

# A Taxonomy of Specialized Tourism Ecosystems (STESY): Toward New Geographies for Sustainable Territorial Planning

Rachele Vanessa Gatto

 <https://orcid.org/0009-0007-3024-112X>

*University of Basilicata, Italy*

Simone Corrado

 <https://orcid.org/0000-0002-0433-2219>

*University of Basilicata, Italy*

Francesco Scorza

 <https://orcid.org/0000-0001-6149-7346>

*University of Basilicata, Italy*

**Received:** May 14th, 2025 | **Accepted:** June 24th, 2025

## ABSTRACT

Tourism externalities, such as gentrification, over-tourism, and the Bilbao effect, are key concerns in contemporary urban and regional planning. A wide range of approaches for measuring sustainable tourism have been developed, highlighting the challenges associated with comparing performance and outcomes across different destinations and scales. To address these issues, the paper proposes a spatially explicit taxonomic classification of the tourism ecosystem structure to a relevant set of spatial variables that characterize the supply of a specialized tourism value chain. The study identifies, evaluates, and compares specialized tourism destinations areas, applying the balanced supply index to produce a high-resolution cultural tourism map. The approach strengthens electronic planning by integrating geospatial data into a robust analytical framework, aiding sustainable tourism management and regional planning. It supports place-specific policy design and promotes adaptive, data-driven urban and regional electronic planning.

## KEYWORDS

Sustainable Tourism, Complex Systems, Regional Development

## INTRODUCTION

In 2023, the tourism sector accounted for 9.1% of the global 23.2% gross domestic product increase since 2022, helping to get closer to pre-Covid levels (that amount was only 4.1% below the 2019 level) (World Travel and Tourism Council, 2023). As a top growing industry, tourism plays a significant role in global and local economies, employment, environmental pressure, and social cohesion (Casado-Aranda et al., 2021; Getz, 1998; Naselli et al., 2022; Sharpley, 2002).

Assuming tourism as a place-oriented activity, the spatial dimension of the phenomena is the focus of the research in this paper.

DOI: 10.4018/IJEPR.397668

This article published as an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>) which permits unrestricted use, distribution, and production in any medium, provided the author of the original work and original publication source are properly credited.

Although tourism is widely recognized as a driver of development in disadvantaged areas (Croes et al., 2021), it is also well known that tourism, in addition to positive impacts, generates negative externalities as highlighted by relevant literature (Sarrión-Gavilán et al., 2015) and current policies issues (Bei & Celata, 2024; Eugenio-Martin et al., 2019; Ferreri & Sanyal, 2018; Kapera, 2018; Kowalczyk-Anioł, 2023; Morales-Pérez et al., 2022).

Regeneration processes linked to the construction of a main attractor (i.e. the Bilbao effect) and aimed at boosting the tourist demand represent a successful strategy (Hansen et al., 2023; Lumsdon & McGrath, 2011; Scorza & Gatto, 2023). Questions arise in the relationship between urban transformation and the fundamental contribution of other coordinated actions supporting such a strategy (Raevskikh, 2018).

If we consider the territorial dimension of specific tourism activities, localized impacts and nonlinear distribution of benefits and threats emerge. Phenomena such as over-tourism (Balmer, 2024; Guy, 2024; Trono et al., 2022), and gentrification reveal the potential negative implication of tourism in territorial transformation (Ignaccolo et al., 2023). Practical evidence relies upon overrunning the capacity of DAs to manage the request of tourist demand and preserve multidimensional assets (Abdullah et al., 2024; Ballesta, 2024; Chaney & Séraphin, 2023)

Social externalities of unplanned tourism development may be represented by the trend of the massive accommodation conversions of housing into Airbnb rentals. As a general consequence, the unexpected price increase in the real estate market in the neighborhood causes social diseases such as limited access and the out-migration of residents (Lagonigro et al., 2020). The seasonality of different activities related to tourism marks another feature of turnover in the local labor market (Milano et al., 2024; Stojčić et al., 2022).

The growing attention on the management and valorization of territorial assets (Zhang et al., 2022) for tourism purposes and the evident relevance of tourism in local economies requires the adoption of policies, strategies, and analytical tools able to assess the principles of sustainable tourism development (Romão & Neuts, 2017; United Nations Human Settlement Programme, 2016; Vitasurya, 2016).

The United Nations World Tourism Organization (UNWTO) defines sustainable tourism as “Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities” (UNWTO, 2024).

Tools to monitor the impact of tourism as regards environmental, cultural, spatial, and economic sustainability supporting decision-makers (Somarakis & Stratigea, 2019) in long-term sustainable scenarios development are mainly applied and experimented with in the academic debate (Lu & Nepal, 2009). Planning practices involving policy regulation and tourism management still lack a shared framework for approaching the regulation of tourism activities (Scorza & Gatto, 2023).

A wide range of approaches to measure sustainable tourism have been developed highlighting challenges in comparing performance and outcomes across different destinations and scales.

On one hand, statistical or econometric analyses are based on data geographically referenced following the spatial aspect of tourism as an important dependence. On the other hand, the mainstream dashboards of available statistical data (i.e. Eurostat) have limited spatial and temporal resolutions for describing local and specific impact in territorial patterns/geographies (Batista e Silva et al., 2018). In addition, spatial regression models have been adopted (Lagonigro et al., 2020) to understand the spatial distribution of Airbnb. Either way, the absence of spatial unevenness emerges (Jiang et al., 2024).

Moving beyond the classical spatial model of analyzing the impacts of tourism on the territory, this paper proposes a systematic approach that integrates and considers the fundamental characteristics of the complex tourism phenomenon.

The study aims to improve existing knowledge in assessing tourism phenomena on a territorial scale. In detail, the study (a) opens up opportunities for application in measurement, management, and policy making through the proposed taxonomy; (b) provides a new geography of a specialized TS at a territorial scale based on the spatiotemporal distribution of elements characterizing the supply chain;

(c) develops the balanced tourist supply index describing structural offer; (d) exploits the results for policy implication in a specific case study area of the Basilicata region of Italy.

The paper is structured as follow: in the first section, we propose a taxonomy for identifying tourism ecosystems at the territorial scale, drawing on complex theory in sustainable planning. The framework helps assess how well these systems align with principles of sustainability and better understand how specialized tourism ecosystems (STESY) evolve and respond to internal and external changes. In the Data and Methods section, the application of spatial temporal data describes in more detail the input data and the methodology applied to assess such multidimensional scope. In the Results section, we show tourist density supply maps at high spatial resolution in the specific case study. The last section of the paper discusses the work done and sets out areas that would benefit from further development.

## TAXONOMY FOR IDENTIFYING THE TOURISM ECOSYSTEM

### Sustainable Tourism Development and Complex Systems

Strategic spatial planning for sustainable tourism development calls for institutions adopting a comprehensive integrated governance approach. Spatial relations at different scales encourage different governance levels to work together more effectively (Albrechts et al., 2003). In addition, data and tools support the assessment of a common vision focusing on strategic assets in territorial policy agendas for enhancing local identity and sustainability goals (Friedmann et al., 2004).

In recent years, tourism phenomena have crossed socioeconomic trends in a deep transformation of spatial dimension and public domain. The spatial dimension implies the intersection of activities and networks that are physically co-located in an area (Healey, 2004). The focus on the spatial relationships of territories (Albrechts & Balducci, 2013) leads to a more effective coordinated action across different sectors, addressing issues of sustainability, equity, and economic growth in a more integrated way (Allen, 1997).

Gaining valuable insight into tourism activity in the territorial local system entails examining complex and multidisciplinary issues (Alonso-Almeida et al., 2019). Defining these issues helps to identify synergies and conflicts among different agendas.

As Merinero-Rodríguez and Pulido-Fernández (2016) point out, tourism must be approached from a systemic perspective, which requires tools capable of analyzing its different components and the relationships between them.

To develop an alternative approach to tourism analysis, modeling, and understanding the structures and organization of a region, we can start by assuming four fundamental characteristics of the system. Based on the literature, these assumptions provide the foundation for analyzing how tourism operates within a given geographical context. Here's how such characteristics could be framed:

- The TS is a geographic locus underlining the importance of the uniqueness of territorial assets, activities, and the differentiation of tourism supply (Jepson & Sharpley, 2015; Kindl da Cunha, 2005; Romão & Neuts, 2017).
- The TS is the interaction between supply (stakeholders) and demand (tourism flows; Inskeep, 1991; Mihalic, 2020). Defining components is essential for analyzing how tourism functions, develops, and evolves.
- The TS is an open system constantly influenced by economy, politics, technology, and natural conditions (Merinero-Rodríguez & Pulido-Fernández, 2016). For instance, the COVID-19 pandemic drastically affected tourism flows and demand. Lockdowns, travel restrictions, and health concerns led to a sudden and dramatic decline in international and domestic travel, causing significant disruptions across the entire tourism industry (Bakar & Rosbi, 2020).

- The TS is characterized by nonlinear relationships, where the connection between cause (input) and effect (output) is neither straightforward nor proportional. For example, a small increase in tourist arrivals in a sensitive ecosystem can lead to severe environmental degradation. The search for analytical solutions to complex problems sometimes becomes impossible. A possible approach is to focus on sub-systems attempting to find a linear problem.

## STESY Taxonomy

The proposed methodological and conceptual approach represents an original framework for the comprehensive assessment of tourism phenomena in a multi-scale and multi-stakeholder perspective for which the authors use the term STESY. To model tourism phenomena from an explicit territorial perspective we define a domain taxonomy as a conceptual framework to organize knowledge and information sharing from the analytical stages of territorial classification to the strategic decision-making. The taxonomy provides a systematic way of classifying or organizing information in a hierarchical structure. This helps to break down complex knowledge domains into structured categories, making them easier to navigate and ensuring that the same objects or concepts are referred to consistently across the TS.

The conceptual framework for defining STESY according to the proposed taxonomy allows categorization of spatial entities into three different level of classification referring both to the territorial scale and the level of complexity. The proposed taxonomy is based on three main ontological classes:

- specialized tourism destination area (DA): the community of spatial elements identified in specialized attractions (e.g. cultural tourism), services (e.g. accommodation, restaurants), and reachability
- specialized tourism system (TS): the spatial identification of one or more specialized DAs in which it is possible to recognize the intersection of tourist demand and the supply of a specific category of tourism chain
- STESY: “A tourist ecosystem is defined as a network of interrelated and interdependent nodes that characterize one or more tourist destinations area providing benefits in a territorial development scenario” (Gatto & Scorza, 2023, p. 5. The STESY is structured as a network of stakeholders and spatial entities belonging to a specialized TS (Corrado et al., 2024; Gatto & Scorza, 2023). Stakeholder communities are made by all the actors involved in the specialized TS such as operators, small and medium-sized enterprises, public bodies, and the local population.

Therefore, a DA is a geographical area, not delineated by administrative boundaries, where visitors stay overnight. The concept can be formalized as:

$$DA_j = f(a_j, st, r),$$

Specialization ( $j$ ) is the attribute describing tourism categories; it refers to a tourism supply chain. Each DA is “specialized” based on the type(s) of tourism present (cultural, gastronomic, etc.); thus, the tourism specializations define the offerings of a territory. Critically, the type of activity (such as trekking, cultural visits, or gastronomic experiences) and the motivational purpose (such as environmental appreciation, heritage exploration, or leisure) associated with each geolocated point of interest (POI) are the primary drivers informing the classification of the destination’s tourism profile. These elements define the functional character of the destination and determine its specialization.

Thus, specialization is not a static or externally imposed classification but a data-driven outcome reflecting the observed composition of tourism offer and demand. This methodological approach allows for a nuanced understanding of tourism territories.

The function  $f$  represents the spatial complex model based on the configurational relations among elements assessed according to analytical purposes oriented to describe tourism specialization. The elements are described as follows: Attractors ( $a_j$ ) are POIs within a recognized and specialized tourist offer. Each attractor is located in spatial configuration and collects a set of activities linked to tourist demand addressing classification. UNWTO international references, national/regional ones as in the Italian National Strategic Plan for Tourism 2023–2027 (Ministero del Turismo, 2023), or the case study area of this research as laid out in the Regional Tourism Plan of the Basilicata Region (Regione Basilicata, 2008) all lack a unified and homogeneous classification of tourism categories. Specifically, an attractor is an element of the territory recognized by national and/or international agencies, bodies, and organizations, and included in a list such as United Nations Educational, Scientific, UNESCO Sites, “Italy’s Most Beautiful Villages,” Blue Flag, and Ministry of Cultural Heritage and Activities and Tourism (MIBACT). The designation  $st$  represents POIs having to do with services involved in the supply chain (restaurants and accommodations); and  $r$  represents the reachability.

The taxonomy proposed, in particular the DA, describe the components of the territorial offer referring to a specialized tourist supply chain. Through a case study, we focus on the territorial network through the local representation of DA elements understanding the behavior of the DA’s overcoming the territorial units for statistics.

## STUDY AREA, DATA, AND METHODOLOGY

### The Study Area

The analysis shifts from a classic broad, aggregate analytical regional view to low-dimensional vector embedding points (POIs) that represent  $DA_j$  elements, such as specialized attractors (e.g., cultural tourism) and services (e.g., accommodation, restaurants). To provide a clearer understanding, the following description represents the DAs analyzed in a case study area including “Monticchio Laghi” and “Alto Bradano” in the Basilicata region of Italy.

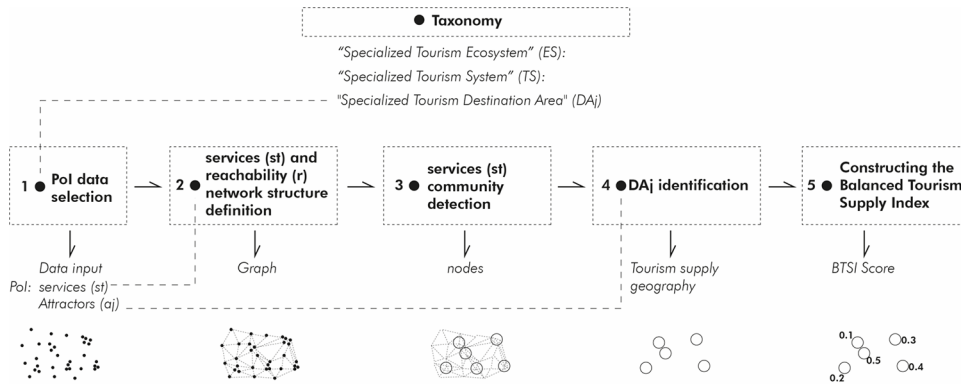
The study area has an extension of 3,722.06 km<sup>2</sup> on the border between the northern part of the Basilicata region and the western part of Apulia. Basilicata is one of the regions with the lowest population density in Italy (56.3 inhabitants/km<sup>2</sup>), influenced by a development delay that stems from a centuries-old infrastructural deficit causing low fertility rate, working-age migration, and economic decline (Annunziata et al., 2024).

As part of the National Recovery and Resilience Plan investments, the Ministry of Culture released a public call for proposals to recover and make peripheral and abandoned settlements attractive and more competitive in the national tourism market, asking regions to submit projects to invest in. Basilicata focused on the regeneration of the Monticchio Laghi areas. The €20 million investment of public funds is intended to catalyze economic rejuvenation in the area, tapping into the tourism potential of both cultural and natural tourism. Within this area, there is a regional park and several cultural sites, including medieval castles, national museums, and UNESCO and archeological sites that offer significant potential for cultural tourism. Thus, strategies for spatial development based on internal resources related to the system of widespread naturalness and the uniqueness of historical and cultural values are sought.

### Data and Methods

In order to produce the balanced tourism supply index (BTSI) and related tourism supply map, we collect  $DA_j$  POI data from different sources. Then, for the construction of the network of  $DA_j$  a set of operations were conducted using the statistical software Python and geographical information systems (GIS). The methodological workflow is outlined below in five analytical steps (Figure 1).

Figure 1. The Methodological Workflow



### Step 1: $DA_j$ POI Data Selection

European directives boost advanced data analytics, including big data and key enabling technologies, such as artificial intelligence and blockchain, for a digital and greener transformation of the industry (Muench et al., 2022). However, due to the skewed and imbalanced information technology infrastructures between urban, peri-urban and rural contexts, the implementation of this approach is challenging in territories that lack adequate data infrastructure. Indeed, while predicting tourism flow could help service providers in designing better tourism strategies for businesses and local administrations, this advantage appears to be minimal in less developed regions. In these rural areas, the lack of detailed data to map tourism supply systems is a challenge, and our work focuses on finding practical solutions to this problem. The data collection step refers to elements of  $DA_j$  in the study area. The dataset was compiled through a combination of institutional sources, including UNESCO Sites, Italy’s Most Beautiful Villages, MIBACT, the Italian Environment Fund, and the Basilicata Region’s cultural registry, as well as public geographic platforms such as Google Maps application programming interface (API) Places and OpenStreetMap (OSM). This integration of multiple data sources aimed to provide a comprehensive overview of the local cultural tourism offerings, with particular attention to rural and less digitally structured areas. While OSM was a key resource, its limitations in rural areas—due to the crowd-sourced nature of its data—meant that additional information was needed (Biljecki et al., 2023; Y. Yan et al., 2020). As summarized in Table 1, the collected dataset was structured around key categories of POIs relevant to cultural tourism.

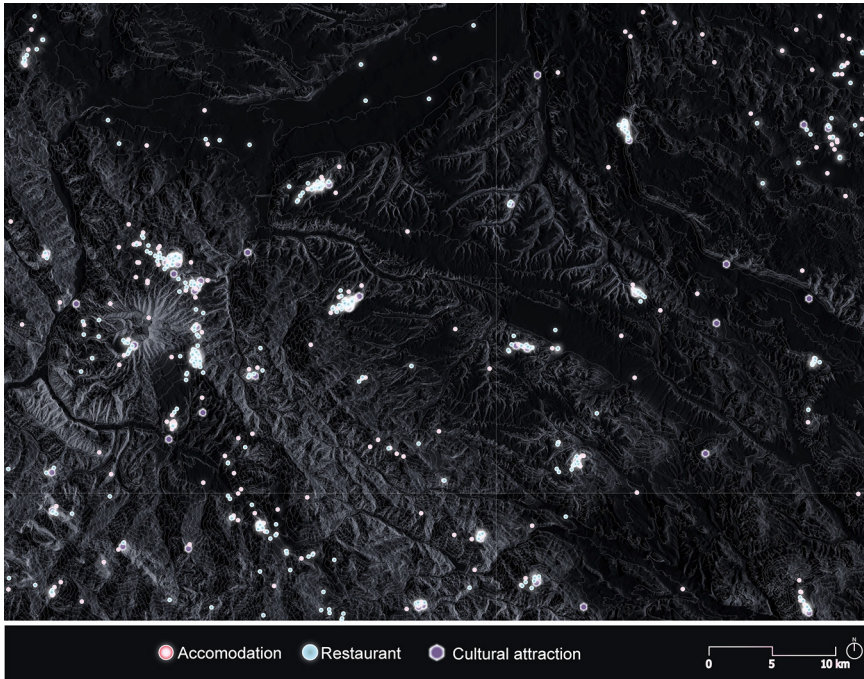
Table 1. Data Collection

| POIs category |            | Number of mapped entities | Source of data  | Type  | Activity  | Purpose  |
|---------------|------------|---------------------------|---|---|---|--|
| $a_j$         |            | 78                        | UNESCO Sites, Italy's most beautiful villages, MIBACT, FAI, Cultural heritage – Basilicata region, Google Maps Places API | Castles, churches, fortified towers, museums, monuments, archaeological sites | Visits, exhibitions, local art and cultural experiences | Exploring heritage, history, traditions, and cultural identity |
| <i>st</i>     | <i>R</i>   | 442                       | Google Maps Places API, OSM   | Restaurants, cafes, bars  | Restoration   |  |
|               | <i>Acc</i> | 417                       | Google Maps API Places, OSM, APT Basilicata   | Hotels, guest houses, B&B   | Accommodation   |  |

*Note.* POI = point of interest;  $a_j$  = cultural attractors; UNESCO = United Nations Educational, Scientific, and Cultural Organization; MIBACT = Ministry of Cultural Heritage and Activities and Tourism; FAI = Italian Environment Fund; *st* = service-related point of interest; *R* = food and beverage services; API = application programming interface; OSM = OpenStreetMap; *Acc* = accommodation facilities; APT = Regional Tourism Promotion Agency; B&B = bed and breakfasts.

The  $a_j$  category included cultural attractors—castles, churches, fortified towers, museums, monuments, and archaeological sites—with 78 mapped entities drawn from official national and regional inventories as well as crowd-sourced platforms. The *R* category accounted for 442 food and beverage services (restaurants, cafes, bars), while the *Acc* category included 417 accommodation facilities (hotels, guest houses, bed and breakfasts), both primarily mapped using Google Maps API, OSM, and data from the Basilicata Regional Tourism Promotion Agency. These service-related POIs were grouped under the broader classification *st*, while the variable *r* represented road network distances calculated between POIs for accessibility analysis. Consequently, the specialization category (*j*) of the DA was framed within the cultural tourism typology, integrating both attractors and services into a spatially explicit model suitable for GIS-based analysis. Each geolocated POI was associated with a specific activity (e.g., cultural visits) and a corresponding purpose of visit (e.g., heritage exploration), which together determined the specialization of a given tourism destination. This specialization was not predefined but emerged from the observed composition of tourism supply in each area. This logic allowed for a data-driven identification of tourism specializations, which was particularly useful in rural or multifunctional territories where tourism forms were diverse and less formally structured. It also supported comparative analysis, spatial clustering, and destination planning within a GIS-based decision-making framework.

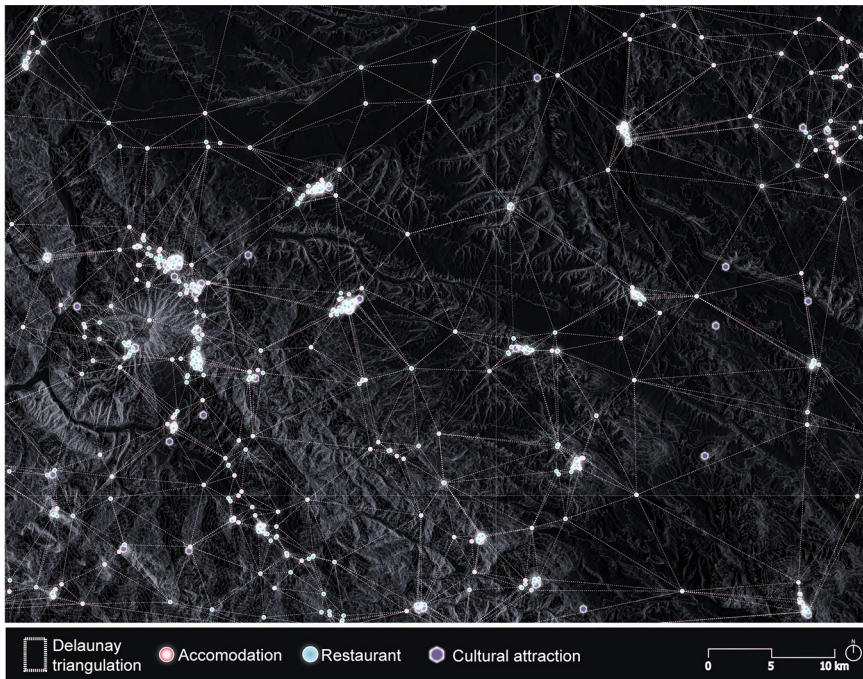
Figure 2. Map of Entities



### Step 2: $S_t$ and $r$ Network Structure

Once we obtained the map of the  $DA_j$  POI, we defined the spatial model to represent and analyze the relationships among POIs in order to map the  $DA_j$ s. To address these challenges, the graphs approach was chosen. The graph structures (Figure 3) were spatially compact, compared to the rigid grid, and Delaunay triangulation (DT) is an example of this (Huang et al., 2023). The DT graphs approach offered a robust method for mapping the interactions between spatial entities (Xu et al., 2022; X. Yan et al., 2019). According to selected reference literature, the graph can be generated by connecting all POIs within a given study area using DT (Huang et al., 2023; Xu et al., 2022; X. Yan et al., 2019). In this network, the POIs served as nodes, with their respective category embedding ( $Acc$ ,  $R$ ) representing the node features. The edges between nodes were characterized by weights depending on the spatial distance of the road network ( $r$ ).

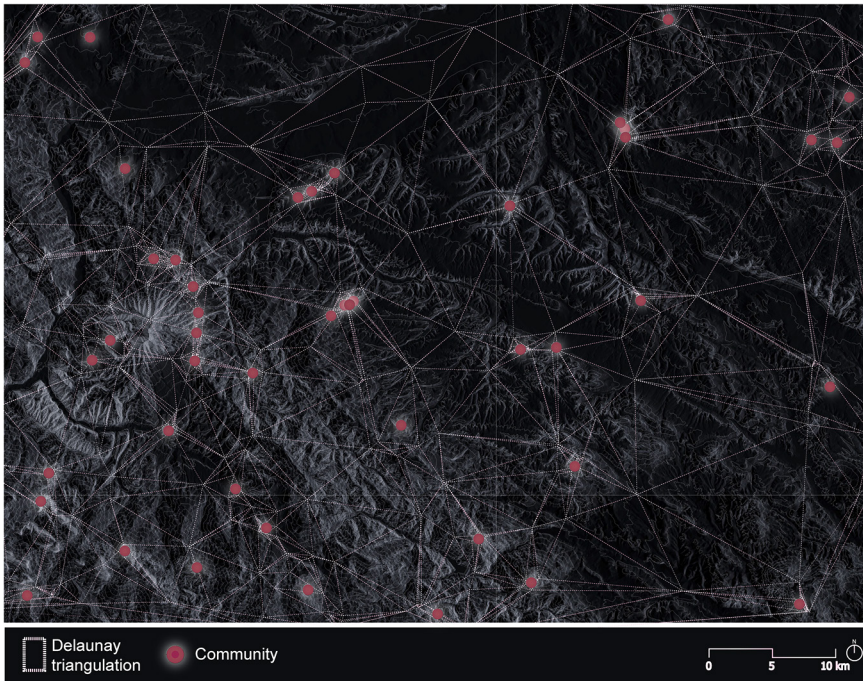
Figure 3. The Graph Structures



### Step 3: St Community Detection

We applied a Louvain community detection algorithm derived from graph theory to identify non-overlapping community (Blondel et al., 2008). The modularity of a graph was used to analyze the structure of the graph and quantify the strength of interactions between nodes in the respective groups (Blondel et al., 2008). In this way, it was possible to divide the network into  $c1, \dots, cn$  communities. Modularity is often used in optimization algorithms to identify the structure of communities in networks. One of the main advantages of modularity maximization is that it did not require us to specify a priori the number of communities we wanted to detect. We used only the topological interactions between nodes (Dugué & Perez, 2015). By projecting POIs on the graph, weighted on  $r$ , we identified communities of services through the network (Figure 4).

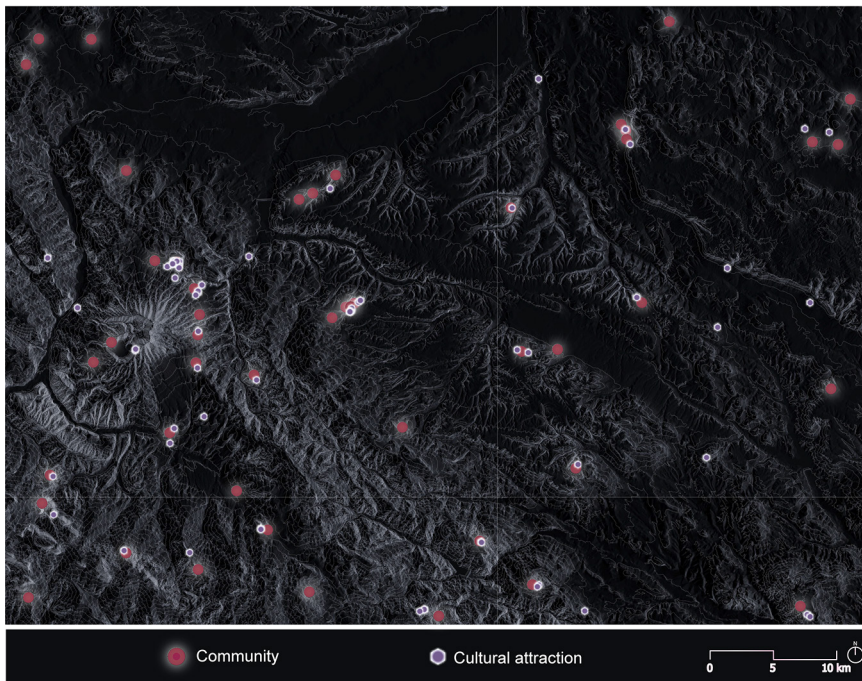
Figure 4. Communities of Services Through the Network



#### Step 4: $DA_j$ Identification

Moreover, to define the DA, each attractor was assigned to a single POI's community based on the nearest neighbor approach, considering both the spatial configuration of the attractors and their proximity to the community centroids. Firstly, we used the standard deviational ellipse (SDE) to map the centroid of the service community. The SDE is specifically useful for indicating the distribution density of a set of geographic units (Gong, 2002). Unlike the non-cartographic distance circle, which measures dispersion using a single parameter, the SDE captures both dispersion and directional trends in two dimensions through the angle of rotation ( $\theta$ ), the dispersion along the major and the minor axis (Myint, 2008). In this way, we ensured consistency with the spatial configuration of the communities in the study area. Subsequently we applied the nearest neighbor search algorithm from GIS processing to calculate distance between  $st$  and  $a_j$  and joined them together to identify  $DA_j$ . This method ensured that each attractor was associated with the nearest service community, respecting the principle of spatial proximity in geographic analysis (Miller, 2004; Ponds et al., 2007), and ensuring spatial consistency between attractors and services within the study area (Figure 5).

Figure 5. Spatial Relation Between Attractors and Services Within the Study Area



### Step 5: Constructing the BTSI

We identified 52 DAs representing the region's supply of cultural tourism. Each DA is characterized by three components: restaurants, accommodations ( $st$ ), and cultural attractors ( $a_j$ ), balanced by their reachability. The BTSI was defined dividing the number of accommodations by the number of restaurants for each community. According to the UNWTO, a tourist destination is defined as a place where visitors can spend at least one overnight stay, making accommodations a key element of its structure. Comparing accommodations ( $Acc$ ) to restaurants ( $R$ ) provided insight into whether a DA was structured to provide services for day visits or longer tourists stays, which helped us understand the local tourism dynamics and supply infrastructure balance, favoring the comparison among DAs inside the system.

$$BTSI = i (Acc/R)$$

A BTSI value greater than or equal to 1 indicated a well-structured tourism supply system, with an emphasis on cultural tourism that supports overnight stays. In contrast, a BTSI value below 1 suggested a tourism structure that was less focused on accommodating overnight visitors, potentially indicating a day-visit-oriented system lacking sufficient infrastructure for longer stays. Considering that the study area was characterized to be a rural area where tourism supply was fragmented and not characterizing the local economic structure, we needed to restrict the application of the BTSI index to more significant  $DA_j$  selecting those where the presence of supply services was consistent. From the whole set of DAs, a significant sample of communities was selected for further analysis. We used the following selection criteria:

1. DAs where the number of restaurants ( $R$ ) was below the population average (denoted as  $m_R$ ) were excluded.

2. DAs where the number of accommodations ( $Acc$ ) was below the population average (denoted as  $m_{Acc}$ ) were similarly excluded.

Table 2 below represents the structure of the data, where communities were classified based on their attractors, accommodations, and restaurants availability.

**Table 2. The Structure of the Data Classification**

| Community ID (C) | Attractors (a) | Accommodations (Acc) | Restaurants (R) | Excluded |
|------------------|----------------|----------------------|-----------------|----------|
| --               | --             | $n_{Acc} < m_{Acc}$  | $n_R < m_R$     | Yes      |

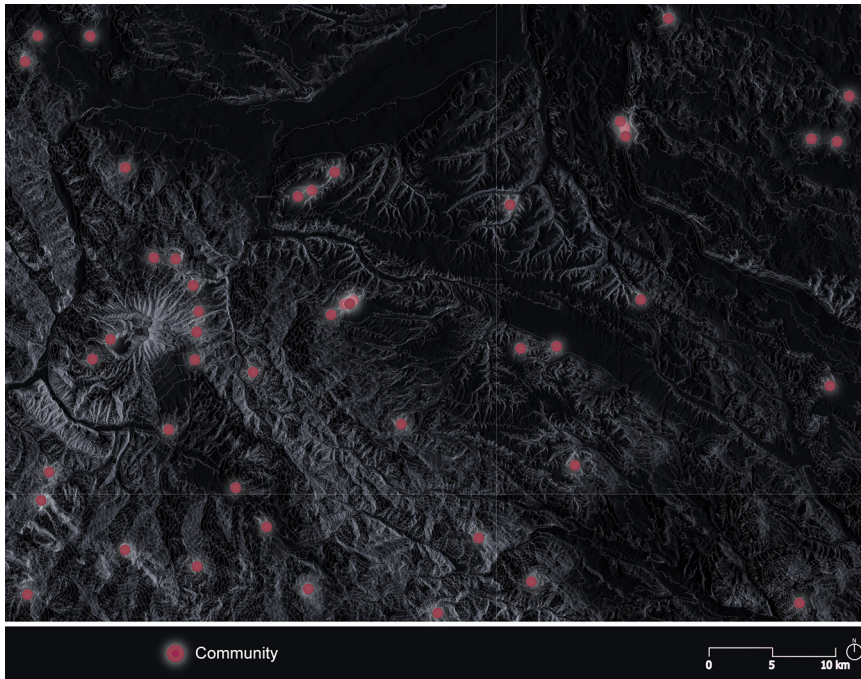
*Note.* Communities where either  $n_{Acc} < m_{Acc}$  or  $n_R < m_R$  are marked as excluded. C = the unique ID assigned to each community; a = the number of attractors (e.g., cultural sites, landmarks) present in each community; Acc = the number of accommodations (e.g., hotels, guesthouses) available in the community; R = the number of restaurants in the community.

This restriction of the analytical sample ensures that only communities with a minimum baseline level of services options were considered in the index, providing a more accurate representation of the balance between these two key factors in tourism infrastructure.

## FINDINGS AND DISCUSSION

The analytical steps determined a new geography of cultural tourism supply for the study area based on  $DA_j$ . Figure 6 represents the  $DA_j$ s as an original territorial structure developed to investigate tourism effects at the local scale. It also enables comparison with general data and trends derived from census statistics aggregated by administrative units (mainly Province or Nomenclature of Territorial Units for Statistics Level 2). It means that the local TSs could be better investigated through  $DA_j$ s units intended as a functional spatial element representing detailed territorial structures including key actors and key features in the tourism supply system.

Figure 6. The 52 Original Specialized Destination Areas Intended as a Functional Spatial Element Representing Detailed Territorial Structures



The application of the BTSI index allowed us to select those territorial units where we expected a formal organization of tourism supply, including the presence of local tourism supply chains. Here, tourism-related economic value can act as a driver of local development when framed within a sustainability-oriented perspective. This research hypothesis opens up future possibilities for investigating each  $DA_j$  at a lowest scale in greater depth and modeling the functional relations among  $DA_j$ s to improve the action of territorial promotion on the global market of tourism supply.

As we reported before, we restricted the sample from the 52 original  $DA_j$ s to 19  $DA_j$ s. Among this sub-sample we already verified that the presence of a characterizing attractor in each  $DA_j$  represented a condition to identify a structured local tourism supply chain. We intended as a “characterizing attractor” a cultural landmark expressing a super-regional capacity to be the main purpose of travel. Table 3 depicts the characteristics of the selected  $DA_j$ s group.

Table 3. Balanced Tourism Supply Index Highlighting the Disparity in Tourism Infrastructure Between Communities With Strong Cultural Attractors and Those With Less Recognized Sites

| DA ID (C) | Attractors (a) | Accommodation (Acc) | Restaurant (R) | Total services (St) | Total community (TC) | Balanced tourism supply index | Characterizing attractor |
|-----------|----------------|---------------------|----------------|---------------------|----------------------|-------------------------------|--------------------------|
| 11        | 1              | 18                  | 31             | 49                  | 50                   | 0,580645161                   | -                        |
| 14        | 7              | 10                  | 15             | 25                  | 32                   | 0,666666667                   | -                        |
| 31        | 1              | 18                  | 23             | 41                  | 42                   | 0,782608696                   | -                        |
| 36        | 3              | 12                  | 15             | 27                  | 30                   | 0,8                           | -                        |
| 24        | 2              | 9                   | 11             | 20                  | 22                   | 0,818181818                   | -                        |

*continued on following page*

Table 3. Continued

| DA ID (C) | Attractors (a) | Accommodation (Acc) | Restaurant (R) | Total services (St) | Total community (TC) | Balanced tourism supply index | Characterizing attractor |
|-----------|----------------|---------------------|----------------|---------------------|----------------------|-------------------------------|--------------------------|
| 40        | 2              | 13                  | 15             | 28                  | 30                   | 0,866666667                   | -                        |
| 30        | 13             | 20                  | 21             | 41                  | 54                   | <b>0,952380952</b>            | castle                   |
| 15        | 1              | 11                  | 11             | 22                  | 23                   | <b>1</b>                      | castle                   |
| 19        | 3              | 13                  | 12             | 25                  | 28                   | <b>1,083333333</b>            | castle                   |
| 38        | 5              | 10                  | 9              | 19                  | 24                   | <b>1,111111111</b>            | castle                   |
| 29        | 7              | 10                  | 9              | 19                  | 26                   | <b>1,111111111</b>            | -                        |
| 41        | 2              | 10                  | 8              | 18                  | 20                   | <b>1,25</b>                   | castle                   |
| 33        | 3              | 13                  | 10             | 23                  | 26                   | <b>1,3</b>                    | FAI                      |
| 46        | 3              | 12                  | 9              | 21                  | 24                   | <b>1,333333333</b>            | castle                   |
| 28        | 2              | 13                  | 9              | 22                  | 24                   | <b>1,444444444</b>            | castle                   |
| 20        | 2              | 14                  | 9              | 23                  | 25                   | <b>1,555555556</b>            | castle                   |
| 42        | 4              | 14                  | 9              | 23                  | 27                   | <b>1,555555556</b>            | castle                   |
| 22        | 13             | 19                  | 11             | 30                  | 43                   | <b>1,727272727</b>            | castle                   |
| 35        | 3              | 25                  | 12             | 37                  | 40                   | <b>2,083333333</b>            | Castle + UNESCO          |

*Note.* DA = a geographical area, not delineated by administrative boundaries, where visitors stay overnight; C = community identification; a = attractors; Acc = accommodation facilities; R = food and beverage services; St = Accomodation facilities and food and beverage services; TC = total community; FAI = Italian Environment Fund; UNESCO = United Nations Educational, Scientific, and Cultural Organization.

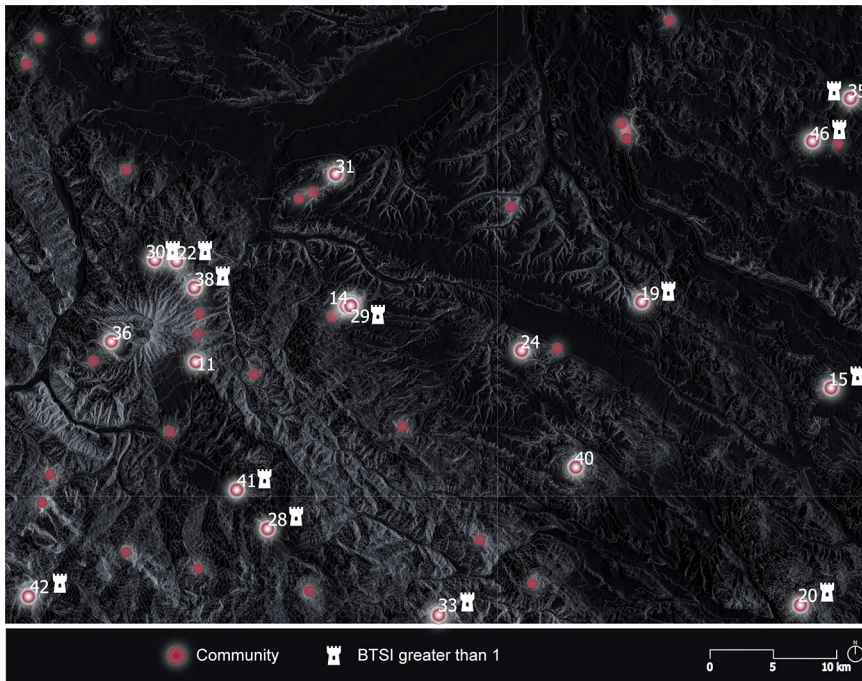
The *DA<sub>j</sub>s* were sorted per increasing values of BTSI index. It was possible to assess that higher values of BTSI (> 0.95) characterized 68% of the distribution. Additionally, when we investigated the attractors' features, we detected that the highest BTSI *DA<sub>j</sub>s* had a castle as the main attractor (i.e. characterizing attractor). That meant that a rare attractor was a more motivating factor in generating tourism travels and presences.

Communities with a BTSI greater than 1, such as ID35, exhibited a strong cultural attraction system. In fact, the highest-ranking community was related to Castel del Monte, a UNESCO World Heritage Site. This demonstrated a clear correlation between a high BTSI and the presence of globally recognized cultural landmarks.

On the other hand, communities with a BTSI below 1, such as such ID11, the Rionero municipality, showed a different trend. The results showed that these communities were less equipped to support overnight tourism. For instance, Rionero's cultural attractors were less relevant.

The BTSI highlighted the disparity in tourism infrastructure between communities with strong cultural attractors and those with less recognized sites (Figure 7). Communities like Castel del Monte, with high-index values, were bolstered by world-renowned landmarks, enhancing their ability to support sustainable tourism. Conversely, communities with lower index values struggled due to the absence of such attractions, limiting their tourism development potential.

Figure 7. Spatial Distribution of Balanced Tourism Supply Index and Specialized Destination Areas



## CONCLUSION

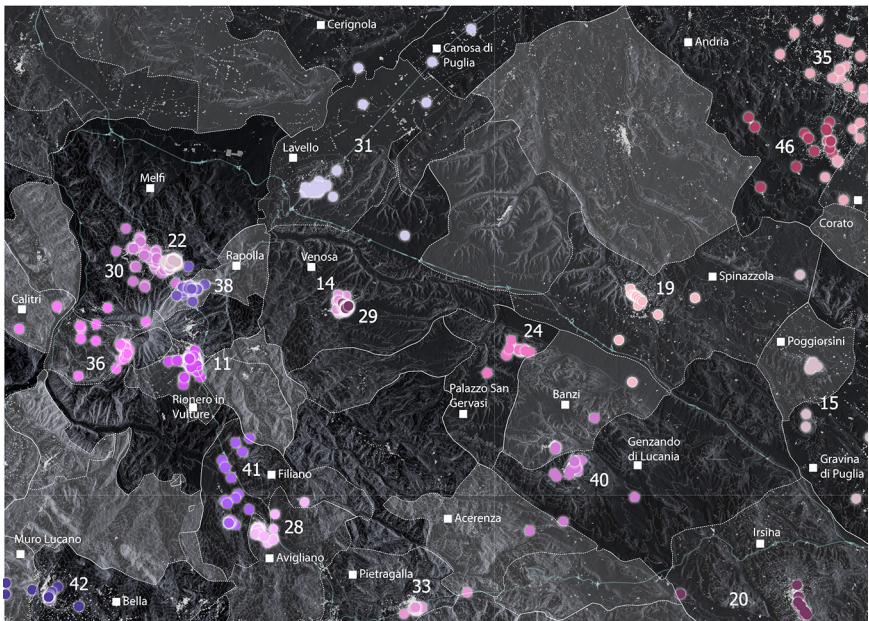
This paper uses a systematic approach to consider the tourism phenomenon in all its territorial complexity, integrating the fundamental characteristics according to a clear taxonomic model based on three classes: DA, TS, STESY. This approach provides an analytical way to define new geography of specialized TS at a territorial scale suitable to improve territorial development policies through the proposed taxonomy based on improved territorial spatial knowledge.

Moving from the definition of tourism taxonomy as it drew on complex theory in sustainable planning through the computational model, the case study produces tourist density supply maps at high spatial resolution, demonstrating the local diversity of tourism communities in a low density settlement area: the Basilicata region of Italy.

Through the relational geography (Healey, 2004) applied to the tourism supply spatial assessment, the boundaries of DAs closely describe the local components of the TS at an appropriately detailed scale. As Batty (2023) argued, “The significant point in this argument is that cities are increasingly connected to one another and their wider environment cannot be easily broken off from the city system itself” (p.3).

We assumed that the administrative boundaries do not necessarily align with the physical boundaries identifying a thematic spatial system (Figure 8.). Tourism flows, infrastructures, and economic interdependencies usually extend beyond formal jurisdictional limits, highlighting the need to consider a broader, interconnected spatial perspective when analyzing tourism dynamics.

Figure 8. Spatial Distribution of the 19 Specialized Destination Areas Overlaid on Administrative Boundaries



The map in Figure 8 illustrates how the functional units extend beyond municipal jurisdictions, emphasizing the need for a multiscalar and cross-border perspective in tourism planning. The inclusion of administrative limits allows for better visualization of the mismatch between institutional boundaries and functional spatial organization.

In the proposed analytical model, the spatial aggregation of services is weighted according to point-to-point accessibility, determining service communities based on proximity of access. We affirm that a multiscalar approach envisions an ecosystem divided into subsystems of the tourism value chain. Thus, the focus is not on zones, but rather on aggregations of heterogeneous points defined by spatial relationships. The scale, therefore, does not consider traditional statistical units (e.g., Nomenclature of Territorial Units), but a series of geographically localized networks and sub-networks that depend on the specialized tourism features.

The detailed maps offered by representing spatial entities through POIs enable a place-oriented understanding of the relationships among single services, beyond the aggregated spatial similarities that often hide insights. For example, the modifiable area unit problem demonstrates how data aggregation, while useful for cartographic representation, can distort the analysis needed for effective place-based policymaking. A case in point is the Italian National Institute of Statistics (ISTAT) classification of tourism density at the municipal level in Italy: although this classification helps for national representation, it fails to identify local communities and tourism niches that specialize in offering a specialized tourism typology. Thus, the analysis shifts from a broad, aggregate analytical-regions view to a low-dimensional vector embedding points (POIs) representations of systems' entities, such as specialized tourism attractors (e.g. cultural tourism) and services (e.g. accommodation, restaurants).

The taxonomy and the analytical model STESY, through the classification of DAs and the elaboration of the BTSI, offers a replicable method for mapping tourism supply imbalances and supporting policy choices on where to enhance accommodations or services. Local authorities can use this information to prioritize investments in areas with high cultural potential but limited infrastructure, guiding funding for restoration, mobility, and service improvement.

Concerning the case study application, the research directly contributes to place-based knowledge development in the Basilicata region, a context characterized by fragmented settlements, underexploited heritage, and emerging tourism niches. Basilicata's territorial identity, rooted in historical layers, rural landscapes, and community traditions and deeply influenced by infrastructural weaknesses of the tourism supply system, demonstrates high potentials in tourism development. The proposed framework offers a quantitative, spatially explicit, and measurable dashboard as a decision support system favoring transdisciplinary views and scenario building for a more grounded approach to tourism development that enhances local identities and informs adaptive policymaking.

The relevance of the findings for the Basilicata region includes both a deepening knowledge framework and, in terms of policy implication, a driving contribution to improve ongoing investment policy in tourism infrastructure. The new geography of the research area based on DAs reveals a fragmented territorial structure in which the rarest attractors (less common in the distribution of cultural landmarks of the territory) play a driving role in tourism flows. This new analytical approach may support functional agglomeration for DAs promoting collaboration among local institutional players for maximizing territorial tourism potential. In light of the proposed classification and within the framework of the tourism ecosystem, the identification and formalization of the stakeholder network emerge as a critical development. Future developments will aim to map, using available data, the stakeholder network structured by functional roles within the tourism ecosystem (Ducci et al., 2023), in relation to the spatial distribution of the identified POIs. This formalization is instrumental to enhancing qualitative further analyses of the territory (e.g., questionnaires), as it enables a more structured and consistent organization of knowledge in line with high resolution territorial assessments.

Additionally, the revealed structure of the system also represents relevant information for private investors (i.e., micro-investments in residential accommodation or macro-investments in tourism facilities and services) requiring specific rules facilitating specific territorial processes oriented toward a more balanced and sustainable local TS. Finally, potential benefits deriving from a deeper awareness of territorial capital in tourism supply and from ongoing investments in tourism infrastructure include the opportunity to design specialized territorial promotion actions. These actions can be based on local tourism specializations and identified target markets, while avoiding overtourism effects.

Extending the focus at the regional scale, the STESY model aligns with strategic goals set by the Basilicata region to promote sustainable and place-based tourism. By offering a high-resolution spatial assessment of cultural tourism supply, the study supports regional efforts to promote minor cultural heritage, to foster tourism in inland areas, and to improve territorial cohesion. The research offers tools to identify tourism potentials outside traditional hotspots, enabling more targeted investment and planning decisions in accordance with the Regional Tourism Plan (Regione Basilicata, 2008).

From a comprehensive perspective of electronic planning research, the taxonomy developed in this study provides a tool to align data-driven tourism and cultural planning under shared sustainable development goals. By identifying areas with significant but under-activated cultural potential, the model supports the design of integrated programs that link heritage valorization with tourism promotion. This approach encourages coordinated policies and funding schemes that benefit both residents and visitors, helping cultural initiatives become drivers of inclusive and sustainable growth.

Research limitations include the dependence of the analytical framework on expert knowledge of input data selection and the verification of the adherence of the results to the specific case study reality, while a more automated framework could extend the application of the model, producing robust and accountable results. Moreover, the application of the taxonomy and the consequent results must be discussed with public bodies and private operators contributing to the local tourism value chain in order to fit with specific issues in policy making and investment planning.

This research can potentially support the sustainable management of tourism phenomena, which has faced in recent years unpredictable development in term of flows and consequent impacts (i.e., overtourism). Both researchers and practitioners are focused on experimental policymaking in order

to understand the effective impacts of restrictive policies such as Venice's tourism tax and Barcelona's limitation on accommodation licenses.

In the future, the proposed analytics might be applied to a wider range of tourism specialization (i.e., natural and adventure tourism, seaside tourism, and eno-gastronomic tourism) in multiple case study areas in order to acquire additional information about the relation between specialized attractors and local tourism supply chains directedly related to targeted tourism typologies. Additionally, extensive data sources could help to achieve a more detailed granularity of the input information in order to improve the quality of the elaborations. Building on the attributes of POIs, upcoming research will contribute to the development of an indicator-based framework designed to quantify phenomena associated with the tourism processes of the selected destinations, including measures of levels of attractiveness derived from data such as ratings and user-generated reviews.

## RECOMMENDATIONS

This paper fosters an alternative path for mapping the geographies of tourism value chains, offering significant insights into their spatial dynamics and operational interdependencies. Based on the findings, the following recommendations are proposed:

### Application in Measurement, Management, and Policy

Policies for effective tourism management are often oriented toward the general indication of objectives to be pursued on the basis of generic indicators and analyses. Public bodies and regional development agencies are encouraged to integrate this approach to integrate the dynamics of the tourism supply value chain with spatial development strategies.

This integration can improve local competitiveness through the identification of specialized attractors in the territory (Corallo et al., 2018), optimize the allocation of resources in areas where there is a greater robustness of infrastructures capable of supporting the system, or integrate specific services in areas that have good parameters of attractors and presences but poor equipment. The BTSI highlights the disparity in tourism infrastructure between communities with strong cultural attractions and those with less recognized sites, providing insights into possible actions to coordinate a sustainable strategy between identified neighboring  $DA_j$ .

### Adoption of Spatially Explicit Analytical Tools

A new geography of the TSs at a territorial scale based on the spatiotemporal distribution of the elements allows us to integrate the spatial analysis into the assessment of a specialized tourism supply chain. A methodological gap is highlighted for the univocal measurement of phenomena in different territorial areas belonging to a scale of analysis not in line with the scale of the tourism phenomenon. These results lead to an incomparability of the case studies and the effects of tourism. Starting from the assumption that tourism involves site specific phenomena and that its effects are linked to the measurement of the capacity of the territory compared with the demand for goods and services, this approach allows us to trace the specific territorial phenomenon through these variables applicable in any territorial area. We can correlate a high BTSI with the presence of globally recognized cultural reference points by tracing a specific path to manage the system variables in order to describe the phenomena of the tourism supply. In fact, studies indicate a greater presence of tourists in proximity to attractors, regardless of the territorial morphology.

### Application in a Tourism-Specific Supply Chain

The mapping technique should be piloted in specific tourism industries with complex or fragmented value chains such as natural and adventure tourism, seaside tourism, and eno-gastronomic tourism. Such applications could validate the method's adaptability and reveal tourism industry-specific challenges and opportunities. The applicability of the method to different tourism specializations

allows the development of a quantitative analysis, monitoring, and an evaluation framework over time by drawing on territorial data.

### **Interdisciplinary Framework**

The study strengthens the link between geographical analysis and economic theories, offering a method that allows us to explore the spatial distribution of economic activities along value chains. This approach allows us to overcome traditional models that tend to neglect the territorial dimension. The use of advanced spatial tools and multiscalar data represents a significant advance in the analysis of tourism value chains. The proposed methodology identifies through quantitative data a tourism value chain, offering a more complete representation of network dynamics. The system variables carry with them attributes of value that trace a complex network of actors, services, and public bodies. It is useful for economists and planners to identify stakeholders directly involved in decision-making processes, reinforcing and monitoring the tourism impacts.

### **Relevance for Sustainable Planning**

The work provides a useful methodological basis for linking global value chains to regional development policies. This helps to bridge the gap between the global scale of economic activities and local governance strategies, laying the foundations for more effective and sustainable spatial planning. The study emphasizes the need to integrate environmental and social considerations in the mapping of value chains. This approach supports more informed and sustainability-oriented research, helping to identify critical points for targeted interventions.

These recommendations aim to bridge the gap between academic innovation and practical application, ensuring the method's potential is fully realized in advancing knowledge and informing policy.

### **COMPETING INTERESTS**

The authors of this publication declare there are no competing interests.

### **FUNDING**

This research was supported by Next Generation the European Union – National Recovery and Resilience Plan (PNRR), Tech4You project (CUP: C43C22000400006).

### **AUTHOR NOTE**

Correspondence concerning this article should be addressed to Rachele Gatto, [rachelevanessa.gatto@unibas.it](mailto:rachelevanessa.gatto@unibas.it); Simone Corrado, [simone.corrado@unibas.it](mailto:simone.corrado@unibas.it); and Francesco Scorza [francesco.scorza@unibas.it](mailto:francesco.scorza@unibas.it)

## REFERENCES

- Abdullah, R., Xavier, B. D., Nampung, H., Varghese, V., & Fujiwara, A. (2024). Managing transit-oriented development: A comparative analysis of expert groups and multi-criteria decision making methods. *Sustainable Cities and Society*, *115*, 105871. Advance online publication. DOI: 10.1016/j.scs.2024.105871
- Albrechts, L., & Balducci, A. (2013). Practicing strategic planning: In search of critical features to explain the strategic character of plans. *The Planning Review*, *49*(3), 16–27. <https://doi.org/10.1080/02513625.2013.859001>
- Albrechts, L., Healey, P., & Kunzmann, K. R. (2003). Strategic spatial planning and regional governance in Europe. *Journal of the American Planning Association*, *69*(2), 113–129. DOI: 10.1080/01944360308976301
- Allen, P. M. (1997). Cities and regions as evolutionary, complex systems. *Journal of Geographical Systems*, *4*(1), 103–130. [https://www.researchgate.net/publication/245024105\\_Cities\\_and\\_Regions\\_as\\_Evolutionary\\_Complex\\_Systems](https://www.researchgate.net/publication/245024105_Cities_and_Regions_as_Evolutionary_Complex_Systems)
- Alonso-Almeida, M.-M., Borrajo-Millán, F., & Yi, L. (2019). Are social media data pushing overtourism? The case of Barcelona and Chinese tourists. *Sustainability (Basel)*, *11*(12), 3356. DOI: 10.3390/su11123356
- Annunziata, A., Scorza, F., Corrado, S., & Murgante, B. (2024). Unveiling intra-rural divides: Investigating decline and prosperity in rural areas: The case study of southern Italy. *European Planning Studies*, *32*(7), 1478–1505. DOI: 10.1080/09654313.2024.2335312
- Bakar, N. A., & Rosbi, S. (2020). Effect of Coronavirus disease (COVID-19) to tourism industry. *International Journal of Advanced Engineering Research and Science*, *7*(4), 189–193. DOI: 10.22161/ijaers.74.23
- Ballesta, S. H. (2024). Collaborative and professional accommodations on Airbnb: Exploring patterns for sustainable tourism management in Spain. *Cities (London, England)*, *154*(August), 105400. Advance online publication. DOI: 10.1016/j.cities.2024.105400
- Balmer, C. (2024, July 12). *Venice entry charge set to rise in 2025 to try to thin crowds*. Reuters. <https://www.reuters.com/World/Europe/Venice-Entry-Charge-Set-Rise-2025-Try-Thin-Crowds-2024-07-12/>
- Batista e Silva, F., Marín Herrera, M. A., Rosina, K., Ribeiro Barranco, R., Freire, S., & Schiavina, M. (2018). Analysing spatiotemporal patterns of tourism in Europe at high-resolution with conventional and big data sources. *Tourism Management*, *68*, 101–115. DOI: 10.1016/j.tourman.2018.02.020
- Batty, M. (2023). The boundary problem. *Environment and Planning. B, Urban Analytics and City Science*, *50*(7), 1707–1710. DOI: 10.1177/23998083231202903
- Bei, G., & Celata, F. (2024). Annals of tourism research challenges and effects of short-term rentals regulation: A counterfactual assessment of European cities. *Annals of Tourism Research*, *101*(2023). Article, 103605. Advance online publication. DOI: 10.1016/j.annals.2023.103605
- Biljecki, F., Chow, Y. S., & Lee, K. (2023). Quality of crowdsourced geospatial building information: A global assessment of OpenStreetMap attributes. *Building and Environment*, *237*, 110295. Advance online publication. DOI: 10.1016/j.buildenv.2023.110295
- Blondel, V. D., Guillaume, J. L., Lambiotte, R., & Lefebvre, E. (2008). Fast unfolding of communities in large networks. *Journal of Statistical Mechanics*, *2008*(10), P10008. Advance online publication. DOI: 10.1088/1742-5468/2008/10/P10008
- Casado-Aranda, L. A., Sánchez-Fernández, J., & Bastidas-Manzano, A. B. (2021). Tourism research after the COVID-19 outbreak: Insights for more sustainable, local and smart cities. *Sustainable Cities and Society*, *73*, 103126. Advance online publication. DOI: 10.1016/j.scs.2021.103126 PMID: 36570019
- Chaney, D., & Séraphin, H. (2023). A systematic literature review and lexicometric analysis on overtourism: Towards an ambidextrous perspective. *Journal of Environmental Management*, *347*, 119123. Advance online publication. DOI: 10.1016/j.jenvman.2023.119123 PMID: 37778061
- Corallo, A., Trono, A., Fortunato, L., Pettinato, F., & Schina, L. (2018). Cultural event management and urban e-planning through bottom-up user participation. *International Journal of E-Planning Research*, *7*(1), 15–33. DOI: 10.4018/IJEPR.2018010102

- Corrado, S., Romaniello, F., Gatto, R. V., & Scorza, F. (2024). Tourism asset and spatial complexity analyzed through graph-structured data analysis BT. In Gervasi, O., Murgante, B., Garau, C., Taniar, D., Rocha, A. M. A. C., & Faginas Lago, M. N. (Eds.), *Computational science and its applications – ICCSA 2024 workshops* (pp. 357–364). Springer Nature Switzerland.
- Croes, R., Ridderstaat, J., Bąk, M., & Zientara, P. (2021). Tourism specialization, economic growth, human development and transition economies: The case of Poland. *Tourism Management*, 82, 104181. Advance online publication. DOI: 10.1016/j.tourman.2020.104181
- Ducci, M., Janssen, R., Burgers, G.-J., & Rotondo, F. (2023). Mapping local perceptions for the planning of cultural landscapes. *International Journal of E-Planning Research*, 12(1), 1–27. DOI: 10.4018/IJEPR.317378
- Dugué, N., & Perez, A. (2015). *Directed Louvain: Maximizing modularity in directed networks*. HAL Archives Ouvertes. Université d'Orléans.
- Eugenio-Martin, J. L., Cazorla-Artiles, J. M., & González-Martel, C. (2019). On the determinants of Airbnb location and its spatial distribution. *Tourism Economics*, 25(8), 1224–1244. DOI: 10.1177/1354816618825415
- Ferreri, M., & Sanyal, R. (2018). Platform economies and urban planning: Airbnb and regulated deregulation in London. *Urban Studies (Edinburgh, Scotland)*, 55(15), 3353–3368. DOI: 10.1177/0042098017751982
- Friedmann, J., Balducci, A., Wiewel, W. I. M., & Healey, P. (2004). Strategic spatial planning and the longer range. *Planning Theory & Practice*, 5(1), 49–67. DOI: 10.1080/1464935042000185062
- Gatto, R. V., & Scorza, F. (2023). Tourism ecosystem domains. In Gervasi, O., Murgante, B., Rocha, A. M. A. C., Garau, C., Scorza, F., Karaca, Y., & Torre, C. M. (Eds.), *Computational science and its applications – ICCSA 2023 workshops* (pp. 81–89). Springer., DOI: 10.1007/978-3-031-37123-3\_7
- Getz, D. (1998). Developing rural tourism: The potential of beach resort hinterlands. In Faulkner, B., Tidswell, C., Weaver, D. (Eds.), *Progress in tourism and hospitality research: Proceedings of the eighth Australian Tourism and Hospitality Research Conference* (pp. 700–714). Bureau of Tourism Research.
- Gong, J. (2002). Clarifying the standard deviational ellipse. *Geographical Analysis*, 34(2), 155–167. DOI: 10.1111/j.1538-4632.2002.tb01082.x
- Guy, J. (2024, July 9). *Barcelona anti-tourism protesters fire water pistols at visitors*. CNN. <https://edition.cnn.com/2024/07/08/Travel/Barcelona-Tourism-Protests-Scli-Intl/index.html>
- Hansen, T., Olk, S., & Thomsen, T. U. (2023). A meta-analysis of sustainable tourist behavioral intention and the moderating effects of national culture. *Journal of Sustainable Tourism*, 32(5), 1–21. DOI: 10.1080/09669582.2023.2186825
- Healey, P. (2004). The treatment of space and place in the new strategic spatial planning in Europe. *International Journal of Urban and Regional Research*, 28(1), 45–67. DOI: 10.1111/j.0309-1317.2004.00502.x
- Huang, W., Zhang, D., Mai, G., Guo, X., & Cui, L. (2023). Learning urban region representations with POIs and hierarchical graph infomax. *ISPRS Journal of Photogrammetry and Remote Sensing*, 196, 134–145. DOI: 10.1016/j.isprs.2022.11.021
- Ignaccolo, C., Zheng, Y., & Williams, S. (2023). Tourism morphometrics in Venice: Constructing a tourism services index (TSI) to unmask the spatial interplay between tourism and urban form. *Cities (London, England)*, 140, 104369. Advance online publication. DOI: 10.1016/j.cities.2023.104369
- Inskeep, E. (1991). *Tourism planning: An integrated and sustainable development approach*. Van Nostrano Reinhold. <https://archive.org/details/tourismplanningi0000insk/page/n5/mode/2up>
- Jepson, D., & Sharpley, R. (2015). More than sense of place? Exploring the emotional dimension of rural tourism experiences. *Journal of Sustainable Tourism*, 23(8–9), 1157–1178. DOI: 10.1080/09669582.2014.953543
- Jiang, X., Ye, D., Li, K., Feng, R., Wu, Y., & Yang, T. (2024). Built environment and airbnb spatial distribution in Hong Kong : A case study considering the spatial heterogeneity and multiscale effects. *Applied Geography (Sevenoaks, England)*, 166, 103262. Advance online publication. DOI: 10.1016/j.apgeog.2024.103262
- Kapera, I. (2018). Sustainable tourism development efforts by local governments in Poland. *Sustainable Cities and Society*, 40, 581–588. DOI: 10.1016/j.scs.2018.05.001

- Kindl da Cunha, S., & Cunha, J. (2005). Tourism cluster competitiveness and sustainability: Proposal for a systemic model to measure the impact of tourism on local development. *BAR - Brazilian Administration Review*, 2(2), 47–62. DOI: 10.1590/S1807-76922005000200005
- Kowalczyk-Anioł, J. (2023). Rethinking tourism-driven urban transformation and social tourism impact: A scenario from a CEE city. *Cities (London, England)*, 134, 104178. Advance online publication. DOI: 10.1016/j.cities.2022.104178
- Lagonigro, R., Martori, J. C., & Apparicio, P. (2020). Understanding Airbnb spatial distribution in a southern European city: The case of Barcelona. *Applied Geography (Sevenoaks, England)*, 115, 102136. Advance online publication. DOI: 10.1016/j.apgeog.2019.102136
- Lu, J., & Nepal, S. (2009). Sustainable tourism research: An analysis of papers published in the *Journal of Sustainable Tourism*. *Journal of Sustainable Tourism*, 17(1), 5–16. DOI: 10.1080/09669580802582480
- Lumsdon, L. M., & McGrath, P. (2011). Developing a conceptual framework for slow travel: A grounded theory approach. *Journal of Sustainable Tourism*, 19(3), 265–279. DOI: 10.1080/09669582.2010.519438
- Merinero-Rodríguez, R., & Pulido-Fernández, J. I. (2016). Analysing relationships in tourism: A review. *Tourism Management*, 54, 122–135. DOI: 10.1016/j.tourman.2015.10.010
- Mihalic, T. (2020). Conceptualising overtourism: A sustainability approach. *Annals of Tourism Research*, 84, 103025. Advance online publication. DOI: 10.1016/j.annals.2020.103025
- Milano, C., Koens, K., & Russo, A. P. (2024). The politics of urban tourism (im)mobilities: Critical perspectives on inequalities and social justice. *Cities (London, England)*, 152, 105148. Advance online publication. DOI: 10.1016/j.cities.2024.105148
- Miller, H. J. (2004). Tobler's first law and spatial analysis. *Annals of the Association of American Geographers*, 94(2), 284–289. <https://www.jstor.org/stable/3693985>. DOI: 10.1111/j.1467-8306.2004.09402005.x
- Ministero del Turismo. (2023). *Piano strategico del turismo 2023–2027*. <https://www.ministeroturismo.gov.it/piano-strategico-del-turismo-2/>
- Morales-Pérez, S., Garay, L., & Wilson, J. (2022). Airbnb's contribution to socio-spatial inequalities and geographies of resistance in Barcelona. *Tourism Geographies*, 24(6–7), 978–1001. DOI: 10.1080/14616688.2020.1795712
- Muench, S., Stoermer, E., Jensen, K., Asikainen, T., Salvi, M., & Scapolo, F. (2022). *Towards a green & digital future* (Report No. KJ-NA-31075-EN-N). Publications Office of the European Union. DOI: 10.2760/977331
- Myint, S. W. (2008). An exploration of spatial dispersion, pattern, and association of socio-economic functional units in an urban system. *Applied Geography (Sevenoaks, England)*, 28(3), 168–188. DOI: 10.1016/j.apgeog.2008.02.005
- Naselli, F., Bellone, C. B., Pali, M., & Andreassi, F. (2022). Tirana as an open lab: A pilot for an integrated research tourism vision pre-/post-pandemic. *International Journal of E-Planning Research*, 11(1), 1–18. DOI: 10.4018/IJEPR.299546
- Ponds, R., van Oort, F., & Frenken, K. (2007). The geographical and institutional proximity of research collaboration. *Papers in Regional Science*, 86(3), 423–443. DOI: 10.1111/j.1435-5957.2007.00126.x
- Raevskikh, E. (2018). Anticipating the “Bilbao effect”: Transformations of the city of Arles before the opening of the Luma Foundation. *Cities (London, England)*, 83, 92–107. DOI: 10.1016/j.cities.2018.06.012
- Regione Basilicata. (2008). *Piano Turistico Regionale*.
- Romão, J., & Neuts, B. (2017). Territorial capital, smart tourism specialization and sustainable regional development: Experiences from Europe. *Habitat International*, 68, 64–74. DOI: 10.1016/j.habitatint.2017.04.006
- Sarrión-Gavilán, M. D., Benítez-Márquez, M. D., & Mora-Rangel, E. O. (2015). Spatial distribution of tourism supply in Andalusia. *Tourism Management Perspectives*, 15, 29–45. DOI: 10.1016/j.tmp.2015.03.008
- Scorza, F., & Gatto, R. V. (2023). Identifying territorial values for tourism development: The case study of Calabrian Greek area. *Sustainability (Basel)*, 15(6), 5501. Advance online publication. DOI: 10.3390/su15065501

- Sharpley, R. (2002). Rural tourism and the challenge of tourism diversification: The case of Cyprus. *Tourism Management*, 23(3), 233–244. DOI: 10.1016/S0261-5177(01)00078-4
- Somarakis, G., & Stratigea, A. (2019). Guiding informed choices on participation tools in spatial planning: An e-decision support system. *International Journal of E-Planning Research*, 8(3), 38–61. DOI: 10.4018/IJEPR.2019070103
- Stojčić, N., Mikulić, J., & Vizek, M. (2022). High season, low growth: The impact of tourism seasonality and vulnerability to tourism on the emergence of high-growth firms. *Tourism Management*, 89, 104455. DOI: 10.1016/j.tourman.2021.104455
- Trono, A., Schmude, J., & Duda, T. (2022). *Managing cultural tourism: A sustainability approach: Vol. 2. Tourism Recovery from COVID-19: Prospects for over- and under-tourism regions*. World Scientific. [https://doi.org/doi:10.1142/9789811260247\\_0001](https://doi.org/doi:10.1142/9789811260247_0001)
- United Nations Human Settlements Programme. (2016). *World cities report*. United Nations. DOI: 10.18356/4665f6fb-
- United Nations World Tourism Organization. (2024). *Statistical framework for measuring the sustainability of tourism (SF-MST)*. United Nations Statistical Commission. [https://unstats.un.org/UNSDWebsite/statcom/session\\_55/documents/BG-4a-SF-MST-E.pdf](https://unstats.un.org/UNSDWebsite/statcom/session_55/documents/BG-4a-SF-MST-E.pdf)
- Vitasurya, V. R. (2016). Local Wisdom for Sustainable Development of Rural Tourism, Case on Kalibiru and Lopati Village, Province of Daerah Istimewa Yogyakarta. *Procedia: Social and Behavioral Sciences*, 216, 97–108. DOI: 10.1016/j.sbspro.2015.12.014
- World Travel and Tourism Council. (2023). *Economic impact report*. <https://wtcc.org/research/economic-impact/cities>
- Xu, Y., Zhou, B., Jin, S., Xie, X., Chen, Z., Hu, S., & He, N. (2022). A framework for urban land use classification by integrating the spatial context of points of interest and graph convolutional neural network method. *Computers, Environment and Urban Systems*, 95, 101807. Advance online publication. DOI: 10.1016/j.compenurbsys.2022.101807
- Yan, X., Ai, T., Yang, M., & Yin, H. (2019). A graph convolutional neural network for classification of building patterns using spatial vector data. *ISPRS Journal of Photogrammetry and Remote Sensing*, 150, 259–273. DOI: 10.1016/j.isprsjprs.2019.02.010
- Yan, Y., Feng, C. C., Huang, W., Fan, H., Wang, Y. C., & Zipf, A. (2020). Volunteered geographic information research in the first decade: A narrative review of selected journal articles in GIScience. *International Journal of Geographical Information Science*, 34(9), 1765–1791. DOI: 10.1080/13658816.2020.1730848
- Zhang, Q., Lu, L., Huang, J., & Zhang, X. (2022). Uneven development and tourism gentrification in the metropolitan fringe: A case study of Wuzhen Xizha in Zhejiang Province, China. *Cities (London, England)*, 121, 103476. Advance online publication. DOI: 10.1016/j.cities.2021.103476

*Simone Corrado is a Ph.D. student at the Laboratory of Urban and Regional Systems Engineering (LISUT), School of Engineering, University of Basilicata. He is an Environmental Engineer and is a Ph.D. in “Engineering for innovation and sustainable development”. Master graduated cum laude from the University of Basilicata discussing a thesis titled: Machine Learning based approach to assess territorial marginality. My research field concerns the implementation of data-driven models to support and define scenarios for decision making processes in urban and regional planning. My PhD research goal is understanding the dynamics of complex environments, such as the urban one, by combining GeoAI algorithms with XAI (Explainable Artificial Intelligence) techniques for Machine Learning. An additional interest is to analyze local cultural identity through citizen participation in co-design and has already participated in several Geodesign workshops.*

*Francesco Scorza is Associate Professor of Urban and Regional Planning at the University of Basilicata (UNIBAS), where he teaches in the Master’s programs in Engineering and Architecture. His background is in Environmental Engineering and holds a Ph.D. in Sciences and Methods for the European City and Territory from the University of Pisa. His research focuses on regional sustainable development, the New Urban Agenda and advanced urban analytics applied to urban and regional planning. His expertise includes GeoDesign, innovative knowledge management in planning processes, decision support systems (DSS). His research spans advanced topics such as territorial cohesion, tourism planning, ecosystem services, energy planning, climate adaptation policies and designs, sustainable urban accessibility. He is a member of the Academic Board of the Ph.D. Program in Engineering for Innovation and Sustainable Development, and serves in relevant institutional academic boards as appointed delegate. He has managed and contributed to numerous national and international research projects and collaborates with public and private institutions. He is an active member of several scientific associations and program committee of international research groups and conferences. Since 2018, he has served as President of the Basilicata section of National Institute of Urban Planning (INU). He published widely in his investigation area (more than 145 papers; 23 h-index Scopus) also serves as a Guest Editor for leading international journals.*