

Mapping tourism potential: a GIS-based analytical model applied to Aragón, Spain

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Abstract:

Tourism potential can be understood as the capacity of a destination to attract and accommodate tourists in relation to the quantity, significance, and state of conservation of its natural and cultural resources (Anderson, 2007; Shohan, Toleuuly, and Assadova, 2012). However, tourism resources are not the only dimension to consider. In line with Anderson (2007), accessibility also plays a key role in tourism potential analysis. Furthermore, Bassey (2015) highlights the importance of infrastructure and services in supporting and enhancing tourism activity.

This contribution presents a GIS-based methodological framework for the assessment of territorial tourism potential, advancing existing approaches (Hoang et al., 2018; Salehipour et al., 2025) by explicitly integrating accessibility as a proxy for potential demand, while emphasizing the role of cartography as both an analytical and communicative tool. The approach is applied to the Autonomous Community of Aragón (Spain), a region characterized by strong territorial contrasts between consolidated tourist areas and underutilized rural spaces affected by processes of depopulation.

The proposed framework conceptualizes tourism as a multidimensional spatial system structured by the interaction between three key dimensions utilised in previous studies (Boullón, 2006; López Olivares, 2014; Hoang et al., 2018; Braga et al., 2023; Withanage et al., 2024): (i) the attraction capacity of heritage resources, (ii) the functional capacity of territorial infrastructure and services, and (iii) the accessibility of potential demand. These dimensions are operationalized through the construction of spatial indicators derived from heterogeneous data sources, including institutional datasets and open geospatial data.

All analyses are conducted for Aragón using the Census 1 km² population grid, version 2021, provided by EUROSTAT (2025), allowing for a continuous and comparable representation of territorial dynamics beyond administrative boundaries. This spatial framework supports the identification of intra-regional spatial variability and reduces biases commonly associated with aggregated administrative units. The resulting geodatabase integrates point, linear, and polygonal features corresponding to tourism resources and infrastructure, which are systematically classified and hierarchized to support indicator construction.

The methodological workflow is structured as a sequence of geospatial analysis and cartographic modelling process. First, a Heritage Resources Index is calculated through the weighted aggregation of georeferenced territorial assets, reflecting the spatial distribution and hierarchical relevance of tourism resources. Second, a set of indicators related to infrastructure and services is combined into a composite Infrastructure and Services Index, capturing the functional capacity of the territory to support tourism activity. Third, accessibility is modelled using a gravity-based approach, where population data are integrated with travel-time matrices derived from road networks, computed using OpenRouteService (ORS) and based on OpenStreetMap (OSM) data, allowing the estimation of potential demand based on open-source technologies.

A key contribution of the study lies in the integrated spatial modelling of these dimensions within a coherent GIS framework, where cartographic outputs support the analytical process. Intermediate maps are used to represent and interpret each dimension of the model, enhancing both transparency and interpretability. The normalization and classification of indicators, including logarithmic transformations for highly skewed variables, further contribute to improving the readability and analytical value of the maps. Furthermore, accessibility is not treated as a simple measure of proximity, but as a representation of spatial interaction between population distribution and travel-time costs.

The final Tourism Potential Index (TPI) is obtained through the weighted combination of the three dimensions, following established formulations in the literature while adapting them to a high-resolution spatial context. In addition, a bivariate cartographic approach is employed to jointly represent the spatial interaction between supply and demand tourism factors, enabling the identification of distinct territorial typologies, such as areas of high potential, underutilized regions, and structurally imbalanced zones.

The resulting cartographies, including the Tourism Potential Index and a bivariate representation of supply and demand, are expected to reveal clear spatial patterns within the regional tourism system. High potential areas are likely to be concentrated in urban centers and well-connected mountain regions, where the convergence of resources, infrastructure, and accessibility reinforces their attractiveness. Conversely, extensive rural areas are expected to exhibit significant tourism potential but remain weakly integrated into the system, reflecting conditions of limited accessibility or insufficient functional capacity. These preliminary insights highlight the importance of accessibility as a structuring factor and suggest its role as a key driver of territorial tourism potential.

The proposed methodology is transferable to other regional contexts and offers a robust basis for the development of planning strategies aimed at promoting a more balanced and sustainable distribution of tourism activity.

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