

Investigating the Relationship Between Land Use and Wealth in Italian Provinces

Giuseppe Borruso[1(✉)], Andrea Gallo[1,3(✉)], Francesco Magris[1(✉)], and Nicola Pontarollo[2(✉)]

[1] University of Trieste, Via A.Valerio 4/1, 34127 Trieste (TS), Italy
{giuseppe.borruso,francesco.magris}@deams.units.it, andrea.gallo3@phd.units.it
[2] University of Brescia, Via S.Faustino 74/B (BS), 25122 Brescia, Italy
nicola.pontarollo@unibs.it
[3] Ca' Foscari Venezia University, Dorsoduro, 3246, 30124 Venezia, Italy

Abstract. Land consumption is a significant problem in all economies, as it is having a significant impact on the quality of the environment. These effects include soil sealing, increased hydrogeological hazards, diminished pollution and greenhouse gas sequestration, and intensified competition over land for human activities. This problem is closely related to the phenomena of urban and non-urban sprawl. In this study we delve into the growing problem of land consumption, investigating its correlation with economic development. Our analysis focuses on the Italian context, using provinces as an intermediate administrative scale, and analyzes the evolution of land consumption over the past two decades in relation to economic development (GDP). We use spatial analysis techniques and local indicators of spatial association (LISA) to investigate both local effects and spatial clustering. Over the years examined, distinct spatial patterns of land use proximity emerge, showing areas with pronounced land use dominance in nearby locations. The implications of these findings may be notable for policy makers at the local, regional and national levels as they guide land development strategies.

Keywords: Land Use · LISA Methods · Spatial Analysis · Land Consumption

1 Introduction

The paper delves into the intricate relationship between economic growth and environmental sustainability. The focus is settled on the interplay between economic prosperity, urban development, and land use in Italy's different provinces. Challenged by concerns about the finite nature of our planet's resources and the need for sustainable development, the study aims to comprehensively explore the connection between Gross Domestic Product (GDP) per capita and land use.

The accelerating pace of urbanization, a consequence of economic progress, significantly influences land use patterns. The central question guiding the research is if economic progress within provinces results in responsible land use or contributes to environmental degradation. Inspired by the framework of the Environmental Kuznets

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O. Gervasi et al. (Eds.): ICCSA 2024 Workshops, LNCS 14817, pp. 401–412, 2024.
https://doi.org/10.1007/978-3-031-65238-7_27

Curve (EKC), which posits a non-linear relationship between economic growth and environmental quality, the study unfolds in two phases [1, 2].

The first phase of this article involves presenting more discursive contents in which the analysis of theoretical literature is presented, investigating the relationship between land use and GDP per capita dynamics on a national scale [3]. In the second phase, the study investigates this specific relationship through geospatial analysis tools such as the local indicator of spatial association (LISA) and different thematic maps. The aim is to determine, on a national scale, the evolution and the complex set of relationships that result from the relationship between these two indicators.

Utilizing methods of geospatial analysis, the research seeks to understand the interaction between economic wealth and land use practices. By analyzing data from the 107 Italian provinces, the study aims to identify patterns, thresholds, and potential saturation effects in the relationship between GDP per capita and land consumption. The analysis not only contributes to scholarly discourse but also holds implications for urban policy-making and sustainable development strategies.

The study aspires to shed light on pathways aligning economic progress with responsible land use, envisioning a future where prosperity and ecological sustainability coexist [4–6]. In conclusion, the text emphasizes the importance of the research's implications for shaping a sustainable and balanced trajectory for economic development and land use in the examined Italian provinces.

2 Land Use Dynamics and the Relationship Between Wealth and Land Consumption

This paper highlights various factors influencing the relationship between environmental degradation and income levels, with a focus on the income elasticity of environmental quality demand. This factor suggests that people prioritize environmental quality once their standard of living reaches a certain threshold, leading to a shift from quantity-based exploitation of natural resources to a focus on quality [7, 8].

The paper then narrows its focus to specific strands within the broader EKC literature, particularly exploring the relationship between income levels and urban development. It references research analyzing land use at a territorial level, by applying different methodologies of analysis, it's possible to find several works focused on spatial econometrics techniques to evaluate the relationship between land use and GDP per capita, in the context of the Environmental Kuznets Curve hypothesis. These studies use different proxies to define environmental degradation [9–11], but it is a rather widespread tendency to use land consumption as an indicator of environmental degradation. Several studies have investigated the implications of land use on environmental sustainability and local communities [12], highlighting how land use contributes to biodiversity loss, soil erosion, increased greenhouse gas emissions, impaired air and water quality, and increased susceptibility to extreme events such as floods and droughts [13]. In addition, numerous researchers have tried to understand and explain the drivers of land use change. Among these causes, we can indeed see that urban expansion, intensive agriculture, industrialization, and infrastructure development [14, 15] represent some of the main drivers of transformation.

In the context of the paper's goals, the authors plan to investigate the relationship between income levels and land use in 107 Italian provinces. The overall aim is to contribute valuable insights to the understanding the implications for sustainable development policies. The paper underscores the need to strike a delicate balance between economic prosperity and environmental preservation, emphasizing the complexity of this relationship and the importance of innovative solutions and collaborative efforts for achieving long-term sustainability.

3 Data and Methods

3.1 Setting the Context

We can highlight the nature related to the dynamics of land consumption and particularly in the context of environmental changes and human pressures. Scholars have extensively explored the adverse impacts of land consumption, linking it to biodiversity loss, soil erosion, greenhouse gas emissions, compromised air and water quality, and heightened vulnerability to extreme events [16, 17].

Root causes of land consumption, such as urban sprawl, intensive agriculture, industrialization, and infrastructure development, have been thoroughly examined [18–20]. Strategies like comprehensive land use planning, effective policies, and sustainable resource management are deemed essential for countering land consumption and ensuring environmental protection. Innovative approaches, including sustainable urban planning, efficient agricultural practices, eco-friendly technologies, and public awareness campaigns, are explored in the scientific literature [21, 22].

The concept of land use, encompassing various functions and socio-economic purposes, is emphasized for its pivotal role in ecological consequences, including agricultural land depletion, increased vulnerability to flooding, biodiversity loss, and contributions to climate change [21]. The text provides alarming data on land consumption in Italy, with the Fig. 1 aimed at introducing the national study area, that reveal an increasing trend and a loss of 2.2 square meters of land every second, as presented in Fig. 2 reported by Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA).

The connection between land consumption and population dynamics is discussed, highlighting an increase in artificial surfaces even with stable or decreasing resident populations. Data demonstrates a substantial rise in land consumed per capita, indicating rapid land transformation in Italy [23, 24]. The country faces a significant challenge with the swift expansion of artificial land cover, surpassing the EU average, leading to the loss of natural or semi-natural land, particularly due to urban sprawl in regions like Lombardy, Veneto, and Campania [25].

Specific provinces, including Brescia, Rome, and Naples, experience notable spikes in land use. Exceptions like Trieste, Gorizia, and Ancona successfully implement soil restoration efforts. Densely populated areas witness substantial increases in consumed land, contributing to the loss of green spaces and rising temperatures. Buildings occupy a significant portion of consumed land, with over 310 square kilometers occupied by unused and degraded structures [23]. The overall message underscores the urgency of addressing land consumption in Italy to ensure sustainable development and environmental preservation.



Fig. 1. Italian Framework for regional and provincial territorial aggregation

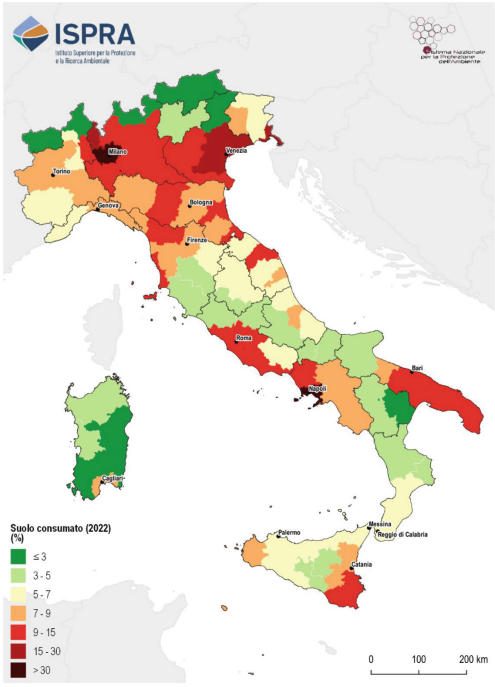


Fig. 2. Land Use consumption 2022 per provinces. Source: ISPRA – Istituto Superiore per la Protezione e la Ricerca

3.2 Methods

To understand the complex relationship between land consumption and wealth, the study considered the techniques of spatial autocorrelation, that can be considered as technique aimed at analyzing the spatial distribution of different elements while assessing the degree of influence and relationship with neighboring ones [26]. The Moran I (1948) index outlined by the following formula (1) is known as a global indicator of spatial autocorrelation and provides an indication of the presence of spatial autocorrelation.

$$I = \frac{N \sum_i \sum_j w_{ji}(x_i - \overline{x})(x_i - \overline{x})}{(\sum_i \sum_j w_{ji}) \sum_i (x_i - \overline{x})^2} \tag{1}$$

Instead, the specific location of high autocorrelation values is provided by the Local Indicators of Spatial Association (LISA) [27, 28]. One of the most widely used LISA indices is the one proposed by Anselin (1995) [30], which is regarded as a 'local' Moran indicator. We can also see, how the sum of all local Moran indices is equal to the Moran value.

Five cases can emerge, in which observations can be characterized by:

- High values of the phenomenon and high levels of similarity with the neighborhood (high-high), known as hot spots.
- Low values of the phenomenon and low levels of similarity with the neighborhood (low-low), known as cold spots.
- High values of the phenomenon and low levels of similarity with the neighborhood (high-low).
- Low values of the phenomenon and high levels of similarity with the neighborhood (low-high).
- Being completely devoid of significant autocorrelation.

The indicator is useful for assessing, for each spatial unit, the similarity between observations referring to a place in relation to adjacent elements [27]. The LISA indices provide an effective measure of the degree of relative spatial association between each spatial unit and its surrounding elements, allowing the type of spatial concentration to highlight spatial clusters related to a given phenomenon. This indicator has been widely used in the literature to capture the dynamics of spatial aggregation, and in particular, it has been applied to the analysis of urban sprawl on provincial and regional scales [28, 29].

3.3 Data Collection

The text focuses on understanding development dynamics in relation to the Kuznets environmental curve, analyzing land consumption across 107 Italian provinces from 2016 to 2021. The provinces are classified based on the NUTS 3 classification by Eurostat, with variations in provincial subdivisions in certain regions. The study highlights the diverse socio-cultural and economic aspects of the Italian territory, with Northern Italy characterized by industrial districts and higher per capita income compared to central and southern Italy. The geographical diversity of Italy is emphasized, with Northern Italy's

industrial focus and higher per capita income. The variables chosen for analysis provide insights into the relationship between land consumption, income, and urbanization. The study contributes to a nuanced understanding of development trajectories in different regions of Italy.

In particular, in this contribution, data on the percentage variation of land consumption per inhabitant for the 107 Italian provinces which can be found in the dataset provided by ISPRA, Istituto Superiore per la Protezione e la Ricerca Ambientale [30] and related to the logarithm of GDP per capita per province were taken into analysis, reported in euros at constant 2015 prices, with the GDP deflator taken from the World Bank, whose source is ISTAT [30], Istituto Nazionale di Statistica and the number of inhabitants per province was taken from Eurostat database.

These two different indicators were systematized through geo-spatial representation tools and in particular through the use of the Moran Index, in order to highlight the conjunctural trend of these two indicators in order to find whether there were common or inverse dynamics between land consumption and level of wealth.

4 Results and Discussion

To figure out the dynamics of development, we can observe that, post the 2008 economic crisis, the real estate sector witnessed a notable deceleration that has yet to fully recover. It peaked in 2006, experienced a decline until 2011, followed by a subsequent stagnation from 2011 to 2022 [32, 33]. Both private and public investments primarily targeted addressing housing needs, accompanied by a slowdown in the construction industry. This, along with a relatively steady population growth rate, created a situation where demand was saturated by existing built-up areas. These dynamics align strongly with expectations. Additionally, it is crucial to emphasize the trend of population concentration within specific urban centers. Particularly noteworthy is the ongoing urbanization shift towards the major urban centers in the Lombardy, Lazio, and Campania regions, significantly contributing to the expansion of Italian cities [34].

Hence, based on this analysis, we can infer a robust correlation between investment flows in the real estate sector and dynamics associated with land use. Consequently, the stagnant phase currently observed in Italy, characterized by limited economic growth, directly results in a restrained increase in land use. Conversely, an expansive period is linked to heightened construction activity for new residential, commercial, or industrial buildings, thereby escalating the demand for land in urban development and promoting the expansion of sealed soil.

To gain a deeper understanding of the evolving trend of land consumption at the provincial level, we employ the spatial distribution of land consumption and observe clustering phenomena, as depicted in Fig. 5. Moran's I the positive and statistically significant Moran's I suggests that areas with similar proportions of residential built-up land tend to be in close proximity. The increasing per capita land consumption share over the analyzed period indicates a growing trend of clustering, as illustrated in Fig. 4. Moreover, the rising Gini Coefficient, acting as a measure of spatial inequality in this context, aligns with Moran's I, affirming the inclination towards polarization. However, it is noteworthy that the obtained results align with the findings presented by Bimonte and Stabile (2017) [9], who utilized building permits as a proxy for land consumption.

The cluster analysis carried out through Moran's I regarding the level of GDP per capita, presented in Fig. 3 shows an extremely unequal distribution of income between the north and south of the national context. In particular, this methodology allows us to put in evidence how there is a clear territorial discontinuity regarding the distribution of wealth per capita. By highlighting results similar to those found in literature [35, 36], we can in fact observe how this index is able to photograph the different spatial distribution of income on a national scale, observing an extremely sensitive distinction between the north and south of the country, with an insignificant band represented by central Italy [37].

Income inequality on a national scale represents not only an economic problem, but also an important social problem [38]. Economic instability and low job prospects are an important driver for the internal mobility of young people who annually choose to migrate from southern or island areas of Italy to northern regions for work or study.

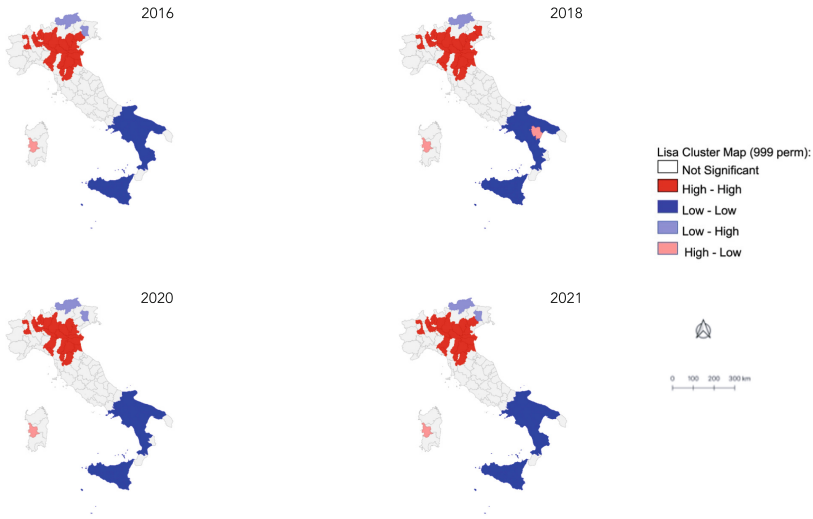


Fig. 3. Moran Index cluster map for the logarithm of the GDP per capita for years 2016, 2018, 2020, 2021

On the other hand, as far as the percentage change in per capita land consumption is concerned, we can see that there is a constant trend between 2016 and 2020, in which several provinces in southern Italy are involved, with particular reference to Puglia, Campania and Sicily, clearly observable in Figs. 4 and 5. We must also note how this dynamic tends to reverse in 2021, where we can see that there is an extremely significant cluster regarding an area covering the Italian regions of northern Emilia-Romagna, Veneto, and eastern Lombardy.

This significant increase in land consumption in 2021 may find reason to be related to the economic recovery that occurred following the global Covid-19 pandemic and the start of the nationwide economic recovery plan. The previous five-year period, on the other hand, was strongly characterized by a multitude of investments in infrastructure

spending by the Italian government, aimed at reducing the economic gap between the north and south of the country. With this in mind, we can note, how in particular the National Operational Plan (NOP 2014–2020) [39] has allocated substantial resources to try to improve the productive economic fabric of Southern Italy: this could be one of the causes to which we can attribute an extremely relevant soil increase for the previously mentioned areas.

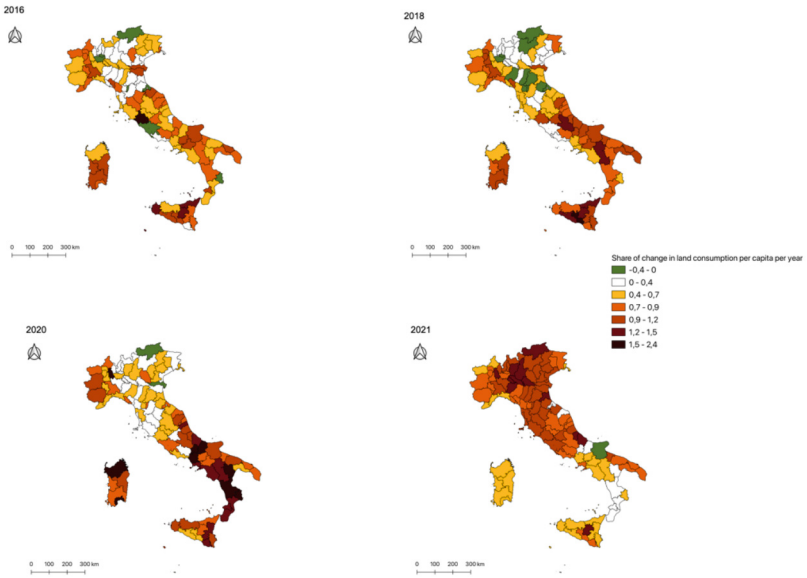


Fig. 4. Share of change in land consumption per capita year 2016, 2018, 2020, 2021 Source: Author's elaboration on data ISPRA

Bringing together the results of the spatial analysis regarding the distribution of GDP and land consumption, it becomes clear that there is an inverse relationship between these two indicators. This relationship is also highlighted in the graphs presented in Fig. 6.

The distribution of economic well-being is strongly polarized between the more prosperous northern Italy, due in part to the widespread presence of a better industrial and infrastructural fabric, while southern Italy is economically more underdeveloped. Conversely, with regard to the variation in land consumption, we can observe that it is precisely southern Italy that is subject to more relevant systemic pushes and significantly increases the amount of land consumed in the five-year period 2016–2021. This leads us to conclude that there might be an inverse relationship between land consumption and GDP per capita, where it must be pointed out, however, that in the face of an observable trend between 2016 and 2020, the year 2021 represents a turnaround from the previous data analyzed.

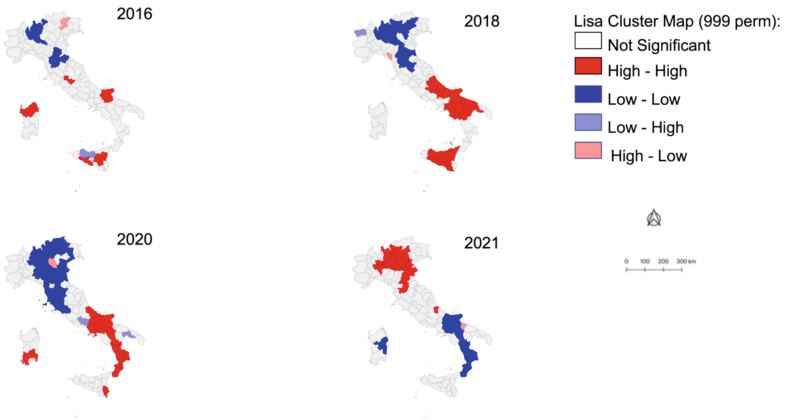


Fig. 5. Moran Index cluster map for the share of change of land use per capita year 2016, 2018, 2020, 2021

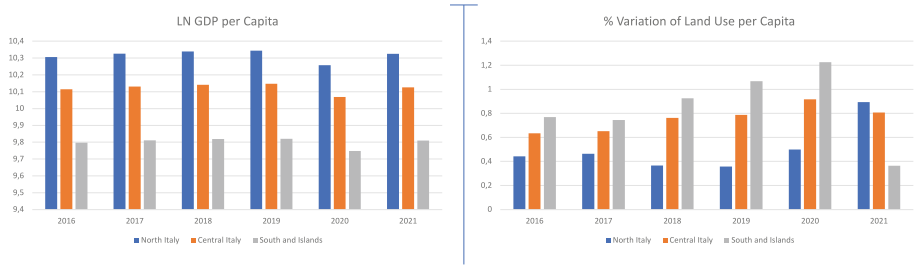


Fig. 6. Graphs of the trend of the log of the GDP per capita and the % change in Land Use per capita

5 Conclusions

This paper conducts an empirical analysis of the relationship between GDP per capita and land consumption in the Italian NUTS 3 provincial context, focusing on the unexplored area of provincial-level land use. The study identifies a clear convex relationship between land consumption and economic development, suggesting a clustering tendency towards major urban and suburban centers, reflecting metropolitan expansion and agglomeration around production districts. The choice to use land use as a proxy for environmental degradation stems from its environmental and social implications, contributing to biodiversity loss, greenhouse gas emissions, and societal dynamics related to urban agglomeration.

The spatial analysis catches the impact of land use change's interaction with neighboring provinces, emphasizing the regional and provincial dependence on socio-economic dynamics. From the spatial analysis we can see that there is a relationship between income per capita and land consumption, and in particular we can see that on a certain level of spatial distribution, beyond a certain income, environmental preservation gives way to land development, prioritizing private gains over societal costs. This finding

aligns with other studies on land degradation in Italy, pointing to economic, social, and political factors driving the construction and real estate sector at the expense of broader social interests.

In conclusion, the study challenges the assumption that achieving sustainable development is an automatic process, emphasizing the need to move beyond market-based economics toward political and social considerations. The results underscore the complex interplay of economic, social, and political factors influencing environmental outcomes.

Acknowledgments. Conceptualization, methodology, formal analysis, materials and resources, software and data curation: all authors. Validation: all authors. In particular: Magris and Pontarollo wrote Sect. 1, Gallo wrote Sect. 2, 3.1, 4; Borruso wrote Sect. 3.2; Borruso and Gallo wrote Sect. 3.3; all the authors wrote Sect. 5.

Disclosure of Interests.. The authors have no competing interests to declare that are relevant to the content of this article .

References

1. Ayres, R.U.: Resources, environment, and economics: Applications of the materials/energy balance principle. Wiley, United States (1978)
2. Kuznets, S.: Economic growth and income inequality. Am. Econ. Rev. **49**, 1–28 (1955)
3. Dinda, S.: Environmental Kuznets curve hypothesis: a survey. Ecol. Econ. **49**(4), 431–455 (2004)
4. Gill, A.R., Viswanathan, K.K., Hassan, S.: A test of environmental Kuznets curve (EKC) for carbon emission and potential of renewable energy to reduce green house gases (GHG) in Malaysia. Environ. Dev. Sustain. **20**, 1103–1114 (2018)
5. Grossman, G.M., Krueger, A.B.: Environmental impacts of a North American free trade agreement (1991)
6. Stern, D.I.: Progress on the environmental Kuznets curve? Environ. Dev. Econ. **3**(2), 173–196 (1998)
7. Barbier, E.B.: Introduction to the environmental Kuznets curve special issue. Environ. Dev. Econ. **2**(4), 369–381 (1997)
8. Mrabet, Z., Alsamara, M.: Testing the Kuznets Curve hypothesis for Qatar: a comparison between carbon dioxide and ecological footprint. Renew. Sustain. Energy Rev. **70**, 1366–1375 (2017)
9. Bimonte, S., Stabile, A.: Land consumption and income in Italy: a case of inverted EKC. Ecol. Econ. **131**, 36–43 (2017)
10. Bimonte, S., Stabile, A.: The effect of growth and corruption on soil sealing in Italy: a regional environmental Kuznets Curve analysis. Environ. Resource Econ. **74**, 1497–1518 (2019)
11. Pontarollo, N., Serpieri, C.: Testing the environmental Kuznets Curve hypothesis on land use: the case of Romania. Land Use Policy **97**, 104695 (2020)
12. Marsh, W.M., Grossa, J., Jr.: Environmental geography: science, land use, and earth systems. John Wiley and Sons, New York (1996)
13. Turner, W.R.: Citywide biological monitoring as a tool for ecology and conservation in urban landscapes: the case of the Tucson Bird Count. Landsc. Urban Plan. **65**(3), 149–166 (2003)
14. Walker, B., Salt, D.: Resilience thinking: sustaining ecosystems and people in a changing world. Island press, Washington (2012)

15. Meerow, S., Newell, J.P., Stults, M.: Defining urban resilience: A review. Landscape Urban Planning **147**, 38–49 (2016). https://doi.org/10.1016/j.landurbplan.2015.11.011
16. Janssen, M. A.: An update on the scholarly networks on resilience, vulnerability, and adaptation within the human dimensions of global environmental change. Ecol. Soc. **12**(2) (2007)
17. Maddison, D.: Environmental Kuznets curves: a spatial econometric approach. J. Environ. Econ. Manag. **51**(2), 218–230 (2006)
18. Amato, F., Maimone, B.A., Martellozzo, F., Nolè, G., Murgante, B.: The effects of urban policies on the development of urban areas. Sustainability **8**(4), 297 (2016)
19. Bencardino, M.: Land take and urban sprawl: drivers e contrasting policies. Boll. della Società Geografica Italiana **8**(2), 217–237 (2015)
20. Bencardino, M.: An estimate of land take in municipal planning of the Campania Region. In: Gervasi, O., et al. (eds.) ICCSA 2017. LNCS, vol. 10408, pp. 73–88. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-62404-4_6
21. Turner, N.J., Davidson-Hunt, I.J., O'flaherty, M.: Living on the edge: ecological and cultural edges as sources of diversity for social—ecological resilience. Hum. Ecol. **31**, 439–461 (2003)
22. Hassan, Z., et al.: Dynamics of land use and land cover change (LULCC) using geospatial techniques: a case study of Islamabad Pakistan. Springerplus **5**, 1–11 (2016)
23. Sistema Nazionale per la Protezione dell'Ambiente (SNPA), Consumo di suolo e servizi ecosistemici. Edizione 2022. Report tecnico SNPA (2022)
24. Gallo, A., De Simone, C.S.: Agrovoltaic as an answer to the difficult relationship between land use and photovoltaics. a case study from Apulia Region. In: Gervasi O., Murgante B., Misra S., Rocha. A.M.A.C. Garau C. (eds), Computational Science and Its Applications – ICCSA Workshops 2023, LNCS vol. 14110, pp. 547–559, Springer-Verlag, Berlin (2023). https://doi.org/10.1007/978-3-031-37114-1_38
25. Iodice, S., Garbarino, E., Cerreta, M., Tonini, D.: Sustainability assessment of construction and demolition waste management applied to an Italian case. Waste Manage. **128**, 83–98 (2021)
26. Balletto, G., Sinatra, M., Milesi, A., Ghiani, E., Borruso, G.: A conceptual framework to correlate the electric transition and well-being and equity. The Italy case. In: Gervasi O., Murgante B., Misra S. Garau C. (eds), Computational Science and Its Applications – ICCSA Workshops 2023, LNCS vol. 14112, pp. 66–80, Springer-Verlag, Berlin (2023). https://doi.org/10.1007/978-3-031-37120-2_5
27. Murgante, B., Borruso, G.: Analyzing migration phenomena with spatial autocorrelation techniques. In: Murgante, B., Gervasi, O., Misra, S., Nedjah, N., Rocha, A.M.A.C., Taniar, D., Apduhan, B.O. (eds.) ICCSA 2012. LNCS, vol. 7334, pp. 670–685. Springer, Heidelberg (2012). https://doi.org/10.1007/978-3-642-31075-1_50
28. Balletto, G., Mundula, L., Milesi, A., Ladu, M.: Cohesion policies in Italian metropolitan cities. Evaluation and challenges. In: Gervasi, O., Murgante, B., Misra, S., Garau, C., Blečić, I., Taniar, D., Apduhan, B.O., Rocha, A.M.A.C., Tarantino, E., Torre, C.M., Karaca, Y. (eds.) ICCSA 2020. LNCS, vol. 12255, pp. 441–455. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58820-5_33
29. Balletto, G., Sinatra, M., Sinatra, F., Borruso, G.: Industrial Symbiosis and Circular Urban Practices. In: Marucci A., Zullo F., Fiorini L., Saganeiti L. (eds), Lecture Notes in Civil Engineering, Proceeding of International Conference on Innovation in Urban and Regional Planning (INPUT), Volume 2, pp. 14–24, Cham: Springer Nature Switzerland (2023). https://doi.org/10.1007/978-3-031-54096-7_2
30. https://www.isprambiente.gov.it/it/attivita/suolo-e-territorio/suolo/il-consumo-di-suolo/i-dati-sul-consumo-di-suolo .Access 13 Jan (2023)
31. Anselin, L.: Local indicators of spatial association—LISA. Geogr. Anal. **27**(2), 93–115 (1995)

32. Belotti, E.: The invisible hand of the shareholding state: the financialization of Italian real-estate investment funds for social housing. Hous. Stud. **38**(7), 1260–1283 (2023)
33. Storm, S.: Lost in deflation: Why Italy's woes are a warning to the whole Eurozone. Int. J. Polit. Econ. **48**(3), 195–237 (2019)
34. Gavinelli, D., Molinari, P.: Il Piemonte nordorientale: area "cerniera" o piattaforma territoriale nel sistema urbano europeo? Rivista Geografica Italiana **122**(4), 489–502 (2015)
35. Impicciatore, R., Tosi, F.: Student mobility in Italy: the increasing role of family background during the expansion of higher education supply. Res. Soc. Stratification Mobility **62**, 100409 (2019)
36. Cannari, L., Gambacorta, R., D'Alessio, G.: Capital gains and wealth distribution in Italy. SSRN Electron. J. (2008). https://doi.org/10.2139/ssrn.1182603
37. Salvati, L., Zitti, M., Carlucci, M.: Territorial systems, regional disparities and sustainability: Economic structure and soil degradation in Italy. Sustainability **6**(5), 3086–3104 (2014)
38. Enea, M.: From South to North? Mobility of Southern Italian students at the transition from the first to the second level university degree. In: Studies in Theoretical and Applied Statistics: SIS 2016, pp. 239–249. Springer International Publishing, Salerno, Italy (2018). https://doi.org/10.1007/978-3-319-73906-9_22
39. https://ponir.mit.gov.it/#:~:text=Il%20PON%20Infrastrutture%20e%20Reti,l%27ambiente%20e%20il%20territorio. Access 29 Jan 2024