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Regional analysis of the sustainable development of two Mediterranean countries: Spain and Italy

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Abstract

The 17 Sustainable Development Goals (SDGs) require the implementation of 167 targets aimed at eradicating poverty, protecting the planet and improving the quality of life of humankind. The United Nations calls for uniform sustainable development at the global, local and individual levels. This research pursues a twofold objective: first, to obtain evidence on the extent to which the achievement of the (SDGs) may be uniform across territories; second, to identify the socioeconomic characteristics that contribute to sustainable development. The empirical analysis has been carried out using clustering, cross efficiency and contingency tables applied to statistical information from 101 municipalities in Spain and Italy. The results provide evidence of inequalities between territories, revealing that only in the dimensions *People* (SDGs 1, 2, 3, 4, and 5) and *Prosperity* (SDGs 7, 8, 9, 10, and 11) has the desired homogeneity been attained. Notable differences are found in the degree of compliance with the other SDGs. Furthermore, it is shown that the socioeconomic characteristics associated with the geographical location contribute substantially to the gap between municipalities. In order to ensure countries' sustainable development, there is a need for environmental policies adapted to the specific features of each region.

KEYWORDS
cluster analysis, contingency tables, cross-efficiency, environmental policy, municipal compliance, sustainable development

1 | INTRODUCTION

The Sustainable Development Goals (SDGs) were adopted by the member states of the United Nations (UN) in 2015, as part of the 2030 Agenda to ensure the Sustainable Development (SD) of the planet (UN, 2015). Grounded in more than 20 years of work, they are all aimed at making humankind aware of the importance of establishing common guidelines relating to three fundamental purposes:

eradicating poverty, protecting the planet and improving people's lives. This work allowed 17 SDGs to be defined, and in order to achieve them, 169 targets must be met before 2030 (Pizzi et al., 2020). In short, a universal roadmap has been drawn up, aimed at ensuring a more equitable world where no one is left behind.

However, since it is a long-term process, any socioeconomic shock can throw the planned trajectory off course. For example, the health catastrophe caused by COVID-19 has detracted from the accomplishments of the first 5 years (Sharma et al., 2021). The shock that hit the labour market has translated into a rise in poverty and a disregard for environmental issues (Shulla et al., 2021).

Consequently, compliance with the Paris Agreement aimed at limiting global warming experienced a major setback in 2021. The global mean temperature was $\sim$1.11°C above pre-industrial levels, a long way off the target established. Likewise, armed conflicts such as the Russian–Ukrainian war have negative impacts, the extent of which remains unclear. They hinder the full cooperation of developed countries, weakening the constitutional infrastructure needed to support SD and exacerbating environmental disasters (Pereira et al., 2022; Petersmann, 2022).

Time is running out and there is still so much to be done. The UN is urging society to mobilise at all levels to get back on the path towards SD. Specifically, there is a need for action on three levels: *global*, in search of universal leadership with no shortage of the resources needed to achieve the SDGs; *local*, where the corresponding administrations have to facilitate the adoption of the necessary regulatory frameworks; and *individual*, to build a united army focused on fighting inequality and climate change. With this triple purpose, the United Nations Development Programme (UNDP) has defined the new Strategic Plan 2022–2025 (UNDP, 2022). The plan puts greater emphasis on the role of innovation and the development of actions aimed at achieving the goals established, thus seeking to ensure that no territory is left behind.

The rules established for compliance with the SDGs must address spatial and temporal equity in order to bridge any possible gaps that may have arisen in their realisation at the regional level (Ibourk & Raoui, 2021). In addition to a national-level assessment, territories require quantitative techniques at other levels to facilitate a more detailed evaluation of the progress made in achieving the SDGs. Huan et al. (2021) propose a composite index to assess the sustainability achievements of countries from Central and Eastern Europe. According to Managi et al. (2021) the capacity for innovation and development of different localities around the world constitutes a tool that can set them apart in terms of SD. In this regard, Walsh et al. (2020) find evidence of the need to target public policies at investments in innovation that foster the achievement of the goals set in each period.

Regardless of the spatial level of the actions undertaken, they can all be framed within one of the five dimensions of the 2030 Agenda, also known as the 5Ps: *People, Planet, Prosperity, Peace* and *Partnership* (Hepp et al., 2019). The literature includes numerous studies that propose various different classifications of the SDGs encompassed under the 5Ps (Tremblay et al., 2020). These classifications facilitate the analysis of the progress made in different territories (Azerbaijan, 2017; Poland, 2018; Slovenia, 2017). The proposal in this research is to conduct a municipal-level study of the degree of compliance with the SDGs in Spain and Italy for 2020, with reference to the configuration of the 5Ps proposed by a wide-ranging scientific community (Leal Filho et al., 2018; Lo-Iacono-Ferreira et al., 2022; OECD, 2017). We might a priori expect to see broad similarities between these two countries due to their geographical location and level of socioeconomic development. The aim of the study centres on identifying whether there is homogeneity in the achievement of the goals set or, conversely, the prevailing situation is one where some areas lag behind and thus require special treatment. The results will

provide policymakers with relevant information on aspects and municipalities that will need more attention in the coming years. Specifically, we seek to answer two research questions:

> **Q1.** *Is there territorial uniformity in the development of the 5Ps in Spain and Italy?*

By means of a cluster analysis applied to the main municipalities of both countries, we can detect whether the 5Ps are differentiating factors between the analysed territories.

> **Q2.** *What are the aspects that contribute to SD in these two Mediterranean countries?*

A variant of data envelopment analysis (DEA), cross-efficiency (CE), is used to construct a ranking reflecting the degree of overall compliance with the SDGs at the municipal level. Contingency tables are then used to assess the possible link between various characteristics of the municipality and its position in the ranking.

The 2030 Agenda seeks to ensure that everyone benefits by committing to the holistic development of the planet. This requires uniform progress to be made at all levels (individual, local and global); hence, there is a need for tools that can be used to measure the achievements made while accounting for the specific characteristics of the regions analysed. This paper is a novel contribution to the literature in that it offers an instrument to identify a municipal-level profile of the population groups that, for some reason, are lagging behind in terms of compliance with the SDGs. Moreover, the comparative analysis between Spain and Italy will allow us to detect any significant differences there may be between these two countries, which both belong to the European Union (EU) and are governed by the same EU regulations on sustainability. The results will provide policymakers with quantitative information on which to base the most appropriate, customised measures for each territory, correcting any issues that may be causing divergences.

The rest of the paper is structured as follows. Section 2 reviews the literature on compliance with the SDGs and issues that affect it. Section 3 presents the methods and variables used. The results of the research are analysed in Section 4. Lastly, the conclusions, the contribution of the study and the limitations are set out in Section 5.

2 | LITERATURE REVIEW

Structuring the SDGs as a series of concrete goals requires an overarching vision of the issues to be addressed, in order to establish joint actions that foster universal SD (Haas et al., 2021). These days the term sustainability is used in any societal or economic sphere where the ultimate aim is to make the world better. In this respect, there is a broad literature in which calls for 'sustainable globalization' cover ecological (McCracken & Meyer, 2018), economic (Okafor-Yarwood, 2019; Schroeder et al., 2018) and social (Gill & Germann, 2022; Xie et al., 2021) cooperation and the need for humankind to stand united in this struggle.

The pandemic has had a major impact on the path towards achieving this much sought-after SD. According to the annual report from the UN (2021), the effects have been felt both in terms of human lives and people's livelihoods. In 2020, more than 120 million people fell into poverty, 225 million full-time jobs were lost, and about 132 million more people were affected by chronic hunger. That said, not all countries have had the same experience. In the last 5 years, the EU has made remarkable progress towards almost all of the goals. This task has been facilitated by the ambitious strategy defined around the European Green Deal, digitalization and the Social Rights Action Plan. Furthermore, all this has been accompanied by significant financial resources to help member states overcome the consequences of the pandemic and ensure there are no delays in the achievement of the SDGs (Eurostat, 2022). The differences between countries are becoming ever more noticeable. The results reported by Elavarasan et al. (2022) confirm that SDG1 (Ending poverty) and SDG8 (Decent work and economic growth) have been the hardest hit: a prompt humanitarian response by developed countries is needed to curb poverty.

At a global level, the UN calls on humankind not to forget the lessons learned, claiming that this learning will help ensure we are up to the task of achieving the challenges of the future. In less than a decade, the 17 SDGs and the Paris Climate Agreement must be met. The levels of interdependence between the two make it difficult to bring about changes in specific indicators (Laumann et al., 2022). We are therefore facing a period of intense action and transformation, where global commitment will be the key to success.

The scientific community has shown great interest in analysing the possible contradictions between the need for ongoing socioeconomic development and for environmental protection, all the more so in developing countries (Coscieme et al., 2020; Hickel, 2019). In this regard, Madni et al. (2021), using a sample of 116 developing economies, demonstrate that GDP growth, the financial sector, and energy consumption produce a rise in carbon dioxide emissions. Conversely, social interconnection, quality institutions, and inclusive financial development foster environmental cleanliness. According to Shahbaz et al. (2021), the growth model in India negatively affects climate quality due to its heavy dependence on fossil fuels. Adewuyi and Awodumi (2021) go as far as to argue that sustainable growth is not feasible in South Africa and Nigeria, even in a hypothetical scenario in which a structural change was successfully brought about. However, as shown by Ouyang et al. (2019), wealth plays a hugely relevant role in the arduous task of mitigating PM2.5 concentrations. In short, the specific characteristics of different territories create barriers to achieving unified progress; as such, SDG17 (Partnerships for the goals) plays a critical part in this process. Universal SD is only achievable through global partnerships and global cooperation among all countries.

Given the importance of guaranteeing SD as a way to solve the grave problems facing humanity, there is a need for assessments of the degree of compliance with the targets set and how they are implemented (Allen et al., 2021). The analysis conducted by Spangenberg (2017) provides evidence of the need to reformulate some aspects of the SDGs, with the authors arguing that the obligations for governments are limited, and almost non-existent for companies and consumers. It is thus necessary to improve the means of implementation. Allen et al. (2018) recommend periodic systematic reviews as a way to ensure the measures adopted are appropriate for the purposes pursued. All this has sparked the interest of a critical mass of researchers conducting studies aimed at evaluating progress made, shortcomings and opportunities for achieving the SDGs (Benedek et al., 2021; Olabi et al., 2022; Phillips, 2021; Sarkodie, 2022; Streimikis & Baležentis, 2020). Nevertheless, it should be borne in mind that in all those studies the results obtained are hugely sensitive to the choice of indicators and evaluation methods.

Meeting the 169 targets defined for the 17 SDGs requires harnessing the synergies between them to resolve possible conflicts and reinforce positive interactions (Boar et al., 2022; Zhao et al., 2021). This has led to the grouping of the SDGs around five central axes (5Ps), facilitating the allocation of resources and thereby optimising the results achieved. It can be seen that the assessment of the SDGs has aroused the interest of the scientific community, as reflected in recent studies (Table 1).

The vast majority of the analyses reveal connections between the SDGs, which should be exploited to help accelerate progress towards SD and thus guarantee the success of the measures adopted (Nerland et al., 2022; Xu et al., 2021; Zhang et al., 2022; Zhu et al., 2022). To that end, and based on an analysis at the municipal level, the proposed research provides evidence on issues that play a decisive role in attaining unified sustainability at the national level.

3 | MATERIALS AND METHODS

3.1 | Materials

The treatment of the SDGs is based on the idea of harnessing the synergies in the five central axes, the 5Ps (Figure 1): *People*, putting an end to poverty, ensuring the dignity and equality of the population; *Peace*, promoting peace and justice, where all human beings have the same rights; *Partnership*, securing strong global partnerships to help the underprivileged; *Planet*, protecting natural resources and combating climate change; and *Prosperity*, assuring all humankind a prosperous life in harmony with nature. The aggregation of the SDGs around these pillars allows for a more effective assessment of the current situation. The 5Ps have been used only to perform the cluster analysis and check for uniformity in the analysed territories. However, the ranking has been produced based on the levels registered in each of the 17 SDGs.

The research carried out is based on the reports published in 2020 by the Red Española para el Desarrollo Sostenible (Spanish Network for Sustainable Development) and the Fondazione Eni Enrico Mattei (FEEM, 2020; REDS, 2020) on the degree of compliance with the SDGs by 103 municipalities (provincial capitals) in Spain and Italy, respectively. The statistics in these reports enable the homogeneous treatment of all regions in the same country, offering a general overview of the path taken to ensure national sustainability. In both reports, the assessment of the SDGs has been carried out in line with the methodology developed by the Sustainable Development

TABLE 1 Literature review on SDG evaluation

Author	Sample	Objective	Methodology	Results
Allen et al. (2019)	Twenty-two countries in the Arab world	Assess and prioritise SDG targets based on their level of urgency, systemic impact, and policy gap	Multi-criteria analysis	The integration of systems thinking and analysis with more traditional approaches is a key component of the assessment.
Ghosh and Rajan (2019)	Twenty organizations from emerging economies	Analysis of inclusive business models as market-based solutions to contribute to the achievement of the SDGs.	Analysis of case studies	Provides a better understanding of inclusive business models. Evidences the importance of certain SDGs in different business sectors.
Tremblay et al. (2020)	Thirty surveys	Present a classification of the SDGs and their targets based on the 5Ps	Quantification system	The more similar the targets in terms of the classification, the more positive the interactions
González del Campo et al. (2020)	Published academic literature	Review current engagement of strategic environmental assessment with the SDGs both in the academic literature and in practice.	Systematic review	Shift towards the adoption of a new plan-making paradigm, particularly supported by governments' increasingly proactive embrace of SDGs
Stefanescu (2021)	Official documents	Understand the conceptual matches between the 5Ps and the Integrated Reporting (IR) and Global Reporting Initiative (GRI) frameworks	Qualitative approach	IR and GRI frameworks provide the prerequisites to ensure the achievement of SDGs, due to the sustainability issues they cover.
Carlsen and Bruggemann (2022)	One hundred and two countries	Analysis of the status and development of the SDGs	Partial ordering methodology	On the basis of the 5Ps, it determines the impact of the SDGs on countries grouped according to their economic and regional affiliation.
Verdejo et al. (2022)	Living labs of the University of Jaén	The analysis and implementation of the SDGs in Smart Labs	Literature review and a case study	The evaluation of SDGs in Smart Labs serves to provide comfort, health, and sustainability in society.
Kostetckaia and Hametner (2022)	Official EU SDG indicator set	Analysis of synergies and trade-offs between the SDGs in the EU member states.	Regression analysis	There is negative relationship between countries' progress and the shares of trade-offs among SDG indicators, and a moderate positive relationship between progress and synergies
Bandari et al. (2022)	Interviews with local stakeholders and contextual analysis	Capture tacit knowledge to derive interactions among priority SDGs and their targets	Case study	A successful implementation of SDGs depends on an understanding of SDG interactions.
Hatayama (2022)	Reports of 61 metal companies	Examine the relationship between the metal industry and the SDGs	Quantitative evaluation	The metal industry places the most emphasis on SDGs 8, 3 and 12, and is less closely associated with SDGs 14, 2, and 1
Reverte (2022)	Sixty-four countries worldwide	Analyse whether the differences in the level of achievement of SDGs can be explained by 19 institutional variables.	Quintuple helix model	Public policies have a crucial role in achieving SDGs: they improve institutional quality, governance systems and economic freedom

TABLE 1 (Continued)

Author	Sample	Objective	Methodology	Results
Huan et al. (2022)	Six countries in Southeast Asia	Construct a new composite assessment framework to prioritise SDG targets	Multi-perspective composite assessment framework	Target 6.5 has the highest priority, followed by targets 6.4 and 6.6, while the lowest ranking target is 6.1

Abbreviation: SDG, Sustainable Development Goal.

FIGURE 1 Aggregation of the Sustainable Development Goals (SDGs) under the 5Ps [Colour figure can be viewed at wileyonlinelibrary.com]
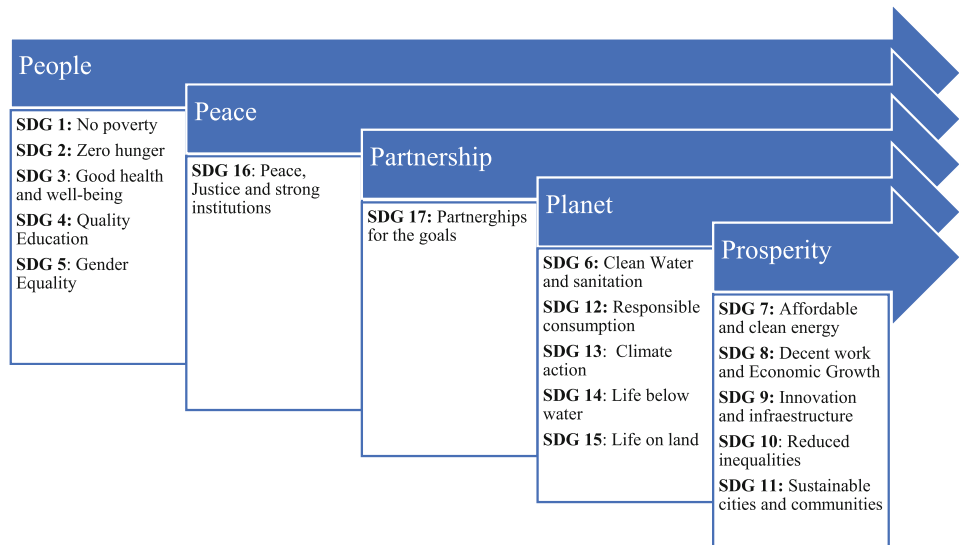

People
SDG 1: No poverty
SDG 2: Zero hunger
SDG 3: Good health and well-being
SDG 4: Quality Education
SDG 5: Gender Equality

Peace
SDG 16: Peace, Justice and strong institutions

Partnership
SDG 17: Partnerghips for the goals

Planet
SDG 6: Clean Water and sanitation
SDG 12: Responsible consumption
SDG 13: Climate action
SDG 14: Life below water
SDG 15: Life on land

Prosperity
SDG 7: Affordable and clean energy
SDG 8: Decent work and Economic Growth
SDG 9: Innovation and infraestructure
SDG 10: Reduced inequalities
SDG 11: Sustainable cities and communities

TABLE 2 Descriptive statistics of the variables (2020)

	People	Peace	Partnership	Planet	Prosperity
Spanish cities					
Mean	44.15	57.39	43.26	47.73	49.24
Max	55.27	82.09	94.42	64.77	60.57
Min	26.25	7.83	5.33	28.64	36.48
SD	5.11	12.35	19.99	8.16	5.70
Number	101	101	101	101	101
Italian cities					
Mean	54.27	54.20	66.46	59.08	44.63
Max	73.96	90.80	95.80	84.88	62.48
Min	19.06	5.60	23.50	34.68	24.36
SD	13.51	17.61	17.93	10.02	8.54
Number	101	101	101	101	101

targets set under a certain SDG. Table 2 shows the main descriptive statistics of the SDGs, aggregated under the 5Ps.

The overall assessment reveals that both countries are part way to meeting the goals, with *Peace* (SDG 16) and *Partnership* (SDG 17) showing the best performance in Spain and Italy, respectively. There is also high dispersion in these dimensions. For example, in Spain, the values of 82.09 (*Peace*) and 94.42 (*Partnership*) reached in Pozuelo de Alarcon and Pamplona, respectively, stand in contrast to those registered by other municipalities such as Ceuta and Teruel, which register just 7.83 in *Peace* and 5.33 in *Partnership*. Something similar happens in Italy, where Messina scores only 5.6 in *Peace* compared to the score of 90.8 by Arezzo. Therefore, even with the European commitment to making unified progress towards the sustainability of all nations, there are still territories that need a direct boost, which should take the form of measures aimed at promoting good practices.

Solutions Network. However, the indicators used are conditional on data availability and the subject matter addressed. Hence, different items have been included when creating the Spanish and Italian indices, preventing a direct comparison between the absolute values achieved by the territories of these two countries. Furthermore, the territories that lacked the necessary information for the analysis have been eliminated, leaving 101 Spanish and Italian cities. Both reports rate the SDGs on a scale of 0–100 according to the degree of compliance with the goal, where 100 indicates full compliance with the

3.2 | Methods

To achieve the research objective, different methods are applied in various stages (Figure 2), which together enable the analysis of the Spanish and Italian territories.

The first research question is answered by applying cluster analysis to identify patterns of performance in the analysed cities based on the available information on the degree of compliance with the SDGs, all aggregated under the 5Ps. This method has been widely used in various
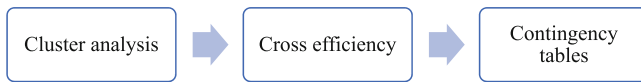
FIGURE 2 Research design [Colour figure can be viewed at wileyonlinelibrary.com]

fields of the literature such as medicine (Lin et al., 2021), transportation (Corrêa de Carvalho & Dumke de Medeiros, 2021; Medina-Molina & Rey-Tienda, 2022), education (Duta et al., 2021) and even in the context of the SDGs (Çağlar & Gürler, 2022; Linnerud et al., 2021; Pizzi et al., 2021). This paper uses a hierarchical cluster analysis, based on Ward's method and squared Euclidean distance. In addition, the number of clusters has been identified from a dendrogram, and subsequently tested using the non-parametric Kruskal–Wallis test.

The second research question is answered by using CE, a variant of DEA, where the ultimate aim is not to determine the efficiency of the decision-making units (DMUs) but to produce a ranking of them. This method has proved popular for the construction of synthetic indices, where the ordering of DMUs makes it possible to identify the best performing ones (García-Mollá et al., 2021; Marti & Puertas, 2020; Puertas et al., 2022).

CE was originally proposed by Sexton et al. (1986) and later popularised by Doyle and Green (1994). It is grounded in traditional DEA (Banker et al., 1984; Charnes et al., 1978), and combines self- and peer-evaluation mechanisms (Anderson et al., 2002). It is carried out in two stages: in the first, each DMU is given a self-evaluated efficiency score derived from its own set of optimal weights, while the second stage involves a comparison of peer-evaluated efficiencies determined according to the optimal weights of other DMUs (Liu et al., 2019). The result is the construction of a CE matrix where the relative efficiency of one unit is rated according to the optimal weights of the others. The elements of said matrix are calculated from the following expression:

$$E_{kj} = \frac{\sum_{r=1}^{s} u_{rk} y_{rj}}{\sum_{i=1}^{m} v_{ik} x_{ij}} \quad j = 1, \dots, n; k = 1, \dots, n \tag{1}$$

where x_{ij} represents the quantities of input i consumed by the jth unit, y_{rj} the observed quantities of output r produced by the jth unit, u_{rk} the weights of the inputs for DMU_k, v_{ik} the weights of the outputs for DMU_k and E_{kj} the performance of DMU_j using the weights obtained for DMU_k.

All the elements E_{kj} take values between 0 and 1, with those on the diagonal corresponding to the standard DEA. Finally, the CE score of each DMU is calculated as the mean of the corresponding E_{kj}. The application of this method requires the definition of input and output variables. Given the nature of the bases used, where the SDG performance rating is scored from low to high, with 100 representing maximum compliance, the inputs have to be converted into factors to be improved. To do so, a monotonic decreasing transformation is applied; that is, 100 minus the original values (Martí et al., 2017).

TABLE 3 Two-dimensional contingency table

		Variable Y				
		1	**2**	**j**	**R**	**Total**
Variable X	1	n_{11}	n_{12}	n_{1j}	n_{1R}	n_{1+}
	2	n_{21}	n_{22}	n_{2j}	n_{2R}	n_{2+}
	i	n_{i1}	n_{i2}	n_{ij}	n_{iR}	n_{i+}
	R	n_{R1}	n_{R2}	n_{Rj}	n_{RR}	n_{R+}
	Total	n_{+1}	n_{+2}	n_{+j}	n_{+R}	n

Lastly, based on the ranking obtained, contingency tables are used to analyse the possible connection between the ranking of the territories and certain socioeconomic characteristics that could, a priori, be expected to play a key role in the position held. Since they have proved very useful for examining the associations between factors, contingency tables have recently attracted interest in a wide variety of areas including the circular economy (Virlanuta et al., 2020; Marti & Puertas, 2021), the energy sector (Marti & Puertas, 2022), food safety (Marti et al., 2021), climate change (Puertas & Marti, 2021), and even education (Aleixo & Azeiteiro, 2019).

It is a statistical tool that captures and displays the relationship between two categorical variables. The objective is to analyse the degree of association through the combination of the characteristics of each category defined in the row and column of the table (Álvarez de Toledo et al., 2018). The analysis proposed in this paper is carried out by constructing square contingency tables, since it is a bidirectional analysis with a one-to-one correspondence between the categories of the variables (Table 3).

Where X and Y present R categories that intersect in a table of dimension $R \times R$, n_{ij} is the frequency observed in a random sample of a given population for the cell (i, j), with $i, j = 1 \dots, R$, and n being the total sample size.

Below, the hypotheses are tested to analyse the possible independence between the variables under analysis, with the null hypothesis being that there is no association between them. The resulting Chi-square statistic is given by the following expression:

$$\chi^2 = \frac{\sum_{i=1}^{h} \sum_{j=1}^{k} (n_{ij} - E_{ij})^2}{E_{ij}} \tag{2}$$

where, n_{ij} are the observed frequencies and E_{ij} the expected frequencies.

The null hypothesis is rejected if the level of significance of the statistic is less than .05, thus indicating the association between variables can be accepted. However, this test cannot show the direction of the association, which may be positive or negative. The solution to this limitation is to calculate either the Contingency Coefficient, when at least one of the variables is nominal, or the Gamma coefficient, if both variables are ordinal.

TABLE 4 Distribution of the quartiles applied to the ordinal variables

	Position in ranking	Population density (hab/km^2)	Wealth (euros per capita)
Spanish cities			
Q1	1–25	55–518	16,100–21,650
Q2	26–50	555–1518	21,700–22,950
Q3	51–75	1548–3824	23,000–24,435
Q4	76–101	3940–20,754	24,440–60,300
Italian cities			
Q1	1–25	77–394	16,900–20,600
Q2	26–50	454–801	20,650–22,450
Q3	51–75	807–1510	22,470–24,850
Q4	76–101	1521–8151	24,900–33,200

TABLE 5 Results of the cluster analysis

	People	Peace	Partnership	Planet	Prosperity
Spanish cities					
Cluster 1	**44.79**	**63.09**	31.11	44.94	**51.04**
Cluster 2	**44.44**	**62.37**	**68.09**	**51.04**	**49.57**
Cluster 3	42.72	41.85	32.81	**48.27**	45.86
Mean total	44.15	57.39	43.26	47.73	49.24
K–W	Chi-sq: 2.563 *p* value: .277	Chi-sq: 50.786 *p* value: .000	Chi-sq: 64.712 *p* value: .000	Chi-sq: 10.176 *p* value: .006	Chi-sq: 14.140 *p* value: .000
Italian cities					
Cluster 1	**61.8**	**68.2**	**81.9**	**66.6**	**46.2**
Cluster 2	**59.1**	**59.6**	54.6	55.8	**45.6**
Cluster 3	39.1	31.5	**68.5**	56.4	41.5
Mean total	54.3	54.2	66.5	59.1	44.6
K–W	Chi-sq: 41.778 *p* value: .000	Chi-sq: 67.405 *p* value: .000	Chi-sq: 44.914 *p* value: .000	Chi-sq: 24.938 *p* value: .000	Chi-sq: 4.186 *p* value: .123

The values in bold reflect the clusters that have obtained values above the total mean in the dimensions analyzed.

In this study, the ranking produced using CE has been divided into four groups, thus classifying the cities in quartiles. This variable has been related to three other socioeconomic variables: population density, wealth and geographical area. Since the first two of these are ordinal variables, they have been categorized into quartiles in a similar way to the ranking (Table 4).

However, since geographical area is a nominal variable, it has been associated with the cardinal direction of the province to which the analysed municipalities belong: Northwest, Northeast, Centre, and South and Islands. Thus, three contingency tables corresponding to the ordinal variables have been constructed for each of the countries under study, yielding the information needed to answer the second research question.

4 | RESULTS AND DISCUSSION

Q1. *Is there territorial uniformity in the development of the 5Ps in Spain and Italy?*

The cluster analysis carried out identified three groups of municipalities in both countries. In light of some of the specific features observed in these clusters, we cannot give an affirmative answer to the research question posed (Tables 5 and A1). The dimension *People* (SDGs 1, 2, 3, 4 and 5) in Spain and *Prosperity* (SDGs 7, 8, 9, 10 and 11) in Italy are the only two Ps that are undergoing homogenous development across the territory, as confirmed by the Kruskall–Wallis test (*p* value >.05). However, although the measures implemented around these dimensions are fostering uniform compliance with the targets set, greater efforts are needed, since they register values of just under 45% in the analysed countries (44.15% for *People* in Spain and 44.6% for *Prosperity* in Italy).

Furthermore, the results reveal that *Peace*, *Partnership* and *Planet* require more attention; the high dispersion here highlights the uneven progress made towards these goals. In Spain, Cluster 2 registers 68.09% in *Partnership* (SDG17) while other municipalities barely exceed 31% (Cluster 1). In this same dimension, the Italian territories in Cluster 1 achieve a level of 81.9% while others reach only 54.6%. Overall, it can be seen that the Spanish Cluster 2 and the Italian Cluster 1 record above-average values in all the Ps analysed. A detailed analysis of these localities is needed to determine which of the adopted measures have enabled them to achieve greater development.

TABLE 6 Statistics of contingency tables

Variable X-variable Y	Chi-sq	p Value	Gamma/Coeff. of contingency	p Value
Spanish cities				
Ranking-density	12.253	.199	−0.137	.210
Ranking-wealth	6.713	.667	0.001	.990
Ranking-location	20.056	.018	0.407	.018
Italian cities				
Ranking-density	7.793	.555	0.114	.297
Ranking-wealth	26.537	.002	0.444	.000
Ranking-location	31.738	.000	0.489	.000

TABLE 7 Spanish and Italian contingency tables

		Position in the ranking				
		1–25	26–50	51–75	76–101	Total
Spanish cities						
Geographical area	Northeast	9	4	6	6	25
	Northwest	0	7	2	2	11
	Centre-East	12	9	7	6	34
	South Islands	4	5	10	12	31
	Total	25	25	25	26	101
Italian cities						
Geographical area	Northeast	9	8	4	1	22
	Northwest	5	9	6	5	25
	Centre	8	4	10	3	25
	South Islands	3	4	5	17	29
	Total	25	25	25	26	101
Wealth	High (Q4)	10	7	8	0	25
	Medium high (Q3)	8	8	5	4	25
	Medium low (Q2)	2	7	8	8	25
	Low (Q1)	5	3	4	14	26
	Total	25	25	25	26	101

The results of the Spanish index show that the degree of compliance of these territories barely exceeds 45% in four of the five dimensions. *Peace* (SDG16) is at the top with 57.39%, reflecting the global concern about securing peace and justice through solid institutions that foster a climate of harmony. In Italy, on the other hand, it can be seen that all of the dimensions except *Prosperity* (44.6%) exceed 50%; in other words, they are halfway to the achievement of the SDGs. However, due to the methodological differences in the construction of the regional indices, it cannot be claimed that Italian regions have surpassed the Spanish ones. As proof of this, at the national level, the SDG index for the EU places Spain ahead of Italy in terms of meeting the goals (Lafortune et al., 2021).

In essence, the analysis carried out points to the conclusion that, at the local level, Spain and Italy need better coordination and cooperation to ensure uniform achievement of all SDGs. The results confirm the existence of large territorial inequalities in meeting the SDGs (*Q1*). Delegating powers to municipal governments and the autonomy to allocate budget amounts for these purposes sometimes causes a lag in certain SDGs. There is a need for alignment between governments, public institutions, social entities, the private sector and civil society in order to enhance the universality of the targets set.

The literature provides some evidence that could help correct the situation. Chopra et al. (2022) argue that the strong interconnection between the 17 SDGs and the deficient management of certain regions endangers the future of the planet. Others such as Mehmood (2021) point the finger at a lack of education in sustainability. It is also worth recalling the power of financial resources throughout this process: sometimes a lack of wealth can undermine the achievement of the targets, widening socioeconomic gaps (Valencia et al., 2021; Wang et al., 2022). At the local and individual level, there must be a proactive culture oriented towards innovation as a key factor in achieving the SDGs (Calabrese et al., 2021).

Q2. *What are the aspects that contribute to SD in these two Mediterranean countries?*

CE has been used to produce a ranking of Spanish and Italian municipalities based on their degree of compliance with the SDGs

(Table A2). Among Spanish cities, Zaragoza and Logroño stand out for holding the top positions, registering high values in SDGs 6, 8, 16 and 17. In Italy it is Trento and Bolzano that head up the ranking, with values close to 100 in most SDGs.

These two rankings have been divided into quartiles (Table 4) to analyse the possible link between the position held in the ranking and characteristics of the territories, specifically the population density (hab/km^2), wealth (per capita income) and geographical area. Table 6 shows the statistics for the contingency tables constructed, indicating the variables between which there is a relationship of dependence (Chi-sq, p value <.05) and the direction of the association (Gamma/contingency coefficient, p value <.05).

The results reveal that the geographical area is a determinant of a municipality's position in the ranking in both countries, while wealth is only a conditioning factor in Italy; in both cases, there is a direct relationship. In Spain, the greater centralization of environmental measures adopted by the government could be behind these results. The delegation of these regulations to the municipal level has been more limited and overseen by national laws. This fact, combined with the smaller wealth differential between the Spanish areas analysed, means that this variable has not turned out to be a decisive factor.

Regarding population density, which might be expected to pose an obstacle to the successful implementation of sustainability measures, it is not found to be significant. This reason for this result could lie in the characteristics of the sample used, as all the municipalities included are provincial capitals or areas with a certain volume of inhabitants, meaning there are not any particularly significant differences in terms of population concentration. Authors such as Ehrlich et al. (2018) consider density to be an essential variable in the analysis of climate risks. Furthermore, given the same concentration of PM2.5, more populated areas face greater risks of exposure (Dong et al., 2022). Therefore, it would be a variable worth taking into account in other geographical contexts. Table 7 shows the contingency tables for which the association between variables is found to be significant.

In Table 7, it can be seen that both the Spanish and Italian municipalities of the Northeast and the Centre have shown greater commitment to achieving the SDGs. Also worth noting is the Italian Northwest, where more than 50% of its cities are in the top two quartiles of the ranking. Conversely, the South-Islands of both countries are dominated by municipalities that need to focus more on meeting the sustainability targets.

In both Italy and Spain there are major cultural and economic differences due to location. The North is characterised by the greater intensity of the manufacturing sector and services that provide work to a significant share of inhabitants, whereas agriculture predominates in the South, and is sometimes in decline, exacerbating unemployment and in turn poverty and sociocultural backwardness. This has resulted in significant differences in terms of SD. On top of this is the wealth of the former areas, which fosters investment in innovation aimed at achieving the goals set by the 2030 Agenda and periodically reviewed by the European Commission. Thus, the Italian municipalities that hold the first and second positions in the ranking are also characterized by

their notable level of wealth, in contrast with the poorer populations coming at the bottom of the ranking. These results are in line with the research of Bresciani et al. (2021), who have demonstrated the notable gap between the North and South in Spain and Italy in terms of the innovation policies implemented, which in turn can influence the environmental health and the economic development of the territories. Other authors such as Alaimo and Maggino (2020) and D'Adamo et al. (2021, 2022) confirm the gap between the Italian regions, raising the need to adopt policies that help reduce the gap between North and South, while trying to restore the country's competitiveness at the European and global levels. Policies that bolster territories' economic growth will help drive compliance with the SDGs, as has been shown in Italy. In other neighbouring countries such as Portugal, France and even Greece, which also show marked socioeconomic differences between regions, measures should be implemented to enhance human capital and promote sustainable development. This calls for cooperation from all territories, involving citizens in decision-making.

The conditioning factors in the municipalities of the Northeast and the Centre are more conducive to implementing the six transformations needed for compliance with the SDGs: (1) education and equality; (2) quality of life and demographics; (3) sustainable industry; (4) environmental sustainability; (5) sustainable cities; and (6) the digital revolution (Sachs et al., 2019). All of this requires significant investments and strong cooperation from governments, businesses and civil society. There is evidence of the effort made by the Spanish industrial sector in the implementation of the Triple Bottom Line: Social, Environmental and Financial. The results are translating into a significant change in business culture, and the benefits of incorporating SDGs into business strategies are beginning to be recognised (Verdejo et al., 2022). Szymańska and Zalewska (2021) consider education to be a key element for the implementation of EU strategies concerning the SDGs.

Ultimately, municipalities must be self-critical and analyse the key factors that may cause them to diverge from the path to SD. Over the next few years, the world will undergo a revolution aimed at achieving the targets set in the 2030 Agenda. A major transformation of cities is expected, with digital infrastructures gaining ground (Kolesnichenko et al., 2021). There is thus a need to assess the current gap between territories in order to be able to focus resources and efforts on the areas that are lagging furthest behind in achieving compliance with the SDGs. The South-Islands area should foster the sociocultural and economic development of its territories in order to more closely resemble the profile of the regions showing the most effective compliance with the SDGs.

5 | CONCLUSIONS

In future, quality of future life will strongly depend on the fulfilment of the responsibilities imposed by the 2030 Agenda. In less than a decade, all countries are supposed to have reached the 169 targets that guarantee the achievement of the 17 SDGs. Nobody can be left behind: issues such as global warming, equality and sustainability, with

the latter understood in all its versions, are issues that concern the entire planet. The whole of humankind stands under the same umbrella, creating a need to promote cooperation and partnerships between countries. In this paper, a detailed analysis has been conducted of the situation of 101 municipalities in Spain and Italy in order to identify the dimensions that make a difference.

The results reveal that uniform progress throughout Spain and Italy has only been made in *People* and *Prosperity*, respectively. The rest of the Ps show clear differentiation, based on which the municipalities can be grouped into three clusters, highlighting how some outperform others. Likewise, the ranking of municipalities based on their achievement of the SDGs shows that, in both countries, characteristics relating to geographical location clearly influence their position in the ranking. Moreover, in Italy, wealth is also a determinant. These are territories with very different sociological and economic characteristics, revealing a pattern of behaviour that could help decision-makers to promote policies aimed at the development of the areas that are lagging furthest behind. However, this must be accompanied by government aid to help ensure the measures materialise into concrete actions, promoting efforts such as the consumption of renewables, the circular economy, waste management, sustainable mobility, and the restoration of ecosystems, among others.

New technologies must be used to guarantee the sustainable development of all cities, leaving none of them behind; this is where green public policies and investments play a critical role. The central governments in collaboration with the territorial governments must define the key factors that will guarantee continual progress towards compliance with the SDGs. However, there is no time to waste: there are items such as pollution, the signs of which are becoming ever more ubiquitous, causing major humanitarian and economic catastrophes.

In short, these results reveal the pressing need to define precise targets that foster SD in cities. They must all advance at an even pace that guarantees, first of all, sustainability at the national level, but without overlooking the ultimate goal, the planet. The responsibility does not fall solely on public entities and companies; it is universal, and the entire population must work in this direction to secure a better future.

Analyses of other countries, which would enable a global view of the situation, are prevented by a lack of statistical information at the municipal level. Furthermore, we would need four editions of the reports used here in order to carry out a dynamic analysis that allows us to identify possible interactions that are hindering the satisfactory achievement of the SDGs.

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CONFLICT OF INTEREST

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TABLE A1 Spanish and Italian municipalities belonging to each cluster

	Spain
Cluster 1	Roquetas de Mar, El Ejido, Granada, Badajoz, Chiclana de la Frontera, Talavera de la Reina, Lugo, Toledo, Merida, Zamora, Vigo, Teruel, Huelva, Alcalá de Henares, Coslada, Castellon de la Plana, Alcorcón, Orense, Salamanca, Burgos, Móstoles, Segovia, Cartagena, Huesca, Ciudad Real, Guadalajara, Avilés, Palencia, Baracaldo, Leganes, Pontevedra, Parla, Albacete, Avila, Fuenlabrada, San Sebastián de los Reyes, Pozuelo de Alarcón, Torrejón de Ardoz, León, Cuenca, Santiago de Compostela, Las Rozas de Madrid
Cluster 2	Fuengirola, Alicante, Málaga, Madrid, Arona, Córdoba, Logroño, Las Palmas de Gran Canaria, Valencia, Gijon, Tarragona, Cáceres, Barcelona, Torrent, Zaragoza, Sevilla, Pamplona, Lleida, Donostia, Lorca, Alcobendas, Cornellá de Llobregat, Oviedo, Santa Cruz de Tenerife, Rivas-Vaciamadrid, Bilbao, La Coruña, Getafe, Valladolid, Santander, Soria, Girona
Cluster 3	Algeciras, Ceuta, Melilla, Torrevieja, Marbella, Almería, Mijas, Jerez de la Frontera, Cádiz, El Puerto de Santa María, Reus, Palma, Elche, Telde, Hospitalet de Llobregat, Sabadell, Dos Hermanas, Badalona, San Cristóbal, Mataró, San Fernando Tarrasa, Jaén, San Baudilio de Llobregat, San Cugat del Vallés, Santa Coloma de Gramanet.
	Italy
Cluster 1	Aosta, Asti, Avellino, Bergamo, Biella, Bolzano, Brescia, Como, Cremona, Cuneo, Gorizia, La Spezia, Lecco, Lodi, Mantova, Monza, Novara, Padova, Pavia, Pordenone, Rimini, Salerno, Savona, Sondrio, Trento, Treviso, Udine, Varese, Vercelli, Verona
Cluster 2	Alessandria, Ancona, Ascoli Piceno, Belluno, Benevento, Bologna, Campobasso, Chieti, Ferrara, Firenze, Forli, Frosinone, Genova, Grosseto, Imperia, L'Aquila, Livorno, Lucca, Macerata, Massa, Milano, Modena, Parma, Perugia, Pesaro, Pescara, Pisa, Pistoia, Potenza, Prato, Ravenna, Reggio Nell'Emilia, Rieti, Rovigo, Sassari, Siena, Teramo, Terni, Torino, Trieste, Venezia, Verbania, Viterbo
Cluster 3	Agrigento, Bari, Brindisi, Cagliari, Caltanissetta, Catania, Catanzaro, Cosenza, Crotone, Enna, Foggia, Latina Lecce, Matera, Messina, Napoli, Nuoro, Oristano, Palermo, Piacenza, Ragusa, Reggio di Calabria, Roma, Siracusa, Taranto, Trapani, Vibo Valentia, Vicenza

TABLE A2 Ranking of municipalities by their degree of compliance with the SDGs

Spanish cities	Ranking	Spanish cities	Ranking	Italian cities	Ranking	Italian cities	Ranking
Zaragoza	1	La Coruña	52	Trento	1	Como	52
Logroño	2	Tarragona	53	Bolzano	2	Novara	53
SC del Vallés	3	Salamanca	54	Pordenone	3	Milano	54
R-Vaciamadrid	4	Orense	55	Udine	4	Firenze	55
Soria	5	SS Reyes	56	Macerata	5	Savona	56
P de Alarcón	6	Valladolid	57	Padova	6	Varese	57
Getafe	7	Mérida	58	Matera	7	Brindisi	58
Girona	8	Jaén	59	Mantova	8	Aosta	59
Donostia	9	Murcia	60	Pesaro	9	Ferrara	60
Cáceres	10	SB Llobregat	61	Perugia	10	Chieti	61
Cuenca	11	Alicante	62	Trieste	11	Torino	62
Alcobendas	12	Granada	63	Ancona	12	Salerno	63
Lorca	13	Palma	64	Treviso	13	Grosseto	64
Las Rozas	14	Málaga	65	Cagliari	14	Latina	65
Alcorcón	15	Ciudad Real	66	Parma	15	Ragusa	66
San Fernando	16	Bilbao	67	Lodi	16	Benevento	67
Lleida	17	Castellón	68	Sondrio	17	Pisa	68
Córdoba	18	Mataró	69	L'Aquila	18	Venezia	69
Madrid	19	Leganés	70	Nuoro	19	Roma	70
C Frontera	20	Algeciras	71	Teramo	20	Frosinone	71
Burgos	21	J de la Frontera	72	Cuneo	21	Campobasso	72
Palencia	22	Almería	73	A Piceno	22	Pescara	73
Huesca	23	Huelva	74	Prato	23	Potenza	74
Móstoles	24	Reus	75	Bologna	24	Viterbo	75
Tarrasa	25	Telde	76	Bergamo	25	Verbania	76
Vigo	26	SC Gramanet	77	Lecce	26	Enna	77
A de Henares	27	Zamora	78	Verona	27	Agrigento	78

TABLE A2 (Continued)

Spanish cities	Ranking	Spanish cities	Ranking	Italian cities	Ranking	Italian cities	Ranking
Albacete	28	Pontevedra	79	Brescia	28	Asti	79
Gijón	29	Dos Hermanas	80	Lecco	29	Sassari	80
Barcelona	30	Parla	81	L Spezia	30	V Valentia	81
Lugo	31	R de Mar	82	Siena	31	Bari	82
P Santa María	32	Gran Canaria	83	Biella	32	Taranto	83
SC Tenerife	33	Teruel	84	Pavia	33	Genova	84
Valencia	34	T de Ardoz	85	Gorizia	34	Alessandria	85
C Llobregat	35	Segovia	86	Monza	35	Lucca	86
Ávila	36	Toledo	87	Forlì	36	Cosenza	87
Sabadell	37	Coslada	88	Ravenna	37	Catanzaro	88
Pamplona	38	Melilla	89	Rieti	38	R Nell'Emilia	89
Fuenlabrada	39	Badalona	90	Vicenza	39	Imperia	90
Elche	40	Arona	91	Modena	40	Trapani	91
SC La Laguna	41	T de la Reina	92	Oristano	41	Siracusa	92
Cartagena	42	Avilés	93	Avellino	42	Pistoia	93
Mijas	43	H de Llobregat	94	Belluno	43	Catania	94
Santander	44	Sevilla	95	Terni	44	R Calabria	95
S Compostela	45	El Ejido	96	Piacenza	45	Massa	96
León	46	Marbella	97	Vercelli	46	Crotone	97
Torrent	47	Ceuta	98	Foggia	47	Caltanissetta	98
Guadalajara	48	Baracaldo	99	Cremona	48	Palermo	99
Oviedo	49	Fuengirola	100	Livorno	49	Napoli	100
Badajoz	50	Torrevieja	101	Rimini	50	Messina	101
Cádiz	51			Rovigo	51		

Abbreviation: SDG, Sustainable Development Goal.