European Journal of Geography

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Received: 27/10/2025
Revised: 07/02/2026
Revised: 25/03/2026
Accepted: 27/03/2026
Published: 28/03/2026

Editor:
Dr. Alexandros Bartzokas-Tsiompras

Research Article

A Comparative Assessment of Spatial Factors Influencing Women's Access to High-Skilled Employment in Albania, Bulgaria, and Türkiye

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Abstract: Women's labor force participation remains limited in many parts of Southeast Europe and surrounding regions, including Albania, Bulgaria, and Türkiye. While prior research has examined social and institutional drivers of low female labor force participation, the influence of geographic factors on women's access to employment has received comparatively less attention. This study addresses that gap by applying the Geospatial Women's Employment Analytical Framework (GeoWEAF) to assess how place-based factors shape women's high-skilled employment opportunities in Albania, Bulgaria, and Türkiye. These countries were selected due to their shared challenges in advancing gender equality in employment, as well as their differing institutional contexts, development trajectories, and stages of European Union integration, making them a valuable basis for comparative analysis. This application modifies the original framework by excluding the environmental hazards factor, given its ambiguous and non-directional effects, and by introducing spatially disaggregated representations of attitudes toward women in STEM and digital inclusion, which were originally applied at the national level. It also revises the methodology for assessing active transport to address data limitations and adjusts both the scoring and weighting schemes to better capture the contextual and spatial variation in the selected countries. The analysis reveals that, although urban areas generally exhibit higher levels of enablement, substantial intra-urban variation persists, with some areas within cities displaying levels of enablement comparable to rural regions. These findings highlight the importance of incorporating spatial analysis into gender and labor market research. Mapping underserved areas in services and infrastructure, and those exhibiting heightened vulnerability to risks, can enhance the targeting of interventions to accelerate women's inclusion in the workforce.

Keywords: women; employment; spatial analysis; Albania; Bulgaria, Türkiye

Highlights:

- This study used GeoWEAF to examine spatial inequalities in women's access to high-skilled employment.
- The results reveal persistent spatial disparities, including within major urban areas.
- Spatial analysis should play a central role in gender-focused labor diagnostics to inform inclusive development policies.

DOI: 10.48088/ejg.c.may.17.1.093.120
ISSN: 1792-1341
E-ISSN: 2410-7433

1. Introduction

Research suggests that women experience and perceive spaces differently from men (Pereira & Rebelo, 2024). For instance, women are more likely to take into account factors such as safety, lighting, and visibility when navigating public

spaces (Mayen Huerta & Cafagna, 2021; Navarrete-Hernandez et al., 2021), which can strongly influence their mobility choices, daily travel routines, and access to economic, educational, and recreational opportunities (Lino & Kanashiro, 2024). Moreover, social roles related to caregiving and household responsibilities, often undertaken by women, require them to make trips that serve multiple purposes, such as childcare, shopping, and healthcare visits, resulting in more complex travel patterns (Hanrahan, 2018; Mahadevia & Advani, 2016). Due to these variations in needs and travel patterns, studies have observed that women are more likely than men to accept lower wages for shorter commutes or part-time positions, which may facilitate the management of household responsibilities or reduce exposure to certain risks (Farré et al., 2023; McQuaid & Chen, 2012).

Nonetheless, even with the growing body of evidence linking spatial characteristics of living environments to women's economic empowerment (Banks et al., 2022), place-based factors are frequently overlooked in traditional gender-focused labor market analyses (Bimrose et al., 2015; Harris & Short, 2014). Conventional approaches tend to prioritize individual-level characteristics, aggregated economic indicators, or sector-specific trends, while often leaving location-specific characteristics underexamined (Harris & Short, 2014). The absence of a geospatial lens restricts comprehensive insight into the mechanisms through which distance, commuting behaviors, and the unequal spatial distribution of employment opportunities may affect women's workforce participation (Banks et al., 2022). To address this gap, this study aims to examine how spatial factors influence the extent to which a region enables women's access to employment in three countries: Albania, Bulgaria, and Türkiye. All three countries were part of the Ottoman Empire and continue to face persistent challenges in women's labor force participation, while differing markedly in gender norms, governance structures, and economic trajectories, including their levels of integration into the European Union (EU). This study will focus on high-skilled employment, defined as occupations that require advanced education and specialized training, typically corresponding to professional, managerial, and technical roles (ISCO major groups 1–3) (ILOSTAT, 2026). These occupations are generally associated with higher wages, greater employment stability, and clearer career progression pathways (Schwartz, 2016), which make them particularly relevant for understanding disparities in access to more secure and upwardly mobile forms of employment. The primary research questions informing this study are: (i) Which spatial factors constrain women's economic empowerment in each context, and (ii) in what ways do the selected countries differ with respect to the spatial factors influencing women's high-skilled employment? To answer these two questions, the present analysis applied the Geospatial Women's Employment Analytical Framework (GeoWEAF), a novel framework that suggests the evaluation of 15 key spatial factors to assess how supportive a location is of women's access to high-skilled employment (Mayen Huerta et al., 2025). The framework was adapted to reflect the specific contexts of the countries studied. We applied a two-tiered analysis. First, we assessed the enabling conditions in each country at a spatial resolution of 100 by 100 meters. Then, we analyzed how these conditions varied by level of urbanization, distinguishing between urban, peri-urban, and rural contexts. This approach enabled us to identify spatial inequalities in access to services and infrastructure across different settlement types and, critically, to compare how such territorial patterns differ among the three countries, thereby addressing the cross-national dimension of the second research question.

2. Literature Review

Women's economic participation is broadly acknowledged as a fundamental driver of sustainable development, fostering economic growth, enhancing productivity, and advancing social equity (Ogbari et al., 2024). Nevertheless, despite these recognized benefits, female participation rates in employment often remain lower than those of men, with gender gaps in labor market engagement persisting in several regions and sectors (Desai & Joshi, 2019). This underrepresentation often constrains economic performance, undermines household income security, and reinforces existing social inequalities (Klasen, 2018). Furthermore, it diminishes the efficacy of demographic and social policies, undermines the tax base essential for maintaining welfare systems, and restricts the transfer of economic benefits to subsequent generations (Johnston & Yarrow, 2024). As such, addressing persistent gender disparities in employment is not only a matter of equity but also a prerequisite for achieving long-term economic resilience.

Notably, the Balkans represent a region characterized by markedly low rates of female labor force participation, recording the lowest levels of women's workforce engagement in Europe (Gashi et al., 2019; Rexhepi & Vataj, 2023). Despite recent improvements in women's educational attainment and the introduction of legal frameworks promoting gender equality in employment across the region, these advances have not translated into a corresponding increase in women's labor market engagement (Tahiri & Kovaci, 2024). For instance, data from the International Monetary Fund

https://doi.org/10.48088/ejg.c.may.17.1.093.120

show female labor force participation rates of around 45 % in most Balkan countries, with countries such as Kosovo reporting rates below 20% (Kapsoli & Mohona, 2025). This disparity is even more pronounced in high-skilled employment, including Science, Technology, Engineering, and Mathematics (STEM) fields, where wage gaps relative to men are often wider (Imdorf et al., 2015). Such disparities carry significant implications for economic development and social inclusion in the region, underscoring the need to examine the underlying conditions that continue to restrict women's participation in the labor market.

Research suggests that one factor that may hinder Balkan women's participation in the workforce is a persistent gender wage gap, which discourages labor market entry, limits long-term career advancement, and reduces incentives for women to invest in their professional development (Blau & Kahn, 2017). A recent study by Rexhepi and Vataj, involving 11 Balkan countries, found that approximately two-thirds of employed women work in the public sector or in sales (Rexhepi & Vataj, 2023). The study also reported that women earn, on average, salaries that are 11% lower than those of men with comparable job responsibilities and professional training. These findings are consistent with evidence from a study conducted in Serbia, North Macedonia, and Montenegro, which reported gender pay gaps of 11%, 13.4%, and 17.9%, respectively (Avlijaš et al., 2013). Similarly, a study conducted in six Western Balkan countries found that, between 2015 and 2019, women, on average, earned up to 16% less than men in similar job positions (Ilić, 2022). These disparities influence women's perceptions of fairness and their motivation to seek employment. For example, a 2022 study conducted across five Balkan countries (Bulgaria, Slovenia, Croatia, Montenegro, and Serbia) found that women generally perceive their incomes as less fair than those of men, decreasing their incentive to work (R. Stoilova & Kaloyan, 2022).

Additionally, several studies also allude to discriminatory social norms as a key factor contributing to the notably low female labor force participation rates in the region (Ilić, 2022). A study conducted in North Macedonia found that gender stereotypes and prevailing cultural norms related to childcare responsibilities negatively affect women's participation in paid employment and contribute to their decisions to remain economically inactive (Petreski et al., 2025). Likewise, evidence from Bosnia and Herzegovina suggests that social norms contribute to increasing gender inequality, reflected in low female labor participation, higher unemployment among women, and disparities in occupations and positions (Bučan & Ramić-Mesihović, 2023). In Bulgaria, regional disparities in upper secondary vocational education, shaped by gender stereotypes, influence patterns of industrial specialization and perpetuate unequal opportunities, including the continued gender segregation seen especially in engineering and technical domains (Imdorf et al., 2015). These inequalities endure despite comprehensive national legislative frameworks promoting gender equality and a growing recognition of women's role as decision-makers (Feenstra, 2021).

The evidence presented above suggests that social norms and unequal institutional frameworks remain significant factors restricting women's access to employment in the Balkans. However, these observations are not exhaustive. Despite the EU membership of some Balkan countries, which has strengthened legislative frameworks and promoted alignment with European gender equality standards, female labor force participation in these nations has not seen a substantial increase (R. Stoilova & Kaloyan, 2022). For instance, in Croatia, gender equality has been shaped by EU accession and the efforts of both state and civil society actors, resulting in certain advances, such as generous maternity leave allowances relative to other EU countries (Robayo et al., 2020). Nevertheless, female labor force participation remains low, at around 48% (Robayo et al., 2020). This rate is similar to that of Romania (49%), another EU member state in the Balkans. In Romania, women's labor market participation also lags behind the EU average (70%), despite the presence of formal legislative commitments to gender equality (Jaba et al., 2017; World Bank, 2024a).

Evidence from other contexts suggests that place-based factors, such as access to services and infrastructure, may play a decisive role in shaping women's labor market participation by influencing both the opportunities available and the constraints on their mobility (Jaba et al., 2017). For example, a literature review of evidence from the United States found that access to reliable transport is associated with improved employment outcomes for women (Bastiaanssen, 2020). Likewise, a study examining the relationship between transport infrastructure and women's employment in India found that access to paved or unpaved roads, as well as frequent bus services, increased the likelihood of women's participation in nonagricultural employment (Jaba et al., 2017). Similarly, evidence from Spain suggests that low perceptions of street safety, a place-based factor, restrict women's commuting options and limit their access to certain employment opportunities (Casado-Díaz et al., 2023). Nonetheless, although an expanding body of research links spatial factors to women's economic participation, to the best of our knowledge, no geospatial analyses of employment have been conducted in the Balkans or surrounding regions to date. This constitutes a significant gap in the literature, given

https://doi.org/10.48088/ejg.c.may.17.1.093.120

the region's distinct labor market dynamics and persistent gender disparities. Therefore, addressing this gap is crucial, as spatial analysis can provide valuable insights into how geography shapes women's access to employment opportunities and highlight place-based barriers to economic inclusion (Franklin et al., 2023).

3. Countries Studied

This research adopts a case study approach, focusing on Albania, Bulgaria, and Türkiye, to examine the spatial dimensions of women's economic participation in high-skilled employment. Albania and Bulgaria were selected as case studies because they are both located in the Balkan region and exhibit similarly low levels of female labor force participation, despite following distinct economic and political trajectories. Albania, a post-socialist country and official candidate for EU membership since 2014, faces institutional weaknesses, widespread informality, and limited foreign investment, all of which constrain the pace of its economic transformation (Luli, 2024). As of 2024, female labor force participation was estimated at 53.5%, compared to 68.2% for men (World Bank, 2025). Notably, 50.2 % of this employment is categorized as vulnerable, significantly exceeding the regional average of 11.5 % observed for women in Europe and Central Asia (World Bank, 2025). Bulgaria, a member of the EU since 2007, has undertaken significant institutional reforms and deepened its integration into EU economic structures (Zhelev, 2025a), yet female labor force participation remains low at 50.9 % (World Bank, 2025). Only 6.1 % of female employment in Bulgaria is classified as vulnerable, suggesting more stable job conditions compared to Albania. This relative stability, however, has not resulted in gender parity, as women continue to face persistent gender wage gaps and are disproportionately concentrated in lower-paid sectors (Ligocká, 2022). Notably, both countries have experienced stagnant growth in female labor force participation since the 1990s (see Table A.1, Appendix).

Türkiye, on the other hand, was included in the analysis due to its historical, economic, and political ties to Southeast Europe, as well as its status as an EU candidate country since 1999. While most of its territory lies in Asia, Türkiye shares demographic characteristics and labor market challenges with the Balkan states. As of 2024, the female labor force participation rate was 36.3 % (World Bank, 2025), reflecting the influence of restrictive gender norms and limited childcare provision (Aktaş & Uysal, 2016; Selim & Kaya, 2018). Similar to Albania and Bulgaria, women's economic participation has remained stagnant since the 1990s (see Table , Appendix), although at a significantly lower rate. The inclusion of Türkiye in the analysis provides a more comprehensive comparative perspective on how spatial factors influence women's access to employment in countries that share a legacy of Ottoman rule and regional dynamics, yet differ significantly in their stages of integration into the EU.

In addition to differing levels of EU integration, prevailing gender norms also vary across the three countries, offering a meaningful basis for comparison. In Türkiye, traditional expectations continue to associate women predominantly with caregiving and domestic roles (Cuberes & Teignier, 2016; Yılmaz Fındık, 2025). A review of 10 studies published from 2008 to 2025 found that enduring patriarchal norms, including traditional domestic gender roles, religious influences, institutional shortcomings, and restricted access to childcare and parental leave, continue to obstruct Turkish women's participation in the labor force (Bilici, 2025). These barriers are particularly evident in rural areas and among lower-income households, where societal attitudes often discourage women from seeking employment outside the home (Bilici, 2025). In Albania, research suggests that the social and economic transformations following the collapse of the socialist regime reinforced gender stereotypes and reversed earlier gains in women's education, employment, and participation in public life (Vullnetari & King, 2016). Finally, in Bulgaria, recent national research shows that patriarchal gender-role stereotypes persist across generations, with older adults displaying stronger traditional views on family roles, while younger cohorts demonstrate more egalitarian attitudes shaped by exposure to democratic values and education (Manolov et al., 2023). The latter suggests the potential for long-term normative change that could support greater gender equality in high-skilled employment.

In terms of governance structures, Albania has undergone significant decentralization reforms since 2015, including the consolidation of local government units into 61 municipalities and the adoption of a new legal and fiscal framework to support local self-governance (Toska & Bejko Gjika, 2019). While these reforms represent a shift toward greater local autonomy, evidence suggests that disparities in administrative capacity and financial resources across municipalities continue to affect the delivery of public services and infrastructure at the local level (Hegele et al., 2024). In Bulgaria, evidence indicates that EU structural funds have supported growth in regional GDP, employment, investment, and household income since 2007 (D. Stoilova, 2025). However, regional disparities persist, as more developed regions absorb more funding. Türkiye operates under a unitary governance system, with central control over planning and service

provision (Sezgin, 2018). Regional inequalities remain significant, with western and coastal areas benefiting from stronger infrastructure and investment, while eastern and southeastern regions face underdevelopment (Sakarya, 2025).

These governance and cultural differences intersect with broader structural dynamics in shaping women's employment. In Albania, delayed economic diversification and limited integration into global value chains have hindered the development of labor-intensive sectors that traditionally absorb female labor, such as textiles or services (Ilahi et al., 2019). In Bulgaria, integration into the EU has facilitated institutional modernization, yet labor market flexibilization and emigration have also contributed to job polarization, disproportionately affecting women with lower qualifications (Zhelev, 2025b). Türkiye presents a different institutional trajectory, where rapid urbanization and industrial growth have expanded job opportunities in certain urban regions, but without a corresponding expansion of care infrastructure or gender-equal labor protections (Bilici, 2025). The country's dualistic labor market, with a small formalized core and a large informal periphery, continues to reinforce gender inequalities, especially in regions outside the industrialized West (Arslan, 2020). The common regional influences, differing degrees of EU integration, and unique institutional and cultural settings make these three countries compelling subjects for comparative analysis.

4. Materials and Methods

This study adopts the GeoWEAF as its primary theoretical and analytical framework. Developed through a comprehensive literature review, the framework identifies spatial factors that influence women's economic opportunities and examines how these factors have been conceptualized and measured in empirical research (Mayen Huerta et al., 2025). Through thematic analysis, 15 factors were identified and organized into three overarching dimensions (see Table 1).

Table 1. GeoWEAF dimensions and factors (Mayen Huerta et al., 2025)

Dimension	What it measures	Factor	What it measures	Why it matters
Contextual Dimension (CD)	Assesses legal provisions that influence gender equality in the workforce.	1.1 Workplace discrimination	The 2024 Women, Business and the Law (WBL) "Workplace" score, capturing legal provisions related to gender equality in employment.	Determines whether the law ensures equal employment by allowing women to work on the same terms as men, prohibiting discrimination, and supporting flexible working arrangements.
		1.2 Regulatory frameworks	The average of the 2024 WBL "Pay" and "Parenthood" indicators, reflecting legal provisions on equal pay and parental leave.	Reflects the extent to which laws promote fair pay, equal access to all types of work, and support continued employment through parental leave and protection during pregnancy.
		1.3 Financial inclusion	The 2024 WBL "Entrepreneurship" indicator, reflecting legal conditions for women to start and operate businesses.	Assesses whether laws and policies support women's ability to start and run businesses, and the extent to which these are effectively implemented.
Accessibility Dimension (AD)	Examines the proximity to essential services.	2.1 Women's travel patterns (WTP)	Catchment areas from key services associated with caregiving responsibilities, derived through network analysis.	Shapes the spatial limits of women's daily mobility.
		2.2 Access to public transportation	Catchment areas from public transport stops derived using network analysis.	Enables physical connectivity to essential services and destinations.
		2.3 Access to education and training facilities	Catchment areas from tertiary education and specialized training facilities derived using network analysis.	Facilitates access to skills development and qualification opportunities.

https://doi.org/10.48088/ejg.c.may.17.1.093.120

		2.4 Access to healthcare facilities	Catchment areas from healthcare facilities derived using network analysis.	Supports the ability to address health needs without disrupting daily activities.
		2.5 Access to financial facilities	Catchment areas from financial institutions derived using network analysis.	Enables engagement with financial systems necessary for economic participation.
Place Characterization Dimension (PD)	Focuses on the physical, social, and environmental features of a location that enable mobility, inclusion, and connectivity.	3.1 Active transport	Road segment suitability for active transport based on road classification, surface type, and the presence of pedestrian and cycling infrastructure.	Affects local connectivity and the ability to access nearby services and workplaces without reliance on private transport.
		3.2 Safety perception	Buffers around streetlights, used as a proxy for nighttime safety.	Public lighting determines the perception of safety and usability of urban spaces for women at night, thereby influencing their mobility patterns and their ability to commute to and from work.
		3.3 Fragility, conflict, and violence (FCV)	Buffers around ACLED events, with radii adjusted according to event intensity.	Limits the availability of stable employment environments and disrupts access to workplaces and services.
		3.4 Attitudes towards women in STEM	Women's educational attainment in STEM fields within populated areas.	Influences whether women pursue and are accepted into high-skilled and male-dominated occupations.
		3.5 Digital inclusion	Internet connectivity availability, measured using Ookla polygons.	Enables participation in knowledge-based, remote, and technology-driven employment and supports job search and recruitment processes.
		3.6 Water and sanitation	Buffers around points of interest, including public taps, wells, and other community water sources.	Reduces time burdens associated with domestic tasks, freeing time for education and employment.
		3.7 Environmental hazards (*Excluded from the analysis*)	Exposure to environmental risks such as floods, landslides, or extreme events using raster global datasets.	Can disrupt infrastructure, mobility, and access to workplaces, although effects vary depending on the local context.

The novelty of the framework lies not in establishing relationships between spatial factors and employment outcomes, but in synthesizing the literature to determine the factors that constitute an enabling environment for women's access to employment and translating these into a composite index. GeoWEAF's objective is to complement existing approaches by incorporating a spatial lens that enhances analytical depth and reveals patterns and constraints that might otherwise remain obscured in conventional labor market assessments.

To generate the index score, all computed factors are resampled and converted to raster format at a resolution of 100 by 100 meters, ensuring consistency across datasets. Each dimension score is calculated as the average of its underlying factors, and the composite GeoWEAF score is derived as the arithmetic mean of the three dimension scores: (CD + AD + PD) / 3. However, the authors of GeoWEAF emphasize that the weights assigned to both the dimensions and the individual factors should be adapted to the specific context under analysis. This is because certain components may carry more significance in some settings than in others (Mayen Huerta et al., 2025). In line with this recommendation, and to better reflect the characteristics of the study area, we placed greater emphasis on the two dimensions that offer more spatial detail and variation, namely AD and PD. Based on this rationale, we adjusted the weights assigned to each dimension as follows:

$$GeoWEAF = 0.45*AD + 0.45*PD + 0.10CD$$

https://doi.org/10.48088/ejg.c.may.17.1.093.120

Notably, each factor is scored on a standardized scale from 0 to 5. As a result, the final index value also falls within this range. Although the index score is calculated as a continuous variable, the final output is categorized into five discrete enablement classes. The interpretation of these classes is shown in Table 2:

Table 2. GeoWEAF score interpretation

Score Range	Score Interpretation
0 to 1	The location has very low levels of enablement for women's access to employment.
1.1 to 2	The location has low levels of enablement for women's access to employment.
2.1 to 3	The location has moderate levels of enablement for women's access to employment.
3.1 to 4	The location has enabling conditions for women's access to employment.
4.1 to 5	The location offers highly enabling conditions for women's access to employment opportunities.

To date, the framework has been applied only in the context of Saint Lucia. This study represents the first effort to adapt it to a broader regional setting and to employ it in a comparative analysis. The following sections outline the methodology used to calculate each dimension along with its corresponding factors.

4.1. Contextual Dimension Methodology

To assess the Contextual Dimension, GeoWEAF draws on the Women, Business and the Law (WBL) dataset, which provides standardized and internationally comparable indicators of the legal frameworks shaping women's economic opportunities (World Bank, 2024b). To evaluate the first CD factor, workplace discrimination, the 2024 WBL score for "workplace" was used. The assessment of regulatory frameworks was based on the average of the 2024 WBL "pay" and "parenthood" indicators, which capture legislative differences related to equal pay and parental leave. For the financial inclusion factor, the 2024 WBL "entrepreneurship" indicator was used, as it reflects the extent to which legal systems enable women to start and operate businesses.

The GeoWEAF methodology recommends applying a linear interpolation of the source indicators to a standardized scale from 0 to 5. However, after reviewing the WBL methodology and results, we observed that the distribution of scores is not normal but highly skewed toward higher values. This reflects the fact that in most parts of the world, basic rights for working women are already formally recognized in legislation. At the same time, the omission of even one critical regulation may still represent a significant barrier to women's economic participation, a nuance that is not adequately captured through a simple linear transformation.

To address this issue, we modified the conversion system by introducing a non-linear adjustment that assigns greater penalties to missing legal protections (Table 3). Because the WBL indicators capture the legal environment at the national level, the same score was applied uniformly across the entire country. The results were rasterized into a 100 by 100-meter grid to support spatial overlays and the calculation of the final index score.

Table 3. Conversion from 2024 WBL scores to Contextual factor scores

2024 WBL Score	Factor Score	Enablement Level
[100 -95]	5	Highly enabling
[90-95)	4	Enabling
[80-90)	3	Moderately enabling
[75-80)	2	Low enabling
[60-75)	1	Very low enabling
[0-60)	0	Non-enabling

https://doi.org/10.48088/ejg.c.may.17.1.093.120

4.2. Accessibility Dimension Methodology

The Accessibility Dimension was assessed by defining catchment areas around key facilities using network analysis, where the factor score decreased as the catchment area expanded. Table 4 presents the thresholds established to score the AD factors. These thresholds were selected by the GeoWEAF authors based on an extensive literature review, which identified the distances beyond which various facilities are no longer considered accessible by walking (Mayen Huerta et al., 2025). Thresholds differ across facility types, as women's perceptions of accessibility can vary based on the specific purpose and function of each facility (Mayen Huerta, 2022). For instance, women may find longer walks unreasonable when going to supermarkets or public transport stops, but might consider them acceptable when traveling to hospitals (Demsash & Walle, 2023).

All point locations for relevant facilities were extracted from OpenStreetMap (OSM) (OSM, 2025). Importantly, the WTP factor includes the analysis of access to childcare centers, kindergartens, pharmacies, grocery stores, and green spaces. These facilities were deemed relevant, as they reflect the spatial distribution of everyday services that shape women's mobility patterns and influence the time constraints they face in carrying out daily activities. Financial facilities were considered only when they offered in-person banking services; ATMs were excluded. Likewise, education facilities were limited to institutions offering tertiary or specialized education to reflect high-skilled employment requirements. Once the catchment areas were established, the results were rasterized at a 100 by 100-meter resolution for consistency. All five factors were then overlaid, and the average value within each raster cell represented the overall AD score.

Markedly, all facility data obtained from OSM (both for the AD and PD) underwent a quality assessment using the Ohsome Quality API, a tool developed by the Heidelberg Institute for Geoinformation Technology that allows for the analysis of the temporal and spatial evolution of OSM data (HeiGIT, 2026). The API was used to evaluate the currentness and completeness of facility datasets across Albania, Bulgaria, and Türkiye. Results from the quality check indicated that all three countries performed similarly in terms of data coverage and recency. Thus, the consistency provides a reliable foundation for conducting a comparative spatial analysis, as differences observed in the results are less likely to stem from underlying data quality issues.

Table 4. Accessibility scoring system based on proximity to key facilities

Factor score	Women's Travel Patterns (WTP) [distance in meters]	Access to Public Transport [distance in meters]	Access to Health Facilities [distance in meters]	Access to Education Facilities [distance in meters]	Access to Financial Facilities [distance in meters]
5	0 - 400	0 - 250	0 - 2,000	0 - 2,000	0 - 500
4	401 - 800	251 - 500	2,001 - 4,000	2,001 - 4,000	501 – 1,000
3	801 - 1,200	501 - 750	4,001 - 6,000	4,001 - 6,000	1,001 - 1,500
2	1,201 - 1,500	751 - 1,000	6,001 - 8,000	6,001 - 8,000	1,501 - 2,000
1	1,501 - 2,000	1,001 - 1,500	8,001 - 10,000	8,001 - 10,000	2,001 - 3,000
0	Over 2,000	Over 1,500	Over 10,000	Over 10,000	Over 3,000

4.3. Place-Characterization Dimension Methodology

The Place-Characterization Dimension is the most complex and methodologically diverse, as it includes seven distinct factors, each assessed using a different approach. In Mayen et al. (2025), the first factor, active transport, was proposed to be evaluated by assigning scores to raster cells based on the presence of features such as sidewalks, crosswalks, and cycleways. These features are typically extracted from Mapillary, a platform that provides crowdsourced street-level imagery (Mapillary, 2025). However, after analyzing data completeness for these datasets across the three focus regions, we found that coverage was highly inconsistent and, in many areas, significantly incomplete. As noted by Vestena et al. (2023), sidewalks and other features supporting active transport are rarely mapped, despite their importance (De Moraes Vestena et al., 2023).

https://doi.org/10.48088/ejg.c.may.17.1.093.120

As a result, the recommended approach for assessing this factor was adapted, drawing on a method similar to that of Golan et al., who developed an index to evaluate how suitable roads are for women walking, scoring individual road segments accordingly (Golan et al., 2019). In this approach, first, the road network was extracted from OSM. Then, the suitability for active transport was assessed based on three characteristics: road classification, surface type, and the presence of pedestrian or cycling infrastructure. Once the road segments were classified, the resulting layer was rasterized at the same resolution as the CD and AD layers. Raster cells (100 by 100 meters) containing suitable roads were assigned the highest active transport score, while those lacking any road infrastructure received a score of zero. The detailed classification scheme is presented in Table 5.

The evaluation of both the second PD factor, safety perception, and the sixth PD factor, water and sanitation, was conducted using a similar methodology. Points of interest (POI) were obtained from Mapillary and OpenStreetMap, and buffer zones were created to define their areas of coverage: 3 km for water and sanitation facilities and 1 km for safety-related points. Water POIs included public taps, wells, and other community water sources. For the safety perception POIs, we used the streetlight dataset, based on the assumption that better-lit areas are associated with higher perceived safety for pedestrians, particularly women (Mayen Huerta & Cafagna, 2021; Navarrete-Hernandez et al., 2021; Saad et al., 2021). After buffering, the resulting datasets were rasterized. Raster cells intersecting 80% or more with a buffer received a score of 5; those intersecting between 60% and 79% received a 4; between 40% and 59% received a 3; between 20% and 39% received a 2; between 1% and 19% received a 1; and those with no intersection received a score of 0.

Table 5. Active transport scores according to road type

Key	Road type	Factor Score	Key	Road type	Factor Score
Highway	motorway	1	Highway	pedestrian	5
	trunk	1		footway	5
	primary	2		cycleway	4
	secondary	3		path	4
	tertiary	4		bridleway	3
	unclassified	3		steps	5
	residential	5		track	2
	motorway_link	1	Cycleway	lane	4
	trunk_link	1		shared_lane	4
	primary_link	2		share_busway	4
	secondary_link	3		track	4
	tertiary_link	4		separate	4
	living_street	5		crossing	4
	service	3		shoulder	4
	road	3		link	4

The third PD factor, FCV, was assessed using the methodology developed for the Conflict Exposure Calculator by the Armed Conflict Location and Event Data Project (ACLED), from which conflict event data was also sourced (ACLED, 2025). Unlike the methodology used in Mayen et al. (2025), which applied a uniform 5 km buffer to all events, we employed variable buffer sizes determined by the type of conflict event recorded at each POI, in accordance with ACLED's guidelines. This adjustment allowed for a more nuanced representation of conflict exposure. The buffer sizes and their corresponding scores are presented in Table 6. During rasterization, each raster cell (100 by 100 meters) intersecting a buffer was assigned the corresponding buffer score. Cells with no intersection received a default score of 5, indicating an absence of recorded FCV events in those areas. When a raster cell intersected multiple buffers, the score with the lowest value was applied.

https://doi.org/10.48088/ejg.c.may.17.1.093.120

Table 6. FCV scores, depending on the type of event, as classified by ACLED

Event Type	Default Buffer Distance	Factor Score
Battles and explosions	5 km	5
Explosions and remote violence	5 km	4
Violence against civilians	2 km	3
Protests/riots	1 km/ 2 km	1
No intersecting events	NA	0

The assessment of the fourth PD factor, attitudes towards women in STEM, and the fifth, digital inclusion, followed a similar methodological approach, which differed from the one employed by Mayen et al. (2025). In the latter, the percentage of female graduates in STEM fields and the percentage of households with internet access were converted to a 0–5 scale using linear interpolation and applied uniformly at the national level. This method, however, did not capture spatial variation within countries. In our revised approach, both indicators were mapped only in relevant areas.

For the fourth PD factor, the interpolated scores based on the percentage of female graduates in STEM fields were assigned exclusively to inhabited areas, as identified using the Global Human Settlement–Settlement Model (GHS-SMOD) dataset (Copernicus EU, 2025). The dataset provides global spatial data at a 1 km² resolution and classifies human settlements into eight categories: urban centers, dense urban clusters, semi-dense urban clusters, suburban or peri-urban areas, rural clusters, low-density rural areas, very low-density rural areas, and water bodies. Only raster cells located within inhabited areas received a score, under the assumption that attitudes are relevant only where people reside. Default classes excluded from GHS-SMOD include Class 10 (Water) and Class 11 (Very Low-Density Rural Areas). For the digital inclusion factor, spatial data was sourced from Ookla's connectivity dataset (Ookla, 2025). Only raster cells that intersected with Ookla-defined connectivity polygons were assigned a score. Cells outside of these polygons were assigned a score of 0, indicating no access. The resulting datasets for both factors were resampled to a 100 by 100-meter resolution to ensure consistency with the overall analysis.

Finally, the environmental hazards factor was excluded from this analysis. This factor was originally conceptualized within the GeoWEAF framework as a composite measure of exposure to multiple hazards, including fires, droughts, landslides, floods, and tropical cyclones. Existing literature indicates that environmental hazards can influence women's labor outcomes by affecting mobility, access to resources, and the allocation of time to caregiving responsibilities (Chowdhury et al., 2022). For instance, evidence from Pakistan shows that flooding alters the gender division of labor and increases women's overall workload (Akter, 2021). Likewise, research in Metro Manila suggests that flooding shapes women's work-related mobility, thereby influencing access to economic opportunities (Akyelken, 2020). However, these effects are highly context-specific and not consistently directional. Evidence from Bangladesh shows that flooding can increase women's participation in the labor market as a coping strategy (Canessa & Giannelli, 2021). This is associated with gains in employment and income, as well as greater engagement in autonomous wage-earning activities, and in some cases, enhanced bargaining power within the household (Canessa & Giannelli, 2021). These contrasting findings suggest that while natural hazards often exacerbate vulnerabilities, they can also, under certain conditions, reshape labor dynamics in ways that expand women's economic roles. In the absence of robust, context-specific evidence for the countries included in this study (Albania, Bulgaria, and Türkiye), this factor was not retained in the analysis.

4.4. Rural vs Urban

After completing the GeoWEAF analysis, we assessed the extent to which urban areas outperform rural areas in supporting women's access to high-skilled employment by comparing average index scores, as well as minimum and maximum values, across settlement types, classified according to their degree of urbanization. This analysis was motivated by existing literature showing that services and infrastructure are disproportionately concentrated in urban areas (Nicoletti et al., 2023), and that a more equitable distribution of services is essential for reducing spatial inequalities and promoting inclusive development (Mayen Huerta & Cafagna, 2021). For this purpose, we again used the GHS-SMOD dataset, which applies the Degree of Urbanization methodology endorsed by the United Nations Statistical Commission (Copernicus EU, 2025).

5. Results

5.1. GeoWEAF Results

The results of the GeoWEAF analysis for the three case studies are presented in Figure 1, Figure 2, and Figure 3. In Albania, Figure 1 shows that highly enabling areas are not limited to Tirana but also extend to other urban and coastal centers such as Durrës, Vlorë, and Shkodër, as well as smaller clusters in the southeast. Notably, most areas within the main urban centers exhibit at least moderate levels of enablement, with none classified as having very low enablement. The remaining inhabited areas in the country are characterized primarily by moderate to low enablement scores, with no rural areas classified as having very low levels of enablement. Bulgaria shows a broadly similar pattern, with high enablement concentrated around Sofia and several secondary cities, including Plovdiv, Varna, Burgas, and Ruse, complemented by moderately enabling zones along major transport corridors and the Black Sea coast. Large rural regions, however, display lower levels of enablement, again with an absence of very low scores. Türkiye presents a sharper contrast, with highly enabling conditions found almost exclusively in major urban centers, and even within these, there are pockets of very low enablement. Additionally, highly enabling conditions are more concentrated in and around Istanbul compared to Ankara and Izmir, where such conditions are more limited and surrounded by larger areas of moderate to low enablement. Rural regions across the country exhibit low to very low levels of enablement.

5.2. Contextual Dimension Results

In terms of Contextual Dimension scores (Table 7), Bulgaria achieved a perfect score across all three factors, workplace discrimination, regulatory frameworks, and financial inclusion, indicating a strong regulatory environment supporting gender equality in employment. Albania also obtained perfect scores in workplace discrimination and financial inclusion; however, its overall performance in regulatory frameworks was affected by a score of 3 in the parenthood indicator, reflecting shortcomings in parental leave policies and childcare support mechanisms. Türkiye achieved a perfect score in workplace discrimination, but scored low (2) in both regulatory frameworks and financial inclusion. These results indicate considerable institutional diversity across the region, with Bulgaria closely aligned with EU standards, Albania demonstrating partial progress but persistent gaps, and Türkiye showing continued limitations.

Table 7. Contextual Dimension Results

Contextual Dimension	**CD Scores Albania**	**CD Scores Bulgaria**	**CD Scores Türkiye**
Workplace discrimination	5	5	5
WBL Workplace	5	5	5
Regulatory Frameworks	4	5	2
WBL Pay	5	5	2
WBL Parenthood	3	5	3
Financial Inclusion	5	5	2
WBL Entrepreneurship	5	5	2
TOTAL	**5**	**5**	**3**

5.3. Accessibility Dimension Results

The Accessibility Dimension results for inhabited areas across the three countries reveal a pronounced divide between rural and urban regions (see Figure **B**B.1, FigureB.2 and Figure B.3 in Appendix B). The three countries received the lowest scores in this dimension, with rural areas predominantly exhibiting very low levels of enablement. Specifically, Istanbul and Sofia stand out as the two cases where the provision of services is most evenly distributed, with gaps appearing primarily in peripheral areas. In contrast, other major urban centers exhibit a more uneven distribution of services, with several neighborhoods classified as having low or very low levels of enablement.

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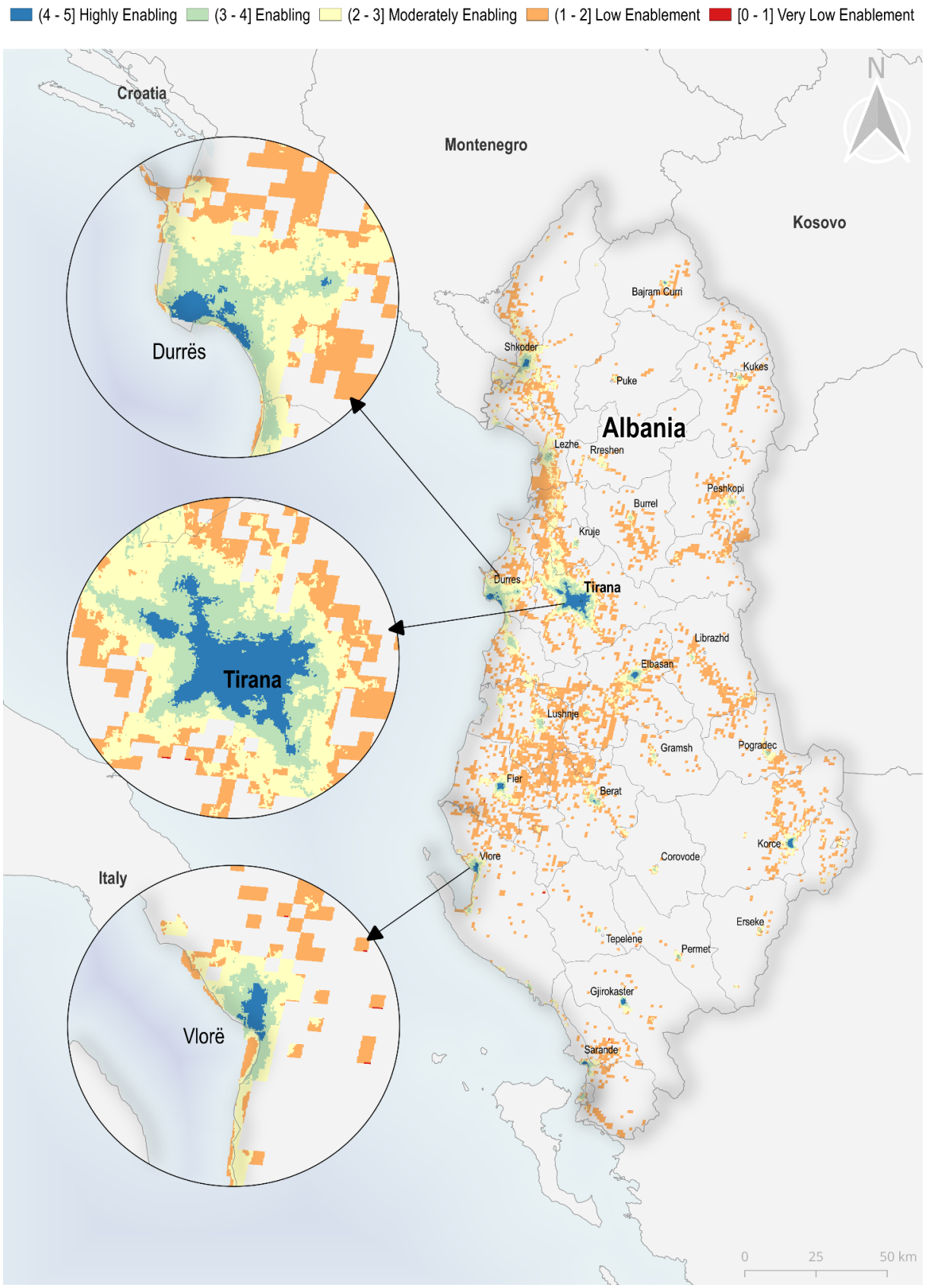

Figure 1. Results of the GeoWEAF analysis for the inhabited areas of Albania

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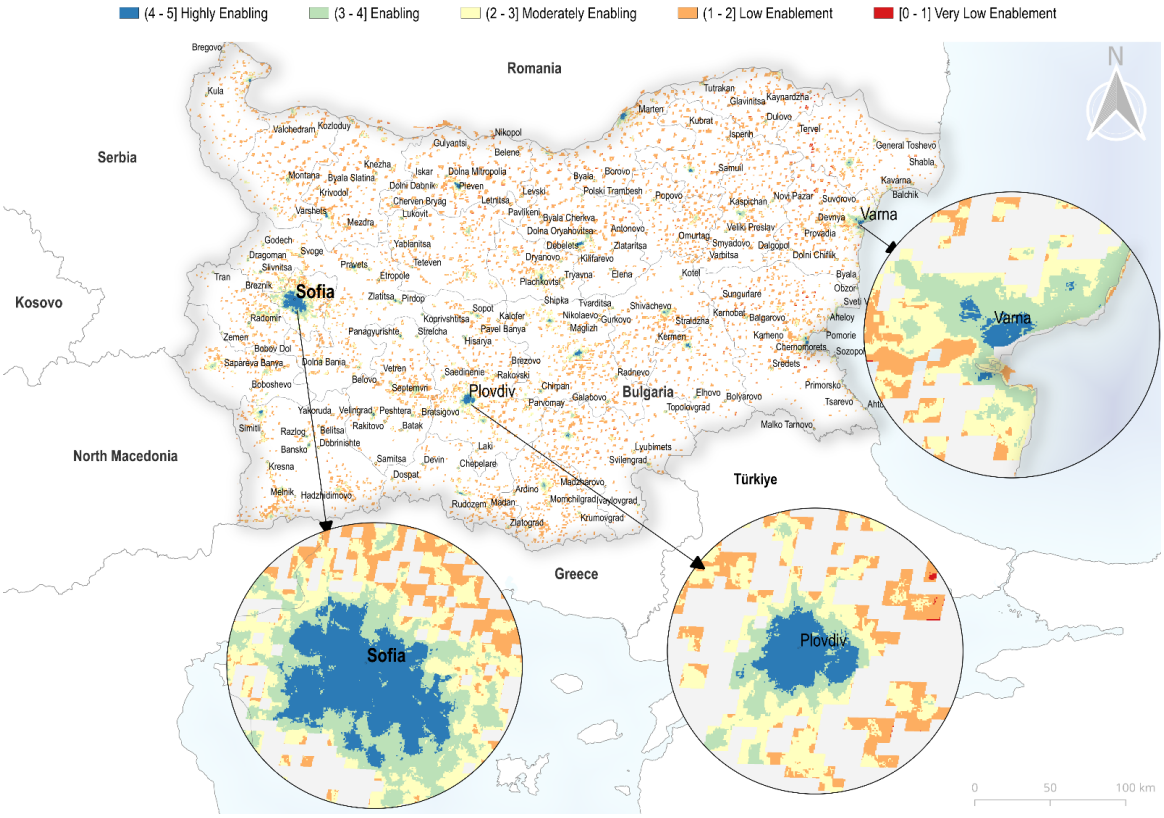

Figure 2. Results of the GeoWEAF analysis for the inhabited areas of Bulgaria

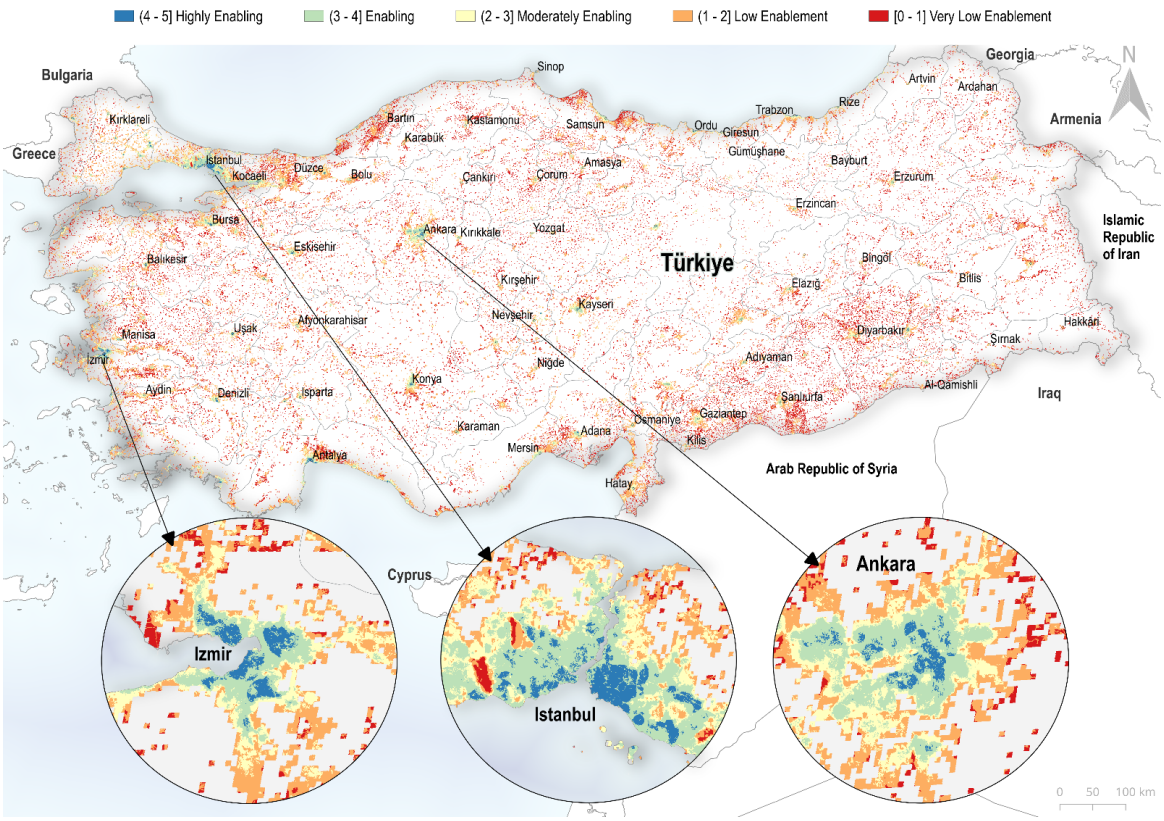

Figure 3. Results of the GeoWEAF analysis for the inhabited areas of Türkiye

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5.4. Place-Characterization Results

The Place-Characterization Dimension results indicate that this is the dimension with the fewest occurrences of very high enabling scores (4–5). Although very low levels of enablement were not observed in Albania or Bulgaria, no areas in Varna (Bulgaria) attained the highest level of enablement (see Figure B.4 and B.4 in Appendix B). Interestingly, the three largest cities in Türkiye exhibit pockets of very low enablement within the PC dimension (see FigureB.5 in Appendix B). Across the three cases, road infrastructure emerges as one of the strongest components, with connectivity extending throughout most inhabited areas. However, in Türkiye, segments suitable for active transport are less prevalent outside main cities. All three countries showed significant limitations in street lighting and digital inclusion, with extensive portions of the populated territory, including several secondary cities, lacking adequate internet coverage and public lighting. The share of female graduates in STEM fields also remains in the low-enabling category for Albania, Bulgaria, and Türkiye, suggesting limited participation of women in traditionally male-dominated sectors. In terms of differences, FCV events in Türkiye contribute to lower scores in Istanbul, Ankara, and the eastern regions, whereas Albania and Bulgaria are largely unaffected by such events. Lastly, access to water and sanitation services appears relatively even across the populated territories of all three countries, indicating a more uniform distribution.

5.5. Results: Rural Vs Urban

When comparing GeoWEAF scores by degree of urbanization according to the GHS-SMOD classification, values are significantly higher in rasters classified as urban centers and dense urban clusters, and they progressively decline as areas transition toward more rural classifications. With respect to the maximum GeoWEAF scores (Figure), all three countries report their highest values in urban centers and dense urban clusters. Albania exhibits its highest GeoWEAF values in the more urbanized settlement types, peaking at 4.6 in dense urban clusters and closely followed by 4.5 in urban centers. In contrast, there is a pronounced decline in semi-dense urban clusters, where the value drops to 3.1, the lowest across all categories. The values then recover in suburban or peri-urban areas (3.8) and remain relatively stable in rural clusters (3.7), before declining slightly again in low-density rural areas. Overall, the pattern highlights a non-linear urban-rural gradient, with semi-dense urban areas representing a relatively low point in performance. Bulgaria shows relatively limited variation in maximum GeoWEAF values across settlement types, ranging from 3.9 in low-density rural areas to 4.6 in urban centers. Values remain consistently close across categories, including 4.5 in dense urban clusters, 4.4 in suburban or peri-urban areas, and 4.1 in both semi-dense urban and rural clusters, indicating a more even distribution compared to Albania. Türkiye reaches its highest maximum GeoWEAF value of 4.4 in urban centers, followed by 4.3 in dense urban clusters. Values then decline to 3.7 in semi-dense urban clusters, before increasing to 3.9 in both suburban or peri-urban and rural cluster categories, which are higher than the semi-dense urban value. The lowest value is observed in low-density rural areas, at 3.5.

Across the three countries, average GeoWEAF scores are generally higher in more urbanized settlement types, but the patterns differ (Figure 54). Bulgaria records higher values than the other countries in most categories, including 3.9 in urban centers and 2.7 in semi-dense urban clusters, although it matches Albania in dense urban clusters (3.3) and low-density rural areas (1.6). Albania shows a non-linear pattern, with scores declining from urban centers (3.7) and dense urban clusters (3.3) to semi-dense urban clusters (2.1), then increasing in suburban or peri-urban areas (2.4) before declining again in rural categories. In contrast, Türkiye records the lowest values across all settlement types, with a steady decline from 2.8 in urban centers to 1.1 in low-density rural areas.

The minimum GeoWEAF scores reveal clear cross-country disparities, with Türkiye consistently recording the lowest values across all settlement types, ranging narrowly between 0.4 and 0.6 (Figure 65). This indicates persistently weak baseline levels of enablement for women's employment access across the entire settlement hierarchy. In contrast, Albania records the highest minimum values in most categories, including 2.7 in urban centers and 2.2 in dense urban clusters, and remains at or above 1.0 even in low-density rural areas. This suggests that even the least advantaged areas in Albania maintain comparatively stronger enabling conditions. Bulgaria occupies an intermediate position, with minimum values generally below Albania but consistently above Türkiye. Overall, the results highlight that Türkiye exhibits consistently low baseline conditions across all settlement types.

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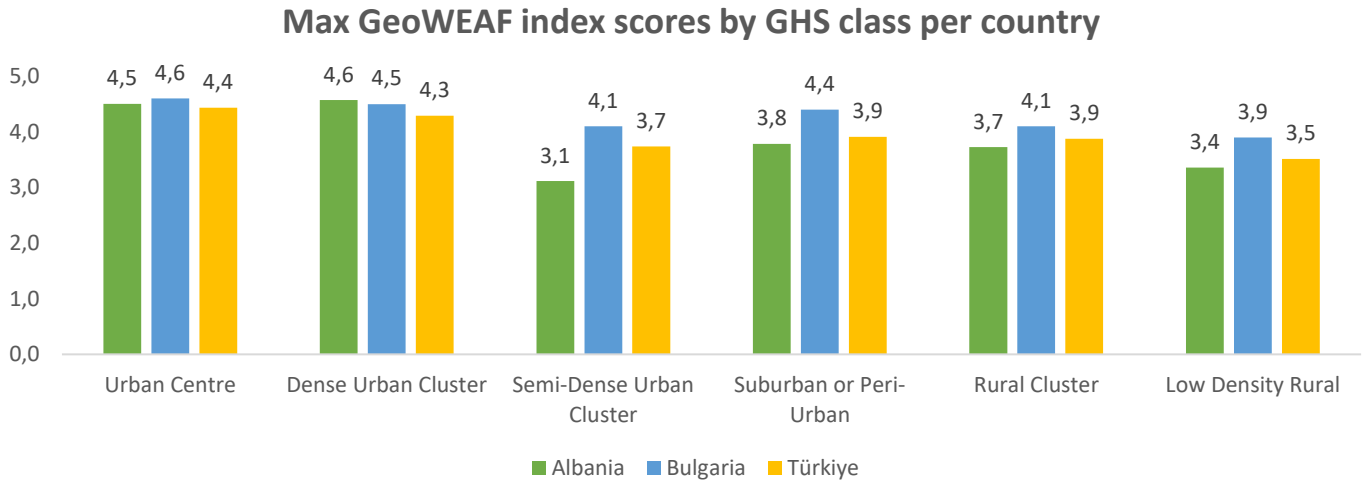

Figure 4. Max GeoWEAF scores by GHS class in Albania, Bulgaria, and Türkiye

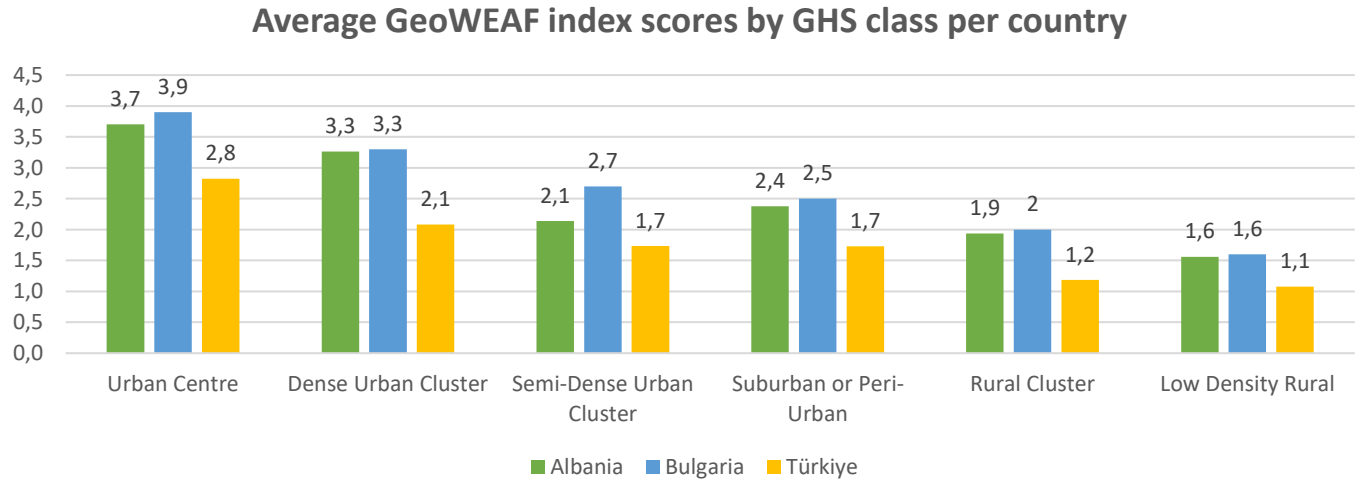

Figure 54. Mean GeoWEAF scores by GHS class in Albania, Bulgaria, and Türkiye

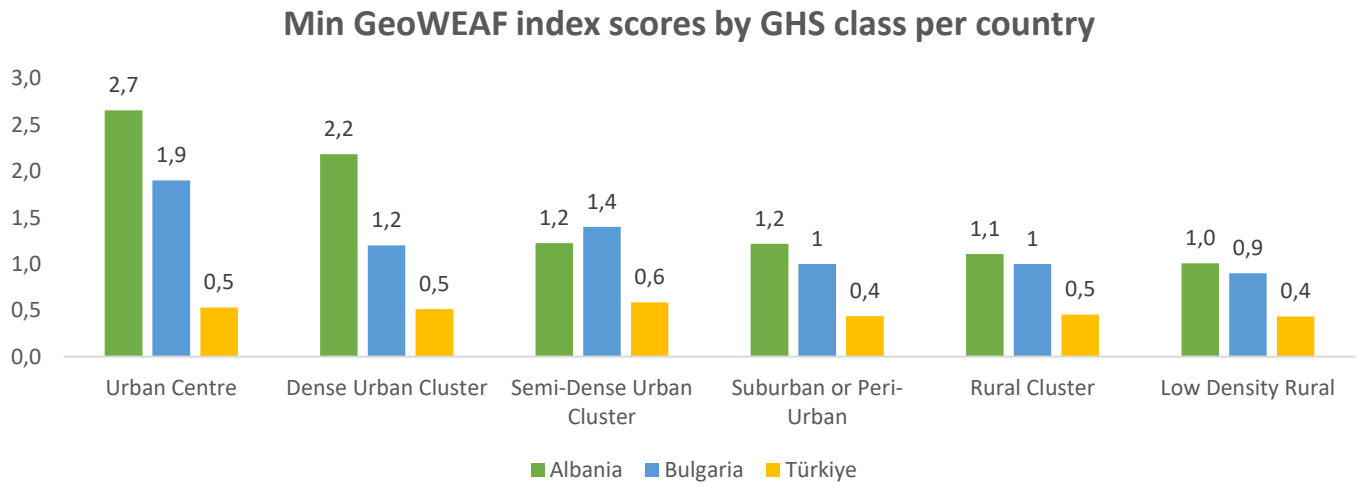

Figure 65. Min GeoWEAF scores by GHS class in Albania, Bulgaria, and Türkiye

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6. Discussion

The practical application of GeoWEAF in Albania, Bulgaria, and Türkiye aimed to generate new insights into the geographic barriers that may restrict women's access to high-skilled employment in three contexts that share similarly low levels of female labor force participation. When comparing countries in terms of their regulatory environment for supporting women's access to work (CD), Bulgaria stands out for having strong laws and regulations. However, these protections have not translated into substantial gains in women's labor force participation (50.9%), which remains below the EU average (70%) (Mazreku et al., 2024; World Bank, 2024a). In Albania, the CD results suggest that the laws and regulations intended to support working parents remain limited. This gap is reflected in a 2024 study by Andrea Cinque, Cecilia Poggi, and Juna Miluka, which found that having an additional child significantly reduces employment opportunities for Albanian women, particularly those with lower education or wealth (Cinque et al., 2024). The study highlights the lack of targeted policies to support working mothers, especially in less urbanized areas, where limited access to childcare and family support services continues to hinder women's participation in the labor market (Cinque et al., 2024).

Türkiye recorded the lowest score on the CD among the three countries examined in this study. Although women in Türkiye outperform men in measures of human capital, this has not translated into wage equality, as highlighted in the study by Gizem Kaya and Raziye Selim on persistent gender-based disparities (Selim & Kaya, 2018). On average, women earn around 8% less than men in the middle-income range, and about 4.5% less among higher earners (Aktaş & Uysal, 2016). These differences cannot be fully explained by qualifications or job experience alone, pointing to persistent discrimination in the labor market (Dalaman, 2024; Kilinç & Işik, 2023). For instance, a 2023 study by Çağlayan-Akay and Komuryakan found that women experience a significant motherhood wage penalty, with lower-paid women disproportionately affected, whereas fatherhood has minimal to no impact on male earnings (Caglayan-Akay & Komuryakan, 2024). As in many other countries, the COVID-19 crisis further exacerbated these challenges, widening existing gender gaps and heightening the risk of long-term inequalities (Gunes & Chang, 2023).

Furthermore, in the case of women entrepreneurs, the literature shows that religious affiliation in Türkiye can both facilitate access to trust-based networks and resources, while simultaneously creating exclusionary dynamics and reputational risks within a politically and culturally conservative context (Ozasir Kacar, 2025). Such informal mechanisms affect women's ability to navigate entrepreneurial ecosystems, influencing their access to funding, visibility, and legitimacy in traditionally male-dominated business environments (Kalafatoglu & Mendoza, 2017). In addition, women continue to face significant barriers in accessing financial capital, stemming from limited collateral ownership, gender bias in lending practices, and restricted entry into male-dominated financial networks (Maden, 2015). For instance, a 2019 World Bank study found that gender bias among loan officers in Türkiye significantly affected access to finance for women-led small and medium-sized enterprises, with female applicants receiving, on average, loan amounts $14,000 lower than their male counterparts (Alibhai et al., 2019). Markedly, the study revealed that 35% of loan officers exhibited bias against women, though this tendency decreased with professional experience (Alibhai et al., 2019). Finally, social expectations related to caregiving responsibilities, combined with the limited availability of family-friendly workplace policies, as reflected in the low parenthood indicator score, continue to constrain women's full participation in the labor market (Ozoguz, 2025). This highlights the need to strengthen legal protections for working mothers and to expand financial inclusion initiatives in Türkiye.

As for the AD, this is the dimension in which the three countries received the lowest scores, with very low levels of enablement observed in most rural areas. While urban areas generally offer more favorable conditions for women regarding access to services and infrastructure, scores within cities remain uneven, with some neighborhoods benefiting less from the distribution of services. This uneven spatial distribution highlights the need for more targeted, place-based interventions that address both rural disadvantage and intra-urban disparities in access to enabling services (Olsen et al., 2026). As noted by Frick and Rodríguez-Pose, the neglect of smaller urban centers in terms of service provision has profound consequences, as it exacerbates women's spatial and social exclusion and further constrains their participation in formal employment (Frick & Rodríguez-Pose, 2018). The rural–urban divide in access to key services is especially important in sectors such as renewable energy and agriculture, where production sites and employment opportunities are often located outside major urban centers (Shmelev, 2020). As a result, women seeking to participate in these sectors may have to contend with limited access to nearby support services and mobility options. Notably, all three countries received low scores in the provision of services such as public transport stops and childcare facilities. In particular, the limited availability of childcare facilities reflects persistent underinvestment in social infrastructure, which

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disproportionately affects working mothers. A study from Tokyo illustrates this dynamic, showing that increasing the supply of childcare facilities can help boost women's workforce participation by reducing the gap between service demand and availability (Kawabata, 2014). Similarly, evidence from a study in El Salvador shows that women prioritize access to safe commuting and childcare over higher wages, underscoring the importance of service provision in enabling employment (Contreras et al., 2026). Investing in care infrastructure, particularly in suburban and rural areas, is especially important in the case of Türkiye, where spatial inequalities were the most pronounced. Evidence from recent research in the country shows that expanding the early childhood care and preschool education sector not only creates more jobs overall but does so in a more gender-equitable manner compared to sectors such as construction (Kim et al., 2017).

In relation to the PD, all three areas exhibited relatively well-developed active transport infrastructure. However, their overall scores in this dimension are constrained by deficits in other factors. In particular, the proportion of women graduating from STEM disciplines remains low in the three countries. This outcome may be linked to persistent gender segregation in education and academic careers. Evidence from Albania shows that women are often underrepresented in technical and scientific fields and disproportionately absent from senior academic positions (Titili et al., 2024). In Bulgaria, evidence suggests that regional disparities in the availability of vocational education programs reinforce gender segregation by shaping women's educational and career pathways (Ilieva-Trichkova et al., 2015). This regional segregation is also evident in Türkiye, where studies show a positive correlation between women's participation in STEM and factors such as per capita GDP, the number of higher education instructors, central government budget expenditure, and the provincial population ratio (Özmen, 2024). These dynamics favor Istanbul while leaving other regions behind.

In addition, in the three countries, digital connectivity is not sufficiently extended beyond major urban centers, and the availability of street lighting remains limited. Specifically, inadequate street lighting reduces women's sense of safety in public spaces, discourages mobility after dark, and limits their ability to access employment and services outside daytime hours (Davoudian, 2019; Mayen Huerta & Cafagna, 2021; Svechkina et al., 2020). Evidence from Albania shows that even in Tirana, the capital, public lighting conditions on many streets do not meet the requirements set out by legislation (Spahiu et al., 2018). Likewise, in Bulgaria, street lighting was not consistently available across all urban areas.

In Türkiye, major urban centers report relatively favorable safety perceptions; however, overall index scores are reduced by elevated FCV-related risks in provinces such as Hakkâri, Şırnak, Diyarbakır, Mardin, and Van. Evidence further indicates that FCV constrains women's economic participation, although women engaged in formal employment are less likely to experience domestic violence than those outside the labor market (Algül & Yarbaşi, 2021; Greulich & Dasré, 2022). A 2017 study on Syrian refugee women living on the outskirts of Istanbul found that many have normalized violence and experience heightened insecurity, which significantly limits their ability to move freely (Freedman et al., 2017). More recently, extremist attacks linked to groups such as DHKP-C (Revolutionary People's Liberation Party–Front) have highlighted ongoing security threats, while large-scale political protests and episodes of civil unrest have further shaped perceptions of instability in the city (Ramazanogullari, 2022; UK Government, 2025). Together, these dynamics contribute to an amplified sense of insecurity in Istanbul, offsetting otherwise favorable infrastructure conditions.

The study's findings underscore the critical value of applying a geospatial lens to gendered labor market research. By moving beyond national averages and sector-level indicators, GeoWEAF scores reveal how localized spatial inequalities in access to infrastructure, services, and exposure to social risks can shape women's ability to participate in the labor market. This place-based perspective highlights that even within relatively well-performing urban regions, as illustrated by the maps and GHS class comparison, pockets of disadvantage persist. Such localized disparities can restrict employment opportunities, particularly for women who face mobility limitations, caregiving responsibilities, or safety concerns. Integrating geospatial data into labor market diagnostics enables more granular and equity-oriented policy-making by identifying where targeted interventions are most urgently needed (Verma, 2024). In this context, geospatial analysis should not be viewed as a supplementary tool but rather as a foundational component of strategies aimed at building inclusive, territorially balanced, and gender-equitable labor markets (Williams & Luginaah, 2022). This approach is especially relevant in countries such as Albania and Bulgaria, where local administrative units have the authority to define development priorities. In these settings, spatially disaggregated data can support the design of more gender-responsive local strategies.

7. Limitations

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This analysis was subject to three main limitations. First, GeoWEAF does not fully account for social and cultural factors that may significantly influence women's participation in the workforce. Consequently, although the index score provides a numerical representation of enablement levels, it may not adequately capture barriers related to gender norms, discrimination, or informal practices that limit women's opportunities, as there is limited geospatial or georeferenced information available on these aspects. Thus, high scores may not always correlate with improved employment outcomes, particularly in regions where cultural constraints remain prevalent. To address this limitation, future research should seek to complement geospatial analysis with qualitative or survey-based data on social attitudes and institutional barriers, enabling a more comprehensive understanding of women's employment constraints.

Second, since the methodology relies on open data from various sources, discrepancies in data collection methods, accuracy, and completeness can lead to inconsistencies in scoring across countries. In some areas, the lack of comprehensive geospatial or georeferenced information can result in either overestimated or underestimated enablement levels, reducing the score's reliability. Countries with a richer geospatial data landscape might achieve highly accurate GeoWEAF scores due to the availability of detailed and precise spatial information. In contrast, countries with limited geospatial data may have less accurate analyses, not necessarily because the enabling conditions for women's employment are worse, but because the lack of comprehensive data introduces gaps or uncertainties in the assessment. To mitigate this limitation, applications of GeoWEAF must incorporate data quality assessments and, where possible, triangulate open-source data with national statistical or administrative sources to improve consistency and reliability across contexts.

Third, the static nature of the score can be problematic in rapidly changing environments. Social, economic, and infrastructural developments may quickly alter the enabling conditions, making past scores outdated. Therefore, regular updates and situational analysis are necessary to maintain the relevance and accuracy of the indicator.

8. Conclusions

This study applied an adapted version of the GeoWEAF framework in Albania, Bulgaria, and Türkiye to assess how place-based factors shape the enabling conditions that support women's access to high-skilled employment. The framework was designed to address gaps in gender labor diagnostics, which frequently overlook spatial inequalities. The analysis showed that, despite differences in socio-economic contexts and development trajectories, the three countries share some regional patterns of spatial inequalities that restrict women's participation in highly skilled employment. Across the three cases, women face disadvantages stemming from limited access to services outside major urban centers, inadequate digital connectivity, and continued underrepresentation among STEM graduates, which reflects prevailing unfavorable attitudes toward women in traditionally male-dominated fields. Together, these barriers significantly constrain women's ability to enter and remain in the high-skilled labor market.

The results showed some variation in enabling conditions. Bulgaria performed the strongest, with solid legal protections and a more even distribution of infrastructure and services extending beyond major urban centers. Nevertheless, digital divides continue to limit women's access to high-skilled employment, while gaps persist in central regions, and some urban centers (as defined by GHS classes) still exhibit pockets of low enablement. Albania displayed sharp territorial inequalities, with enabling conditions concentrated in Tirana and along the western corridor, while the eastern and southern regions remain underserved in terms of public transport, care-related infrastructure, and financial facilities. Türkiye exhibited the most pronounced rural–urban divide, with relatively strong outcomes in service provision in and around major urban centers; however, these are partly offset by risks associated with FCV. Importantly, disparities are also evident at a granular, intra-urban level, with some areas within cities exhibiting very low levels of enablement comparable to rural areas. Beyond major urban centers, much of the inhabited territory shows limited access to essential services and weak connectivity.

The analysis of GeoWEAF scores by urban class confirmed the persistence of a strong urban–rural divide across the three countries. Women in urban centers and dense clusters benefit from more supportive conditions, while those in suburban, peri-urban, and rural areas continue to face structural disadvantages. Bulgaria showed relatively small differences across settlement types, while Albania exhibited a non-linear pattern, with semi-dense urban areas performing worse than both more urbanized and some rural areas. In contrast, Türkiye showed a steady decline from urban to rural areas and consistently lower values overall. Minimum scores further reinforced these differences, with Türkiye recording uniformly low values across all settlement types, whereas Albania maintained higher minimum levels even in rural areas, indicating more stable baseline conditions.

https://doi.org/10.48088/ejg.c.may.17.1.093.120

Funding: This research was financed by the Global Data Facility at the World Bank Data Group.

Data Availability Statement: All datasets used as inputs for this analysis are open-source and accessible through the referenced sources.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A.1. Labor force participation rate (1990–2024, five-year intervals), total (% of population ages 15–64) (modeled ILO; World Bank, 2025)

Year	Albania			Bulgaria			Türkiye		
	Female	Male	Difference	Female	Male	Difference	Female	Male	Difference
1990	50.8	72.7	21.9	49.4	57.9	8.5	33.9	79.2	45.3
1995	51.5	73.4	21.9	47.1	56.8	9.8	30.8	77.5	46.7
2000	49.8	71.8	21.9	44.3	56.0	11.7	26.5	73.6	47.0
2005	47.2	66.2	18.9	44.6	56.0	11.4	23.1	70.0	46.9
2010	46.8	63.9	17.1	47.8	59.6	11.8	27.4	70.3	42.9
2015	47.1	64.3	17.1	48.7	60.1	11.4	31.4	71.4	40.0
2020	50.6	65.3	14.6	49.3	62.7	13.4	30.8	68.1	37.2
2024	53.5	68.2	14.7	50.9	63.0	12.1	36.3	71.4	35.1

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Appendix B

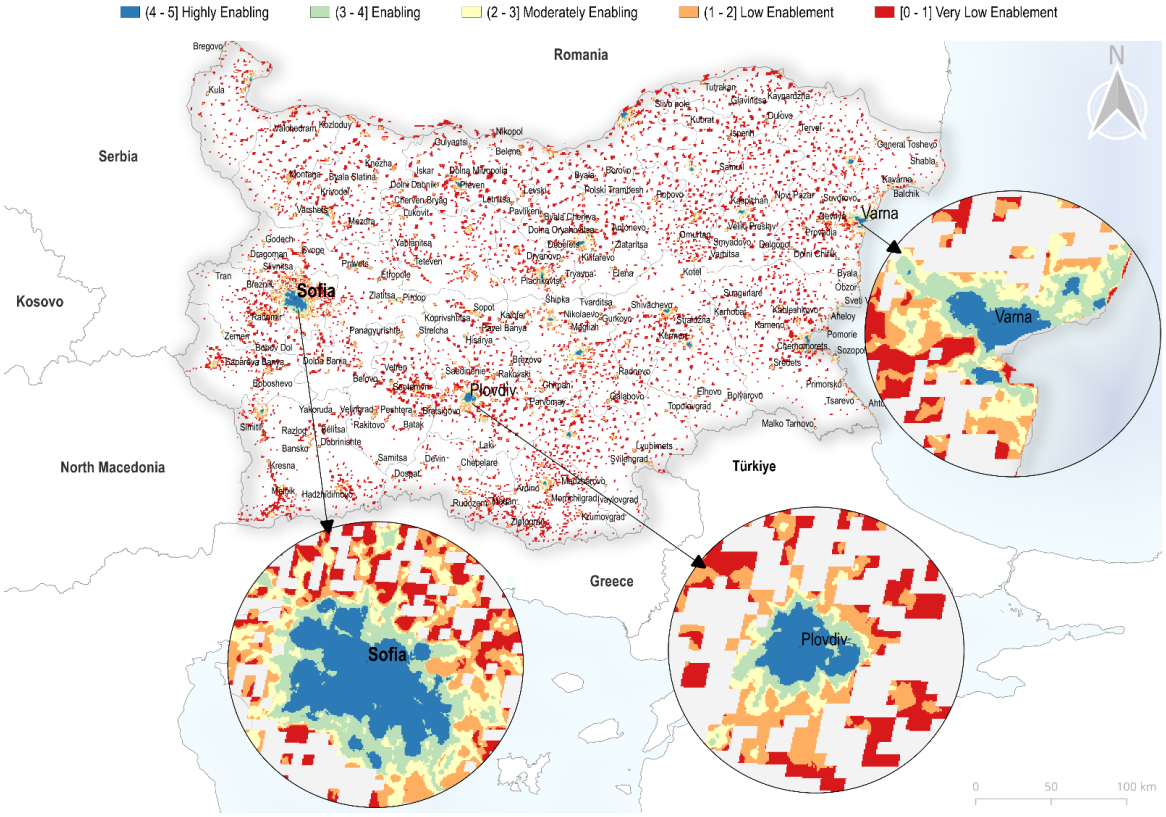

Figure B.1. Results of the Accessibility Dimension analysis for the inhabited areas of Bulgaria

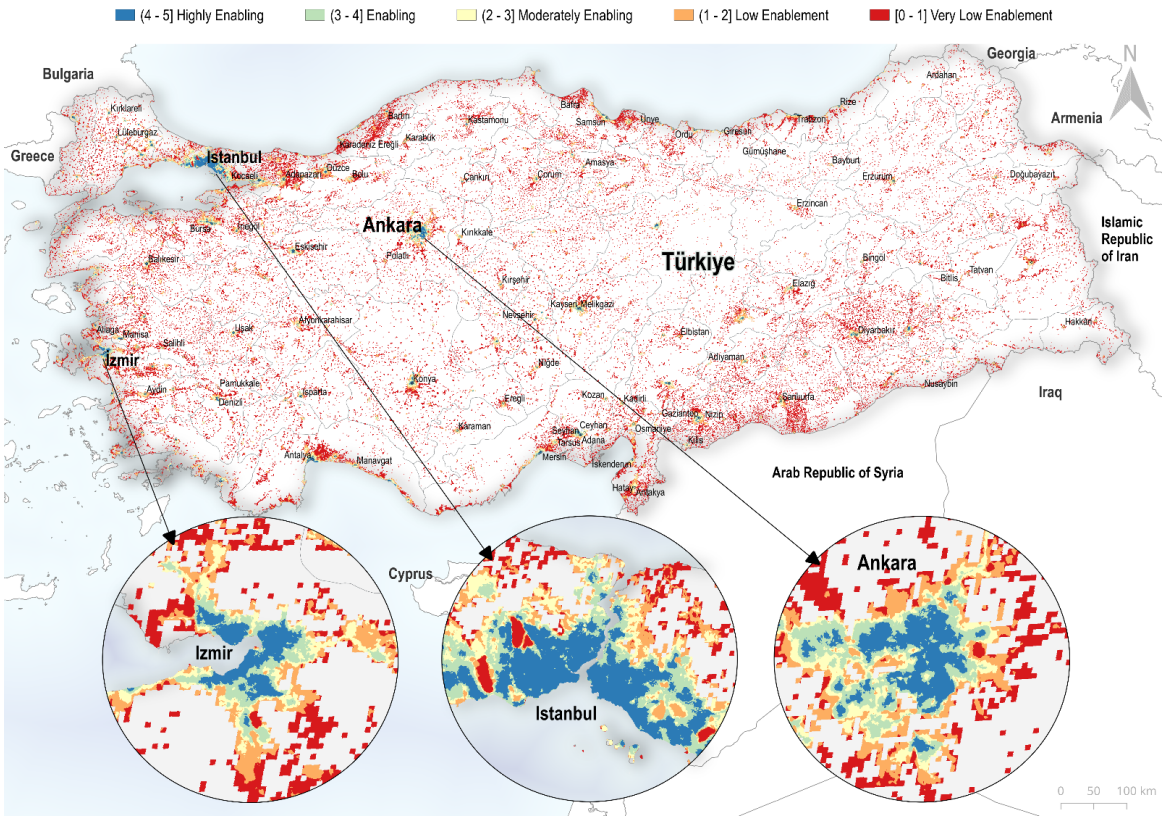

Figure B.2. Results of the Accessibility Dimension analysis for the inhabited areas of Türkiye

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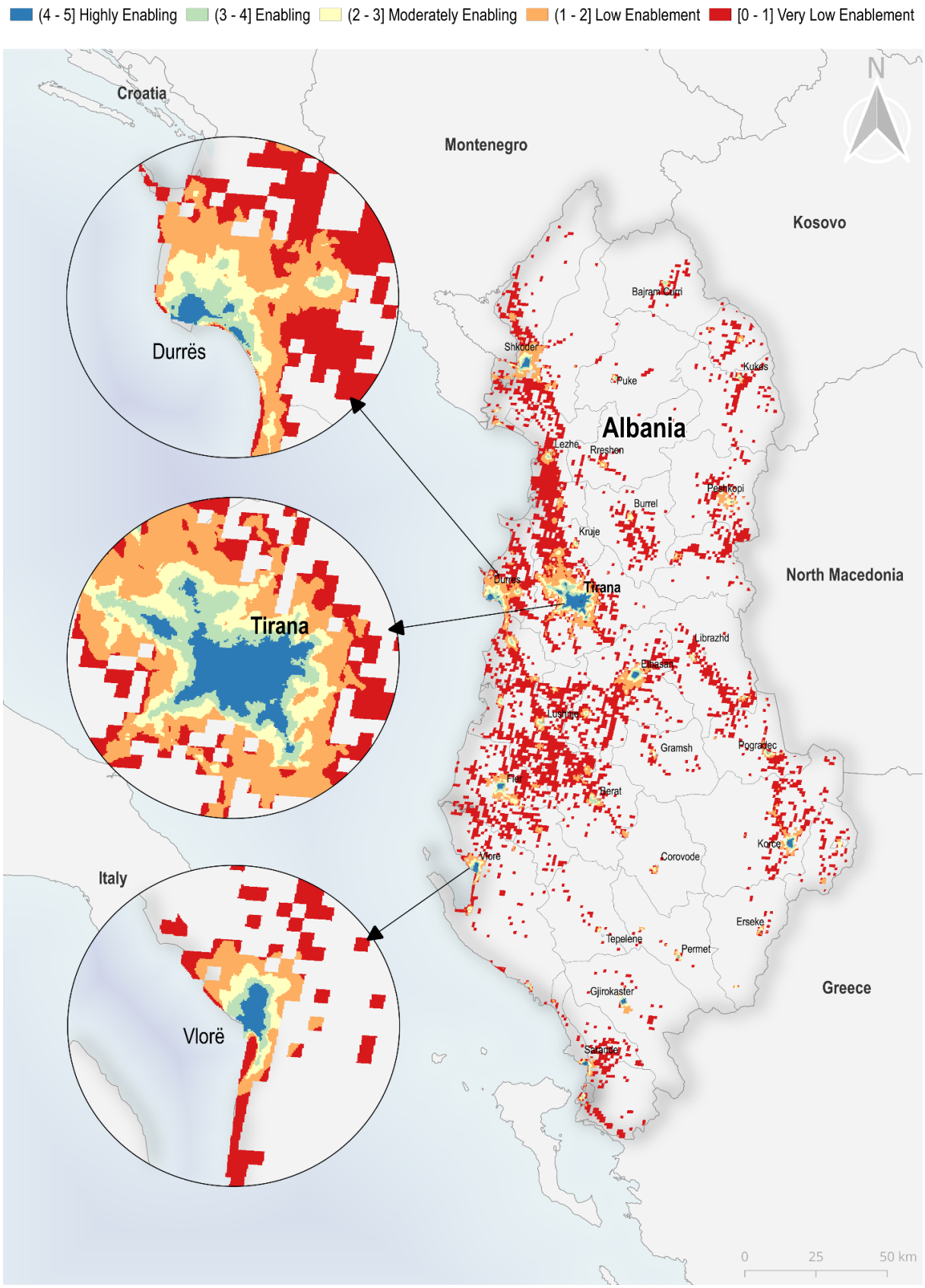

Figure B.3. Results of the Accessibility Dimension analysis for the inhabited areas of Albania

https://doi.org/10.48088/ejg.c.may.17.1.093.120

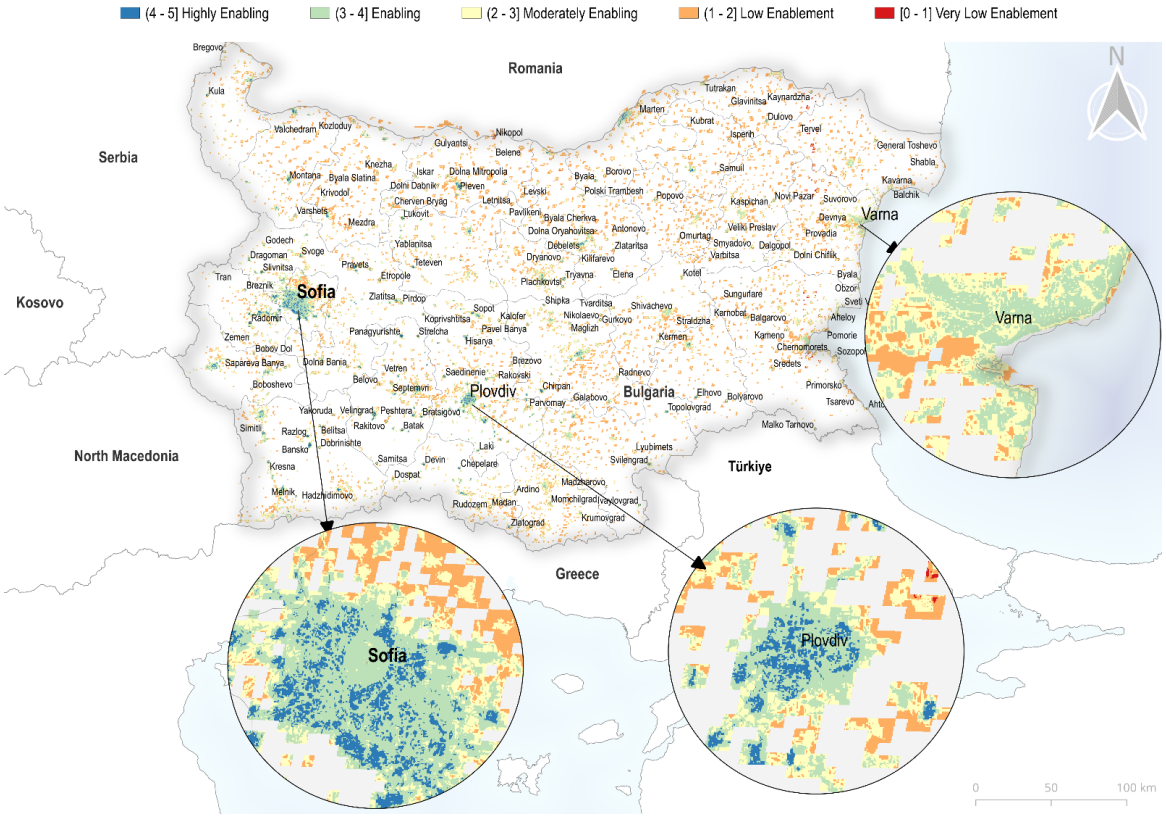

Figure B.4. Results of the Place-Characterization Dimension analysis for the inhabited areas of Bulgaria

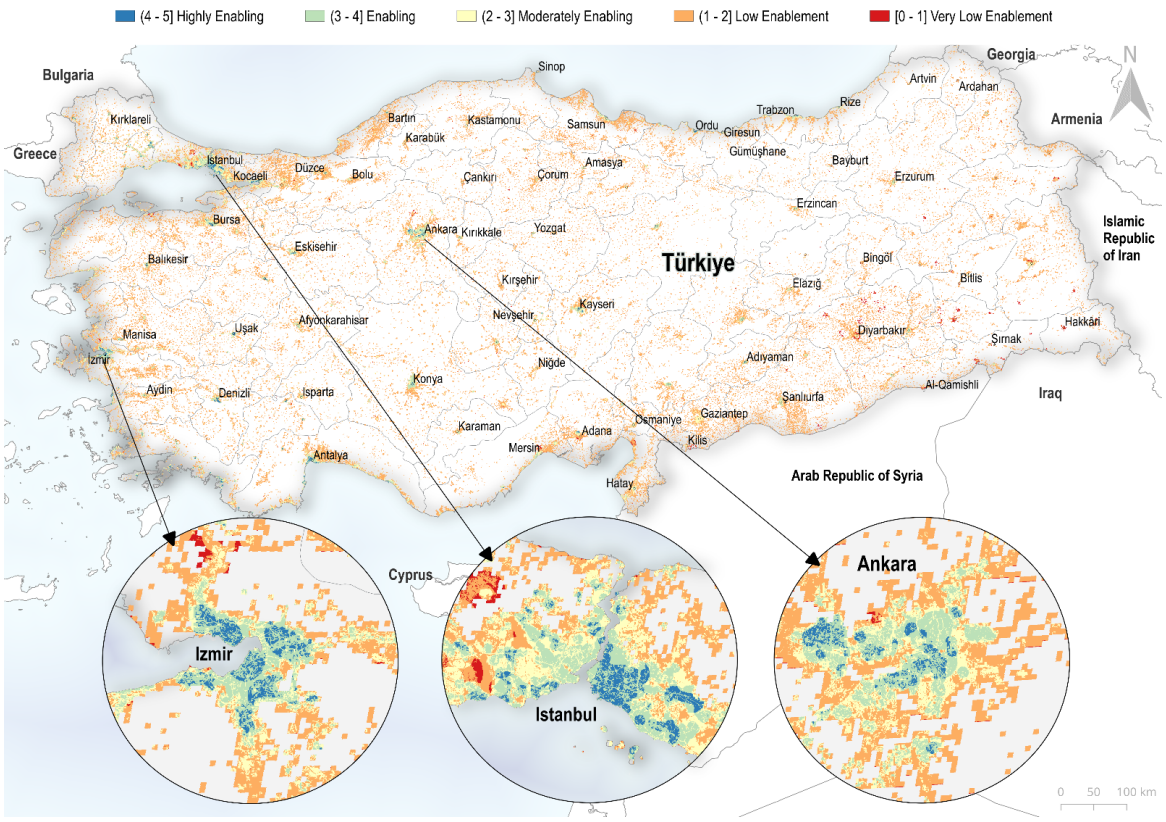

Figure B.5. Results of the Place-Characterization Dimension analysis for the inhabited areas of Türkiye

https://doi.org/10.48088/ejg.c.may.17.1.093.120

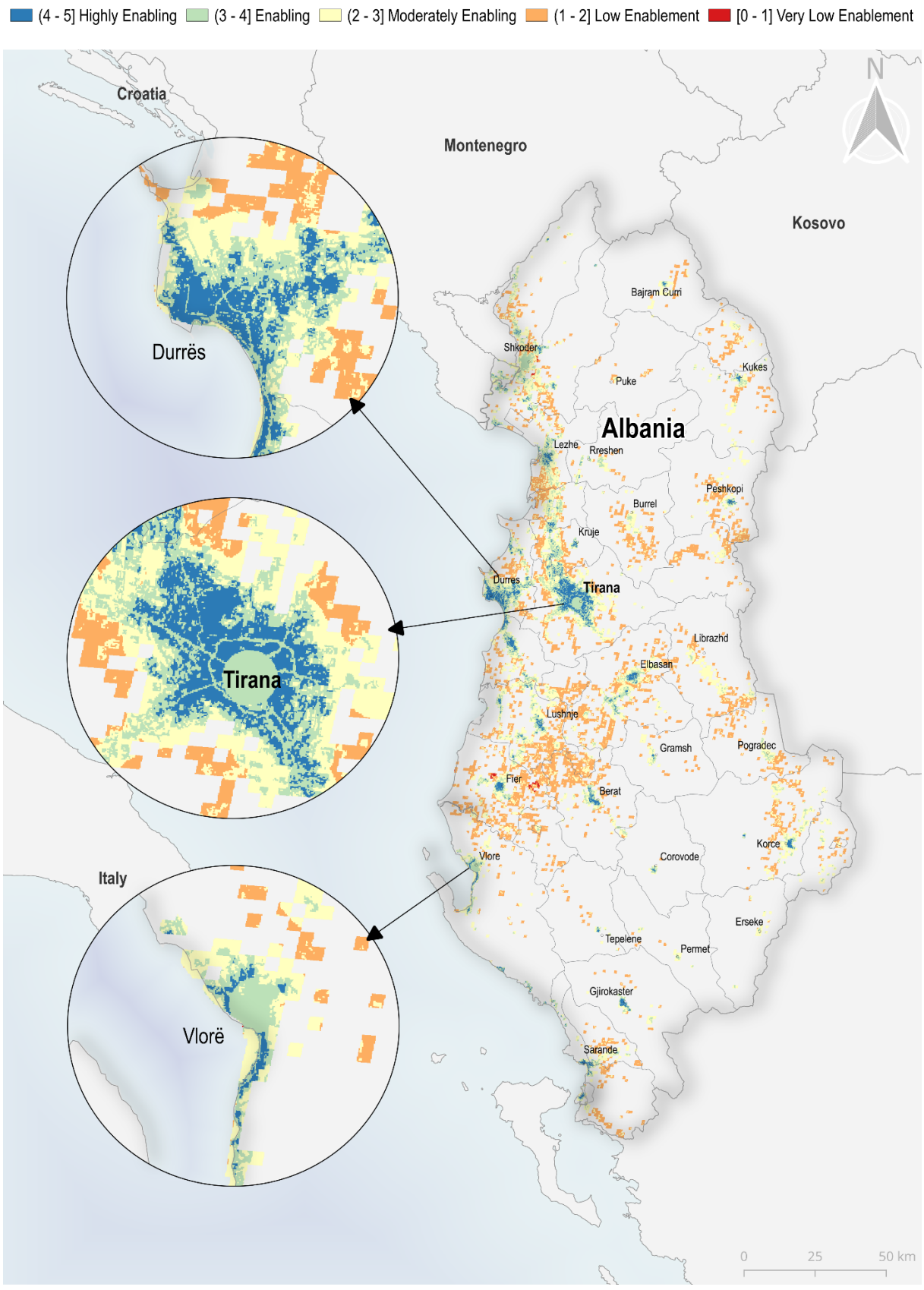

Figure B.6. Results of the Place-Characterization Dimension analysis for the inhabited areas of Albania

https://doi.org/10.48088/ejg.c.may.17.1.093.120

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