

Evaluating Territorial Capital of Fragile Territories: The Case of Sardinia

Ivan Blečić[1](✉), Arnaldo Cecchini[2], Valeria Saiu[1], and Giuseppe A. Trunfio[2]

[1] University of Cagliari, Via Corte d'Appello 78, Cagliari, Italy
ivanblecic@unica.it
[2] University of Sassari, Viale San Pietro, 07100 Sassari, Italy

Abstract. We present a framework for the evaluation of "territorial capital", specifically devised as support for policy design on fragile territories, the so called "inner areas". The evaluation procedure leverages open data sources in a multi-criteria spatial evaluation procedure, yielding a dashboard with geographical distribution of indicators of territorial capital, subdivided into its eight constituent dimensions (human, social, cognitive, infrastructural, productive, relational, environmental, and settlement capital). To showcase the working, outputs, and possible uses of the evaluation framework for territorial analysis and policy design, we present the results of a case study application on the Island of Sardinia. The interest and novelty of this research is possibly threefold: the conceptualisation of the notion of "territorial capital" in terms of capabilities for development; its operationalisation in a spatial evaluation model which accounts also for potential spatial interactions; and finally, the application in the case study, illustrating possible employment and usefulness of such results for territorial analysis and policy design.

Keywords: Territorial capital · Multi-criteria spatial evaluation · Fragile territories · Internal areas · Sardinia

1 Introduction

In Europe, many non-coastal territories with historical settlements distant from, or poorly connected with major urban centres, especially in mountainous or agricultural areas, experience demographic stagnation or decline accompanied by general impoverishment. In Italy, this phenomenon is often identified as the "crisis of inner areas" (*crisi delle aree interne*).

In Sardinia, given it being an island with a peculiar morphology, the geographical traits of this phenomenon have been synthesised as a "donut with a hole" [1].

The history of human settlements has frequently seen phenomena of dislocation of populations and activities from the coast to the interior and vice versa, from high-density areas to more sparse areas and vice versa, and the disappearance of prosperous communities for climatic, economic, and social factors, or due to conflicts of various kinds [2, 3]. But perhaps we live in an epoch in which it is possible not to passively surrender

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to this happening, also because the consequences of the abandonment of many such territories can trigger calamitous environmental effects as well as lead to the destruction of histories and cultures.

Yet not all inner areas are created equal. Perhaps not all can and should be "rescued": for some it may be unavoidable to accept the demographic decline and only to ensure their environmental integrity and preservation of ecosystem services; for others it could be apt to put in place suitable safeguard measures, perhaps providing for forms of temporary human uses; other inner areas can perhaps be "defended" as stable settlements, protecting their fragility, and subsidising housing and not-fully competitive economic activities; yet others, with appropriate policies and investments, may become innovative production centres in the fields of agriculture, tourism, services, and research, attracting new populations [4, 5].

But to identify which is which, it is necessary to measure, evaluate and compare the territories. Assessing different dimensions of their fragility and capabilities for development is relevant both for such strategic choices, and for designing appropriate policies.

In this paper we propose one such evaluation framework specifically devised as support for policy design on the "inner areas". The evaluation framework is based on the concept of "territorial capital" and leverages open data sources in a multi-criteria spatial evaluation procedure, yielding a dashboard with geographical distribution of indicators of territorial capital, subdivided into its eight constituent dimensions (human, social, cognitive, infrastructural, productive, relational, environmental, and settlement capital). To showcase the working, outputs, and possible uses of the evaluation framework for territorial analysis and policy design, we present the results of a case study application on the Island of Sardinia. The interest and novelty of this research is possibly threefold: the conceptualisation of the notion of "territorial capital" in terms of capabilities for development; its operationalisation in a spatial evaluation model which accounts also for potential spatial interactions; and finally, the application in the case study, illustrating possible employment and usefulness of such results for territorial analysis and policy design.

In the next section we present the background, main sources, and relevant previous research. In Sect. 3 we describe the evaluation methodology, the structure of the evaluation model, its articulation in eight dimensions of territorial capital, and the data sources used for calculating the respective indicators. Section 4 is dedicated to presenting and discussing the results of the case study we conducted on the island of Sardinia. The article ends with concluding remarks on employment and usefulness of such results for territorial analysis and policy design, indicating possible future developments of the presented framework.

2 Background and Previous Research

The National Strategy for Inner Areas adopted in Italy in 2013 points at the so called "territorial capital" among the factors for contrasting the decline of inner areas (the expression "territorial capital" is used 18 times in the text of the National Strategy): «For the construction of an economic development strategy for inner areas, this relationship

starts from the unused "territorial capital" present in these territories: the natural, cultural capital and cognitive, the social energy of the local population and potential residents, production systems (agricultural, tourism, manufacturing)».

An expression used in conjunction with territorial capital is "economic development potential" (8 times in the text).

Hence, our starting point for the assessment of fragility and development potential of inner areas was to refer, with all due cautions, to the concept of territorial capital.

Following ([6], p.1387), territorial capital can be defined as «the set of localised assets – natural, human, artificial, organizational, relational and cognitive – that constitute the competitive potential of a given territory». The concept of territorial capital is dynamic and changes according to the social, political, economic, and cultural conditions of a specific time and place. Following the report by Farrell, Thirion and Soto ([7], p. 19), within the European LEADER program aimed at supporting integrated development of rural areas, the territorial capital includes «all of the elements available to the area, both tangible and intangible, which in some respects constitute assets and in others constraints» and underlies the development of a territorial project (or vision of the future) conceived as «a multi-faceted living entity (with economic, social, institutional, cultural and other facets) that evolves over time». This characteristic is also corroborated by the Organisation for Economic Co-operation and Development (OECD) ([8], p. 15) that highlight the factors that determine the region's territorial capital:

> *"[G]eographical location, size, factor of production endowment, climate, traditions, natural resources, quality of life or the agglomeration economies provided by its cities... Other factors may be 'untraded interdependencies' such as understandings, customs and informal rules that enable economic actors to work together under conditions of uncertainty, or the solidarity, mutual assistance and co-opting of ideas that often develop in small and medium-size enterprises working in the same sector (social capital). Lastly there is an intangible factor, 'something in the air', called 'the environment' and which is the outcome of a combination of institutions, rules, practices, producers, researchers and policy-makers, that make a certain creativity and innovation possible. This territorial capital generates a higher return for certain kinds of investments than for others since they are better suited to the area and use its assets and potential more effectively…".*

The concept of territorial capital has become significant in the context of the place-based approach, the guiding principle of European Union Cohesion Policy (Barca 2009). Many studies suggest a positive relationship between territorial capital and economic growth [9]. Territorial capital can significantly affect the impact of policies on regional growth [10] and of specific expenditure axes [11, 12]. In this context Barca et al. [13] pay attention on the "unused" territorial capital of inner areas, considered as a measure of the economic development potential.

More recently, this concept is taken up in the Territorial Agenda of the European Union for 2020 "Towards an Inclusive, Smart and Sustainable Europe of Diverse Regions" [14] and for 2030 "A future for all places" [15] which point out the central role of a place-based approach based on the territorial capital to long-term development and competitiveness for places.

While we are aware of the limits and risks of referring to the concept of "capital", we can interpret it by purifying the term of its many connotations and from its purely productive orientation (i.e., the set of goods intended for productive uses to obtain new production) and relate it instead to the concept of "endowments", of stock of resources in the broad sense. In this sense, we hold, the of concept of territorial capital can be fruitful as an operational framework for evaluating of the fragilities, opportunities, and development potential of inner areas as fragile territories.

3 Methodology

Based on the above premises, we have developed a spatial evaluation model assessing territorial capital on the spatial scale of municipalities. Despite the importance of this local geographical scale to calibrate and ensure effectiveness to territorial policies, municipal dimension is still little studied in economic and territorial studies on territorial capital that are usually focused on a major spatial scale (e.g. provincial) [16]. Therefore, in the proposed evaluation model, the territorial capital is expressed at this spatial scale as an aggregate measure combining eight constituent dimensions (capitals): human, social, cognitive, infrastructural, productive, relational, environmental, and settlement capital, each assessed as aggregating a set of indicators. Our choices to articulate territorial capital in these eight dimensions is in many respects provisional since the concept is not consolidated in the literature. However, we settle with this structuring to make our results somewhat comparable with a 2012 study at the national level [17], which proposes similar framework, and in accordance with several studies which have suggested conceptual and analytical frameworks to capture a range of issues encompassed by the concept of territorial capital [17–24].

Our choice of indicators was also guided by the need to have data available, and possibly updatable in a quasi-automatic way.

The proposed methodology allows to evaluate and map the capital of a given territory at municipal level, providing a platform to investigate the performance of eight different categories of capital (see Table 1). For each, we identify a set of relevant indicators – some already used in the literature and others developed by us – that highlight existing or potential assets and their accessibility that can increase the capital base of a given territorial context.

The 33 indicators included in the eight categories of the proposed territorial capital framework encompass a range of different physical (e.g. infrastructure and building structures, natural resources) and immaterial dimensions (e.g. wellbeing, knowledge, productivity, entrepreneurial dynamism and innovation) that integrate multiple perspectives and levels of analysis from different disciplines and sectors of government responsible for health and social care, education, environmental protection, transport development and other critical services. These indicators simplify the complex reality of a territory into easily communicable data and for this reason are applicable to a large spectrum of contexts, then allowing to achieve uniformity of reporting and easily compare different territories.

The definition and indicators used to assess each capital is shown in Table 1 and briefly described in the following text.

Table 1. The eight categories of capitals that compose the proposed "Territorial Capital Index" and related indicators.

Territorial sub-capitals	Indicators	Territorial sub-capitals	Indicators
HUMAN	1.1) Old-age index; 1.2) Specific employment rate; 1.3) Education index; 1.4) Migratory balance	PRODUCTIVE	5.1) Entrepreneurship index; 5.2) Tourism accomodation capacity; 5.3) Start-up companies; 5.4) Average income
SOCIAL	2.1) Voting population; 2.2) Voluntary associations; 2.3) Expenditure for social services; 2.4) Socio-educational users	RELATIONAL	6.1) Public funding; 6.2) University students; 6.3) Bank branches; 6.4) Business networks
COGNITIVE	3.1) Cultural and recreational services; 3.2) Expenditure for culture; 3.3) Broadband accessibility; 3.4) Social promotion associations	ENVIRONMENTAL	7.1) Parks and protected areas; 7.2) Utilized agricultural area; 7.3) Areas at risk; 7.4) Waste sorting; 7.5) Sustainable energy
INFRASTRUCTURAL	4.1) Health services; 4.2) Suburban public transport; 4.3) Postal offices; 4.4) Police stations	SETTLEMENT	8.1) Uninhabited housing; 8.2) Housing quality; 8.3) Average age of buildings; 8.4) Average income from buildings

1. Human Capital (HC) is considered central by many studies [25–27]. We refer to [28] that conceives the human capital as a qualitative attribute of a territory, directly related to the level of education, training and skills of its inhabitants that are positively related to their ability to perform labour and individual's productivity. Thus, investments in human resource can be viewed as strategic investments for increasing territorial wealth. We evaluate the HC through four indicators related to "Educational level", "Employment rate", but also "Population ageing" and "Migratory balance" that provide information about territorial attractiveness and the risk of population decline.

2. Social Capital (SC) emphasises the importance of shared norms, values and understandings that balances societal and individual interests and facilitate co-operation within or among groups [8] and endogenous bottom-up development processes [29–35]. In this context the social capital includes the territorial "relational capital" as the solidarity and active citizenship, associated with a higher propensity to work together toward shared goals [19, 20, 36–41]). According to this notion, we evaluate SC using four indicators that measure "Voluntary associations", "Voting population", "Socio-Educational Users" and "Expenditure for social services".

3. Cognitive Capital (CC) incorporates information about knowledge and individual's ability to learn new skills [42, 43] that are enhanced by new technologies and reinforced by cultural experiences [44–46]. Thus, the CC can be defined as «the result of the application of accumulated knowledge and intangible fundamental human intellectual activity, manifested in the generation of innovations, ideas, invention or improvement of techniques and technologies, including endo-resources technologies» ((Kirshin and Titov 2012) cit in [47]). Proposed indicators are: one the one hand, "Broadband Accessibility" and, one the other hand, "Cultural and recreational services" and "Expenditure for culture" both for heritage and cultural activities and "Social promotion associations".

4. Infrastructural Capital (IC) is the fixed capital of territories, including infrastructural assets, railways, pipelines, communications towers and lines, dams and plants [18, 48] as resources that guarantee local connections and significant interactions with non-local actors [24], attract people and investments and promote local economic growth and the competitiveness of the territory [49, 50]. Thus, the IC is a public good «characterized by long duration, technical indivisibility and a high capital-output ratio» [51], complementary to the productive capital [52]. Proposed indicators are "Suburban Public Transport", "Postal Offices", "Police Stations" and "Health services".

5. Productive Capital (PC) refers to the classical "capital" theory, and it can be distinguishing between variable and constant capital. The first adds value in production and consist in labour services, the second is the system of physical systems necessary for the production. We consider the business networks, incubators, production of sophisticated or intermediate goods which provide information about the productive potential of a given territory [8, 20]. Thus, suitable indicators are: "Entrepreneurship Index", "Start-up companies", "Tourism Accommodation Capacity" and "Average Income" of inhabitants.

6. Relational Capital (RC) is related to the category of "relational goods" introduced by researchers from different disciplines: the philosopher Martha Nussbaum [53], the sociologist Pierpaolo Donati [54], the economists Benedetto Gui [55] and Carole Uhlaner [56]. Accordingly, a relational good refers to that good that are linked with interpersonal

experiences, where it is the relationship itself that matters: this kind of goods are both co-produced and co-consumed by the subjects involved [57]. Thus, the RC is the ability of a territory to activate physical and immaterial exchanges between firms, institutions and people [58]. A high level of relational capital can improve production and efficiency of public service delivery [59]. We propose as indicators for RC: "Public Funding", "University Students", "Bank Branches" and "Business Networks".

7. Environmental Capital (EC) is an essential prerequisite for human survival and economic activity, which includes goods and services provided by natural environments [60–63]. EC comprises the endowment of renewable and non-renewable stocks of natural resources that can create a competitive advantage both in terms of cost and differentiation [64]. Among these, agriculture is increasing in importance as a provider of opportunities for income generation and environmental protection. According to this concept, we propose these four indicators: "Parks and Protected Areas" and "Utilized Agricultural Area" but also those factors that have an impact on their quality, such as the potential exposure to "Environmental Risk" and the management of environmental resources to prevent pollution such as "Waste sorting" and "Sustainable Energy".

8. Settlement Capital (SC) in our study refers to the housing supply and quality which is an important part of the infrastructural capital of cities that significatively affects the people's lives [17, 22]. Human settlements, in fact, as a part of the physical infrastructure essential for development [65], must ensure the right to adequate housing for all, according to the 2030 Agenda Sustainable Development Goal (SDG) 11 "Sustainable Cities and communities" [66]. Thus, the SC measures those factors that allow identify inadequate housing such as the structural quality of the building "Housing Quality" and the "Average age of buildings" that can be directly related to energy consumption and, consequently, to the housing costs. Furthermore, we consider the "Uninhabited Housing" as a consistent risk factor of degradation and the "Average income from buildings" that in general is associated with their quality.

Aggregation Procedure. The eight categories of capital are calculated at municipal level. For each municipality, the aggregate index of each capital is calculated as a mean value of scaled min-max (in [0, 1]) sub-indicators respective to that category capital (see Table 1). This scale is constructed by considering the value of the indicator for the municipality from which the minimum regional value is subtracted; it is then divided by the difference between the maximum regional value and the minimum value. In some cases, the complement to one of the result must be considered. The calculation (in this first processing) is done by giving equal weight to each indicator in the calculation of each of the capitals and to each capital in the calculation of the territorial capital. Finally, the aggregate Territorial Capital Index (TCI) for each municipality is calculated and the average of indices of each capital.

The user frontend of the software tool, deployed through web mapping platform Mango, further allows to manipulate the evaluation structure by modifying or adding indicators, weighing them, spatially aggregate the municipalities by proximity or by administrative division, and producing historical series and customisable maps.

4 Case Study: Sardinia

We have applied the proposed methodology to evaluate the territorial capital of municipalities of Sardinian Region in Italy. The Sardinian territory is made up of 377 municipalities, that are very different from each other in population size, infrastructural and structural facilities, environment characteristics, demographic and socio-economic attributes. The scale of analysis highlighted these differences which are difficult to observe in aggregate data at the provincial or regional level.

We calculated the value of each indicator of the eight TCI categories and for each administrative boundary using a wide range of local data available from National and

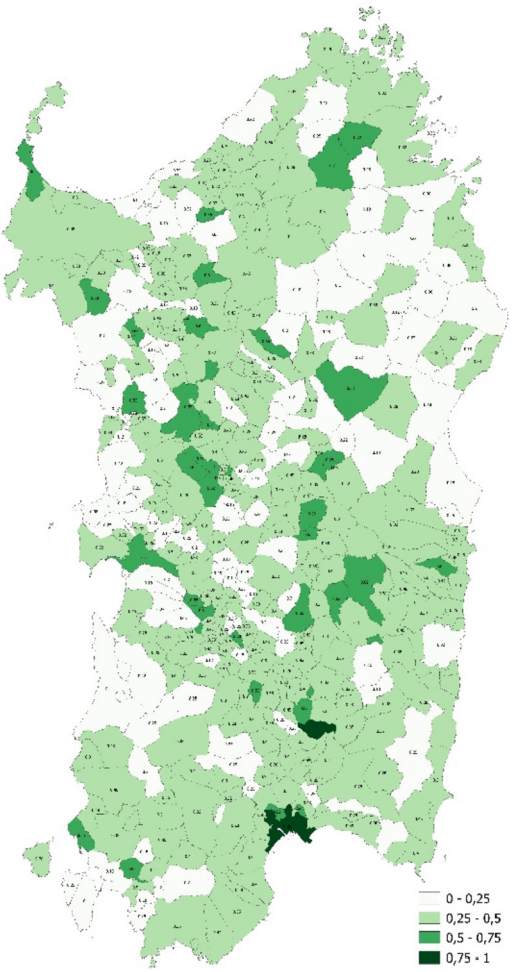


Fig. 1. The "Territorial Capital Index" (TCI) of the 377 Sardinian municipalities: values range from: 0–0.25 (low), 0.25–0.5 (middle), 0.5–0.75 (middle-high), 0.75–1 (high).

Regional authorities and statistical institutions (e.g. the Italian National Institute of Statistics - ISTAT, the Italian Ministry of the Environment, the Institute for Environmental Protection and Research – ISPRA, Regional Information System) and open data sources that include information about mobility and transport (see Table 1).

As Fig. 1 shows, only the Metropolitan City of Cagliari and Sant'Andrea Frius have a high TCI value, with the majority of municipalities having an intermediate TCI middle value.

The analysis of the eight TCI categories shows different scenarios (see Figs. 2 and 3).

Small municipalities generally have greater values of Social, Cognitive, Relational and Infrastructural capital.

Only 7 of 377 municipalities have a high level of Social Capital – Sant'Antonio di Gallura, Padria, Romana, Sarule, Turri, Vallermosa and Tratalias – all with a population of less than 2,000 inhabitants and four of these with less than 600 inhabitants.

Only five municipalities have a high level of Cognitive Capital – Semestene, Villanova Tulo, Turri, Elini – all with a population of less than 1,000 inhabitants and one of these (Semestene) with about 150 inhabitants.

The highest level of the Relational Capital is reached by seven municipalities – Ardara (784 ab.), Monteleone Rocca Doria (102 ab.), Semestene (156 ab.), Sagama (201 ab.), Fonni (3,942 ab.), Osini (790 ab.) and Sant'Andrea Frius (1,786 ab.) – one of these with about 100 inhabitants.

Surprisingly the Infrastructural Capital reaches higher values only in five little municipalities – Romana, Osidda, Sorradile and Boroneddu - all with a population of less than 600 inhabitants.

Instead, the Human and Settlement Capital are higher in larger cities: the Metropolitan City of Cagliari (MC-Cagliari), Sassari, Olbia, Nuoro and Oristano. Only Quartu Sant'Elena, the third largest cities of Sardinia, have a middle-high level of HC.

The Settlement Capital is greater in Nuoro, Arborea, Sant'Andrea Frius, the MC-Cagliari, Capoterra, Elmas, Sestu and Selargius, most of them with a population over 1,000 inhabitants.

Furthermore, the comparison between the seven largest cities of Sardinia – MC-Cagliari, Sassari, Quartu Sant'Elena, Olbia, Alghero Nuoro and Oristano – shows the differences in the global TCI values and specific TC categories.

The MC-Cagliari have a high level of Human, Productive and Settlement Capital but a very low value of Environmental and Infrastructural Capital.

Sassari have a middle value of TCI, that hides a high level of Human Capital and a very low level of Infrastructural Capital.

Quartu Sant'Elena, Olbia and Alghero have a middle value of TCI coherent with the middle-high value of the Settlement Capital and a low value of Cognitive and Infrastructural Capital.

Nuoro and Oristano have a middle-high value of TCI and a low value of Cognitive Capital.

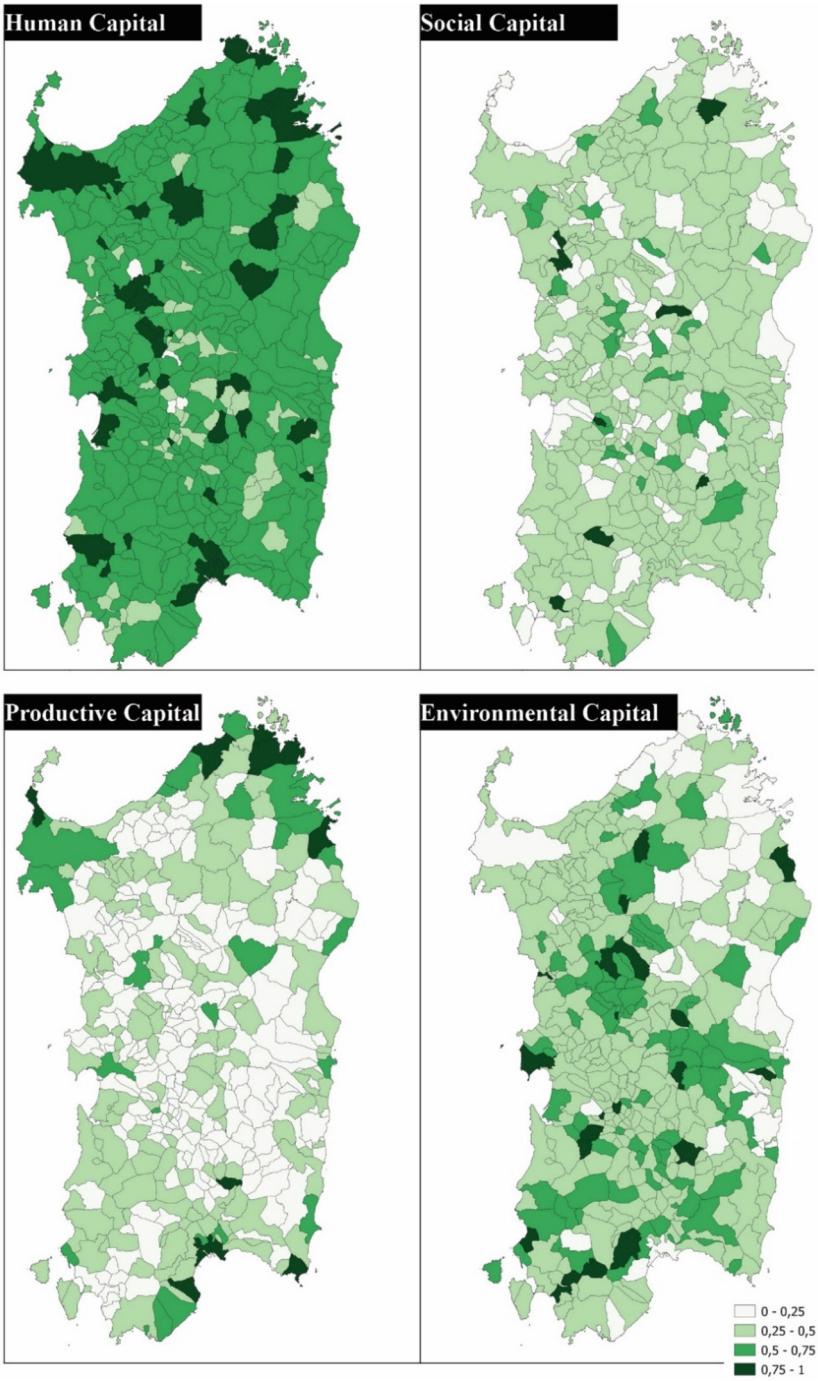


Fig. 2. Four of the eight TCI categories: human, social, productive and environmental.

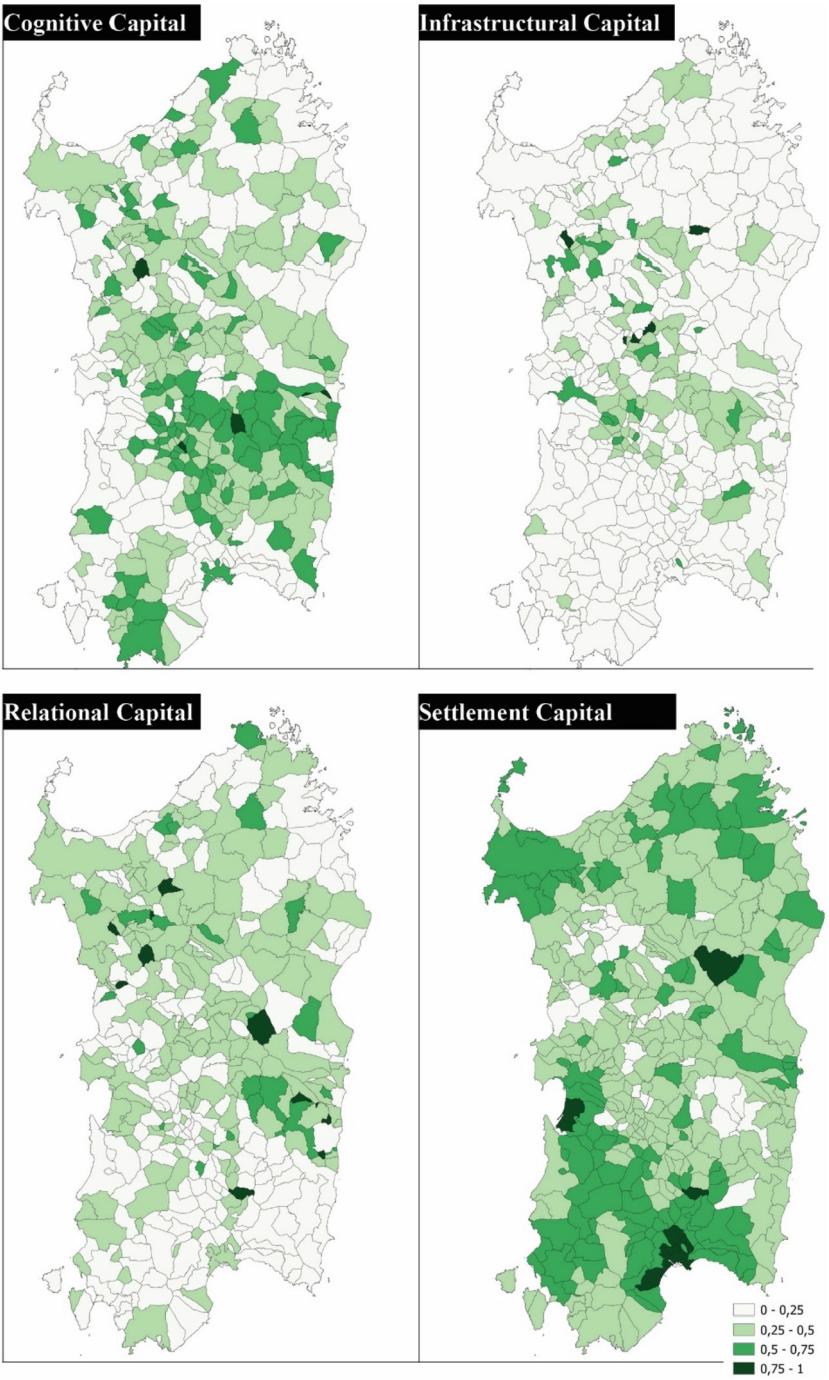


Fig. 3. Four of eight TCI categories: cognitive, infrastructural, relational and settlement.

5 Conclusions

The usefulness of a tool like the one we are proposing is to suggest possible policies. In this sense, it is important to observe similar TCI values on aggregate can result from different values of different capitals, offering clues for decision both in terms of possible objectives and strategies, and for the temporal articulation of the actions.

As we said, not all internal areas may have the same desired destiny. The proposed evaluation system makes it possible to identify possible destinies and also to "measure" the distance between the two.

Moreover, if we consider that some indicators must be evaluated (also) in wider territorial areas than municipal administrative borders, and that there are (also) phenomena with neighbourhood effects with nearby municipalities, the system helps to identify the appropriate areas for policies and to plan for diffusive impacts of actions within these areas.

In a context in which the choices related to the Italian PNNR (which is the articulation of the European Recovery Plan) often appear to be episodic and not conceived systemically, having tools such as this to help decision-making which operate from a system perspective can represent a way to avoid inconsistent or ineffective actions.

In this sense, we envision further development of our evaluation tool to allow to classify territorial entities both in one of the categories proposed by the National Strategy for Inner Areas ("poles", "belt municipality", "intermediate", "peripheral" and "ultra-peripheral") combining it with out TCI. From this combination and from other information on territorial endowments of higher rank, classes can emerge that group territories by fragility and potential.

In this sense, our proposal – which is based on a set of indicators that can be expanded and whose weights can be different, and on "units" that can be chosen according to the type of actions undertaken – allows for the construction of a systemic approach to policies. In fact, it does not replace the choice of decision-makers or the initiatives of local communities whose responsibility is to define visions and objectives, but it provides a tool that serves to evaluate the set of actions most useful for achieving them.

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