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A Spatial Decision Support System for the Regeneration of Italian Villages (Borghi) and Marginal Areas

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Summary

The disparity between cities and marginal areas has long been a structural issue in Italy. Currently, 16% of the Italian population lives in small municipalities. Among them, 26% are aged 65 and over, while only 12% are young. The demographic composition of these areas highlights a growing fragility as depopulation and aging populations threaten their long-term sustainability. The active population plays a crucial role in shaping the future of these territories, as their governance and active policies will determine the resilience of these communities. Moreover, in a post COVID-19 pandemic scenario, low-density areas have renewed interest at national and international institutional levels as strategic spaces for fostering more just and sustainable territorial systems. This shift in perspective underscores the need for policies that move beyond single interventions to embrace systemic, long-term strategies that can generate measurable impacts.

In this context, innovative spatial planning processes are essential for designing future scenarios aligned with global sustainability goals. Policies must focus on fostering intergenerational alliances and enhancing residential opportunities for younger generations, ensuring both demographic and economic stability. Without systemic action, only a few visionary municipalities will be able to reverse the current trends, while many others risk further decline. The challenge ahead is to implement strategic, system-thinking policies that not only support these territories, but also make them attractive places to live and invest in for future generations.

The national project "Rinascita dei borghi - per il rilancio delle aree marginali e lo sviluppo di poli di attrattività" aims to create the conditions to repopulate and rebalance shrinking marginal territories by establishing new centres of attractiveness. This research is a contribution of this project but mostly aims to support decision-making processes in the development of resilient, sustainable, safe, and inclusive urban areas through a comprehensive spatial analysis and evaluation of the Italian territory. To do so, the thesis follows a mixed-method approach that integrates quantitative approaches and Geographical Information System (GIS) instruments with qualitative stakeholder involvement techniques.

A systematic literature review has been preliminary conducted to examine the existing spatial digital decision support tools. A comparative maturity analysis was performed to evaluate the most robust digital tools selected. This analysis also emphasizes the importance of identifying the most suitable tools for three distinct user groups—public administrators, researchers, and urban planners. This review serves as a foundational guide for decision-makers and a support for this research that aims to define a digital interactive spatial tool to aid local authorities in creating a responsive environment for future local policy actions toward sustainable local development. Following this, the methodological framework of this study is structured in three sections: (i) Identification and mapping of the Italian villages as the focus of the analysis, followed by an exploration of the socio-economic and territorial dynamics within the Italian context, in order to perform a multivariate cluster analysis aimed at assessing and classifying the diverse conditions in which these villages exist. (ii) Building upon this analysis, the study develops an interactive GIS-based web dashboard that enables spatial visualization of the results and supports strategic territorial planning, offering an accessible platform

for both policymakers and local stakeholders. (iii) Furthermore, it proposes an indicator-based framework specifically designed to monitor regeneration processes and align local development trajectories with global sustainability goals. The framework was tested through the Alta Sabina case study and adapted to support the development of a Voluntary Local Review for the Green Community of Alta Sabina.

The study outcomes support Italian policymakers by providing an innovative digital tool as a Spatial Decision Support System (SDSS) that analyses and assesses territories for supporting more efficient spatial planning processes and co-creating future scenarios consistent with global goals at the local level.

Overall, this thesis contributes to the field of territorial sustainability by proposing a digital, data-driven framework for assessing and supporting the regeneration of marginal areas, with a particular focus on Italian villages. It highlights the value of integrating stakeholder perspectives, spatial analysis, and participatory planning processes in the evaluation of local development trajectories. While the methodology provides a robust foundation for spatial decision-making, certain limitations - such as data availability, granularity, and the evolving nature of local governance frameworks - are acknowledged, emphasizing the need for ongoing updates and refinements. This research offers practical tools and conceptual insights for local administrations, practitioners, and policymakers committed to promoting inclusive and sustainable regeneration processes. Moreover, it lays the groundwork for future research and policy experimentation aimed at strengthening the resilience, liveability, and territorial equity of small settlements in Italy and comparable contexts globally.