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SMART VILLAGE LABS

D1.3 Typology on social wellbeing, resilience and exclusion of European rural areas

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Executive Summary

This deliverable outlines the conceptual, methodological, and operational framework for the development of a territorial typology on social wellbeing, resilience, and exclusion in European rural areas, as part of Task 1.5 of the INSPIRE project. As the conclusive component of Work Package 1 (WP1), this task builds upon the knowledge base, analytical approaches, and data infrastructures generated through previous tasks (T1.1 to T1.4). Its purpose is to synthesise these insights into a structured and policy-relevant classification of rural areas across Europe. The resulting typology will serve not only as a core analytical output of WP1, but also as a cross-cutting tool that underpins various elements of the project—particularly the piloting of Smart Village Labs (WPs 3 and 4), the co-design of context-sensitive solutions, and the construction of the Rural Social Inclusion Policy Dashboard (WP5).

The typology is conceived as a novel, multi-dimensional instrument to classify European rural territories in terms of their performance and vulnerabilities regarding social inclusion, as well as their potential for resilience and positive development trajectories. It will go beyond conventional macro-economic criteria to integrate a broad array of dimensions, including socio-political participation, access to key services, environmental and infrastructural conditions, institutional capacity, cultural embeddedness, and civic engagement. The typology will thus allow for a more nuanced understanding of rural exclusion and inclusion, reflecting the complex and interrelated nature of social wellbeing.

The creation of this typology responds to a pressing need identified in both the academic literature and policy frameworks: the lack of integrated and territorially grounded tools to guide decision-making and tailor interventions to rural specificities. The revised literature indicates that social exclusion in rural areas is often shaped by spatially embedded patterns of disadvantage, such as weak connectivity, ageing populations, reduced service access, and governance gaps. However, rural areas also exhibit resilience factors—such as strong local identities, social capital, and collaborative networks—that are not captured by standard economic indicators. INSPIRE's typology aims to fill this gap by offering a territorial lens that reveals both the vulnerabilities and the assets of rural regions, trying to capture most of the aspects found in the revised works.

Methodologically, the typology was developed through a combination of advanced statistical techniques and participatory refinement. Clustering methods such as hierarchical clustering and principal component analysis (PCA) were applied to high-dimensional datasets covering both structural and context-specific variables. These datasets were assembled from secondary sources (including Eurostat, the European Rural Observatory, national statistical offices) and from primary data collected under WP1, integrating information and concepts from the macro (global trends), meso (national governance), and micro (community-level dynamics) scales. The typology was constructed at the NUTS3 and NUTS2 levels, which allows for EU-wide comparability.

Connection with other WPs of the INSPIRE project

The territorial typology will not be a static academic classification, but a living tool designed for usability and impact. As outlined in WP5, it will be a core component of the INSPIRE Rural Social Inclusion Policy Dashboard, functioning as a digital interface through which users—policy makers, practitioners, and community leaders—can explore rural profiles and receive tailored recommendations. The typology will be embedded in the project's dissemination and co-creation strategy: draft versions were discussed with partners and stakeholders in dedicated workshops, and

its application will be tested and calibrated in selected pilot regions. This iterative and participatory process ensures that the typology reflects the lived realities of rural communities, and that it is both technically sound and practically meaningful.

Furthermore, the typology will directly inform the implementation and monitoring of Smart Village Labs under WP3 and WP4. By classifying pilot territories according to their social inclusion profiles, the typology will help partners adapt governance structures, co-creation methodologies, and deployment strategies to each site's specific needs and capacities. This territorial anchoring will enhance the effectiveness and sustainability of the solutions proposed and will support the design of policies that are truly place-based.

In sum, this deliverable introduces the rationale, scope, and anticipated value of the territorial typology to be developed under Task 1.5. It defines its strategic position within the broader INSPIRE architecture and outlines the principles that will guide its construction and operationalisation. The next steps will focus on the design and empirical implementation of the typology, its validation with stakeholders, and its integration into the project's tools, especially the dashboard. In doing so, T1.5 contributes not only to the scientific advancement of knowledge on rural social inclusion, but also to the delivery of actionable outputs that can support inclusive policy design, service innovation, and territorial resilience in diverse rural contexts across Europe.

Contents

List of Tables

List of Figures

List of Terms and Definitions

Abbreviation	Definition
AI	Artificial intelligence
AROPE	At Risk of Poverty or Social Exclusion
CATI	Computer-Assisted Telephone Interviewing
CLLD	Community-led local development
DE	Determinants Identified
EPSCO	Employment and Social Affairs Council
EU	European Union
EU 2020	Europe 2020 Strategy
EU 2030	Europe 2030 Targets
EU-SILC	EU Statistics on Income and Living Conditions
GDPR	General Data Protection Regulation
ICT	Information and Communication Technology
INSPIRE	"Supporting the inclusion, wellbeing, and growth of rural areas through multi-actor Smart Villages labs for enhanced governance frameworks" (Horizon Europe project)
IPCC	The Intergovernmental Panel on Climate Change
Laeken Indicators	Indicators to monitor poverty and social exclusion, developed by the European Council
LNOB	Leaving no one behind
NEETs	Not in Education, Employment, or Training (youth indicator)
NGOs	Non-profit organizations
NUTS	Nomenclature of Territorial Units for Statistics
R&D	Research and development
SDGs	Sustainable Development Goals
SE	Social Economy
SES	Socioeconomic status
SMEs	Small and Medium-sized Enterprises
SWOT	Strengths, Weaknesses, Opportunities and Threats
Twin Transition	Digital and green transitions
OECD	Organisation for Economic Co-operation and Development
UNESCE	United Nations Economic Commission for Europe

1.Introduction

As of 2024, nearly one in five Europeans—approximately 93.3 million people—were living at risk of poverty or social exclusion. Despite sustained efforts and a wide range of policy interventions, poverty levels across the continent have remained relatively stable over the past decade, pointing to persistent and deeply rooted structural challenges. These disparities are not evenly distributed: while countries such as Bulgaria and Romania report deprivation rates approaching 30%, others, like Slovenia and the Czech Republic, maintain levels closer to 15%. However, national averages often mask sharper inequalities at the subnational level, where some regions experience poverty rates exceeding 30%, and in certain cases, even surpassing 40%.

Within this broader picture, rural areas emerge as particularly susceptible to marginalisation and socio-economic vulnerability. These territories are characterised by structural disadvantages that distinguish them from urban settings, including limited access to public services, fewer employment opportunities, and restricted physical and digital connectivity. Additionally, demographic trends such as depopulation and population ageing—prevalent in many rural regions—further erode resilience by shrinking the active workforce and increasing pressure on already fragile welfare systems. These challenges are compounded by the internal heterogeneity of rural areas, highlighting the need for more granular analyses that can capture the territorial diversity of exclusion and inform more effective, targeted responses.

Given this complexity, generic, “one-size-fits-all” strategies are ill-suited to tackling the multifaceted nature of social exclusion in rural Europe. Instead, a more differentiated, territorially sensitive approach is needed—one that recognises the varying configurations of vulnerability across regions and allows for the design of tailored, place-based interventions. In response to this need, the present study aims to develop a regional typology of social exclusion in rural areas of the European Union, integrating both socio-economic and spatial dimensions to identify distinct patterns of disadvantage. The typology is intended not only to enhance the precision of policy design and targeting but also to serve as a practical tool for policymakers, practitioners, and stakeholders seeking to understand and address the complex realities of rural exclusion.

More specifically, this deliverable address two interrelated research questions:

- What territorial patterns of social exclusion can be identified across rural EU regions?
- Which socio-economic and spatial factors most strongly differentiate these patterns?

By answering these questions, the findings provide valuable insights to guide the design of place-based policies aimed at reducing rural poverty and social exclusion. The remainder of this deliverable is structured as follows. Section 2 reviews the relevant literature on social exclusion and wellbeing, with a particular focus on rural areas and previous typological approaches. Section 3 outlines the methodological framework employed for constructing the typology, while Section 4 details the indicators, data coverage, and spatial scales considered. Sections 5 and 6 present the empirical results at the NUTS3 and NUTS2 levels, respectively, including exploratory analyses, clustering outcomes, fuzzy membership assessments, and cluster characterisations. Section 7 provides a sensitivity analysis to test the robustness of the typologies against alternative specifications. Section 8 applies the framework to the INSPIRE piloting regions, illustrating how the typology operates in diverse territorial contexts. Finally, Section 9 concludes by summarising the key findings and their policy implications.

2. Literature Review

2.1. Social exclusion and wellbeing

Social exclusion is recognised as a complex, multidimensional phenomenon characterised by systematic marginalisation from various facets of societal life, encompassing economic, social, political, relational, institutional, and cultural dimensions (Sen, 2000; Silver, 2015; Levitas, 2007). Although closely linked to poverty, social exclusion extends beyond economic deprivation to include restricted access to essential resources and participation, limited capabilities, and compromised human agency (Sen, 2000). Sen's capability approach particularly highlights how exclusion is fundamentally about limiting individual freedoms and opportunities essential for achieving desired states of wellbeing, thus directly implicating both individual and collective wellbeing.

Wellbeing itself is a broad and multifaceted concept often differentiated into objective and subjective components. Objective wellbeing encompasses measurable indicators such as economic stability, employment status, health outcomes, educational attainment, housing conditions, and access to public services (Bradshaw et al., 2004). Subjective wellbeing reflects personal perceptions and evaluations, including overall life satisfaction, emotional health, happiness, and resilience to stress (Hoff & Walsh, 2018). The interconnection between social exclusion and wellbeing is notably profound, as social exclusion inherently compromises both objective life conditions and subjective experiences of personal and communal welfare.

Within contemporary approaches to poverty and exclusion, there is growing consensus that no single indicator can adequately capture the complexity of these phenomena. The capability approach (Sen, 2000) has been particularly influential in promoting a multidimensional understanding, though debates continue regarding the specific domains and their relative weight. Nonetheless, there is broad agreement around a core set of dimensions through which exclusion typically manifests (see Levitas, 2007):

- Economic exclusion remains central—not only due to its relative ease of measurement, but because of its strong interlinkages with other domains of deprivation. This includes income insecurity, precarious employment, long-term unemployment and vulnerability to poverty.
- Health and well-being encompass both physical and mental health outcomes, life satisfaction, and access to health care. It also includes related issues such as educational attainment and gender-based inequalities, which influence individual capabilities.
- Living conditions refer to the material and infrastructural context in which individuals live. This includes access to basic services, housing quality, transport networks and digital connectivity—all which condition participation and inclusion.
- Social participation and civic engagement cover the ability to engage in community life, maintain meaningful social relationships, exercise political voice, and access spaces of cultural recognition and representation.

Together, these dimensions offer a robust and context-sensitive framework for analysing exclusion not as a static condition, but as a dynamic, processual phenomenon shaped by structural and spatial inequalities.

The INSPIRE project deliverable D1.1 (INSPIRE, 2025) expands the conceptualisation of exclusion and wellbeing by providing a rural-specific analytical framework. It incorporates a comprehensive

array of quantitative and qualitative indicators, addressing how geographical isolation, infrastructure limitations, and economic vulnerabilities specifically affect rural contexts. By acknowledging rural distinctiveness, such as reduced access to health services, limited educational opportunities, and economic stagnation, the INSPIRE framework provides a nuanced, contextual understanding necessary for designing effective policy interventions aimed at enhancing rural wellbeing and reducing exclusion.

Furthermore, the framework emphasises qualitative assessments, including local community perspectives and experiences, to capture the nuanced reality of rural life. Such qualitative methodologies complement traditional quantitative approaches by revealing lived experiences of exclusion, community resilience strategies, and individual coping mechanisms that quantitative metrics alone might overlook. Consequently, the INSPIRE project underscores the importance of combining subjective evaluations of wellbeing with objective socio-economic indicators to create a robust and comprehensive assessment of rural social exclusion.

Beyond its theoretical significance, the concept of social exclusion has also played an increasingly prominent role in European policy discourse. Originating in France during the 1960s as a term to describe those disconnected from mainstream society, the concept gained traction in the 1980s in response to the social fallout from economic restructuring and rising unemployment (Atkinson & Davoudi, 2000; Tuparevska et al., 2024). By the early 2000s, exclusion had been fully integrated into EU-level policy frameworks, most notably through the Lisbon Strategy (2000) and the adoption of the Laeken Indicators (2001), which formalised a more comprehensive approach to poverty monitoring (Nolan & Whelan, 2011).

This reflects a gradual shift from purely economic indicators towards more inclusive and context-sensitive approaches. Initiatives such as the Lisbon Strategy (2000), the Laeken Indicators, and Europe 2020's AROPE measure reflect this broader perspective by explicitly addressing multiple dimensions of exclusion, including severe material deprivation, very low work intensity, and income poverty. Despite this evolution, the multidimensional nature of exclusion often remains peripheral within mainstream policy prioritisation, overshadowed by macroeconomic objectives (Copeland, 2023).

Recent developments at the EU policy level, however, indicate increasing recognition of social exclusion as central to achieving sustainable and inclusive growth. The European Pillar of Social Rights, for instance, explicitly acknowledges the role of inclusive social protection systems, equitable access to education and training, and effective healthcare provision as essential elements of comprehensive wellbeing. This policy recognition aligns closely with academic conceptualisations emphasising the complex interactions between exclusion and wellbeing, thus providing robust foundations for integrated rural development strategies.

Overall, integrating comprehensive frameworks such as those developed by the INSPIRE project into EU policy-making processes can significantly enhance the accuracy, effectiveness, and responsiveness of interventions aimed at addressing rural exclusion and wellbeing. This alignment between theory, empirical measurement, and policy underscores the necessity of adopting multidimensional, territorially nuanced strategies to mitigate exclusion and enhance rural wellbeing effectively.

2.2. Specific aspects of social exclusion and wellbeing in rural areas

Social exclusion and wellbeing in rural areas are shaped by distinct structural, demographic, and spatial factors that compound one another and result in unique forms of disadvantage (European Commission, 2008). The INSPIRE Deliverable 1.1 confirms that these dimensions interact across multiple domains—employment, health, education, housing, civic engagement, and infrastructure—creating a complex web of exclusion that is particularly acute in geographically peripheral, demographically declining, or infrastructurally deficient regions.

One of the most persistent characteristics of rural exclusion is geographic isolation. Physical remoteness limits access to essential services—such as healthcare, education, transport, and digital infrastructure—and often delays or prevents rural residents from participating fully in social and economic life. Poor connectivity, both digital and physical, aggravates the problem, especially in ageing regions where mobility is already constrained. For example, the report highlights how the absence of adequate transport systems and digital exclusion often leave residents dependent on limited personal resources to access work or services.

The INSPIRE framework also shows that rural areas suffer from health disparities rooted in both access and outcomes. Shortages of medical personnel, under-equipped facilities, and the lack of specialist care create significant gaps in provision. Indicators such as unmet medical needs, mental health prevalence, and healthy life years show significantly worse performance in rural areas. These outcomes are further exacerbated by housing deficiencies (e.g., dampness, overcrowding, energy poverty), which affect vulnerable groups such as the elderly and low-income households.

Demographic challenges, including depopulation and population ageing, add further complexity. The outmigration of young people in search of better opportunities leads to a shrinking workforce and weaker local economies. Meanwhile, ageing populations require greater support in the face of diminishing care infrastructures. These trends undermine community cohesion and reduce the resilience of rural communities (Commins, 2004; Shucksmith, 2012). There is a risk of compounded exclusion when ageing intersects with poor infrastructure, ill health, and income poverty.

The interaction between economic insecurity and employment exclusion is central to rural disadvantage. The framework emphasises that rural areas often suffer from low labour force participation, low-quality employment, and job market segmentation—factors that contribute to persistent poverty and material deprivation. Indicators such as quasi-jobless households, in-work poverty, and income inequality (S80/S20 ratio, Gini index) are useful tools to capture these deficits.

Social participation and civic engagement are likewise hindered in rural areas. Sparse populations, limited meeting places, and high levels of outmigration reduce the opportunities for formal volunteering, civic organisation, or political advocacy. Where bonding social capital (strong local ties) remains, it may paradoxically restrict broader social inclusion by fostering inward-looking dynamics resistant to newcomers or marginalised groups (Richmond and Casali, 2022). Shortall (2008) critiques the tendency to interpret low participation rates in rural development programmes as simple evidence of exclusion. Instead, she argues that exclusion in rural contexts must be understood in relation to community dynamics, local power structures, and the diversity of experiences within rural populations.

MacKinnon et al. (2022) reinforce this call for contextual sensitivity, criticising urban-centric policy frameworks that neglect the specific conditions of so-called 'left-behind' places—including rural and post-industrial areas—by reducing development potential to narrow economic indicators. They advocate for a broader, territorially sensitive understanding of development that incorporates social, political and environmental dimensions, alongside issues of belonging and place attachment.

Cultural isolation and the absence of shared spaces for interaction and creativity also reinforce exclusion. The report discusses the absence of cultural and recreational infrastructure, which limits opportunities for personal development, socialisation, and local pride. Without such amenities, residents—especially youth—feel culturally and socially excluded, fuelling further outmigration and weakening community resilience.

Digital exclusion stands out as a critical contemporary barrier. Lack of broadband access and digital skills impedes access to online education, telehealth, and remote work—further widening the rural-urban divide. This affects not only individuals but also local businesses, schools, and service providers. The COVID-19 pandemic laid bare this vulnerability, especially in education and healthcare delivery.

Moreover, structural determinants—such as gender, age, ethnicity, disability, and migration status—intersect with the rural condition to create compounded vulnerabilities. Women, for instance, are more likely to be employed in informal and poorly paid work and shoulder unpaid care responsibilities. Migrants and ethnic minorities often face added layers of discrimination, linguistic barriers, and precarious housing or employment conditions. For individuals with disabilities, rural exclusion is magnified by poor accessibility and lack of tailored services.

The INSPIRE Deliverable calls for a multidimensional, territorially sensitive framework that integrates both quantitative indicators (e.g. AROPE, Laeken) and qualitative insights gathered from communities themselves. It also recommends cross-sectoral strategies that align housing, health, employment, and digital policies, supported by robust governance structures and long-term investments. This holistic approach is essential for addressing the systemic nature of rural exclusion and advancing wellbeing in a sustainable and equitable way.

Effective rural-specific policies addressing exclusion and enhancing wellbeing require targeted, multidimensional approaches. Enhancing infrastructure, particularly in digital connectivity and transportation, is crucial to reducing geographic isolation and facilitating access to essential services. Economic diversification initiatives, including supporting small businesses, encouraging entrepreneurship, and investing in local industries, are essential for sustainable rural development. Additionally, policies should focus on fostering social inclusion and community resilience through active citizen participation, inclusive local governance, and comprehensive social service delivery.

2.3. Typologies of rural areas related to wellbeing and social exclusion

Over the past two decades, scholarly interest has increasingly focused on developing territorial typologies that reflect the complexity of rural areas—particularly regarding social exclusion, inclusion, and wellbeing. This trend responds to the limitations of binary urban–rural distinctions, encouraging

more nuanced and multi-scalar approaches that can capture the diversity and specificity of rural regions in Europe. Within the framework of the INSPIRE project, such approaches are essential to developing typologies that guide territorial policy towards greater social inclusion and resilience.

Regional typologies play a longstanding role in spatial analysis, offering tools to simplify territorial complexity, support comparative research, and inform targeted interventions. In the EU context, typologies have been used to differentiate urban and rural areas (Dijkstra & Poelman, 2014), classify border regions (Topaloglou et al., 2005), and develop refined rural classifications such as those from the EDORA project and the subsequent work of Copus (2008) and Hedlund (2016). Other examples include Cardoso et al. (2025), who identify functional roles of NUTS2 regions in European knowledge networks, and Navarro et al. (2009), who classify EU regions by innovation profiles. These studies illustrate the capacity of typologies to represent multidimensional characteristics of territories, enabling more accurate benchmarking and tailored, place-sensitive policy interventions.

However, while many of these typologies address economic or innovation-related dimensions of regional development, few explicitly focus on the multidimensional nature of social exclusion in rural areas. Some initiatives—such as ESPON's TIPSE project or the Territorial Quality of Life Index—have mapped poverty and wellbeing, but they are not designed to generate typologies of rural social exclusion. We have reviewed some 40 studies defining territorial typologies to study rural areas and to what extent they are focused on social exclusion or wellbeing. Without a big surprise, we have found that only a fraction explicitly focuses on exclusion-related indicators such as service access, social relationships, material deprivation, and civic engagement within typological frameworks.

The typology being developed within the INSPIRE project addresses this void by constructing a territorial classification that reflects both the structural heterogeneity of rural regions and the specific pathways through which exclusion is manifested. Drawing on a comprehensive review of the literature and systematic comparison of existing approaches, the INSPIRE framework seeks to identify common exclusion profiles at the NUTS2 and NUTS3 levels, using a set of harmonised indicators rooted in accessibility, ageing, service deficits, economic vulnerability, and social capital.

From a methodological perspective, rural typologies employ diverse techniques, ranging from conventional urban–rural splits to complex multivariate clustering. Many early studies were based on population density and distance from urban centres, but newer approaches integrate a broader range of variables. Whelan et al. (2023), for example, differentiate between cities, urban towns, commuter zones, and rural areas to explore economic exclusion in Ireland, revealing patterns that binary typologies obscure. Bernard and Šimon (2017), in the Czech Republic, use factor analysis to identify four types of rural peripheries based on demographic, education, and accessibility variables.

A particularly relevant strand of literature examines inner peripheries—regions that are not remote in physical terms but are functionally marginalised due to systemic deficits. De Toni et al. (2021) and Ortega-Reig et al. (2023) both analyse access to services in such areas, showing how grid-based mapping and spatial indicators can uncover exclusion even in regions close to urban centres. Alonso et al. (2023) contribute by employing cluster analysis at the municipal level in Aragón (Spain) to examine financial exclusion, revealing substantial heterogeneity in access to banking and digital infrastructure.

Sulis (2021) adds to this landscape by proposing the notion of "lonely places"—areas marked by service isolation and low population density. These typologies stress the need for spatial diagnostics

sensitive to infrastructural voids. Dahlberg and McKee (2018) further note that in rural Barnsley (UK), neighbourhood-level exclusion (e.g., lack of civic amenities and public spaces) is more impactful on wellbeing than in urban counterparts.

The studies reviewed show that the most frequently used dimensions in rural typologies linked to exclusion and wellbeing are:

- Access to services (15 studies)
- Economic exclusion and employment vulnerability (15 studies)
- Social relationships, connectedness, and capital (13 studies)
- Demographic dynamics (e.g., ageing, depopulation)
- Education, environment, civic engagement, and health (featured in multiple studies)

Methodologically, clustering and factor analysis dominate the field, often accompanied by spatial mapping and qualitative validation. Most typologies operate at the regional (NUTS2) and local (municipality or NUTS3) levels, offering the granularity needed for place-sensitive policy. Some recent examples incorporate multilevel approaches. For instance, Micha et al. (2021) assess how the Common Agricultural Policy affects social inclusion by applying typologies at both NUTS3 and LAU levels. Meloni et al. (2023) apply systematic review methods to examine the rural–urban wellbeing gap across multiple typological distinctions.

Importantly, INSPIRE D1.1 aligns with these findings and complements them by developing indicators that highlight the specific territorial determinants of exclusion and wellbeing in rural Europe. These include demographic structure, health outcomes, housing conditions, labour market access, and digital connectivity. The deliverable confirms that rural exclusion often occurs in overlapping domains, which can only be fully understood through multidimensional and spatially explicit typologies.

There is broad consensus in the literature that exclusion and wellbeing in rural areas are not homogeneous, and that place-based interventions are essential. Dahlberg and McKee (2018) find that neighbourhood-level exclusion has a more severe impact in rural than in urban contexts. Spoor et al. (2014) observe that, despite significant deficits in services, rural populations in parts of Southeastern Europe report relatively high levels of life satisfaction—suggesting the importance of social capital as a compensatory factor. Bernard and Šimon (2017) identify variation within periphery types, distinguishing between ‘cold’ peripheries (highly isolated) and ‘hot’ peripheries (socioeconomically vulnerable but with development potential), reinforcing the need for differentiated policy approaches tailored to territorial realities. Spoor et al. (2014) note that high life satisfaction in parts of Southeast Europe coexists with poor infrastructure, suggesting compensatory roles for social capital and cultural cohesion. Social capital can function in two contrasting ways. On the one hand, it may be exclusive, fostering inward-looking dynamics that resist the integration of newcomers (Richmond & Casali, 2022). On the other hand, it may be inclusive, understood as dense networks of civic engagement that nurture trust, reciprocity, and cooperation, ultimately contributing to a healthier society (Shortall, 2008).

Thus, developing rural typologies grounded in exclusion and wellbeing dimensions is not only an academic exercise but a practical tool for equitable policy design. The INSPIRE typology builds on these foundations to propose a robust, multidimensional, and territorially sensitive framework—an essential step for fostering inclusive and resilient rural futures across Europe.

3. Methodological Approach for Typology Construction

3.1. Rationale and conceptual underpinnings

The classification of space into typologies has deep roots in rural and regional studies. Early contributions, such as those by Sorokin and Zimmerman (1929) and Cloke (1977), conceptualised space along a linear urban–rural continuum, if socioeconomic vitality declined with distance from urban centres. However, critiques emerged early on: Pahl (1966) proposed a more networked, non-linear spatial model; Pettersson (2001) showed that remoteness does not inherently imply deprivation; and Falk (1976) demonstrated that commonly used rurality indicators were often weakly correlated. Cloke's own typology, based on principal component analysis, explained only a limited share of internal rural variation.

Recent literature has since moved decisively toward a multidimensional conceptualisation of territorial heterogeneity. Hedlund (2016), for example, developed a typology of rural Sweden using high-resolution data and cluster analysis, identifying five clusters and sixteen subtypes. His approach, which explicitly rejects the continuum model, aligns with the OECD's (2006) call for place-based policy grounded in spatial diversity. European comparative work (Copus et al., 2008; Aubert et al., 2006; Banski & Stola, 2002) further confirms that typologies aligned with real spatial dynamics rarely follow national administrative boundaries.

This methodological orientation also underpins the INSPIRE project's approach. The classification of rural areas by social exclusion and wellbeing requires moving beyond simplified distinctions and adopting a typological lens that reflects the multidimensional interplay of accessibility, services, economic structure, demographics, and environmental context. As with the Regional Attractiveness Index developed in projects like MOBI-TWIN, we embrace a multidimensional framework that integrates traditional, digital, and green dimensions of regional wellbeing.

This perspective also resonates with insights from innovation studies. Eder (2019), for instance, introduces the concept of peripheralization, which explains how regions at the geographic margins may still possess strong innovation capacity when supported by synthetic or symbolic knowledge bases. Asheim and Gertler (2005) and Tödtling and Trippl (2005) similarly challenge binary spatial classifications, highlighting how institutional and economic complexity drive performance. In this spirit, the INSPIRE typology refrains from treating remoteness or rurality as inherently problematic, instead focusing on structural combinations that create or mitigate exclusion.

3.2. Clustering techniques

To construct the typology of rural exclusion and wellbeing, we adopted a multi-stage clustering approach combining hierarchical, non-hierarchical, and fuzzy techniques. This approach balances exploratory openness with analytical rigour and ensures interpretability across multiple spatial levels.

Cluster analysis refers to a set of statistical methods that group observational units—in our case, NUTS2 or NUTS3 regions—into mutually exclusive clusters based on multidimensional similarity. The

aim is to maximise within-cluster homogeneity and between-cluster heterogeneity. Clustering is particularly suitable for typology construction because it enables the identification of latent structures within complex data, supporting both empirical exploration and policy formulation.

The first stage of the process involved exploratory hierarchical clustering, specifically using Ward's method with Euclidean distance. This agglomerative method does not require a pre-specified number of clusters and allows visual examination of data structure through dendrograms. The optimal number of clusters was identified based on large jumps in fusion coefficients and visual clarity of aggregation levels.

In the second stage, we implemented K-Means clustering using the number of clusters identified in the hierarchical stage. This non-hierarchical method is efficient for larger datasets and ensures consistent groupings by minimising squared distances to cluster centroids. The K-Means stage refined our initial results and provided stable, replicable classifications of regions.

Finally, a third stage used fuzzy clustering, specifically the fuzzy c-means (FCM) algorithm. Unlike hard clustering, fuzzy clustering allows for degrees of membership, recognising that territorial characteristics often overlap. This is especially important in the context of rural exclusion, where economic, demographic, and service-related features intersect in complex ways. The FCM algorithm calculates degrees of regional belonging to multiple clusters, creating a more nuanced representation of rural heterogeneity.

Throughout, careful attention was paid to the selection of input variables. Variables were screened to avoid multicollinearity and to ensure representation across the dimensions of exclusion and wellbeing identified in the literature and Deliverable 1.1. These include access to services, employment vulnerability, ageing, digital connectivity, housing quality, and social capital proxies. Validation can be carried out using internal metrics such as silhouette scores and between-cluster variance ratios. For the fuzzy clustering, some techniques are available for evaluation, including the partition coefficient, classification entropy, and proportion exponent. The triangulation of methods strengthens the robustness of the final typology and enhances its relevance for place-based policy.

In summary, the methodological approach employed by INSPIRE rejects linear or binary models of spatial classification. It recognises the complex and overlapping nature of rural disadvantages and constructs a typology that is both empirically robust and conceptually sensitive. The integration of hierarchical, K-Means, and fuzzy clustering methods allows for both clarity and interpretability, offering a solid foundation for subsequent analysis and policy design.

3.3. Qualitative refinement through expert deliberation

As foreseen in Task 1.5, once the draft typology was constructed, it was presented to the INSPIRE consortium in a dedicated virtual workshop. The aim was to ensure that the classification of European rural areas at NUTS3 level was not only analytically consistent but also meaningful from a policy and governance perspective.

During this session, university partners and external experts (mostly from the INSPIRE Advisory Board) discussed the robustness of the clusters, the adequacy of the selected dimensions (resilience, inclusionary governance, and wellbeing), and the clarity of the resulting territorial categories. Through

the engagement of external experts, partners elicited feedback from people who represented rural regions that did not belong in the INSPIRE pilot areas, thus enriching perspectives. The deliberation provided qualitative validation of the statistical work and pointed to several adjustments that improved the interpretability and relevance of the typology.

This step guaranteed that the draft results were collectively scrutinised before being finalised, in line with the procedures described in the project's Description of Action. The refined typology will subsequently serve as the first component of the Rural Social Inclusion Policy Dashboard, ensuring that it is both scientifically rigorous and practically useful for stakeholders and policymakers.

4. Analytical Considerations: Indicators, Coverage and Spatial Scale

We begin by examining the variables that underpin the concepts of social exclusion and wellbeing, drawing on the list of indicators identified in INSPIRE D1.1. As discussed in that document, rural areas exhibit distinctive socio-economic and infrastructural features that shape how social inclusion and exclusion are experienced and measured. These regions often contend with limited public services, long distances to essential facilities, a narrow range of employment opportunities, and uneven digital connectivity. Such conditions highlight the need for more nuanced indicators capable of capturing the specific dynamics of social exclusion and inclusion in rural contexts.

As in D1.1. the list of indicators for measuring social exclusion/inclusion includes four key dimensions:

- Economic Security and Employment
- Health and Wellbeing
- Living Conditions
- Social participation and Engagement

The full list of indicators comprehends up to 40 variables, although given the natural constraints of data, not all indicators are available at the more granular level, NUTS3, which include 18 variables. **Table 4.1** displays the list of indicators by dimension and spatial level availability.

Table 4.1. Indicators of Social Exclusion and Wellbeing by Dimension and Spatial Availability

Label	Description	Level
Economic Security and Employment		
GDP per capita in PPS	Gross Domestic Product per capita adjusted for purchasing power standards	NUTS3
Real Productivity per Hour	Economic output (GDP) per hour worked adjusted for inflation	NUTS3
Job Opportunities	Number of jobs over working age (15–64) population	NUTS3
Employment in Agriculture	Share of employment in agriculture	NUTS3
Employment in Industry	Share of employment in industry	NUTS3
Employment Rate	Percentage of the working-age population currently employed	NUTS2
Employment in Science and Technology	Share of workers employed in science and tech sectors	NUTS2
Net Disposable Income per capita in PPS	Money available after taxes and deductions in PPP	NUTS2
Employment Rate Gender Gap	Gap between working-age men and women who are employed	NUTS2
Unemployment Rate	Percentage of labour force without a job	NUTS2
NEET Rate	Percentage of young people (15–29) not in education, employment, or training	NUTS2
At Risk of Poverty	Share below at-risk-of-poverty threshold	NUTS2
Work Intensity	Share of people living in low work intensity households	NUTS2
Severe material and social deprivation	Share under enforced lack of necessary/desirable items	NUTS2
Living Conditions		
Population living in <15 min from hospital	Share within 15 minutes driving of hospital	NUTS3
Exposure PM2.5	Premature deaths attributed to PM2.5	NUTS3
Internet Connectivity	Average download speed in Mbps	NUTS3
Health and Wellbeing		
Lifespan	Average number of years a person is expected to live	NUTS3
Lifespan gender gap	Gap between females and males in life expectancy	NUTS3

Age Dependency Ratio	Ratio of dependents (young and old) to working-age population	NUTS3
Average age of mother at birth	Average age of women when giving birth	NUTS3
Crude rate of net migration	Net rate of immigration over population in thousands	NUTS3
Early Pregnancy	Births from women under 20	NUTS3
Fertility Rate	Births per woman	NUTS3
Median Age	Median age of the population	NUTS3
Mental Health	Standardised death rates for mental and behavioural disorders	NUTS2
Infant Mortality	Number of infant deaths (under 1 year) per 1,000 live births	NUTS2
Deaths from Alcoholism	Standardised death rates for mental and behavioural disorders derived from alcoholism (per 100 000 inhabitants)	NUTS2
Intended self-harm	Standardised death rate derived from intentional self-harm (per 100 000 inhabitants)	NUTS2
Gender gap in Intended self-harm	Gap between females and males in intentional self-harm death rates	NUTS2
Secondary Educational Attainment	Percentage of the population that has completed upper secondary education	NUTS2
Gender Gap in Tertiary Education	Gender gap in the percentage of the population that has completed higher education	NUTS2
Tertiary Educational Attainment	Percentage of the population that has completed higher education	NUTS2
Participation in education and training	Share in formal/informal learning (25–64)	NUTS2
Social participation and Engagement		
Eurosceptic votes	Share of votes to Eurosceptic parties (somewhat and strongly opposed to the EU)	NUTS3
Hard Eurosceptic votes	Share of votes to Eurosceptic parties (strongly opposed to the EU)	NUTS3
Electoral Turnover	Votes cast over eligible voters	NUTS3
Criminality (robberies)	Number of robberies per 100,000 inhabitants	NUTS3
EQGI	European Quality of Government Index	NUTS2

We use the official territorial typology at NUTS3 level developed by the European commission.[1] The main criterion for defining such territories is based on density and city size: at an initial level, high-density clusters are identified as groups of grid cells with a population density of at least 1,500 inhabitants/km² and collectively a population of at least 50,000 inhabitants. Urban areas include such urban centres plus surrounding commuting zones. Metropolitan NUTS3 regions are defined as regions where at least 50% of the population lives inside a functional urban area that is composed of more than 250,000 inhabitants. At the NUTS2 level we use the work from Vaisanen et al. (2024) from the MOBITWN Horizon Europe project. They follow the same criteria than the official classification and define regions as Predominantly rural (50% or more of the population live in rural regions); Intermediate (More than 20% but less than 50% live in rural regions or 50% or more live in rural regions, but the urban centre population is 200,000 or more and is at least 25% of the population); or Predominantly urban (20% or less live in rural regions or more than 20% but less than 50% live in rural regions, but the urban centre population is at least 500,000 and has at least 25% of the total population).

At this stage, a decision must be made regarding the trade-off between indicator coverage and spatial scale. While a set of around 20 indicators at the NUTS3 level appears sufficient to discriminate between rural regions, several key social exclusion variables—such as the at-risk-of-poverty rate, social trust, and education-related indicators—are not available at this scale.

[1] The complete methodology can be accessed at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Territorial_typologies_manual

There are up to 412 rural NUTS3 units, representing approximately 35% of all NUTS3 regions (1,166 in total). At the NUTS2 level, 67 rural regions account for about 28% of the total. Including intermediate regions would significantly increase the number of units considered—up to 79% of all NUTS3 and NUTS2 regions—thereby undermining the usefulness of the typology for developing targeted policies (**Figure 4.1**).

To undertake a comprehensive analysis of the spatial distribution of social exclusion, we proceed to define spatial typologies at both the NUTS3 and NUTS2 levels. The NUTS3 level enables a more detailed spatial representation of a set of indicators related to social exclusion and wellbeing. In contrast, the NUTS2 level, although less spatially granular, is more closely aligned with the core conceptual definitions of social exclusion and wellbeing, which are central to the INSPIRE project.

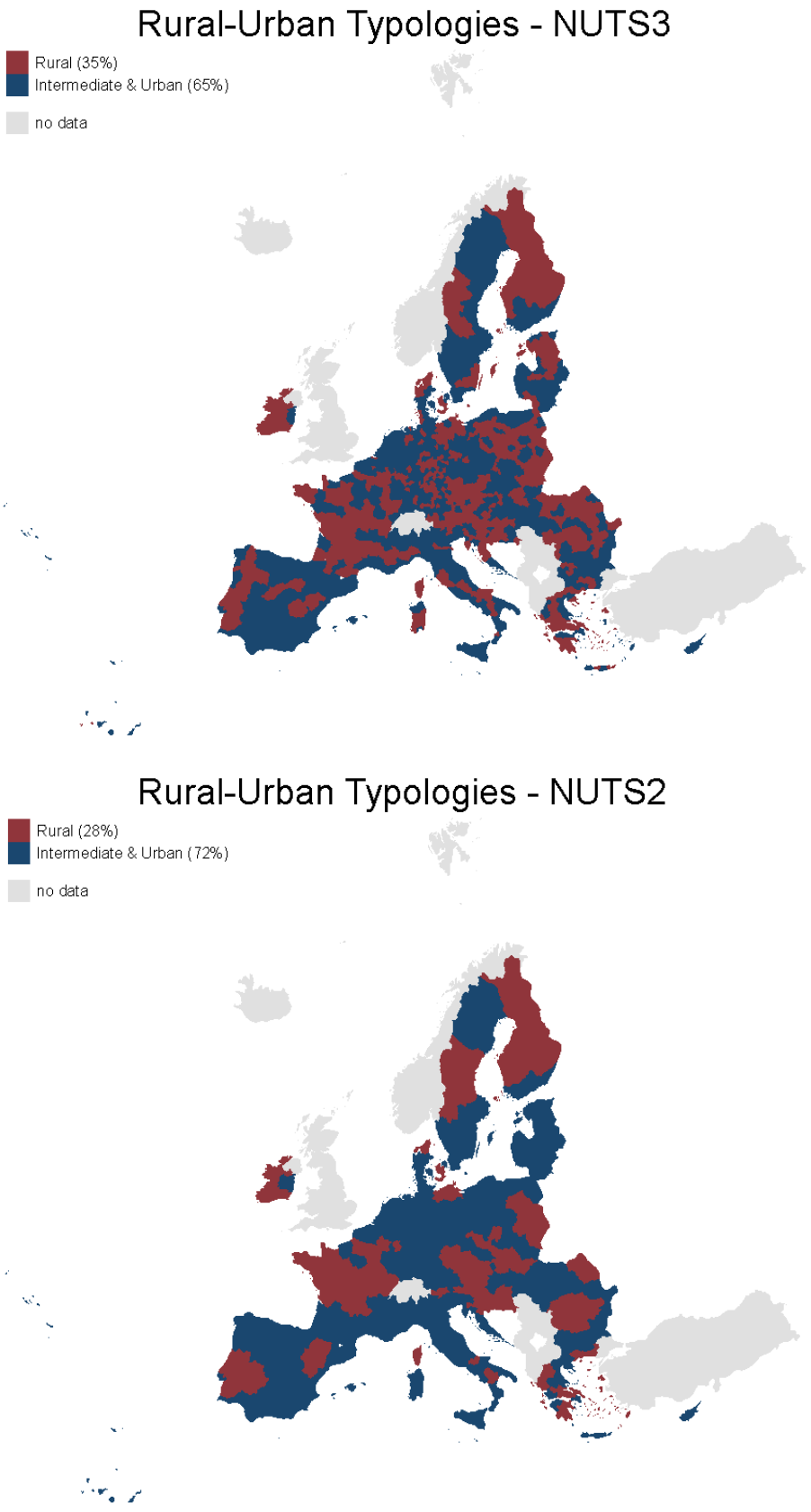


Figure 4.1. Rural – Intermediate & Urban regions. NUTS2 and NUTS3 spatial scales.

5. Typology at NUTS3 Level

5.1. Exploratory analysis

We start describing the data considered for the analysis of NUTS3 regions. The available information captures variables for all the dimensions of social exclusion and wellbeing. The economic variables include indicators such as GDP per capita in PPS, Real Productivity per Hour, Job Opportunities, Employment Rate and Employment in Agriculture and Industry. The Health and Wellbeing dimension considers a wider number of indicators: Lifespan, Age Dependency Ratio, Average age of mother at birth, Crude rate of net migration, Early Pregnancy, Fertility Rate, Median Age plus an indicator of gender inequality, namely the relative difference of life expectancy between men and women. The Living Conditions dimension includes Population living in a <15 minutes range from a hospital, Exposure PM2.5 and Internet Connectivity. Finally, the Social participation and Engagement dimension contemplates Eurosceptic votes, Electoral Turnover and Criminality (robberies).

Table 5.1 displays the descriptive statistics for all NUTS3 regions, plus the descriptive statistics for Rural and Intermediate regions.

Table 5.1. Descriptive statistics of the Indicators of Social Exclusion and Wellbeing

	Rural NUTS3 regions		Intermediate NUTS3 regions		All NUTS3 regions	
Indicators	**Mean**	**St. Dev.**	**Mean**	**St. Dev.**	**Mean**	**St. Dev.**
GDP per capita in PPS	31,078 €	11,754 €	35,658 €	14,321 €	36,211 €	15,801 €
Real Productivity per Hour	34.90	18.03	39.49	16.17	39.50	17.63
Job Opportunities	0.71	0.17	0.75	0.19	0.75	0.19
Employment in Agriculture	0.10	0.10	0.05	0.06	0.06	0.08
Employment in Industry	0.20	0.11	0.19	0.10	0.18	0.10
Population living in <15 min from hospital	66.39	20.63	82.63	15.27	79.43	19.49
Internet Connectivity	81.42	33.03	98.82	35.71	96.92	37.74
Exposure PM2.5	47.40	37.76	52.18	36.96	51.06	37.33
Fertility Rate	1.54	0.23	1.49	0.28	1.50	0.26
Median Age	47.02	3.50	46.07	3.73	46.01	3.75
Age Dependency Ratio	61.72	7.26	59.07	6.44	59.14	7.00
Average age of mother at birth	30.44	1.28	30.89	1.30	30.88	1.31
Early Pregnancy	0.03	0.03	0.02	0.03	0.02	0.03
Crude rate of net migration	3.67	11.18	6.07	13.39	5.57	13.11
Lifespan	81.26	2.46	81.70	2.37	81.68	2.32
Gender inequality in Lifespan	0.07	0.02	0.06	0.02	0.06	0.02
Criminality (robberies)	17.68	15.24	34.64	39.97	34.91	44.04
Eurosceptic votes	24.67	18.34	24.34	18.60	24.43	18.57
Hard Eurosceptic votes	12.85	10.37	14.56	11.85	13.83	11.30
Electoral Turnover	63.46	15.25	68.13	14.57	67.08	14.58

The table compares average values for several indicators across rural, intermediate, and all NUTS3 regions, offering insights into disparities between these territorial types.

- **Economic conditions** show a clear disadvantage for rural areas. GDP per capita in PPS is substantially lower in rural regions (€31,078) than in intermediate (€35,658) and all regions (€36,211). Real productivity per hour follows a similar trend (34.9 in rural vs. 39.5 in both intermediate and overall), as do job opportunities, though the difference is less marked (0.71 vs. 0.75). Notably, employment in agriculture is significantly higher in rural areas (0.10)

compared to intermediate (0.05), while employment in industry is marginally higher in rural areas (0.20 vs. 0.19).

- In terms of **Living conditions**, rural areas again show relative disadvantages. Access to hospitals is worse, with only 66% of the population living within 15 minutes of a hospital, compared to 83% in intermediate regions. Internet connectivity is also lower in rural regions (81.4 vs. 98.8), though exposure to PM2.5 pollution is slightly lower (47.4 vs. 52.2), indicating better air quality.
- For **Health and Wellbeing**, differences are subtler. Fertility rates are slightly higher in rural regions (1.54 vs. 1.49), and rural populations are slightly older (median age of 47.0 vs. 46.1) with a higher age dependency ratio (61.7 vs. 59.1). The average age of mothers at birth is lower in rural regions (30.44 vs. 30.88), and early pregnancies are marginally more common (0.03 vs. 0.02). Migration rates are lower in rural regions (3.67 vs. 6.07), and lifespan is slightly shorter (81.26 vs. 81.70), with a marginally higher gender inequality in lifespan.
- Regarding **Social participation and Engagement**, rural areas experience fewer robberies (17.7 vs. 34.6), suggesting lower crime rates. Hard Euroscepticism is lower in rural areas (12.9%) than in intermediate regions (14.6%), while electoral turnout is also slightly lower (63.5% vs. 68.1%).

In summary, rural regions consistently lag-behind in economic development and access to services, and while health outcomes are only slightly worse, they still reflect demographic ageing and social vulnerability. On the positive side, rural regions tend to have better environmental quality and lower crime rates.

The next step involves selecting the clustering variables to be included in the analysis. It is advisable to avoid using an excessive number of clustering variables, as this increases the likelihood that they will no longer be sufficiently dissimilar. A high degree of collinearity between variables diminishes their ability to distinguish between groups. For example, if highly correlated variables (e.g. with a correlation of around 0.90) are included in the cluster analysis, the specific dimensions they represent may become overrepresented in the resulting clusters.

The correlation between the different indicators is not low. Among all indicators we find high correlations between Lifespan & Age of Mother at Birth (0.78), GDP & Productivity (0.70), Inequality in Lifespan & Lifespan (–0.71) or Early Pregnancy & Age of Mother (–0.74). While 35–40% of paired correlations display low values (below 0.3 in absolute terms), high correlations can damage the clustering process by overweighting some dimensions, reducing interpretability and, most important, damaging numerical stability. To reduce the correlation between dimensions—and thereby enhance the discriminatory power of the data—we have chosen to conduct a Principal Components Analysis (PCA) using all variables associated with Social Exclusion and Wellbeing.

As the main interest of our analysis are rural regions, we avoid performing statistical analyses for all European NUTS3 regions. Nevertheless, to show the discriminatory power of the considered technique we have performed a PCA of all NUTS3 regions (1,166) in Europe. This allows us to inspect if the statistical work enables us to discriminate correctly between types of regions. This study, which can be found in Appendix 1. Overall, the principal components reflect a clear gradient, distinguishing between rural, intermediate and urban regions: urban regions dominate on prosperity-related dimensions, rural areas concentrate demographic and social vulnerabilities, and intermediate regions occupy a nuanced, less polarised middle ground. With this brief exercise we show that the use of PCA can discriminate between types of regions, which is our interest for rural NUTS3.

The first outputs of the PCA for the 412 rural areas results in **Figure 5.1**, showing the scree plot and the rotated first two components, and **Table 5.2,** which shows the correlation of the indicators with the rotated components.

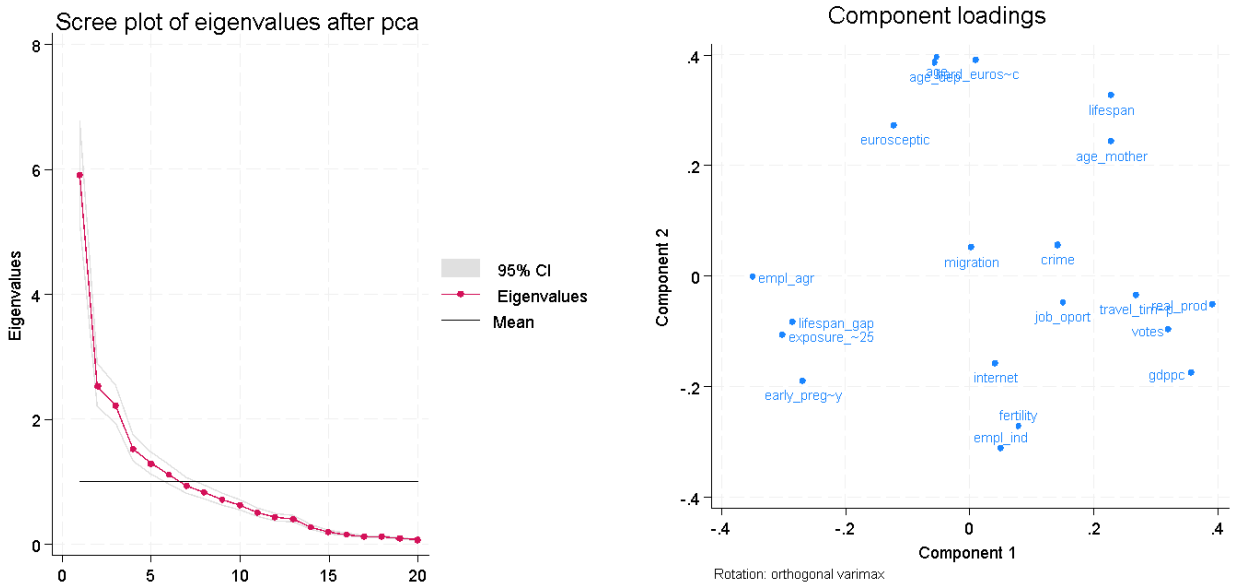


Figure 5.1. Principal Component Analysis: Scree Plot and Variable Loadings of the first two components (Varimax Rotation). Rural NUTS3 regions.

Table 5.2. PCA analysis results: correlation of rotated components. Rural NUTS3 regions.

	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
GDP per capita in PPS	0.2607	-0.3004	-0.0003	-0.0303	0.0355	-0.1681
Real Productivity per Hour	0.3406	-0.1989	0.1267	-0.0000	-0.0237	0.0483
Job Opportunities	0.1196	-0.1026	0.0915	-0.1536	0.2900	-0.4907
Employment in Agriculture	-0.3231	0.1344	-0.0515	-0.2108	-0.0185	-0.1769
Employment in Industry	-0.0750	-0.3062	-0.1415	0.1192	0.4048	0.3230
Population living in <15 min from hospital	0.2337	-0.1362	0.2123	0.2850	0.2506	0.0107
Internet Connectivity	-0.0231	-0.1613	0.4230	0.0577	-0.4001	-0.2207
Exposure PM2.5	-0.3191	0.0186	-0.1439	0.2779	0.1557	-0.0964
Fertility Rate	-0.0331	-0.2811	0.3823	-0.0432	0.1145	0.3592
Median Age	0.1048	0.3854	0.1083	-0.2568	0.4126	0.0277
Age Dependency Ratio	0.0985	0.3776	0.3862	-0.1739	0.1562	0.0996
Average age of mother at birth	0.3049	0.1356	-0.2987	-0.0727	-0.1753	-0.1685
Early Pregnancy	-0.3212	-0.0703	0.2283	-0.1438	0.0609	0.0101
Crude rate of net migration	0.0221	0.0463	-0.0550	-0.2149	-0.3911	0.5596
Lifespan	0.3372	0.2124	-0.0624	-0.0891	-0.1454	-0.0079
Gender inequality in Lifespan	-0.2950	0.0348	0.1256	0.2054	-0.1121	-0.1173
Criminality (robberies)	0.1527	-0.0037	0.4304	0.0351	-0.1191	-0.0784

Hard Eurosceptic votes	-0.0063	0.2980	0.1077	0.6257	-0.1514	-0.0117
Eurosceptic votes	0.1610	0.3556	0.0365	0.3191	0.1918	0.1807
Electoral Turnover	0.2576	-0.2140	-0.1975	0.2004	-0.0017	0.0274

This PCA focuses exclusively on rural regions and reveals a structure that, while sharing some patterns with the PCA performed on all regions, also displays distinct differences—particularly in the relative weight and orientation of demographic, economic, and political variables across components. We just consider up to 6 components with an eigenvalue higher than 1, capturing 73% of the total variance. Next, we review the basic results for illustrative purposes (**Figure 13.1**) in Appendix 2 displays the spatial distribution of the 6 components in rural regions).

Component 1 accounts for the largest share of variance (29.5%) and reflects **General wellbeing and socioeconomic advantage**. It is positively associated with lifespan, productivity, income, and delayed motherhood, while negatively correlated with early pregnancy, environmental exposure (PM2.5), and gender inequality. This component captures a divide between economically prosperous rural regions with favourable health and demographic profiles and those facing persistent vulnerabilities.

Component 2 explains 12.6% of the variance and represents a **Demographic maturity and civic structure** dimension. It is driven by high median age, age dependency ratios, and electoral participation, and shows weaker economic indicators. This highlight ageing politically engaged rural communities with limited economic dynamism.

Component 3 (11.0%) captures **Family and fertility structures**, defined by high fertility rates, early pregnancies, and younger population profiles. It contrasts traditional family-oriented rural regions with those experiencing demographic delay or ageing.

Component 4, explaining 7.6%, is linked to **Institutional distrust and political disaffection**, with strong associations with hard Eurosceptic votes and gender inequality. It points to territories where structural disadvantage may be coupled with declining trust in mainstream institutions.

Component 5 (6.5%) represents **Industrial legacy and demographic stagnation**. It loads positively on industrial employment and median age but negatively on net migration, suggesting older, more economically traditional rural areas facing demographic inertia.

Finally, **Component 6**, which contributes 5.6% to the total variance, reflects **Migration dynamics and peripheral transformation**. Strongly correlated with net migration and fertility, it highlights regions undergoing demographic change, likely marked by mobility pressures and socio-economic adaptation.

Taken together, these components offer a multidimensional view of rural diversity, distinguishing between affluent and disadvantaged areas, demographic patterns, institutional conditions, and regions in transition. While some components align with the structure found in the overall dataset—such as those reflecting wellbeing, reproductive behaviour, and migration—others show distinct rural patterns, such as the more fragmented role of digital infrastructure, the nuanced effects of industry and service proximity, and stronger associations between labour opportunities, pollution, and migration.

5.2. Decision of the number of clusters

The next step in the analysis involves applying hierarchical clustering to group rural regions based on their principal component scores. Among the various methods available, single linkage and complete linkage represent two contrasting strategies for defining inter-cluster distance. Single linkage, also known as the minimum distance method, measures the distance between clusters based on the closest pair of observations. This approach tends to produce elongated or chain-like clusters, as it is sensitive to even narrow connections between groups. While useful for detecting outliers or loosely connected structures, it may lead to early merging of dissimilar clusters, resulting in less meaningful classifications. In contrast, complete linkage, or the maximum distance method, considers the furthest pair of observations between clusters. This method favours compact, internally cohesive clusters and greater separation between groups, but it can be overly influenced by outliers and may fragment natural groupings. Ward's method offers a more balanced alternative by minimizing the increase in within-cluster variance at each step. This approach emphasises internal homogeneity and typically produces well-separated and interpretable clusters, making it particularly suitable for socioeconomic typology construction.

Figure 5.2, Figure 5.3 and **Figure 5.4** compare the dendrograms produced by single linkage, complete linkage, and Ward's linkage methods. The single linkage dendrogram (Figure 5.2) reveals a characteristic chaining effect, where clusters are gradually connected through minimal pairwise distances. This leads to elongated, poorly defined groupings that obscure meaningful structural divisions. In contrast, the complete linkage dendrogram (Figure 5.3) exhibits a more fragmented clustering pattern, with highly compact groups and large inter-cluster distances. While this approach enhances separation, it may overemphasise outliers and internal dissimilarities. The Ward's linkage dendrogram (Figure 5.4) strikes a balance between these extremes. By minimising within-cluster variance, it generates well-proportioned, interpretable clusters that reflect underlying regional similarities more clearly. For this reason, Ward's method is selected as the preferred approach for defining the typology of rural regions in the following analysis.

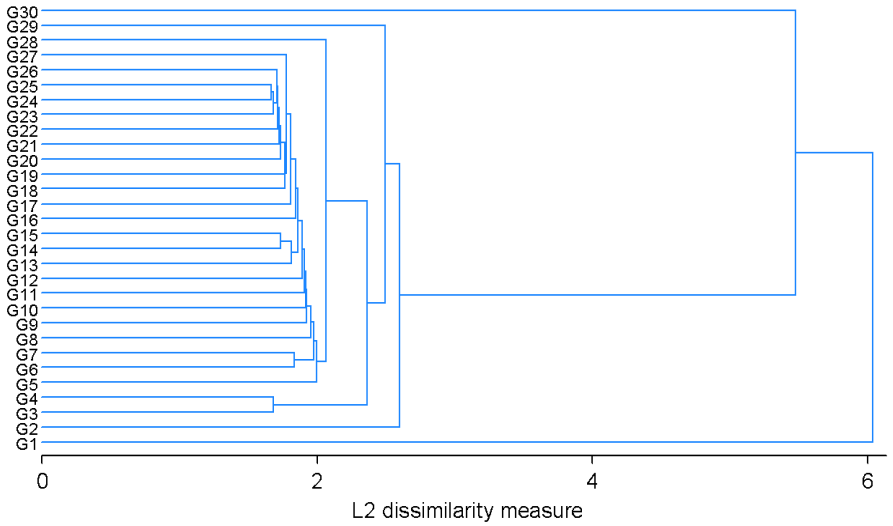


Figure 5.2. Dendrogram Using Single Linkage (Minimum Distance). Rural NUTS3 regions.

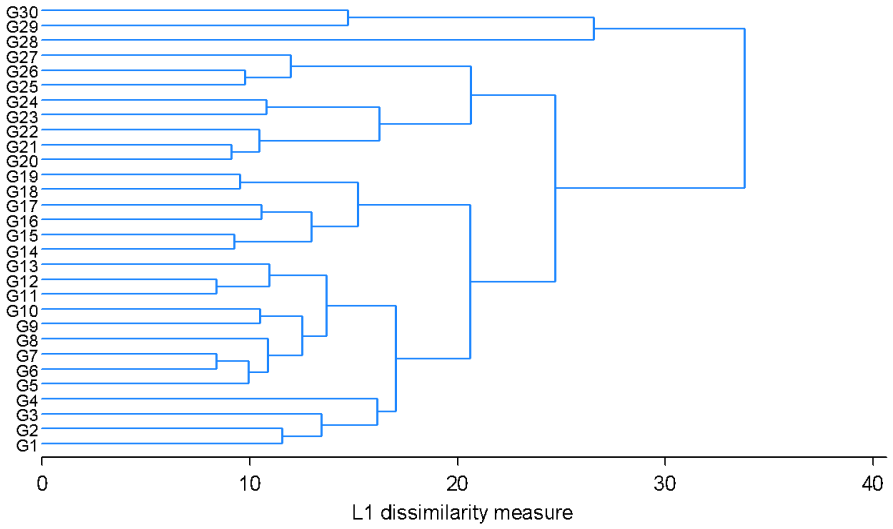


Figure 5.3. Dendrogram Using Complete Linkage (Maximum Distance). Rural NUTS3 regions.

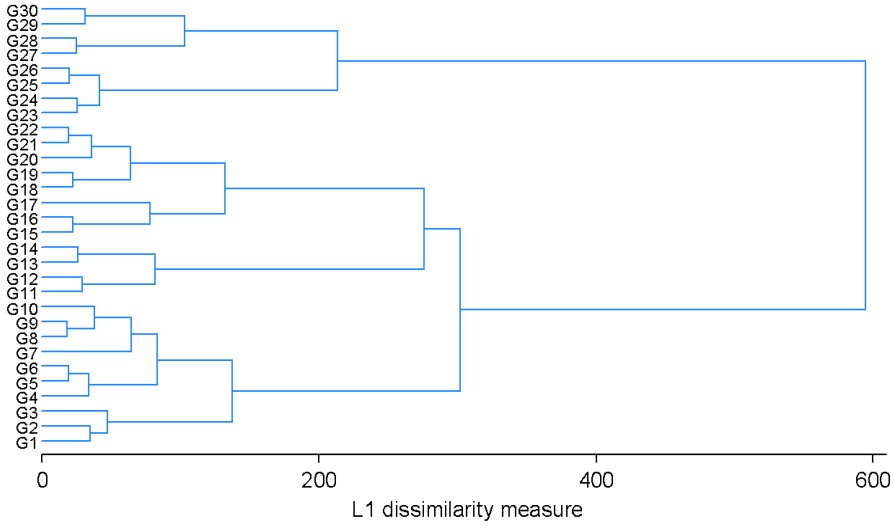


Figure 5.4. Dendrogram Using Ward's Linkage (Minimum Variance). Rural NUTS3 regions.

With the clustering method established, the next step is to determine the optimal number of clusters. This choice is not solely a statistical exercise but also requires consideration of interpretability, empirical relevance, and analytical value. Several approaches are available to inform this decision, each offering distinct advantages. Next, we apply the most robust criteria to ensure that the final typology is both conceptually meaningful and methodologically rigorous.

To inform this decision, we computed four established clustering evaluation metrics across a range of possible cluster solutions (k = 2 to 20): the Within-Cluster Sum of Squares (WSS), its logarithmic transformation (log (WSS)), the proportion of variance explained (η^2), and the Proportional Reduction of Error (PRE). As shown in **Figure 5.5**, each of these indicators offers complementary perspectives on the clustering structure, enabling a balanced assessment between parsimony and explanatory power.

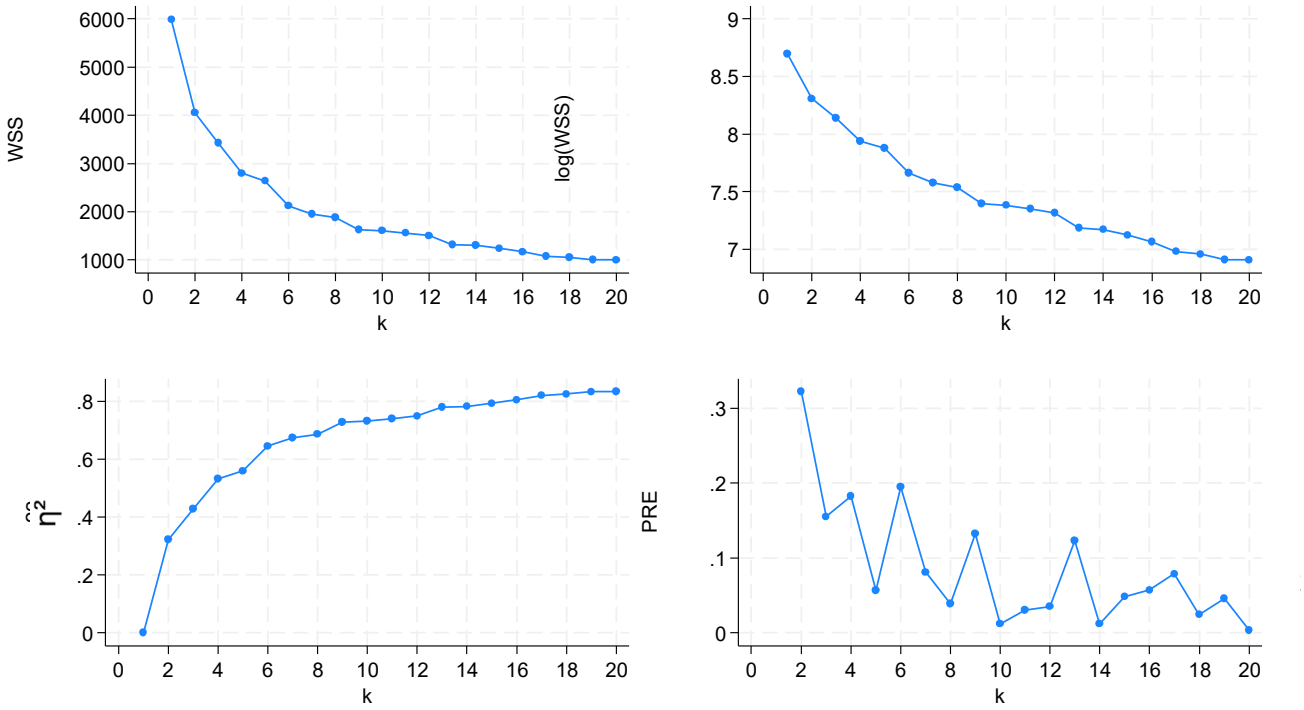


Figure 5.5. Clustering Evaluation Metrics Across Different Numbers of Clusters (k = 2–20). Rural NUTS3 regions.

As is common in typological analysis, the selected number of clusters (**Figure 5.6**) should not be interpreted as a fixed or universal classification. Rather, it serves as a flexible analytical tool tailored to the objectives of this study. By applying multiple statistical criteria alongside qualitative interpretation, we ensure that the final typology is both robust and conceptually meaningful.

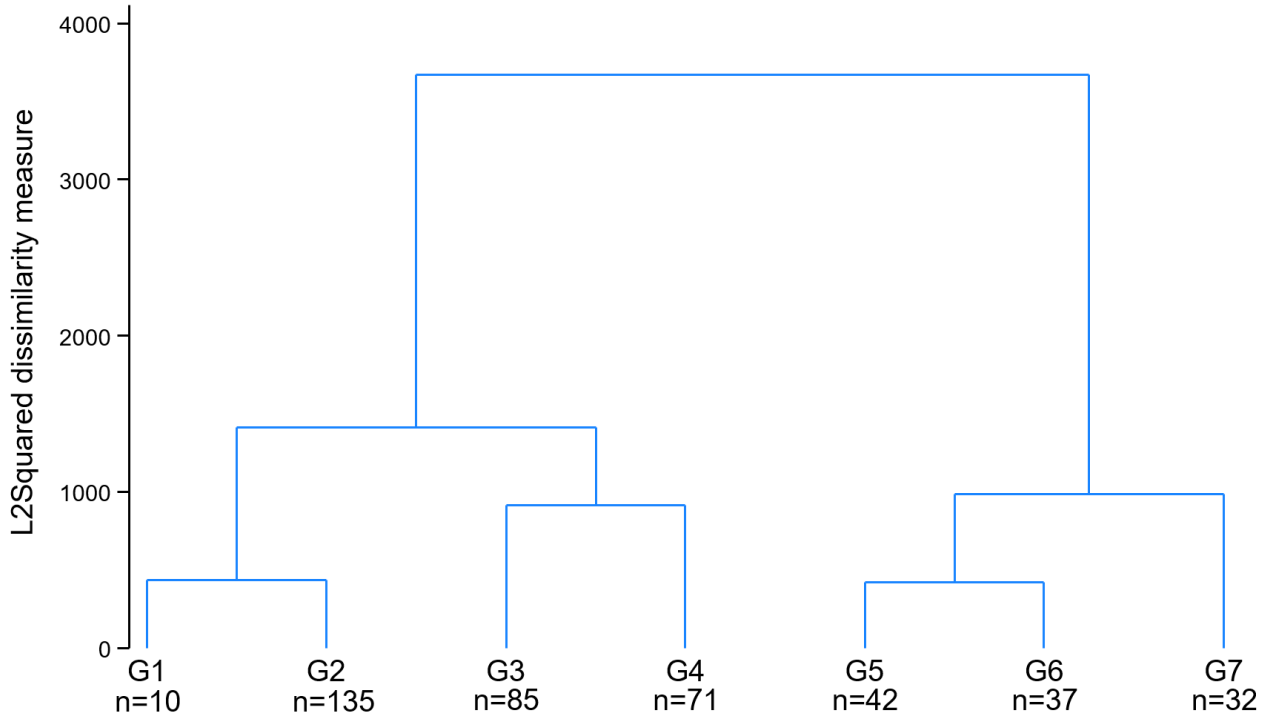


Figure 5.6. Hierarchical Clustering of Rural NUTS3 Regions: Final 7-Cluster Configuration (Ward's Method) regions.

Figure 5.7 maps the seven typologies. For the sake of interpretation, we have assigned a number to every cluster in descending order by level of the first principal component (**Figure 13.2** in Appendix 2 displays the boxplot of the first principal component for every cluster). Besides, Table 5.2. displays the number of rural NUTS3 regions assigned to each of the seven clusters, disaggregated by country. A total of 412 rural regions has been classified, with Cluster 2 (135 regions) being the most and Cluster 1 (10 regions) the least populated.

Germany (DE) stands out with the highest number of rural NUTS3 regions overall (110), distributed mainly across Cluster 1 (8 regions), Cluster 2 (66), and Cluster 3 (36), reflecting significant internal diversity. Cluster 2 is by far the most populated, comprising 135 regions (33%), with a strong concentration in Germany (66), France (49), and Finland (10). This cluster likely represents a dominant rural profile in Western and Northern Europe, with a total of 12 countries represented.

Cluster 3 follows with 85 regions; all located in just two countries: Germany (36) and France (49). Cluster 4 includes regions from up to seven countries, with a notable presence of Greek, Italian, and Portuguese regions, along with three from Spain—suggesting a distinct Southern European pattern.

Although Cluster 5 includes a modest number of regions (42), it spans 12 countries, with a strong presence of Eastern European countries such as Croatia, Slovenia, and the Czech Republic. Cluster 6 is overwhelmingly represented by Poland, while Cluster 7 includes mostly Romanian and Bulgarian regions.

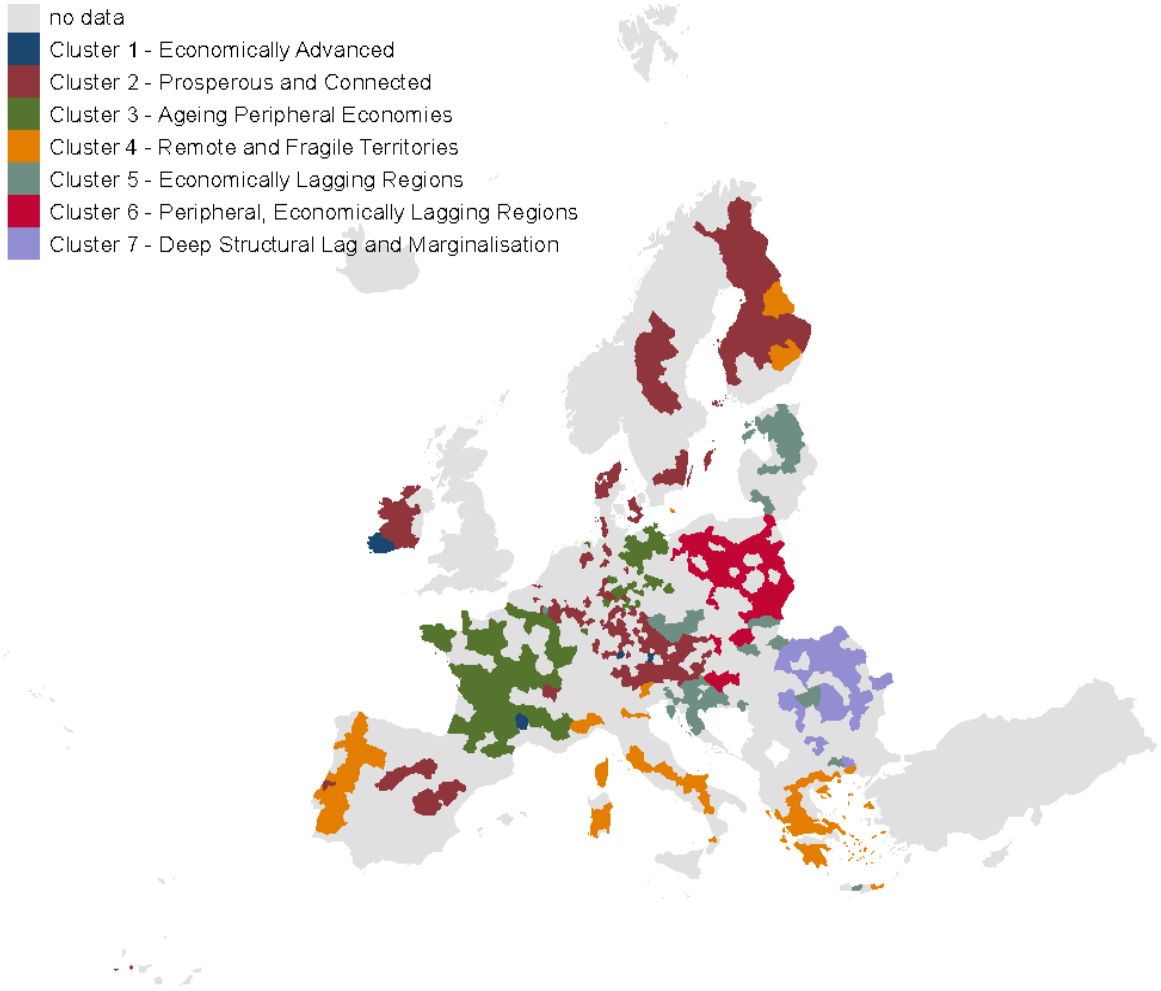


Figure 5.7. Social exclusion typologies – NUTS3 regions.

Overall, **Table 5.3** highlights both cross-national and intra-national diversity in rural typologies. Some clusters reflect broad European patterns (e.g. Clusters 2 and 3), while others reveal geographically specific or structurally distinct profiles (e.g. Clusters 6 and 7). This diversity underscores the value of a multi-cluster approach to better capture the complexity of rural exclusion and wellbeing across the EU.

Table 5.3. Distribution of Rural NUTS3 Regions by Country and Cluster (7-Cluster Typology).

Country	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Total general
AT		24						**24**
BE		11			1			**12**
BG					1		6	**7**
CZ					4			**4**
DE	8	66	36					**110**
DK		3		1				**4**
EE					3			**3**
EL				28	1			**29**
ES		7		3				**10**
FI		10		2				**12**
FR	1	1	49	2				**53**
HR					13			**13**
HU					3	3		**6**

IE	1	5						**6**
IT		1		20				**21**
LT					2			**2**
LV					2			**2**
NL		1						**1**
PL						32		**32**
PT		1		15				**16**
RO					2		26	**28**
SE		5						**5**
SI					9			**9**
SK					1	2		**3**
Total general	**10**	**135**	**85**	**71**	**42**	**37**	**32**	**412**

5.3. Fuzzy membership approach

To overcome the limitations of hard clustering and better account for transitional or ambiguous regional profiles, we complemented the hierarchical Ward method with a fuzzy-like membership approach. While Ward's algorithm assigns each region exclusively to a single cluster, the silhouette plot (**Figure 5.8**) reveals that several regions exhibit low or even negative silhouette widths—indicating weak or conflicting affiliation with their assigned cluster. This uncertainty highlights the need for a more nuanced representation of cluster membership, one that can reflect degrees of belonging rather than rigid classifications.

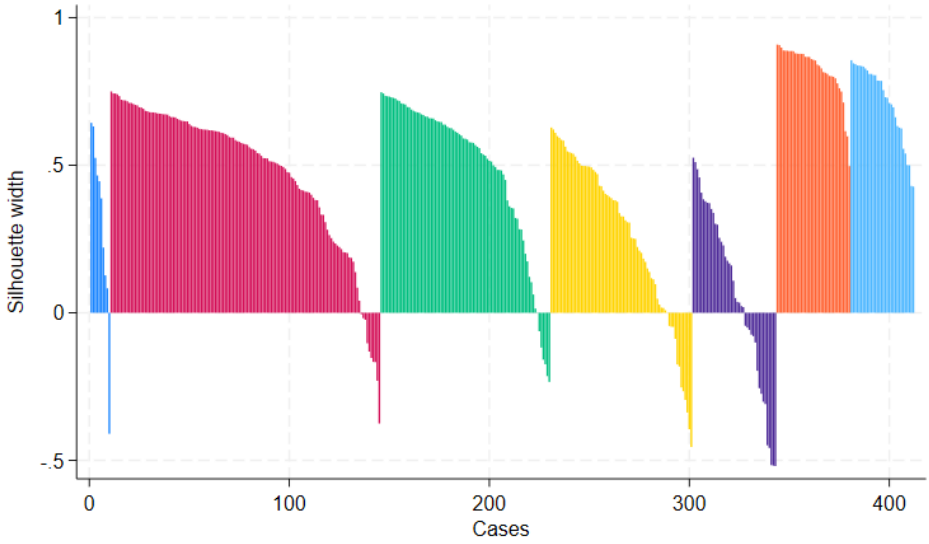


Figure 5.8. Silhouette plot – seven clusters' results. NUTS3 regions.

To explore the heterogeneity of regional profiles more flexibly, we implemented a distance-based fuzzy clustering approximation. This method relied on computing the Euclidean distance between each region and the centroids of the seven previously defined clusters, based on their positions along the first six principal components (PC1 to PC6). Each region's similarity to a given cluster was calculated as the inverse squared distance to that cluster's centroid. These similarity scores were then normalised across all clusters, producing a fuzzy membership matrix in which each region received a value between 0 and 1 for each cluster, with all values summing to one. **Figure 13.3** in the Appendix 2 displays the fuzzy membership of each region to every cluster.

Applying a fuzzy clustering method has allowed us to uncover a degree of complexity in regional patterns that would remain hidden under a hard clustering approach. This technique makes it possible to identify both regions with strong affiliation to a single cluster and others that share characteristics with multiple groups. To quantify this ambiguity, we developed a fuzzy uncertainty index, calculated as one minus the highest cluster membership value for each region. **Figure 5.9** and **Figure 5.10** illustrate the distribution of this uncertainty index from two perspectives: statistical and spatial. The map (**Figure 5.9**) shows clear spatial patterns, with elevated uncertainty levels in several parts of Northern Europe, Southern France, Portugal, Spain, Italy, and areas in Eastern Europe. These regions likely reflect more complex, hybrid territorial profiles that are not easily assigned to a single cluster. In contrast, many areas across Central and parts of Eastern Europe display lower uncertainty scores, suggesting more clear-cut regional identities within the clustering framework.

The boxplot (**Figure 5.10)** complements this spatial perspective by depicting how uncertainty varies within each cluster. Cluster 4 stands out with the highest median uncertainty (the one with regions in Italy, Portugal and Greece), implying that it groups together diverse or transitional regions that resist neat classification. A similarly high level of uncertainty is observed in Cluster 5, belonging to Eastern European regions (Croatia, Slovenia, Czech Republic). Clusters 1, 2 and 3 display heterogeneous patterns, while Clusters 6 and 7 are the ones showing least uncertainty.

Figure 5.9. Fuzzy uncertainty. Geographic distribution. NUTS3 regions.

Finally, **Table 5.4** displays the list of regions with a fuzzy distance between the firstly assigned cluster and the second one below 0.05, or those with a fuzzy uncertainty above 0.70. We also include the level of the first principal component, the one with the highest loading, representing a global picture of the general wellbeing and socioeconomic advantage. The level of the PC1 of every region is compared (standardized measure) against the average of the first and second clusters by fuzzy assignment. These arguments support the expert judgement for any potential reassignment between clusters.

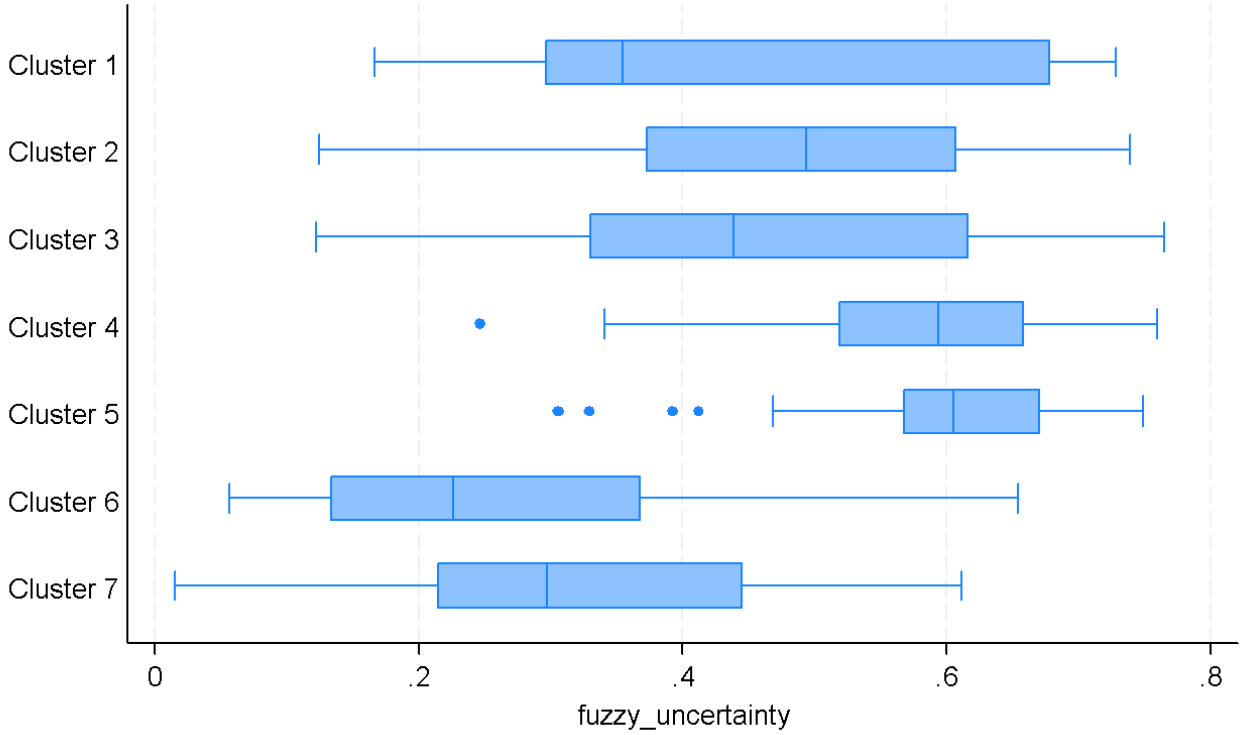


Figure 5.10. Fuzzy uncertainty. Statistic distribution by cluster. NUTS3 regions.

By looking at the list of regions, and after the consideration of the team of experts, we opted for the following reassignment of regions by cluster:

- Regions ES703 (El Hierro) and ES706 (La Gomera) move from cluster 2 to cluster 4 based on the proximity to the centre of such new cluster and based also on the assignment of other Spanish regions to such lower cluster.

Table 5.4. NUTS3 regions with highest level of uncertainty in cluster's assignment.

			1st Assigned Cluster		2nd Assigned Cluster						Standardized PC1 distance	
NUTS3	**Region name**	**Assigned cluster**	**Cluster #**	**Fuzzy Dist**	**Cluster #**	**Fuzzy Dist**	**Distance between 1st and 2nd**	**Fuzzy Uncert.**		**PC1**	**1st cluster**	**2nd cluster**
K041	Prešovský kraj	Cluster 5	6	0.283	5	0.280	0.003	0.72		-3.70	1.31	0.49
PT16H	Beira Baixa	Cluster 4	3	0.288	4	0.284	0.004	0.71		0.43	-2.46	-0.48
EL513	Ροδόπη	Cluster 4	4	0.265	5	0.257	0.008	0.74		-2.51	-2.79	-0.66
DEG0F	Ilm-Kreis	Cluster 3	3	0.298	2	0.290	0.008	0.70		1.59	-1.31	-2.76
BE353	Arr. Philippeville	Cluster 5	2	0.252	5	0.241	0.011	0.75		-0.55	-3.50	3.38
FI194	Etelä-Pohjanmaa	Cluster 2	3	0.364	2	0.346	0.018	0.64		1.44	-1.46	-2.91
DEB3K	Südwestpfalz	Cluster 3	2	0.235	3	0.215	0.020	0.76		1.69	-1.26	-0.27
DE80N	Vorpommern-Greifswald	Cluster 3	3	0.261	4	0.241	0.020	0.74		0.78	-2.11	-0.13
EE004	Lääne-Eesti	Cluster 5	5	0.276	4	0.253	0.023	0.72		-1.19	0.28	-1.42
ES423	Cuenca	Cluster 2	2	0.261	4	0.238	0.023	0.74		0.83	-2.12	0.21
SI032	Podravska	Cluster 5	2	0.304	5	0.279	0.025	0.70		-0.41	-3.35	3.53
DE94H	Wittmund	Cluster 3	2	0.273	4	0.246	0.027	0.73		0.66	-2.29	0.04
PT185	Lezíria do Tejo	Cluster 4	4	0.240	2	0.212	0.028	0.76		-0.14	-0.43	-1.52
DE917	Helmstedt	Cluster 2	2	0.363	3	0.334	0.029	0.64		0.90	-2.05	-1.07
DE27C	Unterallgäu	Cluster 1	2	0.303	1	0.272	0.031	0.70		2.15	-0.80	-3.31
CZ032	Plzeňský kraj	Cluster 5	5	0.279	2	0.244	0.035	0.72		-0.22	1.25	-1.32
ITC18	Alessandria	Cluster 4	4	0.283	3	0.247	0.036	0.72		2.16	1.87	1.24
DEG06	Eichsfeld	Cluster 3	3	0.332	2	0.294	0.038	0.67		1.33	-1.56	-3.01
ITC4B	Mantova	Cluster 4	4	0.242	3	0.203	0.039	0.76		1.83	1.54	0.91
ES703	**El Hierro**	**Cluster 2**	4	0.275	2	0.236	0.039	0.73		1.42	1.13	0.04
DE934	Lüchow-Dannenberg	Cluster 3	3	0.266	2	0.226	0.040	0.73		1.39	-1.50	-2.96
AT212	Oberkärnten	Cluster 2	4	0.338	2	0.297	0.041	0.66		1.32	1.04	-0.06
ES416	Segovia	Cluster 2	2	0.281	4	0.239	0.042	0.72		1.54	-1.41	0.92
DE725	Vogelsbergkreis	Cluster 3	2	0.259	3	0.217	0.042	0.74		1.62	-1.32	-0.34
PT184	Baixo Alentejo	Cluster 4	3	0.244	4	0.202	0.042	0.76		-1.48	-4.37	-2.39
DE918	Northeim	Cluster 3	2	0.247	1	0.201	0.046	0.75		1.48	-1.47	-3.99
PT16B	Oeste	Cluster 4	2	0.254	4	0.208	0.047	0.75		0.07	-2.88	-0.55
FI1D2	Pohjois-Savo	Cluster 2	2	0.335	3	0.287	0.047	0.67		1.54	-1.41	-0.42
ES242	Teruel	Cluster 2	2	0.314	4	0.265	0.049	0.69		1.23	-1.72	0.61
IE053	South-West	Cluster 1	1	0.272	2	0.215	0.057	0.73		7.17	5.07	6.04
ITF46	Foggia	Cluster 4	4	0.296	3	0.238	0.058	0.70		0.54	0.26	-0.37
DE926	Holzminden	Cluster 3	1	0.257	3	0.198	0.059	0.74		1.23	-0.86	0.48

EL433	Ρέθυμνο	Cluster 5	5	0.299	4	0.227	0.072	0.70		-1.11	0.36	-1.34
PT181	Alentejo Litoral	Cluster 4	4	0.272	3	0.194	0.077	0.73		-0.27	-0.56	-1.19
EE008	Lõuna-Eesti	Cluster 5	5	0.270	2	0.187	0.083	0.73		-0.63	0.84	-1.73
ITH37	Rovigo	Cluster 4	4	0.292	3	0.204	0.087	0.71		1.82	1.53	0.90
EL641	Βοιωτία	Cluster 4	5	0.286	2	0.197	0.089	0.71		-0.34	1.13	-1.44
ITC16	Cuneo	Cluster 4	4	0.288	3	0.198	0.090	0.71		1.97	1.68	1.05
DEG0E	Hildburghausen	Cluster 3	3	0.295	4	0.199	0.096	0.70		0.68	-2.21	-0.23
ES706	**La Gomera**	**Cluster 2**	4	0.296	2	0.198	0.098	0.70		0.34	0.05	-1.04

5.4. Clusters description

In this section, we present a typology of rural areas at the NUTS3 level, constructed using a restricted but harmonised set of indicators across four dimensions: Economic Conditions, Living Conditions, Health and Wellbeing, and Social Participation and Engagement. The goal is to explore whether meaningful territorial differentiation is still possible when reducing the indicator list, allowing us to work with finer spatial units. This typology results in seven distinct clusters of rural NUTS3 regions, each reflecting specific territorial profiles. Below, we provide a qualitative interpretation of each cluster based on the average values of the selected indicators. **Table 5.5** displays the average for every variable for cluster.

Table 5.5. NUTS2 regions with highest level of uncertainty in cluster's assignment.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7
GDP per capita in PPS	67362	37548	30298	27419	23988	23776	20375
Real Productivity per Hour	64.26	48.41	44.02	25.97	17.91	14.61	10.04
Job Opportunities	1.52	0.76	0.73	0.72	0.67	0.65	0.65
Employment in Agriculture	0.03	0.04	0.04	0.15	0.14	0.16	0.30
Employment in Industry	0.19	0.21	0.16	0.12	0.36	0.23	0.20
Population living in <15 min from hospital	90.13	74.89	80.19	54.75	50.13	58.25	42.99
Internet Connectivity	102.03	81.59	94.71	58.65	61.65	83.91	112.53
Exposure PM2.5	26.84	23.61	27.74	48.18	68.24	109.86	105.14
Fertility Rate	1.54	1.57	1.67	1.29	1.60	1.33	1.77
Median Age	44.94	46.08	49.47	49.88	45.53	43.10	45.26
Age Dependency Ratio	56.89	58.62	70.37	65.01	58.38	54.82	58.36
Average age of mother at birth	31.38	31.06	30.08	31.68	29.68	29.71	27.58
Early Pregnancy	0.01	0.01	0.02	0.02	0.03	0.03	0.12
Crude rate of net migration	-19.53	6.58	1.30	4.82	7.06	-1.08	3.37
Lifespan	81.87	82.25	82.24	83.04	79.30	78.55	75.99
Lifespan gender gap	4.52	4.17	5.41	4.80	6.33	7.51	7.04
Criminality (robberies)	28.93	17.60	31.94	14.72	7.16	6.63	9.83
Eurosceptic votes	12.34	14.32	36.52	28.56	16.44	54.13	8.78
Hard Eurosceptic votes	9.46	10.21	20.59	20.94	5.60	7.78	1.92
Electoral Turnover	71.77	76.86	60.30	54.99	57.13	70.24	32.02

Next, we describe the characteristics of every cluster.

Cluster 1: Economically Advanced and Well-Connected Industrial Territories with High Civic Engagement (Figure 5.11). This group comprises 10 NUTS3 regions across Germany, France, and Ireland: Traunstein, Landshut, Passau, Straubing, Weiden, Ansbach, Memmingen, Unterallgäu, Lozère, and South-West Ireland. These areas form a cohesive group of high-performing rural and semi-rural territories in terms of economic output, infrastructure, and social participation.

Figure 5.11 Cluster 1 – Economically Advanced.

- **Economic Conditions.** Cluster 1 shows the highest performance in economic terms across all clusters. It has the highest GDP per capita (€67,362) and labour productivity (64.3 €/hour), pointing to strong output levels and efficient economic systems. Job opportunities are also particularly high (1.52), far exceeding all other clusters. The employment structure reveals a moderate reliance on industry (19%) and very limited employment in agriculture (3%), indicating advanced productive systems and a clear post-agrarian orientation. This cluster exemplifies a mature industrial-rural profile with strong economic foundations.
- **Living Conditions.** Living standards are also high. The share of population living within 15 minutes from a hospital is the highest (90.1%), indicating excellent territorial access to healthcare. Internet connectivity is very high (102), reinforcing the digital inclusion of these areas. Meanwhile, air pollution levels (PM2.5) are moderate (26.8), suggesting a relatively clean environment but with room for improvement compared to the cleanest clusters. Altogether, these indicators reflect well-developed physical and digital infrastructures.
- **Health and Wellbeing**. Demographic and health indicators suggest a relatively stable and ageing population. Median age is 44.9 and fertility is slightly above average (1.54), while the age dependency ratio stands at 56.9. Lifespan is among the highest (81.9 years), with a moderate gender gap (4.5 years). The average age at motherhood is 31.4 years. Interestingly, this is the only cluster showing a strongly negative net migration rate (–19.5), which may suggest a gradual population decline, likely due to youth outmigration or ageing dynamics. Early pregnancy is almost non-existent.

- **Social Participation and Engagement.** This cluster is characterised by strong civic engagement, with a high electoral turnout (71.8%). Political attitudes are moderate: Eurosceptic vote (12.3%) and hard Eurosceptic vote (9.5%) are both well below the average. Criminality levels are moderate (28.9), not among the lowest, but not concerning either. Together, these elements point to a stable socio-political environment with engaged citizens and moderate risks in terms of social cohesion.

Cluster 2: Prosperous and Connected Rural Regions with Moderate Ageing (Figure 5.12). This cluster groups a wide range of NUTS3 regions located in Austria, Germany, Belgium, Denmark, Finland, Spain, Ireland, Italy, the Netherlands, Portugal, and Sweden. Despite their geographic spread, these regions share a common profile of economic stability, strong living conditions, and active civic engagement.

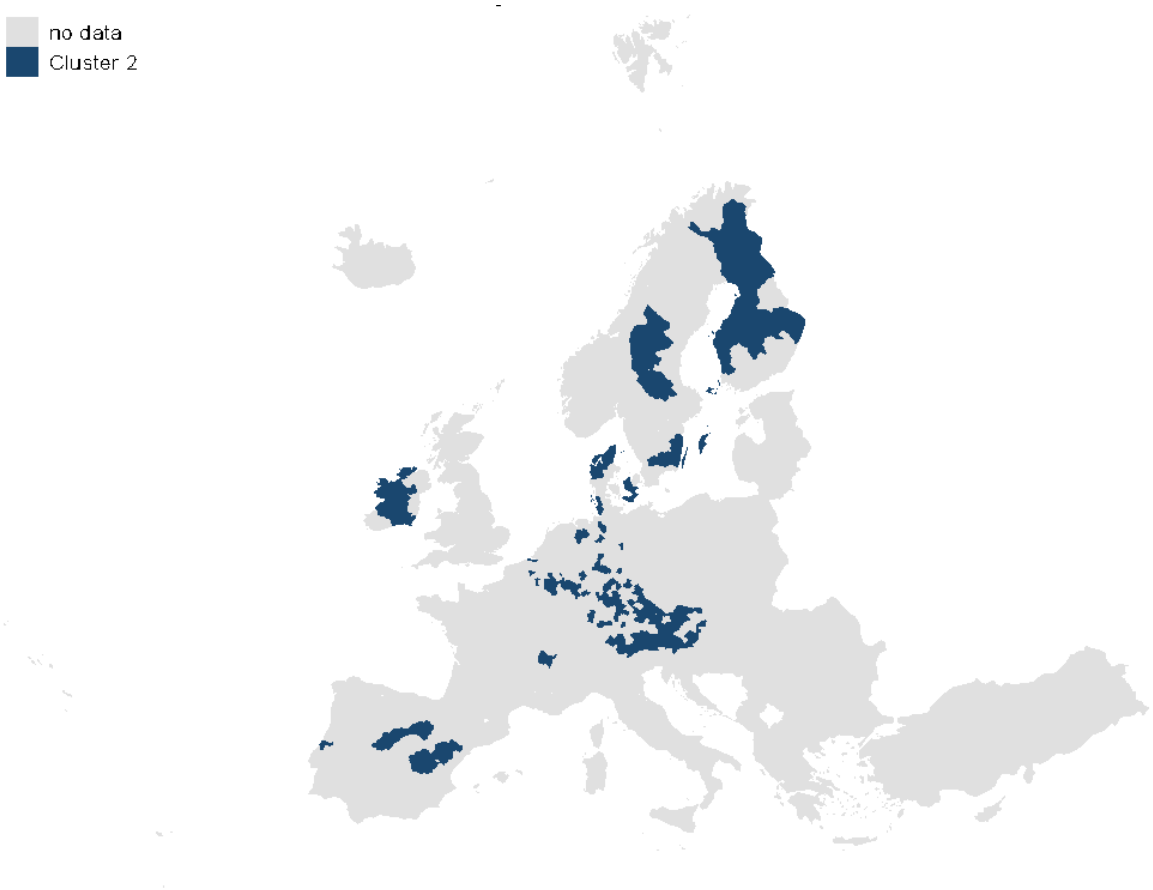


Figure 5.12. Cluster 2 – Prosperous and connected.

- **Economic Conditions.** Cluster 2 is characterised by solid mid-to-high economic performance. GDP per capita (€37,548) and real productivity per hour (€48.41) reflect a well-functioning economy. Job opportunities are strong (0.76), and the economic structure is balanced, with 4% of employment in agriculture and 21% in industry. This mix suggests diversified economies, maintaining some traditional sectors without being overly dependent on them.
- **Living Conditions.** Material and infrastructural conditions are generally favourable. A significant share of the population (74.9%) lives within 15 minutes of a hospital, indicating good accessibility to healthcare. Digital infrastructure is strong (Internet connectivity score: 81.6), supporting modern

services and remote activities. The exposure to fine particulate matter (PM2.5) is low (23.6), pointing to good environmental quality.

- **Health and Wellbeing.** Demographic indicators suggest moderate ageing. The median age is relatively high (46.1), and the age dependency ratio (58.6) confirms a shift toward older population structures. However, life expectancy is the highest among all clusters (82.3 years), indicating good overall health. Fertility rate (1.57) is stable, and the average age of mothers at birth (31.0 years) suggests a slightly delayed fertility schedule. Net migration is positive (6.6), likely due to the regions' attractiveness in terms of quality of life. Other indicators, such as early pregnancy and lifespan gender gap, show moderate and socially sustainable levels.
- **Social Participation and Engagement.** This cluster exhibits notably high civic engagement. It reports the highest electoral turnout across all clusters (76.9%). Eurosceptic vote shares (14.3%) and hard Eurosceptic support (10.2%) are relatively low, indicating a moderate political orientation and trust in European institutions. Crime levels are modest (17.6 robberies per 100,000), reinforcing the image of safe and socially cohesive territories.

Cluster 3 – Ageing Peripheral Economies with Social Disaffection (Figure 5.13). This cluster is composed of a broad set of predominantly rural or semi-rural areas located in Eastern Germany, central and western France, and some northern and eastern parts of the country. The regions in Cluster 3 share several key characteristics: modest economic indicators, a strong industrial tradition, ageing demographics, and signs of political disaffection, particularly in terms of Euroscepticism. These are territories facing long-term structural challenges with relatively weak population renewal and moderate or low migration balances.

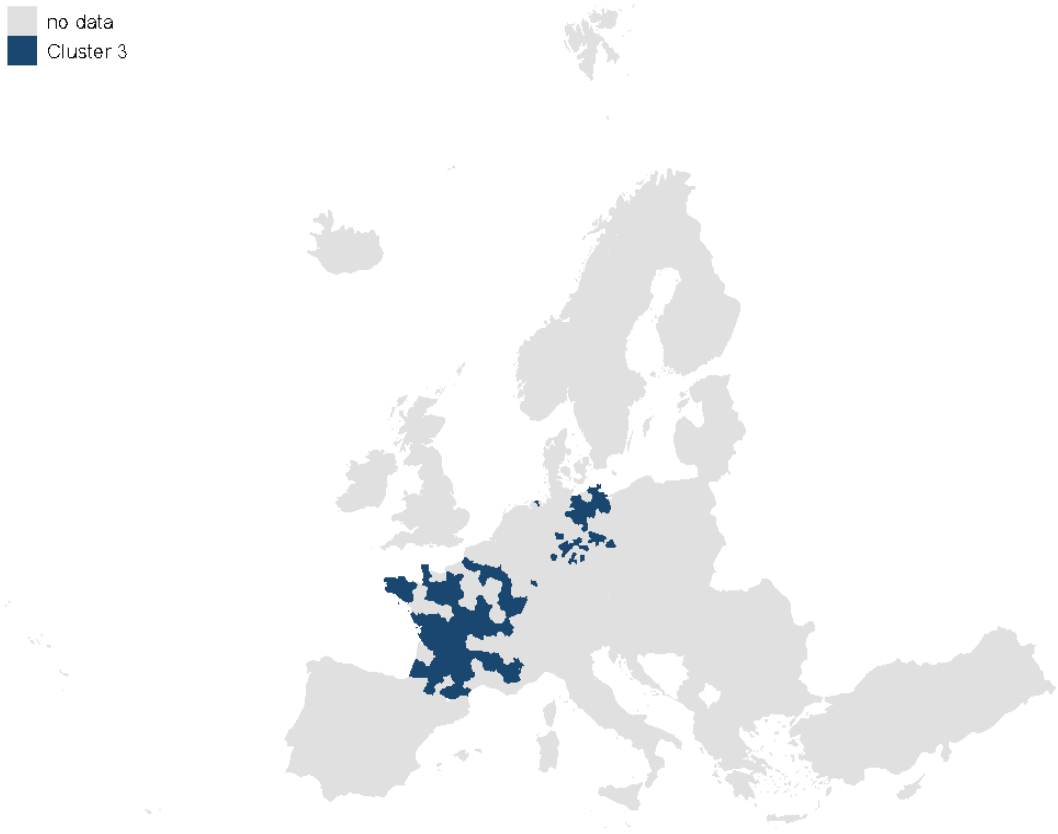


Figure 5.13. Cluster 3 – Ageing and peripherical economies.

- **Economic Conditions.** Cluster 3 regions show modest economic performance. GDP per capita in PPS stands at 30,298, considerably below the EU's more prosperous areas, though not at the bottom of the distribution. Real productivity per hour (44.02) confirms the presence of intermediate productivity levels, suggesting these territories remain economically active but are not part of the most dynamic European poles. Job opportunities are relatively low (0.73, below the average), consistent with the limited dynamism of the local labour markets. Employment in agriculture remains marginal (0.04), whereas industry still plays a role (0.16), suggesting a traditional economic base, possibly linked to manufacturing or processing industries that have not entirely disappeared but are likely declining or stagnating.
- **Living Conditions.** Living conditions reflect moderate to favourable access to infrastructure. A significant proportion of the population lives within 15 minutes of a hospital (80.19%), suggesting reasonable access to basic healthcare facilities. Internet connectivity (94.71) is also above average, which may support efforts toward digital inclusion and remote activity, despite the peripheral character of many of these areas. However, exposure to PM2.5 pollution (27.74), while moderate, could point to some legacy of industrial activity, especially in German regions with a heavy past in manufacturing.
- **Health and Wellbeing.** Health and demographic data describe regions under population ageing pressure. Median age is quite high (49.47, one of the highest across clusters), and the age dependency ratio (70.37) confirms the burden of an ageing population. Fertility rates are slightly above average (1.67), which may soften the ageing trend somewhat, but migration does not offset it: net migration rate is modest (1.30), insufficient to counterbalance the demographic structure. The average age of mothers at birth is 30.08, slightly lower than in more developed urban regions. Early pregnancy is slightly more frequent than in other areas (0.02), though not alarming. Lifespan is good (82.24) but not outstanding, and the gender gap in lifespan (5.41) is significant, consistent with ageing female-dominated populations.
- **Social Participation and Engagement.** This is the most striking and differentiating dimension. Cluster 3 shows very high levels of political disaffection. Eurosceptic votes are the highest of all clusters (36.52), and hard Eurosceptic votes (20.59) are also very elevated. These figures point to deep-seated dissatisfaction with the EU project, likely tied to perceptions of decline, neglect, or marginalisation. Criminality is relatively high (31.94), which may reflect urbanised pockets within these territories or particular socio-economic tensions. Electoral turnout (60.30) is still relatively strong, suggesting that even with disaffection, civic participation remains present, though lower than in more stable clusters.

Cluster 4 – Remote and Fragile Territories with Structural Disadvantages (Figure 5.14). This group includes many peripheral, remote, or island regions in Southern and Eastern Europe, particularly across Greece, Portugal, Southern Italy, Spain, and parts of France and Finland. These regions are often geographically isolated, with limited economic dynamism, fragile infrastructure, and significant demographic and social vulnerabilities. Cluster 4 represents the archetype of structurally disadvantaged rural Europe.

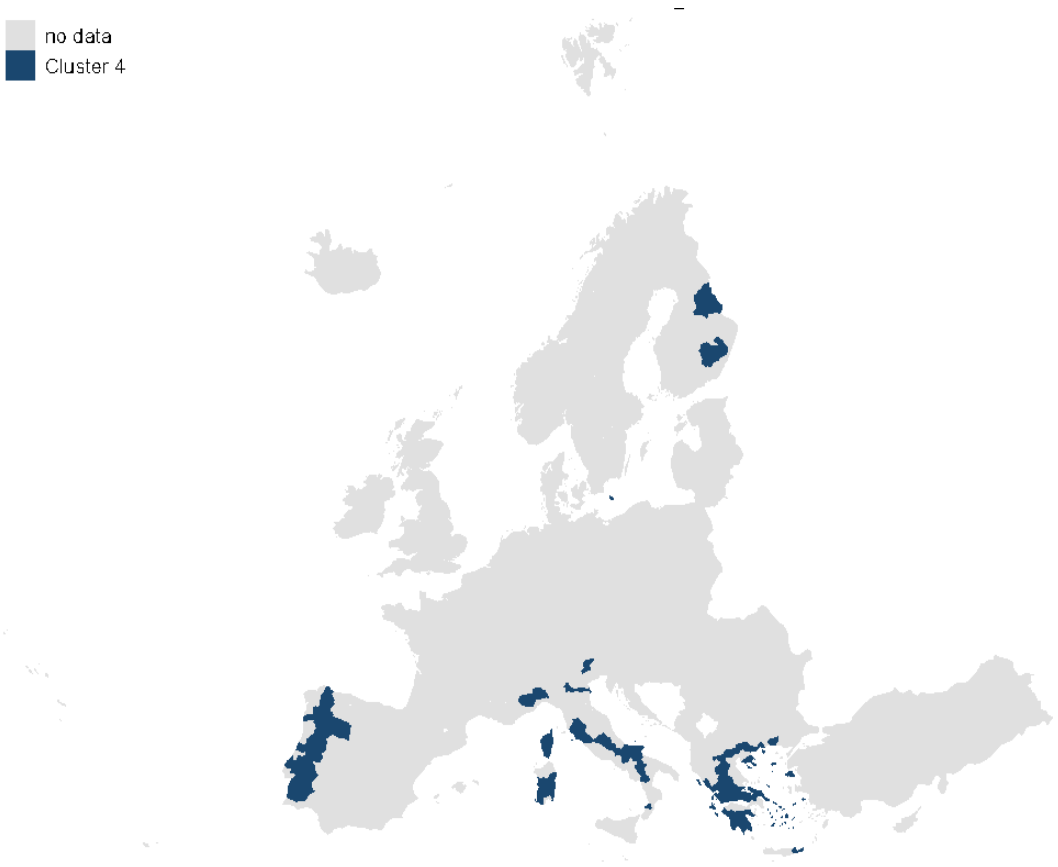


Figure 5.14. Cluster 4 – Remote and fragile territories.

- **Economic Conditions.** Economically, Cluster 4 is among the weakest in the typology. With a GDP per capita of 27,419, and a real productivity per hour of only 25.97, these territories sit well below the EU average. The low job opportunity score (0.72) reflects scarce economic alternatives and likely outmigration of younger or skilled workers. Agriculture maintains a notable presence (0.15), and industry is minimal (0.12). This suggests a reliance on primary activities, small-scale services, or seasonal sectors such as tourism, particularly in island areas.
- **Living Conditions.** Living conditions are challenging. Only 54.75% of the population lives within 15 minutes of a hospital, among the lowest in the typology, pointing to limited access to essential services. Internet connectivity is also poor (58.65), suggesting digital exclusion that can exacerbate broader disparities. These regions face elevated PM2.5 exposure (48.18), possibly due to biomass use, older transport infrastructure, or environmental factors, affecting long-term health and wellbeing.
- **Health and Wellbeing.** The demographic profile of Cluster 4 is heavily skewed toward ageing. The median age (49.88) and the age dependency ratio (65.01) are among the highest in the sample. Fertility (1.29) and net migration (4.82) show a complex picture—some regions retain population through return migration or retirement inflows, but there is little evidence of sustainable generational renewal. Average maternal age (31.68) is slightly higher than in other clusters, while early pregnancy remains low (0.02). Life expectancy (83.04) is relatively good, likely reflecting healthy lifestyles in some rural or Mediterranean environments. Still, the lifespan gender gap (4.80) underlines persistent social and gendered disparities.

- **Social Participation and Engagement.** Social dynamics in Cluster 4 indicate a moderate level of disaffection. Eurosceptic votes are high (28.56), and hard Euroscepticism (20.94) ranks among the top clusters, reflecting deep frustrations with centralised governance or perceived neglect. Electoral turnout (54.99) is comparatively low, pointing to waning civic engagement. Criminality, however, is also low (14.72), suggesting safe but disconnected communities.

Cluster 5 – Economically Lagging Regions with Moderate Demographics and Social Stability (Figure 5.15). Cluster 5 includes a diverse set of Eastern and Central European rural regions, spanning Slovenia, Hungary, Czechia, Croatia, Romania, the Baltic States, and parts of Southern Belgium and Greece. These regions are often non-metropolitan, non-coastal, and located far from major urban centres, but they tend to maintain moderate demographic dynamics and relative social stability, despite enduring long-term economic challenges.

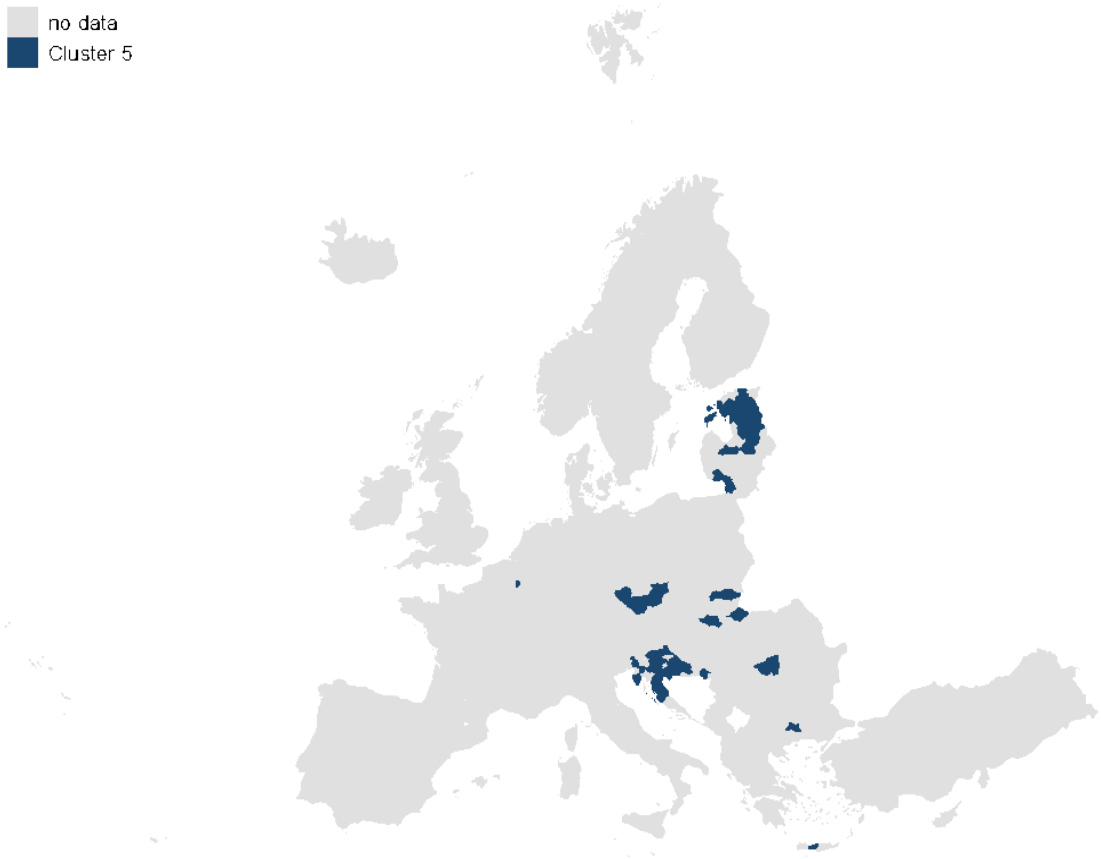


Figure 5.15. Cluster 5 – Economically lagging regions with moderate demographics and social stability.

- **Economic Conditions.** The economic situation in Cluster 5 is clearly fragile, with a GDP per capita of 23,988, which is one of the lowest across the typology. Real productivity per hour (17.91) is also very weak, reflecting low economic diversification, limited industrial bases, and persistent structural deficits. Employment in agriculture (0.14) remains high, while industry is overrepresented (0.36), suggesting dependence on low-to-medium technology manufacturing or

agro-processing sectors. Job opportunities (0.67) are scarce, implying weak labour markets and high potential for outmigration.

- **Living Conditions.** Access to basic services is among the lowest, with only 50.13% of the population living within 15 minutes of a hospital, reflecting healthcare scarcity and low infrastructural density. Internet connectivity (61.65) is modest, showing partial digital lag, though not the lowest in the typology. Environmental exposure to PM2.5 is notably high (68.24), which may reflect outdated transport systems, industrial emissions, or biomass use for heating.
- **Health and Wellbeing.** From a demographic standpoint, Cluster 5 shows a somewhat mixed profile. Fertility (1.60) is relatively high, and the median age is 45.53, suggesting younger populations compared to ageing regions in Western Europe. This is consistent with lower maternal age (29.68) and higher early pregnancy (0.03), pointing to different social and reproductive norms. However, life expectancy is modest (79.30) and the gender gap in lifespan (6.33) is one of the highest, suggesting gendered vulnerabilities in health or labour conditions. The net migration rate (7.06) is surprisingly positive, indicating some regions may be retaining or regaining population, perhaps through return migration or lower emigration pressure.
- **Social Participation and Engagement.** Cluster 5 presents a somewhat contradictory political profile. Eurosceptic votes (16.44) are moderate, and hard Euroscepticism is quite low (5.60), suggesting limited political radicalisation. However, electoral turnout is below average (57.13), which might indicate citizen fatigue, disengagement, or mistrust in institutions. Criminality is the lowest in the typology (7.16), reinforcing the view of these areas as socially cohesive, though economically under strain.

Cluster 6 – Peripheral, Economically Lagging Regions with Structural Constraints and Emerging Demographic Stress (Figure 5.16). Cluster 6 groups together some of the most structurally constrained rural territories in the European Union. The regions are mainly located in Eastern Poland, Southern and Western Hungary, and parts of Slovakia, often far from large cities or major corridors. These regions combine low productivity, fragile economies, weak service access, and early signs of demographic stress. Despite this, some positive demographic indicators suggest potential for regeneration, but only under targeted policy support.

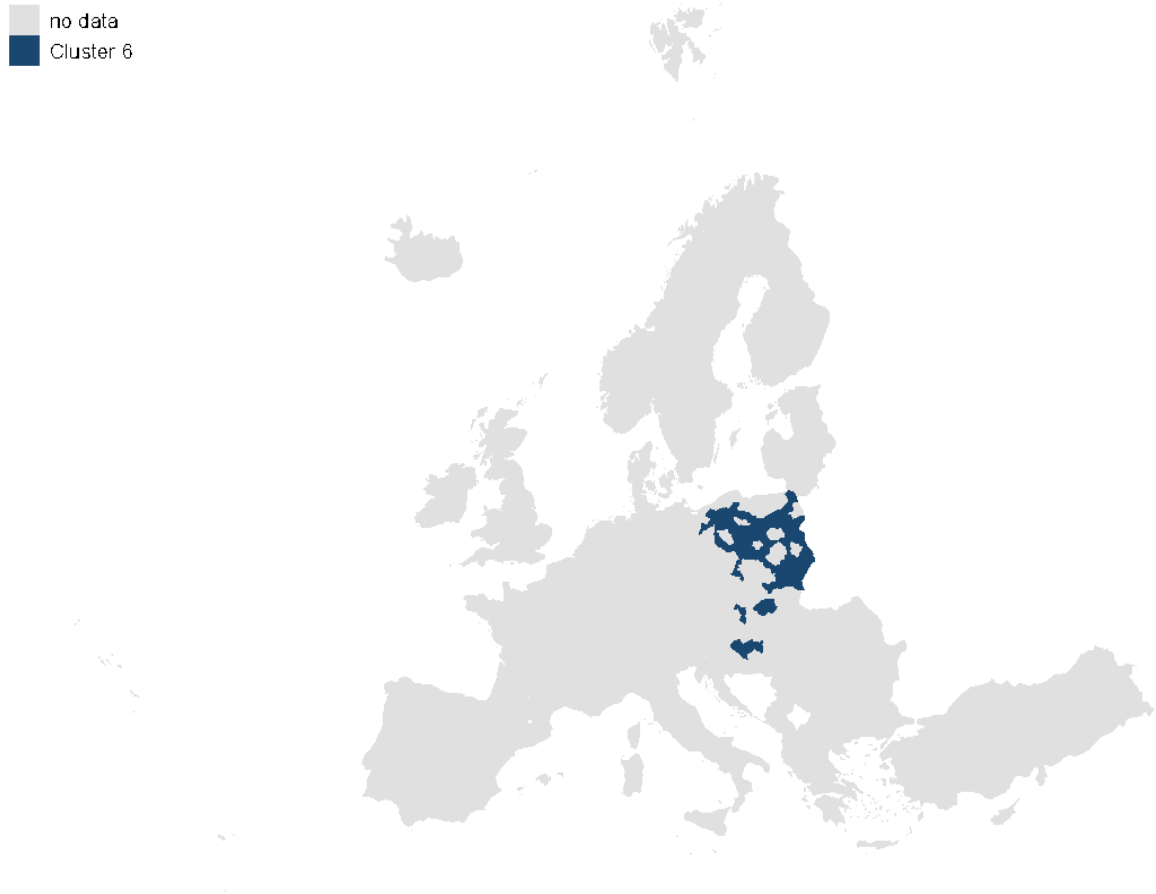


Figure 5.16. Cluster 6 – Peripherical, economically lagging regions with structural constraints and emerging demographic stress.

- **Economic Conditions.** This cluster is among the lowest in terms of GDP per capita (23,776) across all clusters, and productivity per hour (14.61) is strikingly low, revealing structural economic backwardness. Employment in agriculture (0.16) is among the highest of all groups, showing moderate reliance on low-value-added farming and persistent rural economic structures. Employment in industry (0.23) is modest, but industrial modernisation appears limited. Job opportunities are very low (0.65), which likely leads to outmigration, brain drain, or dependence on subsistence economies.
- **Living Conditions.** Access to essential services is very poor, with only 58.25% of the population living near a hospital, and Internet connectivity is surprisingly high (83.91) – the highest of all clusters – suggesting that digital infrastructure investments have reached these areas, although economic uptake may lag-behind. However, PM2.5 exposure (109.86) is the worst in the typology, likely due to solid fuel use, heating practices, and lack of environmental regulation enforcement.
- **Health and Wellbeing.** Demographic indicators show a contradictory picture. Fertility (1.33) is the among the lowest, and the median age (43.10) is also relatively low, suggesting residual demographic vitality. This is reinforced by low maternal age (29.71) and moderately high early pregnancies (0.03), which may reflect socio-cultural norms or limited family planning access. Life expectancy is low (78.55), and the gender gap (7.51) is substantial, underlining serious public health disparities. Migration balance is negative (-1.08), suggesting that long-term sustainability is unclear.

- **Social Participation and Engagement.** Social capital indicators present a complex profile. Criminality is the lowest (6.63), consistent with many rural areas. Euroscepticism (54.13) is extremely high, while hard Euroscepticism (7.78) remains relatively low, highlighting the recent institutional tensions between EU bodies and member states such as Poland and Hungary, intensified by the geopolitical instability following the invasion of Ukraine. In addition, electoral turnout (70.24) is among the highest, which may stem from either a heightened level of political participation or from an escalation in political polarization and instability.

Cluster 7 – Deep Structural Lag and Marginalisation in the Eastern Periphery (Figure 5.17). Cluster 7 brings together regions that face persistent socio-economic disadvantage, historical marginalisation, and a combination of low human development and institutional weakness. Concentrated in Northeastern Bulgaria and large parts of Romania, these regions reflect the deepest territorial divides within the EU, where recovery from post-socialist transition has been slow and uneven.

Figure 5.17. Cluster 7 – Deep structural lag and marginalisation in the eastern periphery.

- **Economic Conditions.** Cluster 7 registers the lowest productivity per hour (10.04) in the entire typology, even below Cluster 6, reflecting entrenched structural barriers and poor industrial modernisation. GDP per capita is also very low (€20,375), with limited diversification of the economic base. Agricultural employment (0.30) remains high, and industrial employment (0.20) is moderate, highlighting a lack of dynamic sectors and an underdeveloped private economy. Access to job opportunities (0.65) is minimal.

- **Living Conditions.** These regions experience acute infrastructural deficits. Only 42.99% of the population is within proximity to a hospital — the worst across all clusters — indicating major barriers to healthcare access. However, Internet penetration (112.53) stands out as the highest compared to the other clusters, underscoring potential recent investments in digital infrastructure which may offer opportunities for development in the future. PM2.5 exposure (105.14) is also high, and combined with lack of healthcare, could contribute to poor health outcomes.
- **Health and Wellbeing.** Demographic data signals long-term fragility. The median age (45.26) is lower than in most Western European clusters, yet life expectancy (75.99) is the lowest in the typology, and early pregnancies (0.12) remain high, revealing limited access to sexual and reproductive health services. The fertility rate (1.77) is high, but so is the gender gap in life expectancy (7.04), suggesting structural gendered vulnerabilities. Migration balance is positive (3.37), likely due to internal relocation dynamics, but this could also be a sign of influx into low-cost peripheries rather than economic revitalisation.
- **Social Participation and Engagement.** This cluster exhibits mixed civic trends. While electoral turnout (32.02) is low, it is not the lowest in the typology. Euroscepticism (8.78) is moderate, and hard Euroscepticism (1.92) is relatively low, possibly suggesting a residual hope or dependency on EU support, even amid deep territorial exclusion. Criminality is very low (9.83), consistent with other remote, low-density regions.

The typology developed in this study offers a detailed and multidimensional portrayal of rural regions across Europe, uncovering deep-seated territorial disparities in social exclusion and wellbeing. Through the classification of NUTS3 rural regions into seven distinct clusters, we reveal the diverse structural, demographic, and socio-economic profiles that underpin exclusionary processes and shape life conditions in rural areas.

A clear East–West divide emerges. Clusters 6 and 7—dominated by regions in Romania, Bulgaria, and Eastern Poland—face the most acute forms of deprivation. These regions combine low productivity and GDP per capita with limited access to healthcare, digital infrastructure, and labour markets. Health outcomes are among the poorest in the EU, and life expectancy gaps, early pregnancies, and low institutional capacity paint a stark picture of structural neglect and persistent marginalisation.

Conversely, Clusters 1 and 2, found primarily in Northern and Central Europe, illustrate relative resilience. They maintain favourable levels of wellbeing, higher public service coverage, and better labour market access. However, even within these more advantaged groups, pockets of exclusion persist—especially among ageing populations and in regions facing depopulation or economic stagnation.

Southern European and insular regions (Clusters 4 and 5) form intermediate profiles, combining relatively low economic performance with mixed indicators of wellbeing and civic engagement. Their challenges are often tied to geographic remoteness, demographic ageing, and strained public services. Yet they also display stronger social cohesion and lower crime rates, signalling alternative forms of resilience.

Clusters 3 and parts of Cluster 5—concentrated in France and parts of Germany and Central Europe—represent structurally vulnerable, demographically shrinking regions. Despite better infrastructure than Eastern counterparts, these regions are marked by low fertility, high median age, and outmigration, raising concerns over their long-term sustainability.

Ultimately, the typology reinforces the need for territorially sensitive approaches to tackling rural exclusion. The analysis is constrained by the limited set of indicators available at the NUTS3 level, which restricts the scope of assessment despite allowing for high spatial resolution. To address this limitation, the next section expands the range of indicators—particularly in dimensions such as social infrastructure, governance, and subjective wellbeing—by incorporating data at the NUTS2 level. While this broader dataset comes at the cost of reduced spatial granularity, it enables a more comprehensive exploration of the multidimensional nature of exclusion and wellbeing across rural Europe, providing a complementary layer to the NUTS3-based cluster typology.

6. Typology at NUTS2 Level

6.1. Exploratory analysis

As reported in section 4, considering a wider spatial scale, NUTS2 regions, allows for working with a longer list of indicators. **Table 6.1** displays the descriptive statistics of the European NUTS2 regions, differentiating by type of region. As took place in the previous section, we provide a brief description.

Economic Conditions continue to highlight significant rural disadvantages. GDP per capita in PPS is markedly lower in rural regions (€31,768) compared to intermediate (€36,296) and all NUTS2 regions (€37,512). Similarly, real productivity per hour is reduced in rural areas (34.46 vs. 38.03 in intermediate and 38.87 overall), and job opportunities are fewer (0.72 vs. 0.75). Rural territories also show higher employment in agriculture (0.09 vs. 0.05) and slightly higher employment in industry (0.18 vs. 0.17), while lagging in employment in science and technology (29.82% vs. 33.84% in intermediate and 33.98% overall). Despite similar unemployment rates, rural areas experience slightly lower overall employment and a marginally wider gender gap in employment.

Income and Poverty Metrics show that rural areas have lower net disposable income (€16,149) compared to intermediate (€17,294) and all regions (€17,423). NEET rates (youth not in employment, education, or training) are higher in rural regions (12.5%), and while poverty rates are relatively similar across regions (~16%), rural areas report slightly lower work intensity (6.97 vs. 8.13).

Living Conditions again reveal weaker infrastructure in rural regions. Only 67.15% of the rural population lives within 15 minutes of a hospital, versus 79.14% in intermediate regions. However, rural areas benefit from lower PM2.5 pollution levels (89.29 vs. 103.69), suggesting better environmental quality. Internet connectivity is broadly similar but still lags slightly in intermediate regions (53.16 vs. 54.40 in rural).

Health and Wellbeing indicators show mixed patterns. Fertility rates are slightly higher in rural areas (1.51), while the median age is also higher (45.57 vs. 44.72), as is the age dependency ratio (60.49 vs. 58.12). Mothers in rural areas tend to be younger at childbirth (30.63 vs. 30.91), and early pregnancies are marginally more common. Lifespan in rural areas is slightly lower (80.08 vs. 80.22), and gender disparities in lifespan are wider. Mental health indicators reflect a disadvantage for rural regions, with lower scores (32.54 vs. 38.84), and higher rates of self-harm (11.83 vs. 10.80) and gender gaps in self-harm. Infant mortality and deaths from alcoholism are also marginally more prevalent in rural territories.

Education outcomes show a familiar gap. Secondary educational attainment is higher in rural regions (51.46%) than intermediate (47.47%), perhaps due to different educational trajectories, but tertiary attainment is lower (30.51% vs. 33.32%). The gender gap in tertiary education is wider in rural areas (8.07%), and participation in education and training is lower (11.35%).

Social participation and Engagement indicators paint a complex picture. Crime rates (measured by robberies) are much lower in rural regions (20.76 vs. 44.27), and levels of hard Eurosceptic voting are similar (13.01% vs. 13.46%). Electoral turnout is slightly lower in rural areas (61.16%), and perceptions of governance (Quality of Government Index) are also marginally lower (0.05 vs. 0.11).

In summary, the NUTS2 data reinforce the territorial disparities already observed at NUTS3. Rural regions consistently underperform in economic, infrastructural, educational, and health-related indicators, although they benefit from lower crime, slightly better air quality, and smaller urban stress. The wider indicator set allows a more granular view, particularly highlighting educational gaps, mental health vulnerabilities, and governance perception differences that merit attention in territorial policy frameworks.

Table 6.1. Descriptive statistics of Social Exclusion and Wellbeing Indicators. NUTS2 regions.

	All NUTS2 regions		Rural NUTS2 regions		Intermediate NUTS2 regions	
Indicators by dimension	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
GDP per capita in PPS	37,512	13,688	31,768	11,719	36,296	11,852
Real Productivity per Hour	38.87	18.81	34.46	19.96	38.03	18.07
Job Opportunities	0.76	0.13	0.72	0.09	0.75	0.12
Employment in Agriculture	0.05	0.06	0.09	0.08	0.05	0.05
Employment in Industry	0.16	0.09	0.18	0.11	0.17	0.08
Employment in Science and Technology	33.98	8.77	29.82	6.94	33.84	7.48
Unemployment Rate	6.23	4.21	6.42	3.25	5.78	3.71
Employment Rate	75.42	7.55	74.53	6.23	76.06	7.17
Employment Rate Gender Gap	9.77	6.01	10.15	7.31	9.42	5.28
Net Disposable Income per capita in PPS	17,423	4,113	16,149	4,176	17,294	4,150
NEET Rate	11.35	5.02	12.50	4.87	11.11	4.80
At Risk of Poverty	16.35	6.93	16.25	6.06	16.42	6.79
Work Intensity	8.14	4.87	6.97	3.16	8.13	5.28
Severe material and social deprivation	6.77	5.37	6.83	6.05	6.86	5.44
Population living in <15 min from hospital	78.93	16.06	67.15	15.03	79.14	13.90
Exposure PM2.5	105.20	40.07	89.29	41.21	103.69	36.13
Internet Connectivity	53.35	38.92	54.40	43.74	53.16	37.58
Fertility Rate	1.49	0.32	1.51	0.20	1.51	0.39
Median Age	44.61	3.72	45.57	2.55	44.72	4.16
Age Dependency Ratio	57.74	6.05	60.49	5.85	58.12	5.68
Average age of mother at birth	31.01	1.27	30.63	1.30	30.91	1.28
Early Pregnancy	0.02	0.03	0.03	0.03	0.02	0.03
Crude rate of net migration	7.16	9.94	4.73	8.66	7.39	9.33
Lifespan	80.42	2.61	80.08	2.68	80.22	2.77
Lifespan gender gap	5.35	1.52	5.77	1.40	5.44	1.60
Mental Health	38.37	20.20	32.54	17.22	38.84	20.88
Infant Mortality	3.21	1.45	3.19	1.41	3.29	1.64
Deaths from Alcoholism	3.76	3.39	4.25	3.72	3.89	3.50
Intended self-harm	10.64	4.06	11.83	5.03	10.80	3.55
Gender gap in Intended self-harm	13.04	5.98	15.79	6.17	13.38	5.46
Secondary Educational Attainment	46.53	12.20	51.46	11.19	47.47	11.92
Tertiary Educational Attainment	33.88	10.37	30.51	8.48	33.32	9.67
Gender Gap in Tertiary Education	6.60	6.30	8.07	6.11	6.64	6.68
Participation in education and training	12.80	7.93	11.35	7.68	12.47	7.81
Criminality (robberies)	45.59	62.23	20.76	18.00	44.27	61.42
Eurosceptic votes	26.49	18.61	27.86	17.81	26.26	18.87
Hard Eurosceptic votes	13.21	10.86	13.01	8.78	13.46	11.44
Electoral Turnover	65.24	15.24	61.16	14.75	65.73	15.57
Quality of Government Index	0.11	0.99	0.05	1.05	0.11	0.97

The next step consists of the reduction of the dimensionality of the list of 39 indicators. **Figure 6.1** plots the scree plot and component loading of the first two principal components (capturing 33% and 14% of total variance respectively), while **Table 6.2** shows the component rotation matrix of the first 9 principal components, the ones with eigenvalue higher than one, and summing up to 82% of total

variance. These components capture distinct territorial dimensions related to economic, social, demographic, and political factors. Below is a summary interpretation of each.

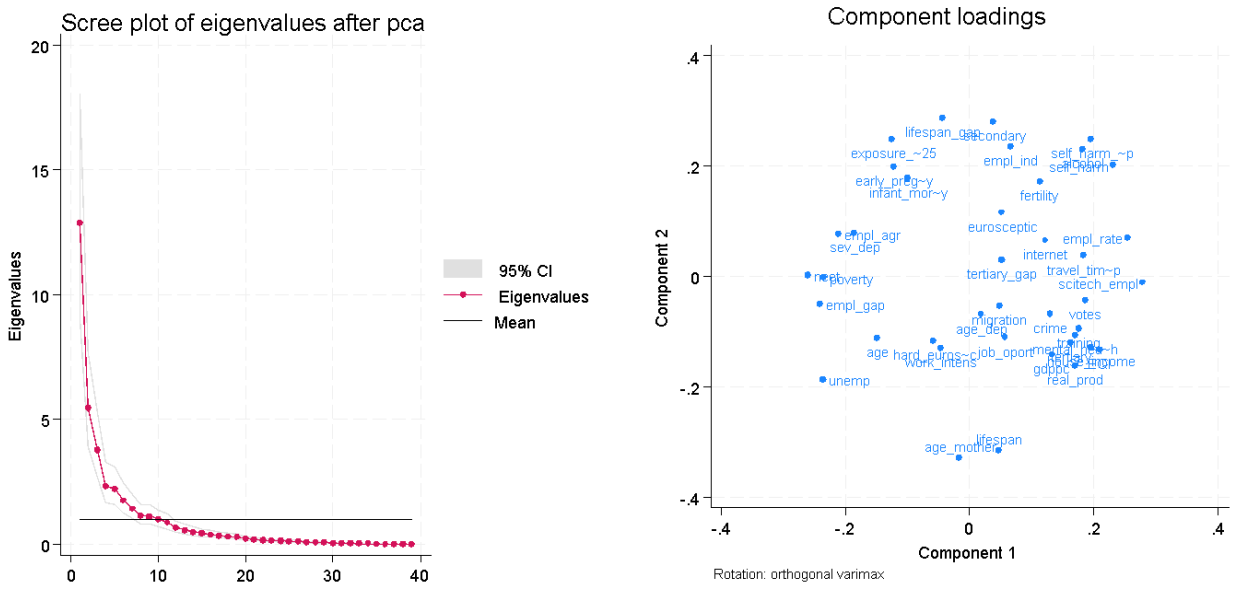


Figure 6.1. Principal Component Analysis: Scree Plot and Variable Loadings of the first two components (Varimax Rotation). Rural NUTS2 regions.

Component 1 – Economic Development and Institutional Quality (32.97%). This dominant axis reflects regional prosperity and social advancement. It is positively associated with high income, productivity, educational attainment (especially tertiary), good health outcomes, and strong governance. Negative loadings include poverty, material deprivation, NEET rates, and poor digital access. It clearly distinguishes well-performing regions from structurally disadvantaged ones.

Component 2 – Labour Market Structure and Social Risk (14.02%). This component captures a profile of traditional industrial labour markets combined with increased social vulnerabilities. Regions scoring high tend to have more employment in industry and higher secondary education, but also show higher levels of self-harm, alcoholism, and gender disparities in mental health. It may reflect areas where socio-economic transitions generate stress, particularly among youth and women.

Component 3 – Demographic Burden and Welfare Fragility (9.70%). Strongly associated with ageing (age dependency), pollution, and limited employment opportunities, this component highlights territories facing demographic pressure and welfare challenges. Positive correlations with early pregnancy and gender gaps in education reinforce the profile of socially vulnerable and economically fragile areas.

Component 4 – Family and Fertility Patterns (5.97%). This dimension links early motherhood, higher fertility, and better physical access to services (e.g. proximity to hospitals). It may reflect more traditional family structures and reproductive behaviours, particularly in rural or peripheral contexts.

Component 5 – Political Discontent and Hard Euroscepticism (5.67%). Heavily loaded on hard Eurosceptic vote shares and protest patterns, this component indicates dissatisfaction with

mainstream politics. It may reflect regions experiencing socio-political alienation, possibly overlapping with economic marginalisation.

Component 6 – Mental Health and Educational Gaps (4.51%). Combines high scores in mental health indicators with disparities in educational attainment, especially gender gaps in tertiary education. It reflects territories where psychosocial wellbeing coexists with uneven access to opportunities.

Component 7 – Migration and Ageing Dynamics (3.66%). This component captures demographic dynamism or pressure, strongly driven by net migration and age structure. It suggests population turnover, potentially linked to mobility, depopulation or demographic replacement processes.

Component 8 – Gendered Social Risk and Limited Access (2.94%). Highlights risks disproportionately affecting women (e.g. gender gaps in self-harm or education) along with lower connectivity and institutional access. It reflects gendered aspects of exclusion, often underexplored in regional typologies.

Component 9 – Electoral Behaviour and Trust in Institutions (2.88%). Correlates with political attitudes, including Eurosceptic voting, turnout, and perceptions of government quality. It points to territorial variation in civic engagement and institutional trust, relevant for understanding regional political divides.

Together, these nine components provide a robust empirical foundation for identifying patterns of social exclusion, wellbeing, and territorial diversity, guiding the construction of meaningful and policy-relevant typologies. This input is the basis for the construction of the regional typologies.

Table 6.2. PCA results: correlation of rotated components. Rural NUTS3 regions.

	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9
GDP per capita in PPS	0.1856	-0.0537	-0.1190	0.2162	-0.0338	-0.1684	-0.0914	0.0773	0.0481
Real Productivity per Hour	0.2283	-0.0518	0.0681	0.1612	-0.0274	-0.1322	-0.1629	0.0996	0.1419
Job Opportunities	0.1047	-0.0660	-0.1811	0.2721	0.2111	0.2304	0.2267	-0.1558	-0.2644
Employment in Agriculture	-0.2220	-0.0415	0.0260	0.1208	-0.1140	0.0748	0.1117	0.0448	-0.2514
Employment in Industry	-0.0637	0.2364	-0.1970	-0.0131	-0.0111	0.1603	-0.0723	0.3023	0.0406
Employment in Science and Technology	0.2441	0.1326	0.0601	-0.0149	-0.0111	0.0283	-0.0533	-0.0015	0.1296
Unemployment Rate	-0.1085	-0.2806	0.2149	-0.0932	-0.0530	0.0535	-0.0706	0.1107	-0.0662
Employment Rate	0.1826	0.1902	-0.1344	0.1571	0.0729	0.1274	0.1282	-0.2611	0.0046
Employment Rate Gender Gap	-0.1823	-0.1653	-0.1679	-0.0741	-0.0057	-0.1928	-0.0194	0.1102	0.1296
Net Disposable Income per capita in PPS	0.2331	-0.0115	-0.0331	0.0237	0.1848	-0.1397	-0.1555	0.0863	-0.1587
NEET Rate	-0.2256	-0.1306	0.1460	0.0380	0.0666	-0.0431	-0.0142	0.0600	0.0739
At Risk of Poverty	-0.2008	-0.1216	0.1399	0.0035	-0.1688	0.1539	-0.1202	0.1102	-0.0802
Work Intensity	0.0264	-0.1358	0.3151	0.0220	-0.0496	0.2745	-0.2656	0.1304	0.2917
Severe material and social deprivation	-0.2007	-0.0271	0.1735	0.2781	-0.0201	-0.0266	-0.1682	-0.0768	0.0795
Population living in <15 min from hospital	0.1384	0.1263	0.1283	-0.0547	0.3317	-0.0356	-0.1577	-0.1870	0.0078
Exposure PM2.5	0.0709	0.1186	0.3020	0.0501	-0.1485	-0.2054	-0.1021	-0.2817	-0.0383
Internet Connectivity	-0.2350	0.1501	-0.0982	-0.0536	0.0188	0.0459	-0.0256	-0.0768	0.1072
Fertility Rate	0.0098	0.2058	0.1643	0.3848	0.1077	-0.1562	0.1468	0.1932	0.1743
Median Age	-0.0720	-0.1720	0.0761	-0.0325	0.3072	0.3654	-0.0538	0.0682	-0.1474
Age Dependency Ratio	0.0503	-0.0498	0.3571	0.0761	0.2145	0.2529	0.3470	0.0483	-0.0336
Average age of mother at birth	0.1527	-0.2910	-0.1006	-0.1716	-0.0661	-0.0664	0.0285	0.1209	-0.0698

Early Pregnancy	-0.2069	0.1087	0.1202	0.2845	-0.0389	0.0115	-0.1063	-0.1209	0.0905
Crude rate of net migration	0.0686	-0.0212	-0.1180	0.1346	-0.2083	-0.1679	0.4195	0.2391	0.2563
Lifespan	0.2002	-0.2474	0.0175	-0.0886	0.0845	-0.1111	0.1201	0.0998	-0.1049
Lifespan gender gap	-0.1842	0.2249	0.0708	-0.1549	0.0240	-0.1093	0.0635	-0.1842	-0.2442
Mental Health	0.1999	-0.0046	-0.0200	0.0830	0.0117	0.2653	-0.2494	0.1060	0.0726
Infant Mortality	-0.1768	0.1020	0.1189	0.1716	0.0066	-0.1060	-0.0314	0.0581	0.1020
Deaths from Alcoholism	0.0392	0.2911	-0.0163	-0.2030	-0.0534	0.1625	-0.1789	0.2454	-0.1060
Intended self-harm	0.0960	0.2907	0.2025	-0.0498	-0.0066	-0.0317	0.0250	0.3515	-0.1259
Gender gap in Intended self-harm	0.0412	0.3141	0.1313	-0.1082	0.0097	-0.0147	0.0942	0.3474	-0.2192
Secondary Educational Attainment	-0.1103	0.2608	-0.1939	0.0041	0.2072	0.1387	0.0207	-0.0323	0.2064
Tertiary Educational Attainment	0.2007	-0.0198	0.1515	-0.0688	-0.2073	-0.0704	0.0775	0.0272	-0.0161
Gender Gap in Tertiary Education	0.0295	0.0523	0.1612	-0.1937	-0.3409	0.2819	0.3728	-0.1583	0.1466
Participation in education and training	0.1996	0.0086	0.1440	0.0353	-0.1682	0.1880	0.0950	-0.1241	0.1488
Criminality (robberies)	0.1454	0.0080	0.2590	0.0155	0.0164	-0.2211	-0.0801	-0.1215	-0.2658
Eurosceptic votes	-0.0149	0.1261	0.1910	-0.4263	0.1654	-0.1666	0.0666	-0.1538	0.2141
Hard Eurosceptic votes	0.0090	-0.1300	0.0789	-0.1582	0.4799	-0.0781	0.1479	0.0896	0.3610
Electoral Turnover	0.1817	0.0577	-0.1695	-0.1561	-0.1711	0.1454	-0.2335	-0.1575	0.1886
Quality of Government Index	0.2476	-0.0073	0.0359	0.1716	0.0066	0.1223	-0.0019	-0.0204	-0.0323

6.2. Decision of the number of clusters

The next step in the analysis involves applying hierarchical clustering to group rural regions based on their principal component scores. As in section 5, we implement the Ward's method, which we favour over the single and complete linkage methods, all reported in **Figure 6.2**, **Figure 6.3**, and **Figure 6.4.**

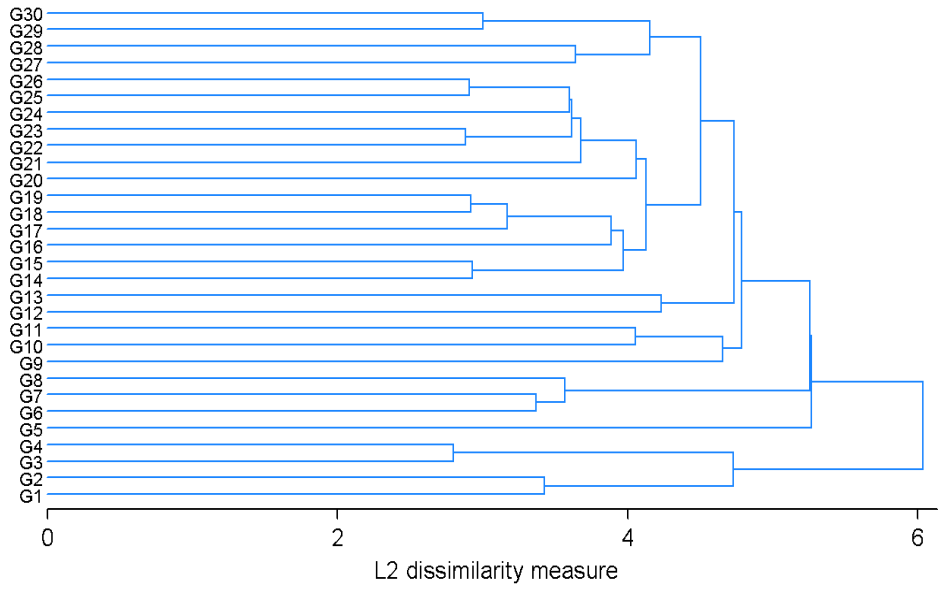


Figure 6.2. Dendrogram Using Single Linkage (Minimum Distance). Rural NUTS2 regions.

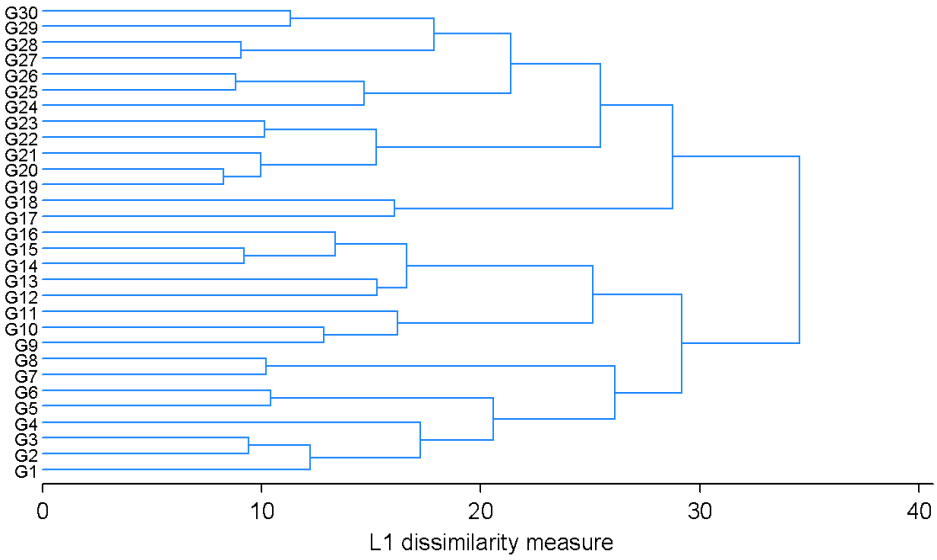


Figure 6.3. Dendrogram Using Complete Linkage (Maximum Distance). Rural NUTS2 regions.

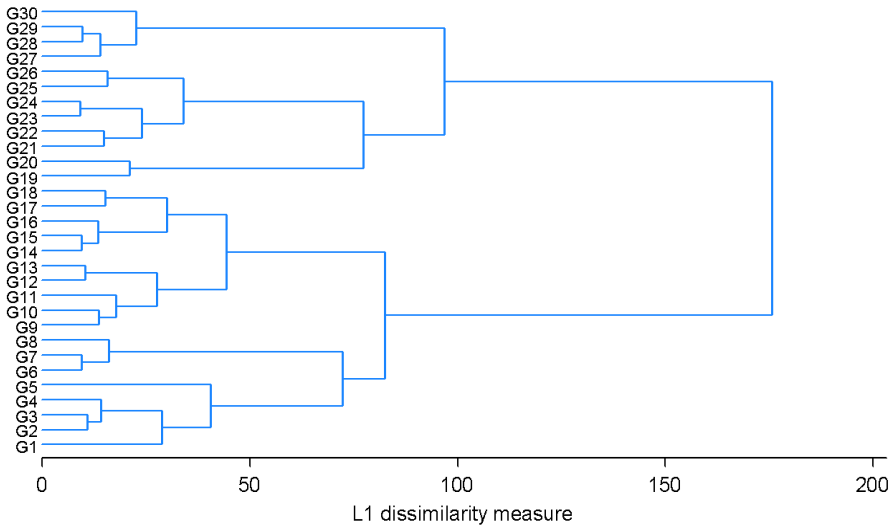


Figure 6.4. Dendrogram Using Ward's Linkage (Minimum Variance). Rural NUTS2 regions.

To determine the optimal number of clusters, we computed four established clustering evaluation metrics across a range of possible cluster solutions (k = 2 to 20): the Within-Cluster Sum of Squares (WSS), its logarithmic transformation (log (WSS)), the proportion of variance explained (η^2), and the Proportional Reduction of boxplot (PRE). They are shown in **Figure 6.5.**

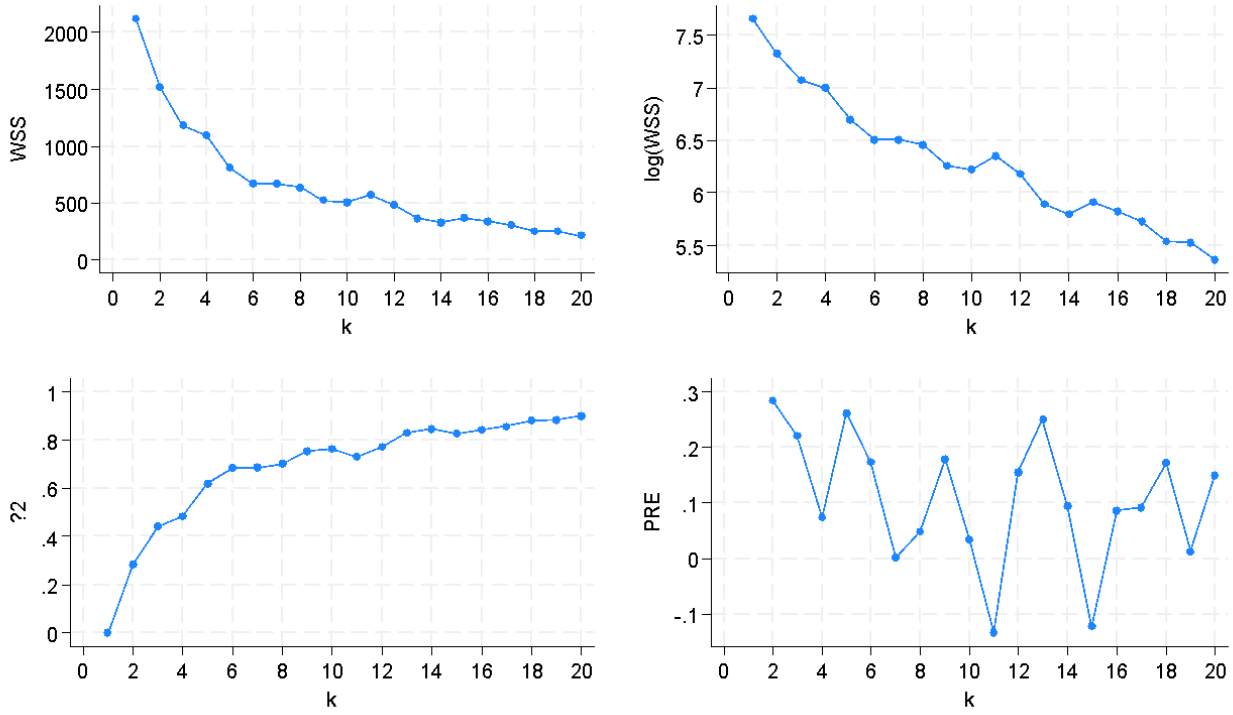


Figure 6.5. Clustering Evaluation Metrics Across Different Numbers of Clusters (k = 2–20). Rural NUTS2 regions.

Based on the diagnostic plots, the most appropriate solution is to retain six groups. The WSS and log (WSS) plots show a clear inflection point at k = 6, after which the reduction in within-cluster variance slows noticeably. Similarly, the η^2 curve shows a strong increase up to six clusters, with more modest gains beyond that point. The PRE plot also exhibits a local maximum at k = 6, before becoming more unstable at higher values. Together, these criteria support the selection of six clusters as a balanced and robust solution. The dendrogram based on Ward's linkage **(Figure 6.6).** confirms the presence of six well-defined groups, supporting the choice derived from the clustering diagnostics. The hierarchical structure shows relatively balanced group sizes, ranging from 5 to 15 regions per cluster. The separation between groups occurs at relatively high levels of dissimilarity, particularly between the left (G1–G3) and right (G4–G6) branches, indicating a clear division in the underlying data structure. This suggests that the six-cluster solution captures substantial heterogeneity among regions while maintaining internal cohesion within groups.

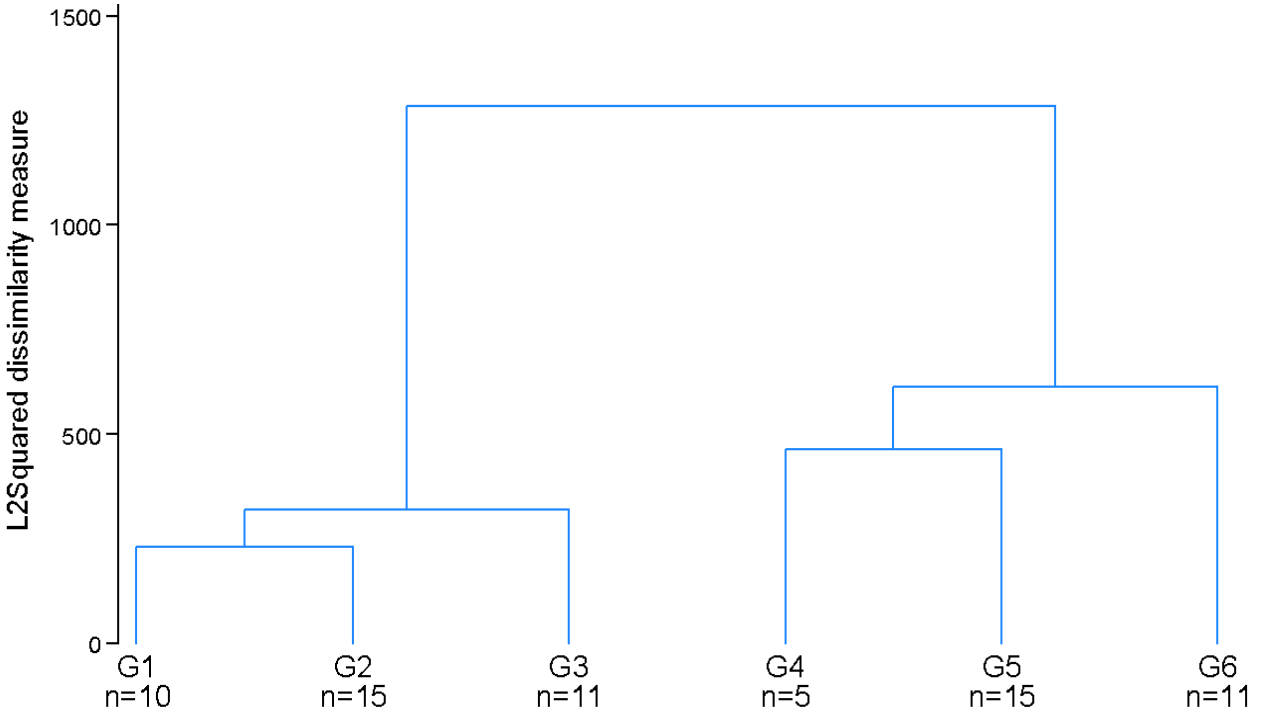


Figure 6.6. Hierarchical Clustering of Rural NUTS2 Regions: Final 6-Cluster Configuration (Ward's Method) regions.

The final step of the analysis involved assigning regions to six distinct clusters based on their social exclusion and wellbeing profiles. The resulting typology is summarised in the map (**Figure 6.7**). The spatial distribution of clusters reveals clear territorial patterns and confirms the analytical robustness of the classification. **Table 6.3** completes the picture with the distribution of regions by cluster and country.

The distribution of clusters across countries further reinforces the meaningfulness of the six-group typology. As shown in the summary table, the clusters are not randomly dispersed but instead reveal coherent national and regional patterns that align with broader territorial development trends in Europe.

Cluster 1, with 15 regions, includes areas from Finland, Ireland, Denmark, Portugal, and Sweden, and reflects a Northern and Western European profile of remote but institutionally strong regions. These are generally less populated territories with stable socio-economic conditions, suggesting resilient but peripheral rural areas.

Cluster 2, also composed of 10 regions, is concentrated in Austria and Germany, with an additional region in Italy. This cluster represents rural-industrial areas with strong labour markets and limited social risks. The national concentration—particularly the five Austrian regions—highlights the territorial coherence and governance-driven development in these areas.

Cluster 3, with 11 regions, is dominated by France, which contributes with all regions in this group. This remarkable national concentration points to a specific French model of intermediate territories—

neither structurally disadvantaged nor highly dynamic—characterised by social stability and moderate development indicators.

Cluster 4 is very territorially diverse, with 15 regions across Central and Eastern Europe, including Czechia, Slovakia, Poland, Hungary, Croatia, and Slovenia. This broad spread confirms the cluster's nature as a transitional space, where post-socialist restructuring and European convergence are still ongoing. It includes both newer and older EU member states and represents territories under structural adaptation.

Cluster 5, with 11 regions, captures the Southern European periphery, with a strong presence of Greek regions (8 out of 11), alongside areas in Italy and Spain. The dominance of Greece in this cluster reinforces the interpretation of structural disadvantage and persistent development gaps, particularly in insular and mountainous contexts.

Cluster 6, the smallest group with only five regions, is formed exclusively by Romanian and Bulgarian regions. This cluster identifies the most vulnerable territories in the typology, characterised by low incomes, demographic pressures, and weak infrastructure. Its national concentration underlines the particular development challenges facing the rural areas of these two Eastern European countries.

In total, 67 NUTS2 regions are classified into the six clusters. While some countries (e.g. Austria, France, Greece) show clear internal cohesion with all regions concentrated in a single cluster, others (e.g. Spain, Italy, Czechia) show greater internal diversity. This distribution demonstrates that, while national trajectories matter, regional differences within countries are also significant and need to be addressed through place-based policies.

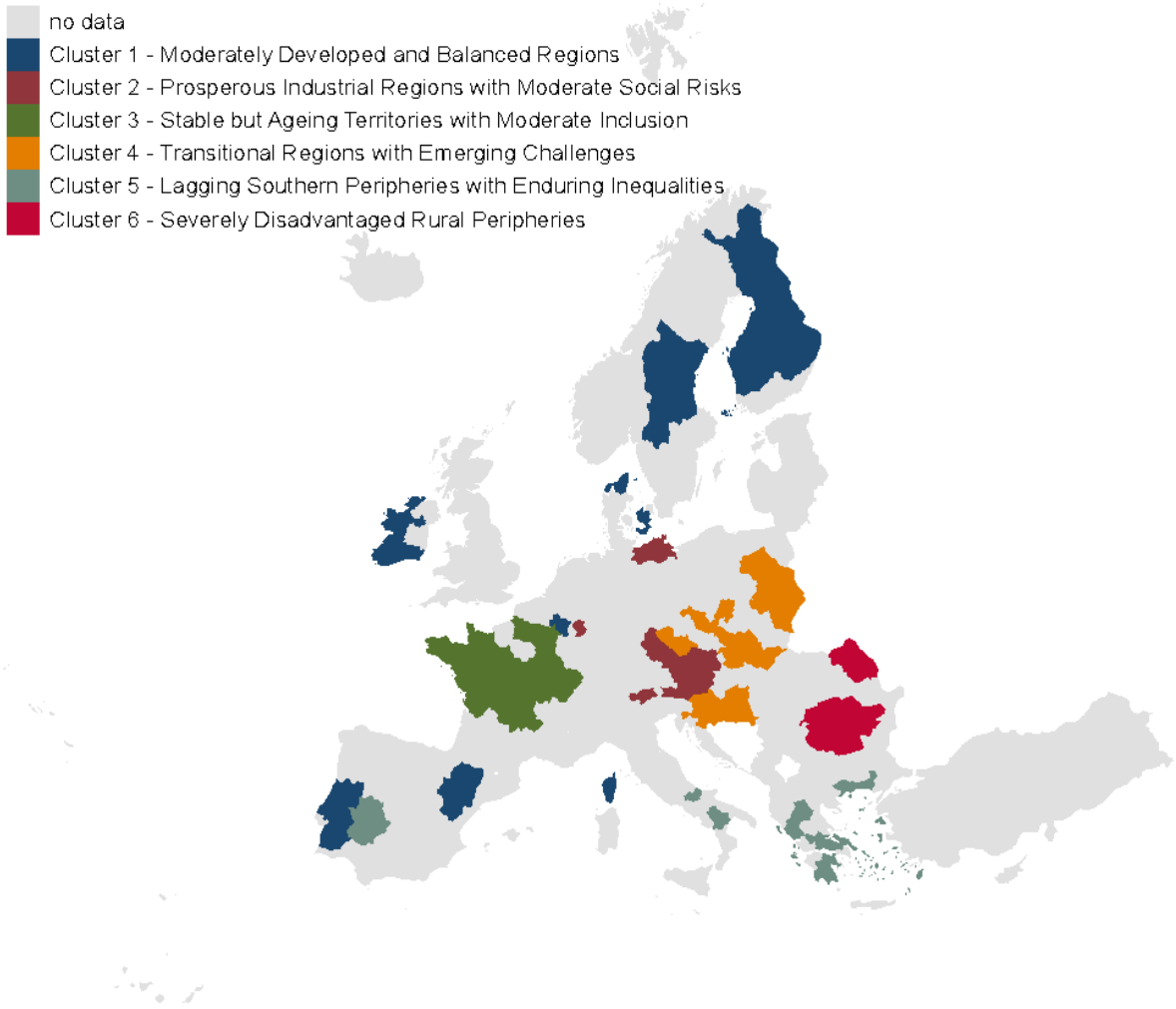


Figure 6.7. Social Exclusion Typologies.

Table 6.3. Distribution of Rural NUTS2 Regions by Country and Cluster (6-Cluster Typology).

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	
AT		5					**5**
BE	2						**2**
BG						2	**2**
CZ				3			**3**
DE		4					**4**
DK	2						**2**
EL					8		**8**
ES	1				1		**2**
FI	3						**3**
FR	1		11				**12**
HR				2			**2**
HU				2			**2**
IE	2						**2**
IT		1			2		**3**
PL				5			**5**
PT	2						**2**
RO						3	**3**

SE	2						**2**
SI				1			**1**
SK				2			**2**
	15	**10**	**11**	**15**	**11**	**5**	**67**

6.3. Fuzzy membership approach

Next, we provide the analysis of the fuzzy-like membership approach. The silhouette plot (**Figure 6.8**) reveals that several regions in one of the clusters exhibit negative silhouette widths—indicating weak or conflicting affiliation with their assigned cluster. This uncertainty highlights the need for a more nuanced representation of cluster membership, one that can reflect degrees of belonging rather than rigid classifications.

We compute the Euclidean distance between each NUTS2 region and the centroids of the six identified clusters, using their coordinates along the first nine principal components (PC1 to PC9). The similarity of each region to a given cluster is defined as the inverse squared distance to that cluster's centroid. These similarity values are then normalised across all clusters, resulting in a fuzzy membership matrix in which each region is assigned a degree of membership between 0 and 1 for each cluster, with the total across clusters summing to one. **Figure 14.3** in the Appendix 3 presents the fuzzy membership scores of each NUTS2 region across the six clusters.

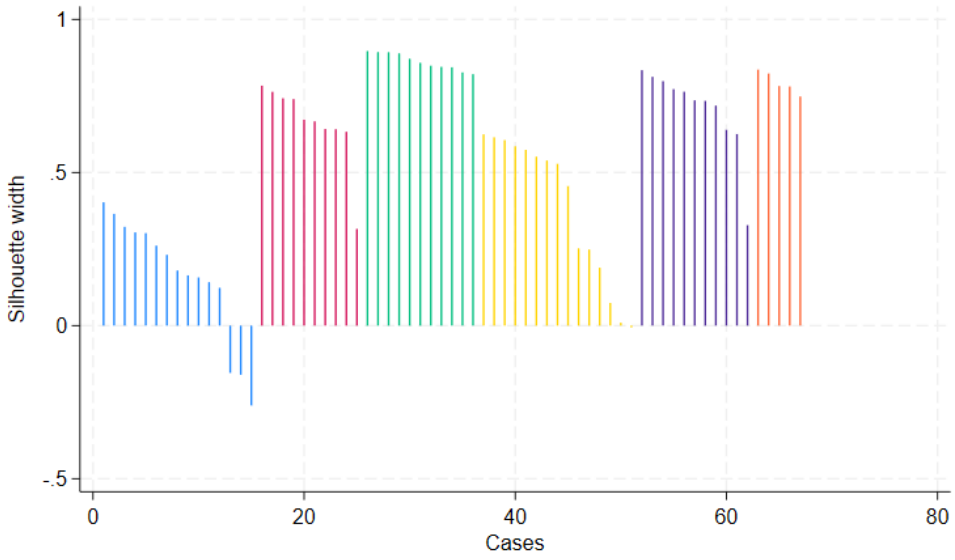


Figure 6.8. Silhouette plot – seven clusters' results. NUTS2 regions.

We computed the fuzzy uncertainty index, defined as one minus the highest membership score for each region. **Figure 6.9** and **Figure 6.10** present the distribution of this index from both statistical and spatial perspectives. The spatial distribution of uncertainty (**Figure 6.9)** shows clear patterns. Notably, several regions in Northern Europe (particularly Finland), Southern France, Western Spain and Portugal, and parts of Italy and Central-Eastern Europe exhibit elevated levels of uncertainty. These territories likely reflect more complex or transitional socio-territorial profiles that cannot be easily captured by a single cluster type. Their mixed memberships may result from overlapping economic,

demographic or governance features that straddle the boundaries of the defined typology. In contrast, many regions across Austria, Germany, Poland, and Romania display low uncertainty scores, suggesting that their territorial characteristics align more clearly with one dominant cluster. These regions exhibit greater internal consistency and can be more confidently assigned within the typological framework. Clusters 1 and 4 are the ones with highest levels of uncertainty.

Table 6.4 presents the list of NUTS2 regions that either show a fuzzy distance below 0.10 between their first and second most likely clusters (a slightly more flexible threshold than the one applied to NUTS3 regions) or display a fuzzy uncertainty value above 0.70. For each of these regions, we also report the score on the first principal component (PC1), which captures overall socioeconomic wellbeing and advantage. This score—standardised by cluster—is compared to the average PC1 values of the first and second clusters to which the region is most closely associated. These comparisons provide a basis for informed expert judgement regarding any potential reassignment of regions to a different cluster, particularly in cases where the original classification appears ambiguous.

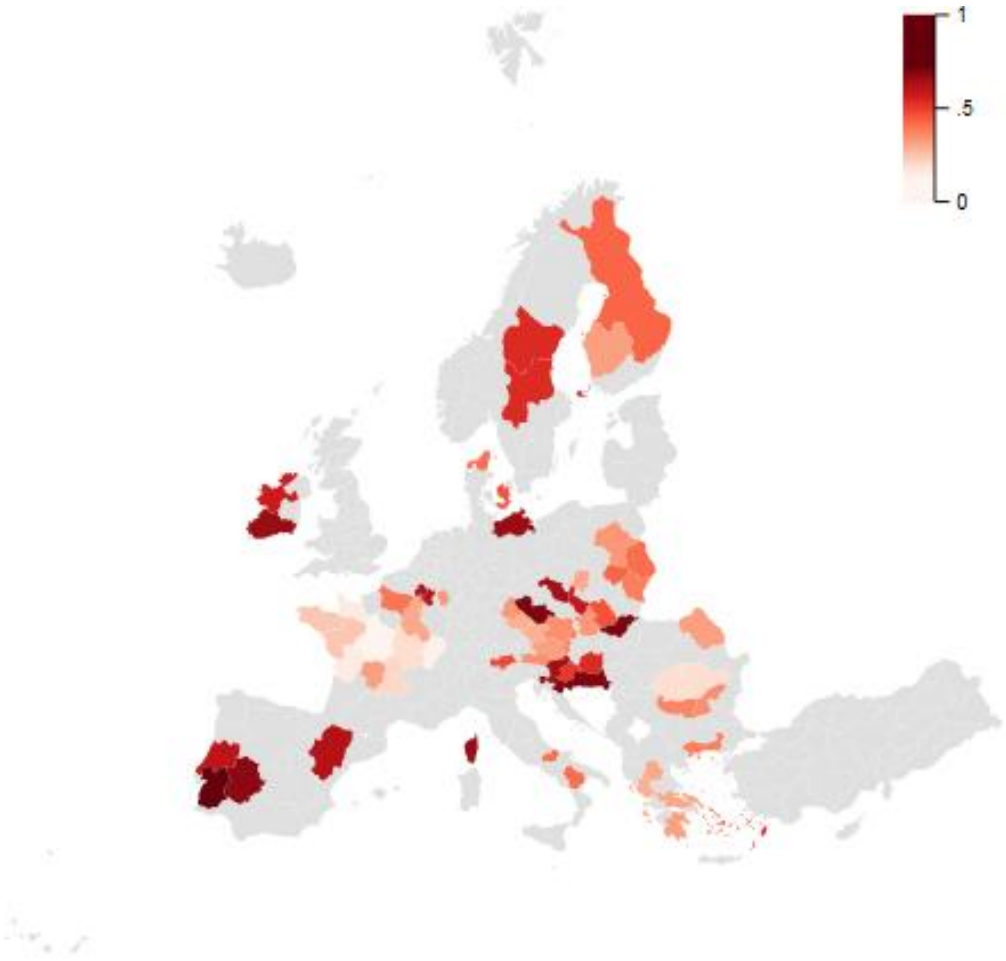


Figure 6.9. Fuzzy uncertainty. Geographic distribution. NUTS2 regions.

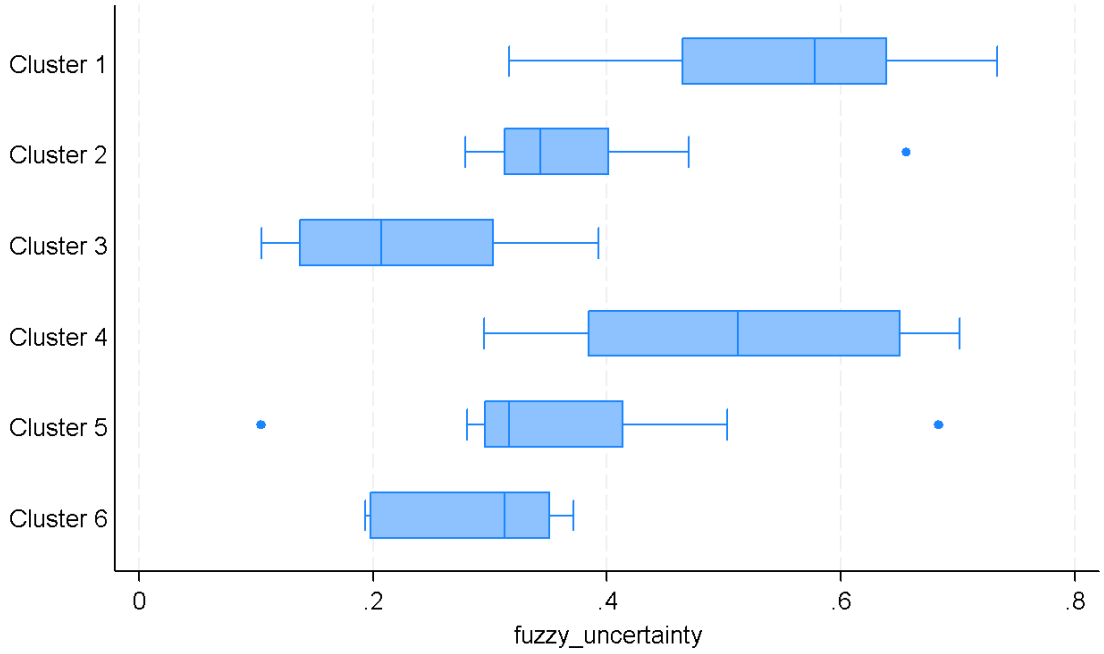


Figure 6.10. Fuzzy uncertainty. Statistic distribution by cluster. NUTS2 regions.

Table 6.4. NUTS2 regions with highest level of uncertainty in cluster's assignment.

			1st Assigned Cluster		2nd Assigned Cluster					Standardized PC1 distance	
NUTS 2	Region name	Assigned cluster	Cluster #	Fuzzy Dist	Cluster #	Fuzzy Dist	Distance between 1st and 2nd	Fuzzy Uncert.	PC1	1st cluster	2nd cluster
HU31	Észak-Magyarország	Cluster 4	4	0.314	6	0.258	0.055	0.686	-4.52	-3.33	4.41
PT18	Alentejo	Cluster 1	1	0.267	3	0.196	0.071	**0.733**	0.12	-1.86	-3.07
CZ03	Jihozápad	Cluster 4	4	0.306	2	0.225	0.081	0.694	0.37	1.55	-4.70
ES43	Extremadura	Cluster 5	5	0.317	1	0.215	0.102	0.683	-0.66	1.67	-2.64
BE35	Prov. Namur	Cluster 1	1	0.362	3	0.260	0.102	0.638	3.12	1.14	-0.06
FRM0	Corse	Cluster 1	1	0.338	3	0.235	0.103	0.662	1.01	-0.98	-2.18
HR02	Panonska Hrvatska	Cluster 4	4	0.299	6	0.185	0.114	**0.701**	-4.52	-3.34	4.41

Given the current level of low uncertainty, we only considered two regions for reassignment: Alentejo (PT18, Portugal) and Panonska Hrvatska (HR02, Croatia), given the high level of uncertainty. Despite the analysis, both regions remain closer to the first assigned cluster in the fuzzy analysis, which corresponds to the same level than the hierarchical cluster. Consequently, for NUTS2 we have not developed any change at this spatial level.

6.4. Clusters description

This section describes the characteristics in terms of the variables linked to Social Exclusion and wellbeing. The statistics summary is reported in **Table 6.5** next we provide a comment for every observed cluster, characterising the main aspects of each.

Table 6.5. Descriptive statistics by Cluster. NUTS2 regions.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
GDP per capita in PPS	38,696	42,719	32,608	25,250	25,697	20,146
Real Productivity per Hour	50.73	48.44	47.25	16.98	22.06	9.32
Job Opportunities	0.75	0.80	0.70	0.68	0.71	0.69
Employment in Agriculture	0.06	0.04	0.05	0.10	0.15	0.28
Employment in Industry	0.13	0.19	0.13	0.31	0.10	0.21
Employment in Science and Technology	34.69	35.20	34.30	28.21	20.49	19.90
Unemployment Rate	6.13	3.52	6.65	4.35	11.67	7.28
Employment Rate	77.31	80.24	75.30	76.15	65.42	68.22
Employment Rate Gender Gap	4.92	7.11	4.84	11.43	21.33	15.24
Net Disposable Income per capita in PPS	17347	22750	18891	12953	13236	9320
NEET Rate	9.32	8.05	12.17	11.52	18.48	21.48
At Risk of Poverty	14.65	11.25	12.97	15.63	22.35	26.68
Work Intensity	8.87	5.34	7.72	4.85	8.15	6.58
Severe material and social deprivation	4.43	3.20	6.00	5.11	9.63	22.16
Population living in <15 min from hospital	65.57	76.77	83.48	64.07	53.94	55.06
Exposure PM2.5	107.28	67.25	135.23	77.07	47.02	107.95
Internet Connectivity	10.58	36.69	23.64	100.66	61.92	133.55
Fertility Rate	1.50	1.47	1.72	1.49	1.30	1.75
Median Age	44.55	46.39	45.17	44.28	47.87	46.68
Age Dependency Ratio	62.65	56.19	67.67	56.13	60.08	60.86
Average age of mother at birth	31.44	31.00	30.49	29.81	31.81	27.58
Early Pregnancy	0.01	0.01	0.02	0.03	0.02	0.11
Crude rate of net migration	9.98	3.09	2.62	5.25	1.47	2.46
Lifespan	81.62	81.25	81.80	77.45	81.54	74.04
Lifespan gender gap	4.49	4.79	6.22	7.09	5.22	7.92
Mental Health	46.67	47.64	31.65	26.33	22.72	2.18
Infant Mortality	2.33	2.37	3.49	3.42	3.20	6.04
Deaths from Alcoholism	3.17	5.27	4.96	7.81	0.52	1.44
Intended self-harm	11.85	12.17	17.47	13.29	4.50	10.34
Gender gap in Intended self-harm	13.85	15.69	21.70	19.74	7.90	14.27
Secondary Educational Attainment	40.43	54.80	47.11	64.41	45.04	62.72
Tertiary Educational Attainment	38.29	30.26	36.68	26.22	25.52	18.02
Gender Gap in Tertiary Education	13.23	-0.31	7.35	11.09	6.02	6.36
Participation in education and training	19.63	11.43	13.92	7.76	5.63	4.04
Criminality (robberies)	32.35	21.11	40.75	7.66	7.67	9.39
Eurosceptic votes	16.07	15.80	49.30	38.43	26.55	11.36
Hard Eurosceptic votes	6.58	15.42	20.61	8.89	20.80	6.06
Electoral Turnover	71.23	75.42	50.38	65.33	52.09	33.62
Quality of Government Index	1.12	0.88	0.52	-0.75	-0.88	-1.41

Cluster 1. Moderately Developed and Balanced Regions (Figure 6.11). It comprises 15 NUTS2 regions from Belgium, Denmark, Spain, Finland, France, Ireland, Portugal, and Sweden. This group reflects a mixed but generally favourable socio-economic profile, especially in relation to economic and living conditions, albeit with specific weaknesses in education and social participation.

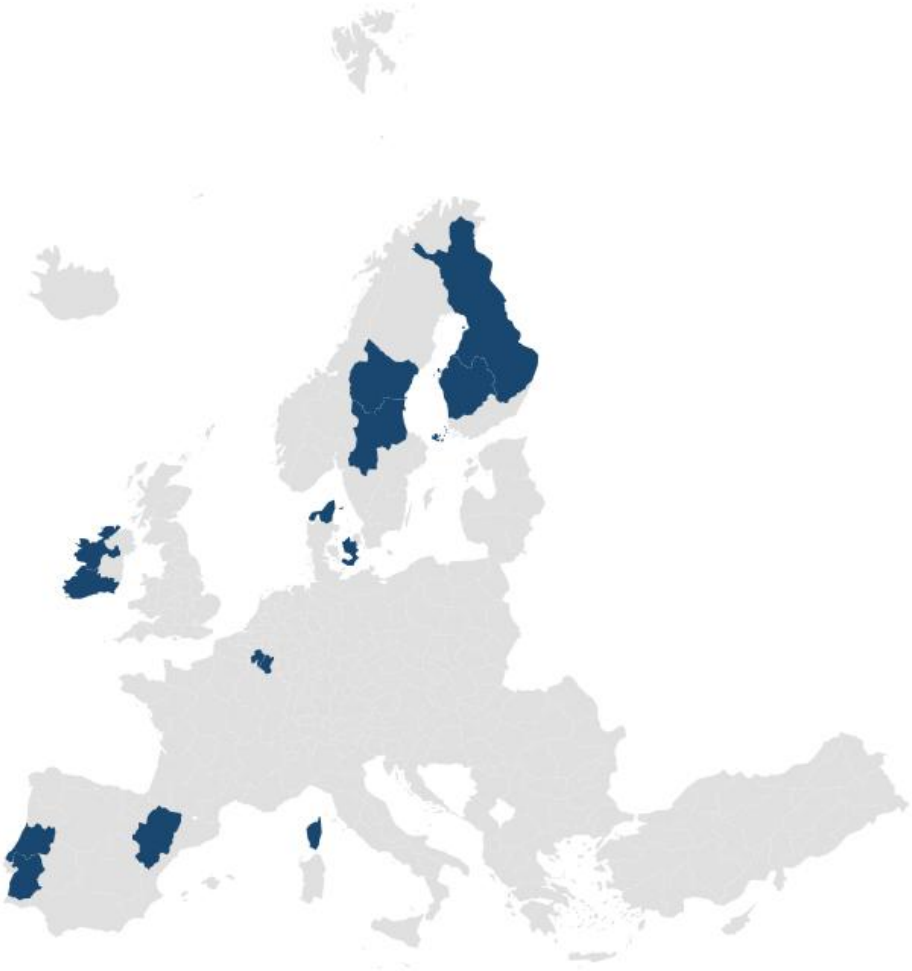


Figure 6.11. Cluster 1 – Moderately developed and balanced regions.

- **Economic Dimension:** Regions in Cluster 1 show relatively strong economic fundamentals. GDP per capita is high (38,696 PPS), as are productivity levels (50.73 €/h) and job opportunities (0.75). Employment in science and technology is robust (34.7%) while the unemployment rate remains moderate (6.1%). Income levels are also solid, with a net disposable income per capita of 17,347 PPS. However, employment in agriculture and industry remains moderate, indicating a balanced but service-oriented labour market structure.
- **Living Conditions:** This cluster presents decent access to healthcare, with 66% of the population living within 15 minutes of a hospital. However, PM2.5 exposure is relatively high (107.3), likely reflecting the inclusion of more urbanised or industrialised regions. Internet connectivity is notably low (10.6), suggesting gaps in digital infrastructure despite otherwise good development levels.
- **Health and Wellbeing:** This group presents relatively strong health outcomes, including a long average lifespan (81.6 years) and a low rate of early pregnancy (1%). However, some vulnerability appears in mental health indicators (46.7) and deaths from alcoholism (3.2). The educational picture is somewhat mixed: tertiary attainment is relatively high (38.3%), but participation in lifelong learning is not particularly strong (19.6%). The gender gap in tertiary education is wide (13.2), and the NEET rate is moderate (9.3%).
- **Social Participation and Engagement:** Cluster 1 regions show moderate levels of Euroscepticism (16.1%) and low support for hard Eurosceptic parties (6.6%). Electoral

participation is very high (71.2%), and perceived government quality is above average (EQGI = 1.12). However, crime levels are significant (32.4 robberies per 100k), reflecting either urbanised areas or higher reporting rates.

Cluster 2. Prosperous Industrial Regions with Moderate Social Risks (Figure 6.12). This cluster includes 10 regions from Austria, Germany, and Northern Italy. These territories are characterised by strong economic performance and favourable labour market indicators, combined with relatively low social risks and good quality of life. The cluster exhibits a mature demographic profile and high integration into industrial and technological sectors.

Figure 6.12. Cluster 2 – Prosperous industrial regions with moderate social risks.

- **Economic Dimension:** This cluster ranks highest in terms of GDP per capita (42,719 PPS) and productivity (48.4 €/h), alongside very high employment rates (80.2%) and a strong job opportunity score (0.80). Employment in science and technology is the highest of all clusters (35.2%), indicating advanced labour markets. The unemployment rate is notably low (3.5%), and disposable income is strong (22,750 PPS). Most socio-economic risk indicators such as NEET rate (8.1%), poverty risk (11.3%), and material deprivation (3.2%) are among the lowest, reinforcing the image of a stable, prosperous cluster.

- **Living Conditions**: Access to services is good (77% within 15 min of a hospital), PM2.5 levels are moderate (67.3), and internet connectivity is decent (36.7). This suggests a generally well-developed infrastructure network, although with room for improvement in digitalisation.
- **Health and Wellbeing:** Regions in this cluster reflect a healthy and ageing population: fertility is slightly below replacement level (1.47), with a median age of 46.4 years. Lifespan is long (81.3 years), and alcohol-related mortality (5.3) and mental health challenges are moderate. The educational profile is mixed: secondary attainment is high (54.8%), but tertiary education is somewhat less widespread (30.3%), and participation in lifelong learning is limited (11.4%). Notably, the gender gap in tertiary education is near zero (–0.31), indicating strong gender balance in higher education access.
- **Social Participation and Engagement:** Cluster 2 shows moderate levels of electoral participation (75.4%) and relatively low Euroscepticism (15.8%). Criminality is low (21.1), and the perceived quality of government is solid (EQGI = 0.88). These indicators suggest institutional stability and civic engagement, which reinforce the broader socioeconomic wellbeing.

Cluster 3. Stable but Ageing Territories with Moderate Inclusion (Figure 6.13). This is composed entirely of rural and semi-rural regions in France, including Centre–Val de Loire, Bretagne, Bourgogne, and Auvergne. These areas reveal a mixed profile with moderately strong economic indicators, solid health outcomes, but some signs of social stress and moderate civic participation.

Figure 6.13. Cluster 3 – Stable but ageing territories with moderate inclusion.

- **Economic Dimension**. This cluster shows mid-range performance economically. GDP per capita (32,608 PPS) and productivity (47.25 €/h) are solid, although lower than those of Clusters 1 and 2. Employment-related indicators are relatively favourable, with a good overall employment rate (75.3%) and a strong presence in science and technology (34.3%). Unemployment stands at 6.7%, slightly above average but not alarming. Poverty indicators are moderate: NEET rate (12.2%) and at-risk-of-poverty (13%) are higher than in the wealthiest clusters, though still below critical thresholds. Disposable income is acceptable (18,891 PPS), and deprivation levels are relatively contained (6%).
- **Living Conditions**. Cluster 3 shows the best access to health services (83.5% of the population within 15 minutes of a hospital), indicating good territorial coverage. However, exposure to PM2.5 is the highest of all clusters (135.2), which may reflect proximity to industrial or urban emissions. Internet connectivity is moderate (23.6), highlighting some digital infrastructure challenges.
- **Health and Wellbeing**. Health outcomes are relatively strong. Life expectancy is among the highest (81.8 years), and the median age (45.2) and fertility (1.72) are balanced. Mental health indicators show some concern: intended self-harm (17.5) and the gender gap in self-harm (21.7) are the highest among all clusters. Deaths from alcoholism (5.0) and infant mortality (3.5) are also slightly elevated. Educational attainment is fair, with 47.1% holding secondary and 36.7% tertiary education. Participation in lifelong learning is moderate (13.9%).
- **Social Participation and Engagement**. This cluster displays the highest levels of Euroscepticism (49.3%) and relatively low trust in government (EQGI = 0.52), suggesting political disenchantment. Electoral participation is lower (50.4%), and criminality rates are the highest (40.8), pointing to social tensions. Nevertheless, gender equality in tertiary education (7.4) is moderate, and access to education is broadly equitable.

Cluster 4. Transitional Regions with Emerging Challenges (Figure 6.14), is composed entirely of rural and transitional regions from Central and Eastern Europe—mainly from the Czech Republic, Slovakia, Poland, Hungary, Croatia, and Slovenia. These regions present a distinctive structural profile: moderate employment levels and relatively sound public infrastructure coexist with economic and social vulnerabilities.

Figure 6.14. Cluster 4 – Transitional regions with emerging challenges.

- **Economic Dimension**. This cluster is marked by relatively weak economic performance. GDP per capita (€25,250) and productivity (€17/h) are low, as are net disposable income (€12,953) and the share of employment in science and technology (28.2%). Employment and unemployment rates (76.2% and 4.4%, respectively) are slightly better than expected, although poverty indicators (NEET rate: 11.5%; at-risk-of-poverty: 15.6%; material deprivation: 5.1%) signal structural exclusion. The share of employment in industry (31%) is the highest of all clusters, reflecting ongoing industrial legacies and lower transition to post-industrial economies.
- **Living Conditions**. Access to hospitals is modest (64.1%), and internet connectivity is surprisingly high (100.7), suggesting a solid digital infrastructure relative to other aspects of territorial development. However, air quality remains an issue: PM2.5 exposure (77.1) is high, with possible long-term effects on health outcomes.
- **Health and Wellbeing**. Demographic and health indicators show mixed results. Life expectancy is below average (77.5), and infant mortality is relatively high (3.4). Mental health scores are concerning, with relatively low wellbeing (26.3), and elevated rates of self-harm (13.3) and alcohol-related deaths (7.8). Educational attainment is decent, particularly for secondary education (64.4%), but tertiary attainment (26.2%) and lifelong learning (7.8%) lag-behind. Gender gaps in tertiary education (11.1) and self-harm (19.7) also remain sizeable.

- **Social Participation and Engagement**. Political engagement is moderate. Eurosceptic sentiment (38.4%) is notable, although not extreme. Electoral turnout (65.3%) is healthy, and criminality is low (7.7), suggesting socially cohesive but politically ambivalent communities. The quality of government score is negative (–0.75), reflecting institutional weaknesses and lower trust in public administration.

Cluster 5. Lagging Southern Peripheries with Enduring Inequalities (Figure 6.15), brings together structurally disadvantaged regions in Southern Europe, specifically from Greece, Spain (Extremadura), and Italy (Molise and Basilicata). These territories represent some of the most vulnerable rural and lagging regions in Europe in terms of both economic performance and social inclusion.

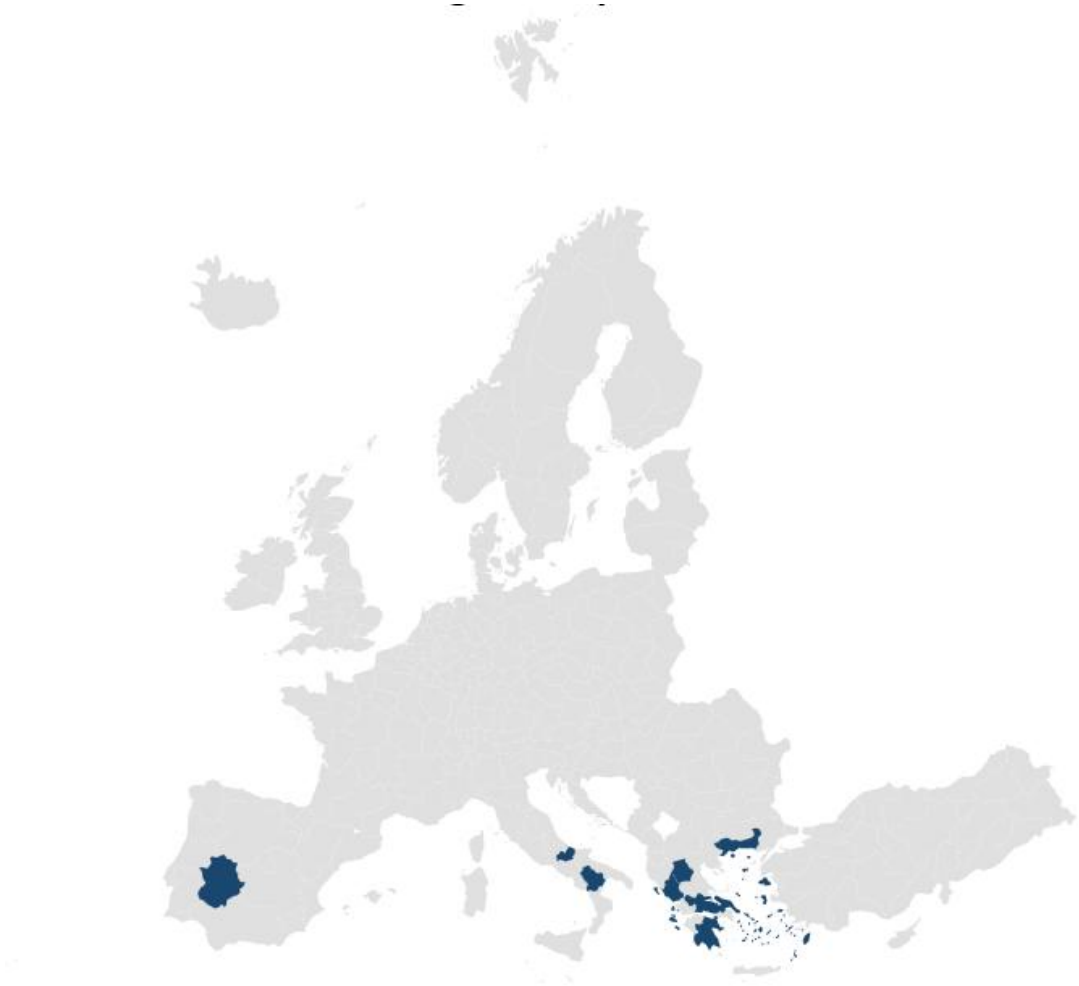


Figure 6.15. Cluster 5 – Lagging southern peripheries with enduring inequalities.

- **Economic Dimension**. This cluster records very low economic figures across the board. GDP per capita (€25,697), productivity (€22/hour), and disposable income (€13,236) all fall well below the EU average. Unemployment is high (11.7%), and the employment rate is the lowest among all clusters (65.4%). The labour market is further weakened by a significant gender employment gap (21.3%), high NEET rates (18.5%), and material and social deprivation

(9.6%). The presence of science and technology employment is limited (20.5%), and although industry employs only 10%, agriculture has the second-highest share (15%), indicating a relatively traditional productive structure.

- **Living Conditions**. Living conditions are precarious. Only 54% of the population lives within 15 minutes of a hospital—the lowest rate across clusters. On the other hand, PM2.5 levels are relatively low (47.0), reflecting less industrial pollution. Internet connectivity is moderate (61.9), but likely to be unevenly distributed across territories.
- **Health and Wellbeing**. The demographic profile indicates an ageing population (median age: 47.9), with the lowest fertility rate (1.30) and highest average age of mothers at birth (31.8). Net migration is almost stagnant (1.5), and life expectancy is still fairly high (81.5), although indicators such as mental health (22.7), infant mortality (3.2), and education-related outcomes point to social vulnerability. Tertiary education attainment (25.5%) and participation in education and training (5.6%) are among the lowest, and gender gaps in education remain visible.
- **Social Participation and Engagement**. Civic engagement appears relatively weak. Although Eurosceptic sentiment is not extreme (26.6%), electoral participation (52.1%) is low, and trust in institutions is low as well, reflected in a negative governance score (–0.88). Robbery rates are also very low (7.7), suggesting low crime but also possibly underreporting or limited urban crime exposure.

Cluster 6. Severely Disadvantaged Rural Peripheries (Figure 6.16), brings together some of the most structurally and socially disadvantaged regions in Eastern Europe, specifically from Bulgaria (Severozapaden, Severen tsentralen) and Romania (Nord-Est, Sud-Muntenia, Sud-Vest Oltenia). These territories consistently rank among the lowest in the EU across nearly all development indicators, reflecting deep-rooted challenges in economic, social, and institutional domains.

Figure 6.16. Cluster 6 – Severely disadvantaged rural peripheries.

- **Economic Dimension**. Economically, Cluster 6 is by far the most deprived. GDP per capita (€20,146), productivity (€9.3/hour), and disposable income (€9,320) are the lowest among all clusters. Employment figures are weak, with an employment rate of only 68.2% and a significant gender gap (15.2%). The unemployment rate is high (7.3%), and NEET rates (21.5%) are the highest. Deprivation levels are critical: over one-fifth of the population faces severe material and social deprivation (22.2%), and the cluster also has the highest share of agricultural employment (28%), indicating a predominance of low-productivity, rural-based economies.
- **Living Conditions**. Living conditions reflect infrastructural deficits. Just 55% of the population lives within 15 minutes of a hospital, and PM2.5 exposure is among the highest (108), signalling severe air pollution. Internet connectivity is the highest (133.6).[2]
- **Health and Wellbeing**. Health and demographic indicators paint a bleak picture. Life expectancy is the lowest (74 years), while infant mortality is the highest (6.0). Mental health scores are extremely low (2.2), and early pregnancies are more common (0.11). Educational outcomes are also poor: only 18% of the population has attained tertiary education, and

[2] Romania stands out with one of the highest internet penetration rates in Europe, outperforming even some of the continent's most affluent nations, even in low settled areas, what has attracted the attention of the media: https://www.blue-europe.eu/analysis-en/short-analysis/romania-and-internet-connectivity-success-factors/#post-12528-footnote-4

participation in lifelong learning is minimal (4.0%). The dependency ratio is relatively high (61%), and average maternal age is the lowest across clusters (27.6), indicating both demographic stress and potential generational disadvantage.

- **Social Participation and Engagement**. Civic engagement and trust in institutions are extremely low. Governance quality is the weakest in Europe (–1.41), and electoral participation is also poor (33.6%). However, Eurosceptic and hard Eurosceptic votes are not particularly elevated (11.4% and 6.1%, respectively), perhaps due to limited political pluralism or disengagement rather than strong ideological positioning.

7. Sensitivity Analysis

In this section, we conduct a sensitivity analysis by comparing the cluster assignments of NUTS2 regions using two different sets of indicators. The first is the comprehensive list developed in Section 6, while the second relies on a more restricted set of variables, aligned with those available at the NUTS3 level.

As discussed in earlier sections, although the extended list of indicators provides a more robust representation of social exclusion and wellbeing, the spatial definition of rural areas benefits from the finer granularity offered by NUTS3-level data. By examining how typologies vary depending on the indicator set, we can better assess the consistency and complementarity of both approaches.

The analysis presented here is deliberately concise, as the methodological steps replicate those described in previous sections. The goal is to evaluate the stability of the typology and support the use of both NUTS2- and NUTS3-based classifications as potentially complementary tools in territorial analysis.

7.1. Definition of the alternative typology

As in previous sections, we start by reducing the dimensionality of the data by means of the principal component technique. As in section 5, we just select 6 components, the ones with an eigenvalue higher than one. All of them capture up to 78% of the total variation. **Figure 7.1** displays the scree plot and the component loading of the first two principal components, which capture up to 45% of the total variance.

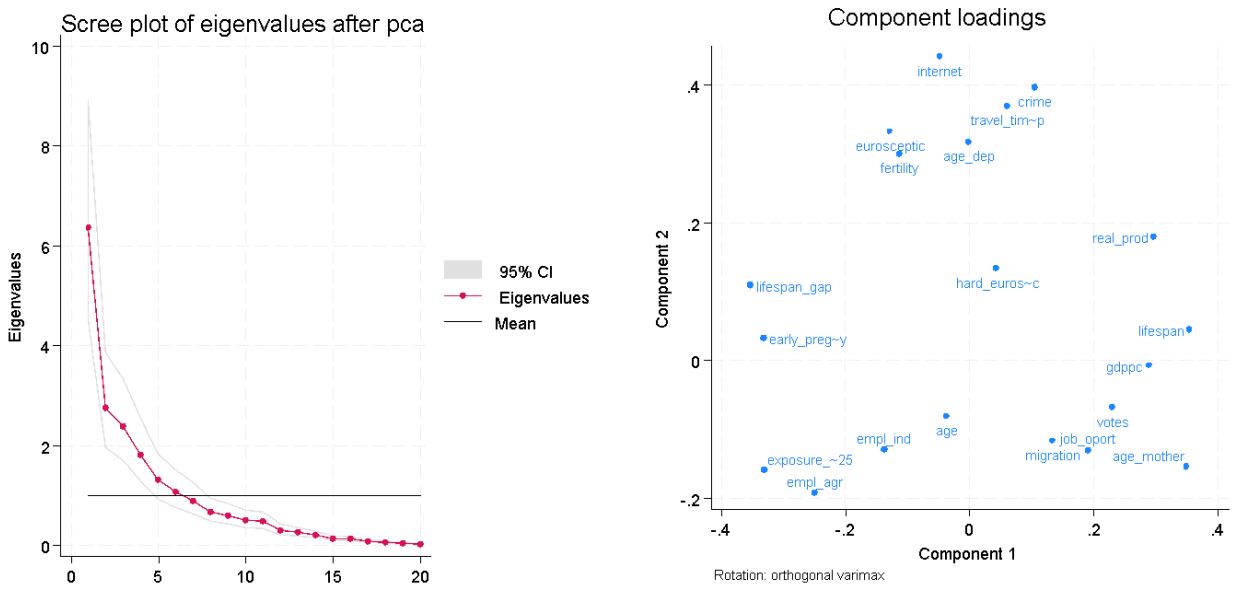


Figure 7.1. Principal Component Analysis: Scree Plot and Variable Loadings of the first two components (Varimax Rotation). Rural NUTS2 regions with the restricted number of indicators.

The decision of the number of clusters is restricted in this case to match the number of clusters resulting from the wider list of indicators. Still, as shown in **Figure 7.2**, choosing 6 clusters seems a reasonable output. The assignment of every region to one of the six clusters results in a new distribution of regions by every cluster, which can be summarised in the dendrogram reported in **Figure 7.3**, and the map of the final distribution is plotted in **Figure 7.4**.

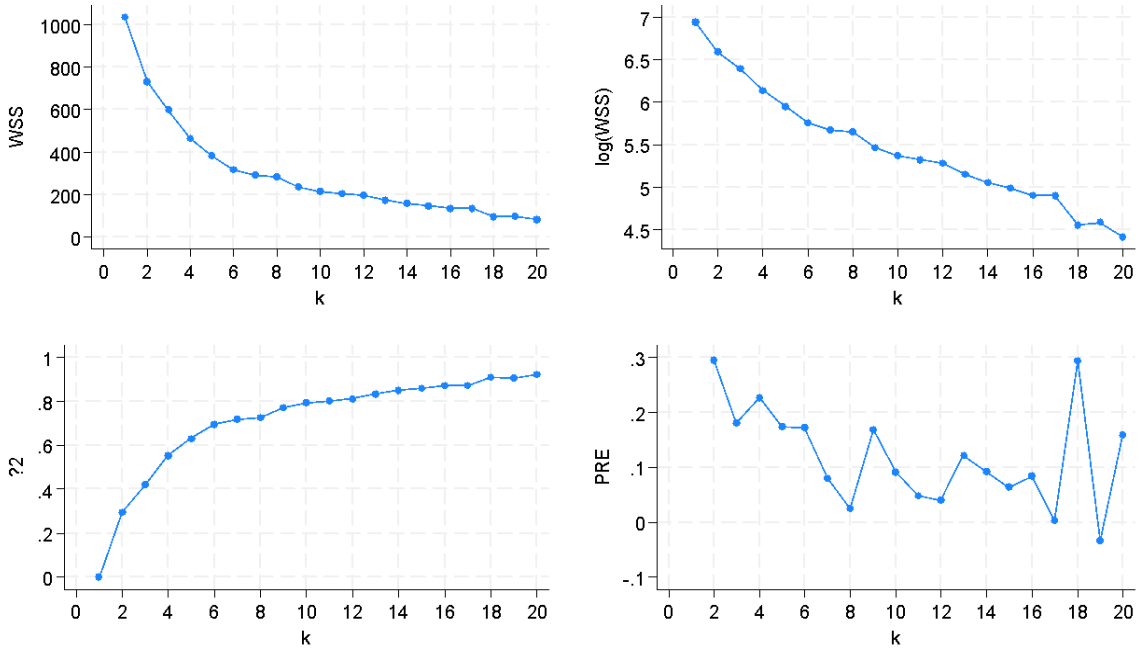


Figure 7.2. Clustering Evaluation Metrics Across Different Numbers of Clusters (k = 2–20). Rural NUTS2 regions with the restricted number of indicators.

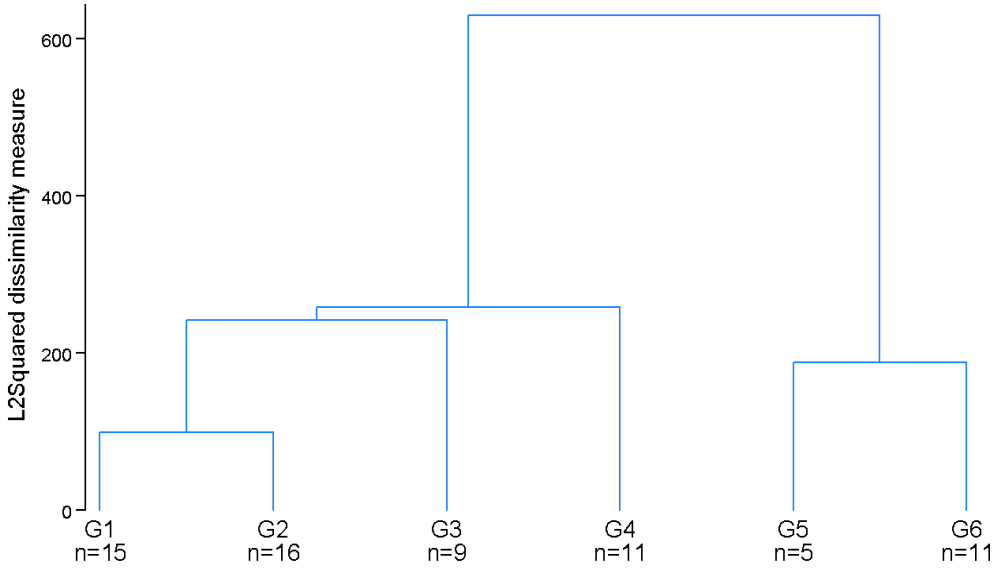


Figure 7.3. Hierarchical Clustering of Rural NUTS2 regions with the restricted number of indicators: Final 6-Cluster Configuration (Ward's Method) regions.

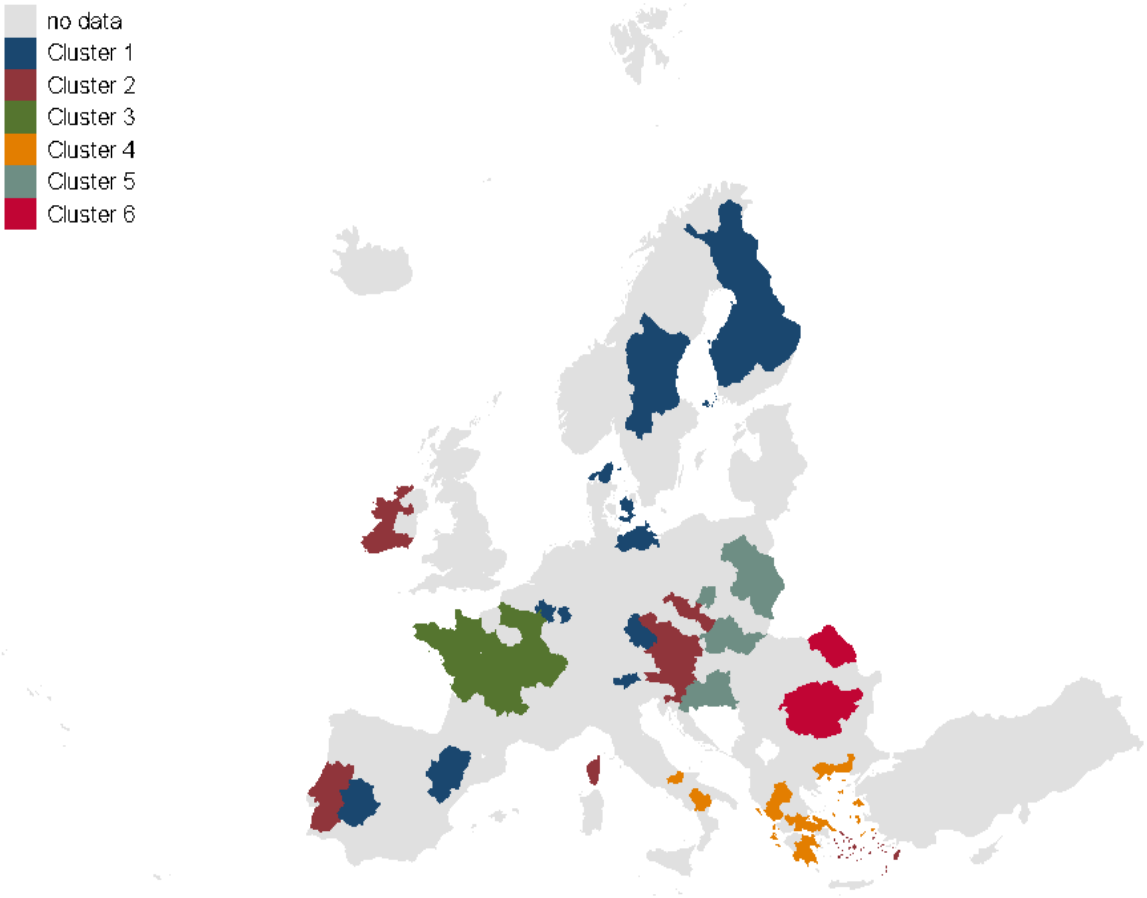


Figure 7.4. Rural typologies – NUTS2 regions with the restricted number of indicators.

7.2. Comparison between alternative typologies

Here we describe the results of the comparison between the typologies' assignment considering the full list of indicators at the NUTS2 level and the alternative NUTS2 typology considering the restricted list of indicators, the one available for NUTS3 regions, which from now on we label as the "restricted" typology.

Table 7.1 provides the detailed cross-tabulation between the full typology (based on the complete set of indicators at NUTS2 level) and the restricted typology (based on the reduced indicator set, also applicable at NUTS3). The results show that, while there is substantial alignment between the two approaches, some mismatches emerge. There are two highly consistent clusters, cluster 3 and 6 shows full alignment in both cases, with all regions consistently classified. These cases suggest that certain structural patterns are robust to the choice of indicator set. However, we observe a partial alignment in clusters 1, 2, 4 and 5. All in all, out of 67 NUTS2 regions, a majority remain consistent across typologies, but roughly one-third are reassigned to a different cluster when the restricted indicator set is used.

Figure 7.6 illustrates these patterns visually, highlighting where clusters remain stable and where the restricted typology produces divergences.

Table 7.1. Cross-tabulation Between Full and Restricted Cluster Typologies (NUTS2 Regions).

NUTS2 Typology	Restricted typology: Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	
Cluster 1	10	5	0	0	0	0	**15**
Cluster 2	5	5	0	0	0	0	**10**
Cluster 3	0	0	11	0	0	0	**11**
Cluster 4	0	4	0	0	11	0	**15**
Cluster 5	1	1	0	9	0	0	**11**
Cluster 6	0	0	0	0	0	5	**5**
	16	**15**	**11**	**9**	**11**	**5**	**67**

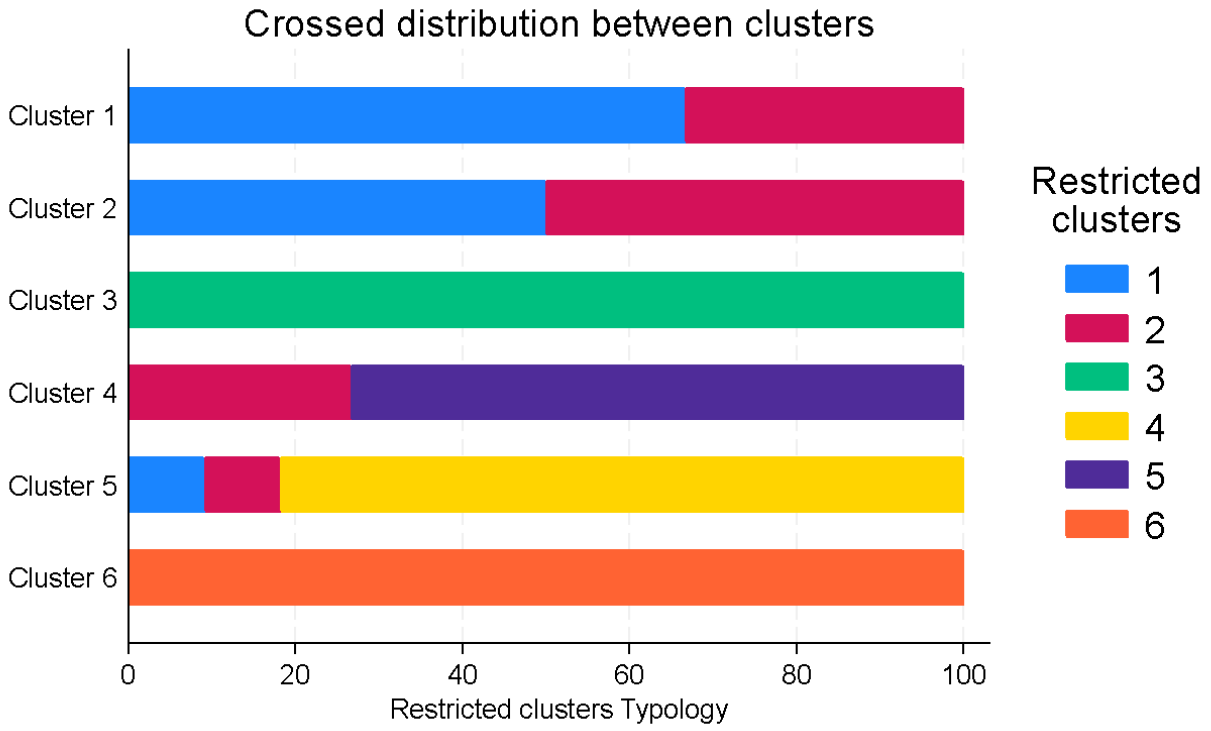


Figure 7.5. Alignment Between Full and Restricted Clustering of NUTS2 Regions.

The list of regions showing a potential change in cluster assignment is presented in **Table 7.2**. It is important to recall that the numbering of clusters follows the average level of the first principal component (PC1), which captures overall wellbeing and socioeconomic advantage. Therefore, when a region moves from Cluster 1 in the full typology to Cluster 2 in the restricted typology, this represents a relative ***downgrade***, while movement in the opposite direction implies an ***upgrade***.

As shown in the table, several regions are *upgraded* in the restricted typology, moving from Cluster 2 to Cluster 1, or from Clusters 4 and 5 to Clusters 1 or 2. These changes suggest that certain characteristics related to social exclusion or wellbeing are underestimated when only the restricted set of indicators is used, resulting in a more favourable classification. This applies to several Eastern

European regions (such as Vzhodna Slovenija, Střední Morava, Severovýchod, and Jihozápad), as well as some Southern European regions, including Extremadura (Spain) and Νότιο Αιγαίο (South Aegean, Greece).

Conversely, a small number of regions appear to be *downgraded* when only the restricted set of indicators is used. This includes two Portuguese regions (Alentejo and Centro) and two Irish regions (Southern and Northern and Western), which move from Cluster 1 in the full typology to Cluster 2 in the restricted one. This suggests that their relative advantage is more evident when the full range of indicators is considered—particularly those related to governance, education, or institutional quality.

Table 7.2. Regions with cluster changes between full and restricted typologies (NUTS2).

NUTS2	Region name	Cluster	Restricted Cluster
PT18	Alentejo	Cluster 1	2
PT16	Centro (PT)	Cluster 1	2
IE05	Southern	Cluster 1	2
IE04	Northern and Western	Cluster 1	2
FRM0	Corse	Cluster 1	2
ITH1	Provincia Autonoma di Bolzano/Bozen	Cluster 2	1
DEB2	Trier	Cluster 2	1
DE80	Mecklenburg-Vorpommern	Cluster 2	1
DE23	Oberpfalz	Cluster 2	1
DE22	Niederbayern	Cluster 2	1
SI03	Vzhodna Slovenija	Cluster 4	2
CZ07	Střední Morava	Cluster 4	2
CZ05	Severovýchod	Cluster 4	2
CZ03	Jihozápad	Cluster 4	2
ES43	Extremadura	Cluster 5	1
EL42	Νότιο Αιγαίο	Cluster 5	2

Despite these reassignments, the association between both classifications is very strong, with a Cramér's V of 0.835 (where a value of 1 indicates perfect agreement). Overall, this confirms that both typologies are largely consistent, but also that relying solely on a restricted list of indicators may lead to biased reclassifications—especially in regions with more complex or nuanced territorial profiles.

Another measure of consistency is the comparison of the average values of the first three principal components—derived from the full list of Social Exclusion and Wellbeing indicators—across clusters defined by the Full Typology and those defined by the Restricted Typology. **Figure 7.6** (panels a to c) displays this comparison. The correlation between the two typologies is very high for the first principal component (0.98) and strong for the third (0.94). In contrast, the second component shows a negative correlation (–0.69), suggesting substantial differences in the grouping of regions for that dimension.

Specifically, the second principal component—labelled Labour Market Structure and Social Risk—is characterised by high loadings on variables such as participation in education and training, self-harm, alcoholism, and gender disparities in mental health. These indicators are not included in the restricted list and therefore do not inform the construction of the Restricted Typology. As a result, a key dimension influencing the differentiation of rural territories is absent, leading to a weakened and potentially biased classification of social exclusion and wellbeing under the restricted indicator set.

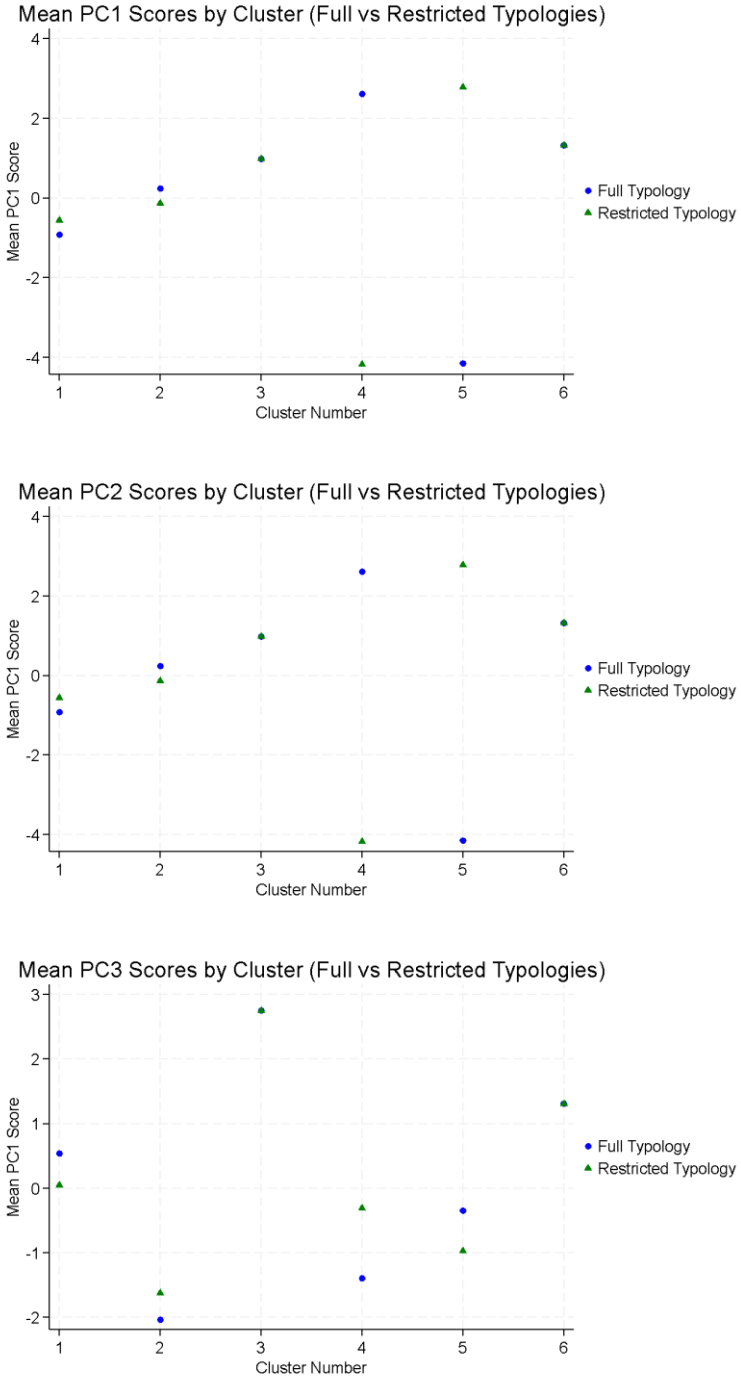


Figure 7.6. Mean Principal Component Scores by Cluster under Full and Restricted Typologies. NUTS2 regions.

The comparison between the Full and Restricted Typologies at the NUTS2 level reveals that, while both approaches produce broadly consistent classifications, the inclusion of a wider set of indicators significantly enhances the capacity to capture complex territorial realities related to social exclusion and wellbeing. The high level of agreement between typologies (Cramér's V = 0.835) confirms their overall coherence, yet relevant mismatches in cluster assignment underscore the analytical limitations of relying on a reduced set of variables.

In particular, the exclusion of key indicators—such as those related to mental health, education and training, and gender disparities—alters the classification of several regions, especially in Eastern and Southern Europe. These discrepancies are most evident in the second principal component, associated with labour market structure and social risk, which shows a negative correlation between the two typologies. As a result, some regions appear either artificially upgraded or downgraded when essential dimensions of disadvantage are omitted.

These findings suggest that, although the restricted typology allows for greater spatial granularity, it comes at the cost of reduced diagnostic power. The full indicator set, despite being applicable only at the NUTS2 level, offers a more robust and nuanced basis for developing territorial classifications and informing policy. For strategic assessments of rural exclusion and wellbeing, prioritising indicator richness over spatial precision may ultimately lead to better-targeted and more effective interventions.

8. INSPIRE Pilot Regions

Next, we describe the assignment of the pilot regions of the INSPIRE project to each of the resulting clusters (**Figure 8.1**). First, it is important to highlight that not all piloting regions correspond to Eurostat's rural classification of either NUTS3 or NUTS2. This is not surprising: since our pilots were defined at a spatially narrow scale, administrative boundaries may naturally overlap with a different rural–urban typology when moving to higher levels of aggregation.

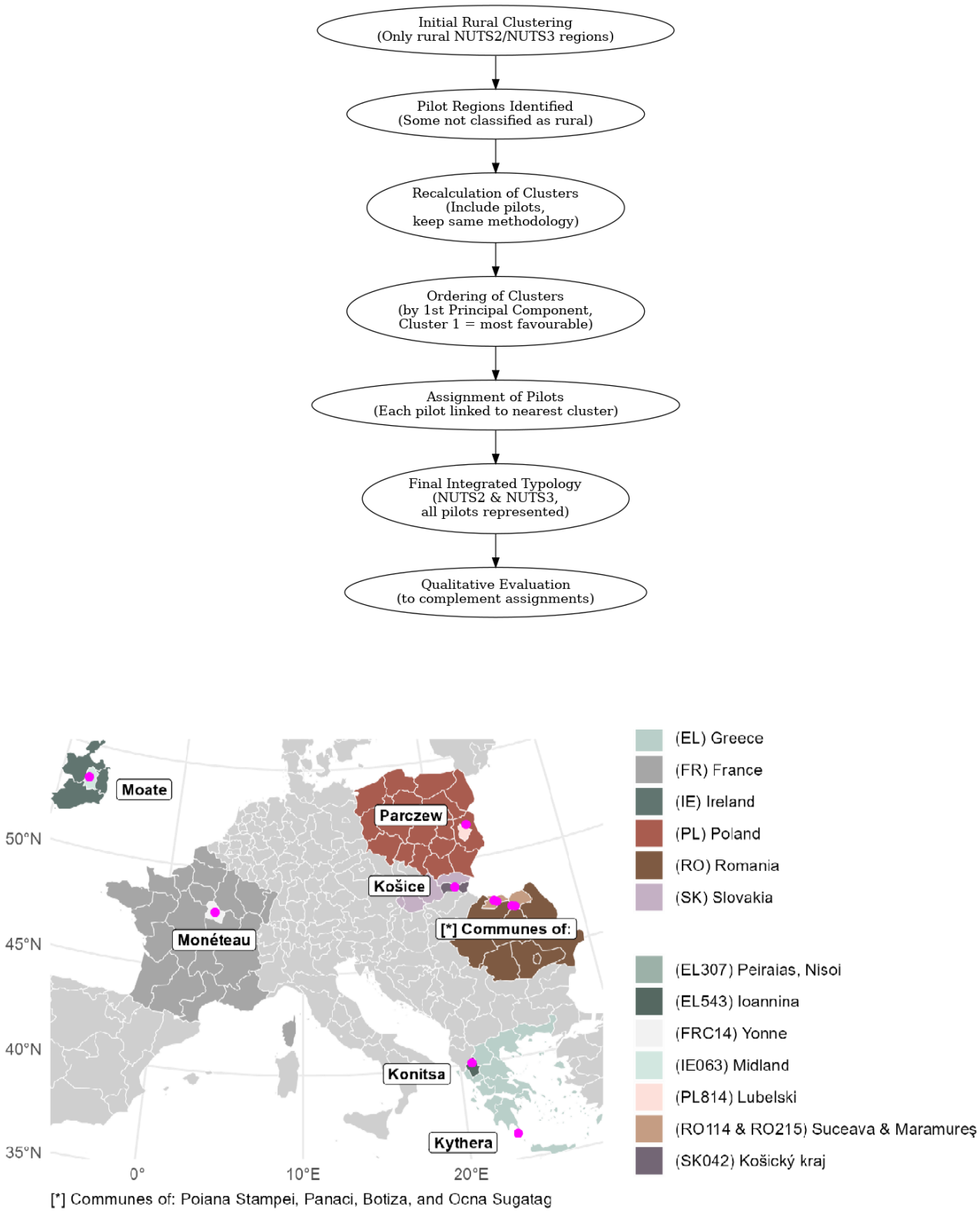
When the rural typologies were first constructed, we deliberately focused only on those NUTS2 and NUTS3 regions that had been classified as rural. This gave us a clear and coherent set of clusters reflecting different patterns of rural inclusion and exclusion. However, once we turned to the pilot regions, the mismatch with the rural definition required a careful methodological solution.

Our chosen approach has been to preserve the integrity of the initial typology, while ensuring that all pilots could be consistently positioned within it. To do so, we recalculated the clustering solution including the pilot regions—treating them as if they were rural—while keeping strictly the same methodological framework: the number of principal components, the dimensionality reduction procedure, and the number of clusters were not modified. The same process was applied both at the NUTS3 and the NUTS2 scales.

Naturally, the inclusion of additional regions introduces some small discrepancies, as new observations slightly reshape the statistical structure. However, the main rationale of the results remains robust. To make interpretation clearer, the new clusters were ordered according to the first principal component, with Cluster 1 representing the most favourable position (lowest level of social exclusion) and higher-numbered clusters indicating greater vulnerability.

This allowed us to assign each non-rural pilot region to the cluster it naturally joined in the extended classification. In practice, this means that the pilots inherit the "level" of social exclusion of their assigned cluster, thus ensuring that all of them—whether rural or not—are represented within the same comparative framework.

Finally, we provide the results of these assignments at both NUTS3 and NUTS2 levels. As expected, some pilots are associated with mixed patterns when moving across scales, which suggests the importance of complementing the quantitative classification with a qualitative evaluation of the final assignments.



Source: INSPIRE project – Deliverable 1.2

Figure 8.1. Spatial Allocation of the Pilot Areas.

The situation of the pilot regions in relation to the rural typologies shows notable differences depending on the territorial level considered and on whether the regions were classified as rural, intermediate or urban.

In France, the case of **Yonne** is straightforward. At both the NUTS2 and NUTS3 levels the region was classified as rural from the outset and was stably assigned to the same group. In both cases it belongs to Cluster 3, which demonstrates full consistency and no alteration when the clusters were recalculated to incorporate the remaining pilot regions.

In Greece, two contrasting realities emerge. **Peiraias, Nisoi**, classified as urban at both levels, was not part of the initial analysis. This region corresponds to the wider Attica area, which includes the Athens metropolitan core, the port of Piraeus and the surrounding islands. Only after the inclusion exercise was it given a place in the typology: at NUTS2 it became part of Cluster 2, while at NUTS3 it was placed in Cluster 4. Its position reflects the difficulty of situating a predominantly urban area within a framework designed for rural regions, but it nonetheless ensures consistency across the typology. By contrast, **Ioannina**, classified as rural at NUTS2 level, was part of the typology from the start, belonging to Cluster 5. At NUTS3, however, the situation differs: it had no initial assignment (it is classified as intermediate at this spatial scale) and after the integration, it is assigned to Cluster 4, showing some variability depending on the scale of analysis.

In Ireland, the **Eastern and Midlands Region** also displays differences by territorial level. This NUTS2 unit corresponds to the Eastern and Midland region, which incorporates Dublin and its metropolitan area alongside surrounding counties. At NUTS2, after the integration it has been placed in Cluster 1, the most favourable group in terms of social exclusion. At NUTS3, however, the region was already in Cluster 2 from the beginning, as it is classified as rural at this spatial scale.

The Polish case of **Dębowa Kłoda – Lubelskie** also illustrates this duality. At NUTS2 it is classified as rural, and the assigned typology of social exclusion corresponds to Cluster 4. At NUTS3, however, the region is classified as intermediate, and our later assignment places the region at Cluster 6, a more vulnerable group, suggesting a certain discrepancy between levels.

In Romania, the regions of **Suceava** and **Maramureș** are clearly rural, and the classification holds both at NUTS2 and NUTS3 levels. Consequently, there is no change in their assignment to Cluster 6 at NUTS2 level and Cluster 7 at NUTS3 level.

Finally, in Slovakia, **Košický kraj** is an example of an intermediate region not included in the initial classification in any of the initial scales of analysis. At both NUTS2 and NUTS3 it lacked a cluster assignment, but with the extended typology it has been consistently placed in Cluster 5 at both levels. This result demonstrates internal coherence and allows the region to be fully integrated into the analytical framework (**Table 8.1**).

Table 8.1. Classification and Cluster Allocation of Pilot Regions (NUTS2 & NUTS3).

Region – NUTS2	**Regional classification**	**Initial NUTS2 typology**	**Final NUTS2 typology**
Yonne (FRC1)	Rural	Cluster 3	Cluster 3
Peiraias, Nisoi (EL30)	Urban	---	Cluster 2
Ioannina (EL54)	Rural	Cluster 5	Cluster 5
Eastern & Midlands (IE06)	Intermediate	---	Cluster 1
Dębowa Kłoda – Lubelskie (PL81)	Rural	Cluster 4	Cluster 4
Suceava (RO21)	Rural	Cluster 6	Cluster 6

Maramureș (RO11)	Rural	Cluster 6	Cluster 6
Košický kraj (SK04)	Intermediate	---	Cluster 5

Region – NUTS3	**Regional classification**	**Initial NUTS3 typology**	**Final NUTS3 typology**
Yonne (FRC14)	Rural	Cluster 3	Cluster 3
Peiraias, Nisoi (EL307)	Urban	---	Cluster 4
Ioannina (EL543)	Intermediate	---	Cluster 4
Eastern & Midlands (IE063)	Rural	Cluster 2	Cluster 2
Dębowa Kłoda – Lubelskie (PL814)	Intermediate	---	Cluster 6
Suceava (RO215)	Rural	Cluster 7	Cluster 7
Maramureș (RO114)	Rural	Cluster 7	Cluster 7
Košický kraj (SK042)	Intermediate	---	Cluster 5

Overall, intermediate and urban regions acquire a defined position after the integration procedure. This procedure ensures that all pilot regions, regardless of their starting point, are incorporated into the common typology and can be analysed on consistent grounds. Next, we describe the characteristics of every pilot region and its corresponding cluster.

8.1. Region 1. Yonne (FRC14)

The Yonne region is mainly rural: 95 of the region's 113 inter-communities are rural and are home to 55% of the population. According to the official classification of the European Commission, the corresponding NUTS3 regions is defined as rural, while according to the work from Vaisanen et al. (2024) it is also a rural region. Its profile offers a picture of a traditional rural area, displaying both convergence with its cluster peers and some divergences when compared with the national and broader European averages (**Figure 8.2, Figure 8.3,** and **Table 8.1**).

Economic performance and labour market: At NUTS3, Yonne's GDP per capita in PPS stands at €30,092, very close to its cluster's average (€30,298). At NUTS2, the figure rises to €33,717, above the cluster average (€32,608) but still below the French mean (€32,403) and well under the European average of all regions (€37,512). Productivity per hour tells a more positive story: €46.9 at NUTS3 and €48.4 at NUTS2, compared with 44.0 and 47.3 for their respective clusters. These values are close to the French benchmark (€47.9) and well above the rural regions' average (€34.5). In short, Yonne shows solid productivity, especially at the local NUTS3 level, despite modest income levels.

Job opportunities (0.68 at NUTS3, 0.70 at NUTS2) are slightly below the national mean (0.70) but higher than the rural average (0.67). Agriculture plays a larger role than in the rest of France: 6% of employment at NUTS3 versus 4% in its cluster and only 3% nationally. Industry is also significant (14% at NUTS3, 12% at NUTS2), above the national 10% and closer to the European all-regions average (16%). These figures highlight a dual economy, rooted in traditional rural activities but with some industrial presence.

At NUTS2, the unemployment rate is 7.3%, above the national figure (6.4%) but below the cluster (8.6). The employment rate (75.4%) nearly mirrors the French national average (75.4). The employment gender gap is strikingly low: just 1.1 percentage points in Yonne compared with 5.6 in its cluster and over 10 nationally. Net disposable income per capita (€19,100) is higher than both the

cluster (€18,891) and rural regions (€16,149), and also above the French mean for rural areas (€17,423), confirming decent household income levels.

Social conditions: The risk of poverty is 13.5%, lower than both cluster (18.2%) and national rural averages (16.2). Severe material and social deprivation is at 6%, in line with the national rate and slightly below the rural average (6.8). NEET rates (12.7%) are above the French average (11.3) but lower than the cluster's 14.4. Overall, social vulnerability appears moderate.

Demographics and migration. Yonne is an ageing region. Its median age is 47.2 years, above both cluster (46.7) and national averages (42.6). The age dependency ratio is very high at 72.9, compared with 65.2 nationally. Fertility (1.9) is slightly above the French average, but net migration is weak (1.6‰), far below the national mean (7.2‰). This combination of ageing and limited inflows signals long-term demographic challenges.

Health and environment. Life expectancy is high (82.1 years), slightly above the national figure (81.4) and cluster average (81.7). Infant mortality is lower than the cluster (2.6 vs. 4.3 per 1,000), suggesting relatively good health services. Environmental exposure is favourable: PM2.5 levels of 78.8 are far lower than the French average (132.7) and even below the rural mean (89.3).

Education and governance. Educational attainment is strong, with secondary education at 46.6% and tertiary at 36.4%, above the French rural mean (30.5%). Participation in lifelong learning is also higher than both cluster and national rural averages. Politically, however, Yonne stands out for its high Euroscepticism: 55.9% of votes fall into this category, well above the French average (40.7). Hard Eurosceptic votes (30.1%) are equally striking. Electoral turnout is relatively low (49.9%), but the Quality of Government index (0.46) is higher than the rural mean (0.05), pointing to robust institutions despite political disaffection.

Overall, Yonne combines solid productivity, balanced incomes, good education and strong governance with significant demographic pressures and high Euroscepticism. It remains a rural territory with relatively favourable living standards yet constrained by ageing and limited demographic renewal.

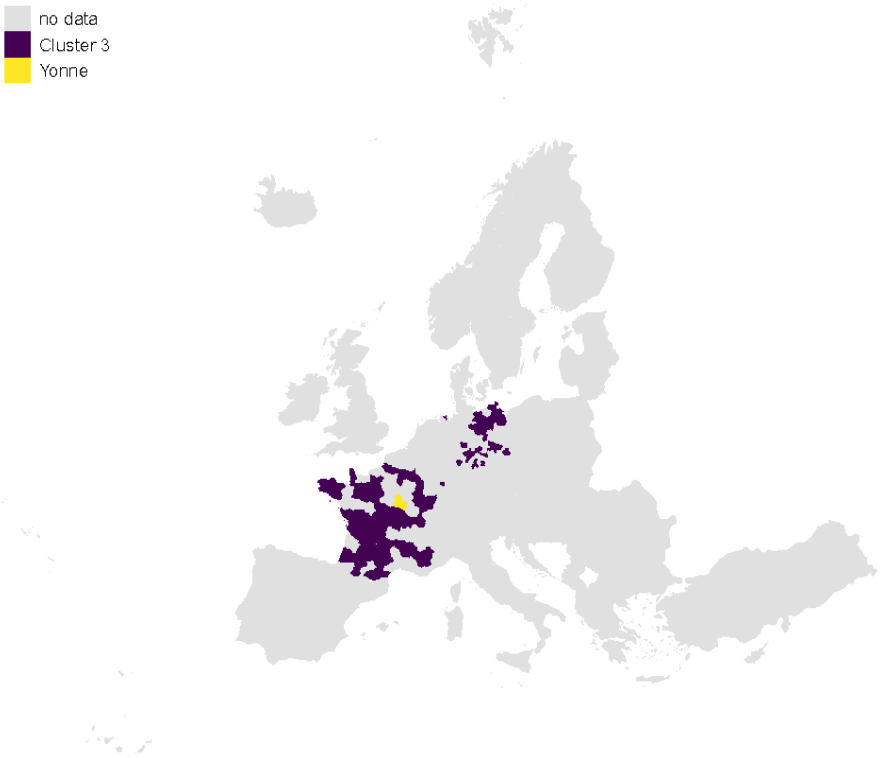


Figure 8.2. NUTS3. Cluster 3 – Ageing Peripheral economies with social disaffection

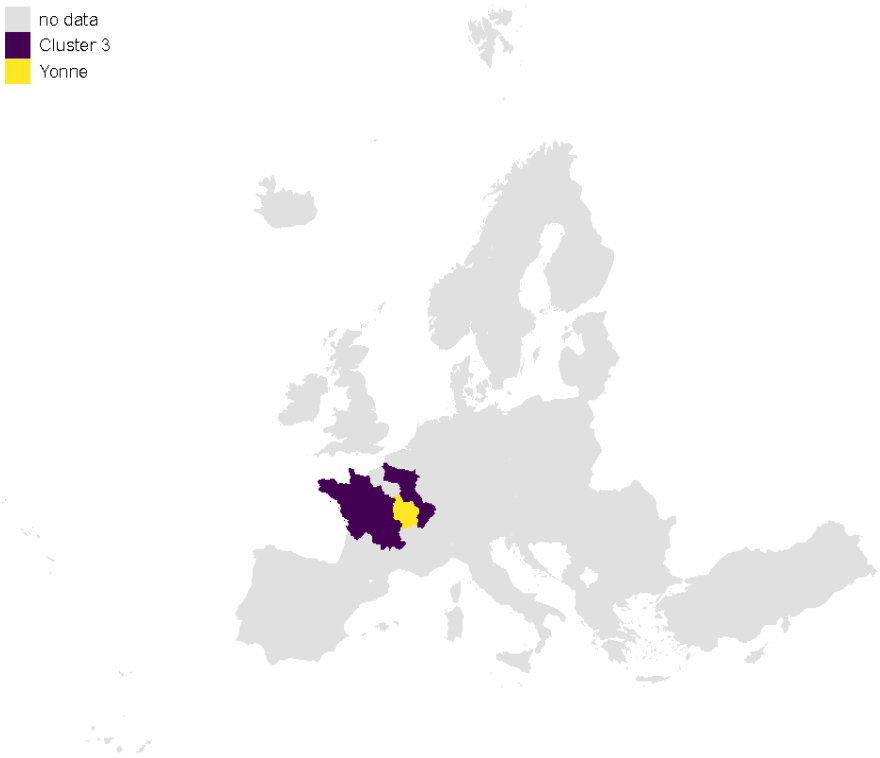


Figure 8.3. NUTS2. Cluster 3 – Stable but ageing territories with moderate inclusion.

Table 8.2. Comparative Indicators for Yonne (FRC14/FRC1): Regional Indicators across NUTS3, NUTS2, National and European Averages.

	NUTS3		NUTS2				
	Pilot Region FRC14	Cluster 3	Pilot Region FRC1	Cluster 3	Pilot Country FR	Rural regions	All regions
GDP per capita in PPS	30092	30298	33717	32608	32403	31768	37512
Real Productivity per Hour	46.9	44.0	48.4	47.3	47.9	34.5	38.9
Job Opportunities	0.68	0.73	0.70	0.70	0.67	0.72	0.76
Employment in Agriculture	0.06	0.04	0.05	0.05	0.03	0.09	0.05
Employment in Industry	0.14	0.16	0.12	0.13	0.10	0.18	0.16
Employment in Science and Technology			35.1	34.3	34.8	29.8	34.0
Unemployment Rate			7.3	6.6	8.6	6.4	6.2
Employment Rate			75.4	75.3	71.4	74.5	75.4
Employment Rate Gender Gap			1.1	4.8	5.6	10.2	9.8
Net Disposable Income per capita in PPS			19100	18891	17581	16149	17423
NEET Rate			12.7	12.2	14.4	12.5	11.3
At Risk of Poverty			13.5	13.0	18.2	16.2	16.3
Work Intensity			8.1	7.7	11.7	7.0	8.1
Severe material and social deprivation			6.0	6.0	8.2	6.8	6.8
Population living in <15 min from hospital	73.9	80.2	86.2	83.5	86.7	67.2	78.9
Exposure PM2.5	78.8	94.7	106.5	135.2	132.7	89.3	105.2
Internet Connectivity	18.9	27.7	18.6	23.6	26.8	54.4	53.3
Fertility Rate	1.9	1.7	1.7	1.7	1.9	1.5	1.5
Median Age	47.2	49.5	46.7	45.2	42.6	45.6	44.6
Age Dependency Ratio	72.9	70.4	70.1	67.7	65.2	60.5	57.7
Average age of mother at birth	30.0	30.1	30.5	30.5	30.5	30.6	31.0
Early Pregnancy	0.018	0.022	0.017	0.018	0.026	0.026	0.022
Crude rate of net migration	1.6	1.3	2.1	2.6	1.7	4.7	7.2
Lifespan	82.1	82.2	81.7	81.8	81.4	80.1	80.4
Lifespan gender gap	5.3	5.4	6.2	6.2	5.8	5.8	5.3
Mental Health			27.6	31.6	29.9	32.5	38.4
Infant Mortality			2.60	3.49	4.29	3.19	3.21
Deaths from Alcoholism			4.46	4.96	4.33	4.25	3.76
Intended self-harm			13.6	17.5	13.6	11.8	10.6
Gender gap in Intended self-harm			17.5	21.7	16.8	15.8	13.0
Secondary Educational Attainment			46.6	47.1	43.3	51.5	46.5
Tertiary Educational Attainment			36.4	36.7	36.5	30.5	33.9
Gender Gap in Tertiary Education			7.2	7.3	7.0	8.1	6.6
Participation in education and training			15.3	13.9	13.3	11.3	12.8
Criminality (robberies)	38.5	31.9	35.3	40.7	95.4	20.8	45.6
Eurosceptic votes	55.9	36.5	51.5	49.3	40.7	27.9	26.5
Hard Eurosceptic votes	30.1	20.6	23.6	20.6	17.9	13.0	13.2
Electoral Turnover	49.9	60.3	50.0	50.4	45.5	61.2	65.2
Quality of Government Index			0.46	0.52	0.24	0.05	0.11

8.2. Region 2. Peiraias. Nisoi (EL307)

According to Eurostat, Peiraia, Nisoi is classified as a predominantly urban, coastal, and mountainous area within the wider region of Attica (EL30). Located in southern Greece between the central and eastern Mediterranean, the region encompasses both mainland and insular territories. Among its islands, the municipality of Kythera is particularly noteworthy, as it has been designated as one of the project's pilot municipalities and is classified as a remote and less-favoured rural area (**Figure 8.4**, **Figure 8.5** and **Table 8.3**).

Economic performance and labour market: At the NUTS3 level, per capita income in PPS recorded €29,007, slightly above the cluster average (€27,419). At NUTS2, the figure amounted to €35,667;

however, it remained below both the cluster average (€42,719) and the European mean (€37,512). Labour productivity registered €22.7 at NUTS3, marginally below the cluster reference (€26.0), and €24.5 at NUTS2, considerably below the cluster benchmark (€48.4). Although these values exceeded the national average (€17.5), they fell well short of the European mean level (€38.9).

Labour market opportunities at NUTS3 recorded 0.70, slightly below the national average (0.75), whereas at NUTS2 the value stood at 0.79, marginally above it. Agricultural employment accounted for only 1% in both cases, far below the national average (16%). By contrast, industry represented 8% of employment at NUTS3 and 9% at NUTS2, substantially below the European rural average (18%). The limited weight of these sectors points to an economy based in services, consistent with the coastal profile of the region and the potential importance of tourism.

At NUTS2, unemployment registered 9.4%, slightly lower than the national rate (11.6%). The employment rate (69.0%) amounted to a level somewhat higher than the national figure but nonetheless remained below the European mean (75.4%). Gender inequality in employment measured 15.6 percentage points, a figure lower than the national benchmark (21.1 pp) yet significantly above the European reference (9.8 pp). Net disposable income per capita (€15,100) surpassed the national average (€12,562) and approached the rural European mean (€16,149).

Social conditions: The poverty rate registered 14.2%, higher than the cluster average (11.2%). Severe material and social deprivation affected 14.6% of the population, far above the cluster figure (3.2%). In line with these results, the NEET rate amounted to 14%, compared with 8.1% in the cluster. Although the region performed better than the national average in certain aspects, it consistently lagged behind both the cluster and the average of rural European regions, indicating a moderate level of social conditions.

Demographics and migration: The region is embedded in a process of demographic ageing. Median age recorded 45.9 years, while the fertility rate (1.2) remained below the national level (1.4). The age dependency ratio (52.9) stood below the European average (57.7). Nonetheless, this figure is at risk of diminishing in the medium and long term, given the persistently low fertility rate and limited immigration inflows (2.0‰ compared with 7.2‰ in Europe).

Health and environment: Life expectancy recorded 80.9 years, slightly above the European average (80.4). Infant mortality registered 3.40 per 1,000, a value close to the European reference (3.21). Moreover, exposure to air pollutants remained particularly low (40.6), far below the European regional average (105.2).

Education and governance: Educational attainment reached comparatively high levels: 43.7% of the population reported tertiary qualifications and 45.7% secondary, with the former significantly above the European average (33.9%). In contrast, participation in lifelong learning amounted to only 3.4%, well below the European mean (12.8%). Social indicators revealed crime levels above the European rural average (56.8 versus 20.8), a pattern that persisted at NUTS3 and reflected the urban character of the region. Political participation remained relatively weak, with voter turnout at 56.1% at NUTS2 and 51.0% at NUTS3, both below the European rural average (61.2%). Moreover, deeper signs of social disaffection appeared in electoral behavior, as Eurosceptic or strongly Eurosceptic parties obtained 24.1% of the vote at NUTS3 and 22.1% at NUTS2. Finally, institutional quality registered a governance score of –1.30, compared with 0.11 in Europe.

Overall, the region displayed the characteristics of a medium-income, service-oriented economy with relatively low productivity and some evidence of social discontent. Although it outperformed national averages in several dimensions, advantages in human capital were not matched by institutional strength. Consequently, this imbalance may generate long-term vulnerabilities, particularly through the combined effects of economic stagnation and demographic stress.

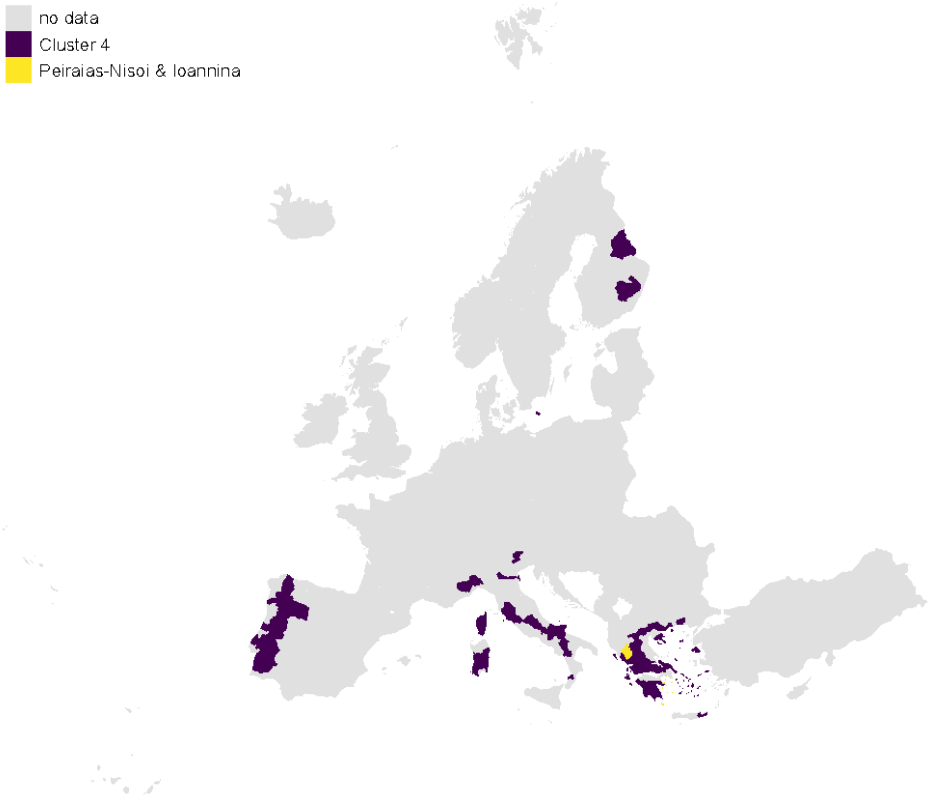


Figure 8.4. NUTS3. Cluster 4 – Remote and fragile territories.

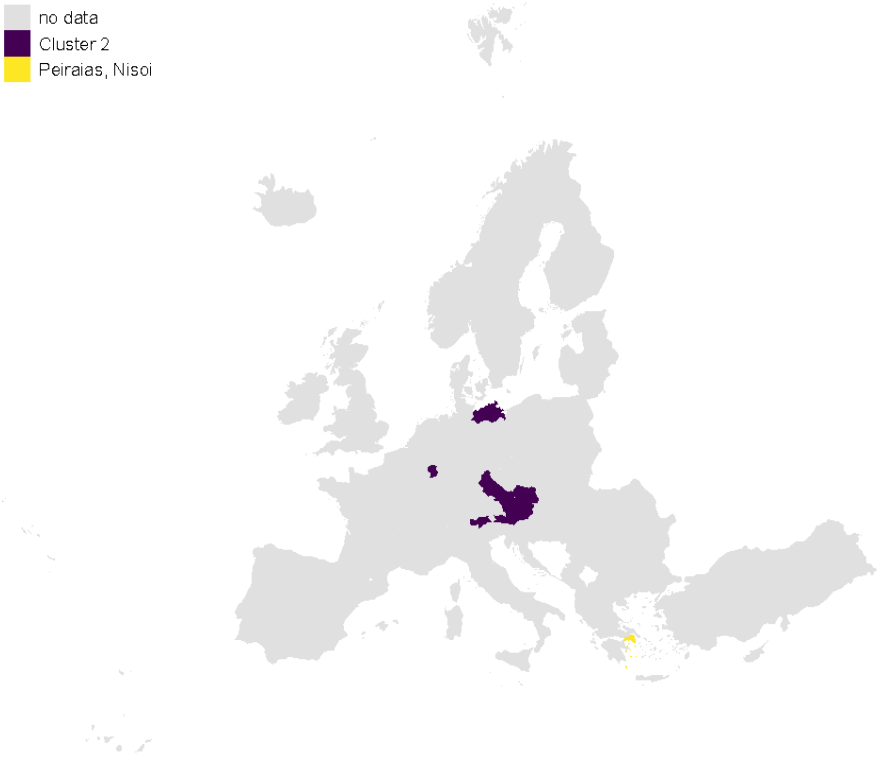


Figure 8.5. NUTS2. Cluster 2 – Prosperous industrial regions with moderate social risks.

Table 8.3. Comparative Indicators for Peiraias, Nisoi (EL307/EL30): Regional Indicators across NUTS3, NUTS2, National and European Averages.

	NUTS 3		NUTS 2				
	Pilot region EL307	**Cluster 4**	**Pilot Region EL30**	**Cluster 2**	**Pilot Country EL**	**Rural regions**	**All regions**
GDP per capita in PPS	29007	27419	35667	42719	24267	31768	37512
Real Productivity per Hour	22.7	26.0	24.5	48.4	17.5	34.5	38.9
Job Opportunities	0.70	0.72	0.79	0.80	0.75	0.72	0.76
Employment in Agriculture	0.01	0.15	0.01	0.04	0.16	0.09	0.05
Employment in Industry	0.08	0.12	0.09	0.19	0.09	0.18	0.16
Employment in Science and Technology			34.1	35.2	20.8	29.8	34.0
Unemployment Rate			9.4	3.5	11.6	6.4	6.2
Employment Rate			69.0	80.2	66.8	74.5	75.4
Employment Rate Gender Gap			15.6	7.1	21.1	10.2	9.8
Net Disposable Income per capita in PPS			15100	22750	12562	16149	17423
NEET Rate			14.0	8.1	17.9	12.5	11.3
At Risk of Poverty			14.2	11.2	20.7	16.2	16.3
Work Intensity			7.7	5.3	8.0	7.0	8.1
Severe material and social deprivation			14.6	3.2	12.2	6.8	6.8
Population living in <15 min from hospital	88.7	54.8	97.2	76.8	59.5	67.2	78.9
Exposure PM2.5	39.3	58.7	40.6	67.3	28.0	89.3	105.2
Internet Connectivity	122.3	48.2	111.5	36.7	78.1	54.4	53.3
Fertility Rate	1.3	1.3	1.2	1.5	1.4	1.5	1.5
Median Age	46.2	49.9	45.9	46.4	47.1	45.6	44.6
Age Dependency Ratio	53.2	65.0	52.9	56.2	60.0	60.5	57.7
Average age of mother at birth	32.1	31.7	32.8	31.0	31.6	30.6	31.0
Early Pregnancy	0.016	0.019	0.018	0.012	0.026	0.026	0.022
Crude rate of net migration	4.2	4.8	2.0	3.1	1.2	4.7	7.2
Lifespan	80.3	83.0	80.9	81.3	81.1	80.1	80.4
Lifespan gender gap	5.6	4.8	4.8	4.8	5.3	5.8	5.3
Mental Health			22.9	47.6	22.7	32.5	38.4
Infant Mortality			3.40	2.37	3.44	3.19	3.21
Deaths from Alcoholism			0.30	5.27	0.56	4.25	3.76
Intended self-harm			3.7	12.2	4.4	11.8	10.6
Gender gap in Intended self-harm			4.7	15.7	7.8	15.8	13.0
Secondary Educational Attainment			45.7	54.8	47.7	51.5	46.5
Tertiary Educational Attainment			43.7	30.3	28.6	30.5	33.9
Gender Gap in Tertiary Education			3.6	-0.3	5.3	8.1	6.6
Participation in education and training			3.4	11.4	3.4	11.3	12.8
Criminality (robberies)	56.8	14.7	56.8	21.1	9.9	20.8	45.6
Eurosceptic votes	24.1	28.6	22.1	15.8	21.4	27.9	26.5
Hard Eurosceptic votes	24.1	20.9	22.1	15.4	21.4	13.0	13.2
Electoral Turnover	51.0	55.0	56.1	75.4	50.9	61.2	65.2
Quality of Government Index			-1.30	0.88	-0.81	0.05	0.11

8.3. Region 3. Ioannina (EL543)

Ioannina region is situated in northwestern Greece, within the Epirus region, in a predominantly mountainous area bordering Albania. According to Eurostat's urban–rural typology, the region is classified as Intermediate. The local economy retains a strong presence of traditional occupations: with an important share of skilled farmers, stockbreeders, fishermen, and craftsmen (**Figure 8.6, Figure 8.7** and **Table 8.4**).

Economic performance and labour market: At the NUTS3 level, per capita income in PPS recorded €19,432, well below the cluster average (€27,419). At NUTS2, the figure amounted to €19,366; however, it remained below both the cluster average (€25,697) and the European mean (€37,512).

Labour productivity registered €15.9 at NUTS3, substantially below the cluster reference (€26.0), and €15.0 at NUTS2, likewise below the cluster benchmark (€22.1). These values were also below the national average (€17.5) and far short of the European level (€38.9).

Labour market opportunities at NUTS3 recorded 0.70, slightly below the national average (0.75), whereas at NUTS2 the value stood at 0.73, closer to but still below it. Agricultural employment accounted for 9% at NUTS3 and 17% at NUTS2, while industry represented 10% and 9%, respectively—both substantially below the European rural average (18%). The employment structure indicates an economy concentrated in services, with agriculture retaining some weight at NUTS2 but industry remaining thin.

At NUTS2, unemployment registered 13.8%, higher than the national rate (11.6%). The employment rate (65.3%) amounted to a level slightly below the national figure (66.8%) and well below the European mean (75.4%). Gender inequality in employment measured 15.9 percentage points, lower than the national benchmark (21.1 pp) yet above the European reference (9.8 pp). Net disposable income per capita (€12,400) was marginally below the national average (€12,562) and considerably short of the rural European mean (€16,149).

Social conditions: The poverty rate registered 16.9%, lower than the cluster average (22.3%) and close to the rural European reference (16.2%). Severe material and social deprivation remained low, affecting 4.4% of the population, below the cluster figure (9.6%). In contrast with these results, the NEET rate amounted to 23.0%, compared with 18.5% in the cluster and 17.9% nationally. Although the region performed better than the cluster on some poverty metrics, youth integration remained comparatively weak.

Demographics and migration: The region is involved in a process of demographic ageing. Median age recorded 49.3 years at NUTS2 (and 47.1 at NUTS3), above the national level (47.1). The age dependency ratio (67.8 at NUTS2; 62.1 at NUTS3) stood above the European average (57.7). Fertility (1.3) remained slightly below the national level (1.4), while net migration inflows (5.9‰ at NUTS2) were below the European reference (7.2‰), underscoring that the ageing profile of the region and the population dynamics could aggravate the age dependency problem that the place is already dealing with.

Health and environment: Life expectancy recorded 82.7 years, above the European average (80.4), with an excellent result obtained at NUTS3 (85.0). Infant mortality registered 4.0 per 1,000, a value higher than the European regional mean (3.21 per 1,000). Moreover, exposure to air pollutants remained particularly low (26.1), below the national level (28.0) and far below the rural European average (89.3).

Education and governance: Educational attainment indicated 43.5% with secondary education and 36.3% with tertiary qualifications at NUTS2, both above the European average (33.9%). Participation in lifelong learning amounted to 2.6%, well below the European mean (12.8%). Social indicators showed robberies well below the European rural average (2.2 versus 20.8). Political participation remained weak, with voter turnout at 51.9% at NUTS2 (and 53.0% at NUTS3), below the European rural average (61.2%). Eurosceptic parties obtained significant support with 18.4% of the vote at NUTS2 (21.4% nationally). Finally, institutional quality registered a governance score of –0.68, compared with 0.11 in Europe.

The region exhibits a moderately low-income economy with subdued productivity, and a sectoral structure in which agriculture outweighs industry. Although several social indicators perform above average, outcomes related to youth and the labour market remain weak. The demographic profile indicates sustained pressures that are unlikely to abate in the short term. Despite human-capital endowments broadly aligned with European standards and comparatively favourable health

outcomes, institutional capacity shows notable shortcomings which—compounded by moderate social discontent—may constrain the region's prospects for progress.

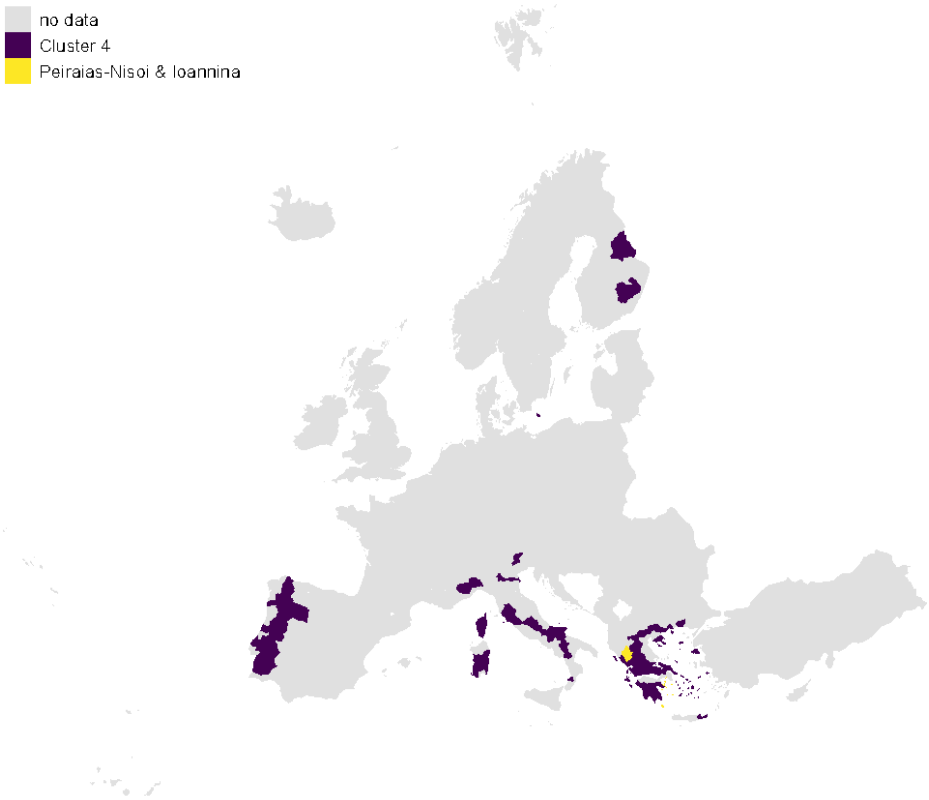


Figure 8.6. NUTS3. Cluster 4 – Remote and fragile territories.

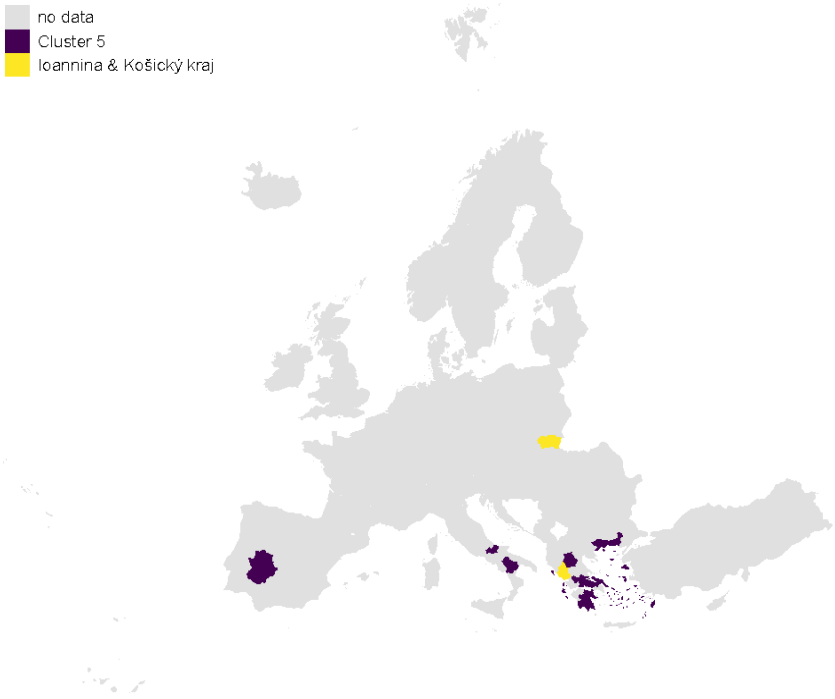


Figure 8.7. NUTS2. Cluster 5 – Lagging southern peripheries with enduring inequalities.

Table 8.4. Comparative Indicators for Ioannina (EL543/EL54): Regional Indicators across NUTS3, NUTS2, National and European Averages.

	NUTS3						
	Pilot region EL543	**Cluster 4**	**Pilot Region EL54**	**Cluster 5**	**Pilot Country EL**	**Rural regions**	**All regions**
GDP per capita in PPS	19432	27419	19366	25697	24267	31768	37512
Real Productivity per Hour	15.9	26.0	15.0	22.1	17.5	34.5	38.9
Job Opportunities	0.70	0.72	0.73	0.71	0.75	0.72	0.76
Employment in Agriculture	0.09	0.15	0.17	0.15	0.16	0.09	0.05
Employment in Industry	0.10	0.12	0.09	0.10	0.09	0.18	0.16
Employment in Science and Technology			23.1	20.5	20.8	29.8	34.0
Unemployment Rate			13.8	11.7	11.6	6.4	6.2
Employment Rate			65.3	65.4	66.8	74.5	75.4
Employment Rate Gender Gap			15.9	21.3	21.1	10.2	9.8
Net Disposable Income per capita in PPS			12400	13236	12562	16149	17423
NEET Rate			23.0	18.5	17.9	12.5	11.3
At Risk of Poverty			16.9	22.3	20.7	16.2	16.3
Work Intensity			5.6	8.2	8.0	7.0	8.1
Severe material and social deprivation			4.4	9.6	12.2	6.8	6.8
Population living in <15 min from hospital	71.2	54.8	57.7	53.9	59.5	67.2	78.9
Exposure PM2.5	27.9	58.7	26.1	47.0	28.0	89.3	105.2
Internet Connectivity	80.0	48.2	73.1	61.9	78.1	54.4	53.3
Fertility Rate	1.3	1.3	1.3	1.3	1.4	1.5	1.5
Median Age	47.1	49.9	49.3	47.9	47.1	45.6	44.6
Age Dependency Ratio	62.1	65.0	67.8	60.1	60.0	60.5	57.7
Average age of mother at birth	32.8	31.7	32.3	31.8	31.6	30.6	31.0
Early Pregnancy	0.010	0.019	0.009	0.022	0.026	0.026	0.022
Crude rate of net migration	11.5	4.8	5.9	1.5	1.2	4.7	7.2
Lifespan	85.0	83.0	82.7	81.5	81.1	80.1	80.4
Lifespan gender gap	4.3	4.8	5.7	5.2	5.3	5.8	5.3
Mental Health			16.3	22.7	22.7	32.5	38.4
Infant Mortality			4.00	3.20	3.44	3.19	3.21
Deaths from Alcoholism			0.24	0.52	0.56	4.25	3.76
Intended self-harm			4.1	4.5	4.4	11.8	10.6
Gender gap in Intended self-harm			5.4	7.9	7.8	15.8	13.0
Secondary Educational Attainment			43.5	45.0	47.7	51.5	46.5
Tertiary Educational Attainment			36.3	25.5	28.6	30.5	33.9
Gender Gap in Tertiary Education			14.6	6.0	5.3	8.1	6.6
Participation in education and training			2.6	5.6	3.4	11.3	12.8
Criminality (robberies)	1.2	14.7	2.2	7.7	9.9	20.8	45.6
Eurosceptic votes	19.6	28.6	18.4	26.5	21.4	27.9	26.5
Hard Eurosceptic votes	19.6	20.9	18.4	20.8	21.4	13.0	13.2
Electoral Turnover	53.0	55.0	51.9	52.1	50.9	61.2	65.2
Quality of Government Index			-0.68	-0.88	-0.81	0.05	0.11

8.4. Region 4. Eastern and Midlands Regions (IE063)

The Midland subregion lies in the east of the country and forms part of the Eastern and Midland Region, one of the nation's four administrative jurisdictions. It is classified as rural; however, when viewed at the NUTS2 scale, aggregate indicators are skewed by the influence of other areas, most notably Dublin. The area is shaped by the Twin Transition, with localities exhibiting peripheral characteristics and a sizeable primary sector that accounts for a substantial share of employment (**Figure 8.8, Figure 8.9,** and **Table 8.5**).

Economic performance and labour market: At NUTS3, Midland's GDP per capita in PPS stands at €22,957, notably below its cluster average (€37,548). At NUTS2, reflecting aggregation with Dublin,

the figure rises to €84,747, more than double the cluster value (€38,696) and above the national mean (€72,926). Productivity per hour shows again a split pattern: 28.6 at NUTS3 versus 48.4 in the cluster, but 99.1 at NUTS2 against a cluster reference of 50.7. In short, Midland combines low income and modest productivity at NUTS3 with very high NUTS2 levels driven by Dublin's inclusion.

Labour market opportunities register 0.68 at NUTS3 and 0.80 at NUTS2, below and above the national average (0.77), respectively. Agriculture accounts for 2% of employment at NUTS2 (national 5%), while its share at NUTS3 is indicated to be higher (7%). Industry represents 13% of jobs at NUTS3 and 9% at NUTS2, compared with 13% nationally. This contributes to a stronger agricultural and industrial footprint locally (NUTS3), with lower shares at NUTS2 due to Dublin's urban weight and influence.

At NUTS2, the unemployment rate reaches 4.5% (national 4.2%), while the employment rate stands at 80.0% (national 78.9%). The employment gender gap amounts to 10 percentage points, well above the cluster average (4.9 pp) and broadly in line with the European reference (9.8 pp). Net disposable income per capita in PPS (17.600) aligns with the European regional average (€17,423).

Social conditions: The risk of poverty amounts to 10.9%, below the national average (13%). Severe material and social deprivation reach 6.7%, slightly above the national reference (5.4%). The NEET rate stands at 8.4%, marginally below the national figure (8.6%). Overall NUTS2 exhibits moderate social vulnerability, potentially influenced by Dublin's inclusion, which may mask intra-regional disparities at more disaggregated scales.

Demographics and migration: The median age remains relatively young, at 38.9 years in NUTS3 and 37.8 years in NUTS2, compared with 44.6 years across European regions. The age-dependency ratio is also lower than the European average (57.7), standing at 54.5 in NUTS3 and 49.3 in NUTS2. Although fertility at NUTS2 is relatively low (1.5), the region compensates through strong net migration inflows (15.3‰ versus 7.2‰ in Europe), which help maintain a younger age structure and ease dependency pressures.

Health and environment: Life expectancy stands at 83.0 years, above the national figure (82.5), accompanied by a low infant mortality (2.6 per 1,000), below the European reference (3.21 per 1,000). By contrast, PM2.5 exposure amounts to 124.9, above the national average (100.0)—likely to reflect greater urban concentration within the NUTS2 aggregate.

Education and governance: Tertiary educational attainment is notably high (58% compared with 33.9% in Europe), with 13.1% of the population participating in lifelong learning. Politically, electoral turnout is moderate at both levels (NUTS3 61.7%, NUTS2 61.6%), with Eurosceptic votes around 4%. Institutional quality is strong: the Quality of Government index stands at 0.92, slightly below the national average (1.04) yet well above the European reference (0.11).

Midland region combines limited productivity and income at NUTS3 with substantially stronger outcomes at NUTS2 owing to Dublin's inclusion. Social indicators are generally favourable, supported by strong human capital, good health outcomes, and a sound institutional environment. Demographic pressures appear contained, as positive net migration mitigates moderate fertility.

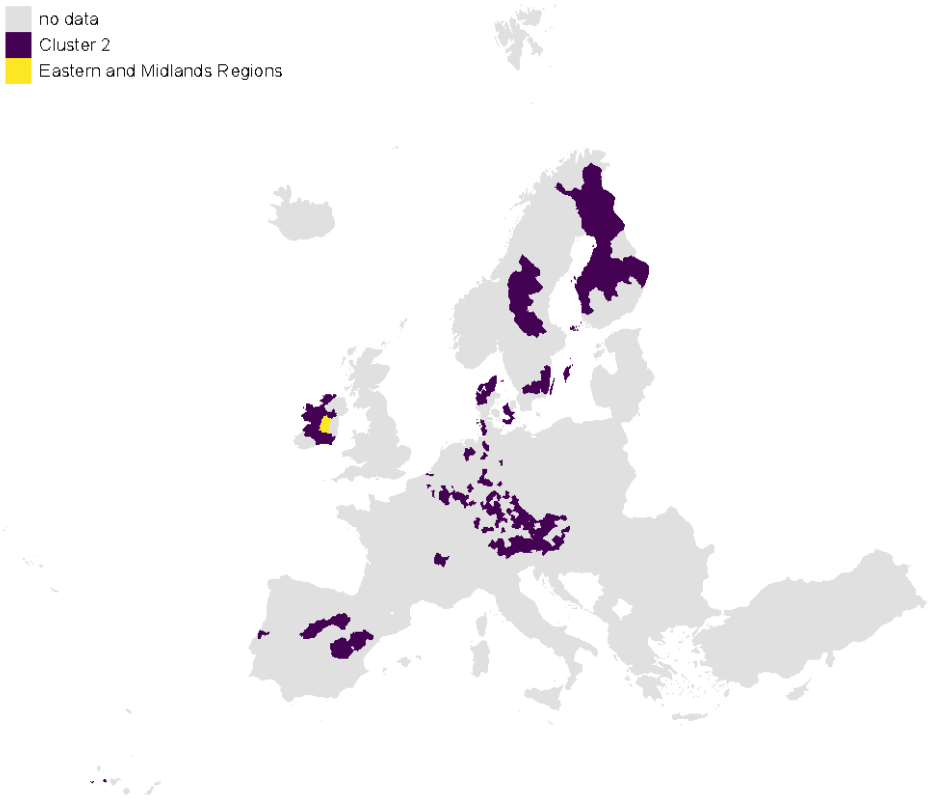


Figure 8.8. NUTS3. Cluster 2 – Prosperous and connected.

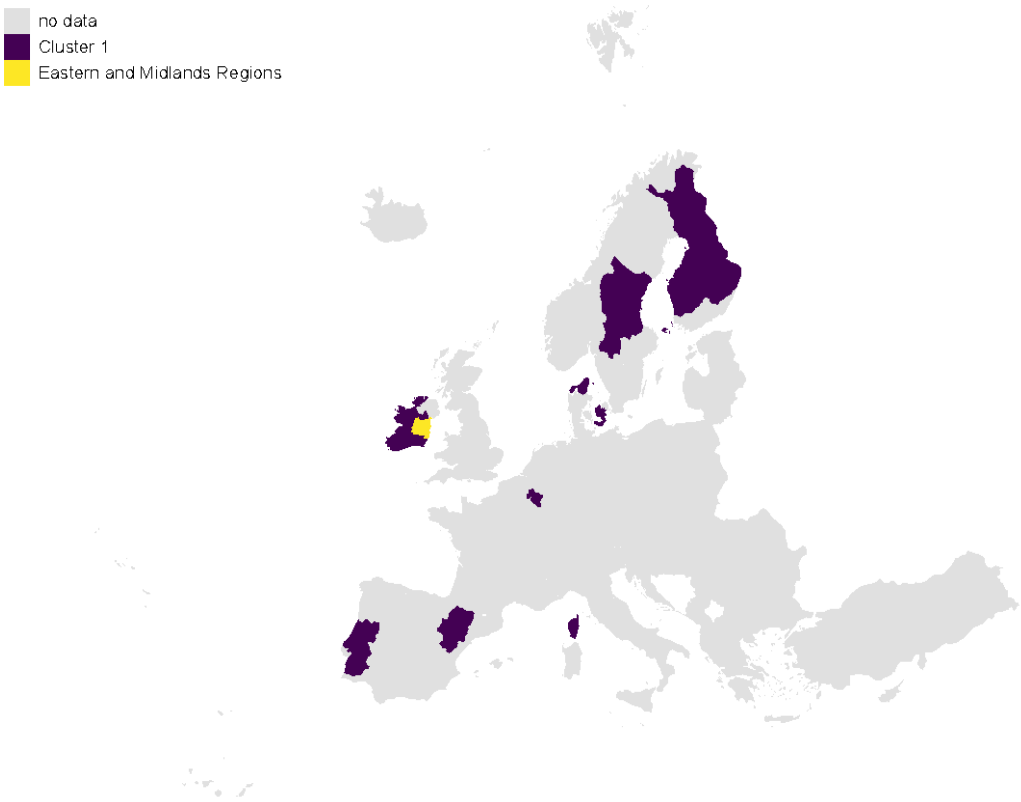


Figure 8.9. NUTS2. Cluster 1 – Moderately developed and balanced regions.

Table 8.5. Comparative Indicators for Eastern & Midlands (IE063/IE06): Regional Indicators across NUTS3, NUTS2, National and European Averages.

	NUTS3		NUTS2				
	Pilot Region IE063	**Cluster 2**	**Pilot Region IE06**	**Cluster 1**	**Pilot Country IE**	**Rural regions**	**All regions**
GDP per capita in PPS	22957	37548	84747	38696	72926	31768	37512
Real Productivity per Hour	28.6	48.4	99.1	50.7	89.8	34.5	38.9
Job Opportunities	0.68	0.76	0.80	0.75	0.77	0.72	0.76
Employment in Agriculture	0.07	0.04	0.02	0.06	0.05	0.09	0.05
Employment in Industry	0.13	0.21	0.09	0.13	0.13	0.18	0.16
Employment in Science and Technology			40.3	34.7	35.9	29.8	34.0
Unemployment Rate			4.5	6.1	4.2	6.4	6.2
Employment Rate			80.0	77.3	78.9	74.5	75.4
Employment Rate Gender Gap			10.0	4.9	9.8	10.2	9.8
Net Disposable Income per capita in PPS			17600	17347	17600	16149	17423
NEET Rate			8.4	9.3	8.6	12.5	11.3
At Risk of Poverty			10.9	14.6	13.0	16.2	16.3
Work Intensity			9.8	8.9	8.7	7.0	8.1
Severe material and social deprivation			6.7	4.4	5.4	6.8	6.8
Population living in <15 min from hospital	42.4	74.9	74.5	65.6	50.7	67.2	78.9
Exposure PM2.5	88.3	81.6	124.9	107.3	100.0	89.3	105.2
Internet Connectivity	7.6	23.6	9.0	10.6	8.6	54.4	53.3
Fertility Rate	1.7	1.6	1.5	1.5	1.6	1.5	1.5
Median Age	38.9	46.1	37.8	44.5	39.5	45.6	44.6
Age Dependency Ratio	54.5	58.6	49.3	62.6	54.2	60.5	57.7
Average age of mother at birth	32.3	31.1	33.0	31.4	33.2	30.6	31.0
Early Pregnancy	0.018	0.012	0.013	0.013	0.011	0.026	0.022
Crude rate of net migration	13.0	6.6	15.3	10.0	20.4	4.7	7.2
Lifespan	83.3	82.3	83.0	81.6	82.5	80.1	80.4
Lifespan gender gap	2.9	4.2	3.1	4.5	3.4	5.8	5.3
Mental Health			57.5	46.7	51.5	32.5	38.4
Infant Mortality			2.60	2.33	3.40	3.19	3.21
Deaths from Alcoholism			0.59	3.17	0.47	4.25	3.76
Intended self-harm			8.6	11.9	9.3	11.8	10.6
Gender gap in Intended self-harm			11.0	13.8	11.8	15.8	13.0
Secondary Educational Attainment			31.3	40.4	34.3	51.5	46.5
Tertiary Educational Attainment			58.0	38.3	53.5	30.5	33.9
Gender Gap in Tertiary Education			4.4	13.2	8.6	8.1	6.6
Participation in education and training			13.1	19.6	12.1	11.3	12.8
Criminality (robberies)	12.6	17.6	50.1	32.4	23.4	20.8	45.6
Eurosceptic votes	1.5	14.3	4.6	16.1	2.4	27.9	26.5
Hard Eurosceptic votes	1.2	10.2	4.2	6.6	2.2	13.0	13.2
Electoral Turnover	61.7	76.9	61.6	71.2	62.9	61.2	65.2
Quality of Government Index			0.92	1.12	1.04	0.05	0.11

8.5. Region 5. Dębowa Kłoda – Lubelskie (PL814)

The Lubelski region is one of the three subregions of the Lubelskie Voivodeship, situated in the eastern part of the country, along the borders with Ukraine and Belarus. According to the Eurostat's urban–rural typology, the NUTS3 region is classified as intermediate, reflecting a mix of rural and urban characteristics. Agriculture has a particularly strong presence in the area, employing a significant share of the workforce, including vulnerable groups such as women and Ukrainian refugees (**Figure 8.10**, **Figure 8.11**, and **Table 8.6**).

Economic performance and labour market: At NUTS3, GDP per capita in PPS stands at €29,137, above the cluster's €23,776 but slightly below the national figure (€30,049). At NUTS2, it reaches

€22,341, under both the cluster (€25,250) and the national mean (€30,049). Productivity per hour is subdued at both scales—13.6 at NUTS3 (compared to the cluster value of 14.6) and 12.3 at NUTS2 (compared to the 17.0 of its cluster). Overall, income is moderate locally but weak region-wide, and productivity lags the national benchmark at both levels.

Labour-market opportunities show a split profile: 0.80 at NUTS3 (above the 0.73 achieved nationally) but 0.70 at NUTS2, indicating that access to jobs is relatively favorable locally yet weaker at the broader regional scale. The sectoral employment indicators show the following mix: agriculture accounts for 9% (NUTS3) and 19% (NUTS2) versus 9% nationally, while industry is 16% at both levels versus 22% nationally, pointing to a notable share of agriculture on the economy, partially explaining the low income and productivity levels. At the NUTS2 level, the remaining subregions are of a predominantly rural character, whereas PL814 is classified as an intermediate region, hosting the urban core of Lublin. This feature may help explain observed differences in income levels and in the sectoral composition of employment between NUTS2 and NUTS3.

At NUTS2, unemployment stands at 4.0% (above the 2.9% nationally) and the employment rate reaches 76.2% (national 77.5%); with a relevant employment gender gap of 11.6 p.p. (below the national value of 12.2 p.p.). Net disposable income per capita reaches €13,400, below the €14,565 achieved nationally, which is consistent with the weaker productivity base.

Social conditions: The risk of poverty is high with 20.4% (above the national average of 15.3%), while severe material and social deprivation stand at 2.4% (national 3.0%) and the NEET rate amounts to 10.3% (national 9.5%). This pattern—high poverty but low deprivation and near-national NEET, suggests income fragility more than broad material hardship, in line with modest productivity and wages.

Demographics and migration: The demographic structure of the region suggests a process of progressive population aging. The median age remains similar to the country average (42.4 at NUTS3 and 43.5 at NUTS2, versus 42.9 nationally) and the age-dependency ratio remains moderate, with a value of is 55.5 at NUTS3 and 56.2 at NUTS2 (compared with 54.7 nationally). However, fertility stands at 1.3 (NUTS3) and 1.2 (NUTS2) versus 1.3 nationally. Net migration is very low, 0.6‰ (NUTS3) and even negative at NUTS2 (−2.0‰), pointing to regional outflows that can erode the working-age base and dampen long term development and stability.

Health and environment: Life expectancy remains moderate by European standards, reaching 79.5 years at NUTS3 and 77.3 years at NUTS2, broadly in line with the national figure of 77.2 years. Infant mortality at NUTS2 is 4.60‰, higher than the national rate of 3.98‰, suggesting greater pressures on early-life health outcomes. Exposure to fine particulate matter (PM2.5) amounts to 118.8 at NUTS3 and 96.6 at NUTS2, compared with 112.4 nationally. Access to hospital services highlights territorial inequalities: while 65.0% of residents at NUTS3 live within 15 minutes of a hospital (national: 71.7%), the share falls to just 37.0% at NUTS2, underlining structural constraints in healthcare accessibility when the region is considered at scale.

Education and governance: At NUTS2, tertiary educational attainment reaches 34.0%, close to the national level (36.3%) and slightly above the EU average (33.9%). Participation in lifelong learning is modest at 7.9%, matching the national figure but falling well short of the EU benchmark (12.8%), highlighting slower progress in adult upskilling. Electoral turnout is comparatively strong—74.1% at NUTS3 and 70.5% at NUTS2, versus 72.9% nationally—yet this civic engagement coexists with high levels of Euroscepticism, with 51.3% of votes at NUTS3 and 58.3% at NUTS2, above the national share (45.2%). Meanwhile, the Quality of Government index stands at −1.09, slightly below the

national average (−0.95) and far from the EU mean (0.11), reflecting persistent concerns around institutional quality and trust that may undermine the effectiveness of public policy.

Overall, the Lubelski region shows moderate levels of development, particularly at NUTS3, with adequate job opportunities but very low productivity. While social conditions reveal a high share of the population at risk of poverty, these deprivations are linked more to limited income than to material hardship. The region's demographic structure points to potential long-term stability challenges, with a relatively ageing population expected to continue growing in the coming years, in the absence of higher fertility or significant inflows of migrants. Despite average levels of human capital, health outcomes remain below national and European standards, while institutional quality is weaker than the EU average and accompanied by a considerable degree of social discontent.

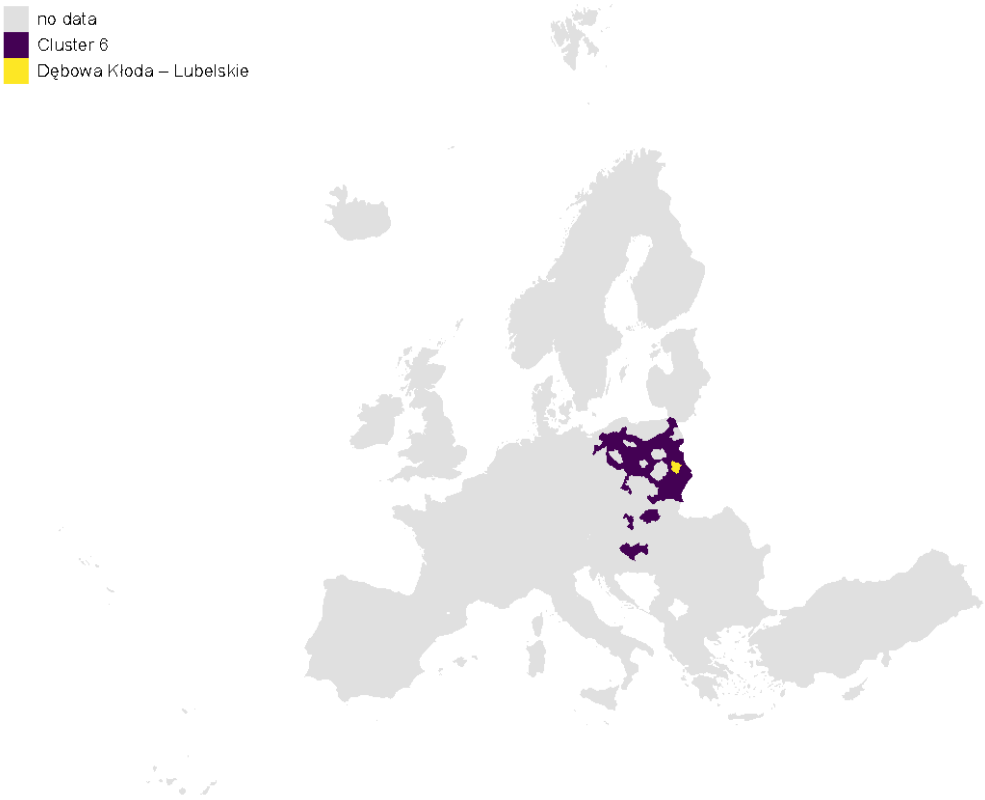


Figure 8.10. NUTS3. Cluster 6 – Peripherical, economically lagging regions.

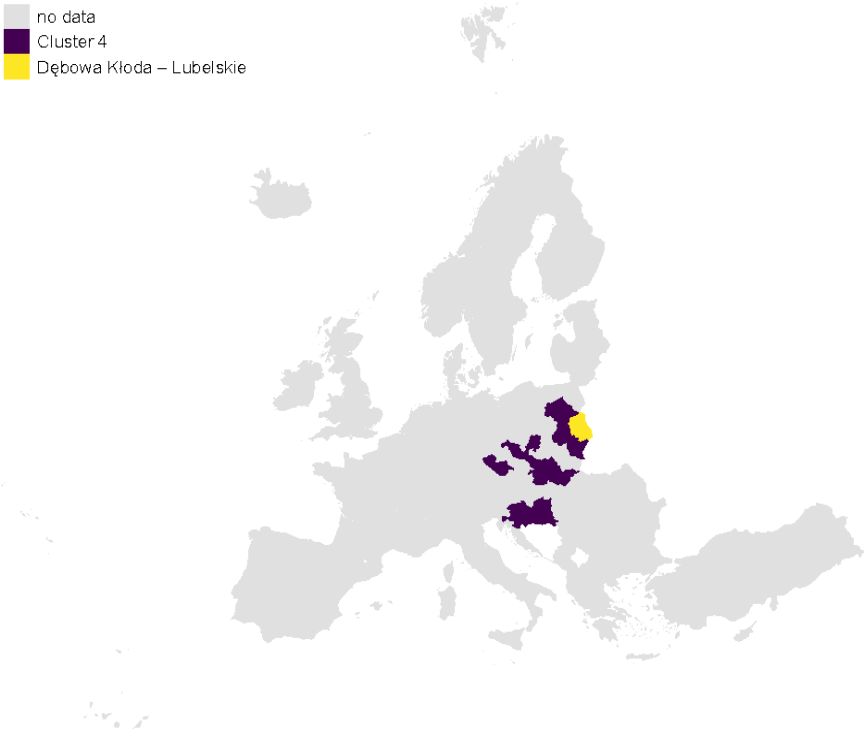


Figure 8.11. NUTS2. Cluster 4 – Transitional regions with emerging challenges.

Table 8.6. Comparative Indicators for Dębowa Kłoda – Lubelskie (PL814/PL81): Regional Indicators across NUTS3, NUTS2, National and European Averages.

	NUTS3		NUTS2				
	Pilot Region PL814	**Cluster 6**	**Pilot Region PL81**	**Cluster 4**	**Pilot Country PL**	**Rural regions**	**All regions**
GDP per capita in PPS	29137	23776	22341	25250	30049	31768	37512
Real Productivity per Hour	13.6	14.6	12.3	17.0	15.6	34.5	38.9
Job Opportunities	0.80	0.65	0.70	0.68	0.73	0.72	0.76
Employment in Agriculture	0.09	0.16	0.19	0.10	0.09	0.09	0.05
Employment in Industry	0.16	0.23	0.16	0.31	0.22	0.18	0.16
Employment in Science and Technology			28.6	28.2	33.8	29.8	34.0
Unemployment Rate			4.0	4.4	2.9	6.4	6.2
Employment Rate			76.2	76.1	77.5	74.5	75.4
Employment Rate Gender Gap			11.6	11.4	12.2	10.2	9.8
Net Disposable Income per capita in PPS			13400	12953	14565	16149	17423
NEET Rate			10.3	11.5	9.5	12.5	11.3
At Risk of Poverty			20.4	15.6	15.3	16.2	16.3
Work Intensity			2.4	4.9	4.5	7.0	8.1
Severe material and social deprivation			2.4	5.1	3.0	6.8	6.8
Population living in <15 min from hospital	65.0	58.3	37.0	64.1	71.7	67.2	78.9
Exposure PM2.5	118.8	83.9	96.6	77.1	112.4	89.3	105.2
Internet Connectivity	130.2	109.9	117.0	100.7	118.0	54.4	53.3
Fertility Rate	1.3	1.3	1.2	1.5	1.3	1.5	1.5
Median Age	42.4	43.1	43.5	44.3	42.9	45.6	44.6
Age Dependency Ratio	55.5	54.8	56.2	56.1	54.7	60.5	57.7
Average age of mother at birth	30.4	29.7	30.3	29.8	29.9	30.6	31.0
Early Pregnancy	0.012	0.025	0.018	0.030	0.019	0.026	0.022
Crude rate of net migration	0.6	-1.1	-2.0	5.2	-0.2	4.7	7.2
Lifespan	79.5	78.5	77.3	77.4	77.2	80.1	80.4
Lifespan gender gap	7.7	7.5	8.5	7.1	7.9	5.8	5.3
Mental Health			12.7	26.3	15.3	32.5	38.4
Infant Mortality			4.60	3.42	3.98	3.19	3.21
Deaths from Alcoholism			9.31	7.81	8.92	4.25	3.76
Intended self-harm			13.6	13.3	12.4	11.8	10.6
Gender gap in Intended self-harm			20.4	19.7	19.2	15.8	13.0
Secondary Educational Attainment			59.2	64.4	57.5	51.5	46.5
Tertiary Educational Attainment			34.0	26.2	36.3	30.5	33.9
Gender Gap in Tertiary Education			17.4	11.1	13.4	8.1	6.6
Participation in education and training			7.9	7.8	7.9	11.3	12.8
Criminality (robberies)	9.7	6.6	7.1	7.7	10.2	20.8	45.6
Eurosceptic votes	51.3	54.1	58.3	38.4	45.2	27.9	26.5
Hard Eurosceptic votes	8.5	7.8	8.1	8.9	7.1	13.0	13.2
Electoral Turnover	74.1	70.2	70.5	65.3	72.9	61.2	65.2
Quality of Government Index			-1.09	-0.75	-0.95	0.05	0.11

8.6. Region 6. Suceava (RO215) and Maramureș (RO114)

According to Eurostat, the counties of Suceava (RO215) and Maramureș (RO114) are predominantly rural and mountainous territories, belonging respectively to the Nord-Vest (RO11) and Nord-Est (RO21) regions. Nord-Vest is situated in the northwest of the country, bordering Hungary and Ukraine, while Nord-Est occupies the northeastern part of Romania, along the frontiers with Ukraine and Moldova. Both territories exhibit marked rural specificities and face persistent structural challenges, including out-migration, demographic ageing, the decline of traditional agricultural activities, and comparatively low levels of economic diversification. Particularly vulnerable groups include the elderly, young people, and ethnic minorities such as Ukrainians, Ruthenians, and Hutsuls (**Figure 8.12**, **Figure 8.13** and **Table 8.7 8.7**).

Economic performance and labour market: At NUTS3, GDP per capita in PPS stood at €17,019 in RO215 and €22,478 in RO114, with RO215 falling below its cluster reference (€20,375) and RO114 exceeding it. At NUTS2, values were €19,214 in RO21 and €28,985 in RO11, both below the national level (€32,057) and well under the European mean (€37,512). Labour productivity reached 7.8 (RO215) and 10.8 (RO114) at NUTS3; at NUTS2, figures were 8.2 (RO21) and 11.9 (RO11), both below the national benchmark (13.6) and far from the European reference (38.9).

Labour market opportunities at NUTS3 were 0.70 in RO215 and 0.60 in RO114; at NUTS2, values reached 0.77 (RO21) and 0.71 (RO11), broadly in line with the national figure (0.69). Agricultural employment was disproportionately high in RO215 (39%) compared with RO114 (17%). At NUTS2, agriculture employed 41% in RO21 and 17% in RO11, with RO21 well above the national share (20%). Industry showed the reverse pattern: 11% in RO215 and 29% in RO114; at NUTS2, 12% in RO21 and 23% in RO11, close to the national average (**22%**). Thus, RO21 displays a strong agricultural profile with limited industry, while RO114/RO11 are comparatively more industrialized.

At NUTS2, unemployment stood at 5.9% in RO21 and 3.0% in RO11, compared with 5.6% nationally. The employment rate at national and European level was 68.5% and 75.4%, respectively; in contrast, RO21 recorded 69.0% and RO11 71.4%. Gender inequality in employment was pronounced: 22.1 p.p. in RO21 and 17.7 p.p. in RO11, compared with 18.9 p.p. nationally and 9.8 p.p. across the EU. Net disposable income per capita was €9,500 in RO21 and €12,200 in RO11, both below the national (€12,463) and European rural mean (€16,149).

Social conditions: Poverty rates were 31.4% in RO21 and 14.7% in RO11, against a national figure of 20.8%. Severe material and social deprivation affected 18.3% (RO21) and 16.3% (RO11), well above the European rural average (6.8%). The NEET rate was 16.8% in RO21 and 14.7% in RO11, compared with 19.5% nationally and 11.3% in Europe. Overall, RO21 shows pronounced vulnerability (high poverty and deprivation), while RO11 performs closer to national averages but still below the European rural benchmark.

Demographics and migration: The median age was 41.6 years in RO21 and 42.3 years in RO11, both slightly below the national average (43.7). Fertility rates stood at 2.0 in RO21 and 1.6 in RO11, compared with 1.7 nationally, indicating relatively favourable dynamics in RO21. The age-dependency ratio was 58.4 in RO21 and 53.4 in RO11, close to the national level (55.7). Net migration remained positive, at +4.1‰ in RO21 and +6.9‰ in RO11, against +5.8‰ nationally and +7.2‰ across Europe. Taken together, these figures point to comparatively younger populations and moderate migratory inflows, particularly in RO11, which may help mitigate ageing pressures in the medium term.

Health and environment: Life expectancy reaches 74.6 years in RO21 and 75.3 years in RO11, closely aligned with the national figure (75.2) but still falling short of the EU average (80.4). Infant mortality amounts to 5.70‰ in RO21 and 5.80‰ in RO11, both exceeding the national rate (5.26‰) and the European rural reference (3.19‰), which highlights persistent pressures in early-life health. Exposure to fine particulate matter (PM2.5) remains elevated, at 138.3 in RO21 and 149.6 in RO11; while RO11 is slightly below the national figure (150.5), both values are considerably higher than the European rural mean (89.3), thus posing long-term environmental health risks. Access to healthcare services achieves only 44.3% in RO21 and 52.8% in RO11 of the population living within 15 minutes of a hospital, compared with 52.4% nationally and 78.9% in the EU, underlining modest territorial accessibility.

Education and governance: At NUTS2, educational attainment reaches 61.8% at secondary level and 13.6% at tertiary level in RO21, while RO11 achieves 62.1% and 17.2%, respectively.

Participation in lifelong learning amounts to 7.6% in RO21 and 8.3% in RO11, both above the national average (6.5%) but still well below the European mean (12.8%). Crime rates (robberies) stand at 13.5 in RO21 and 11.7 in RO11, lower than the European regional mean (45.6). Political participation, however, remains weak, with voter turnout of 27.0% in RO21 and 32.1% in RO11, far below the European rural benchmark. Eurosceptic votes account for 13.1% in RO21 and 6.9% in RO11, compared with a lower national share. Finally, institutional quality registers –1.43 in RO21 and –1.02 in RO11, pointing to persistently low governance performance, particularly acute in RO21.

Overall, both areas display limited levels of development, with the gap being far more pronounced in RO21 compared with RO11, partly reflecting differences in the relative weight of the agricultural and industrial sectors. Social conditions are notably unfavourable, especially in RO21, and are compounded by health and education indicators that remain well below European standards. Although neither region currently faces acute demographic pressures, the broader context is marked by weak political engagement and deficient institutional performance.

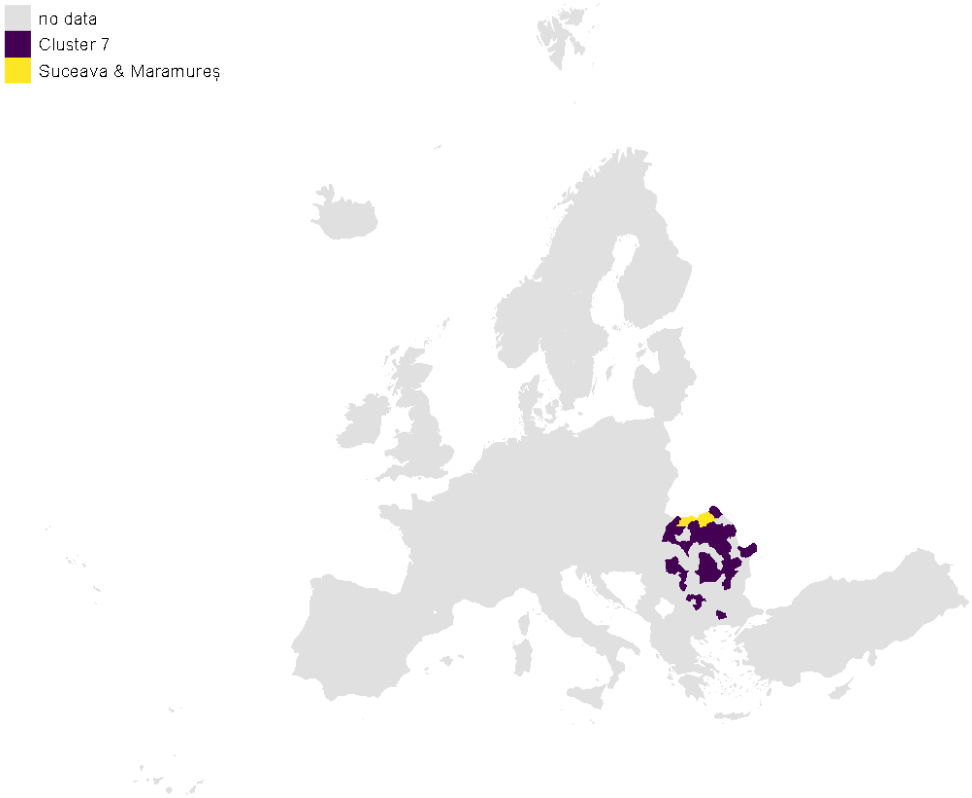


Figure 8.12. NUTS3. Cluster 7 – Deep structural lag and marginalisation.

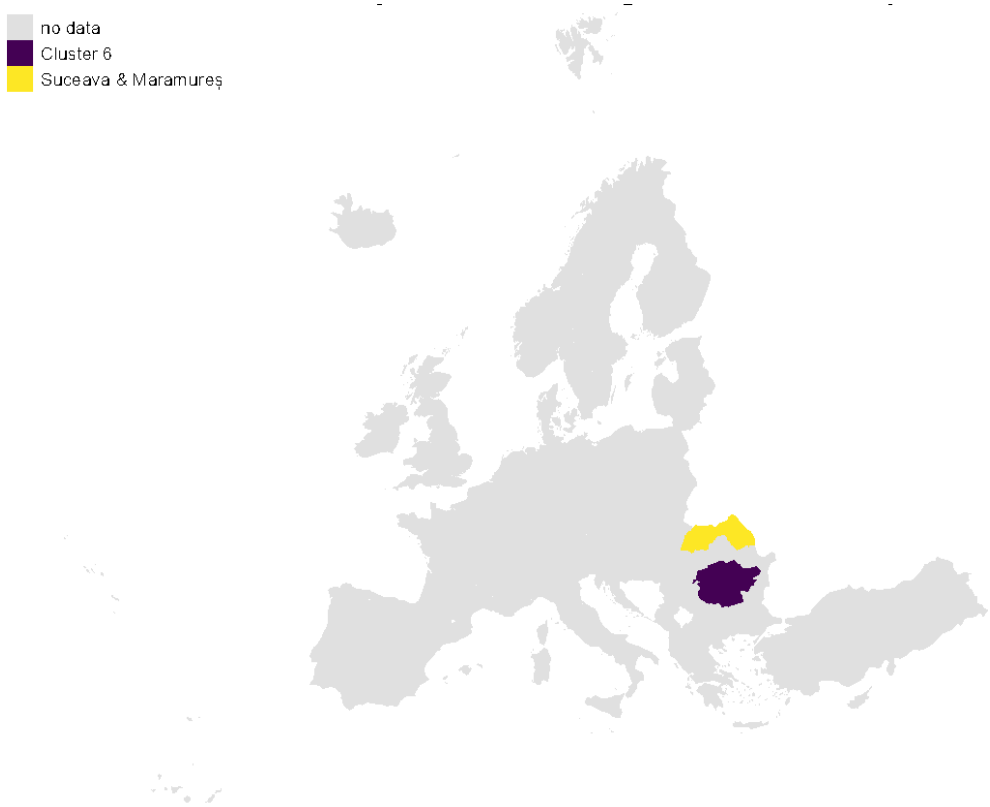


Figure 8.13. NUTS2. Cluster 6 – Severely disadvantaged rural peripheries.

Table 8.7. Comparative Indicators for Suceava (RO215/RO21) and Maramureș (RO114/RO14): Regional Indicators across NUTS3, NUTS2, National and European Averages.

	NUTS 3			NUTS 2					
	Pilot Region EL215	Pilot region EL114	Cluster 7	Pilot Region RO21	Pilot Region RO11	Cluster 6	Pilot Country RO	Rural regions	All regions
GDP per capita in PPS	17019	22478	20375	19214	28985	20146	32057	31768	37512
Real Productivity per Hour	7.8	10.8	10.0	8.2	11.9	9.3	13.6	34.5	38.9
Job Opportunities	0.70	0.60	0.65	0.77	0.71	0.69	0.69	0.72	0.76
Employment in Agriculture	0.39	0.17	0.30	0.41	0.17	0.28	0.20	0.09	0.05
Employment in Industry	0.11	0.29	0.20	0.12	0.23	0.21	0.22	0.18	0.16
Employment in Science and Technology				18.7	20.9	19.9	23.2	29.8	34.0
Unemployment Rate				5.9	3.0	7.3	5.6	6.4	6.2
Employment Rate				69.0	71.4	68.2	68.5	74.5	75.4
Employment Rate Gender Gap				22.1	17.7	15.2	18.9	10.2	9.8
Net Disposable Income per capita in PPS				9500	12200	9320	12463	16149	17423
NEET Rate				16.8	14.7	21.5	19.5	12.5	11.3
At Risk of Poverty				31.4	14.7	26.7	20.8	16.2	16.3
Work Intensity				1.7	3.4	6.6	5.6	7.0	8.1
Severe material and social deprivation				18.3	16.3	22.2	19.7	6.8	6.8
Population living in <15 min from hospital	44.3	53.3	43.0	44.3	52.8	55.1	52.4	67.2	78.9
Exposure PM2.5	131.2	117.5	112.5	138.3	149.6	108.0	150.5	89.3	105.2
Internet Connectivity	91.9	111.5	105.1	106.6	93.9	133.6	102.5	54.4	53.3
Fertility Rate	2.2	1.6	1.8	2.0	1.6	1.8	1.7	1.5	1.5
Median Age	40.4	42.7	45.3	41.6	42.3	46.7	43.7	45.6	44.6
Age Dependency Ratio	59.1	52.0	58.4	58.4	53.4	60.9	55.7	60.5	57.7
Average age of mother at birth	28.7	28.2	27.6	28.5	28.3	27.6	28.2	30.6	31.0
Early Pregnancy	0.062	0.088	0.117	0.079	0.090	0.110	0.094	0.026	0.022
Crude rate of net migration	2.4	4.4	3.4	4.1	6.9	2.5	5.8	4.7	7.2
Lifespan	76.9	76.3	76.0	74.6	75.3	74.0	75.2	80.1	80.4
Lifespan gender gap	6.4	6.4	7.0	8.7	7.3	7.9	7.8	5.8	5.3
Mental Health				2.9	1.5	2.2	2.3	32.5	38.4

Infant Mortality				5.70	5.80	6.04	5.26	3.19	3.21
Deaths from Alcoholism				1.92	0.92	1.44	1.41	4.25	3.76
Intended self-harm				11.4	9.6	10.3	9.1	11.8	10.6
Gender gap in Intended self-harm				18.2	15.2	14.3	14.0	15.8	13.0
Secondary Educational Attainment				61.8	62.1	62.7	61.9	51.5	46.5
Tertiary Educational Attainment				13.6	17.2	18.0	18.8	30.5	33.9
Gender Gap in Tertiary Education				2.6	4.8	6.4	3.6	8.1	6.6
Participation in education and training				7.6	8.3	4.0	6.5	11.3	12.8
Criminality (robberies)	8.1	14.6	9.8	13.5	11.7	9.4	17.2	20.8	45.6
Eurosceptic votes	14.5	7.3	8.8	13.1	6.9	11.4	8.3	27.9	26.5
Hard Eurosceptic votes	0.0	0.0	1.9	0.0	0.0	6.1	0.0	13.0	13.2
Electoral Turnover	28.4	28.3	32.0	27.0	32.1	33.6	31.3	61.2	65.2
Quality of Government Index				-1.43	-1.02	-1.41	-1.27	0.05	0.11

8.7. Region 7. Košický kraj (SK042)

Košický kraj is one of the two regions that constitute the oblast of Eastern Slovakia, situated in the eastern part of the country along the borders with Hungary and Ukraine. According to Eurostat, it is classified as an intermediate and mountainous region. Rural areas within Košický kraj face notable development challenges, including significant gaps in GDP per capita, persistently high levels of long-term unemployment, pronounced brain drain among young people, and limited infrastructure investment (**Figure 8.14**, **Figure 8.15** and **Table 8.8**).

Economic performance and labour market: At NUTS3, GDP per capita in PPS records €24,800, below the national average (€29,334). At NUTS2, the value amounts to €21,334, which remains under both the cluster reference (€25,697) and the European mean across regions (€37,512). Labour productivity reaches 24.9 at NUTS3, slightly above the national level, while at NUTS2 it stands at 22.1, below the national benchmark (24.9) and far from the European figure (38.9).

Labour market opportunities are particularly weak, standing at 0.57 at NUTS3 and 0.55 at NUTS2, compared with the 0,72 reached at the national level. Agricultural employment accounts for 3% at both NUTS2 and NUTS3, in line with the national share (3%), and lower than the European regional mean (6%). Industry, by contrast, represents 22% of employment at NUTS2 and 20% at NUTS3, which underscores the importance of the sector for the regional economy, although the value remains below the national mean (24%).

Unemployment at NUTS2 registers 10.4%, nearly double the national figure (5.5%). The employment rate reaches 71.6%, still below both the national average (78.6%) and the EU mean (75.4%). Gender inequality in employment amounts to 11.8 percentage points, compared with 6.7 p.p. nationally and 9.8 p.p. across the EU. Finally, net disposable income per capita achieves €11,300, lower than the national average (€13,950) and well below the EU regional mean (€17,423).

Social conditions: The poverty rate reaches 21.9%, markedly higher than the national level (13.5%). Severe material and social deprivation affect 11.5% of the population, compared with 6.3% nationally, while the NEET rate amounts to 17.3%, well above the national figure (10.4%). Taken together, these indicators underscore a noticeable level of social vulnerability, consistent with weaker labour demand and higher unemployment.

Demographics and migration: Median age stands at 39.6 years at NUTS2 and 40.3 years at NUTS3, both below the national values (42.2). The age-dependency ratio reaches 51.7 at NUTS2 and 51.9 at NUTS3, closely aligned with the national benchmark (51.7). Fertility is comparatively favourable, amounting to 1.8 at NUTS2 and 1.72 at NUTS3, versus 11.5 nationally Yet this light

demographic advantage is undermined by negative migration balances: −1.5‰ at NUTS2 and −1.1‰ at NUTS3. In short, persistent outflows risk offsetting the benefits of a younger age structure and slightly higher fertility, constraining demographic renewal.

Health and Environment: Life expectancy reaches 76.4 years at NUTS2 and 78.5 years at NUTS3, close to the national level (78.7) yet still falling short of the European regional mean (80.4). Infant mortality stands at 8.10 per 1,000 at NUTS2, more than double the European regional average (3.21 per 1,000), signalling persistent pressures in early-life health outcomes. Exposure to fine particulate matter (PM2.5) amounts to 81.9 at NUTS2 but rises sharply to 122.6 at NUTS3 (compared to a national value of 96.6), suggesting the presence of localized air-quality hotspots with potential long-term health implications.

At NUTS2, 63.9% of the population has at most secondary education, while only 25.4% hold a tertiary degree, well below both the national share (31.8%) and the European average. Participation in lifelong learning reaches 8.9%, slightly above national levels (11.8%) but still falling short of the EU benchmark (12.8%), suggesting limited opportunities for adult reskilling. Civic and political engagement is uneven: electoral turnover stands at 63.8%, lower than the national rate (69.0%), while Eurosceptic and hard-Eurosceptic votes (35.6% and 11.4%) broadly mirror national patterns. Crime rates remain comparatively low, offering a measure of social stability, yet this is offset by weaknesses in governance. The Quality of Government index registers −1.07, below the national score (−0.84) and far from the EU mean (0.11), underscoring institutional fragility.

Overall, the **Košický kraj** displays a moderate level of economic development, accompanied by slightly below-average productivity. This is further compounded by limited labour market opportunities and moderately unfavourable social conditions. While demographic trends are relatively favourable, weaknesses in health outcomes, human capital, and institutional quality constrain the region's broader socio-economic development.

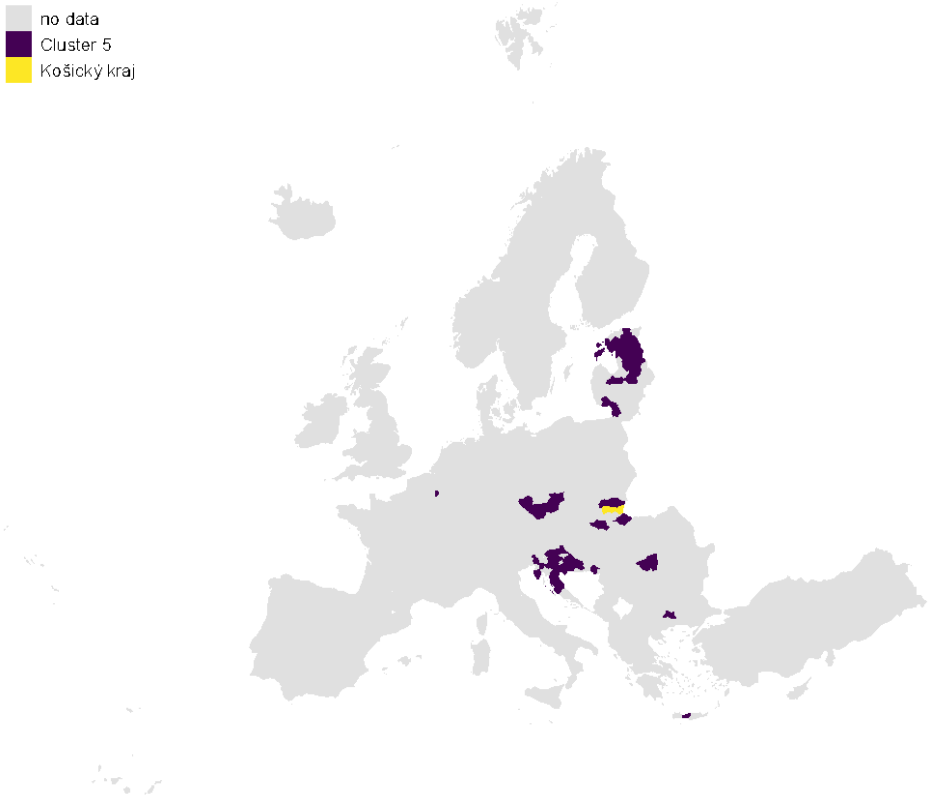


Figure 8.14. NUTS3. Cluster 5 – Economically lagging regions.

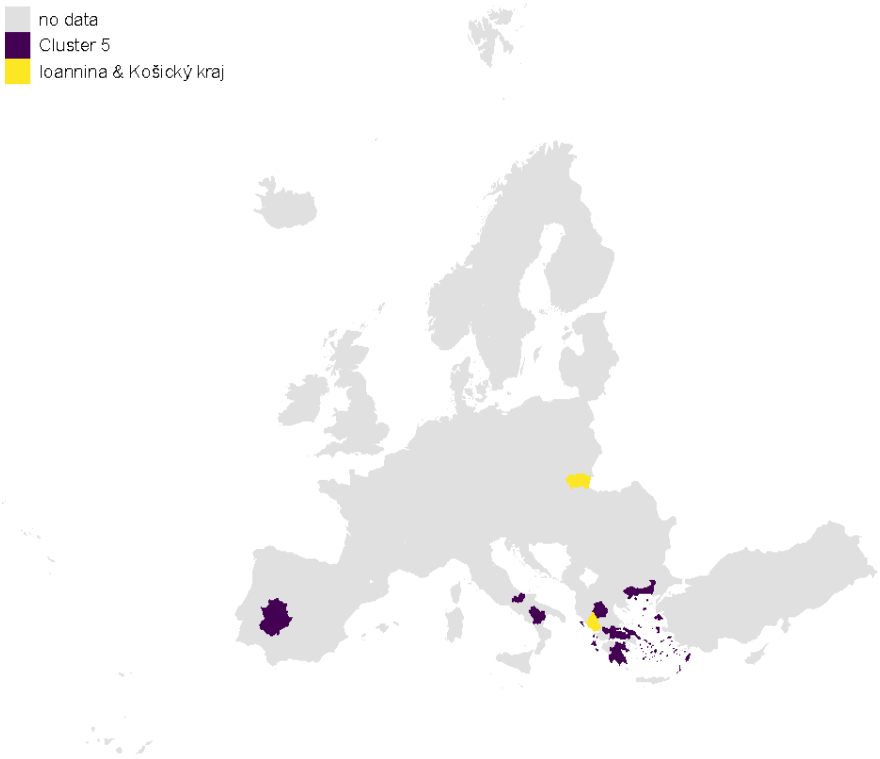


Figure 8.15. NUTS2. Cluster 5 – Lagging southern peripheries with enduring inequalities.

Table 8.8. Comparative Indicators for Suceava (RO215/RO21) and Maramureș (RO114/RO14): Regional Indicators across NUTS3, NUTS2, National and European Averages.

	NUTS3		NUTS2				
	Pilot Region SK042	Cluster 5	Pilot Region_SK04	Cluster 5	Pilot Country SK	Rural regions	All regions
GDP per capita in PPS	24800	23988	21334	25697	33588	31768	37512
Real Productivity per Hour	24.9	17.9	22.1	22.1	24.9	34.5	38.9
Job Opportunities	0.57	0.67	0.55	0.71	0.72	0.72	0.76
Employment in Agriculture	0.03	0.14	0.03	0.15	0.03	0.09	0.05
Employment in Industry	0.20	0.36	0.22	0.10	0.22	0.18	0.16
Employment in Science and Technology			26.8	20.5	33.0	29.8	34.0
Unemployment Rate			10.4	11.7	5.5	6.4	6.2
Employment Rate			71.6	65.4	78.6	74.5	75.4
Employment Rate Gender Gap			11.8	21.3	6.7	10.2	9.8
Net Disposable Income per capita in PPS			11300	13236	13950	16149	17423
NEET Rate			17.3	18.5	10.4	12.5	11.3
At Risk of Poverty			21.9	22.3	13.5	16.2	16.3
Work Intensity			7.7	8.2	4.1	7.0	8.1
Severe material and social deprivation			11.5	9.6	6.3	6.8	6.8
Population living in <15 min from hospital	73.2	50.1	70.2	53.9	73.2	67.2	78.9
Exposure PM2.5	92.9	61.6	81.9	47.0	83.1	89.3	105.2
Internet Connectivity	122.6	68.2	115.4	61.9	94.9	54.4	53.3
Fertility Rate	1.7	1.6	1.8	1.3	1.5	1.5	1.5
Median Age	40.3	45.5	39.6	47.9	42.0	45.6	44.6
Age Dependency Ratio	51.9	58.4	51.7	60.1	51.7	60.5	57.7
Average age of mother at birth	27.5	29.7	27.6	31.8	29.3	30.6	31.0
Early Pregnancy	0.127	0.034	0.120	0.022	0.050	0.026	0.022
Crude rate of net migration	-1.1	7.1	-1.5	1.5	0.9	4.7	7.2
Lifespan	78.5	79.3	76.4	81.5	77.3	80.1	80.4
Lifespan gender gap	6.1	6.3	7.0	5.2	6.7	5.8	5.3
Mental Health			14.8	22.7	10.6	32.5	38.4
Infant Mortality			8,10	3,20	4,38	3,19	3,21
Deaths from Alcoholism			3,43	0,52	2,61	4,25	3,76
Intended self-harm			5,5	4,5	7,0	11,8	10,6
Gender gap in Intended self-harm			6,6	7,9	10,3	15,8	13,0
Secondary Educational Attainment			63,9	45,0	62,5	51,5	46,5
Tertiary Educational Attainment			25,4	25,5	31,8	30,5	33,9
Gender Gap in Tertiary Education			7,6	6,0	9,1	8,1	6,6
Participation in education and training			8,9	5,6	11,8	11,3	12,8
Criminality (robberies)	9,4	7,2	7,5	7,7	6,2	20,8	45,6
Eurosceptic votes	34,6	16,4	35,6	26,5	36,4	27,9	26,5
Hard Eurosceptic votes	10,7	5,6	11,4	20,8	11,5	13,0	13,2
Electoral Turnover	60,8	57,1	63,8	52,1	69,0	61,2	65,2
Quality of Government Index			-1,07	-0,88	-0,84	0,05	0,11

9. Social Exclusion and Territorial Typologies: A Comparative Analysis

In this section we combine the exclusion clusters with existing territorial typologies by Eurostat, defined at NUTS3 level, looking at coastal and mountainous regions separately.

9.1. Coastal regions

According to Eurostat[3], **coastal areas** are defined as regions located along or near a coastline, with the coastline itself understood as the boundary where land and water meet. Because this line can be measured in different ways, such as mean or median tides or high and low tide marks, the European Commission has standardised the use of the mean high tide to delineate EU coastlines. Within this framework, a coastal area refers to a Local Administrative Unit (LAU) that either borders the coastline or has at least 50% of its surface located within 10 kilometres of it, while non-coastal areas are those LAUs that do not border the coastline and have less than 50% of their surface within the same distance.

Coastal regions are defined by the EU[4] at the NUTS3 level of the nomenclature of territorial units for statistics. A region qualifies as coastal if it has a border with a coastline, if more than half of its population lives within 50 kilometres of the coastline according to 1 km² population grid data, or if it is characterised by a strong maritime influence.

Figure 9.1 presents the cross-classification of the social exclusion typologies at NUTS3 level with the distinction between coastal and non-coastal regions. The results reveal a marked concentration of coastal regions in Cluster 4, which alone accounts for almost half of all coastal territories, while non-coastal regions are only marginally represented in this group. This suggests that Cluster 4 captures structural features particularly associated with coastal areas. By contrast, non-coastal regions are more widely distributed across Clusters 2 and 3, which together represent more than half of the inland cases. These two clusters also include a smaller but notable share of coastal territories, indicating some degree of overlap in the socio-economic and demographic profiles of coastal and non-coastal regions. In the remaining clusters (1, 5, 6 and 7), representation is relatively limited, although non-coastal regions consistently appear in each, underlining their greater internal heterogeneity. Overall, the cross-tabulation highlights both the distinctiveness of coastal regions, strongly concentrated in a single cluster, and the more diversified distribution of inland regions across typologies. This differentiation suggests that coastal location plays a role in shaping the socio-economic patterns captured by the exclusion typology.

[3] See here: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Territorial_typologies_manual_-_coastal_areas

[4] See here: https://ec.europa.eu/eurostat/web/coastal-island-outermost-regions/methodology

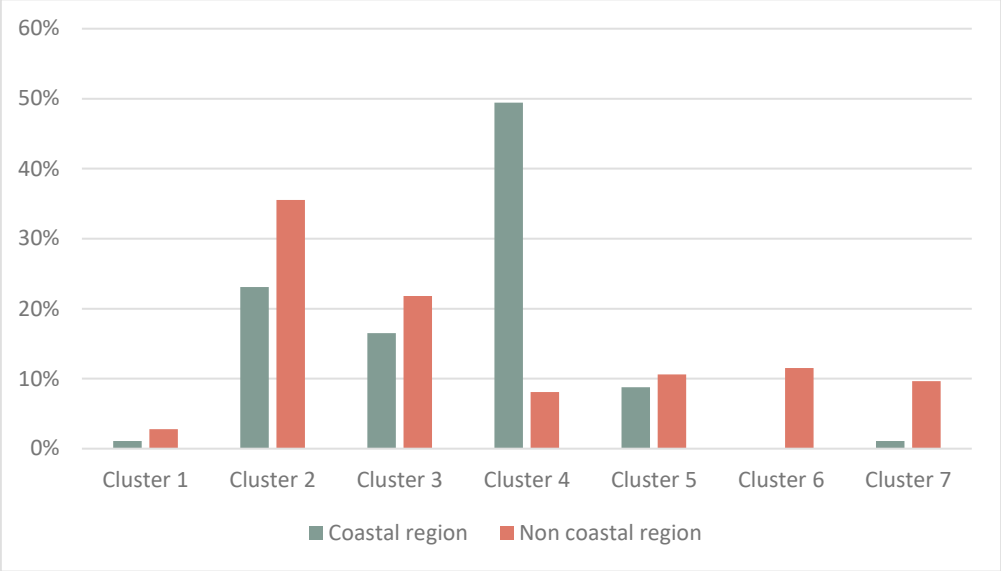


Figure 9.1 Distribution of Social Exclusion Typologies by Coastal and Non-Coastal Region

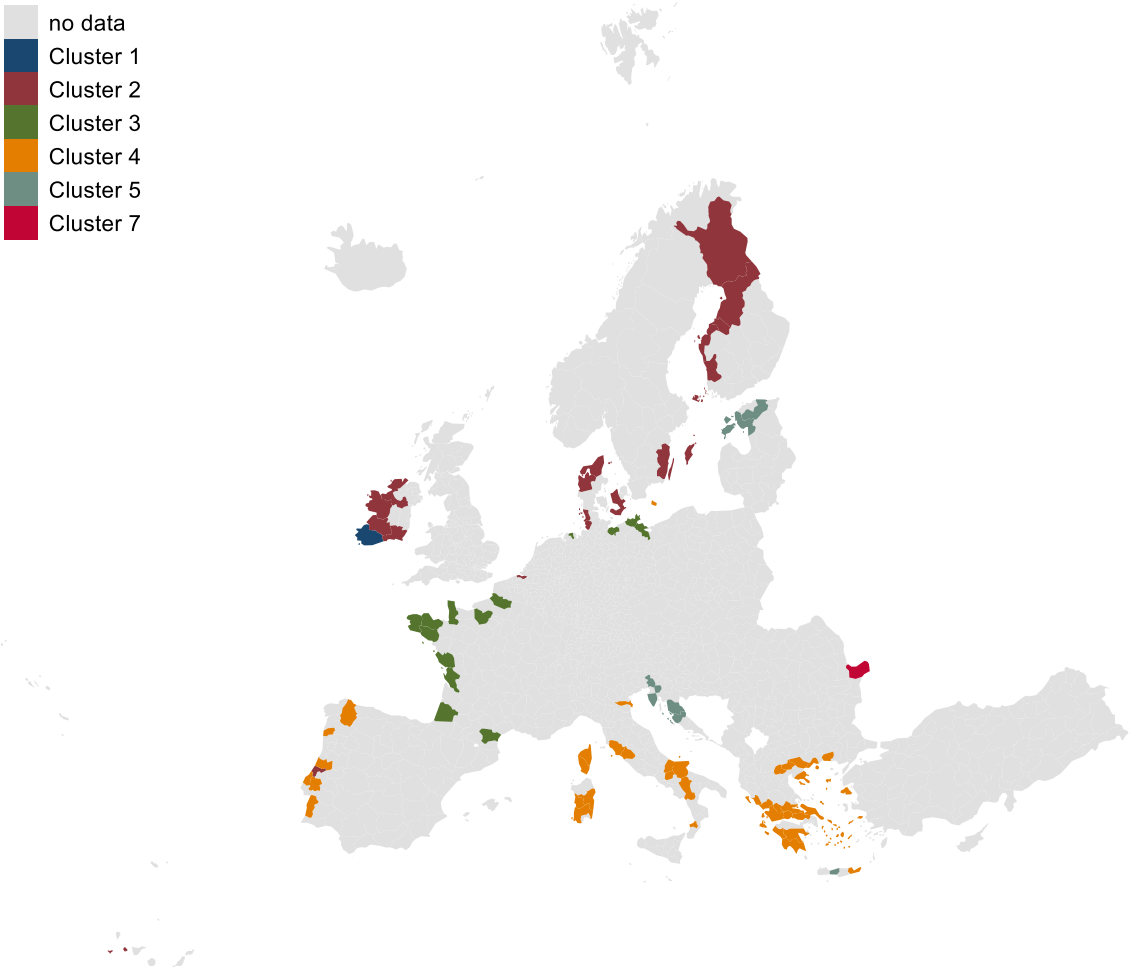


Figure 9.2 Social Exclusion Typologies in Coastal Regions

9.2. Mountain regions

The European Union also applies a territorial typology based on **mountain areas**.[5] This classification distinguishes between mountain regions and non-mountain regions, the latter referring to those that do not meet the criteria for mountain areas. At the NUTS3 level, mountain regions are identified according to three possible conditions: regions where more than 50% of the surface area is covered by topographic mountain terrain; regions where more than 50% of the population resides in such mountainous areas; or regions that meet both criteria simultaneously, with more than half of both the surface and the population located in topographic mountain areas. This typology provides a harmonised framework to capture the specific geographical and demographic features of mountainous territories within the EU, supporting comparative analysis and the design of tailored policies.

Figure 9.3 shows the cross-classification of the social exclusion typologies with the mountain/non-mountain distinction of NUTS3 regions. The results highlight a clear concentration of mountain regions in Cluster 4, which alone accounts for nearly 40% of all mountainous territories. This strong overrepresentation suggests that the socio-economic and demographic characteristics captured in Cluster 4 are particularly linked to mountain contexts. By contrast, non-mountain regions are most heavily concentrated in Clusters 2 and 3, together representing more than 60% of inland, lowland territories. These clusters also include a non-negligible share of mountain regions, pointing to a certain degree of overlap in profiles.

In the remaining clusters (1, 5, 6 and 7), representation is more limited, although both mountain and non-mountain regions are present, underlining that while some typologies are strongly shaped by mountain geography, others cut across both categories. Non-mountain regions appear more evenly distributed across clusters, reflecting their greater internal diversity, while mountain areas are more clearly associated with a specific socio-economic pattern.

Again, there is an association of mountain geography in shaping the exclusion typology, particularly through its concentration in Cluster 4, while also evidencing the more dispersed distribution of non-mountain regions.

[5] See here: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Territorial_typologies_manual_-_mountain_regions

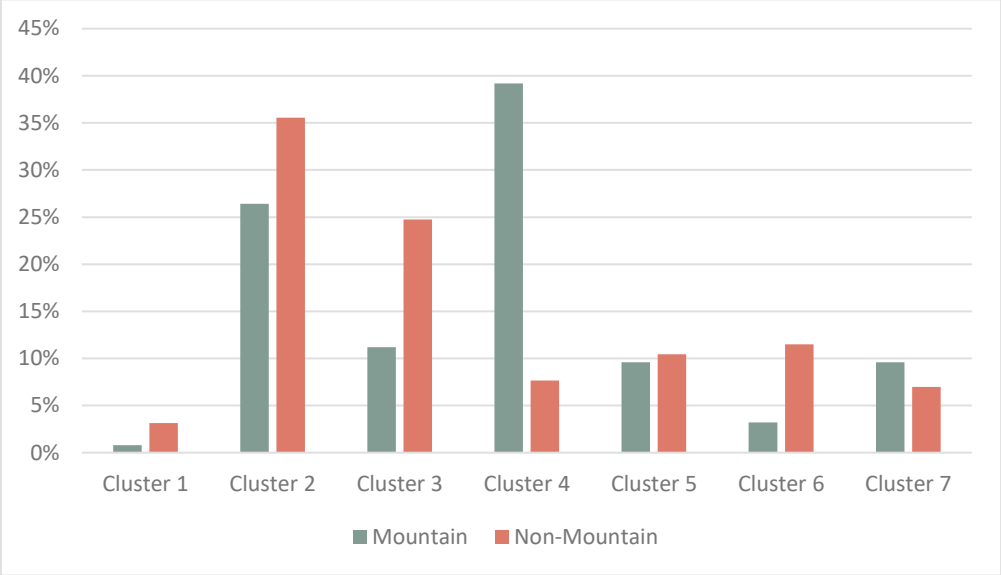


Figure 9.3 Distribution of Social Exclusion Typologies by Mountain and Non- Mountain Region

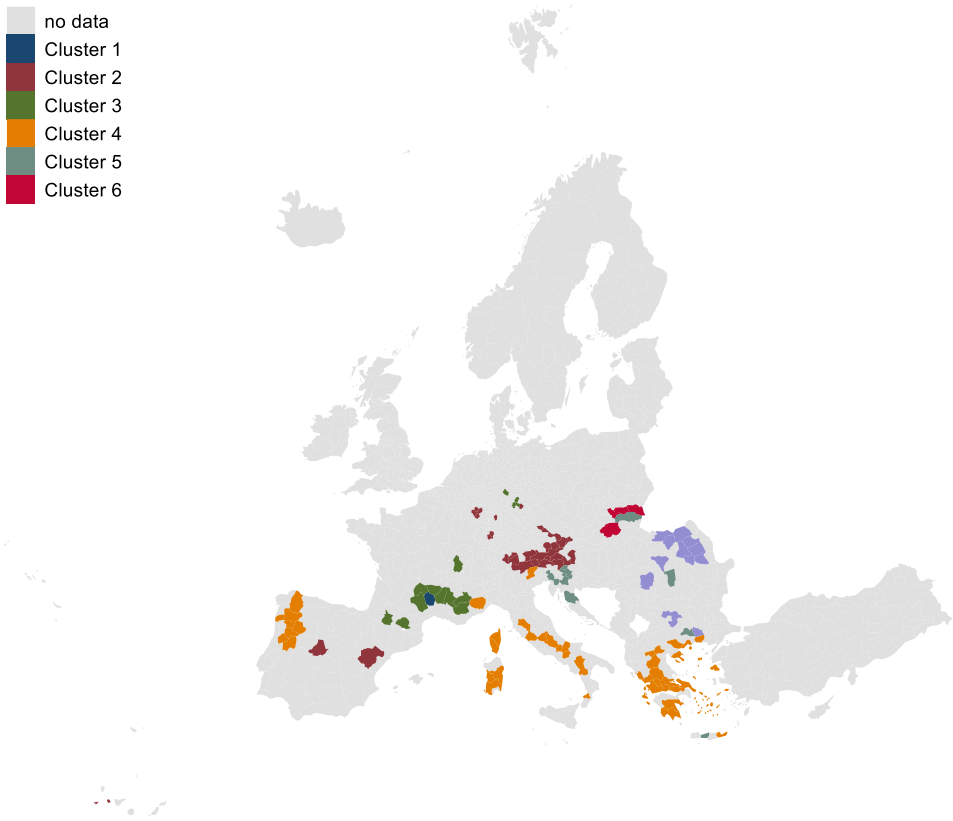


Figure 9.4 Social Exclusion Clusters in Mountain Regions

10. Conclusion

This deliverable provides a comprehensive typology of rural regions in Europe, with a specific focus on social exclusion and wellbeing. Through a carefully designed, data-driven approach combining principal component analysis, and k-means clustering, with a fuzzy approach to delimit uncertain regions, and subsequently validated through a dedicated workshop with consortium experts, we identified meaningful territorial patterns and classifications that reveal the multidimensional nature of rural disparities. The results contribute directly to the goals of the INSPIRE project, offering both an empirical framework and policy-relevant insights for understanding and addressing rural vulnerabilities.

A central contribution of this work is the integration of both NUTS3 and NUTS2 scales into the typology. At the NUTS3 level, the analysis delivers a granular view of rural heterogeneity, offering a highly localised understanding of social exclusion dynamics. Despite being constrained by a limited set of indicators—primarily due to data availability at this finer spatial scale—the typology reveals clear patterns of inequality, from the productive but demographically ageing regions of Western Europe to peripheral territories in Eastern and Southern Europe marked by low wellbeing outcomes, poor service accessibility, and limited institutional capacity. These findings support the need to move beyond the traditional rural–urban dichotomy and instead recognise rural Europe as a complex, diversified landscape of development challenges.

At the NUTS2 level, the use of a broader range of indicators enabled a more nuanced analysis of wellbeing and exclusion, incorporating domains such as governance quality, education, and health-related risks. This expanded typology provided a more comprehensive picture of territorial vulnerabilities, albeit at the cost of losing some of the local precision offered by the NUTS3 analysis. However, the consistency between typologies across scales suggests that both levels offer complementary insights, rather than competing classifications.

The comparison between restricted and expanded indicator sets also highlighted the value of multidimensional approaches. While the restricted indicator set—available at NUTS3—captured core socioeconomic and demographic patterns, it failed to account for deeper structural determinants of exclusion such as access to education and mental health risks. These limitations were especially evident in the misclassification of several regions when moving between the two typologies. The results underline the importance of investing in improved rural data infrastructures, particularly to enhance availability at finer spatial resolutions.

The typologies developed here also offer significant policy utility. We assume that they are a solid but not finished empirical exercise. As it will subsequently serve as the first component of the Rural Social Inclusion Policy Dashboard, comments and further validation from stakeholders and policymakers will improve the final results, allowing for a more solid basis for analysis. They will provide a spatial framework to guide territorial cohesion policies and rural development strategies under the EU's long-term vision for rural areas. The classification system allows for targeted interventions tailored to the specific characteristics and needs of each cluster, rather than adopting one-size-fits-all solutions. For example, regions in Cluster 1 may require support for ageing and healthcare infrastructure, while those in Clusters 6 and 7—especially in Eastern Europe—demand urgent investments in basic services, governance, and economic diversification.

In conclusion, the results of this deliverable stress the need for integrated, territorialised policy responses to social exclusion in rural Europe. They also show that spatial scale and indicator scope are not substitutes, but dimensions to be combined to fully capture the complexity of rural realities. The proposed typologies thus lay the foundation for further analytical and policy work within INSPIRE

and offer a replicable model for future efforts to map territorial inequalities and promote inclusive rural development across Europe.

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12. Appendix 1. PCA for NUTS3 regions in Europe

To find the discriminatory power of the PCA technique, a basic reduction of the dimensionality analysis for all NUTS3 regions in Europe is made. The first 6 components have an eigenvalue higher than one, summing 72% of the total variance. **Figure 12.1** displays the screen plot and the rotated first two components, while **Table 12.1** reports the correlation of the indicators with the rotated components. Even if the PCA is mainly instrumental, we can briefly summarise the results.

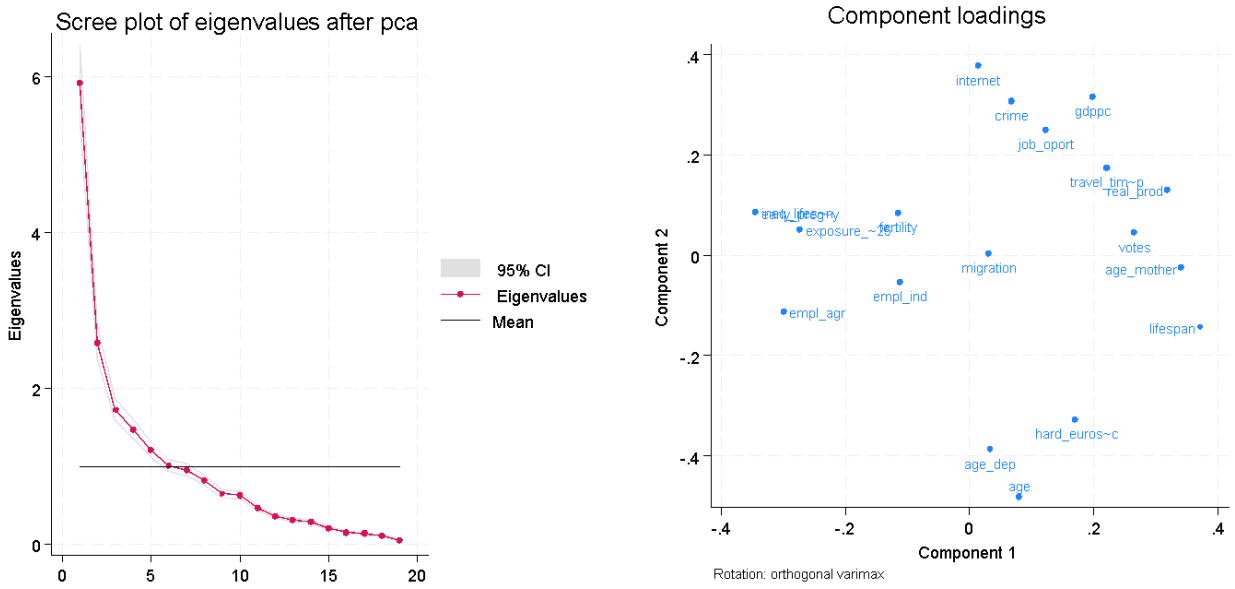


Figure 12.1. Principal Component Analysis: Scree Plot and Variable Loadings of the first two components (Varimax Rotation).

- **Component 1 – General Wellbeing and Socioeconomic Advantage**: This component loads positively on lifespan, real productivity, GDP per capita, and the average age of mothers at birth, while displaying strong negative correlations with early pregnancy, gender inequality in lifespan, and PM2.5 exposure. It differentiates regions with higher economic output and better health outcomes from those characterised by early childbearing, environmental risk, and demographic disadvantage.
- **Component 2 – Demographic Maturity and Civic Engagement:** Component 2 is most strongly associated with median age, age dependency ratio, and electoral turnout, indicating older populations with active civic participation. It also shows a positive correlation with levels of Euroscepticism and a negative correlation with internet connectivity and GDP per capita. This suggests a divide between ageing, politically engaged regions and younger, more digitally connected ones.
- **Component 3 – Family and Fertility Profile**: Defined by strong positive correlations with fertility rate and age dependency ratio, and a negative association with the average age of mothers at birth, this component captures regions with younger family structures and higher birth rates. It reflects demographic dynamism but may also signal challenges related to early motherhood and dependent populations.

- **Component 4 – Industrial Employment and Institutional Trust**: This dimension load heavily on employment in industry, electoral turnout, and criminality, while being negatively associated with lifespan and internet connectivity. It represents regions with a strong industrial base and traditional civic structures, but with lower digital infrastructure and potentially reduced health outcomes.
- **Component 5 – Socio-political Discontent vs. Opportunity**: This component combines high loadings for job opportunities, pollution exposure (PM2.5), and electoral turnout, with a negative association to employment in industry. It suggests territories where economic opportunity may coincide with political disaffection and environmental pressure. potentially revealing underlying tensions in development models.
- **Component 6 – Labour Market Periphery and Migration Dynamics**: Primarily defined by strong positive correlation with job opportunities and the presence of mobility-related variables (e.g. net migration. early pregnancy), this component also shows positive associations with employment in agriculture and GDP per capita. It may reflect peripheral regions adjusting to labour market dynamics, migration flows, and demographic shifts.

Table 12.1. PCA results: correlation of rotated components.

	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
GDP per capita in PPS	0.2212	-0.2939	-0.0106	-0.0942	0.2691	0.2795
Real Productivity per Hour	0.3281	-0.1221	0.2565	0.0084	0.0641	0.0023
Job Opportunities	0.1134	-0.2227	0.0564	-0.183	0.3069	0.5524
Employment in Agriculture	-0.3113	0.0849	-0.0602	0.0101	-0.1713	0.2956
Employment in Industry	-0.121	0.0034	0.0736	-0.4352	0.3509	-0.3039
Population living in <15 min from hospital	0.2377	-0.1405	0.1233	0.0747	0.3325	-0.1083
Internet Connectivity	0.0481	-0.327	-0.0095	0.3567	-0.0457	-0.0691
Exposure PM2.5	-0.263	-0.0177	-0.3206	0.0157	0.4015	-0.0105
Fertility Rate	-0.1123	-0.106	0.5806	0.1937	0.0976	-0.1953
Median Age	0.0376	0.444	0.1779	-0.2253	-0.023	0.2103
Age Dependency Ratio	0.0013	0.3707	0.4768	0.0956	0.0206	0.1537
Average age of mother at birth	0.3421	0.0464	-0.303	-0.0361	-0.1863	0.1125
Early Pregnancy	-0.3427	-0.1044	0.1806	0.1154	0.047	0.1495
Crude rate of net migration	0.0300	-0.0088	-0.0009	0.0111	-0.176	-0.3839
Lifespan	0.3633	0.1672	-0.0437	0.1224	-0.2015	0.0864
Gender inequality in Lifespan	-0.3208	-0.074	-0.1181	0.0698	0.0541	0.0221
Criminality (robberies)	0.0936	-0.2773	0.0746	0.3759	-0.0796	0.0948
Eurosceptic votes	0.0341	0.2779	-0.2439	0.462	0.3472	-0.1253
Electoral Turnover	0.1598	0.4079	-0.0494	0.2636	0.3816	0.0334

We next summarise the results of the PCA by type of region in **Table 12.2.** The table presents the mean scores for each principal component (PC1 to PC6) across three regional typologies: Urban, Intermediate, and Rural. These scores reflect how each type of region is positioned along the six latent dimensions extracted via PCA.

Table 12.2. Mean Principal Component Scores by Regional Typology (Urban. Intermediate. Rural).

	Typology				
	Urban	Intermediate	Rural		% Variance
PC1	1.629	0.105	-1.084		0.283
PC2	-0.797	0.018	0.444		0.141
PC3	-0.491	0.017	0.266		0.087
PC4	0.461	-0.005	-0.263		0.083
PC5	0.236	0.112	-0.278		0.069
PC6	-0.053	-0.139	0.204		0.056

The results show a clear urban–rural divide in the first principal component, which captures general wellbeing and socioeconomic advantage. Urban regions score well above average, while rural areas lag significantly behind. Intermediate regions remain close to the mean across most components, reflecting their transitional character.

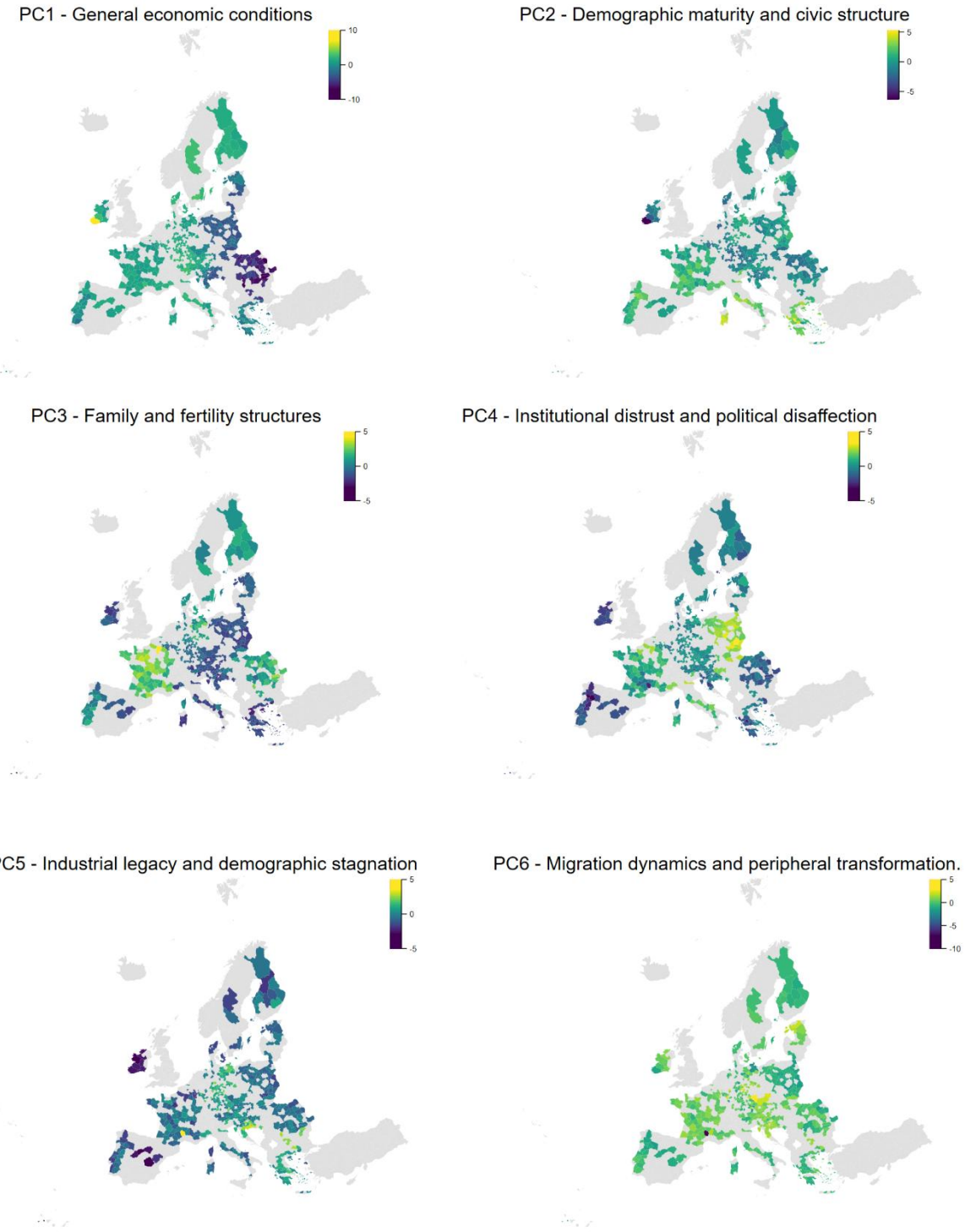
Rural areas stand out positively in components linked to demographic maturity and fertility patterns but tend to score negatively in those related to institutional trust, industrial employment, and socio-political alignment. Urban regions, by contrast, perform better in economic, health, and civic dimensions but show lower scores in demographic ageing and traditional family structures.

Overall, the typology reveals distinct spatial profiles, with urban regions concentrating advantage, rural areas reflecting demographic and social specificity, and intermediate regions occupying a middle ground.

Overall, the principal components reflect a clear gradient: urban regions dominate on prosperity-related dimensions, rural areas concentrate demographic and social vulnerabilities, and intermediate regions occupy a nuanced, less polarised middle ground. With this brief exercise we show that the use of PCA can discriminate between types of regions, what is our interest.

13. Appendix 2. Partial results of NUTS3 regions typology

Figure 13.1. Spatial distribution of every Principal Component by NUTS3 rural regions.



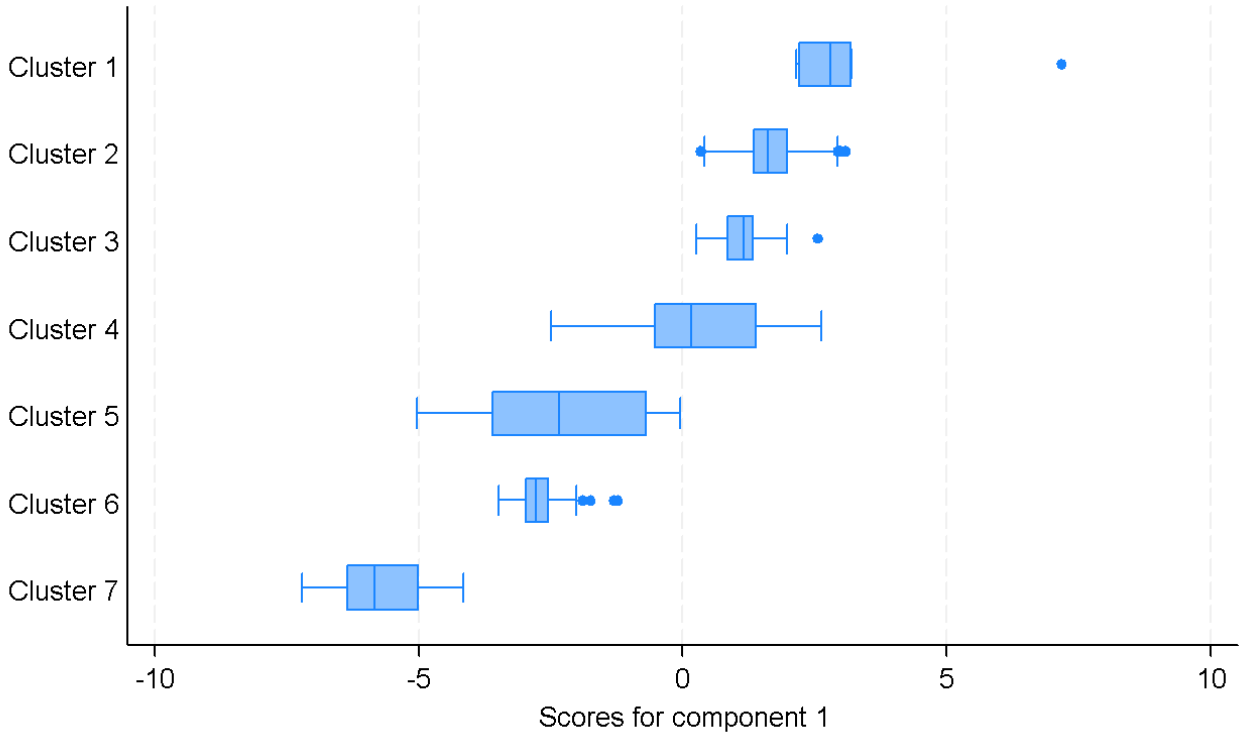
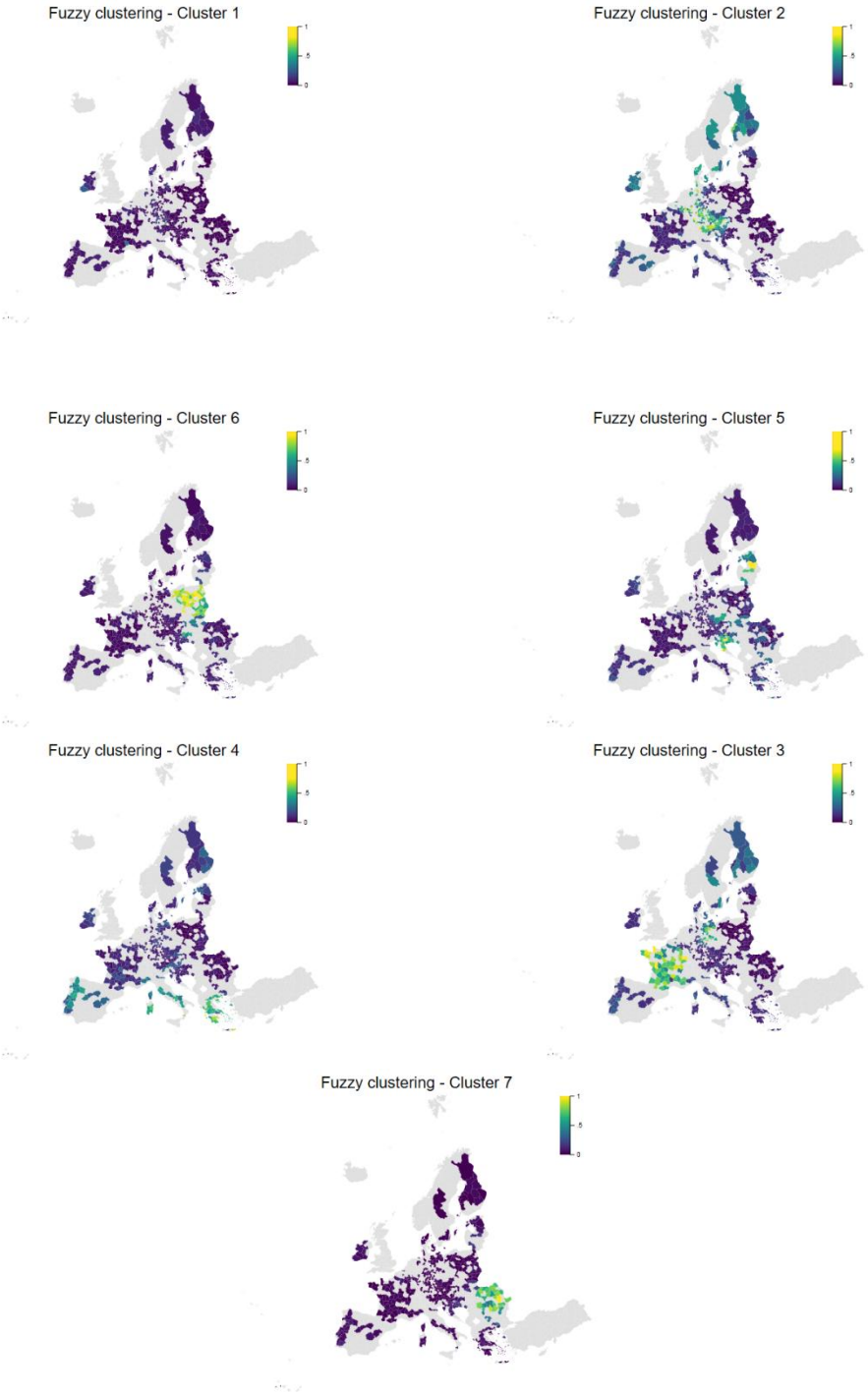


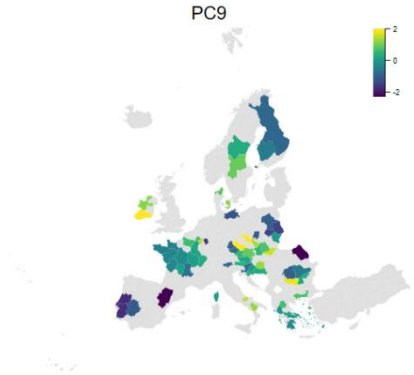
Figure 13.2. Spatial distribution of every Principal Component by NUTS3 rural regions.

Figure 13.3. Fuzzy membership of European NUTS3 Regions to the defined Clusters.



14. Appendix 3. Partial results of NUTS2 regions typology

Figure 14.1. Spatial distribution of every Principal Component by NUTS2 rural regions.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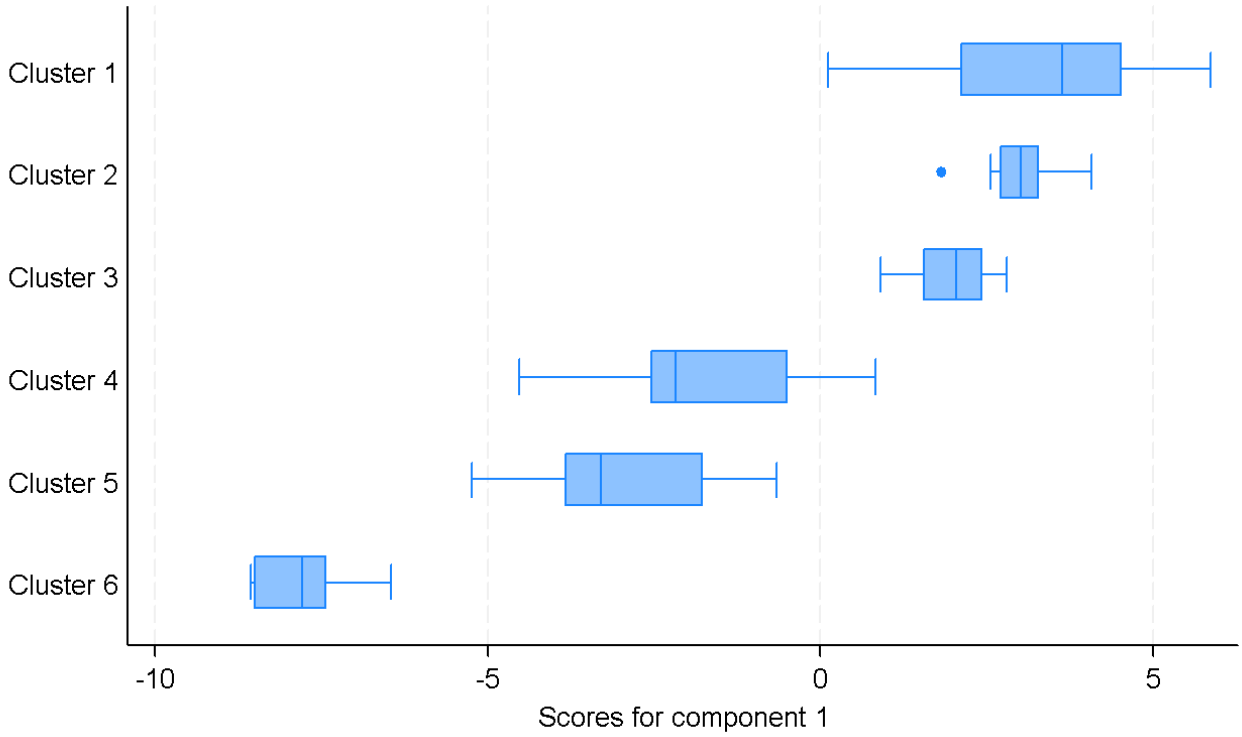

Figure 14.2. Spatial distribution of every Principal Component by NUTS2 rural regions.

Figure 14.3. Fuzzy membership of European NUTS2 Regions to the defined Clusters.

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