

Polycentrism and Insularity Metrics for In-Land Areas

Laura Curatella and Francesco Scorza(✉)

School of Engineering, Laboratory of Urban and Regional Systems Engineering, 10, Viale dell'Ateneo Lucano, 85100 Potenza, Italy
lauracu8@gmail.com, francesco.scorza@unibas.it

Abstract. The aim of polycentrism, as a policy, is to promote balanced territorial development between urban centres and its hinterland by creating functional integration. In this view, polycentric urban systems are a mean to achieve a more efficient and more sustainable territorial organization than single-centric systems and small dispersed settlements. At regional/local level, an operational objective could be to move from one or two dominant regional centres (polarization) to a network of small and medium-sized centres providing regional services. This process has to be finalized through strategic alliances between cities, particularly where critical mass is lacking, and rural partnerships urban exploring common potential and joint development projects.

The idea is to deliver a territorial schema to organize the connection of cities, metropolitan regions and their hinterland through infrastructures and effective services supply distribution. The negative part of this schema represents the territorial insularity effect: it is the case of those in-land areas, considered as the extreme periphery of the polycentric structure, that are not connected, in facts, with any center belonging to the top-level hierarchy adopted in the model.

The study for the identification of territorial structures in Basilicata was carried out through the analysis of various variables: the demographic structure, the infrastructure endowment and organizational models that condition the territorial accessibility. In Basilicata three levels of polycentric hierarchy have been identified, according to different levels of concentration of high and medium-level functions. The insularity effect had been mapped. The calculations reveal a large gap between the outermost and the innermost centres of the Region (referring to their geographical position).

Keywords: Polycentrism · Monocentrism · Territorial balance · Territorial islands · Marginality

1 Introduction

Detecting "insularity effect" in inland areas deals with the operative identification of marginal and remote territorial portions where an adequate level of quality of live and equitable distribution of opportunities if far to be ensured to local inhabitants.

Our approach goes in the direction to adopt quantitative analytics used for the Polycentric territorial organization in order to define targets and metrics characterizing territorial insularity in a specific context: Basilicata region.

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Defining a polycentric territorial model [1–3] means organizing spatial data and information that includes mechanisms that, at the local scale, determine the organization of demand and consequently the provision of services and facilities.

It seeks to interpret the dynamics of settlement, infrastructure and organizational changes that condition territorial accessibility and that lead citizens to self-define residence and systematic displacements according to criteria of optimization of the use of the space and the territory.

The rules and criteria which contribute to the definition of the settlement model are useful in the planning of sustainable forms of territorial development: a substantial and particularly critical exercise in the management of the territories so called to (i.e., low settlement density) in which rules and standards defined for the organization of large metropolitan aggregates lose their effectiveness. Additionally, the "in-land island" goes absolutely out of any standard classification in services and infrastructures supply/availability or "standard costs" estimation for public endowment.

These considerations are at the origin of the research question that underlies this work: identify "insularity effect areas" through the analysis of the polycentric territorial organizational model of Basilicata region (Italy).

It is the case of Basilicata region, one of the regions with the lowest population density of Italy (56,3 inhabitants/kmq), affected by a development delay that results from a secular infrastructural deficit [4, 5].

In this work, two main information components are considered for the definition of poly centric geographies of spatial planning organized on a four-level hierarchy of the Lucanian centres: the demographic structure of the population and the provision of services and equipment. The first refers to the Istat data, the second comes from a work of recollection and mapping of detail of the current offer of public and private services that together determine different levels of territorial endowment. Assessing accessibility in terms of the time needed to travel to centres providing primary services has been decisive for the definition of the geographies highlighted in the research.

This spatial pattern was then compared with a planned dimension which takes into account the evolution of the demand for services and equipment by 2050 according to the current demographic growth rates of ISTAT (in reality of depopulation) for each municipality in Basilicata. The map of insularity effects comes as the complementary geography of the polycentric regional structure. This result opens to a more structured research and analytical investigation about the issues of sustainable and inclusive development that should be completely reconsidered for those territories. The regional government, but also the national government, should act in order to define concrete actions overcoming the standardized governance models that are actually applied to development programs both in EU cohesion framework and extraordinary national development planning tools ("il Piano per il Sud" [6]).

2 The Demographic Structure of Basilicata

Basilicata region is characterized by a high degree of structural backwardness that originates from troubled historical events and difficult geographical conditions. Demographic structure is characterized by a historical trend towards depopulation as a result of migratory processes [7].

The Basilicata described by the data on the demographic structure of population recorded through the last Censuses is characterized by the negative demographic trend, the ageing of the population, the decrease of young people and the increase of foreigners [8]. The demographic analysis provides an image of the region which is characterized by a remarkable polarization in a few centers in the face of the excessive emptiness of the internal areas that favors the intensification of regional gaps. The interpretation of the dynamics of depopulation that has affected the regional territory, in fact, makes a differentiated analysis at territorial level appropriate because it arises from different demographic trends. Strong areas are identified where there are significant increases in population that coincide with the provincial capitals and the municipalities of the hinterland, which accommodate part of the surplus population of the capitals and originate a form of suburbanization. To these areas are added other centers attractors of the region such as for example the Vulture for the presence of the settlement FCA. Sata of Melfi and its related, the Ionian belt for the development of intensive agriculture and tourist attractiveness and, In more recent times, even some centres in the Val d'Agri which, thanks to the large-scale start of oil mining, show an appreciable demographic vitality. The rest of the region, which mostly coincides with the mountain area, is characterized by a significant demographic decline with significant population losses. The negative dynamics are determined by the conformation and the natural characteristics of the territory, by the complex morphology, by a limited coastal development, from particular altimetric characteristics that hinder the development of the productive system rendering more burdensome and less profitable the economic activities and they emphasize the chronic deficiencies is in terms of infrastructural endowment of the territory. These factors contribute to increasing the phenomenon of the abandonment of territories with the relative consequence of the weakening of the socioeconomic system. It is in these areas that the problem of the ageing of the population and the gradual depopulation of the municipalities is most felt.

The latter is not compensated by the increase in foreign immigration that only partially corrects the decline of the regional population. Demographic ageing, in line with global dynamics, is a phenomenon that is as important in the region as it is now widespread. The increase in the elderly population is due to the combined effect of different demographic trends due both to the considerable progress made in the economic, social and health sectors which, by fostering scientific progress, have led to an increase in life expectancy, both the decline in fertility that led to a contraction of births. This is a great achievement, but it necessarily has major economic, social and cultural implications. The social and economic variations associated with the ageing of the population are likely to have significant repercussions in many sectors, with an impact, inter alia, on the size of the working population, on health care, on social protection and social security issues. This territorial weakness is matched by the provision of services to the fragmented population [9–12] (Fig. 1).

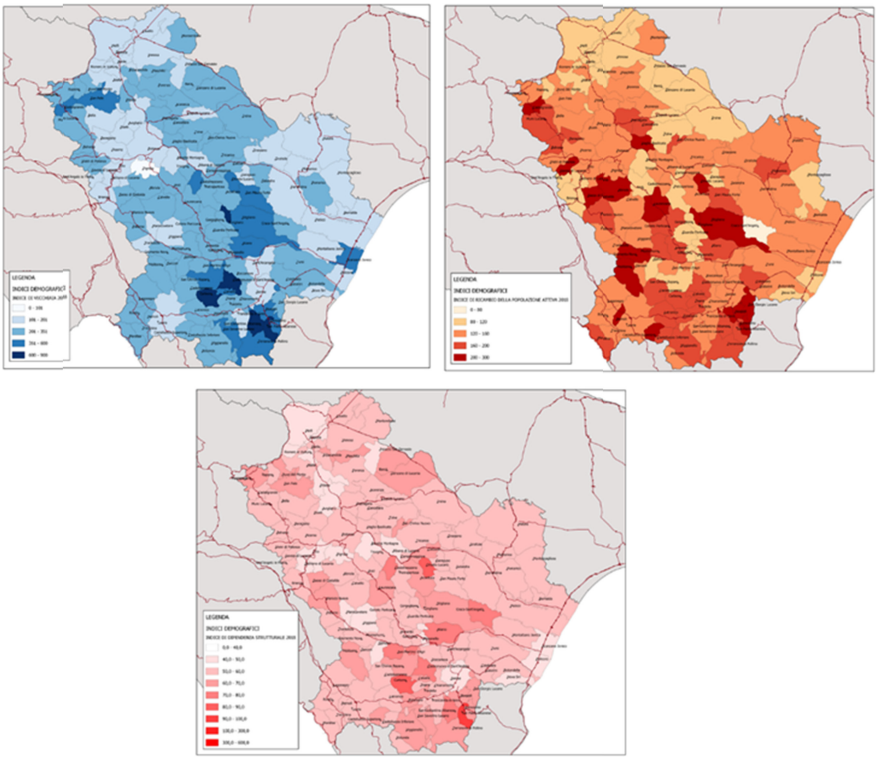


Fig. 1. Some of the demographic indices concerning the Basilicata region are given. They are, respectively: old age index, structural dependency index and turnover index of the working population. The data were updated to 2018.

3 Methodology

The provision of services and equipment is a parameter against which to assess the quality of life in a specific territory also through comparison (benchmark) with reference realities. Other part can be understood as an assessment of deficit, or lack of minimum requirements for the provision of services and equipment in relation to the urban functions exercised by each territorial unit. Using open source data available online, reworked through GIS systems, has defined a map of the services of the territory related to the entire region (including over 17,000 instances) [13]. Ten macro-categories have been defined: trade, culture, education and training, sport and leisure, tourism, general services, public services, financial services, security (Fig. 2).

This paper highlights a very discouraging condition: in principle, we can say that few municipalities in Basilicata really stand out for their equipment and services and are represented, in most cases, from the two provincial capitals and from Melfi and Policoro. To these are added the municipalities of Lagonegro and Lauria.

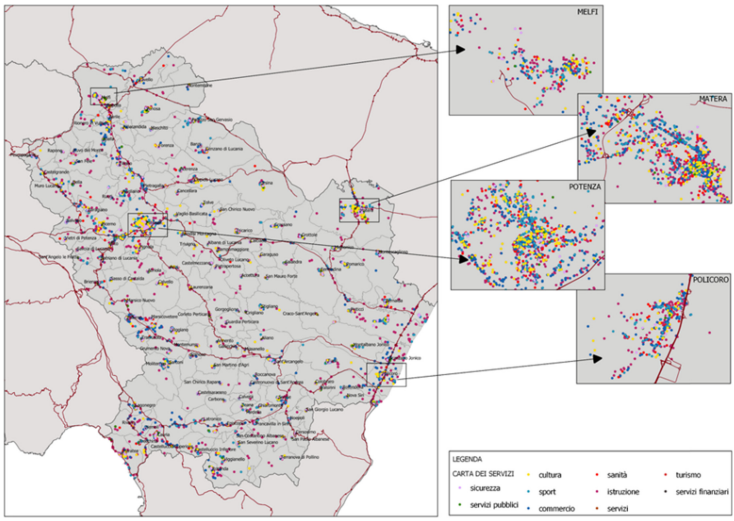


Fig. 2. Map of Basilicata services.

Exploiting the information derived from georeferencing and statistical maps, the analysis has been deepened by means of advanced spatial analysis techniques, such as the Kernel Density Estimation (KDE) [14].

These methodologies allow to study the polarization and the density of economic activities and not in the territory, analyzing the interconnection between them. What has emerged is that the activities are not evenly distributed and are greatly affected by the distribution of the population on the territory. In the most densely populated municipalities, there is a greater concentration of services and also their greater diversification, while the number of services is extremely small in the least populated municipalities.

The kernel density has thus enabled us to identify areas where the values of service and equipment concentration are significant and which represent a greater liveliness in economic terms. These areas are represented by the two regional capitals, the Vulture-Melfese, the Lagonegrese and the Ionian area.

In the more central areas of the Region, where the population is lower and the endowment index is very low, the activity concentration is minimal.

These data were then analyzed on the basis of ACP techniques and territorial classifications to balance levels of supply and demand in relation to territorial accessibility parameters that led us to the definition of a polycentric model for Basilicata [15].

The purpose of the analysis in main components is to reduce the more or less high number of variables describing a set of data to a smaller number of latent variables, limiting as much as possible the loss of information. This happens through a linear transformation of the variables that projects the original ones into a new Cartesian system in which the new variable with the greatest variance is projected on the first

axis, the new variable, depending on the dimensions of the variance, on the second axis and so on.

The reduction of complexity is limited to analyzing the main new variables. The 131 municipalities of Basilicata were evaluated by taking into account 192 variables related to information on population structure, labor and business systems and the provision of services and equipment. This information base describes the socio-demographic structure to which we refer for the proposal of territorial organizational models oriented to balance the demand for services. The variables related to the presence of services, organized on two levels of very detailed classification, describe the side of the offer of services and therefore the territorial endowment. The link between demand and supply of services, although at the basis of any reflection of polycentric organization of the territory, is particularly weak in the analytical determination especially in contexts of low settlement density. Formalized rules for large urban aggregations have no validity in fragmented contexts where the presence of population is weak and declining (weak demand) and where generic services such as retail businesses or small artisans have a value beyond the mere offering of functions and opportunities. Rather, they represent a form of protection of the territory and at the same time an essential element to ensure minimum standards of quality of life for residents.

To the definition of the hierarchy of the centers has been placed side by side the analysis of the territorial accessibility expressed in terms of times of distance that a resident citizen must carry out for the fruition of present services on the territory [16]. [17] The calculation of isochrons is the basis for calculating the population actually falling within the polygons defined by the curves. It is therefore of fundamental importance for a precise identification of the user that gravitates within the defined basins, take into account the census sections and the corresponding population, referring to the last census (Fig. 3).

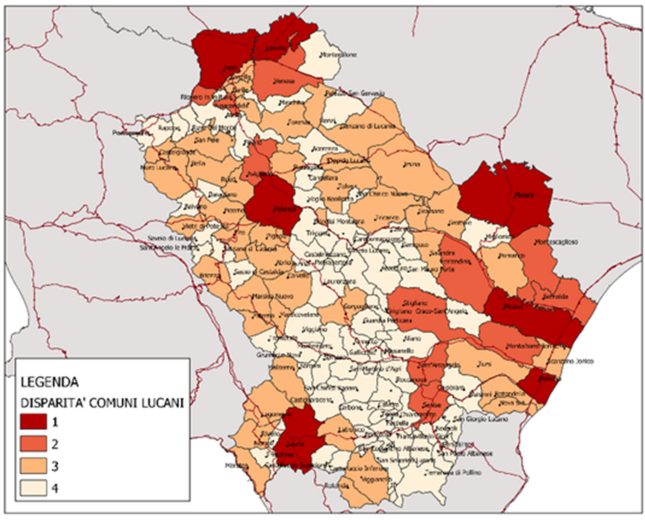


Fig. 3. It represents the inequality and heterogeneity of the municipalities of Basilicata. Data on the services and equipment of each municipality and its population were taken into account.

The following table proposes the polycentric model for Basilicata obtained through the application of the geo-statistical techniques mentioned above [18].

To the centralities of first, second and third levels, correspond isochrone of accessibility to 45 min that demonstrate as wide part of the regional territory is external to areas of proximity. This results in costs for the population which are often unsustainable and in internal and external migration which weakens local demand and contributes to the marginalization of the territory [19] (Fig. 4).

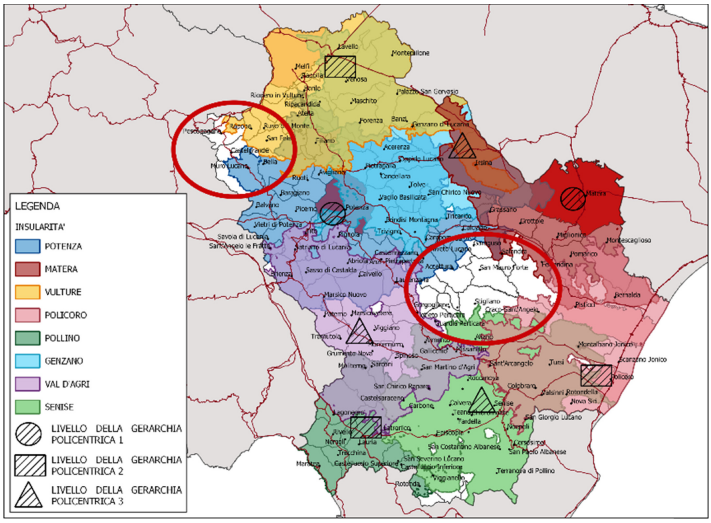


Fig. 4. Insularity map.

The areas defined by 45-min isocrones are wider areas where higher level services are available. These areas, despite their extension, cannot cover the entire territory of Lucania. The municipalities of Garaguso, Mauro Forte, Salandra, Stigliano, Cirigliano, Gorgoglione, Guardia Perticara, Pescopagano and Castelgrande remain outside. For the areas defined by the isocrone at 45 min the area of Potenza is the largest with an area of 2680 km^2 and the most populated with about 175900 inhabitants. Unlike what one would expect the second area for both extension and number of inhabitants is Genzano, center of third level, which with an area of 2233 km^2 encloses 1181815 inhabitants. The area of Matera has an extension of 1494 km^2 with a population.

From the map it can be noted that some municipalities, circled in red, are located outside the isochrone at 45 min and this makes them marginal and peripheral areas not connected with the main municipalities of the Region.

4 Conclusion

If we compare the results obtained and the set of territorial development policies in Basilicata, emerge a geography substantially different form the regional maps that can be found in the main regional development planning documents currently in force in Basilicata (of all the ERDF OP 2014-2020).

Basilicata Region is characterized by structural gaps among municipalities: those located in the hinterland of the territorial arrangements highlighted, which enjoying the presence of services and equipment are in a more favorable position compared to those of the hinterland, difficult to connect and sometimes without basic services.

In the perspective of this paper such gaps has to be considered as a form od insularity effect. It is representative of a new development perspective: island pay a gap of connections and accessibility and therefore needs extraordinary tools supporting territorial development.

This preliminary research basically provides a case study application of statistical and geo-statistical tools in order to map insularity effects in inland areas, further development has to consider the sustainability threshold analysis for those territories in order to deliver proposals and operative tools to adopt "smart" [20] approach in planning ad development. Main issues regards: urban quality [21]; effective planning tools [22]; Ecosystem Services and their provisioning [23]; cultural heritage exploitation [24]; citizens participation [25] and inclusion.

References

1. Contato, A.: Policentrismo reticolare. Teorie, approcci e modelli per lo sviluppo territoriale. Franco Angeli Editore (2019)
2. Clementi, A., Dematteis, G.: Le forme del territorio. Temi ed immagini del mutamento. Laterza (1996)
3. Dematteis, G.: Da aree metropolitane a rete. Tendenze recenti dell'urbanizzazione italiana ed europea. In: Quaderni di scienze storiche (1997)
4. Las Casas, G., Scorza, F., Murgante, B.: Conflicts and sustainable planning: peculiar instances coming from val d'agri structural inter-municipal plan. In: Papa, R., Fistola, R., Gargiulo, C. (eds.) Smart Planning: Sustainability and Mobility in the Age of Change. GET, pp. 163–177. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-77682-8_10
5. Las Casas, G., Lombardo, S., Murgante, B., Pontrandolfi, P., Scorza, F.: Open data for territorial specialization assessment territorial specialization in attracting local development funds: an assessment. Procedure based on open data and open tools. J. L. Use Mobil. Environ. (2014). https://doi.org/10.6092/1970-9870/2557
6. Provenzano G.: Piano Sud 2030, sviluppo e coesione per l'Italia (2020)
7. Comitato Regionale per la programmazione economica della Basilicata.: Schema di sviluppo regionale per la Basilicata, quinquennio 1966/1970 (1967)
8. Scardaccione, G., Scorza, F., Casas, G.L., Murgante, B.: Spatial autocorrelation analysis for the evaluation of migration flows: the Italian case. In: Taniar, D., Gervasi, O., Murgante, B., Pardede, E., Apduhan, Bernady O. (eds.) ICCSA 2010. LNCS, vol. 6016, pp. 62–76. Springer, Heidelberg (2010). https://doi.org/10.1007/978-3-642-12156-2_5

9. Scorza, F., Pilogallo, A., Saganeiti, L., Murgante, B., Pontrandolfi, P.: Comparing the territorial performances of renewable energy sources' plants with an integrated ecosystem services loss assessment: A case study from the Basilicata region (Italy). Sustain. Cities Soc. **56**, 102082 (2020)
10. Di Fazio, S., Modica, G.: Historic rural landscapes: sustainable planning strategies and action criteria. The Italian experience in the global and European context. Sustainability **10**, 3834 (2018)
11. Morano, P., Tajani, F.: Saving soil and financial feasibility. A model to support the public-private partnerships in the regeneration of abandoned areas. Land Use Pol. **73**, 40–48 (2018)
12. Tajani, F., Morano, P.: Concession and lease or sale? A model for the enhancement of public properties in disuse or underutilized. WSEAS Trans. Bus. Econ. **11**, 787–800 (2014). Article no. 74
13. Carbone, R., et al.: Using open data and open tools in defining strategies for the enhancement of Basilicata Region. In: Gervasi, O., et al. (eds.) ICCSA 2018. LNCS, vol. 10964, pp. 725–733. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-95174-4_55
14. Cecchini, A., Plaisant, A.: Analisi e modelli per la pianificazione. Teoria e pratica: lo stato dell'arte. Francoangeli/ Facoltà di Architettura di Alghero (2005)
15. O' Sullivan, D., Unwin, D.: Geographic Information Analysis (2002)
16. Fortunato, G., Scorza, F., Murgante, B.: Cyclable city: a territorial assessment procedure for disruptive policy-making on urban mobility. In: Misra, S., et al. (eds.) ICCSA 2019. LNCS, vol. 11624, pp. 291–307. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-24311-1_21
17. Fortunato, G., Sassano, G., Scorza, F., Murgante, B.: Ciclabilità a Potenza: una proposta di intervento per lo sviluppo della mobilità attiva in un contesto urbano acclive. Urban. Inf. 109–115 (2018)
18. Pontrandolfi, P., Cartolano, A.: The role of intermediate territories for new sustainable planning and governance approaches. criteria and requirements for determining multi-municipal dimension: South Italy case. In: Gervasi, O., et al. (eds.) ICCSA 2018. LNCS, vol. 10964, pp. 744–762. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-95174-4_57
19. Curatella, L.: La struttura policentrica del sistema insediativo lucano: un modello territoriale calibrato sulla dotazione di servizi ed attrezzature. Master thesis in Architectural Engineering, UNIBAS (2020)
20. Murgante, B., Borruso, G.: Smart cities in a smart world. In: Rassia, S.T., Pardalos, P.M. (eds.) Future City Architecture for Optimal Living. SOIA, vol. 102, pp. 13–35. Springer, Cham (2015). https://doi.org/10.1007/978-3-319-15030-7_2
21. Garau, C., Pavan, V.M.: Evaluating urban quality: indicators and assessment tools for smart sustainable cities. Sustainability **10**, 575 (2018). https://doi.org/10.3390/su10030575
22. Scorza, F., Saganeiti, L., Pilogallo, A., Murgante, B.: Ghost planning: the inefficiency of energy sector policies in a low population density region. Archivio Di Studi Urbani e Regionali (ASUR) (2020)
23. Scorza, F., Murgante, B., Las Casas, G., Fortino, Y., Pilogallo, A.: Investigating territorial specialization in tourism sector by ecosystem services approach. In: Stratigea, A., Kavroudakis, D. (eds.) Mediterranean Cities and Island Communities. PI, pp. 161–179. Springer, Cham (2019). https://doi.org/10.1007/978-3-319-99444-4_7
24. Garau, C.: Smart paths for advanced management of cultural heritage. Reg. Stud. Reg. Sci. **1**, 286–293 (2014). https://doi.org/10.1080/21681376.2014.973439
25. Somarakis, G., Stratigea, A.: Public involvement in taking legislative action as to the spatial development of the tourist sector in Greece—the "OpenGov" platform experience. Future Internet **6**, 735–759 (2014). https://doi.org/10.3390/fi6040735