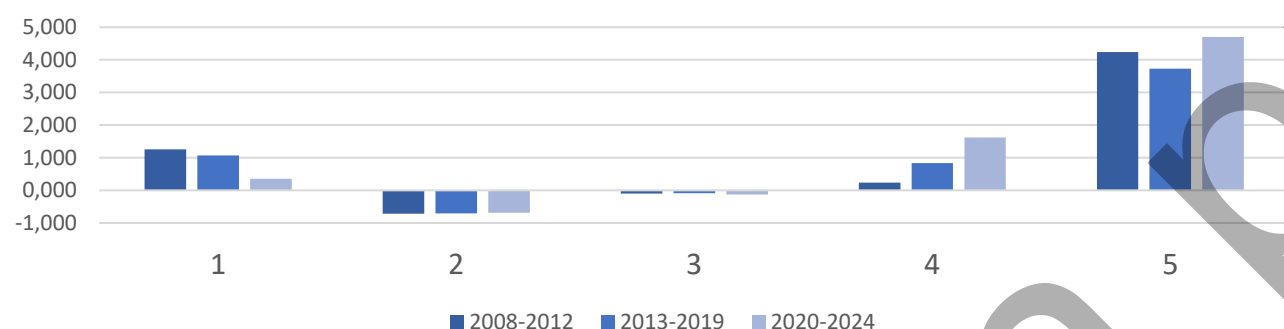
Digitalisation & Big Data Index (2020-2024)



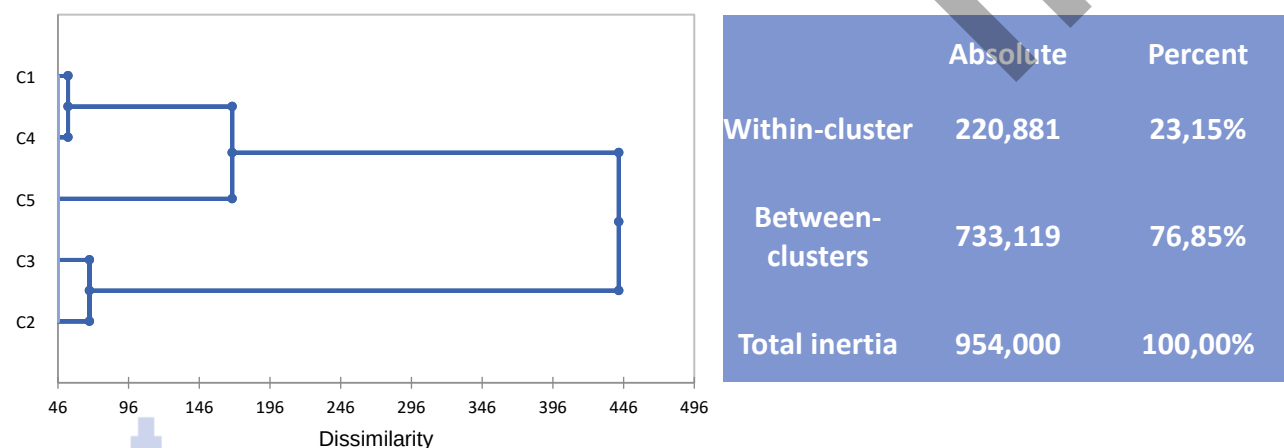
Digitalisation & Big Data Index Clusters



The profile of clusters



Dendrogram



Across the three periods, above-average digital performance remains concentrated in a limited number of urban centres, while many municipalities consistently record below-average values.

The pattern reflects strong path dependence. Cities with established ICT firms, specialised ICT employment, stronger business performance and digitally capable administrations tend to retain their advantage over time.

Leading cities appear as relatively isolated digital nodes, with limited evidence that their digital capabilities generate broad spillovers or regional convergence in surrounding territories.

Digitalisation can strengthen innovation and adaptive governance where economic and institutional capacities already coexist, but is also able to reinforce territorial inequalities where these foundations remain underdeveloped.

The index reveals a highly uneven geography of digital transformability, with the strongest digital ecosystems concentrated in metropolitan and university centres such as Bucharest, Cluj-Napoca, Iasi and Timisoara. In these cities, administrative digitalisation overlaps with skilled ICT employment, ICT entrepreneurial density, high ICT turnover and profitability, creating stronger foundations for data-driven governance, smart public services and innovation-led diversification.

Many small and medium-sized towns remain in the lower performance groups, showing that digital resilience requires more than having a municipal website. Digital resilience also depends on ICT-specific skills, economically viable ICT firms, institutional capacity for urban data analysis and the integration of digital technologies into local development.

Digitalisation can therefore strengthen adaptive capacity in leading urban centres while deepening territorial inequalities where local economic and administrative capabilities remain weak.

Conclusions

- Development of urban data platforms and smart tools for managing traffic, energy, and public services.
- From digitalisation as mere “e-bureaucracy” to the real-time use of data for adaptive decision-making – for example, adjusting mobility policies or public-space management in response to emerging behaviours and risks.
- Need for institutional and technical capacity for urban analytics, not only externally provided platforms.
- The share of local authorities with their own website shows a basic digitalisation of administrations, but says little about data-driven governance; transformability is relatively high where the website is a gateway to e-services and data collection, not just a static shop window.
- Indicators on ITC firms (share in total firms, turnover, profit and employment) suggest that digital transformability is concentrated in a few large urban centres (Bucharest, Cluj, Iasi, Timisoara, Brasov), where the IT&C sector is an economic engine and generates spillover effects in other branches.
- Many small municipalities and mono-industrial towns have a low number of ITC firms and a small share in the local economy, which indicates a limited capacity to use digitalisation as a vector of structural transformation and a risk of territorial digital divide.

Infrastructure and Mobility

This chapter evaluates the quality and coverage of urban technical infrastructure alongside population mobility patterns. It examines the modernization of the transport network and the density of essential utilities—specifically gas and sewage systems—relative to urban expansion and population size. Additionally, by correlating motorization rates with migration and settlement flows, the analysis provides a comprehensive overview of how physical infrastructure keeps pace with demographic shifts and the evolving demands of modern urban living.



Finished dwellings

Tracks the expansion of the local housing stock, reflecting real estate market dynamics and residential development trends.



Privately-owned passenger cars

Tracks motorization rates, serving as a proxy for both economic prosperity and potential environmental and traffic challenges.



Permanent immigrants

Measures the rate of individuals establishing a permanent legal residence in the area, reflecting the city's long-term demographic attractiveness.



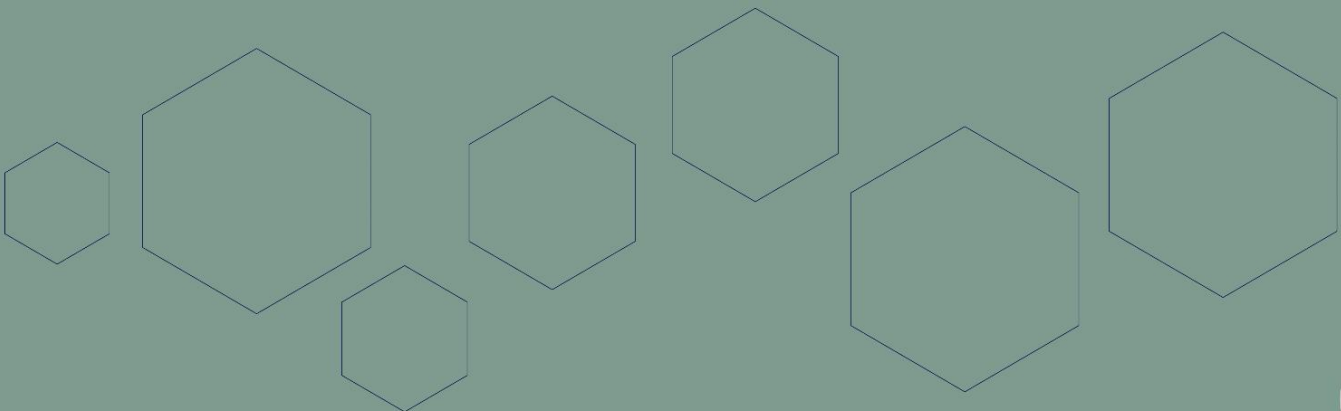
Settlings of the residence

Tracks the flow of people moving into the locality (including temporary or secondary residence), indicating social mobility and residential appeal.

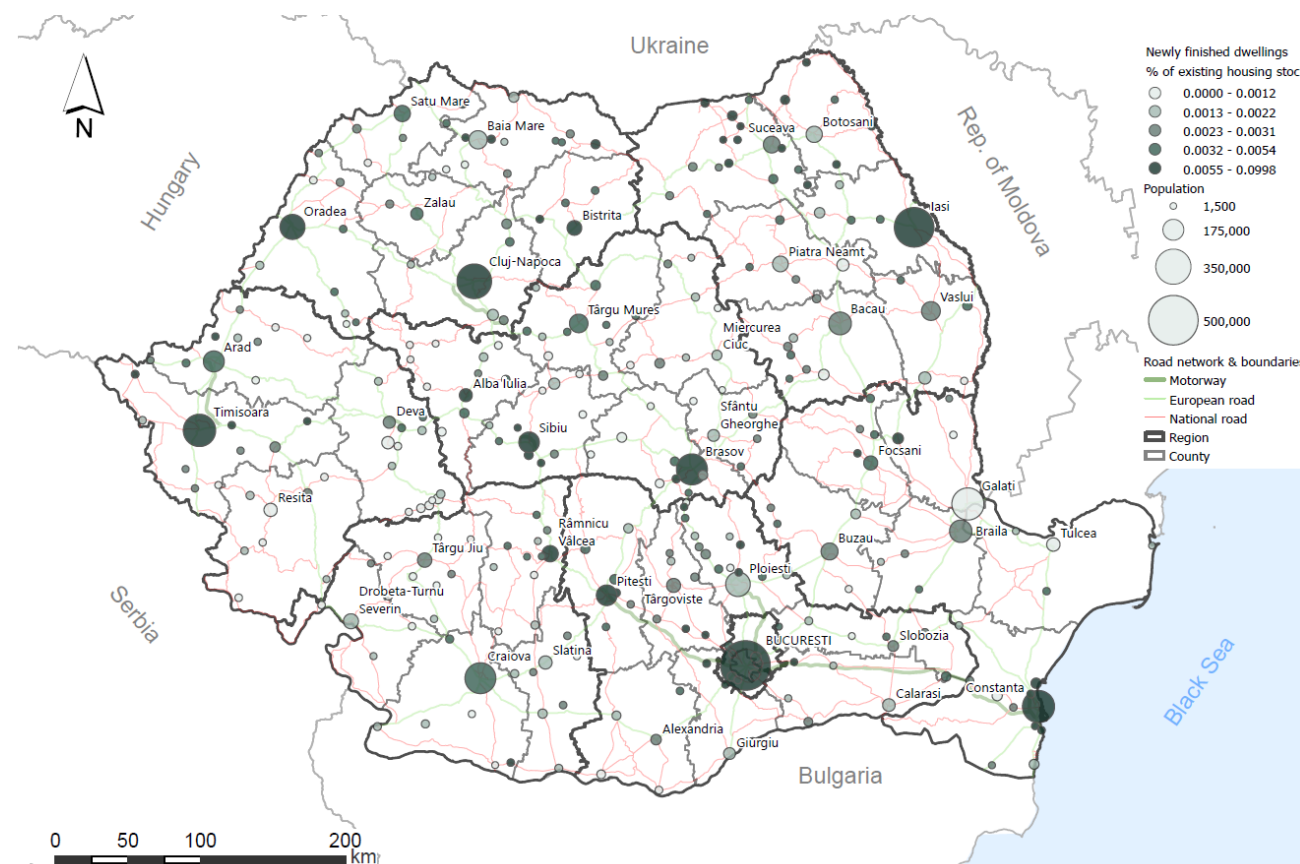


Rate of sewage network length

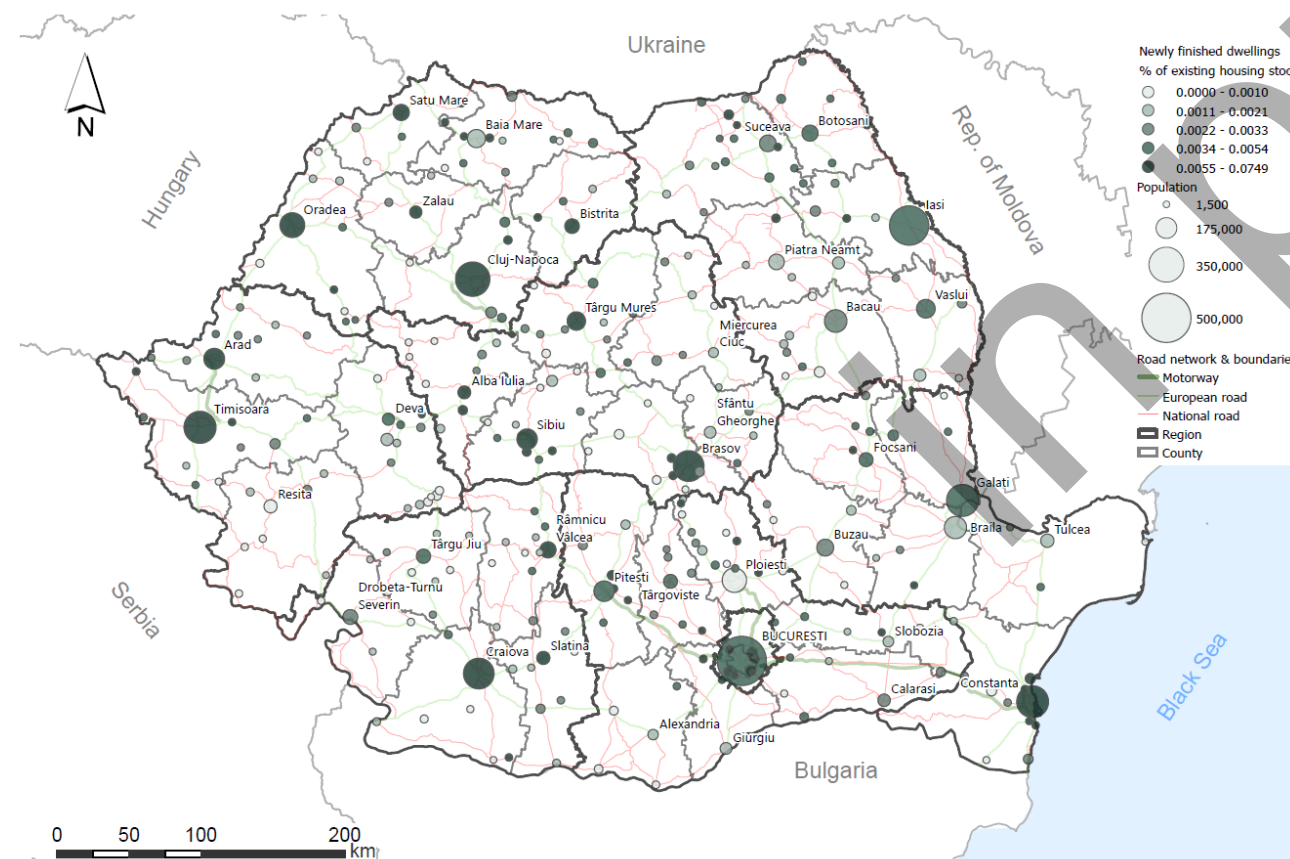
Evaluates the accessibility and development of essential sanitation infrastructure relative to the size of the population it serves.



Newly finished dwellings as share of existing housing stock (2013-2019)



Newly finished dwellings as share of existing housing stock (2020-2024)



The periods of 2013-2019 and 2020-2024 were marked by accelerated expansion of the built environment, particularly in cities that attract investment, population inflows, major university centers, and urban economies characterized by diversification and opportunities. This is most evident in Bucharest, Iași, Cluj-Napoca, Timișoara, and Constanța, with Oradea, Arad, Sibiu, Craiova, and Galați increasingly becoming part of this group.

A notable difference between the two periods is the intensification of construction activity in small and medium-sized cities during 2020-2024, alongside the satellites of Bucharest, whose growth has accelerated as the capital's core becomes saturated. This suggests a gradual redistribution of development pressure outward, both toward secondary urban centers and toward the metropolitan fringes of the largest cities.

At the same time, a broader residential shift is underway, as households with sufficient financial means increasingly opt for peri-urban locations in search of lower density, reduced noise and pollution, more affordable land prices, and greater access to green space. This preference is expressed both within the administrative boundaries of cities and in adjacent communes, as illustrated by cases such as Florești (Cluj County), Miroslava (Iași), and Moșnița Nouă (Timiș).

Official data points to a double issue: firstly, chaotic urban expansion, with the built-up area doubling between the early 1990s and the late 2010s, and secondly, the declining quality of life in city cores, driven by insufficient infrastructure.

The share of newly finished dwellings in the existing stock highlights where the housing system is structurally in motion. Where construction remains active and has not yet locked into low-density peripheries, planning instruments can still steer development toward more compact, energy-efficient, and socially mixed patterns.

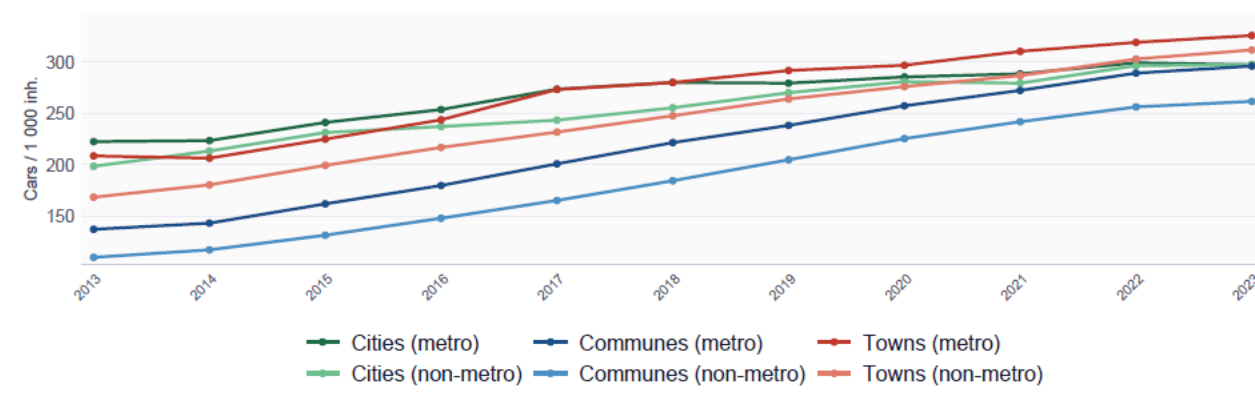
Data on sewage network length per 1,000 inhabitants captures the degree of infrastructural inclusion and the legacy of underinvestment that many Romanian cities continue to face. A persistent gap emerges between the pace at which built-up space expands and building permits are issued, and the pace at which the supporting infrastructure follows, such as technical and utility networks, roads, public transport, and urban services.

Across 2013-2019 and 2020-2024, cities with consistently high car ownership rates include Braşov, Iaşi, and Bucharest, alongside small towns in Constanţa County, Vaslui, Mediaş, Târgu Jiu, towns in Hunedoara and Arad County, and Roman. Relatively low values appear in cities where higher figures might be expected (Cluj-Napoca, Constanţa) as well as in Târgu Mureş and Suceava, the latter operating a fully electric bus fleet.

Between the two periods, increases are recorded in Bucharest, Oradea, Piatra Neamţ, and Reşiţa, while declines are observed in Satu Mare, Piteşti, Alba Iulia, and towns in Olt County.

Private Cars per 1 000 Inhabitants

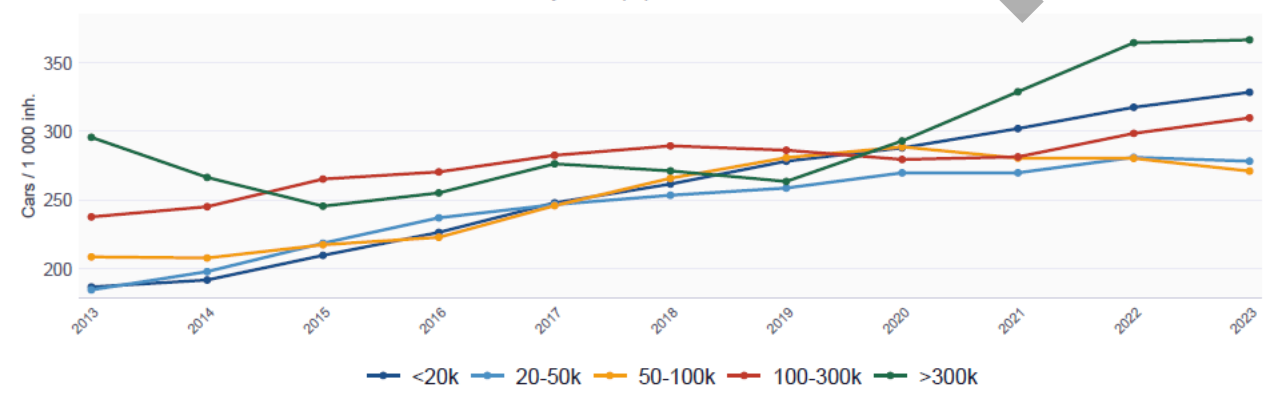
By urban-type class



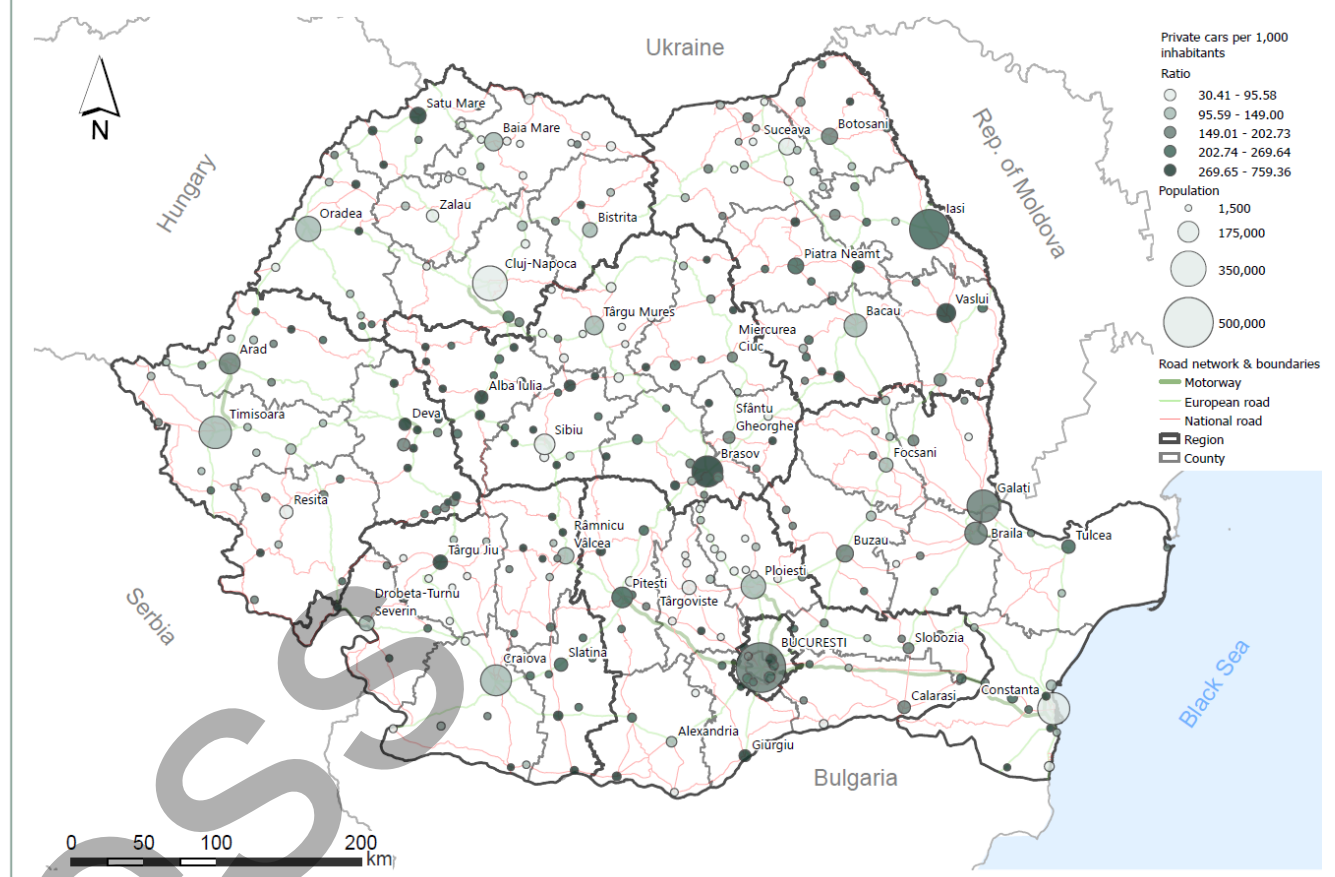
A growing trend is observed across all urban categories and across all population size classes. By settlement category, the highest car ownership rates are found in small towns located within metropolitan areas adjacent to large polarizing cities. The largest cities follow a more uneven trajectory: car numbers reached a trough around 2015, remained relatively stable through 2016-2020, and then rose sharply. Smaller towns, by contrast, display a far more consistent upward pattern throughout. At present, the highest average car ownership is recorded in the country's largest cities, while the lowest is found in medium-sized cities of between 50,000 and 100,000 inhabitants.

Private Cars per 1 000 Inhabitants

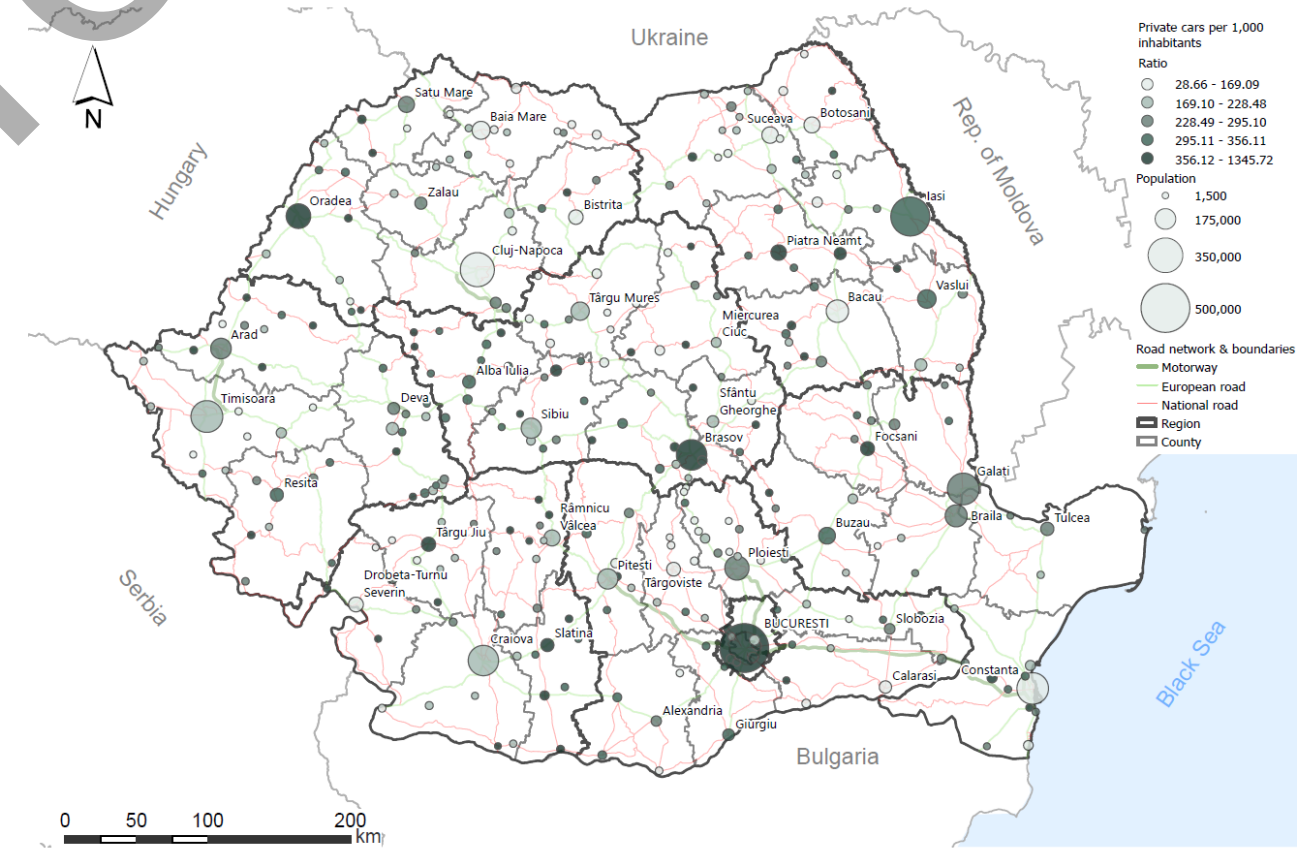
By urban population size class



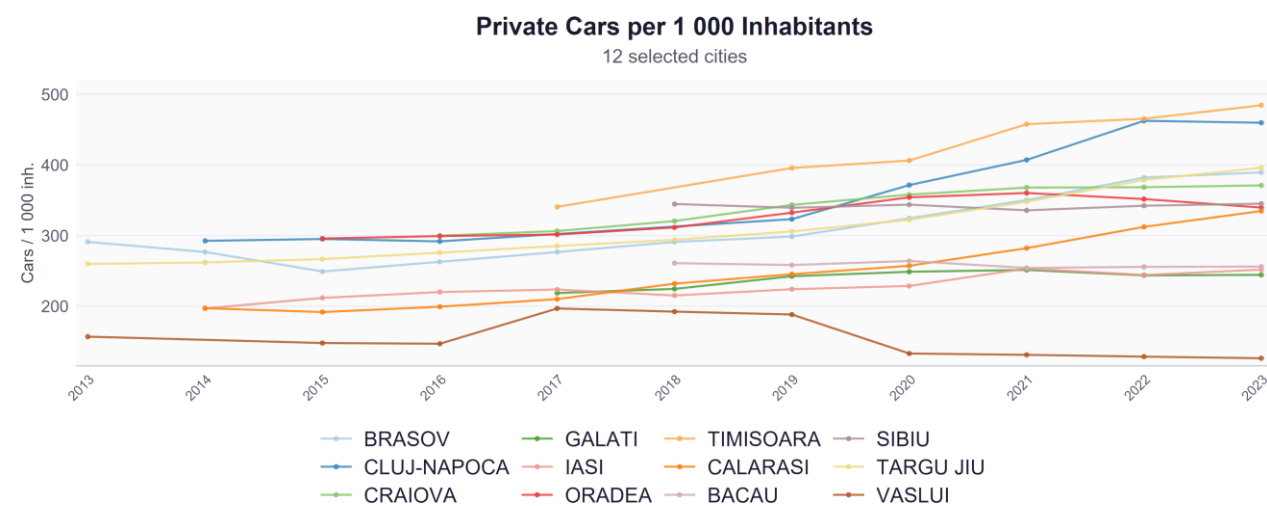
Private cars per 1,000 inhabitants (2013-2019)



Private cars per 1,000 inhabitants (2020-2024)

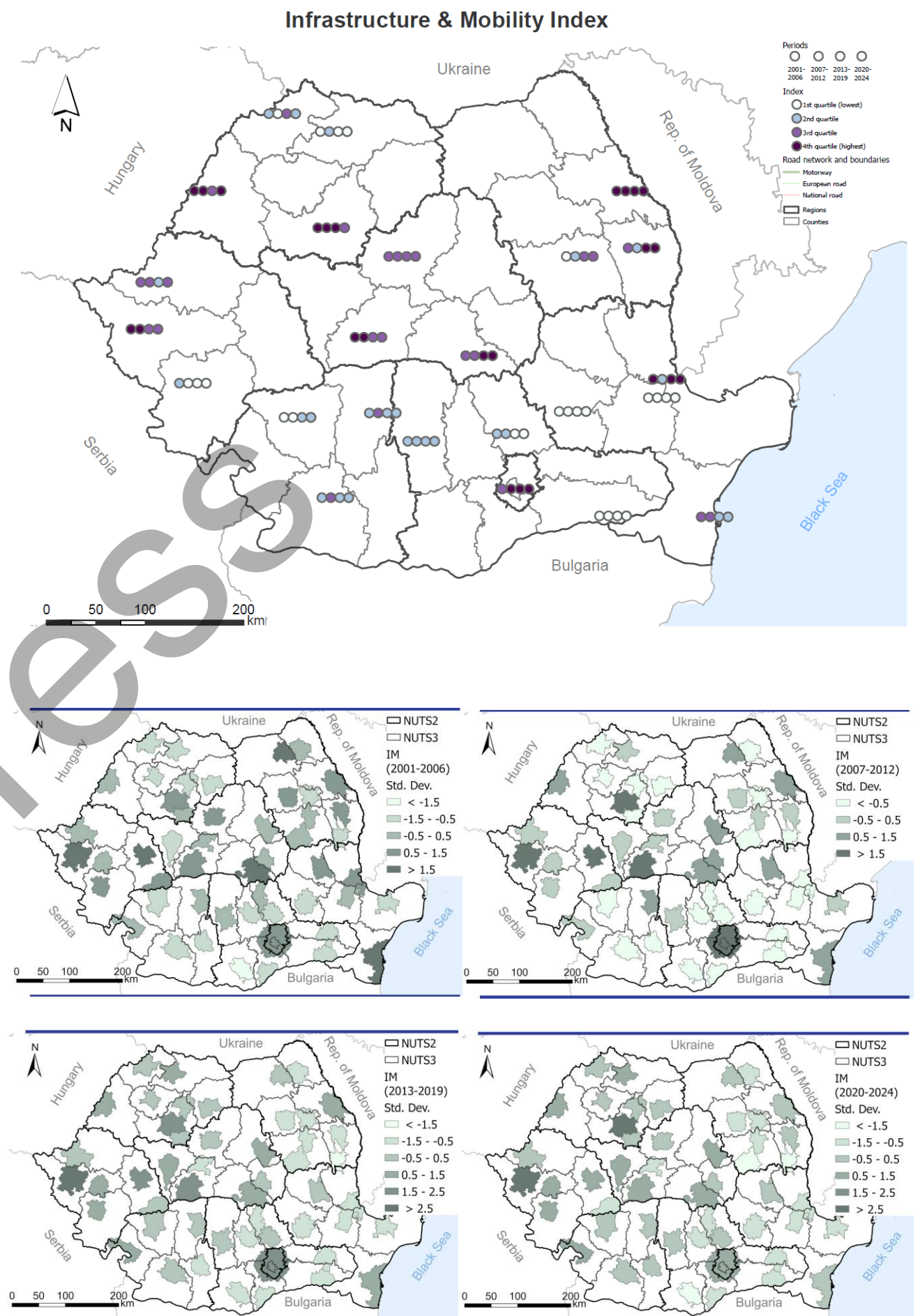


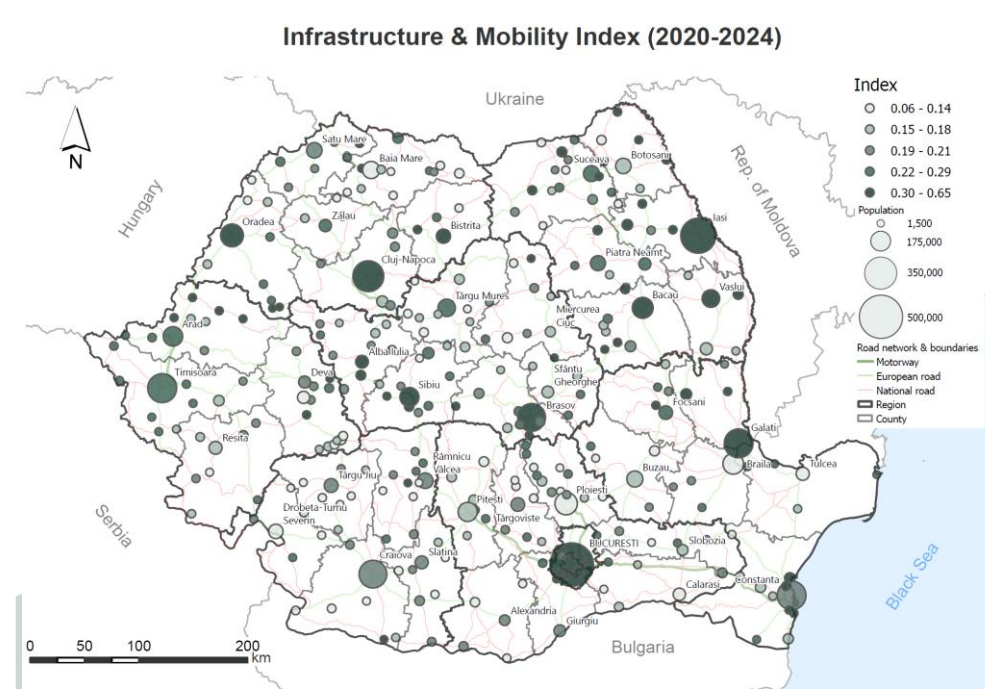
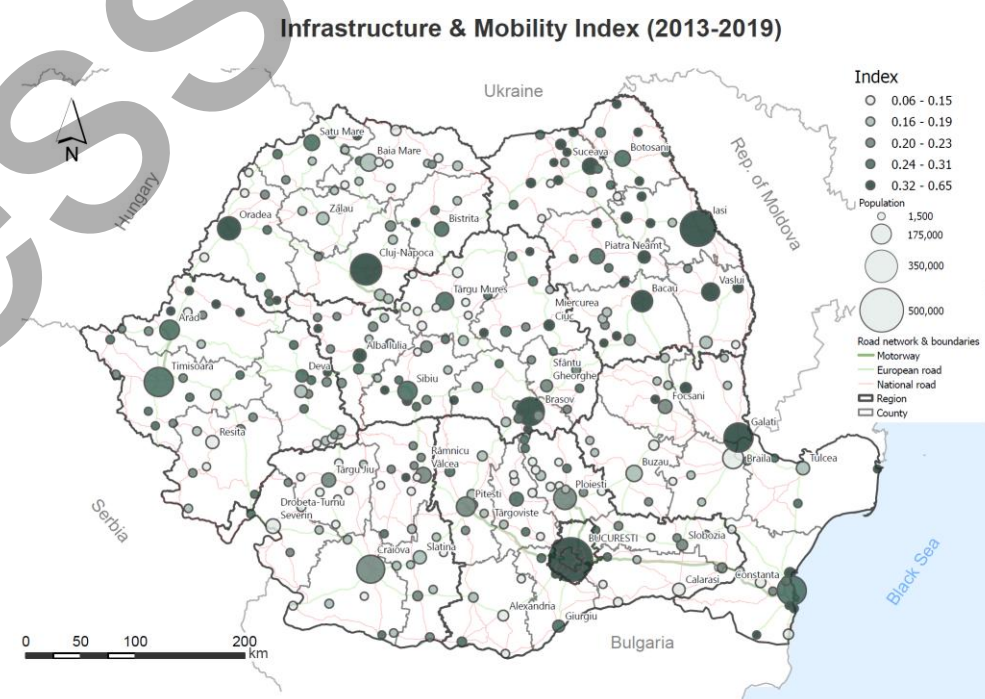
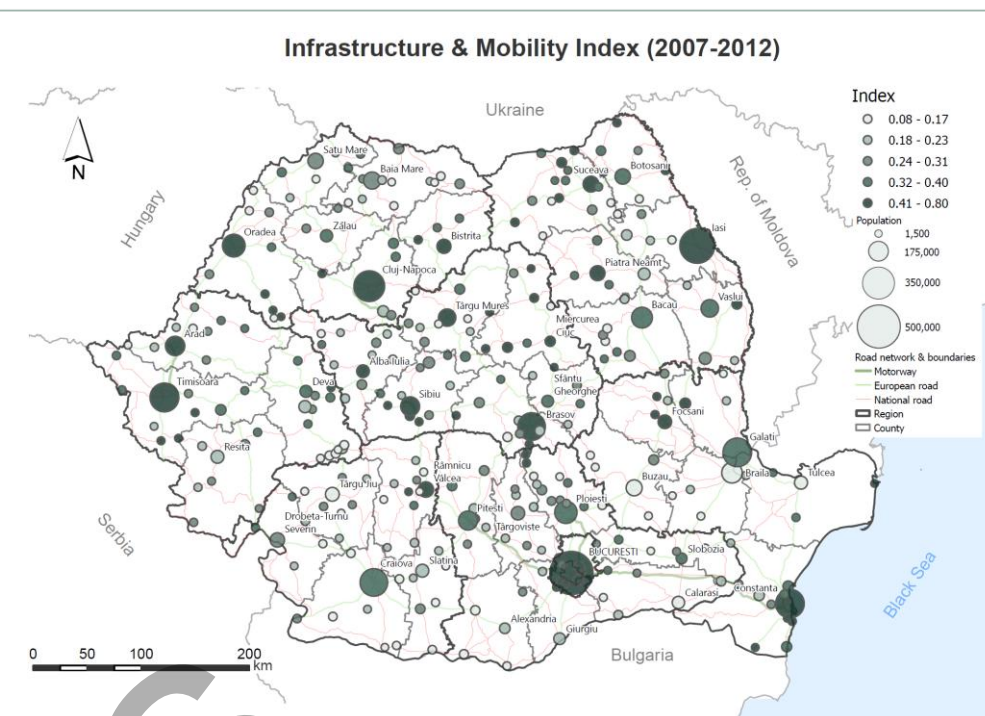
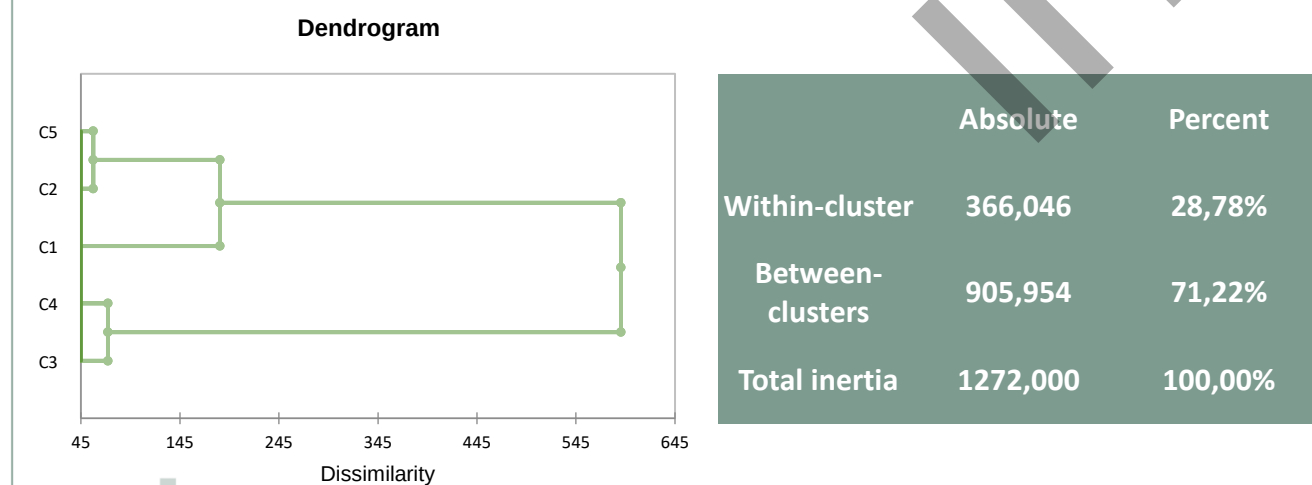
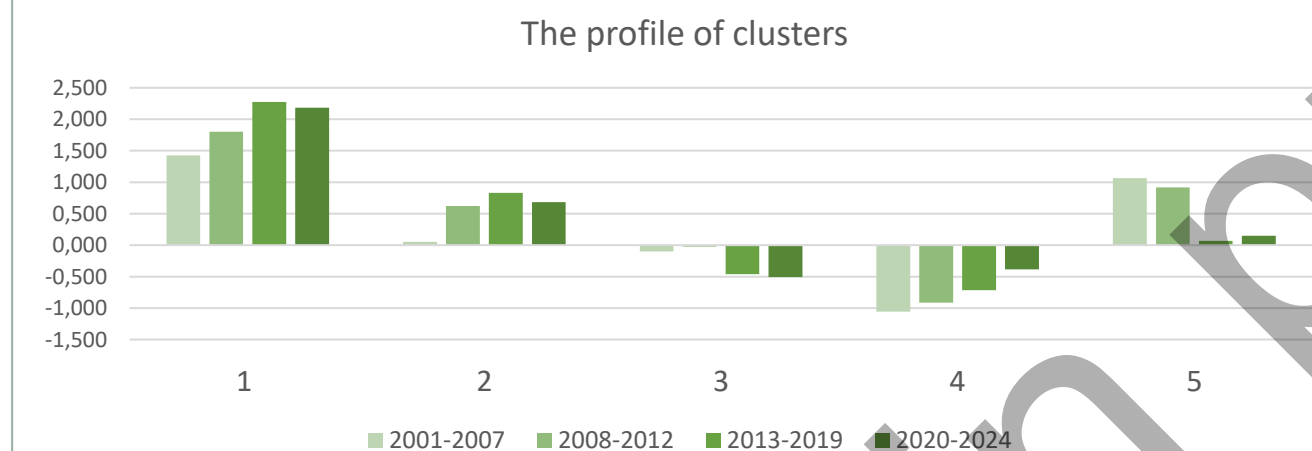
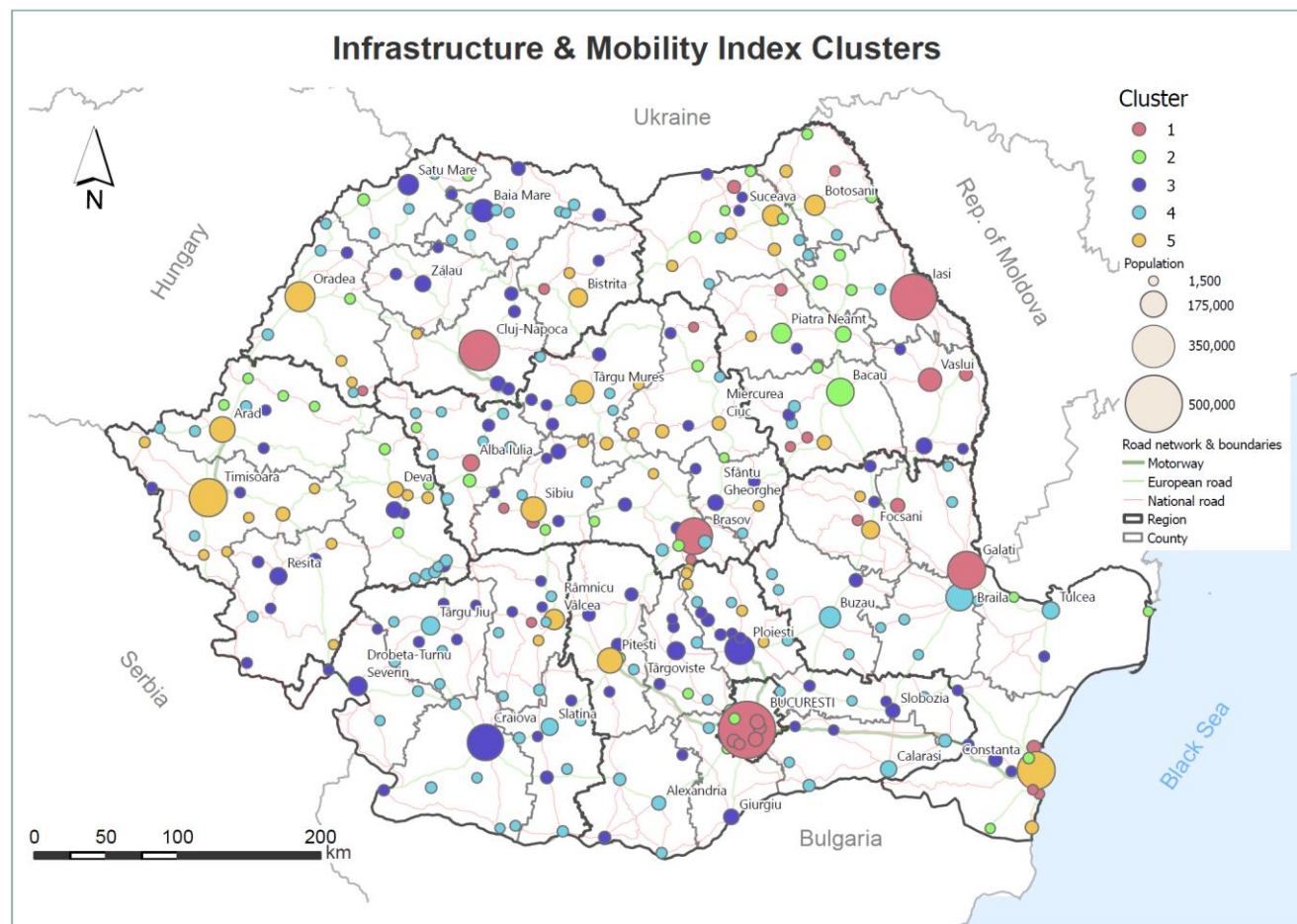
The number of private cars per 1,000 inhabitants indicates the depth of car dependence and the likely resistance to reallocation of road space; Romanian urban areas with high motorisation rates face stronger political and behavioural inertia against transformative mobility policies. Policies encouraging public transport do exist (green Fridays, expansion of networks into metropolitan and rural areas, the introduction of electric buses, fare concessions for young people and older adults), yet service frequency and route connectivity remain areas where improvement is still possible.



External and internal in-migration per 1,000 inhabitants serve as proxies for demographic dynamism and attractiveness: growing cities experience greater development pressure but also have more opportunities to redesign mobility and housing systems for newcomers, while shrinking cities tend to focus on maintaining legacy infrastructure.

Overall values for the infrastructure and mobility index across the four periods reflect consistently strong performance in the metropolitan areas of Cluj-Napoca, Bucharest, Iași, and Brașov. These are cities with favorable geographic positions, well-functioning intermunicipal cooperation, and sustained investment in infrastructure, transport, and mobility. Contrasting trends of gradual decline are observed in Ploiești, Constanța, and Sibiu.





Governance and Institutional Capacity

This chapter evaluates a local government’s ability to manage public resources effectively and deliver services efficiently. It focuses on financial autonomy (how much the city earns vs. relies on others), administrative efficiency (how well it spends money per resident), and collaborative power (how well it works with the EU and its own citizens to drive development). Essentially, it measures if a local authority has the professional skills, legal structures, and financial health to turn public money into long-term community growth.



EU funds

Non-repayable grants from the European Union used to finance specific regional development and infrastructure projects.



Total investment expenditure

The amount of the local budget spent on long-term capital assets (e.g., building roads or schools) rather than daily operations.



Total Expenditure to Total Revenue Ratio

A measure of fiscal balance; it shows if a city is spending within its means (surplus) or overspending (deficit).



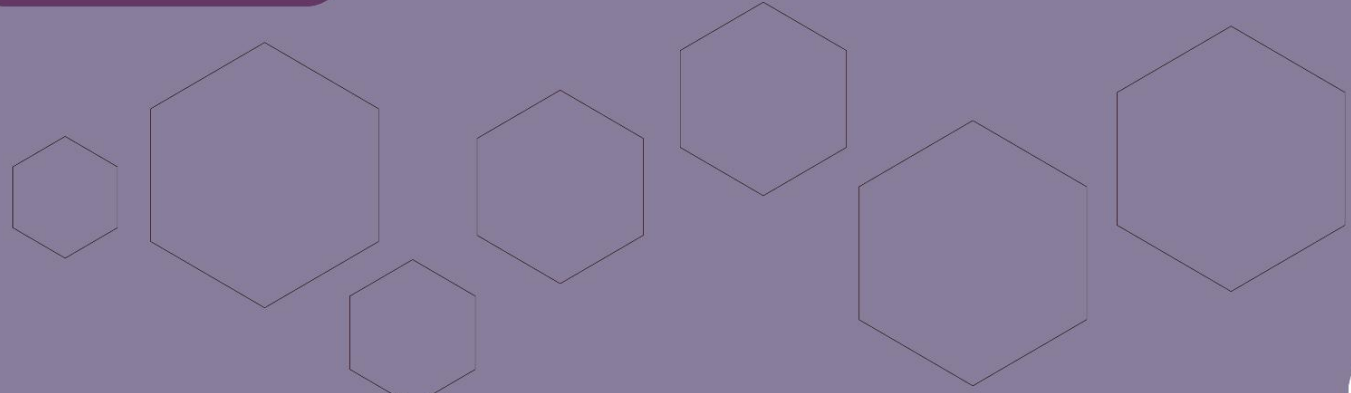
Share of own income in total local budget income

This indicator reflects local financial autonomy by showing the percentage of the total budget generated from a municipality's own taxes and fees rather than external funding.

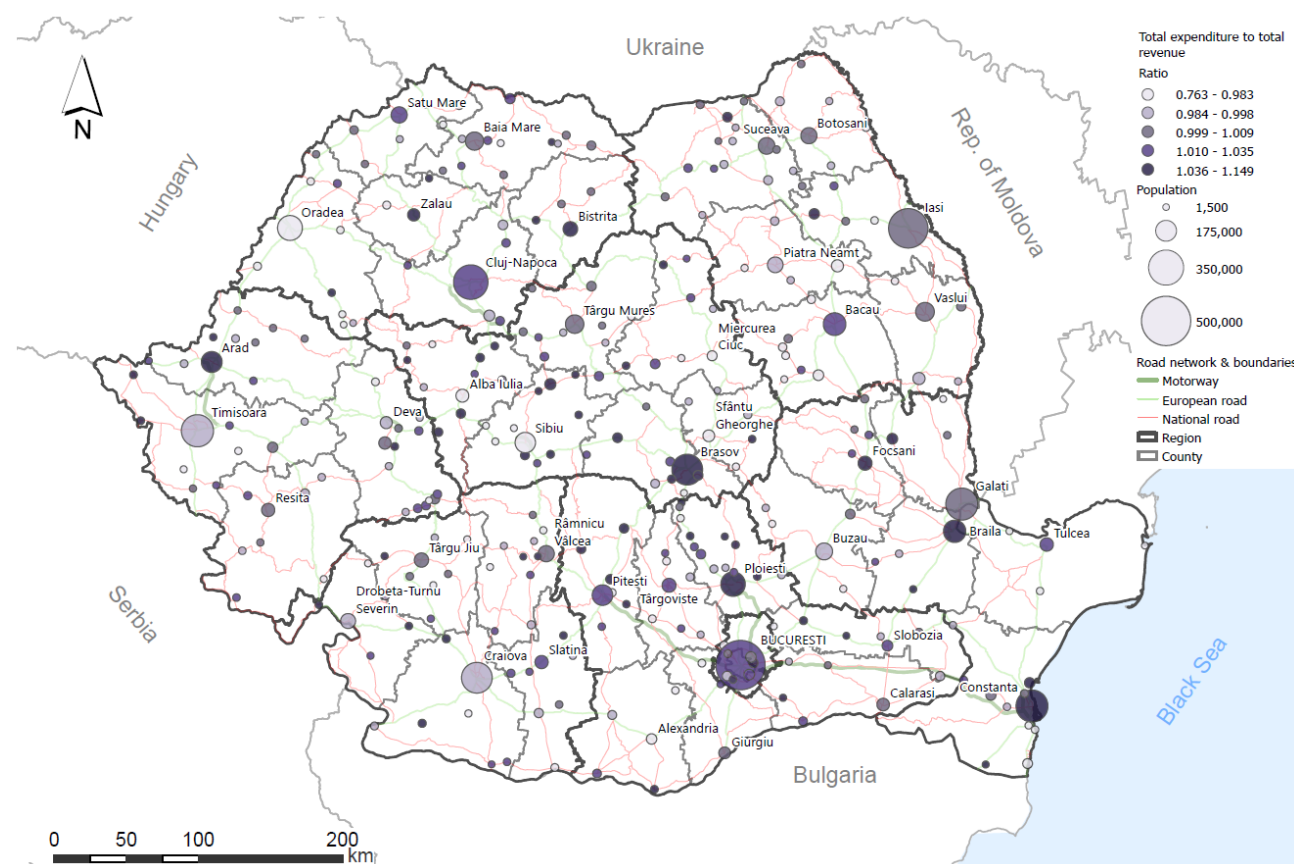


CBIs (Community Based Initiatives)

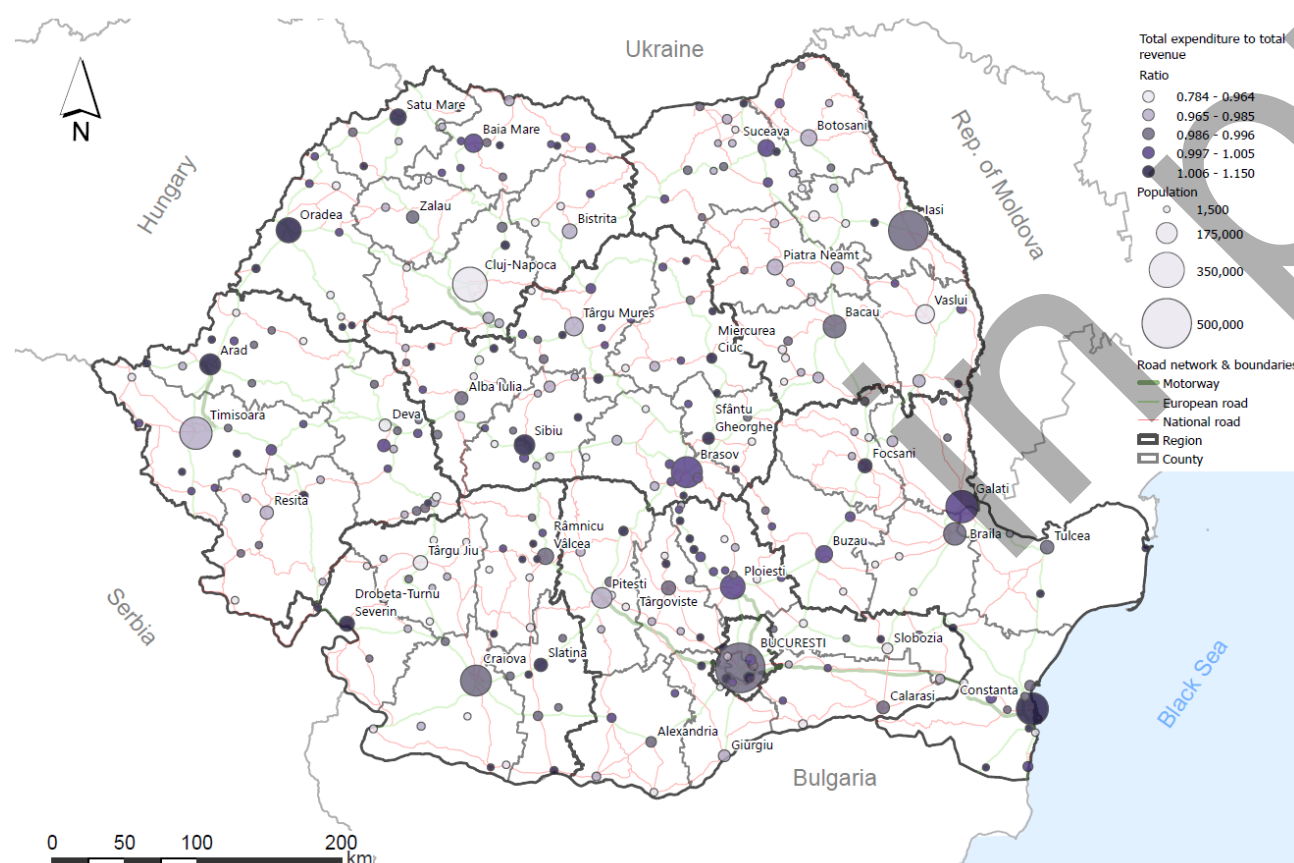
Local projects planned and managed by residents, often supported by small grants or participatory budgeting.



Total expenditure to total revenue (2013-2019)

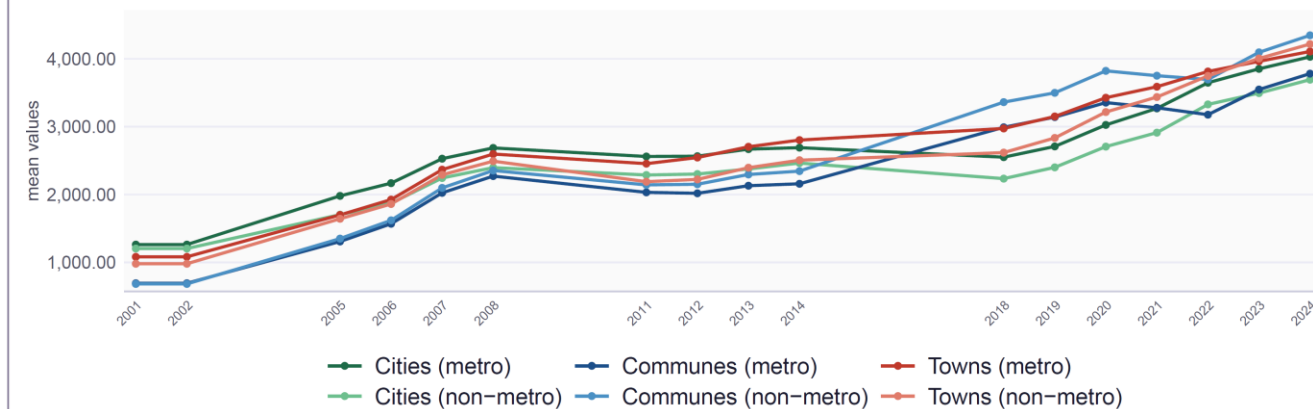


Total expenditure to total revenue (2020-2024)



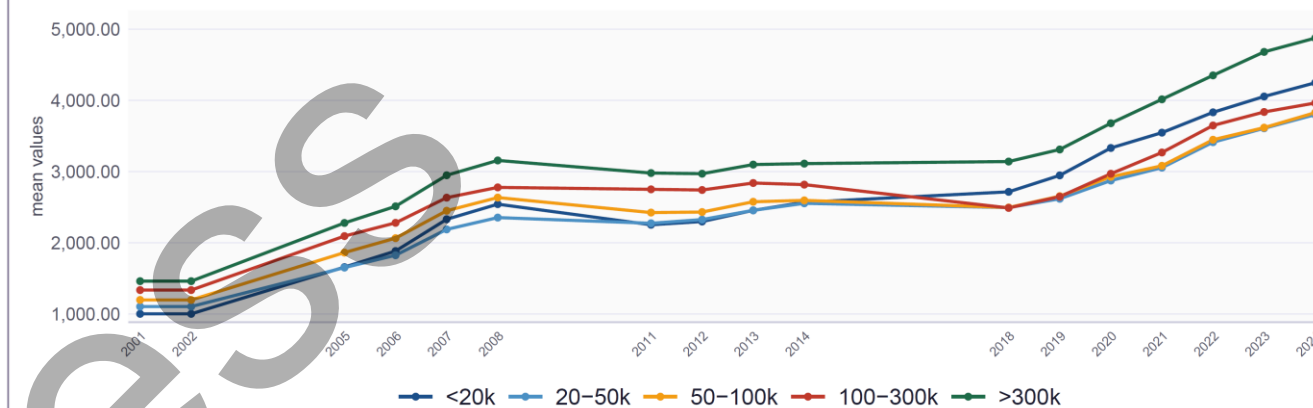
Total Expenditures (Local Budget Execution) (RON) per Capita

By urban-type class



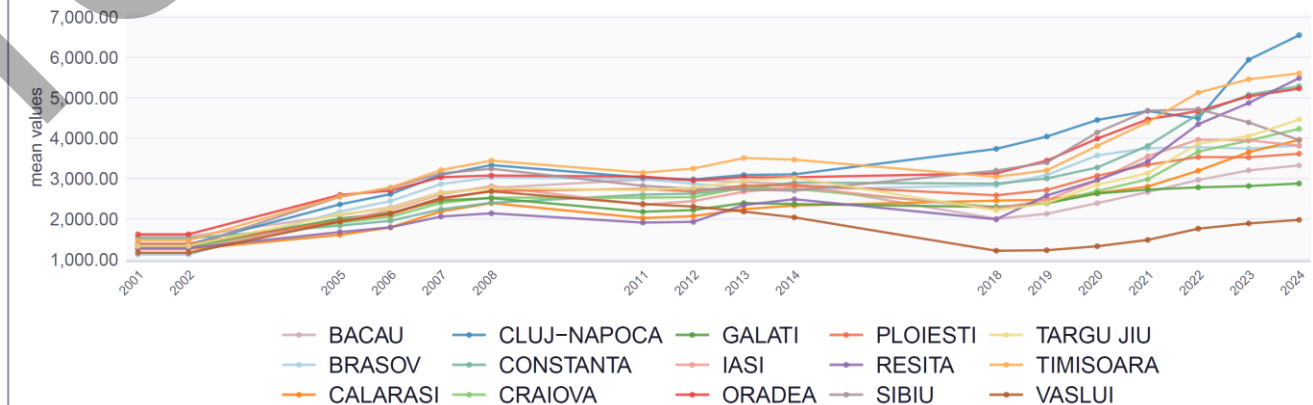
Total Expenditures (Local Budget Execution) (RON) per Capita

By urban population size class



Total Expenditures (Local Budget Execution) (RON) per Capita

15 selected cities



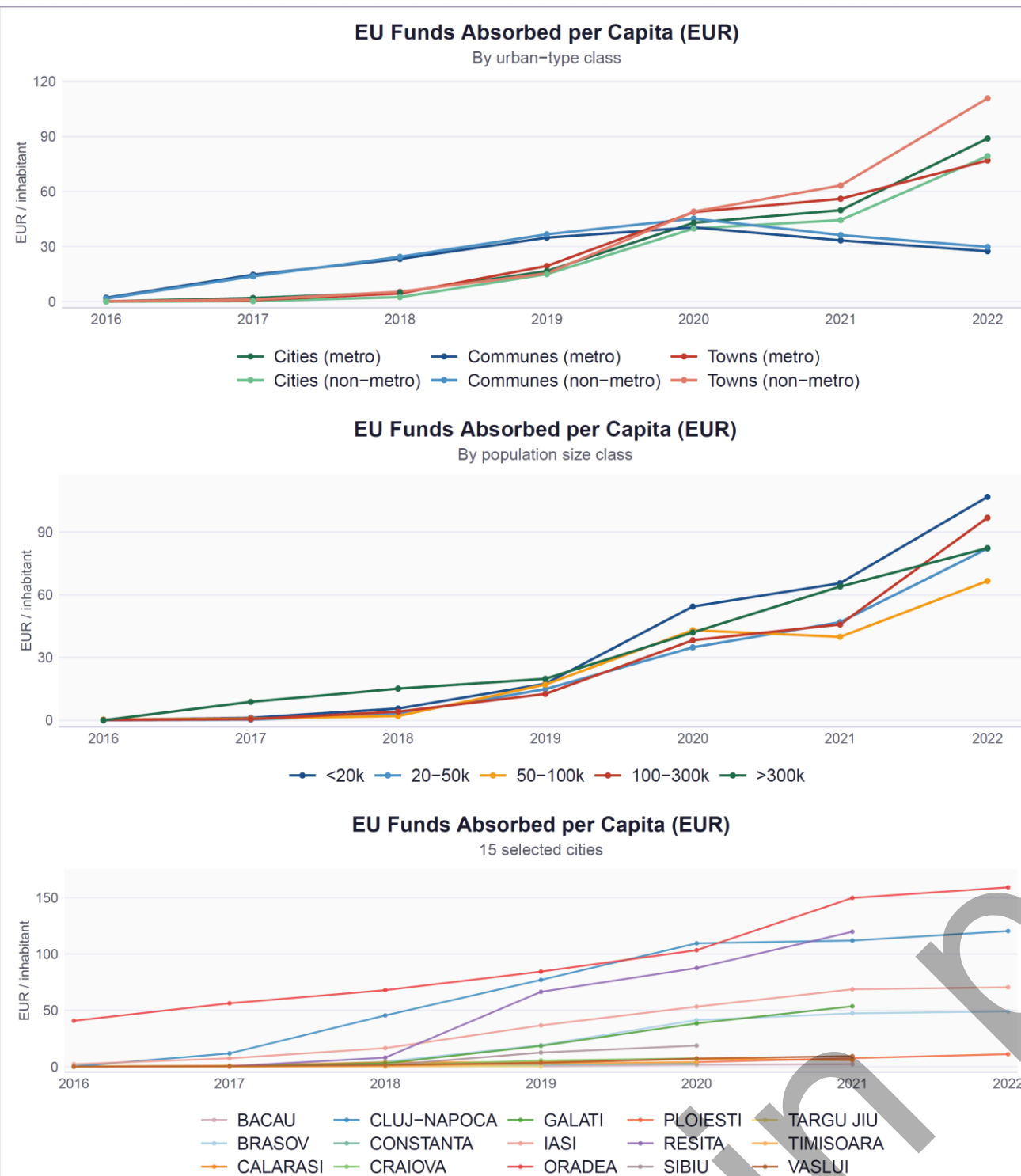
Total expenditure to total revenue ratio

The 2013–2019 pattern suggests a local governance model oriented toward budgetary equilibrium rather than the strategic use of expenditure for urban restructuring.

After 2020, fiscal behaviour remained broadly prudent, but resilience depends on the quality of spending, not only on fiscal balance.

Overall many Romanian municipalities show fiscal stability, but this stability does not necessarily translate into transformative capacity.

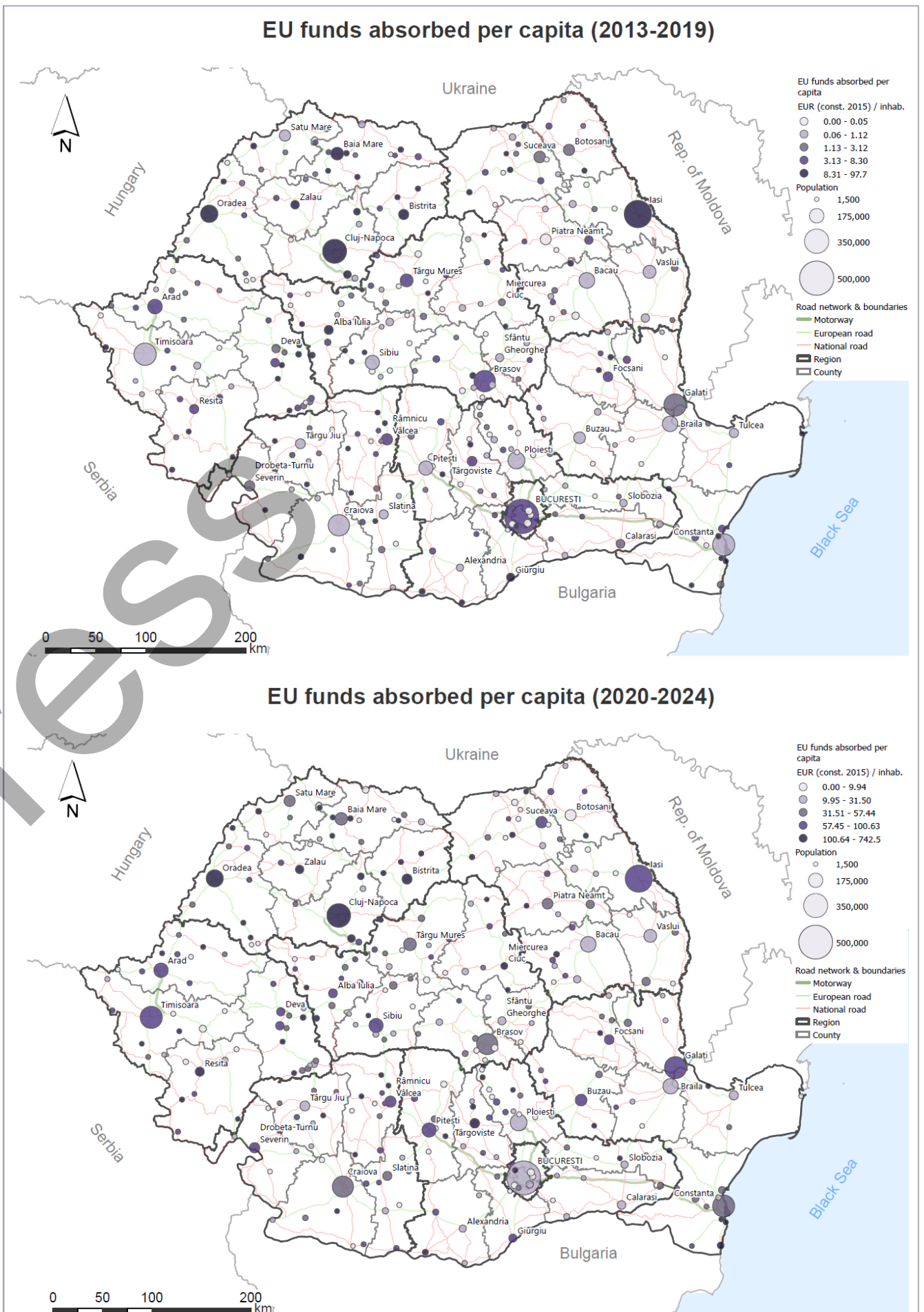
The key question is whether expenditure became more strategic over the years (with investments in green transition, digitalisation or social inclusion), or whether cities merely absorbed crisis-related pressures without changing their development model.



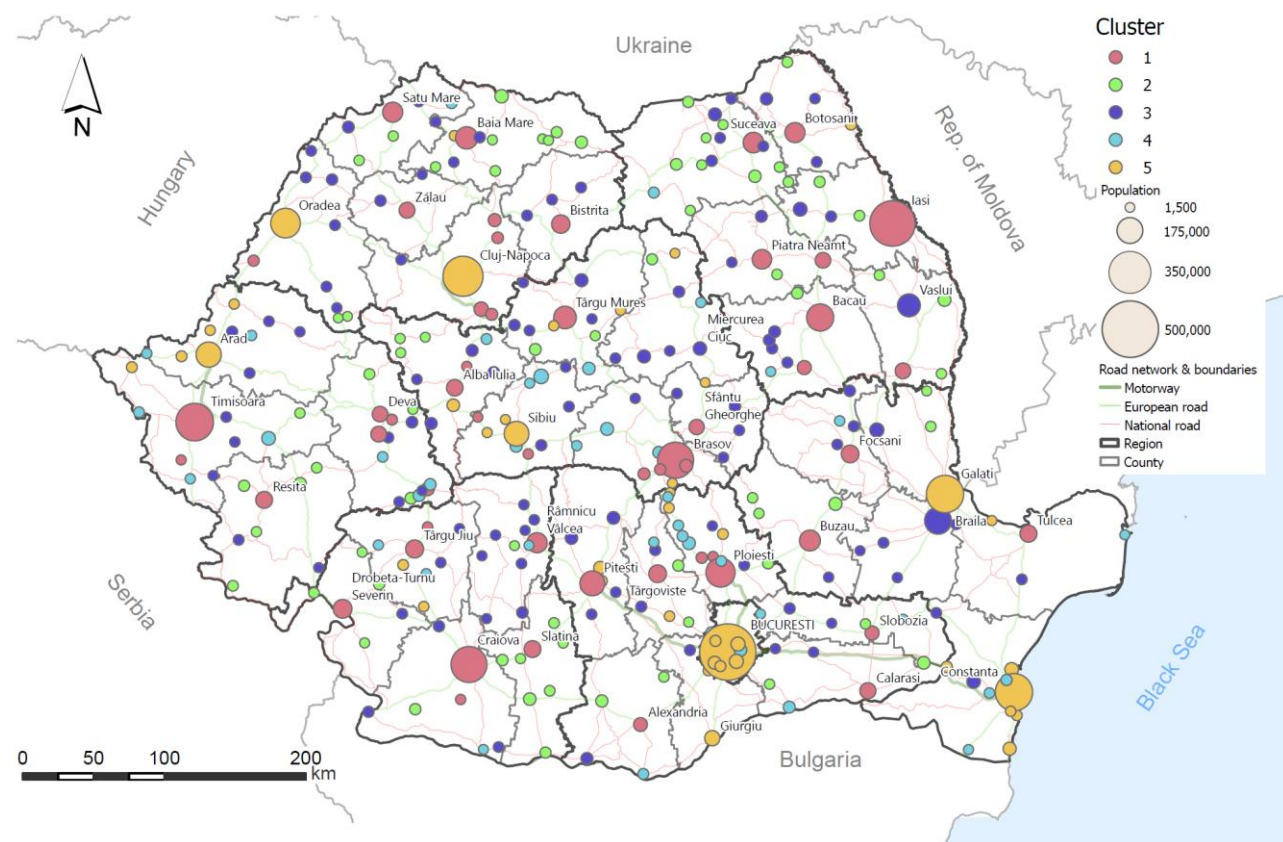
EU funds absorbed per capita

EU fund absorption before 2020 reveals uneven institutional capacity across Romanian municipalities. Some cities used EU funding as a strategic resource for infrastructure, services and urban upgrading, while others remained peripheral to EU-supported transformation.

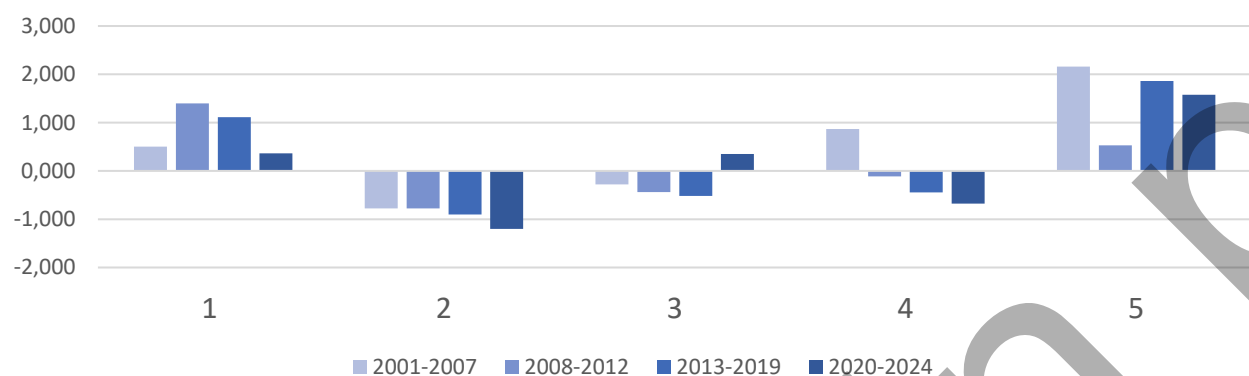
The post-2020 period did not reduce territorial differences; in many cases, it amplified them. EU funds became a major driver for urban resilience, but mainly where local governments were already capable of transforming funding opportunities into coherent projects of change.



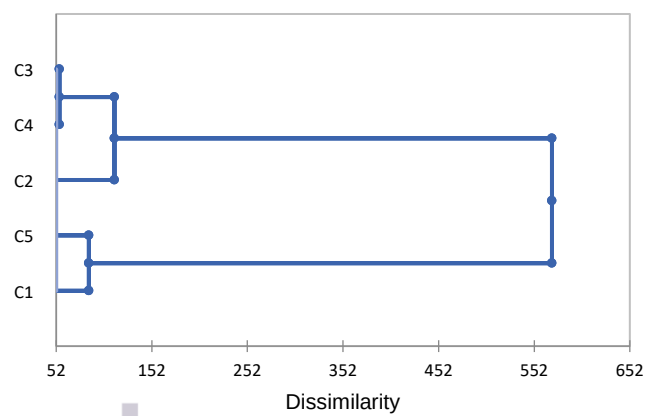
Governance & Institutions Index Clusters



The profile of clusters

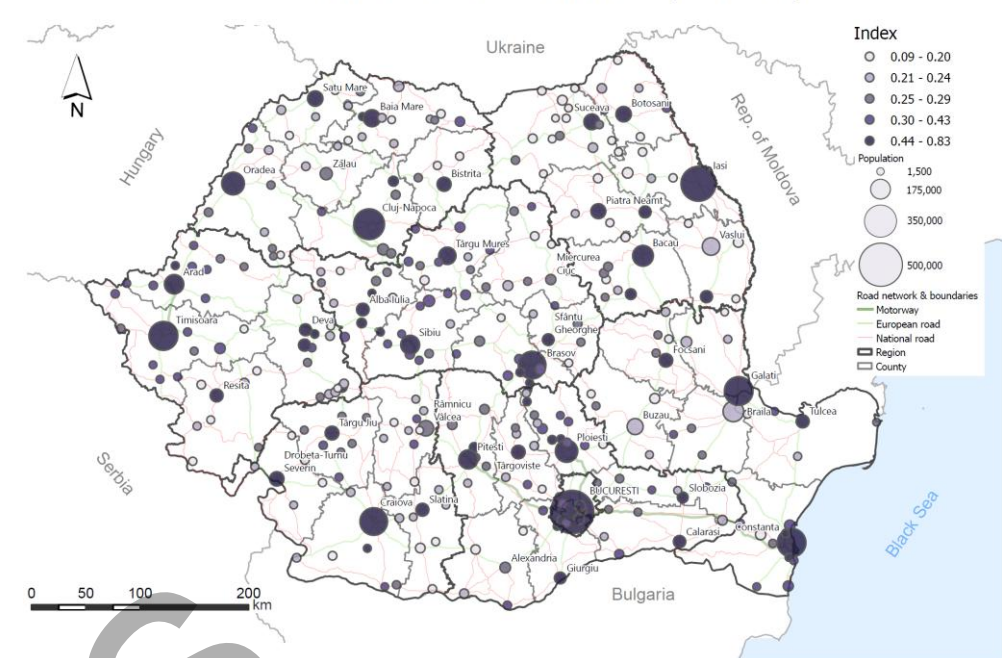


Dendrogram

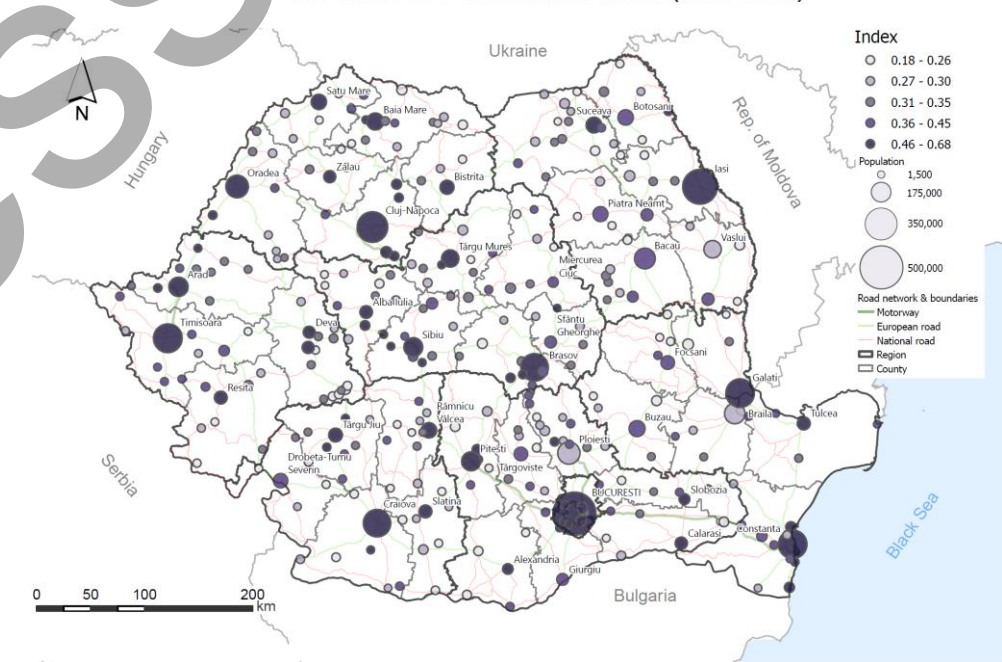


	Absolute	Percent
Within-cluster	446,884	35,13%
Between-clusters	825,116	64,87%
Total inertia	1272,000	100,00%

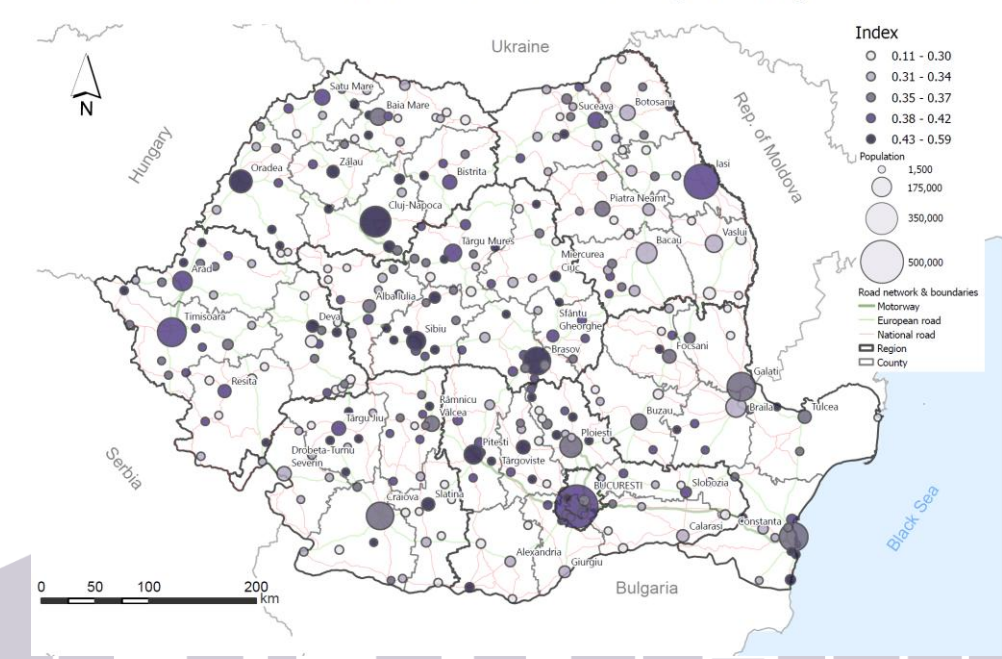
Governance & Institutions Index (2007-2012)



Governance & Institutions Index (2013-2019)



Governance & Institutions Index (2020-2024)



The Governance & Institutions Index shows that transformative resilience is unevenly institutionalised across Romania's urban system. EU funds and local budgets create opportunities for change, but these opportunities are filtered through administrative capacity, professional expertise and the strength of local civil society. The map therefore shows not just where governance is stronger, but where cities are more likely to turn crises and funding cycles into durable urban transformation.

High performance is not determined by city size alone, but by the capacity to combine fiscal autonomy, investment effort, EU-fund absorption and civic mobilisation. Lower-ranking municipalities suggest more fragile governance conditions, including limited fiscal room, weaker project pipelines, thinner civic infrastructure and stronger dependence on externally defined funding opportunities.

The temporal maps show that institutional capacity in Romania is uneven, path-dependent and difficult to consolidate.

A limited group of cities and metropolitan areas repeatedly appears in the higher quartiles and above the national average, suggesting cumulative advantages in administrative expertise, fiscal autonomy, civic density and EU-project implementation. At the same time, the changing relative positions show that governance performance is not fixed. Some territories improve when funding cycles, local leadership and project pipelines align, while others remain locked into weaker institutional positions.

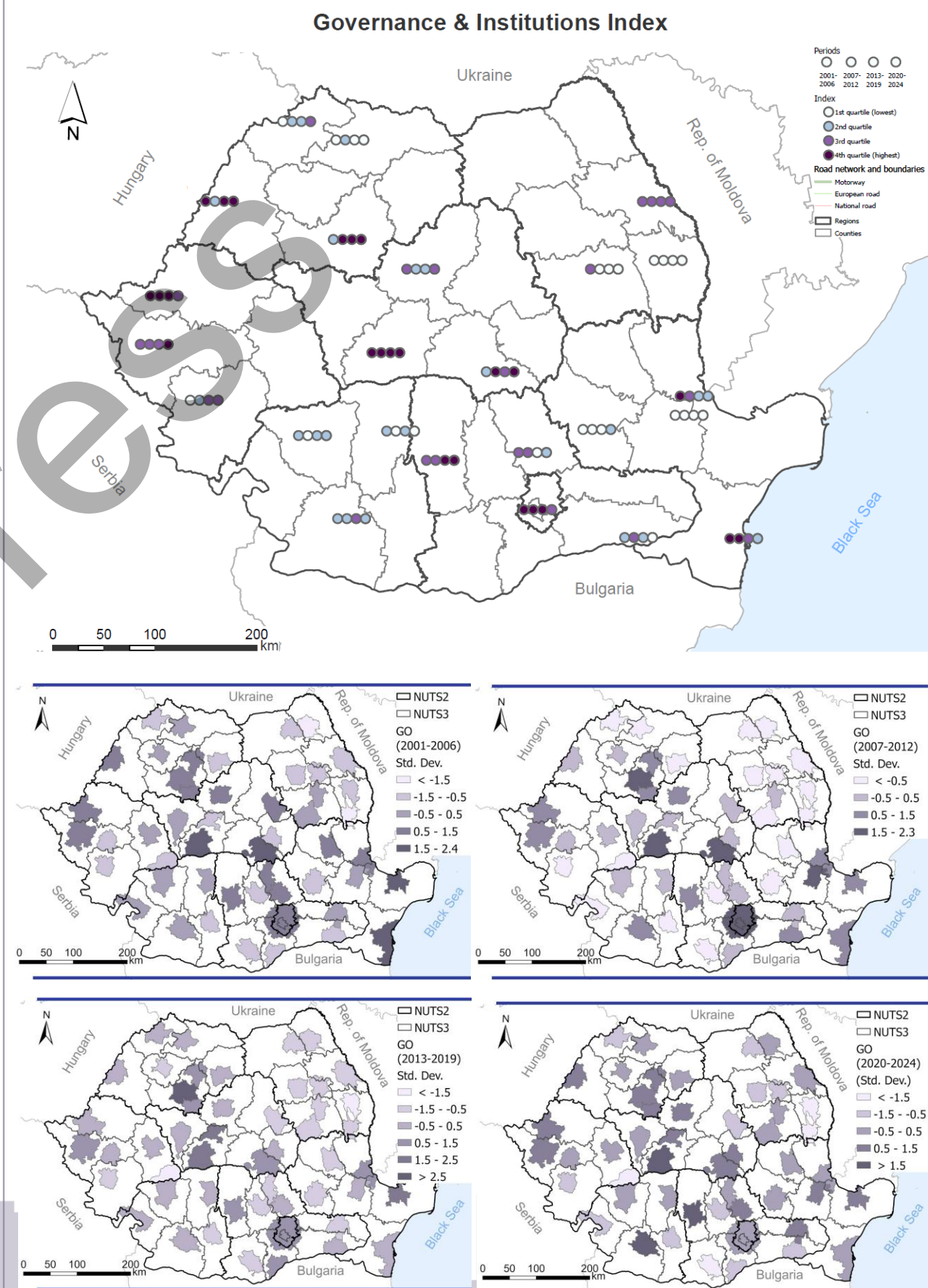
Together, the quartile and standard-deviation maps reveal a central tension of transformative resilience: EU funds and local budgets can open windows for urban transformation, but only where local institutions can turn episodic opportunities into stable, strategic governance capacity.

Conclusions

- The national urban strategy is coordinated set of policy decisions based on *multilevel governance, participation, and co-creation*, in line with the New Leipzig Charter. Its objectives include *strengthening the administrative capacity of cities and improving cooperation across jurisdictions and sectors*.
- Within a resilience-as-transformation logic, the key question is whether local institutions can move from reactive, project-driven governance to adaptive, strategic governance that uses crises as moments for paradigm change. This presupposes institutional stability, skilled human capital, and mechanisms that involve civil society and the private sector in co-producing urban policies.
- Indicators such as EU funds absorbed per capita, the capital-expenditure share, and the proportion of own revenues in local budgets serve as proxies for the institutional *capacity to generate and manage transformation*.
- Data on EU-fund absorption at the municipal level show very large differences between cities, revealing a geography of transformability: some administrations make intensive use of EU instruments (integrated urban

development strategies, regional programmes, RRF) to reconfigure infrastructure and services, while others remain stuck in small, reactive projects.

- The expenditure structure can also reveal the risk of *“investments without transformation”* if funds are concentrated on traditional infrastructure (roads, parking) without connections to digitalisation, green transition or social inclusion.

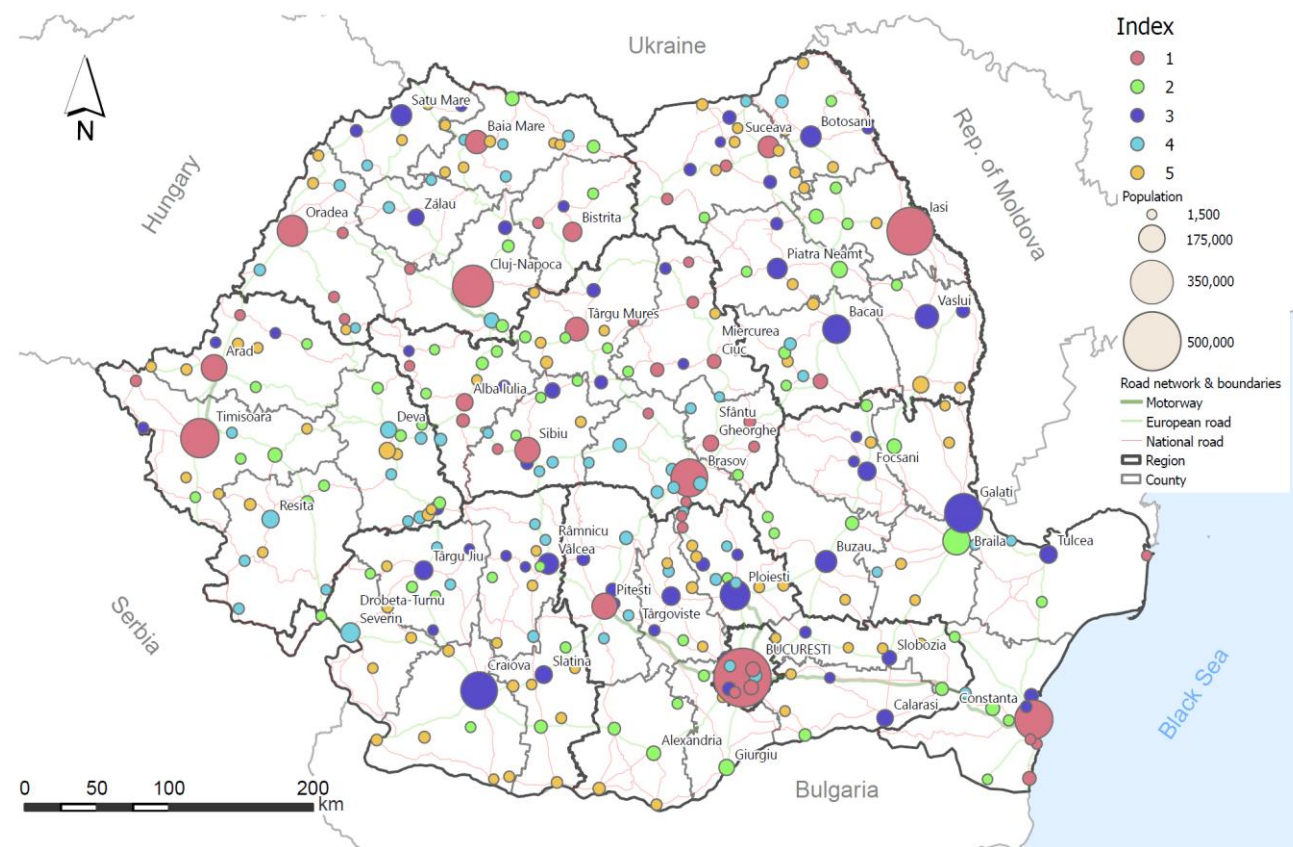




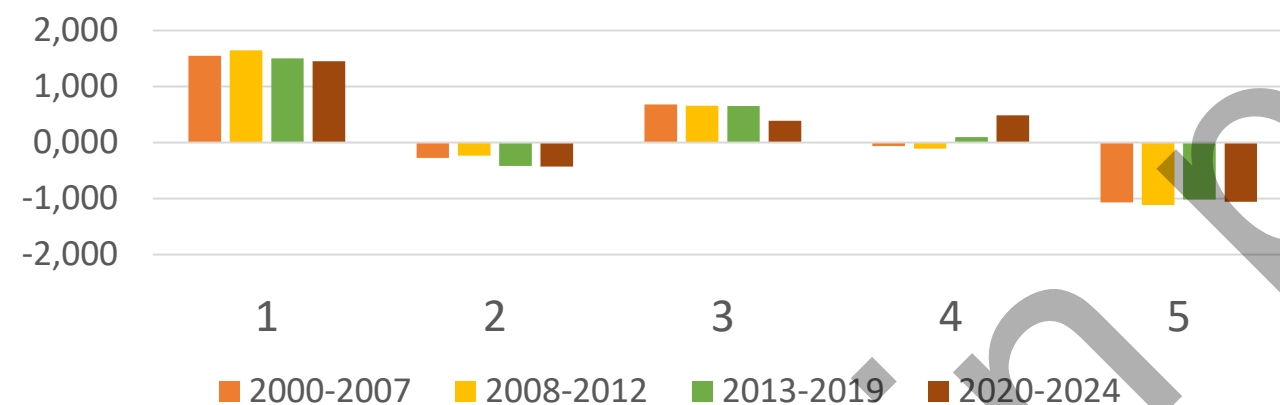
Urban Transformability in Romania: Vulnerability-Opportunity Index

in press

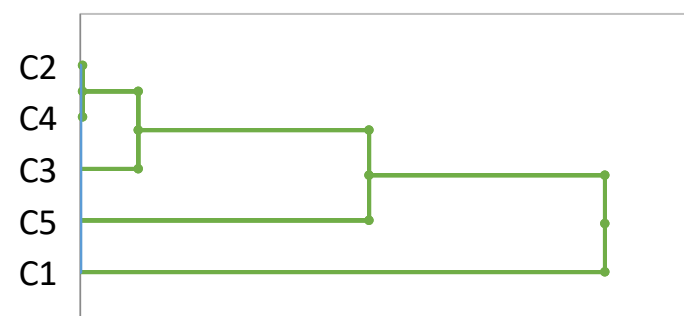
Urban Vulnerability and Transformability Index Clusters



The profile of clusters



Dendrogram



Dissimilarity

	Absolute	Percent
Within-cluster	279,504	21,97%
Between-clusters	992,496	78,03%
Total inertia	1272,000	100,00%

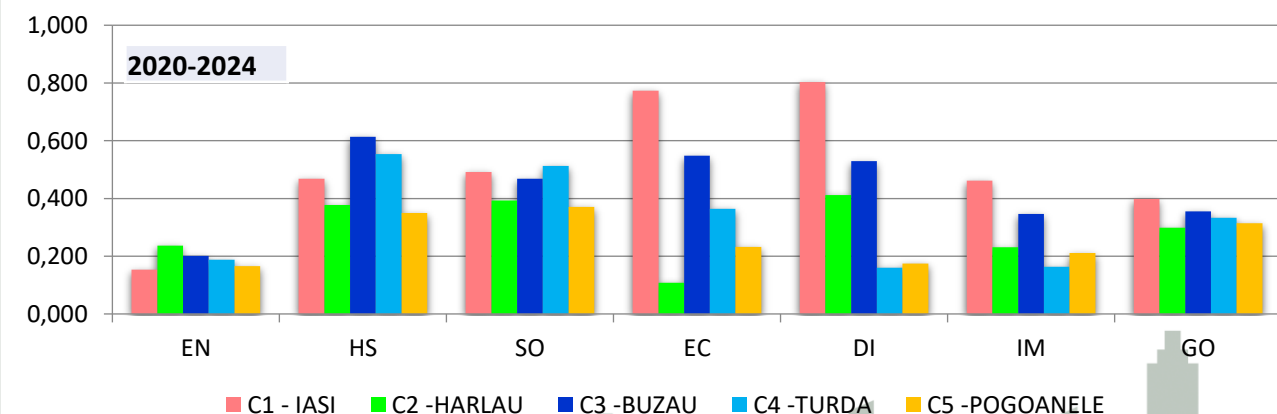
The Vulnerability-Opportunity Index shows predictable distributions but also unexpected situations. Large cities had an advantageous position that they improved over time. They suffered, to a large extent, the initial effects of the major crises (post-communist transition, 2008 economic crisis, COVID-19 pandemic), but had greater resilience, enabling them not only to recover faster but also to develop across all key economic components.

Social, digital, infrastructure, this is also due to superior governance. Within these, a better position is seen for the capital and the regional poles (Cluj-Napoca, Iasi, Timisoara, Oradea, Brasov, Constanta). Small towns, on the other hand, suffered the shock of communist deindustrialisation, and some managed to reconfigure their territory and diversify through tourism or smaller, more efficient industrial activities. Many of these are, however, stagnant (Cluster 2) or declining (Cluster 5) cities – small towns that still retain a strong agricultural profile (Flamanzi, Dabuleni, Ianca, Insuratei) or former small mono-industrial settlements with insufficient restructuring/regeneration in the recent period (Balan, Buhusi, Vulcan, Aninoasa, Calan).

In terms of the selected areas, a relative east-west gradient is observed, with an advantageous situation for once-important cities in Transylvania and for the capital and a lower performance of some once important industrial centres but with lower performance and a relatively peripheral status today (Resita, Calarasi, but also Braila).

The paths that Romanian cities are taking towards transformability is dependent on the historical development trajectories of the territory. Cities that entered the post-socialist period with diversified economies, stronger institutional capacity, high quality human capital and good educational resources, generally retained these advantages, whereas mono-industrial settlements continued to experience structural vulnerabilities despite the three decades of economic transition.

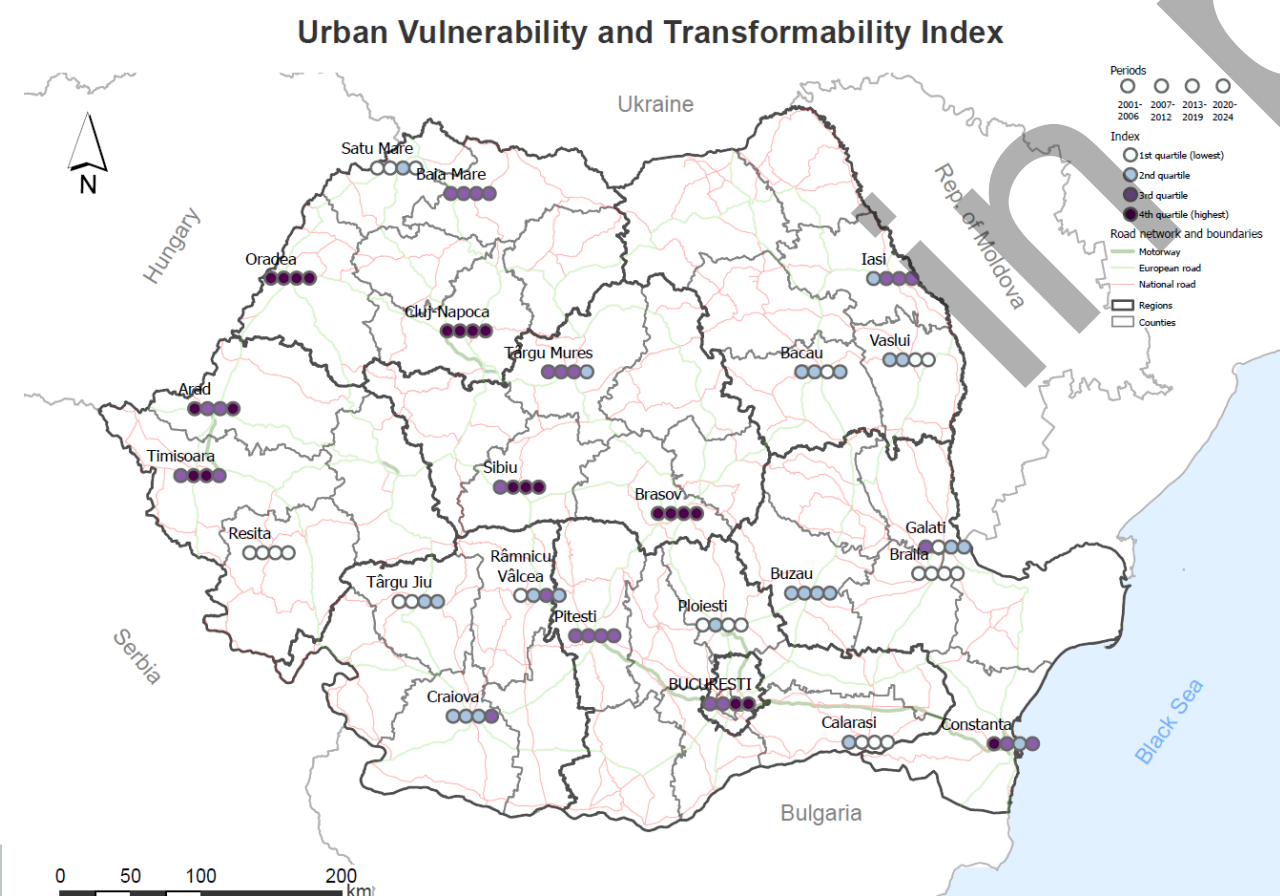
EN	Environment and Climate action
HS	Health and Safety
SO	Social Equity
EC	Economy
DI	Digitalization and Big Data
IM	Infrastructure and Mobility
GO	Governance and Institutional Capacity



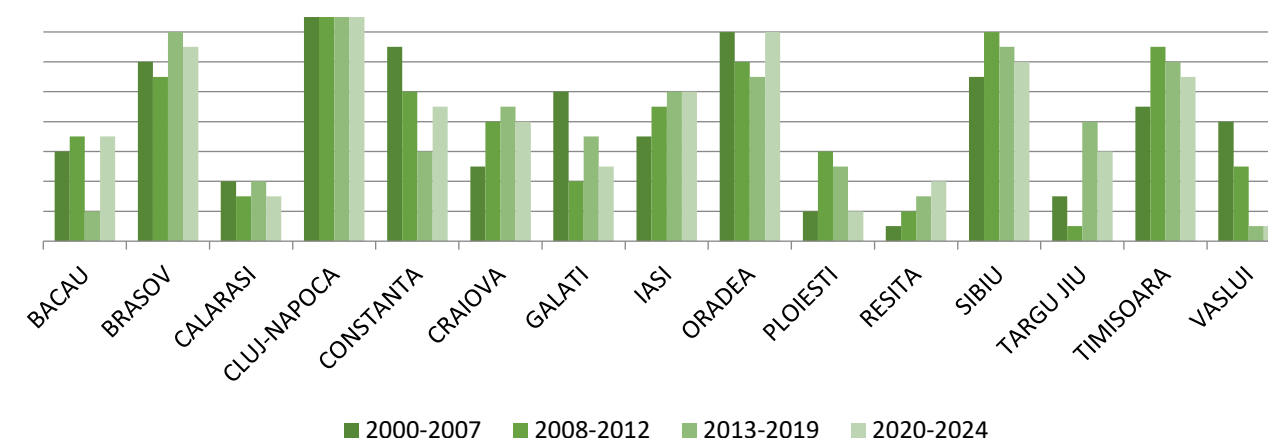
Metropolitan centres often record a favourable performance that reflects agglomeration economies and spillover effects, results often suggested by the scientific literature as well. In contrast, surrounding settlements benefit from improved labour markets, infrastructure investments, innovation networks, and access to specialised services. There are, though, situations where urban areas have a much better performance in indicator values than their surrounding counterparts, creating an excessively unbalanced development.

The contrasting trajectories of cities revealed by the clustering analysis suggest that local governance, strategic planning, and the capacity to attract external funding have become increasingly important determinants of urban transformability. The cluster distribution broadly mirrors Romania's functional urban hierarchy, with national and regional growth poles occupying the categories that perform well in most of the variables comprising the index, while medium-sized cities display more heterogeneous trajectories, and small towns are disproportionately represented among vulnerable clusters.

Romanian cities followed several distinct trajectories of vulnerability and transformability during the study period (four periods between 2000 and 2024). These trajectories reveal similarities and differences in the capacity to respond to economic and social shocks. Cluj-Napoca, Sibiu, Braşov, Oradea, Timişoara consistently recorded the highest index values. Their positions remained stable across all four periods, with minor fluctuations during the 2008 economic crisis and the COVID-19 pandemic. These cities quickly recovered after each shock and consolidated their leading positions. Their performance reflects diversified economies, strong labour markets, effective governance, and a high capacity to attract investment and European funding.



The relative Vulnerability-transformability Index Score
(inverse ranking of selected cities)



A second group includes cities that steadily improved their position over time. Iaşi represents the clearest example of this trajectory, while Bacău also recorded gradual progress. These cities started from less favourable positions but continuously increased their index values. Their evolution suggests that long-term investments in education, infrastructure, digitalisation, and economic diversification strengthened their adaptive capacity. The case of Iaşi illustrates how a regional centre can significantly improve its transformability within two decades. Another trajectory is characterised by fluctuating performance. Constanţa, Galaţi, Târgu Jiu, and Ploieşti alternated between periods of improvement and decline. Their index values followed a zig-zag pattern instead of a continuous linear trend. These cities benefited from favourable economic conditions but reacted more strongly to periods of crisis. Their economies appear to depend on a narrower range of activities, making them more sensitive to external shocks. Although recovery occurred after each downturn, it was generally insufficient to close the gap with the leading metropolitan centres.

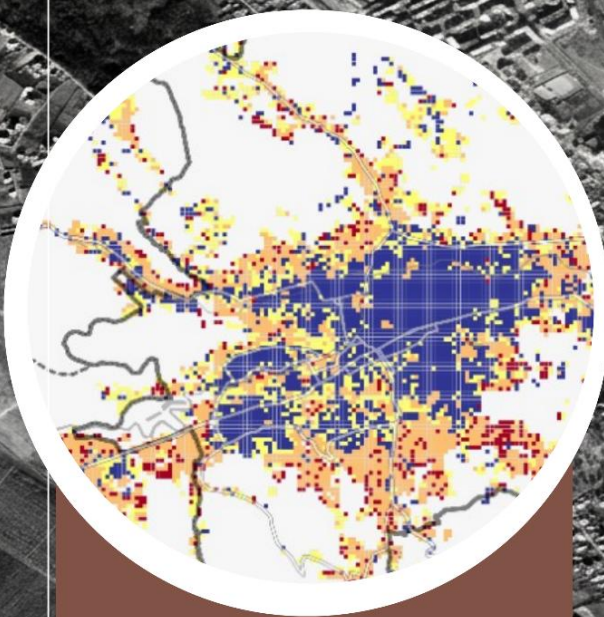
The least favourable trajectory is observed in Reşiţa and Vaslui. These examples show that structural disadvantages can persist for decades when regeneration processes remain limited. Both cities remained at the bottom of the ranking throughout the study period. Their index values changed only slightly, indicating persistent structural vulnerability. In Reşiţa, this trend reflects the long-term consequences of industrial restructuring and population decline. In Vaslui, a peripheral location with limited economic diversification and weaker institutional capacity, urban transformation is a constraint.

Finally, several cities occupied an intermediate position. They maintained moderate index values across most periods. Their trajectories indicate a certain degree of resilience but only modest transformability. Improvements occurred gradually and did not substantially alter their relative position within Romania's urban hierarchy (e.g. Craiova, Bacău).

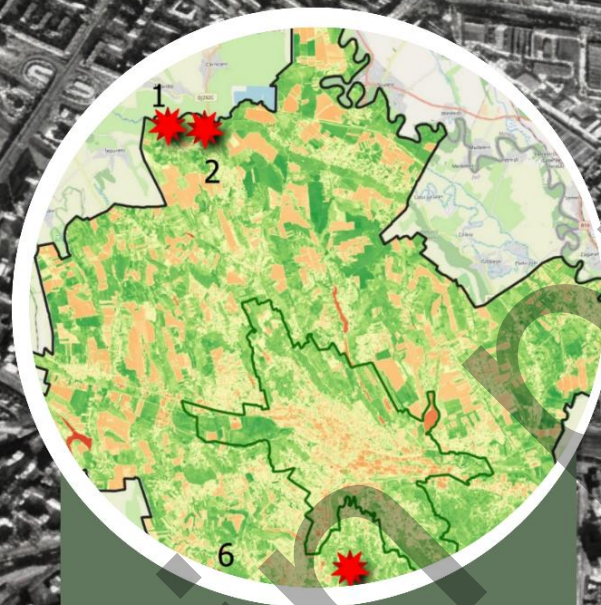
Part 3



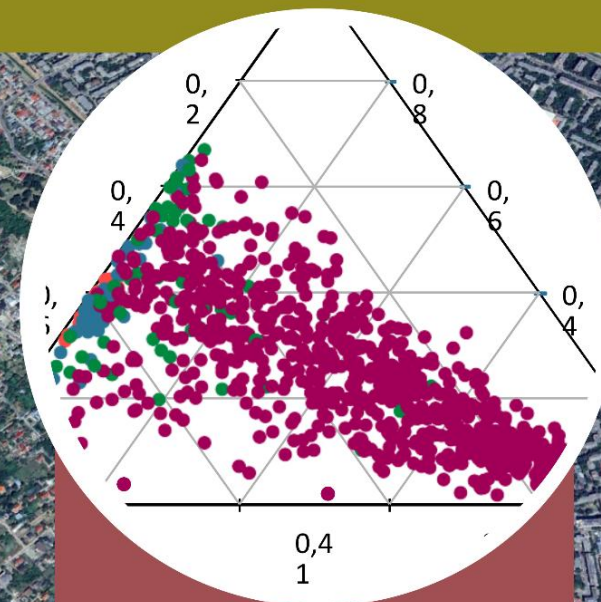
Case Studies of Urban Transformability



The Evolution of Urban Built-up Development Patterns in Two European Post-socialist States



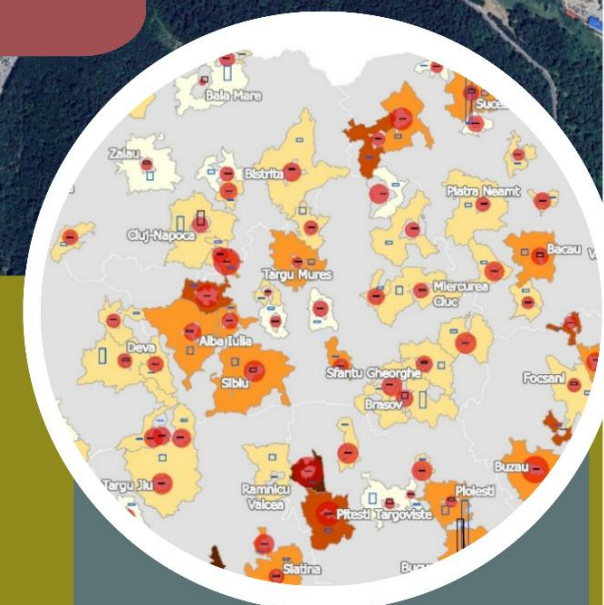
Analysing the trend of Informal Green Spaces in the Iași peri-urban area



Urban and metropolitan socio-professional dynamics in Romania in the last two decades



Accessibility to urban amenities in Romania's cities - a multiscale comparison



Community-based initiatives and business dynamism in the Romanian landscape

CASE STUDY 1. Analysing the trend of Informal Green Spaces in the Iași peri-urban area

1. Defining Informal Green Spaces in the Iași peri-urban area

In recent years, densely populated urban areas have become unsatisfactory for residents as green infrastructure has significantly diminished (Chiesura, 2004; Rupprecht et al., 2015). Apart from some cities that have increased green areas by including informal green spaces (IGS) (Włodarczyk-Marciniak et al., 2020), nearly all European cities are experiencing a reduction in greening (Cortinovis et al., 2019). Unfortunately, IGS in developing cities is perceived as available space for sprawl (Kabisch et al., 2016). As in the Iași urban area, which was greener during the communist period, the IGS has progressively been lost to the expansion of the urban fabric (Figure 1).

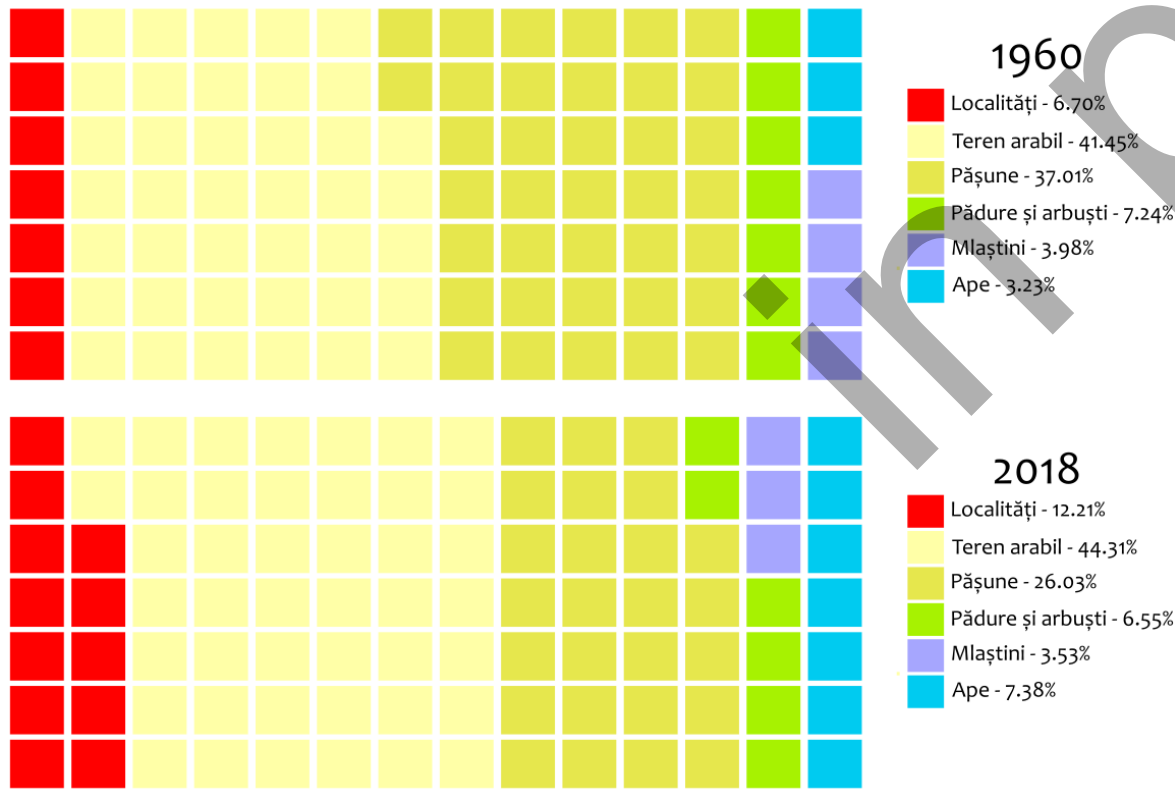


Figure 1. Expansion of urban fabric from 1960 to 2018 (Doru et al. 2023)

Since the prospects for Iași are unfavourable, with only 20 m² of green space per inhabitant—below the European minimum of 26 m² per inhabitant (EBRD, 2023)—this study aims to identify the trend of IGS within a context of ongoing urban sprawl and a lack of policies centred on urban residents' wellbeing.

By concentrating solely on grasslands and forests, we can evaluate vegetation condition based on continuity and spatial coverage. Grasslands and forests occupy the largest parts of the Iași peri-urban area and are the most frequently used by inhabitants, who perceive them as common areas open for free use.

2. Multitemporal trend detection of IGS

In this study, we used Landsat (acquired from Landsat 5, Landsat 7, and Landsat 8) data at 30 m spatial resolution for the period 1984 – 2024.

Identifying and quantifying vegetation dynamics can be achieved through NDVI time-series trend analysis. In this regard, a dedicated tool (R *greenbrown* package), proposed by Forkel et al. (2013), was used.

3. Do we face greening or browning of the IGS?

According to Văculișteanu (2024), at the entire Moldavian Plateau level, the trend shows a pattern: negative in floodplains and positive in hilly areas. The main trigger of this pattern has been hydrology. Although very difficult to separate and quantify, the triggers need closer validation and field exploration. Overall, the climatic influences have been overcome, and the vegetation has shown a strong capacity for recovery. On the other hand, the anthropogenic impact has proved to be the most intrusive factor, affecting vegetation in the long term.

Regarding the IGS chosen sites in the peri-urban areas of Iași, the grassland trend shows variations, with several breakpoints across the six study cases selected (Figure 2). Sites 1 and 2 are located in the floodplain of Jijia, showing a positive trend until 1996, followed by an unexpected increase after 1996, then a decrease until 2002. Both trend breaks are recorded at certain positive events. Even though the trend registered after the break remains positive, in theory, this behaviour is typical of a moisture-prone environment, where even gentle fluctuations are seen as thresholds that change the trend.

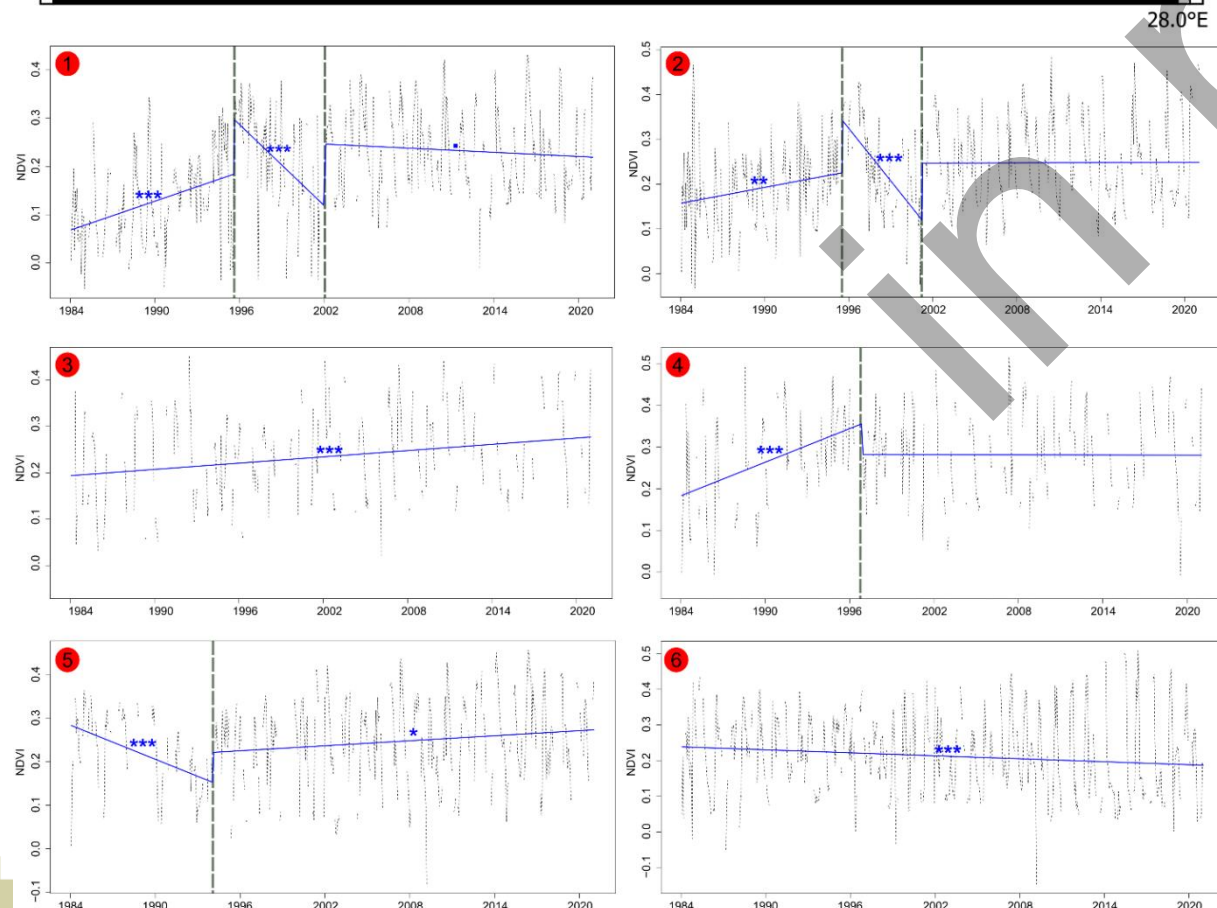
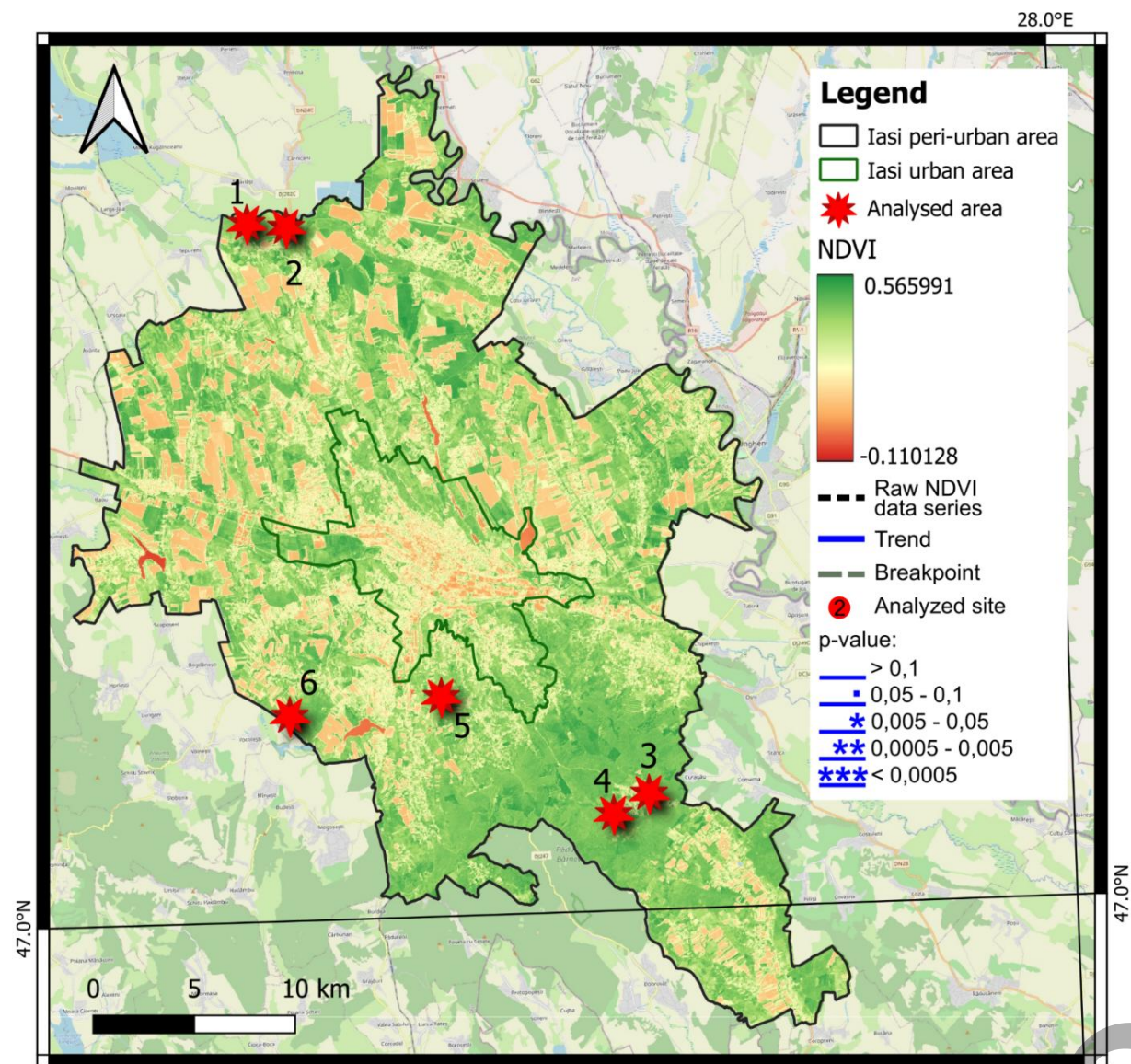


Figure 2. The NDVI trend calculated for forests (1984 - 2024)

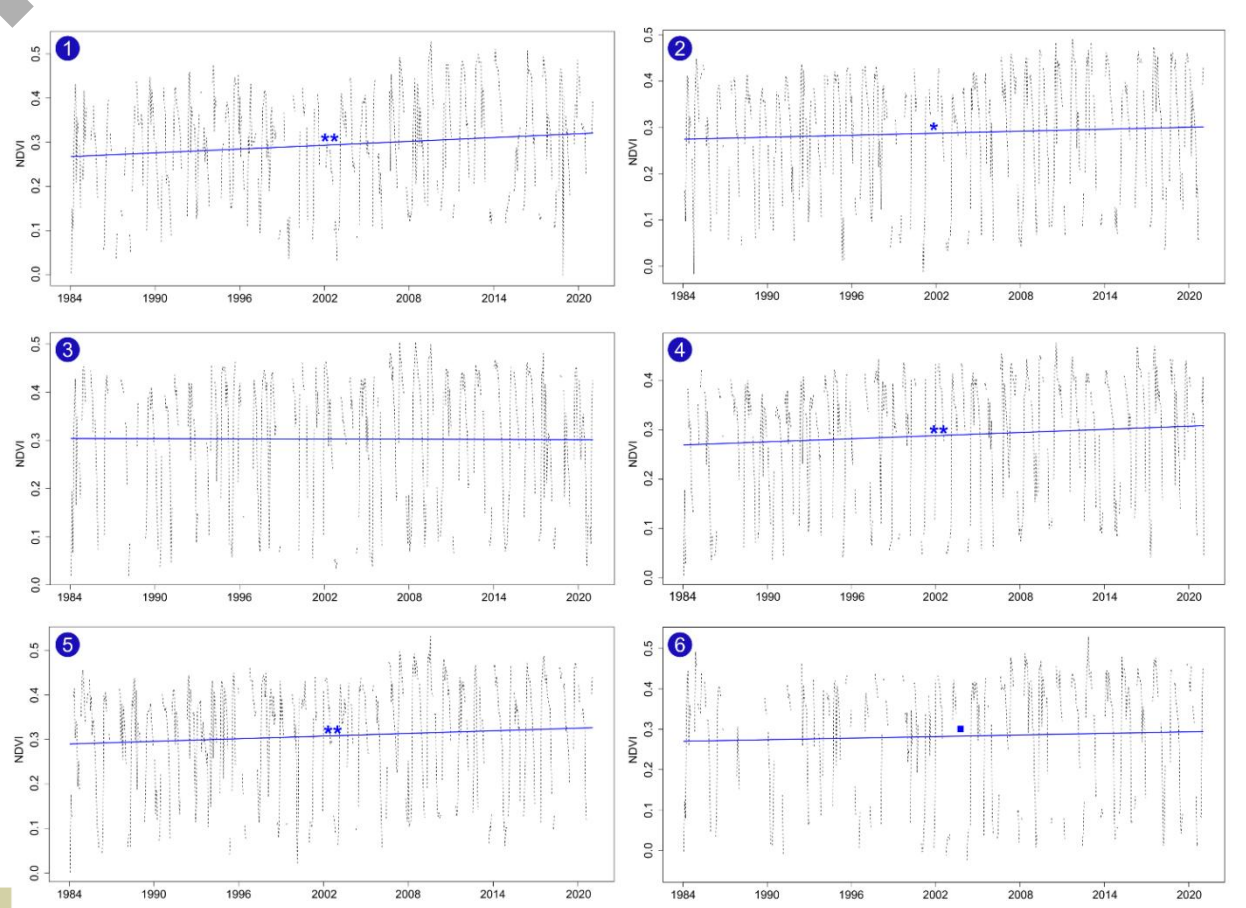
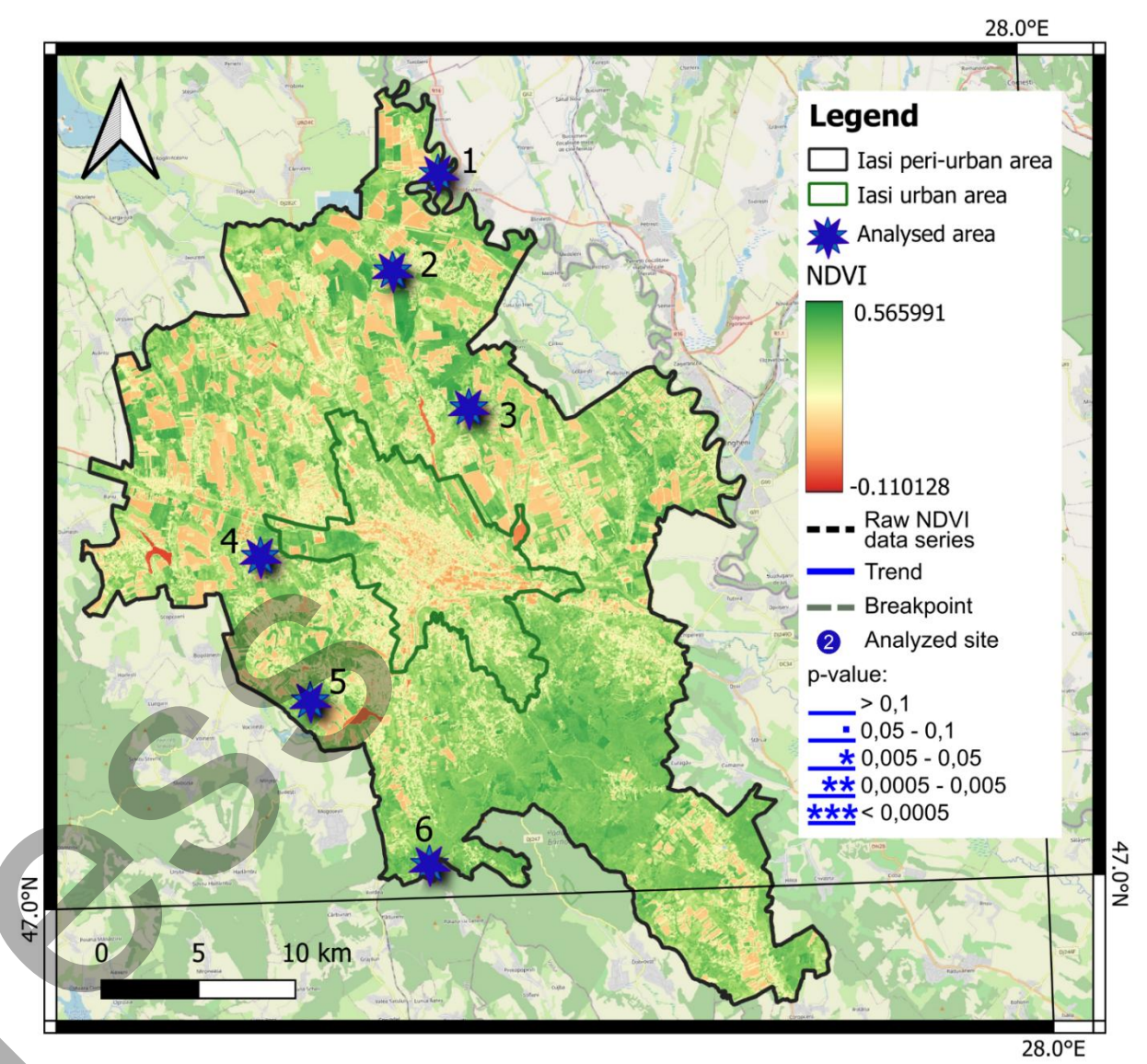


Figure 3. The NDVI trend calculated for forests (1984 - 2024)

Land-surface hydrology is strongly linked to vegetation dynamics (Sun et al., 2017), whether through an increase or a deficit. Floodplains are also sites of recurrent land-use changes, whether they are ideal for crop growth or for urban sprawl.

Sites 3, 4, 5, and 6 are located in hilly areas and show a majority of positive trends. For sites 4 and 5, a breakpoint was reported. Overall, hilly areas are more stable but are still disrupted by anthropogenic interventions and geomorphological processes. Considered in some cases to be inaccessible or to have unfavourable soil types, hilly grasslands are less affected by anthropogenic interventions (Reinermann et al., 2020). Despite their overlap with landslides or gullies, hilly grasslands tend to be more stable.

Forests on the other side show a positive trend (Figure 3), with no breakpoints, indicating that the ecosystems remain quite stable and green. As they are already stronger and more resilient environments, forests are of great interest to society, being often targeted for walking and offering irreplaceable benefits.

Regarding IGS functionality, people in our region of interest are not familiar with the concept. A grassland could be used for pasture, walking, and supporting people's wellbeing and animal feeding. Even though the IGS provides several services to society, it is not yet fully valued or protected. Misunderstanding a concept or the purpose of a place can have unfavourable consequences for the ecosystem and its services.

4. Beyond the greening and browning trend

Over the last two decades, global climate change has been strongly reflected in NDVI data. The lake of snow during winter results in higher overall NDVI values. Even if the trend reflects reality, higher NDVI values do not necessarily mean that the vegetation is doing well. The snow significantly lowers pixel values, and the absence of snow artificially induces a false, high greening trend. Some limitations are also imposed by the data's spatial and temporal resolutions and by the lack of continuity, especially with Landsat 5 and Landsat 7. Nevertheless, the applied method manages to transpose a correct reality by removing seasonality while preserving the real perturbation agents that may affect vegetation, thereby achieving accurate outputs.

5. Keep it green!

Handling the stress differently, grasslands and forests exhibit distinct trends in NDVI. The grasslands are browning, and forests are greening, even though the trends in each are hard to associate with a trigger. Since this study is not focusing on detecting the drivers but on detecting the trend, we may mention that the prospects are quite uncertain. Even if we are not facing a complete browning trend in grasslands, we may remain firm and take

directive actions to preserve the ecosystems, since they are already showing signs of degradation. As informal green spaces, grasslands are mostly affected by anthropogenic intrusions and are considered areas of urban fabric expansion. In the case of forests, their resistance and resilience explain the slightly positive trend. Human interventions are less pronounced, and the climatic trend is most likely positively determining the tendency of forest greening.

When evaluating these dynamic NDVI trajectories within the metropolitan area of Iași, the diverging patterns between ecological typologies transition from mere environmental metrics into clear indicators of urban transformability. The contrasting trends—namely the structural browning of vulnerable grasslands alongside the climate-driven greening of resilient forests—underscore the urgent need for a shift from passive urban management to proactive, adaptive spatial planning. Grasslands, functioning as IGS, are currently bearing the brunt of horizontal urban fabric expansion. This ongoing degradation signals a critical vulnerability in Iași's peri-urban layout, where real estate pressure permanently compromises natural infrastructure before its ecological value can be formally protected or integrated into the city's green blueprint.

Managing urban transformability in Iași requires a strategic pivot toward Nature-Based Solutions and planned green corridors to mitigate climate risks. Relying solely on the passive greening of forests is insufficient to balance the rapid topsoil sealing caused by unauthorised peripheral sprawl. True transformability implies reorganising the landscape by turning threatened grasslands into functional instruments of municipal resilience. Ultimately, Iași must integrate green infrastructure as a core element of its urban design.

CASE STUDY 2. The Evolution of Urban Built-up Development Patterns in Two European Post-socialist States

The transition from the planned to the market economy within Central and Eastern European States after 1989 has determined a series of multiple transformations which reshaped the urban environment and its surroundings, such as political-administrative decentralization, deindustrialization, emergence of land markets, residential suburbanization and the rise of new forms of socio-spatial segregation (Keivani et al., 2001; Sýkora & Bouzarovski, 2012; Stanilov & Sýkora, 2014; Kubeš & Kovács, 2020). Similarly, the urban planning had to suddenly face a new reality, contrasting the socialist norms. The unprepared and underfinanced authorities have enabled private actors to drive the urban expansion due to the lax planning rules, which facilitated the massive approval of building permits. Therefore, the vast agricultural state-owned land located outside the densely-built urban area has been replaced by sprawling residential developments. However, even though the entire region has faced similar challenges, their intensity and pace varied substantially depending upon the national and local context.

Therefore, we approached a comparative analysis of the built-up development patterns of two post-socialist countries, namely Poland and Romania, the largest post-socialist EU members, with a weak enforcement of land use change according to a study conducted by Piorr et al. (2011) and with different avenues regarding the private property during communism and also the restitution of agricultural land after the fall of communism. To conduct the analysis, we selected three second-tier cities from Poland (Szczecin, Bydgoszcz & Lublin) and three Romanian counterparts (Timișoara, Cluj-Napoca and Iași). Using the gridded 100m level built-up area data from 1975 to 2020 (Pesaresi & Politis, 2023a; Pesaresi & Politis, 2023b), we computed one Time Series clustering per country in ArcGIS Pro, which revealed ten space-time patterns of built-up area development, based on their average built surface per 100m cell (1 hectare).

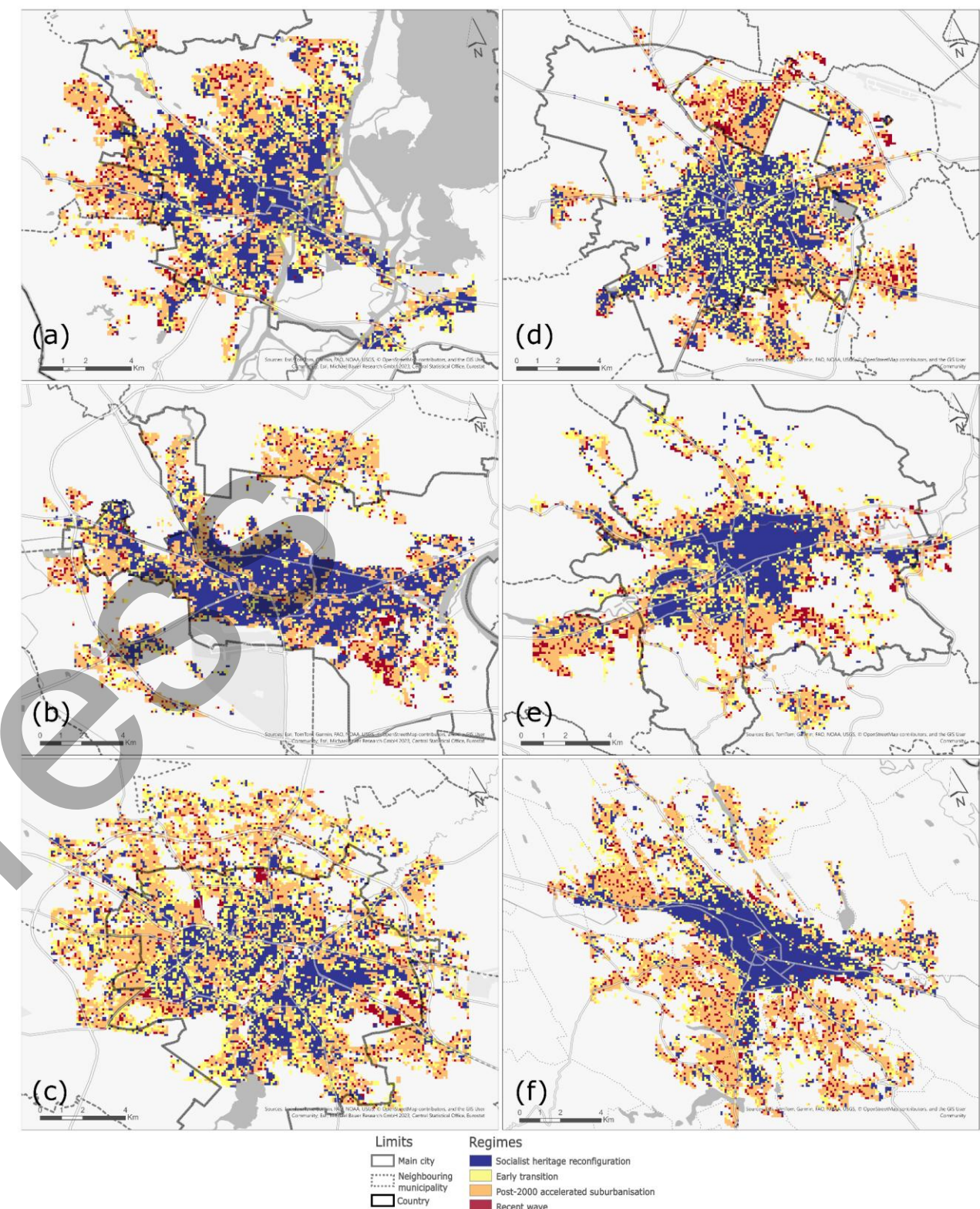


Figure 1. The four evolutionary space-time clusters of built-up development in (a) Szczecin, (b) Bydgoszcz, (c) Lublin, (d) Timișoara, (e) Cluj-Napoca and (f) Iași (own elaboration)

Therefore, we grouped these patterns into four clusters according to their similarities in terms of spatial and temporal evolution. In order to reveal the differences, we charted the total built-up area per cluster and then the land consumption per cluster, obtained by dividing the built-up area to the population residing in each cluster (Schiavina et al., 2023).

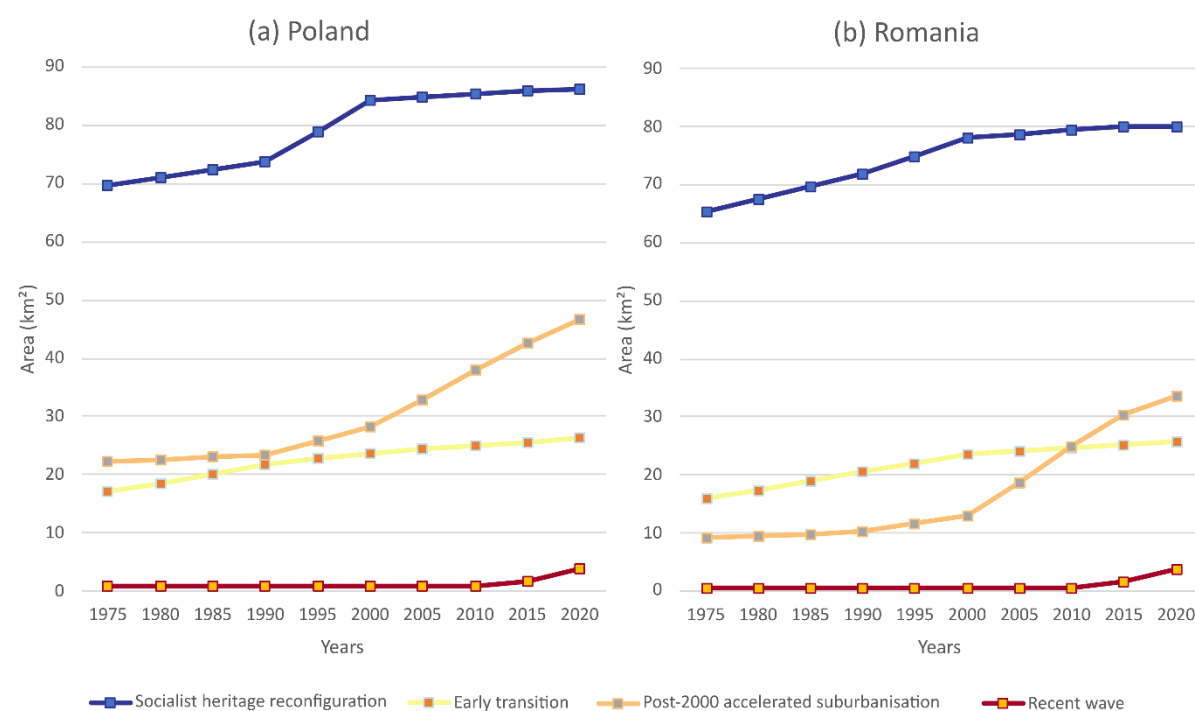


Figure 2. Total built-up area per cluster and per country

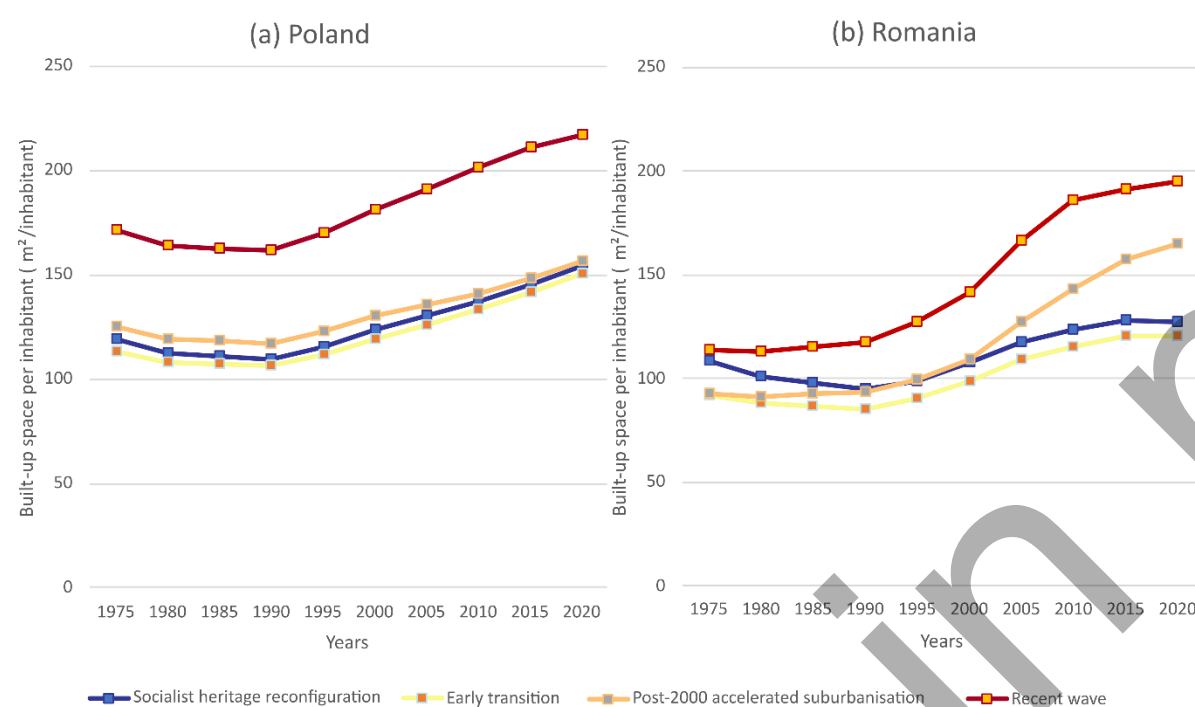


Figure 3. Land consumption per cluster and per country

1. The socialist heritage reconfiguration

This class, depicted in blue, consists of large-panel estates and industrial platforms which shaped the socialist urban cores. It manifests the vastest built-up surfaces in both countries, with a continuous increase until 2000, where the development curbs. However, the pace tends to be slower in socialist Poland than in Romania, although the former exhibits a turning point in 1990, revealing a stronger reconfiguration during the first transitional decade, indicated by the early influx of FDIs (Stańczyk, n.d.).

In terms of land consumption, the built-up area per capita decreases during communism according to the densification of built-up space and population, and increases after 1990 as a result of outmigration to peri-urban areas. The trend tends to be consistent in Poland, while in Romania it flattens to stagnation in 2015-2020.

2. The early transition

Concerning rural, urban and suburban individual housing especially established pre-1990, this class exhibits low-intensity growth, which diminishes during the transitional period. However, the reason why we framed it as early transition is that it overlaps areas in which the post-socialist periurbanization ignited, being more network-dependent in both countries. The land consumption figures tend to match the socialist heritage cluster in each country, however at a slightly lower pace.

3. Post-2000 accelerated suburbanization

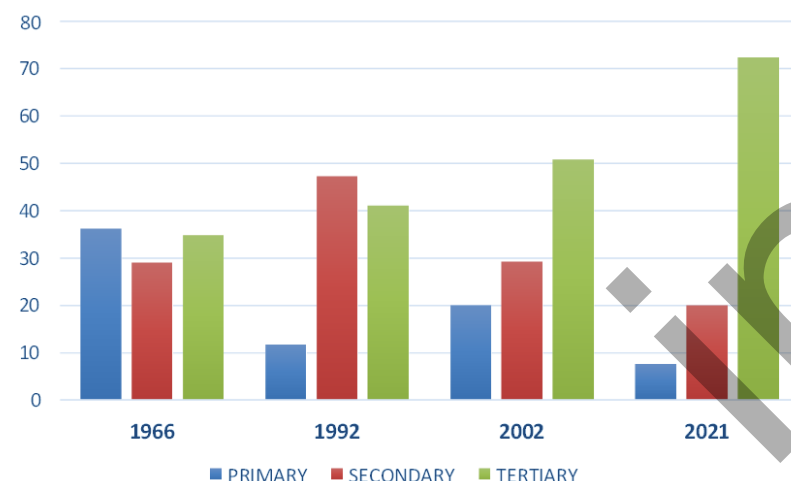
Widely located outside the urban cores while forming clusters within the most accessible peri-urban spots, this class manifests contrasting figures between the two states. Despite the same turning points in 1990 and, more evident, in 2000, the Polish case studies boast a more than double built-up surface until the end of the first transitional decade. After this momentum, the Romanian cities increased their surface by almost 160% between 2000-2020, while their Polish counterparts increased only by 65%. Moreover, the Polish land consumption trend aligns to the previous two classes, while in Romania it overtakes them by a landslide, being 33% more intensive. This fragmented, mostly individual-led, development in this country builds upon the hyper-scattered nature of post-1990 agricultural land restitution, contrasting Poland, which maintained private property during socialism and where restitution was not significant.

4. Recent wave

Almost non-existent until 2010, it highlights the peak of 30 years of permissive planning, revealed by the extreme land consumption values of around 200 m² per inhabitant in 2020. They mostly tend to fill the gaps left by the post-2000 accelerated suburbanization, mostly consisting of atomized forms of single-family housing boom that emerged after the economic crisis. However, Poland features also non-residential constructions which artificially inflate per-capita metrics.

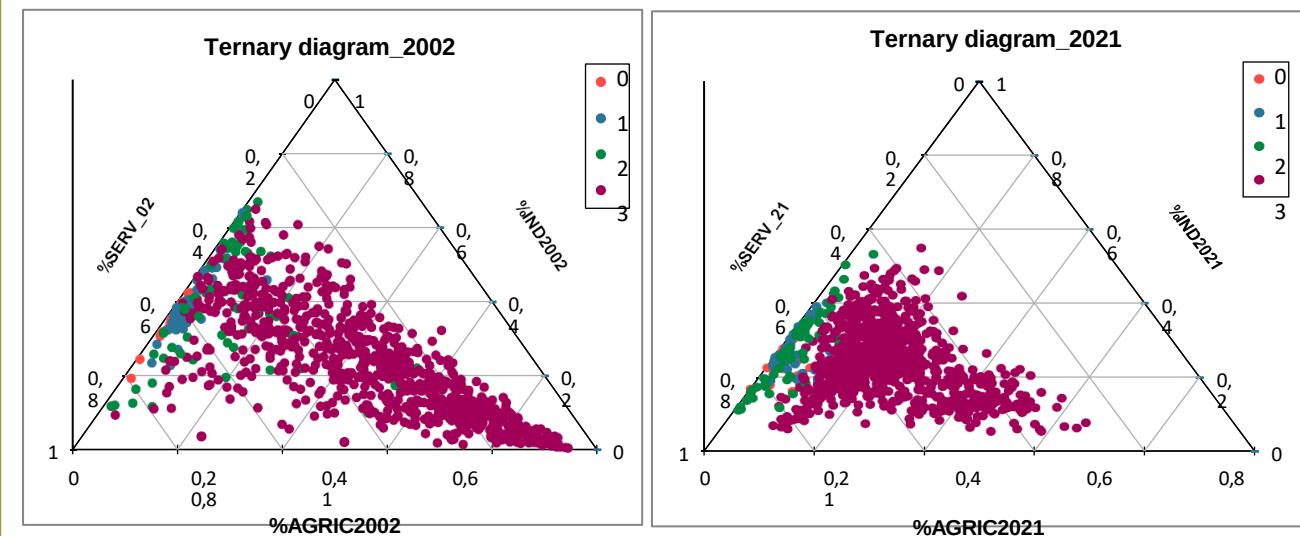
CASE STUDY 3. Urban and metropolitan socio-professional dynamics in Romania in the last two decades

Socio-professional dynamics refer to the evolution and differentiation of the urban active population by occupation and socioeconomic status (Maggioni, 2015; Ungureanu & Muntele, 2018). These dynamics are viewed as a vector of urban transformability, meaning they are the primary force driving functional changes within a city. In former socialist countries, such as those in the current eastern part of the European Union, communist urbanisation, often facilitated by forced industrialisation within a centralised system, led to a distinct division with sharp landscapes and pronounced socio-professional differences between cities and villages. In the 1990s, following the fall of totalitarian regimes, the formerly confined urban sprawl was released. De-industrialisation, tertiarisation, and legislative inconsistencies in urban planning have led to chaotic evolution, an urban mosaic within cities, hypertrophic growth, and uncontrolled outward suburban expansion (Dumitrache et al., 2016). The structural changes in the main economic sectors showed significant transformations between the early period of communist industrialisation (and urbanisation), when the shares of employees in agriculture, industry and services were relatively similar (1966), towards the dominance of industrial activities in cities and areas of influence, but also with a visible tertiary sector immediately after the change of political regime (1992).

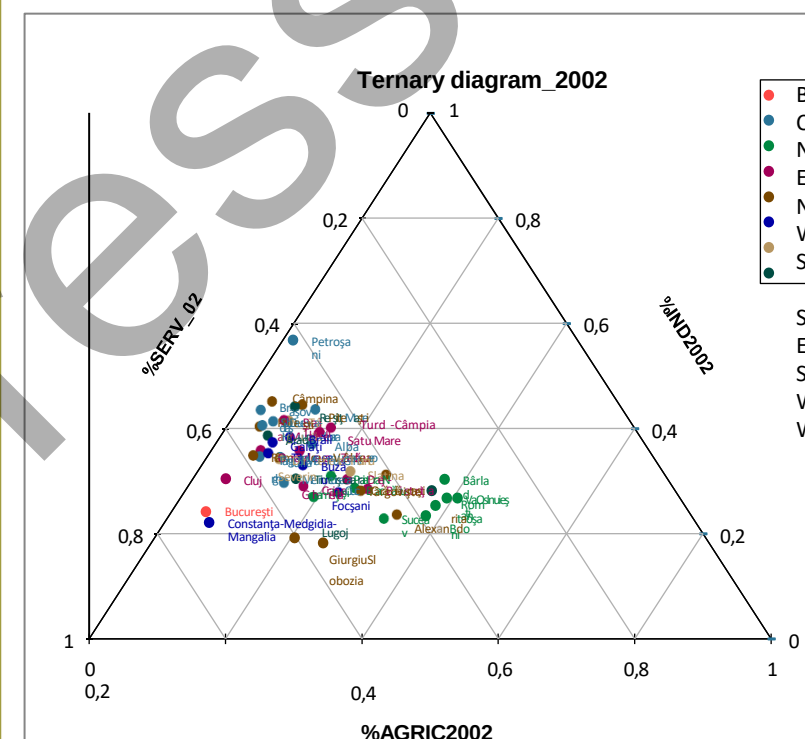


Employment by sector in Romanian metropolitan areas (1966-2021) in percent (%)

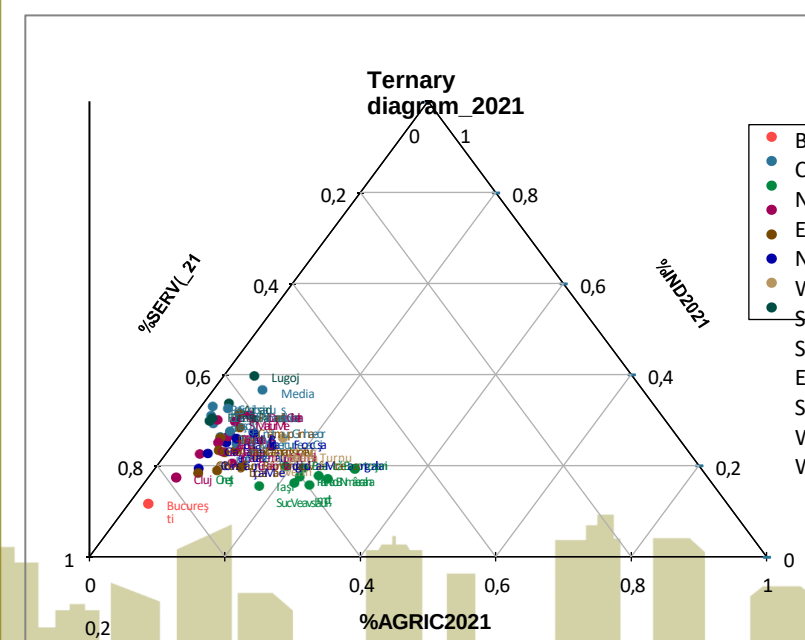
This process enabled professional reconversion and economic diversification, which occurred in extremely uneven ways across different cities (Stoleriu, 2008). The transformation of industries generated urban contraction from a demographic perspective and the development of new industrial zones in peri-urban areas (Popescu, 2014). This trend has continued over the last 35 years, alongside the deindustrialisation process. The ternary diagrams capture the transition from a greater functional diversity with numerous deeply rural communes and a population still predominantly agricultural in 2002 to a much more homogeneous profile with a drastic reduction in agricultural activities, with new industrialisation processes and, primarily through the penetration of the lower tertiary sector, and partly from the higher tertiary sector, within the metropolitan communes.

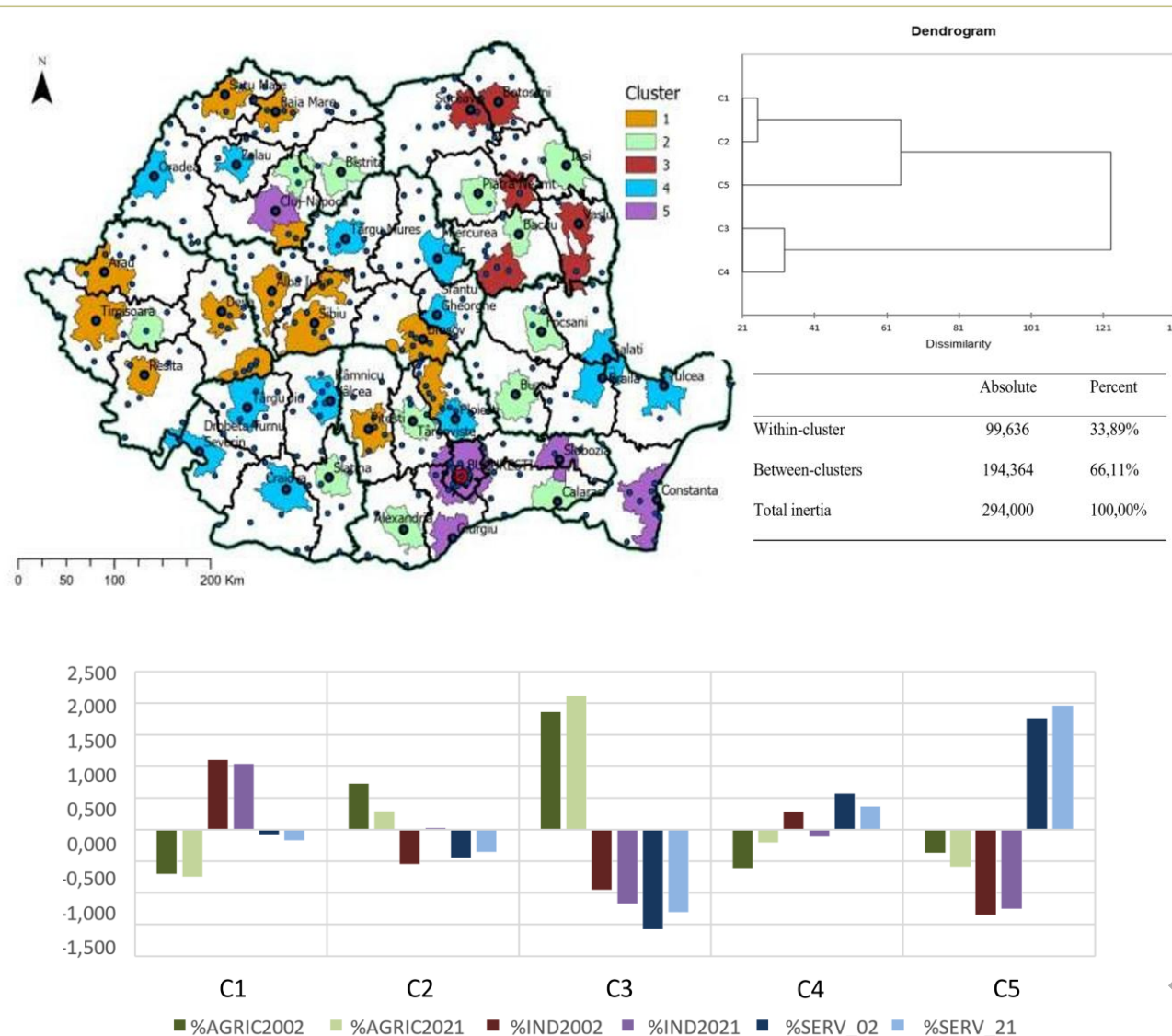


Ternary diagram – employment by sectors in metropolitan areas (LAU2 level)(0– municipalities with over 100,000 inhabitants, 1 – other municipalities, 2- cities in the metropolitan area, 3- rural communes). Own representation, data source Romanian NIS- 2002, 2021 Censuses



Ternary diagram – employment by sectors in metropolitan areas (Metropolitan level) (The MAs are coloured by regions B – Bucharest, C – Central, NE – North-East, NW – North-West, S- South, SE – South-East, SW - South-West, W- West)





Agglomerative hierarchical clustering – the spatial distribution of cities by class, the dendrogram and the intra- and inter-classes variance (a) and the profile of the clusters (b)

These typologies highlight significant economic restructuring processes with implications for social organisation, institutional capacity, and environmental impact.

Class 1 includes metropolitan areas with relatively resilient industrial structures, supported by successful restructuring, modernisation, and a strong base of specialised human capital. Agricultural activity has declined in the surrounding rural areas, while the tertiary sector remains slightly below average. These areas are concentrated in central and western Romania (e.g., Braşov, Sibiu, Timişoara, Arad, Baia Mare, Reşiţa), where proximity to resources and Western markets has supported industrial continuity.

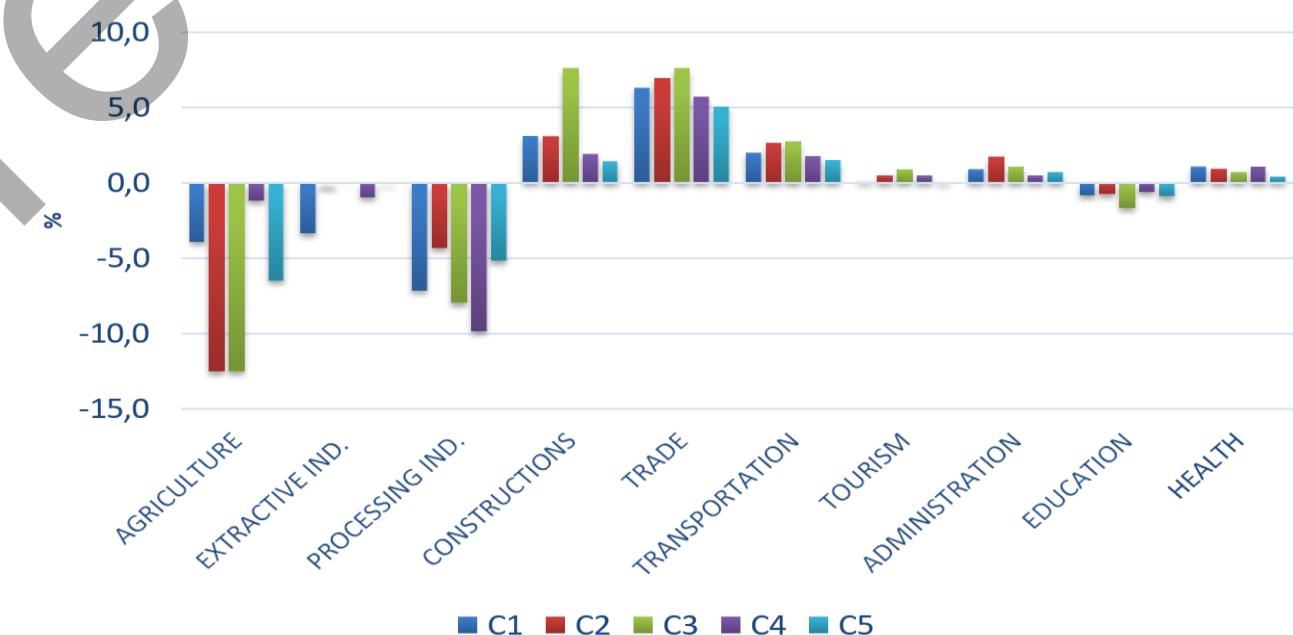
Class 2 comprises cities affected by post-communist deindustrialisation but showing partial recovery through smaller, flexible industries, often located in peri-urban areas. Agriculture remains significant, frequently at the subsistence level, and the tertiary sector is still underdeveloped compared to national averages.

Cities such as Bacău, Focşani, Buzău, and Bistriţa fall into this class, while Iaşi shows strong intra-metropolitan disparities. These areas have been marked by high labor migration and unemployment, particularly in the 1990s.

Class 3 represents the most contrasting profile, maintaining a strong agricultural character, particularly in secondary rural rings. Secondary and tertiary sectors remain underdeveloped, and these metropolitan areas—located exclusively in North-East Romania (e.g., Botoşani, Suceava, Vaslui)—illustrate persistent regional disparities. Notably, informal economic activity and unrecorded international migration distort official indicators, despite visible dynamism in housing and service expansion.

Class 4 exhibits a more balanced structure, transitioning from industrial dominance toward a service-oriented economy, with a sharper decline in agriculture. This heterogeneous group includes both major regional centres such as Galaţi, Craiova, Oradea, and Târgu Mureş and smaller cities such as Tulcea and Zalău.

Class 5 reflects the most advanced metropolitan profiles, characterised by strong tertiary and quaternary sectors and minimal reliance on agriculture or industry. A distinction exists between cities dominated by low-value services (e.g., Slobozia, Giurgiu) and those with advanced economies (e.g., Bucharest, Cluj-Napoca, and Constanţa).



Sectoral analysis reveals a general decline in agriculture and manufacturing, alongside growth in commerce, construction, and transportation. Modest increases are observed in tourism, healthcare, and administration, while employment in education has slightly decreased.

Overall, the profile of socio-economic transformations in the last two decades shows the lack of coherent policies to reduce territorial disparities. As a result, integration into the European Union not only failed to reduce these discrepancies but even accentuated them amid political instability.

CASE STUDY 4. Accessibility to urban amenities in Romania's cities - a multiscalar comparison

Contemporary cities have to deal with the challenges of climate change, urban sprawl, social inequalities, and accentuating environmental degradation. As urban areas continue to expand and populations grow, the traditional car-dependent development model has shown its limitations, as it contributes to air pollution, consumes long times in daily commutes, and contributes to less connected communities. In response to these challenges, the concept of proximity has emerged as a powerful solution in the ongoing transformative process that cities go through. By bringing essential services closer to where people live, proximity-based planning addresses transport emissions, public health, walkable neighborhoods, social cohesion, and overall quality of life (Murgante et al., 2024). Therefore, a truly functional city isn't built solely by concentrating people, but by ensuring a balance between the number of residents and the availability of services they need daily, along with a healthy lifestyle.

In Romanian cities, the distribution of health facilities, schools, healthy food options, spaces for active movement, relaxation areas, and even workplaces was strongly influenced by the strict planning regulations from the communist era. The clustering of high-rise buildings together with proximity services („micro-raioane”) was ensuring increased accessibility. Some of these services can still be found today (schools, parks), while more dynamic fields needed to change their spatial location over time (commerce, health units). The sudden transition after 1989 came along with more unclear and less integrated legislative frameworks on urban planning. Private sector involvement increasingly drives urban facility organization, creating discord with municipal planning frameworks. More compact cities come with advantages and constraints, and the challenge of contemporary planning lies precisely in finding this delicate balance.

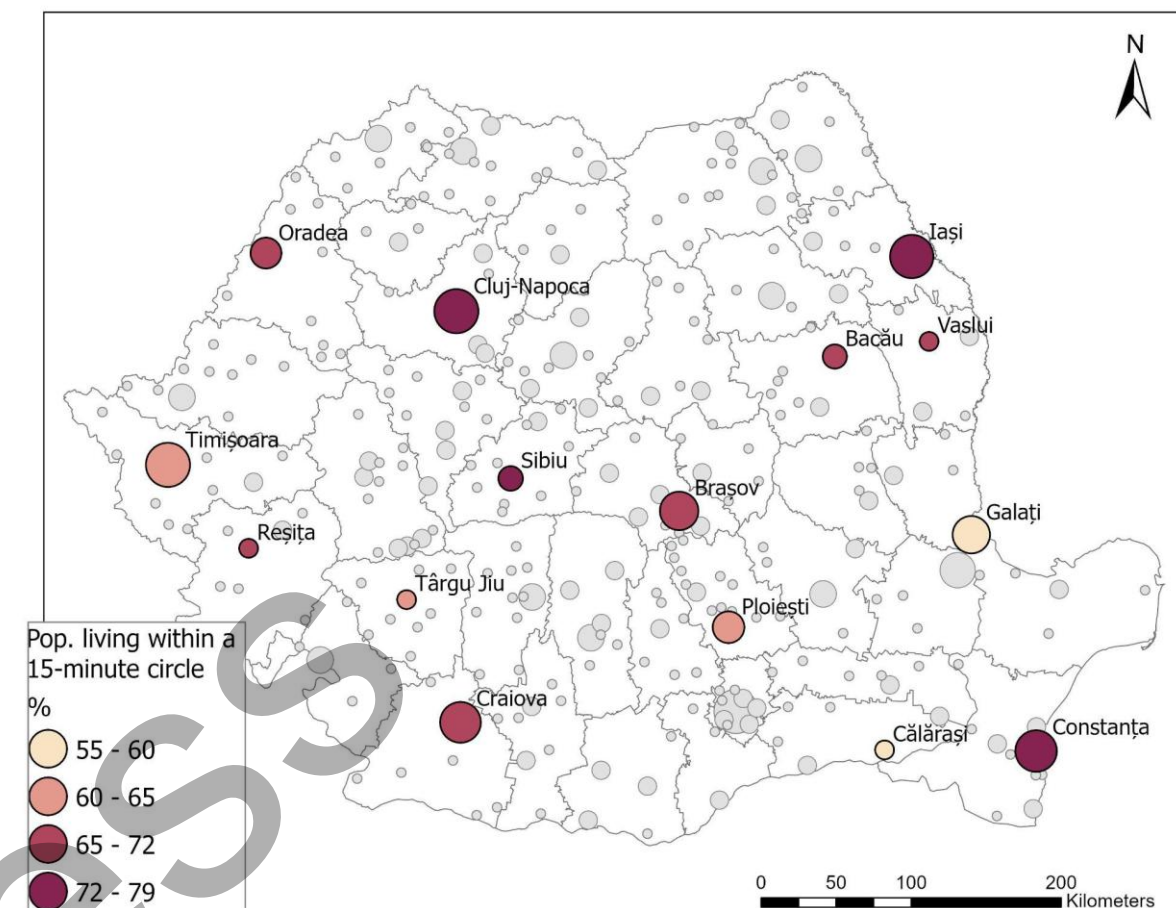


Figure 1. Percentage of people who live within a theoretical 15-minute neighbourhood

The 15-minute city concept proposes a transformation in how planners approach the urban environment (Moreno et al. 2021). Urban infrastructure is therefore reimagined to favor pedestrian routes and dedicated bike lanes, transforming streets into safer and more pleasant spaces. Moreover, local communities grow more cohesive when people frequently meet in neighbourhood public spaces and social events and when they are involved in larger activities within the city.

The proximity index in Figure 1 is inspired by various methodologies in literature (Fanelli et al. 2024, Bruno et al. 2024) and calculates how many people have access in under 15 minutes to any kind of basic facility. The spatial distribution of essential facilities (schools, pharmacies, supermarkets) is illustrated in relation to population density in four cities (Figure 2).

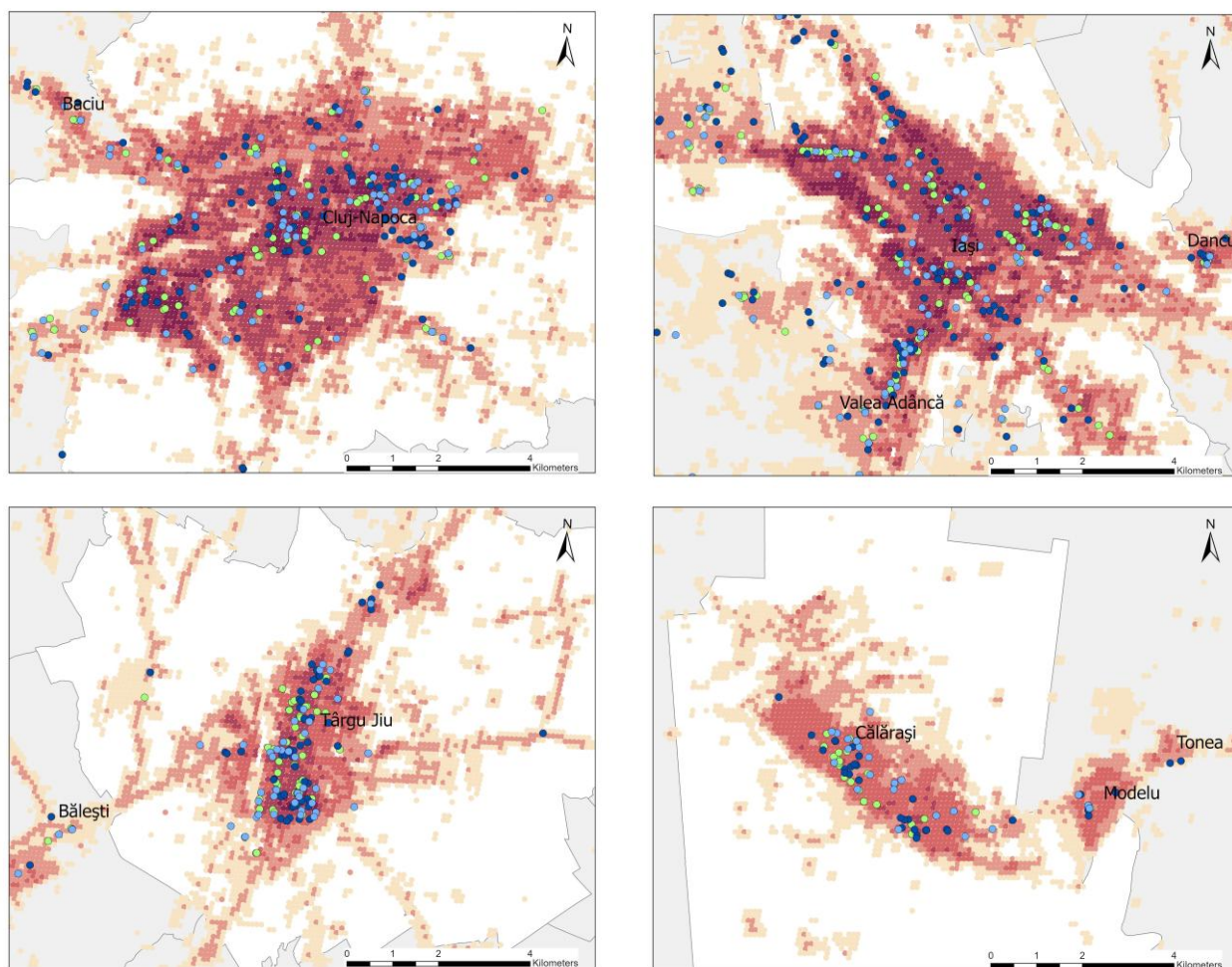


Figure 2. Spatial distribution of facilities and population. The cases of Cluj-Napoca, Iași, Târgu Jiu and Călărași

In the Cluj-Napoca, facilities cluster in high-density populated areas, ensuring equitable access within short walking distances. Its satellite, Florești, is currently one of the country's largest communes and acts as an example where infrastructure is trying to catch up with the fast development of built-up space. Conversely, Călărași shows large gaps in coverage, uneven distribution and less investments from private stakeholders. Unlike the 15-minute city framework, facility placement emerges organically through market forces and private development decisions rather than strategic public intervention, especially for the case of commercial facilities. Deciding their location happens based on land prices, property availability, and developer interests, often favoring accessible roads or profitable demand than population-weighted accessibility. Meanwhile, public facilities (schools, parks, hospitals) follow administrative capacity, available public land and a strong heritage from the socialist planning strict strategies (Stanilov 2007).

Romanian cities are continuously expanding today, successfully attracting students and people seeking for workplaces from rural areas or from smaller towns.

Peri-urban expansion is therefore occurring, as people often look for less crowded places, nature, cooler temperatures, affordability of land, but also easy access to necessities and the feeling of a sense of community. Around the city of Iași, the rapid and usually unintegrated development transforms agricultural land into residential areas without adequate infrastructure planning. Despite being a uniformly balanced city inside the core, adjacent peri-urban areas and rural second ring of communes still have room for improvement. Architects mention that peri-urban communities are built under a “parcel urbanism”, development driven by individual plots rather than comprehensive vision (Covaliu 2026). Streets remain narrow without sidewalks, forcing car dependency and generating a monocentric pattern of traffic. Along with the insufficient infrastructure comes disproportional provision of proximity services, with no pharmacies, shops, schools and public spaces for community within a walking distance (Sandu & Groza 2017). Therefore, isolated living environments appear. Large discrepancies between urban and peri-urban distribution of population and amenities are also found in the cases of Târgu Jiu, Vaslui and Călărași (Figure 3). The case of Reșița clearly shows the influence of the mountainous topography on the form of the built-up space in the city and its metropolitan area.

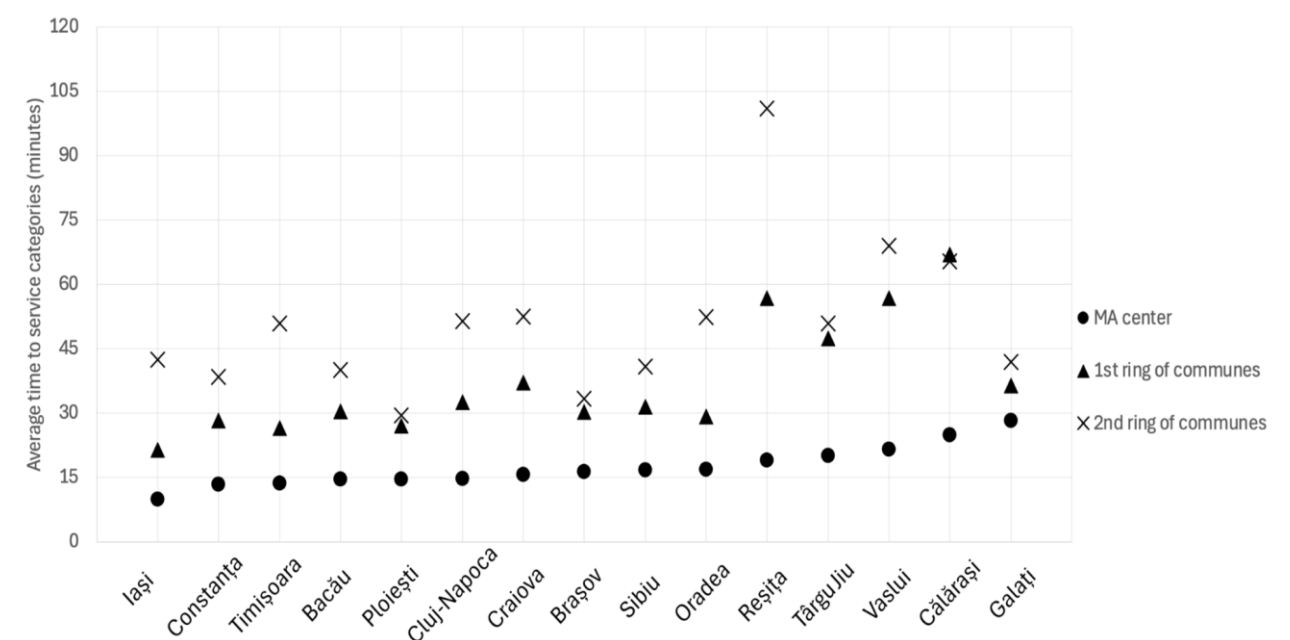


Figure 3. Average time to proximity services within the urban centers and their surrounding communes

CASE STUDY 5. Community-based initiatives and business dynamism in the Romanian landscape

Romania's governance landscape has been deeply shaped by its post-communist trajectory. For decades, local development operated within a centralized, top-down system, leaving very limited room for civic initiative. The transition to a market-based economy and decentralized governance after 1989, reinforced by EU integration, gradually opened space for bottom-up forms of action, with citizens, informal groups, and civic organizations becoming more involved in community life and local problem-solving. Community-based initiatives (CBIs) are a key expression of this shift: a form of self-organization through which citizens mobilize resources and energy to provide public goods or services for their community, representing an informal yet powerful mode of local governance. In doing so, CBIs contribute to what the literature terms "governance capacity," namely the ability of societies to coordinate actors and resources to address public issues (Agranoff & McGuire, 2003; Howlett & Ramesh, 2016; Molenveld et al., 2021).

1. Spatial distribution and evolution of CBIs over time

The number of CBIs increased steadily after 2008 (see fig. 1), both in municipalities and in their metropolitan areas. This parallel growth across urban and peri-urban spaces points to a widening territorial reach of civic engagement and provides an important context for examining how CBIs relate to patterns of business dynamism in the Romanian urban landscape.

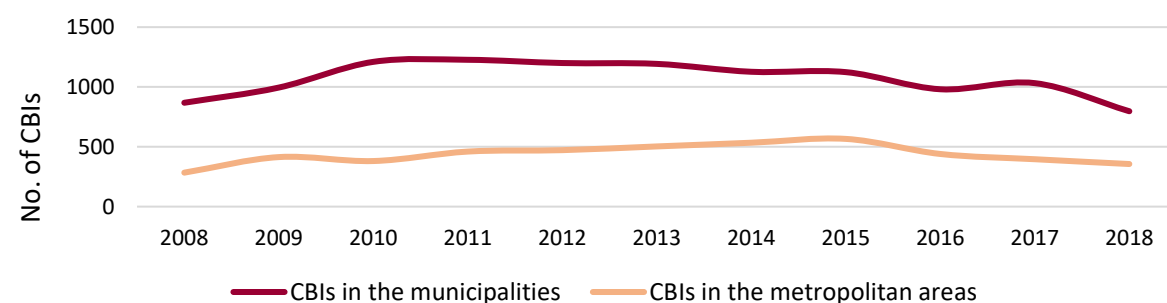


Fig. 1 Trends in the Number of CBIs

Mapping the percentage change in the number of CBIs between 2008 and 2018, a striking pattern of widespread civic growth across Romanian urban regions is revealed. Most municipalities experienced an increase in the number of initiatives, with many metropolitan areas recording growth rates well above 200%, and some exceeding 700%. While the largest and most dynamic cities (e.g., Bucharest, Cluj-Napoca, Timișoara) continued to account for a substantial share of all CBIs, the growth was by no means confined to these traditional centres. Numerous smaller and medium-sized cities also registered considerable percentage increases, pointing to a broadening territorial base of civic engagement over time. Importantly, the growth in cities was mirrored in their surrounding metropolitan areas, where many communities saw their number of initiatives multiply several times over the decade. This pattern of diffuse civic expansion suggests that the conditions enabling community self-organization progressively spread well beyond the initial urban cores.

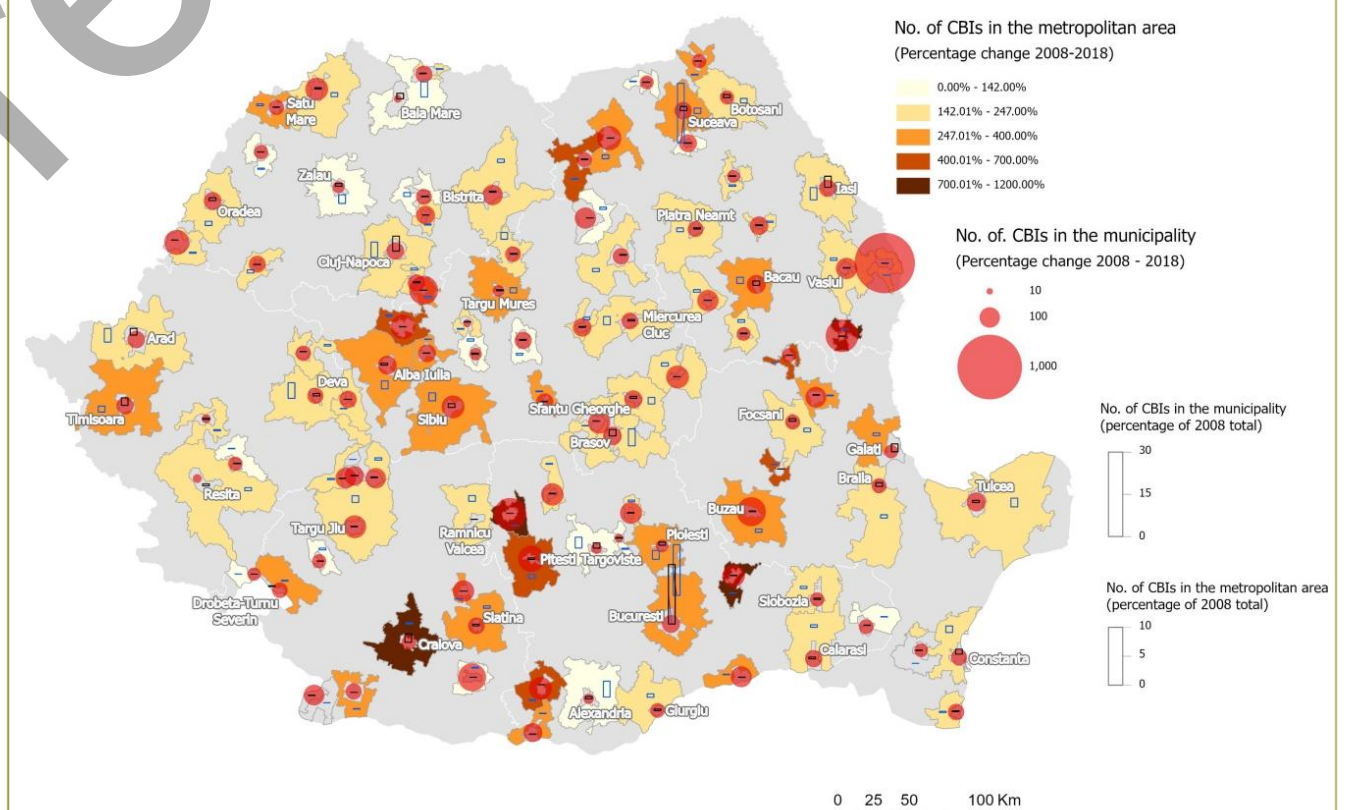


Fig. 2 CBIs spatial distribution and percentage change

2. Linking CBIs and entrepreneurship

Against this background, the maps of business dynamism reveal a more nuanced and differentiated pattern of change between 2008 and 2018. The number of new enterprises declined in the majority of municipalities over this period, reflecting the broader economic pressures that followed the 2008 financial crisis, yet several metropolitan areas recorded substantial increases, in some cases exceeding 250–400%. The entry rate of firms followed a similar trajectory: most cities experienced a decline over the decade, while many metropolitan peripheries registered positive change, with some areas in the south and east showing the largest gains. By contrast, revenue per employee grew almost everywhere between 2008 and 2018, with particularly pronounced increases in a number of mid-sized cities and in specific metropolitan clusters. Taken together, these maps suggest that the evolution of business dynamism over the decade was spatially uneven: firm creation contracted in many urban cores but expanded in parts of their surrounding areas, whereas firm productivity improved more broadly across the territory.

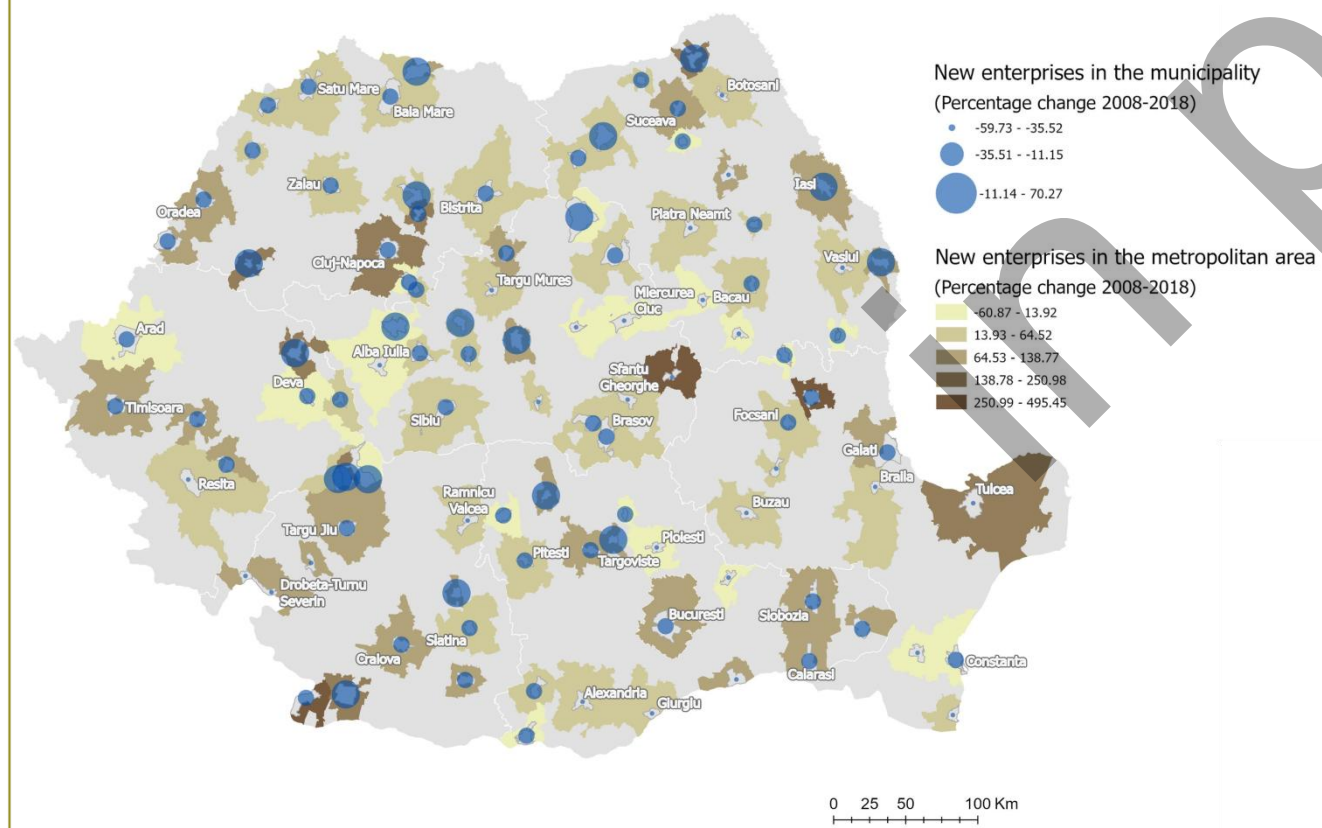


Fig. 3 Newly registered enterprises (2008-2018)

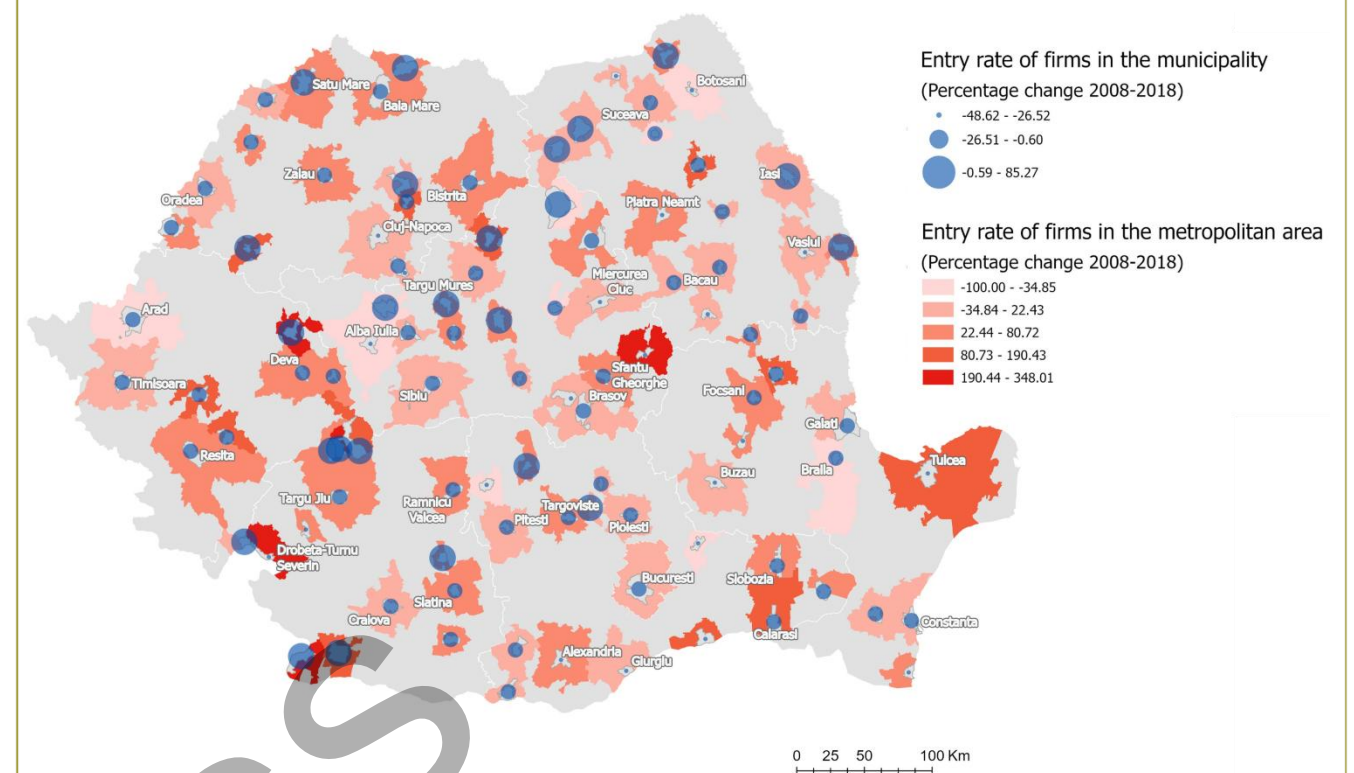


Fig. 4 Firms entry rate (2008-2018)

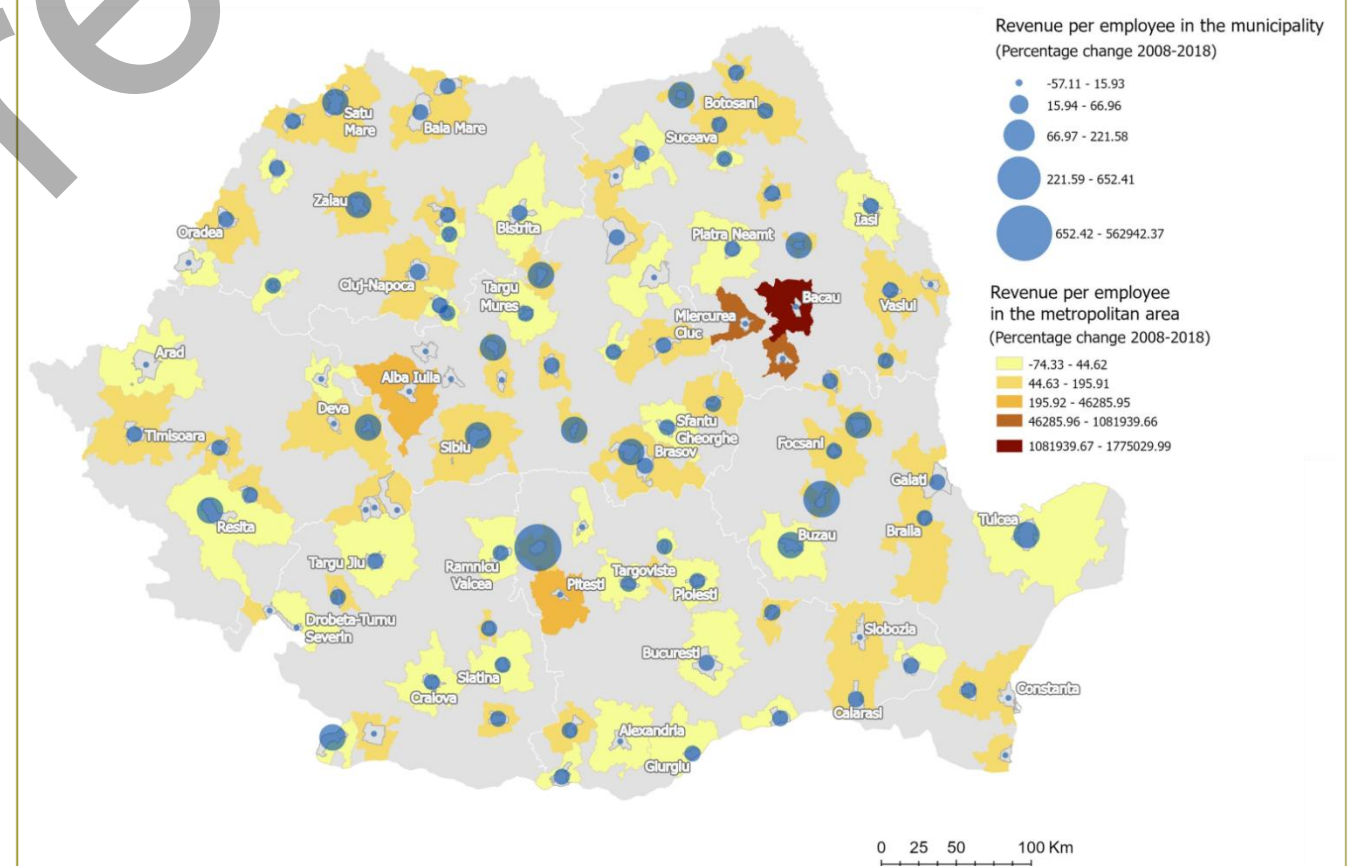


Fig. 5 Revenue per employee (2008-2018)

3. City-level relationships

Moving from spatial to statistical association, the city-level regressions indicate that CBIs are positively related to entrepreneurial formation (see table 1). Higher levels of CBI activity are associated with a significantly larger number of new enterprises, even after controlling for population size and regional dynamics, while the relationship with entry rates is positive but not statistically significant. By contrast, CBIs are negatively associated with revenue per employee across specifications, suggesting that civic participation in cities tends to be stronger in contexts characterized by smaller or less productive firms. Overall, the results point to a differentiated relationship between CBIs and business dynamism: CBIs are linked to higher entrepreneurial activity, but not to higher firm-level productivity in urban contexts.

Table 1. CBIs and firm dynamics in cities

	Log of Number of New Enterprises			Entry rate of enterprises			Log of Revenue per Employee		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Log of CBIs	0.057	0.095*	0.101*	0.011	0.016	0.017	-0.408+	-0.559*	-0.610*
Log of Population	1.262***	1.302***	1.300***	0.024***	0.029***	0.029***	0.288*	0.13	0.145
Distance to Bucharest (km)	0.001***	0.001*	0.001*	0.000	0.000	0.000	0.001	-0.001	-0.001
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Region FE		✓	✓		✓	✓		✓	✓
Region x Year FE			✓			✓			✓
Observations	860	860	860	860	860	860	937	937	937
R2 Adj.	0.862	0.879	0.873	0.216	0.221	0.177	-0.004	0.074	0

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001
Note: Standard errors in parentheses. All models consider the period between 2008-2018.

4. Urban–rural spillovers

Table 2 shifts attention to what happens beyond urban boundaries, in the rural communities that are functionally linked to cities. Rural areas located close to cities with a strong civic ecosystem tend to record higher numbers of newly created firms, pointing to a spillover effect of urban civic capacity. However, this influence is clearly shaped by distance, suggesting that civic-driven benefits are most visible in peri-urban spaces where connections to the city remain strong.

As in the urban analysis, CBIs are not associated with higher revenue per employee, reinforcing the idea that civic engagement mainly supports the emergence of economic activities rather than higher productivity levels. Overall, table 2 highlights the role of cities as anchors of civic and economic vitality, whose influence extends into surrounding rural territories in spatially structured ways.

Table 2. Spatial spillover effects of CBIs on firm dynamics

	Log of Number of New Enterprises	Entry rate of enterprises	Log of Revenue per Employee
Log of CBIs of nearest city	0.254***	0.030	-0.685***
Log of CBIs of nearest city × Distance to nearest city (km)	-0.015***	-0.003*	-0.006
Log of CBIs (Rural Community)	0.276***	0.002	-0.502+
Distance to nearest city (km)	-0.006***	0.006***	0.002
Distance to Bucharest (per 10km)	0.006***	0.008***	-0.033***
Log of population of the nearest city	0.299***	-0.006	0.039
Log of population of the Rural Community	1.023***	-0.080***	-0.085*
Year FE x Region FE	✓	✓	✓
Observations	10,313	10304	11,451
R2 Adj.	0.648	0.043	0.13

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001
Note: All models consider the period between 2008-2018.

5. Key takeaways

This case study illustrates how CBIs evolved into an increasingly important feature of Romania’s landscape and points to a broad diffusion of civic engagement well beyond the largest centres. Business dynamism followed a more differentiated path: firm creation declined in most municipalities yet grew in many metropolitan peripheries, while productivity increased broadly. CBIs appear to foster fertile environments for starting businesses rather than driving productivity, with their influence strongest near urban cores.

Conclusions



in press

The Atlas of Transformative Urban Resilience aims to be an integrated diagnostic and strategic guidance tool at the intersection of urban geography, urbanism, economics, social sciences, environmental sciences, regional sciences and administrative studies. It relies on a solid conceptual framework, anchored in resilience theory and an evolutionary perspective on urban transformability, to show how the existing vulnerabilities of cities and their functional areas can become opportunities for structural change. Beyond its cartographic ambition, the Atlas proposes a way to rethink cities as adaptive systems subject to cycles of disruption, adjustment and reinvention, in which shocks and pressures are not only possible triggers of disasters or crises, but also of transformation, thus becoming “blessings in disguise”.

The approach is built on resilience as the ability to withstand disruptions, manage crises in a coordinated manner, bounce back from decline and innovate to achieve a better state. Urban resilience is defined as the ability of cities and urban functional areas to respond, recover, adapt and even thrive in the face of unexpected shocks or stressors. While the approach focuses on outcomes rather than on detailed shock types, these threats remain in the background.

The methodology applied at the European and national level follows an eight-step workflow: literature review and conceptual framework construction; indicator selection; outlier treatment (winsorization); normalisation; weighting by principal component analysis (PCA) or alternative methods; aggregation into composite indices; and spatial classification by quartile methods, natural thresholds (Jenks) or hierarchical clustering. This architecture guarantees comparability between units, reduces the disproportionate influence of outliers, and, at least at the European level, enables robust exploration of the relationship between indicators corresponding to thematic dimensions and a proxy for human development, the Human Development Index (HDI). The atlas thus becomes a reproducible tool, with a transparent logic for index construction, useful for both research and practitioners.

European Patterns: Persistent Gradients and Inequalities

At the European scale, the Vulnerability-Opportunity Model (VOM) is applied to a sample of 559 cities and urban agglomerations with over 100,000 inhabitants, using 15 indicators grouped into four major subsystems: natural, infrastructure, socio-economic and governance. The results reveal a clear North–South and East–West gradient that spans almost all the dimensions analysed. Cities in the Nordic and North-Western countries – Denmark, Sweden, Finland, the Netherlands, Belgium, Luxembourg, Austria – are distinguished by high HDI values, income and expenditure per capita, good governance capacity (high share of grants in income), high digital performance and, often, environmental quality that also supports quality of life. In contrast, cities in southern and eastern Europe – Romania, Bulgaria, Greece, Portugal, Italy – face low or stagnant HDI, lower incomes, increased exposure to pollutants, limited green spaces, undersized or inefficient infrastructure, and weaker governance, marked by difficulties in accessing financing and resistance to change. Demographic dynamics deepen these differences: the population of cities is declining in former communist countries, in Greece, and in some urban areas in southern Italy and Portugal, while it is growing in the North and North-West, especially under the impetus of external migration.

Early peri-urbanisation in the North-West allowed a relatively managed transition to large metropolitan regions, while in the South and East, the process is more recent and superimposed on post-industrial crises and massive migration, thereby generating a decoupling between declining urban centres and a growing peri-urban hinterland. In many cases, the growth of built-up areas occurs in parallel with population stagnation or decline, signalling trajectories of extensive land consumption and the possible risks of “empty urbanisation”, with low density and high pressure on infrastructure. Overall, the European scale shows that, beyond policy convergence, transformative resilience trajectories remain deeply differentiated, reflecting institutional histories, development models and the quality of governance.

Romania: vulnerabilities, territorial decoupling and opportunities for transformation

The Romanian component of the Atlas extends the analysis, using 7 dimensions, the same as those at the European level, and 43 indicators, a much broader selection of indicators, applied to all official urban units, to a set of 50 theoretical metropolitan areas, and to a subset of 15 cities selected for their role as growth poles, fragilities, or remarkable transformation capacities. The periods analysed – 2000–2007, 2008–2012, 2013–2020, 2020–2026 – are chosen in relation to the major economic and social discontinuities: pre-accession, global crisis, pre-pandemic expansion, pandemic and post-pandemic.

A first major result is the contrast between core cities and the rest of the metropolitan areas: between 2000 and 2020, all core cities experience demographic decline, while many surrounding municipalities and communes grow, and others continue to decline. This decoupling indicates intense peri-urbanisation, especially around second-tier cities, which reconfigures the metropolitan structure through residential suburbanization, functional fragmentation and increasing pressure on land and infrastructure. Although the population decreases in the urban core, the built-up area increases significantly, often by 40–50% or more in the most dynamic metropolitan areas. This creates a gap between demography and land consumption, producing the well-known “American doughnut” effect with obvious implications for sustainability and spatial equity.

Indices such as living floor space per inhabitant, the share of the population aged 65+, infant mortality rates, schooling rates, and spending on education, culture and social assistance outline a complex geography of social equity. Large cities – Bucharest, Cluj-Napoca, Timișoara, Constanța – and certain tourist or cultural centres (Brașov, Sibiu) record increases in living space per capita and higher investments in human capital, suggesting a greater capacity to support transformative trajectories. In contrast, regions such as Moldova, northern Dobrogea or certain mountainous areas remain with low living space values and persistent social pressures, signalling a structural vulnerability that can be amplified by crises. The economic dimension highlights robust growth in local activity. Metropolises remain the main “engines”, but communes, especially those outside metropolitan areas, record the highest recent growth rates, suggesting a process of convergence.

However, the vulnerability of small and mono-industrial cities persists: indicators such as the number of firms per capita, net profit per capita and local budget revenues show that economic transformability is limited where specialisation is rigid, oriented towards low costs and speculative real estate, with few options for reconversion towards green economies, creative industries or advanced services. The environmental, health and infrastructure dimensions add a critical layer: high values of PM2.5 and NO2 in the Bucharest–Ploiești axis, in Iasi, Bacău and other centres, corroborated with modest NDVI (a low vegetation cover or its poor health) and flood risks, indicate socio-ecological systems under major pressure and with effects on the health of the living environment. At the same time, indicators of per capita sewage network length and the dynamics of new housing show that the expansion of the superstructure (buildings) is not adequately matched by the expansion of basic infrastructure, which limits transformability and increases vulnerability to climate or health shocks. This highlights the need for a development model oriented towards regeneration, smart densification and green-blue infrastructure, not just towards physical expansion.

The Atlas also highlights the role of digitalisation and institutional capacity in shaping transformative resilience. Indicators on the share of ICT firms, ICT employees, ICT turnover and profit, as well as the presence of local authority websites, show that digital ecosystems are strongly concentrated in a few university and metropolitan centres – Bucharest, Cluj-Napoca, Iași, Timișoara, Brașov – where digitalisation functions as a driver of innovation, economic diversification and modernisation of public services. Although there are many exceptions, in most small and medium-sized cities the presence of the ICT sector is marginal, indicating a risk of a digital divide and a reduced capacity to use technology and data as tools of adaptation. Cities where digitalisation overlaps with administrative skills, robust economic ecosystems and active social capital have high potential for transformative resilience, as they can move from reaction to anticipation. In contrast, where skills, resources and institutional infrastructures are lacking, digitalisation risks remaining a facade or exacerbating territorial disparities, consolidating the advantages of the centres and marginalising the peripheries.

The governance dimension – captured by indicators on the European funds absorbed, the structure of income and expenditure, the share of own income and investments in total expenditure, as well as the presence of civic initiatives – indicates that transformability is closely linked to the capacity of administrations to design and implement visions, not just to inertially manage current budgets. Cities and metropolitan areas with high levels of fund absorption and own income demonstrate greater financial and institutional autonomy, which allows them to address resilience and sustainability not only in response to crises but also as a long-term development strategy.

Case studies: micro-spatial dynamics of transformability

The case studies included in the Atlas provide a micro-spatial perspective on how transformability materialises in the territory. They show that, beyond statistical aggregates, transformative resilience is built through local, bottom-up initiatives, reconfigurations of space-use practices, professional reconversions, and interventions in mobility, housing, green space, and services.

The analysis of informal green spaces in the peri-urban area of Iași (Case Study 1) shows that informal green spaces function as a latent reservoir of socio-ecological resilience, and their deliberate integration into planning policies can transform the periphery into an even more valuable urban resource with positive effects on the quality of the environment and urban life. The assessment of the evolution of built space in two post-socialist states, Romania and Poland (Case Study 2), highlights how the legacy of centralized planning, combined with post-1990 liberalization, produces different development trajectories, in which urban transformability depends decisively on the capacity to limit sprawl and reorient investments towards compact regeneration, the models of the two countries being in this sense radically different in terms of performance and sustainability. From a socio-economic perspective, the transformations were even more significant. The study on socio-professional dynamics (Case Study 3) indicates that, against the general background of deindustrialisation and tertiarisation, but also of a still timid peri-urban reindustrialisation, Romanian metropolises attract and reconfigure human capital around highly skilled occupations, creating nuclei of economic and institutional transformability, but also the risk of increasing polarisation towards small and mono-industrial cities. The study on accessibility to urban services (Case Study 4) demonstrates that differentiated proximity to basic services – education, health, commerce, culture – is a major determinant of spatial equity and resilience, and reducing “access gaps” becomes an essential condition for the fair transformability of cities and for reducing congestion, traffic and pollution problems. Finally, the study on community initiatives and entrepreneurial dynamism (Case Study 5) shows that urban transformability is not only the result of top-down policies, but relies on the capacity of local communities and firms to generate, connect and scale innovative solutions, making local social and economic capital one of the central pillars of transformative resilience.

Overall, transformative resilience is not reduced to the capacity to “resist” or “return to normal”, but rather involves the ability to use crises and pressures – demographic, economic, climatic, health, technological – as turning points for reconfiguring the urban system in a more sustainable and just direction. For this, several paradigm shifts and, over time, a reconfiguration of all the subsystems that make up the city as a unitary/functional organism are necessary.

The Atlas as an instrument of urban policies in Romania

Some key outcomes regarding urban transformability, through the lens of the vulnerability-opportunity model, which can be operationalised in Romania within urban/metropolitan public policies, emerge from our analysis:

- ***the transition from spatial extension and extensive land consumption (urban sprawl) to compact development models***, with functional mix, spatial equity and resource protection. Data on the expansion of built space in parallel with demographic decline and underinvestment in infrastructure show the risk of a diluted urbanism, vulnerable to environmental or economic crises. Planning policies must privilege regeneration and well-calibrated densification.

- **the recovery by cities of lost (wasted) space and time** through sustainable mobility, integrating chrono-urbanism principles and proximity of current services with efficient public transport, but at the same time reconciling with the natural environment by promoting green and blue infrastructure and nature-based solutions.

- **integrating the social dimension** – social equity, access to public food, health, education, and culture – as a primary infrastructure of transformability. Indices of access to health services, investment in education and culture, and indicators of housing space show that cities capable of investing in human capital and social cohesion are also those with greater potential for adaptation and innovation. In the absence of this social infrastructure, crises tend to block resources in emergency management, leaving little room for structural transformations.

- **strengthening digitalisation** as a tool for adaptive governance, not as simple technical modernisation. The Atlas shows that ICT ecosystems concentrated in metropolises can support transitions towards smart urban models, but only if they are connected to capable administrations and policies that aim to reduce inequalities. Digitalisation policies must therefore aim to both support innovation centres and develop digital capabilities in small and medium-sized cities, in order to increase the quality and performance of human capital (thus making it even more adaptable to today's world), while avoiding the transformation of technology into a new layer of exclusion.

- **promoting polycentric and collaborative governance** appears essential: the differences between core cities and urban functional areas, as well as between regional centres and peripheral territories, suggest that transformability cannot be conceived only at the level of a single administrative-territorial unit. Polycentric mechanisms are needed for metropolitan and regional cooperation, the integration of community initiatives, the use of data for policy coordination, and the systemic addressing of vulnerabilities and the more equitable distribution of opportunities.

Through this approach, the Transformative Urban Resilience Atlas does not just provide a “snapshot” of the current state of cities but also a framework for imagining and assessing future trajectories, in which identified vulnerabilities serve as starting points for transformation strategies. It invites researchers, practitioners, and decision-makers to view cities as systems in motion, to use data not just to describe units or phenomena but to inform decision-making, and to build policies that transform resilience from a crisis response into a sustainable urban society project.

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