Functional Organisational Strategies and Practices in Sparsely Populated Areas (SPA). A Place-Based Proximity-Oriented Approach

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Abstract. The proximity approach has typically been applied at the neighbourhood or district level as a model for increasing accessibility to opportunities and resources that ensure a better quality of life, while its potential in spatial planning has received less attention in both research and practice. The proximity approach used at regional scale presents challenges and issues. Reconsidering the concept of proximity at regional level means rethinking the conditions of accessibility. It requires considering the interrelations and interdependencies between different polarities and, consequently, the economic and social links and ties, according to a network of complementary communities. This paper contributes to the debate initiated by the Organisation for Economic Co-operation and Development (OECD) on peripheral regions. It focuses on the concept of functional urban area referring to sparsely populated peripheral areas (SPAs), whose institutional paucity calls for the need for multilevel governance to align programs and strategies. In an inter-service compensation perspective, including rebalancing between compact and less densely populated urban systems, the authors provide a comprehensive and interconnected place-based proximity-oriented approach aimed at 1. Identifying the parameters and factors to identify functional proximity areas (FPUAs) in SPAs and 2. Strategizing the organisational connectivity for different functional proximity areas. To accomplish this, the authors focus on a case study in SPA with latent tourism potential in Southwestern Sardinia (Italy).

Keywords: Proximity approach · FUAs · Sparsely populated areas (SPA) · Place-based organisational connectivity · regional development · Sardinia

1 Introduction

In 2020, the European institutions allocated a substantial part of the EU budget to the "transition to sustainability," in line with the European Green Deal, to foster and advance a common policy aimed at improving urban environments and social conditions, as cities

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will be crucial in addressing the effects of climate change and preventing emergencies in the forthcoming years [1, 2]. The proximity concept as an urban planning approach for enhancing the quality of urban life [3–5], aims to design cities so that all essential services, conveniences, and social activities are in physical relationship with each other, close in space in terms of distance to travel and in terms of time to arrive. This not only reduces the reliance on private car, but also promotes social cohesion, health, and well-being by enhancing the city's liveability and quality of life. Furthermore, this concept aligns perfectly with current sustainable urban mobility policies, which promote low impact means of transport that are accessible to all citizens, thereby contributing to climate change mitigation and the development of resilient cities [6–8].

However, the proximity approach is typically debated in terms of single neighbourhoods or districts, and its potential in regional planning has attracted less attention in both research and practice. Regional expansion of this concept requires to consider the interrelationships and interdependencies between various urban polarities and, consequently, a group of cities or urban centres linked by economic and social connections, thereby forming a network of interdependent and complementary communities. This approach on a regional scale generates "regional polarities" and effective regional planning, which could be a successful way of addressing contemporary sustainability challenges and enhancing the liveability and quality of life throughout the entire region.

According to the Organization for Economic Co-operation and Development (OECD) data, some 280 million people in Europe are organised in 110 large urban areas, where only 10 cities assume the role of "special" metropolitan governments with some distinctions: London, with a metropolitan government established by law; Hamburg, Amsterdam, Berlin, Madrid, Vienna, with the role of city-states, in which specific legal authorities exercise powers in specific fields in cooperation with local governments; Paris as a city-district; Barcelona, Lyon and Marseille with the role of unions of municipalities, in which the role of functional cooperation between local administrative entities for the management of common problems is evident [9].

These situations are far removed from those of the Italian regions, especially those dealing with demographic rarefaction [10, 11], with reference to peripheral areas with low population density [12]. Not to mention that the GDP generated in cities is a central issue in the economy of the EU and Italy, since urban areas contribute significantly to economic growth and value creation, compared to rural or less densely populated areas, thanks to their high population density, qualified human capital and access to advanced infrastructure and services. If, on the one hand, GDP growth is closely related to economic growth and employment, on the other hand, it is mainly linked to the consumption of material resources (above all, soil and energy) and competition between territories, not in line with the principles of sustainability, which lean towards reducing this consumption [13]. Therefore, is crucial a reorganisation that provides the rebalancing between compact urban systems and less densely populated ones, with a view to possible offsets between advanced services, present in urban areas, and other types of services, above all, dematerialised services [13] and ecosystem services.

From this point of view, this paper contributes to the debate initiated by the OECD on peripheral regions. It focuses on the concept of functional urban area referring to

sparsely populated peripheral areas (SPAs), whose institutional paucity calls for the need for multilevel governance to align programs and strategies [14].

In an inter-service compensation perspective, including rebalancing between compact and less densely populated urban systems, the authors provide a comprehensive and interconnected approach proximity-oriented aimed at:

A) delineating the parameters and factors to identify functional proximity areas in SPAs, so that all the elements and limiting factors for the development of an efficient organisation of the territory are included, and thus it can be regenerated and innovated. B) Recognise the elements of stabilising travel times to plan spatial policies that aim to limit accessibility and infrastructure deficits and shape infrastructure and economic development [15].

To accomplish this, the authors focus on a sustainable alternative and smart mobility network in a peripheral sparsely populated area with latent tourism potential in Sardinia (Italy) is considered as a case study.

2 FUAs and SPAs. A Possible Organisational Correlation

Functional urban areas (FUAs) [16, 17] may more effectively address the needs and potentials of territories that may extend beyond a single administrative boundary.

The OECD's concept of FUA encompasses a "city and its surrounding, less densely populated local units that are part of the city's labour market ('commuting zone')" [16] emphasising their economic and functional interconnections beyond mere density and population size. The FUA definition expands urban boundaries to include areas economically connected through workplace commuting, by using population density and travel-to-work flows as key information. In brief, a FUA capture meaningful connections between cities and their surrounding areas. The degree of urbanisation provides an outlined urban area based on population density and cell contiguity. The FUA concept is used for urban planning policies and territorial cohesion policies to support disadvantaged areas to reduce their one-directional dependency from core areas.

The ESPON 2019 [18] program identifies several indicators to assess accessibility and spatial connectivity that are critical to understanding mobility dynamics within FUAs. Specifically, an interactive web tool - ESPON FUORE[1] (Functional Urban Areas and Regions in Europe) - presents a package of disaggregated indicators to compare FUAs (Fig. 1), offering a synchronised display of maps and graphs, useful for assessing accessibility and travel times in FUAs. The conclusions of ESPON FUORE final report (2020) highlights that "the FUAs are considered as the most common and stable definition of functional regions in the urban environment" (p. 8), although in some cases it is mentioned that delineations areas of geographical specificities originating from ESPON GEOSPECS [19] could be updated or improved[2].

[1] https://fuore.espon.eu/.

[2] GEOSPECS territories complement the selection of the functional regions as defined in the TERCET (Territorial typologies from Eurostat), namely: Islands (with no fixed link to continent); Mountain massifs; Sparsely populated areas; Borders (45 and 90 min) both will be included as the 45 min threshold stands as proxy for cross-border commuting functionality, whereas the 90 min one provides a larger perspective to border influence (Ibid. p. 9).

Key sources that analyse the definition of FUAs and their role in spatial organisation include, for example, the analysis of FUAs through the joint EU-OECD methodology based on commuting flows and travel times [20]. The relationship between commute times, planning, and mobility in relation to the impact on FUAs is the subject of numerous analyses and methods [21–23], including in relation to public transport service planning [24]. Others highlight growth trends in FUAs based on the relationship between population distribution and accessibility [25–27].

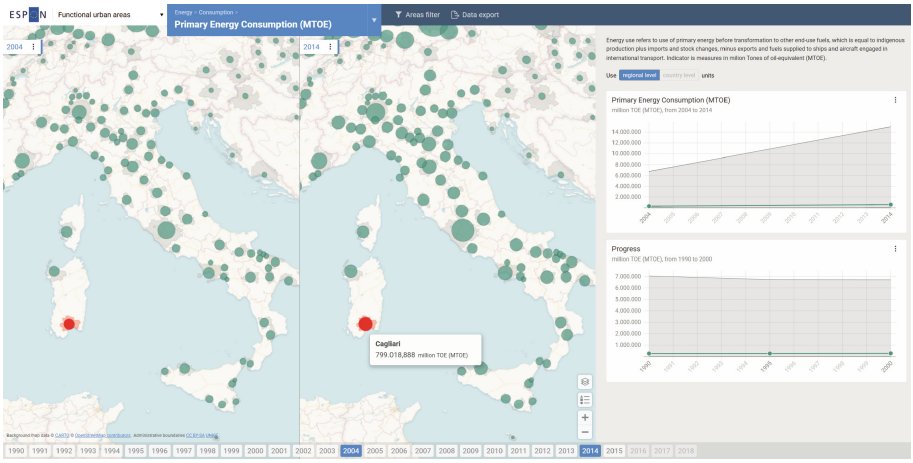

Fig. 1. Espon FUORE. Example of indicator: Primary energy consumption, Energy, FUA

Most definitions based on travel times include the following tripartition for FUAs: 1. *Central* FUAs (Core Functional Urban Areas), areas with a travel time within 30 min of the main city, usually covered by efficient public transport; 2. Intermediate FUAs, areas with travel times between 30 and 60 min, with greater reliance on the private car; Peripheral FUAs, areas beyond 60 min, often characterised by lower population density and less integrated transportation networks. Central FUAs are distinguished by high density of housing and services, high accessibility to public transportation and concentration of advanced economic functions (business, financial, administrative centres). *Intermediate* FUAs are characterised by moderate population density and functional mix (residential, manufacturing, tertiary), presence of satellite cities and secondary poles with partial economic autonomy. They strongly depend on the regional transportation (railways, highways). *Peripheral* FUAs are connected to the central city but with lower density and high dependence on private transportation. The higher incidence of urban sprawl and long-distance commuting is a symptom of a lower accessibility to services than centres and intermediate areas and shows a strong exposure to problems of economic and social marginalisation.

The proximity approach at different spatial scales points to go beyond the traditional core-periphery framework [28]: *the possibility of development of peripheral areas is connected to its potential influence on the changes taking place in the wider area.* Hence, the involvement of peripheral regions, rural areas, and SPAs in spatial organisation and

development processes because of the opportunities arising from the wide availability and their proximity to ecosystem services [29–31], and the establishment of new criteria for defining functional areas in relation to these.

By contrast, Peripheral sparsely populated areas (SPAs) cope with structural limitations in terms of accessibility, depopulation, and rarefaction of services, which hinder their ability to align with EU 2021–2027 Programming. These difficulties often stem from weak cooperation among local and regional stakeholders and limited endowment [31–33] and institutional capacity [34–36]. The OECD stresses the need for multi-level governance frameworks aligned with business needs [37] and calls for multi-level governance to facilitate local cooperative efforts and coordinate strategies effectively [14]. Due to their small scale, these areas cannot act as traditional urban nodes, requiring a distinct spatial and economic development model tailored to their characteristics. Indeed, the small size of many towns and hamlets does not allow them to automatically become the nodes of a network to have supra-local comparability. Hence, a different spatial model is needed for sparsely populated suburban areas than for urban areas, highlighting the economic basis for their development [38]. For our purposes, the authors take into consideration various recent urban planning models centred on the proximity approach. Among them, the territorial model included in the Spanish and Basque urban agenda is considered for its methodological comprehensiveness. In this model urban and rural areas are considered as "entities" operating in a complementary and fractal way, according to the principles of *Ecosystem Urbanism* of Salvador Rueda. The territorial model proposes urban systems – and their functional areas –compact in their morphology, complex in their organisation, metabolically efficient and socially cohesive [38].

Putting this differently, the criteria for defining a functional area cannot be objective because very different variables come into play that depend on the characteristics of the territories in relation to water, waste, energy. etc. Consider, for example, situations where supply sources or treatment plants are outside the functional area of reference (Fig. 2).

Therefore, a functional area must also represent a model of territorial governance that aims for self-sufficiency in food, water, energy and waste cycle [38]. Hence, the delimitation of functional areas depends on very different variables, including metabolic ones, and various interrelated elements, including structural processes, flows of materials, capital and information, space for human living, production, recreation and business activities. These internal conditions are more conducive to development with respect to other areas, especially for their territorial capital [39], 2022). Thus, they require variable geometries for efficient management [38].

A functional proximity urban area (FPUA) is a polycentric organisation organised around urban cores of different nature, where "proximally located cities relate to each other in a synergetic way, making the whole network of cities more than the sum of its parts", particularly in terms of co-operation and complementarity [40]. Thus, the polycentric organisation is structured in a fractal way, developing from the neighbouring proximity unit, which involves a network of complementary communities aimed at promoting multi-level governance and facilitating local cooperative efforts, in accordance with the three micro, meso and macro levels [40, 41].

In conclusion, a FPUA must promote proximity first and foremost through accessibility, connecting the polycentric structure with urban cores within an acceptable time frame. According to this model, the traditional mobility system which generated suburbs is redefined to identify a network of nodes (cores) connected by public transport, sustainable modes of transport and smart infrastructures.

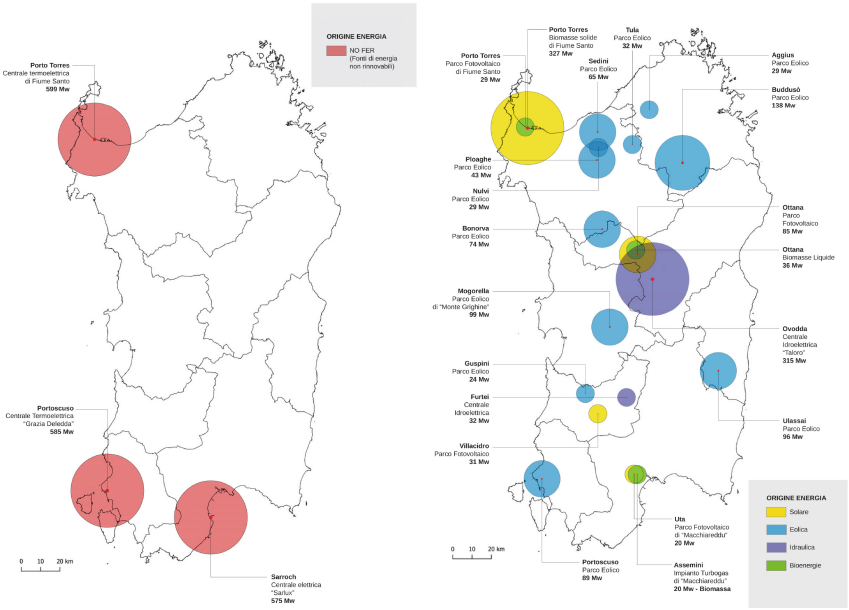

Fig. 2. Energy sources: no RES (left), RES (right), TERNA source. In 2023, production exceeds demand by 43% (consumption: 4.855 KWh per capita)

In other words, it is crucial to strategize the organisational connectivity for different functional proximity areas, by recognizing the elements of stabilizing travel times to plan spatial policies that aim to limit accessibility and infrastructure deficits and shape infrastructure and economic development [15]. Meanwhile, the perspectives of each proximity functional area will depend on its ability to offer different opportunities and forms of comparative advantage based on accessibility to resources, knowledge and, in general, ecosystem services.

3 Defining a Functional Proximity Organisation Model for a SPA. The Implementation of the TSulky Project in S-W Sardinia

Based on these assumptions, the authors attempt to make a theoretical contribution to the potential application of the functional proximity approach on a regional scale by identifying parameters and factors that can satisfy the needs of highly vulnerable regions that cannot achieve a high level of socioeconomic and environmental development due to geographical constraints. To accomplish this, the authors focus on a case study of Sardinia

(Italy). The proposal suggests the development of an interpretive tool for defining a FPUA in a SPA with weak connectivity, such as the Sulcis-Iglesiente (SI) region in S-W Sardinia, Italy. A spatial organisation through a network system of accessible nodes is planned. The aim is to promote interconnections and interdependencies among the network nodes, which are linked to the places of greatest strategic potential in terms of services and attractiveness. The results of the TSulki research project – Tourism and Sustainability in Sulcis (see Acknowledgements) are here considered [42].

The region of Sardinia[3], being an island, has precise boundaries and limits, within which two FUAs are identified, corresponding to its main hubs: Cagliari and Sassari. The island system is divided between coastal areas with high daily traffic and inland areas with low service centralisation [43]. Second, its morphological, geographical, political, and social characteristics determined significant geographical disparities between the coastal and inland organisation from the administrative and political point of view, since structural interdependencies have not been activated to include inland areas in a functional qualifying perspective determined by economic, social, and infrastructure concerns [44–46]. A considerable part of the population commutes every day mainly by private automobile for employment, study, or other purposes. Indeed, compared to inhabitants of the island's main centres, which are supplied with all necessary services, population out of the FUAs and, in general, residents of the smaller centres are obliged to travel every day, incurring extra travel time and financial resources [46].

The SI region in southwestern Sardinia, Italy, where a natural environment of considerable public interest coexists alongside abandoned areas severely degraded by mining and industrial activity, is the context of the research project. This decline is evidenced by demographic indicators, with a disappearing population, high average age, and employment below the regional average, concentrated mainly in the service and tourism sectors[4] [42].

3.1 The Methodological Path

The main objective of the T-Sulky project is to develop a systemic and interdisciplinary approach to enhance the natural, historical, cultural and tourism resources of the SI territorial context. The project aims to improve accessibility to information and services at a *functional proximity area scale*, by organising efficiently physical connections and information, by identifying and making accessible areas of greatest strategic potential in terms of attractiveness of the tangible and intangible resources, with a focus on the

[3] 1.587.413 inhabitants; 24.099,45km^2; Pop. Density 65,36 inhab/km^2 (Italy 195 inhab/km^2); Old-age index 241,8; Turnover index 177,2 (*Source ISTAT 2022*).

[4] The Analysis of the demographic structure divided by age group shows a strong demographic rarefaction, attributable to the decline in the 0–14 age group. The +65 age group accounts for 23%, while the population in the productive age group (15–64), although tending to increase (+1%), grows little compared to the unproductive age groups, which show an increase in average life span. The dependency index of municipalities in the area follows the trend of the regional one, while it is lower than the national index, insular Italy and N-E Italy. The educational level of the population is medium-low, leading to low competitiveness. Employment for the Province is currently among the lowest of the regional average and is concentrated in the service and tourism sectors (ISTAT data 2005–2015).

connections among archaeological-mineral, religious, blue and green landscapes and the system of services in this territory. The first phase of context analysis involved the retrieval and structured organisation of a significant amount of data from various sources, for which careful validation and compliance verification had to be carried out. The Open Data base of Sardegna Geoportale[i] was compared and integrated with cartography and content drawn from official documents and other informal but certified information sources. For example, the framework of physical connections is derived by integrating the existing trail base map taken from OpenStreetMap (OSM) with the trail network from the Regional Hiking Trail Network Plan and IGM tables.

Other analyses include a. the existing and potential spatial networks taken from the unstructured information base of the "S. Barbara Mining Trail Foundation", which includes 21 municipalities of the region; b. Web data and User Generated Contents (UGC) taken from specialised platforms and sites with the help of GIS tools, OpenStreetMap[ii] (OSM) and other applications. The result produced a usable and consultable dataset, as well as a good balance between quantity and quality of the data, fundamental characteristics in the creation of the geospatial database.

The second phase focuses on the interpretive device of spatial knowledge to co-plan accessibility links at different levels of knowledge and scales. This model of place-based organisation is planned through a networked system of accessibility nodes with relationships of mutual influence and conditioning. Each node refers to an inhabited location, as surveyed by National Institute of Statistics (ISTAT), and is characterised by several attributes. The following have been identified: *nodes with contextual attributes*, which have played a generative role in the definition and evolution of the mining landscape; *nodes with general attributes*, specified with respect to three typologies: *spatial, functional, and sociocultural accessibility*. Each node is defined by a description, attributes and indicators [42].

3.2 Context Analysis

The analysis of settlement patterns in terms of appearance, and uses, endowment and distribution of resources and services (Fig. 3), has been of crucial importance in defining organisational – functional proximity areas with which to describe the present and possible functioning of the spatial network and the interactions between nodes (Fig. 3). The analysis of Ecosystem Services [47] follows established procedures already tested in numerous studies [48]. In the first instance, it started with the management of the cartographic data (CLC Land Use 2008 – Areals) from RAS Geoportale. This datum was subdivided, by merging operations of the categories present in the attributes table, into the four ES reference categories .

Each land use class was assigned a value from a minimum of 0 and a maximum of 5. The score indicates the quality level of a parcel concerning each ES[5] (Fig. 4).

[5] For example, a plot of "arable land" might score a low score of 1 for the Cultural ES and simultaneously score a high score of 5 for the Supply ES.

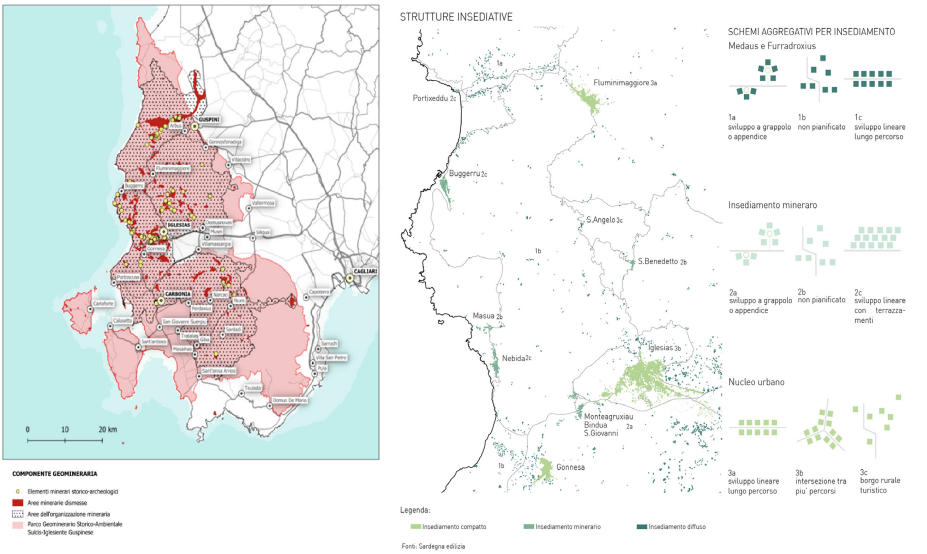

Fig. 3. Archaeological - mining heritage. Elements and areas (left); Settlement patterns (right)

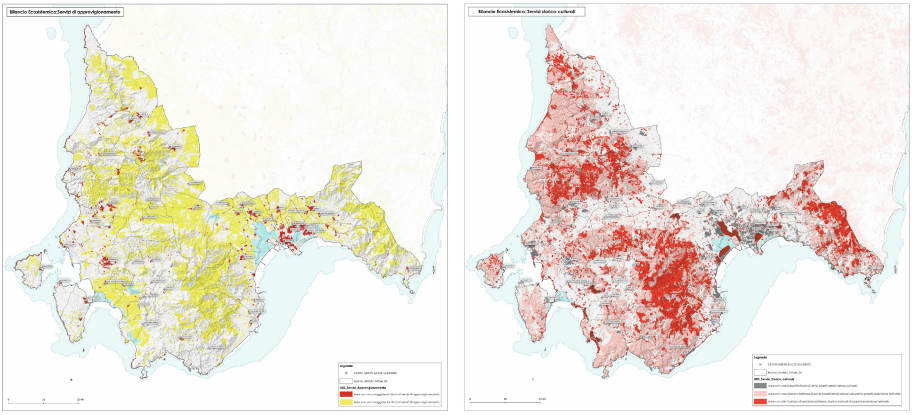

Fig. 4. Ecosystem services balance: provision services (left) and historical and cultural services (right)

Personal services activities were identified and represented through the different databases and classified according to OSM) categories. The final macro-categories of services include: Amenity (general services), Tourism (tourist services), Shop (commercial activities) and Historic (services with cultural-historical significance) (Fig. 5).

A heatmap-based approach was adopted, implemented in a GIS environment using the "density analysis" plugin. The parameters used were defined according to the type of service, for example: for Amenity, values between 0 and 40 services within a radius of 5 km were set, given their greater diffusion (Fig. 6); for Historic and Shop (Fig. 7),

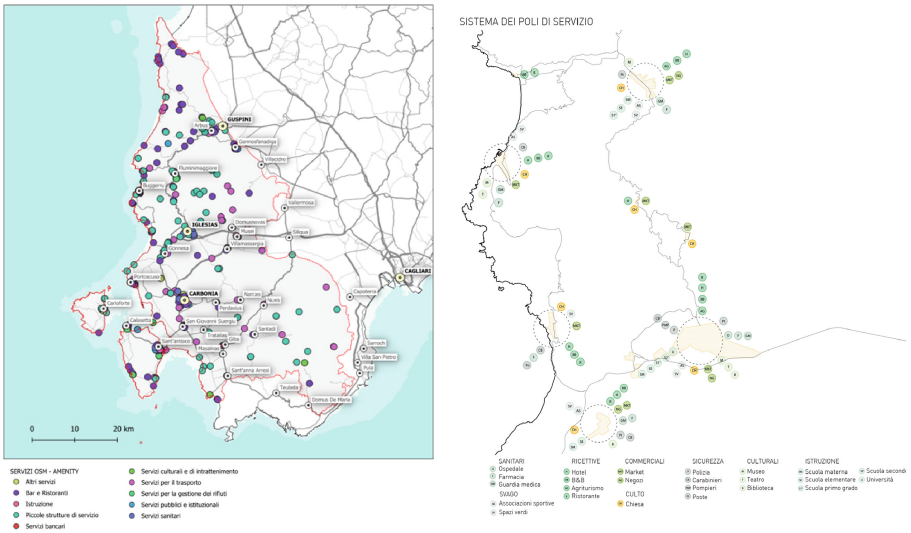

Fig. 5. OSM Services: Amenities, and service centre systems

present in lower numbers, values between 0 and 20 services in the same radius. The results show an uneven distribution of services, with significant concentrations in coastal areas and core centers (Iglesias, Carbonia, Guspini). Amenity services were particularly dense along the coastal belt (S. Antioco, Carloforte, Portoscuso and Buggerru). Tourism services show a more pronounced concentration in the coastal stretch between Gonnesa and Buggerru, as well as in Iglesias (Fig. 6). Shop services show an even distribution, with higher densities in the main centres.

Finally, Historic services show a predominantly coastal distribution and in the southern hinterland, with significant densities around S. Giovanni Suergiu and in S. Antioco. Hence, an overall heatmap was created (Fig. 8), which allowed to highlight the overall distribution of services, confirming the high density of services in the core centres of Iglesias and Carbonia, but pointing out a significant spread also along the coast, from Buggerru to Carbonia, with relevant concentrations in the islands of S. Antioco and S. Pietro. These results underscore the strong polarisation that core centres exert over the entire territory, and reflect the socioeconomic dynamics strongly seasonally affected by tourist flows to coastal areas (Fig. 9). This framework acknowledges the importance of stabilising travel times to plan spatial policies that aim to limit accessibility and infrastructure deficits while guiding infrastructure and economic development.

3.3 Organisation of Physical Connectivity

The infrastructural layout of the area is defined using OSM data, which allowed for an updated and hierarchically classified representation of the road network. The analysis of the road network shows a significant infrastructural deficiency throughout the SI area, with criticality found in the Iglesiente area. The latter, presents a limited road system, mainly characterised by the presence of the SS126 (state highway) and the

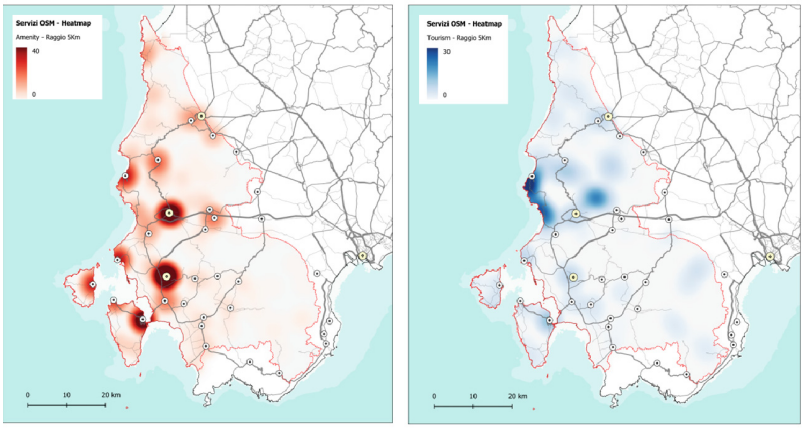

Fig. 6. OSM Services heatmaps: Amenities (left) and Tourism (right) services

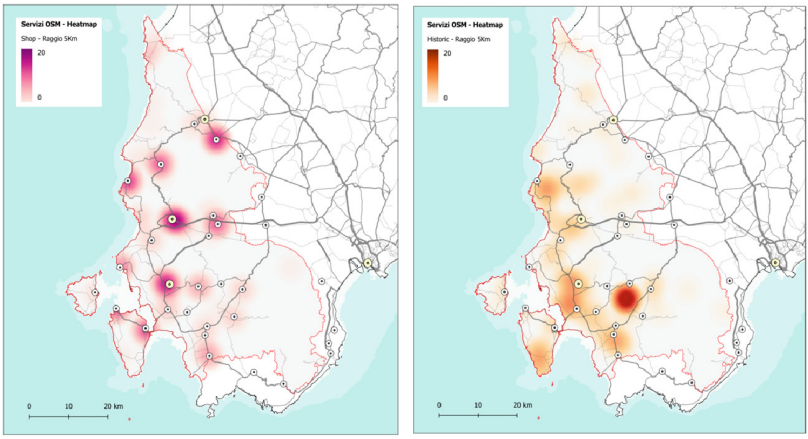

Fig. 7. OSM Services heatmaps: Shop (left) and Historic (right) services

SP83 (provincial road) as the only access routes, a condition strongly influenced by the complex morphology of the territory and the low population density. In contrast, the road network in the Sulcis area is more articulated and interconnected. This situation can be attributed both to a more favourable orographic context and to a greater settlement development, characterised by the presence of numerous towns with related hamlets, embedded in a specialised and organised agricultural fabric. A further factor contributing to the greater viability of the lower Sulcis area is the influence exerted by the industrial hub of Portovesme, which has historically conditioned the socioeconomic dynamics and territorial relations of the area, acting as an attractor and catalyst. The study of the traffic

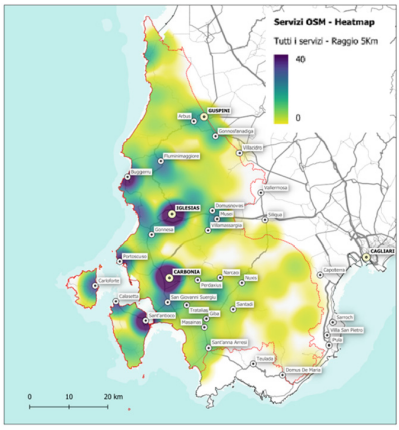

Fig. 8. Overall OSM Services heatmaps

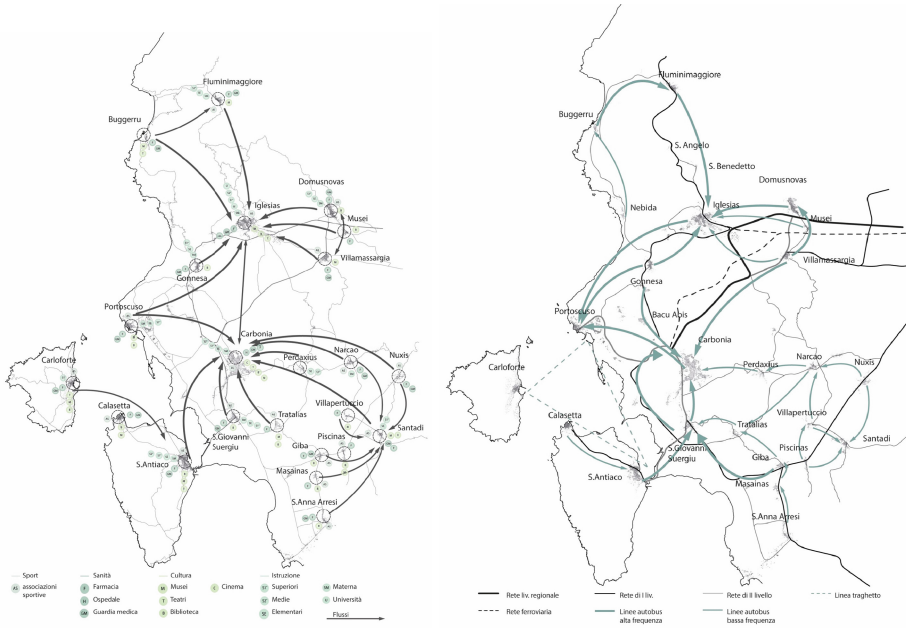

Fig. 9. The system of connections: the system of services and the system of mobility

circulation system in the area is conducted through the analysis of spatial accessibility using the isochrones[6].

The analysis is aimed at assessing accessibility by car, with isochrones of 5, 10 and 15 min (Fig. 10). The results show greater accessibility in the south of the area, between

[6] They are identified in the GIS environment using the ORS Tools Plugin, processed for each municipality considered, assuming the town halls as the point of origin.

the towns of the Sulcis area, with a high interposition of isochrones at 10 min and, in some cases, even at 5 min. On the contrary, in the northern part, the Iglesiente area is less accessible, characterised by a poor intersection of isochrones in the 5- and 10-min bands and showing effective coverage only in the 15-min band.

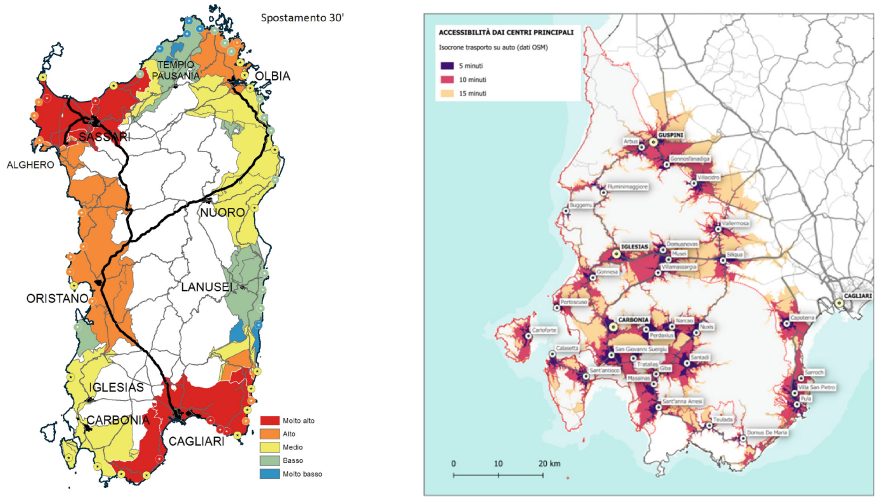

Fig. 10. Displacements in 30 min (left). Accessibility map of urban centres by car (right)

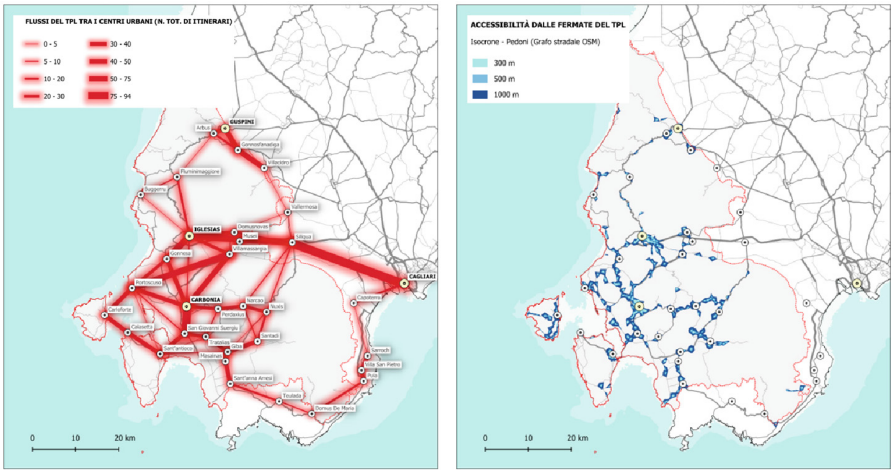

Fig. 11. Map of accessibility of urban centres showing the main PTS flows (left); Map of accessibility to PTS stops on foot (right)

Regarding mobility, data were acquired for local public transport service (PTS) by road and rail (Fig. 11). This phase proved particularly complex both because of the difficulty of retrieving the information and its inherent quality. In particular, the data for

bus lines had some errors, and despite the support provided by the responsible entities, it was not possible to obtain a more accurate version of the information. In any case, the impact of incompleteness of some geometries on the expected results was marginal. As for the dataset related to bus stops, it was possible to conduct a detailed analysis, which allowed the extraction of significant information, useful for the formulation of subsequent conclusions.

Note that PTS analysis takes into consideration the assessment of the service efficiency in terms of the density of stops in urban and rural settings, the spatial distribution of lines across the territory, and their frequency. The latter was examined both in terms of the number of routes passing through a single stop and the number of trips each route makes on a typical weekday. Therefore, to assess the accessibility of local PTS from the pedestrian's point of view, the area was analysed by construction of the Service Areas[7] of 300, 500 and 1000 m (Fig. 11) from the centre of each bus stop (by the plugins "ORS Tools" and "QNEAT3"). These areas were not calculated as simple circular buffers, but considering the OSM street graph, which can be travelled by the pedestrian. This approach made it possible to generate polygons representing the sections of road, reachable by foot within the three specified distances. The results show that in the main urban cores (Iglesias, Carbonia and Guspini) the density of stops was optimal for most of the compact urbanised perimeter, with some small portions not covered. In contrast, sparsely populated areas, especially rural areas, show insufficient coverage, with less accessibility to PTS. The distance of 1,000 m was chosen because it corresponds to about a 15-min walk, which is considered the upper limit for defining a stop as nearby in an urban context[8]. This criterion is essential to ensure that the public transportation service is effectively accessible to pedestrians.

In conclusion, the data on accessibility, transportation and mobility in the area, starting with those made available on the Sardinia Region' Sardinia Mobility portal, do not offer alternatives or additional options for moving around the area to the information already available to residents and visitors. This weakness may represent an opportunity for multimodal integration models involving PTS and operators and associations offering accompanying or moving services (rental with driver, periodic shuttles, carbike sharing, *etc.*). This collaborative activity deploys on three interconnected levels: expanding knowledge of available routes and services, sharing data, and implementing a communication plan, including from road signs.

4 Conclusions

In conclusion, an organisation of functional proximity urban area (FPUA) in terms of accessibility, co-operation and complementarity is recommended in peripheral or insulated regions, like the Sardinian context, characterised by structural disparities such

[7] A Service Area is a defined geographic area that represents the area that can be reached from a specific point (e.g., an infrastructure or service) within a given time or distance, considering the road or transportation network. It is used to analyse the accessibility and coverage of services such as hospitals, police stations, or public transportation.

[8] Proximity in urban mobility refers to the ease of access to a public transportation stop, which is considered accessible if it is within a 15-min walk. This limit is used to assess the efficiency and equity of transportation services.

as: (i) the demographic evolution, concentrated near the coast and in the main Sardinian municipality, Cagliari, causing serious dysfunctions in the local economy, particularly for inland areas [49, 50]; (ii) fragile territorial balances associated with the survival of the island's internal centres (National strategy for internal areas, 2019; Urban area strategy, 2018; Territorial Planning, 2020) and (iii) administrative governance related to weak cooperation among local and regional stakeholders and limited endowment.

Promoting stronger territorial cooperation (core-periphery, urban-rural), starting from main urban processes, can support identifying and provisioning environmental and cultural assets and ensuring better management of them in terms of: a) better management of natural resources; b) better services (public transport, health, education, etc.); c) more sustainable land use and planning; d) to reduce inequalities and social exclusion; e) to create competitive and sustainable economies; f) to enhance the capacity of participating in planning and finance investments and services for sustainable development.

In an inter-service compensation perspective, including rebalancing between compact and less densely populated urban systems, the authors provide a comprehensive and interconnected approach proximity-oriented aimed at: (1) represent and maximise the knowledge-based development potential of SPAs and rural areas and their existing networks, and, on the other hand, to outline possible ways to enhance accessibility to information and services, both for residents and visitors. (2) identifying the parameters and factors depending on different variables, including metabolic ones, and various interrelated elements to identify functional proximity areas in SPAs according to a permanent and replicable program, so that all the elements and limiting factors for the development of an efficient organisation of the territory are included, and thus it can be regenerated and innovated. (3) Recognise the elements of stabilizing travel times by identifying a network that optimizes the available resources to plan spatial policies that aim to limit accessibility and infrastructure deficits and shape infrastructure and economic development. The regionalisation of the functional proximity approach allows to facilitate the regional development process, by establishing and enhancing physical ties (infrastructure, shared services) that generate social and economic ties.

This paper faces several limitations, which deserve further work. First, regarding the funding tools, the survey of this study has investigated S3 strategy for the region of Sardinia, and the authors have not been able to fully assess the implications for specific peripheral SPA like the Sulcis – Iglesiente region. Second, the difficulties in identifying and verifying all the factors depending on different variables to identify functional proximity areas in SPAs especially the metabolic ones concerning self-sufficiency in production and exchange of material resources (food, water, energy and waste cycle).

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