

Dispersed building: map, monitor, and inform territorial planning

Eduardo Gomes¹, Baye Mouhamed Diop¹, André Silva¹, Bruno Barbosa¹, Ana Gonçalves¹, Marta Alvarenga², Ana Franco¹, Mário Caetano², Nuno David², Cláudia M. Viana¹, Jorge Rocha¹, Patrícia Abrantes¹, Paulo Pereira³, Sandra Oliveira¹, Eduarda Marques da Costa

¹ Centre of Geographical Studies (CEG), Associate Laboratory TERRA, Institute of Geography and Spatial Planning (IGOT), Universidade de Lisboa, 1600-276 Lisbon, Portugal

² Direção-Geral do Território

³ Environmental Management Research Laboratory, Mykolas Romeris University, Vilnius, Lithuania

Executive Summary

Dispersed development constitutes one of the most complex territorial challenges in contemporary planning in Portugal. As a discontinuous phenomenon, it leads to the unsustainable consumption of land, infrastructure inefficiency, and difficulties in risk management. The MAPED project focused on the Lisbon and Tagus Valley Region (RLVT), developing a multidimensional methodology supported by 500x500-meter grids to continuously quantify and classify land use. The results reveal that the increase in territorial dispersion correlates negatively with population density and positively with the pressure on rural land (agricultural and forestry). Dispersed building simultaneously results in severe functional exclusion, penalizing populations with very long travel times to access essential services.

Recommendations

- Promote urban infill to halt dispersed expansion and densify consolidated urban fabrics.
- Implement productive greenbelts to protect fertile soils.
- Restrict building in risk areas at the wildland-urban interface (WUI).

Policy Brief Target Audience

Municipalities and local executives, Regional Coordination and Development Commissions (namely CCDR LVT), the Directorate-General for Territorial Development (DGT), spatial planners, and Civil Protection authorities and agents.

Introduction and Problem Statement

Dispersed development represents one of the most challenging phenomena in spatial planning in Portugal. Characterized by landscape fragmentation and the proliferation of buildings outside consolidated urban centers, this dynamic generates severe structural inefficiencies.

There is a significant increase in the costs of providing public infrastructure (water networks, sanitation, waste management, and transport) and the soil sealing of agricultural and forestry land. Additionally, dispersion at the wildland-urban interface exponentially increases the

vulnerability of populations to natural risks, namely wildfires. Traditionally, the morphological complexity of this pattern has hindered its effective monitoring (Abrantes et al., 2016; Barbosa et al., 2026; Gomes et al., 2020).

The MAPED project emerges to bridge this gap, presenting an innovative methodological approach focused on the RLVT, with the objective of informing and empowering policymaking through high-precision spatial metrics.

Analysis / Key Findings

The regional morphological assessment, developed using high-precision spatial information (LiDAR data), allowed for the identification of strong asymmetries in the land artificialization of the RLVT territory. A stagnation of physical growth is observed in the hyper-compact cores of the Lisbon Metropolitan Area, accompanied by the consumption of new land in the transitional peri-urban fringes and an inland scenario characterized by residual levels of artificialization.

By using a 500x500-meter grid combined with an analytical and statistical model (clustering via the K-Means algorithm), it was possible to classify the entire region into six dominant profiles or typologies of dispersion:

- (i) Consolidated built-up areas: where the highest demographic density is found;
- (ii) Peri-urban artificialization areas: fringes focused on logistics and low-density housing;

- (iii) Residential dispersion areas and rural settlements;

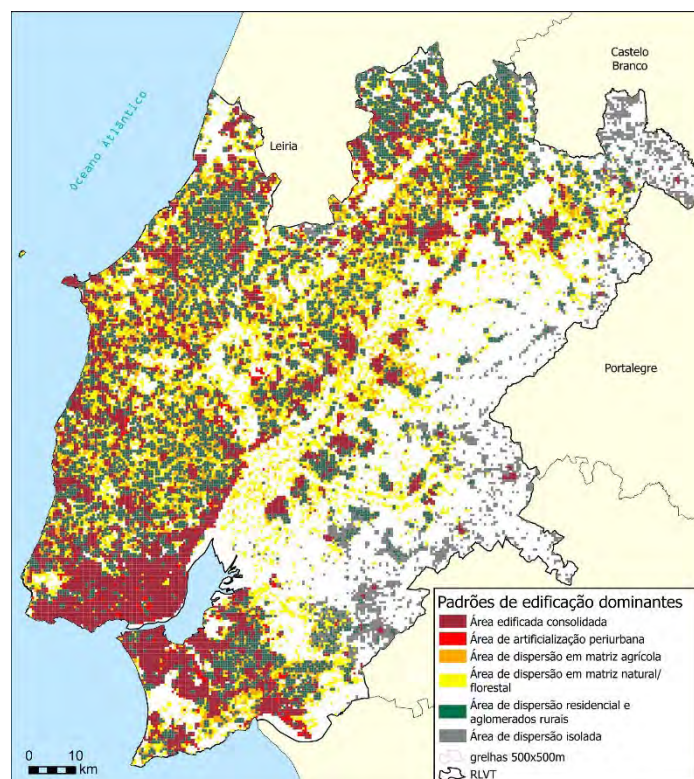
- (iv) Dispersion areas within an agricultural matrix: associated with the productive use of rural land;

- (v) Dispersion areas within a natural/forest matrix: critical areas regarding wildfire risk;

- (vi) Isolated dispersion areas: extremely remote networks dependent on automobile use.

Potential accessibility simulations demonstrate that spatial planning asymmetries cause inefficiencies in dispersed networks. Unlike consolidated areas, dispersed development forces populations to endure significantly higher travel times and costs to access supermarkets, healthcare facilities, post offices, or law enforcement.

Figure 1 – Dominant building pattern per 500x500m grid cell in the RLVT.



Source: prepared by the MAPED team

Policy Options and Recommendations

Combatting scattered development cannot rely on generic regulations; instead, it must be adapted to the six distinct realities identified within the territory. Transversally and at a supra-municipal level, the deployment of three core instruments is recommended:

- (i) Infrastructure and Greenbelts: The active promotion of green infrastructure (greenbelts) is vital to act as a strict boundary against the advance of scattered development, preventing land fragmentation in floodplains and areas with high agricultural and productive capacity.
- (ii) Risk Prevention and Active Enforcement: The proximity of buildings to dense forest areas

(wildland-urban interface) creates annual vulnerabilities. The adoption of a preventive paradigm that prohibits new construction in forest risk areas is recommended.

- (iii) Territorial Governance and Fiscal Models: It is essential to engage communities through spatial planning advisory councils and participatory planning. To support these guidelines, the application of fiscal rules against scattered land use in rural areas is also suggested, establishing reward-and-penalty dynamics for local authorities based on their compact regeneration efforts.

Conclusion

Scattered development cannot continue as a spatial inevitability or a passive byproduct of socioeconomic growth. The results of this study highlight a complex phenomenon, composed of

highly distinct territorial profiles, which generate severe negative externalities, ranging from the continuously rising costs of maintaining public

networks to the exposure of populations to environmental risks, such as wildfires.

The case study applied to the RLVT (Lisbon and Tagus Valley Region) proves that utilizing high-resolution spatial metrics in 500x500-meter grid cells enables local and central decision-makers to apply an empirically

rigorous methodology that is scalable and transferable to other regions of the country. This approach is fundamental to supporting the transition from a reactive model of urbanism to proactive spatial planning that is environmentally sustainable and focused on territorial cohesion.

References

- Abrantes, P., Fontes, I., Gomes, E., & Rocha, J. (2016). Compliance of land cover changes with municipal land use planning: Evidence from the Lisbon metropolitan region (1990-2007). *Land Use Policy*, 51, 120-134.
- Barbosa, B., Oliveira, S., Mário, C., & Rocha, J. (2026). Assessing the influence of building data choice on wildland–urban interface delineation in mainland

Portugal. *Scientific Reports*. Advance online publication.

- Gomes, E., Banos, A., Abrantes, P., Rocha, J., & Schlöpfer, M. (2020). Future land use changes in a peri-urban context: Local stakeholder views. *Science of The Total Environment*, 718, 137381.



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CONTACT

science4policy@planapp.gov.pt

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