Transforming Romanian post-socialist cities by proxilience: a novel proximity-resilience framework in planning more liveable metropolitan areas

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We live in the "new urban world" in which human society, as a whole, and the city, in particular, are subject to increasingly numerous and complex challenges. During the COVID-19 crisis, the 15-minute city concept (Moreno et al. 2021) was adopted as a resilience instrument, not just an answer to a particular situation but also an adaptation that could also produce a long-term transformation of cities into more sustainable, just and livable systems (D'Onofrio & Trusiani 2022, Lanza et al. 2025). The concept was proposed not just for core cities but also for larger metropolitan areas or even at the regional level under the 30-minute territory (Moreno, 2024). Proximity was therefore revisited in the era of digitalization and added as a novel and strong dimension of resilience (Büttner et al. 2024, Compagnucci & Morettini 2020). In cities from post-socialist countries, urban development shows distinct vulnerabilities that compromise the effectiveness of the 15-minC model: i) Socio-economic vulnerabilities: population density, building distribution, and the availability of employment and community activities; ii) Infrastructure and service vulnerabilities: Gaps in access to proximity services, limited mobility options, and uneven distribution of essential amenities. 2) Environmental vulnerabilities: Air pollution and lack of green spaces negatively affect the quality of life. All these three categories can create territorial disparities, i.e. inequities in service access, transportation options, and environmental quality within neighbourhoods and between urban, periurban and rural settlements included in the metropolitan areas.

This study introduces a vulnerability-opportunity model to assess the sustainability of 15-minute cities (15-minC) perspective in post-socialist countries, focusing on urban resilience, proximity, and inclusive growth. Moreover, this research extends the 15-minC model by introducing a proximity index (including access to various essential services weighted by considering the hierarchy of needs) and a proxilience index, a composite index of services, mobility, and resilience indicators to evaluate overall sustainability at the metropolitan level. Proxilience also fosters resource-sharing partnerships between urban and rural areas, allowing for the sustainable management of shared resources.

This paper uses advanced spatial and geostatistical methods, including GIS for spatial modelling and machine learning clustering, to examine the distribution and accessibility of services. At the microscale, we create spatial accessibility models to understand and optimise urban accessibility by leveraging multiple data sources—such as the Global Human Settlement Database (GHSL) for population density and built area data, Copernicus Sentinel images for environmental quality, and web-scraped data on urban services. Additionally, at the commune level, we use geospatial regression analysis to evaluate social, economic and ecological factors of vulnerability or resilience (e.g., income, dependency rate, migratory rate, air pollution index) in relation to access to services, enabling a nuanced understanding of the sustainability of the 15-minC concept in Romanian cities.

The research outcomes emphasise that facilities addressing different human needs can be prioritised by consequence by using an approach derived from Maslow's hierarchy of needs. In rural areas, some higher needs might be lacking. Therefore, it is important to assess not just the quantity (access to amenities) but also the quality of these facilities—the satisfaction of clients

is included in the 15-mic model. Moreover, agglomeration, traffic, and pollution create discomfort even when services are available, while in the rural peripheries, there are lower densities and a lack of services. The optimal areas are less dense neighbourhoods with diverse services and a cleaner environment. Meanwhile, creating new centralities based on proximity service and possibilities for active mobility in these areas could improve their sustainability and resilience. The proxilience index, on the other hand, shows that accessibility does not always imply higher resilience; some more isolated areas can also show resiliency, and, on the contrary, the most agglomerated places can be highly vulnerable. However, in most cases, accessibility and resilience converge, especially in areas where the population pressure on services is under a certain threshold.

These results reflect the recent dynamics of multiple Romanian cities and metropolitan areas. However, this approach focuses on Iasi, a polarising centre from the North-East Region. In this regard, for Iași city, chrono-urbanism could be a viable solution to infrastructural problems, traffic agglomeration, and air pollution. The old central areas and the communist neighbourhoods are closer to a 15-minute city model regarding access to facilities. At the same time, the most significant issues emerge in the peripheral areas of recent urban sprawl. Our analysis shows that access to services will increase the attractiveness of the urban regions and create polycentricity in the metropolitan area, diminishing urban-rural disparities. Creating new centralities based on proximity service and possibilities for active mobility in these areas could improve the general sustainability and quality of life. However, there are still high urban-rural contrasts and steep discontinuity between the peri-urban area and the peripheries of the metropolitan area. Lack of access to specific amenities creates extensive motorised flows towards the city. Therefore, an integrated urban-rural policy and planning approach to metropolitan vulnerabilities and accessibility could include proxilience as the main driver and opportunity to diminish spatial disparities.

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