“Multidimensional assessment of the ESG profile of Portuguese municipalities: A proposal for a composite index using official indicators”

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MULTIDIMENSIONAL ASSESSMENT OF THE ESG PROFILE OF PORTUGUESE MUNICIPALITIES: A PROPOSAL FOR A COMPOSITE INDEX USING OFFICIAL INDICATORS

Abstract

Measuring environmental, social, and governance (ESG) performance in the public sector requires tools capable of integrating heterogeneous, comparable, and geographically disaggregated information. This study aims to develop a composite index for the 308 Portuguese municipalities between 2018 and 2022, based on 95 officials' environmental, social, and governance indicators standardized through min-max normalization and combined using neutral weighting. The findings indicate that annual mean values remained relatively stable, ranging from 32.030% to 33.105%, with moderate growth until 2021 followed by a decline in 2022. The distribution was strongly concentrated around central values but retained substantial dispersion, with scores ranging from 26.361% to 72.621%, indicating persistent territorial disparities. In addition, jackknife analysis showed that the annual mean was only weakly affected by the exclusion of individual municipalities. The index does not measure reporting quality, formal ESG adoption, institutional transparency, or the causal effectiveness of public policies. Its contribution lies in providing a relative, transparent, replicable, and comparable measure for exploratory analysis of municipal ESG patterns.

Keywords ESG, composite indicators, local authorities, sustainability, local governance, official data

JEL Classification H70, H83, Q56, C43

INTRODUCTION

The growing prominence of environmental, social, and governance (ESG) factors has increased demand for comparable information on public-sector sustainability performance. This is especially relevant for local authorities, whose responsibilities directly affect essential services, spatial planning, environmental management, social cohesion, infrastructure, and financial resource allocation. In Portugal, municipalities occupy a particularly important position because of their proximity to citizens and the territorial consequences of their decisions, making them central actors in the local implementation of sustainable development policies.

Municipal ESG analysis, however, faces a substantial methodological challenge. ESG is not a directly observable variable but a multidimensional construct, and its measurement depends on selecting suitable indicators that represent environmental, social, and governance phenomena. This difficulty is evident in the local government sector, where the available data relate specifically to resources, facilities, service volumes, expenditure, territorial characteristics, and socio-institutional conditions, rather than to formal practices regarding the disclosure or adoption of ESG benchmarks.

Official indicators are not considered measures of reporting, the quality of disclosure, institutional transparency, or the formal adoption of ESG principles. Their role lies in operationalizing observable dimensions of the municipal ESG statistical profile, enabling relative comparisons between municipalities and over the analyzed period. Public non-financial reporting, therefore, constitutes a potential application of the information but does not represent the empirical object being directly assessed.

1. LITERATURE REVIEW AND HYPOTHESES

Municipal ESG analysis has gained relevance in public-sector accounting, management, finance, territorial sustainability, and quantitative assessment (Sklavos et al., 2025). Its multidimensional structure creates measurement challenges because environmental, social, and governance dimensions differ in construct definition, scale, statistical properties, and causal structure. Composite indices address this heterogeneity by transforming multiple indicators into a common metric for cross-municipal comparison (Mapar et al., 2020). However, aggregation does not ensure construct validity. Analytical robustness depends on indicator specification, normalization, weighting, aggregation, outlier treatment, sensitivity analysis, and data-quality controls (Cantone & Tomaselli, 2025; Soares et al., 2026a).

Municipalities are central to territorial sustainability through public-service provision, spatial planning, environmental management, social cohesion, public-asset management, and fiscal resource allocation (Almeida, 2024; Garefalakis et al., 2025). The 2030 Agenda reinforces this role through the localization of the Sustainable Development Goals and territorially differentiated policies (Yan et al., 2024). Municipal outcomes are also conditioned by structural covariates such as geography, population, density, economic structure, and service accessibility. Composite indices can therefore identify territorial heterogeneity, but they cannot estimate policy effectiveness without an appropriate causal identification strategy.

Associations between ESG performance and financial or institutional outcomes require econometric caution. Previous research links stronger ESG performance to improved access to finance, lower systemic-risk exposure, and greater fiscal resilience (Celestin & Mishra, 2025; Chen et al., 2023). These relationships may be endogenous. Stronger municipalities may invest more in sustainability, information systems, and reporting, while favorable ESG outcomes may affect reputation and perceived risk. Comparable metrics are necessary, but causal inference requires designs capable of addressing reverse causality, omitted-variable bias, and other sources of endogeneity (Giupponi et al., 2025; Sneideriene & Legenzova, 2025).

Municipal ESG assessment requires frameworks consistent with the institutional characteristics of local government. International standards provide principles on materiality, transparency, accountability, and disclosure, but direct transfer from corporate settings may create construct misalignment (Brink & Singh, 2024; Guo & He, 2024; Liyanage, 2025). Municipal indicators should reflect public-service obligations, redistributive functions, territorial responsibilities, and accountability requirements (Oulasvirta, 2014). Context-specific operationalization may improve content validity but requires balancing dimensional coverage and parsimony. Extensive systems may increase redundancy, multicollinearity, and operational complexity, whereas restrictive systems may generate construct under-representation (Jossin & Peters, 2022).

Composite-index construction generally comprises construct definition, indicator selection, data treatment, normalization, weighting, aggregation, and robustness analysis (Caldas et al., 2020; Fernandez & Martos, 2020; Gao et al., 2023; Greco et al., 2019; Nihayah et al., 2025; Rodrigues & Franco, 2020). Each stage introduces modeling assumptions. Normalization

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affects scale comparability and sensitivity to extremes. Weighting defines the relative contribution of indicators or dimensions. Aggregation determines compensability across components. Final scores and rankings therefore reflect both observed data and the methodological architecture used to generate the synthetic measure.

These constraints do not invalidate composite indices, but they delimit their inferential domain. Such indices remain useful for information synthesis, territorial benchmarking, diagnostic analysis, and cross-sectional comparison (Wehbe & Baroud, 2024). Longitudinal ESG monitoring additionally requires temporal continuity, measurement invariance, stable statistical definitions, and reliable data infrastructure (Siragusa et al., 2021). Missing observations, heterogeneous sources, definitional revisions, or discontinuities in data production may generate measurement artefacts. Apparent temporal variation may therefore reflect changes in the information-generating process rather than substantive changes in municipal ESG conditions (Martins & Cândido, 2015; Moretti & Arias-Salazar, 2025; Petkovová et al., 2020).

An ESG statistical profile differs from public non-financial reporting. Official statistics indices measure municipal conditions, resource endowments, service outputs, and socioeconomic or environmental outcomes rather than disclosure quality, transparency, or reporting compliance (Gu et al., 2024). Structured metrics may strengthen consistency, traceability, and comparability (Calazans et al., 2025; Cunha et al., 2025), while supporting accountability mechanisms and the identification of budgetary issues (Lo-Iacono-Ferreira et al., 2022; Soares et al., 2025b). A high composite score does not demonstrate superior reporting quality or institutional maturity. This distinction is important for green financial instruments, whose credibility depends on material, traceable, and verifiable information (Marlowe, 2024).

Divergence across ESG systems introduces additional uncertainty. The same entity may receive different classifications under different constructs, indicator sets, measurement procedures, or weighting structures (Christensen et al., 2022; Escrig-Olmedo et al., 2019). Indicator availability may create selection bias by favoring dimensions that are easier to quantify while under-representing relevant but less observable characteristics (Fatemi et al., 2015). Limited methodological transparency may also facilitate selective interpretations of performance (Delmas & Burbano, 2011). Official statistical data alone, however, cannot establish manipulation, strategic disclosure, or greenwashing.

Institutional heterogeneity may also affect score comparability. Larger entities generally possess greater administrative capacity, technical resources, information systems, and reporting infrastructure, which may influence measured outcomes (Berg et al., 2022; Ioannou & Serafeim, 2019). Methodological robustness therefore requires transparency, reproducibility, construct validation, and sensitivity analysis (Drempetic et al., 2020). Stakeholder participation may reduce weighting arbitrariness, although representativeness remains problematic (Arsenopoulos et al., 2021). Robustness assessment should compare alternative specifications and test the sensitivity of scores and rankings to modeling assumptions (Nardo et al., 2005). Independent assurance may further strengthen the credibility of sustainability information (Boiral et al., 2019).

The literature reveals a substantive methodological gap. Despite municipalities' role in territorial sustainability, no consensual ESG operationalization fully captures the institutional, fiscal, social, and territorial specificities of local government. International frameworks remain only partially transferable, while composite indices depend on measurement and modeling choices and do not directly assess disclosure quality. The methodological value of a municipal ESG index therefore depends on coherence between construct definition, indicator operationalization, data architecture, statistical procedures, and the scope of inference, rather than on ordinal rankings alone (Soares et al., 2024).

This study aims to develop a composite index to assess and compare the ESG statistical profiles of Portugal's 308 municipalities between 2018 and 2022.

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Following the literature review, the following hypotheses were formulated:

H1: *The index exhibits measurable territorial heterogeneity across Portuguese municipalities.*

H2: *The annual distribution of the index exhibits relative temporal stability over the period from 2018 to 2022.*

H3: *The annual mean of the index exhibits low sensitivity to the individual exclusion of municipalities under the jackknife leave-one-out procedure.*

The hypotheses correspond directly to the empirical procedures adopted. *H1* is assessed using measures of central tendency, dispersion, range, quartiles, and territorial distribution. *H2* is examined through a longitudinal comparison of annual statistics. *H3* is assessed by comparing the original mean with the means obtained after the sequential exclusion of each municipality.

2. METHODS

The study covers all 308 Portuguese municipalities from 2018 to 2022, using annual data from INE and Pordata. Indicators were selected for conceptual relevance, local observability, official sourcing, complete coverage, temporal continuity, and definitional stability. The final dataset includes 95 indicators: 46 environmental, 41 social, and 8 governance indicators overall. Table A1 identifies, for each dimension, the indicators, units, and directions of impact. The dataset underlying the construction and results of the municipal ESG index has been deposited in an open-access repository (Soares et al., 2026b).

Each indicator was assigned a direction of impact defined in advance. For positive indicators, higher values represent more favorable relative positions; for negative indicators, higher values indicate less favorable positions. Once the direction had been defined, all indicators were standardized using the min-max method.

For positive indicators:

$$x_{ijt}^{norm} = \frac{x_{ijt} - \min_i \left(x_{ijt} \right)}{\max_i \left(x_{ijt} \right) - \min_i \left(x_{ijt} \right)} \quad (1)$$

For negative indicators:

$$x_{ijt}^{norm} = \frac{\max_i \left(x_{ijt} \right) - x_{ijt}}{\max_i \left(x_{ijt} \right) - \min_i \left(x_{ijt} \right)} \quad (2)$$

In both expressions, $x_{ijt} \in [0, 1]$. The value 1 indicates the most favorable relative position and 0 the least favorable for indicator *j*, municipality *i*, and year *t*. Normalization was carried out separately for each indicator and year, based on the minimum and maximum values observed across the 308 municipalities. In effect, the index enabled cross-sectional comparisons within each year and longitudinal comparisons of relative positions, but it does not measure absolute progress or regression over a fixed time scale (Münstermann, 2015; Soares et al., 2025a; Mazziotta & Pareto, 2025).

The index was calculated using the simple arithmetic mean of the 95 indicators:

$$ESG_{it} = \frac{1}{95} \sum_{j=1}^{95} x_{ijt}^{norm} \quad (3)$$

The procedure assigns equal weight to each indicator, which corresponds to 1/95. The result is an implicit unequal weighting of the dimensions: 48.4% for the environmental dimension (46/95), 43.2% for the social dimension (41/95), and 8.4% for the governance dimension (8/95). This choice should not be interpreted as an equivalent weighting between the E, S, and G dimensions, but rather as a preference for a neutral weighting at the level of the indicators (Munda & Nardo, 2005).

The stability of the index's annual mean was assessed using the jackknife leave-one-out procedure (Tukey, 1958). For each year, each municipality was successively excluded, and the index mean was recalculated using the remaining 307 municipalities:

$$\theta_{(i)t} = \frac{1}{n-1} \sum_{k \neq i} ESG_{kt}, \quad n = 308. \quad (4)$$

The jackknife mean is the average of the 308 estimates:

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$$\bar{\theta}_{J,K,t} = \frac{1}{n}\sum\nolimits_{i=1}^{n}\theta_{(i)t}, \tag{5}$$

For one standard deviation:

$$\sigma_{jk} = \sqrt{\frac{n-1}{n}\sum\nolimits_{i=1}^{n}\left(\theta_{(i)t} - \bar{\theta}_{J,K,t}\right)^2}. \tag{6}$$

A comparison between the original mean and the leave-one-out means made it possible to assess the individual influence of the municipalities on the aggregate result. The analysis covers all Portuguese municipalities; the jackknife method was used as a structural sensitivity analysis and not as a tool for sample inference regarding an external population. The calculations were carried out using Excel software.

3. RESULTS

The analysis examines the distribution and evolution of the composite ESG index for Portugal's 308 municipalities between 2018 and 2022. Based on 95 indicators, the index represents municipalities' relative ESG profiles rather than the adoption of ESG frameworks, reporting quality, transparency, or policy effectiveness. It therefore provides an aggregate measure of observable environmental, social, and governance conditions, resources, and outcomes. Tables B1 to B5 present the annual index values and corresponding relative positions of all municipalities.

The temporal pattern of the index comprises two distinct phases (Table 1). Between 2018 and 2021, the mean rose from 32.588% to 33.105% (+0.517 percentage points), although annual increases progressively weakened. In 2022, it fell by 1.075 percentage points from 2021 and by 0.558 percentage points from 2018. The median followed the same pattern, rising from 32.170% to 32.605% before declining to 31.532%. Similar reductions in both measures indicate that the decline extended beyond extreme municipalities to the distribution's central segment.

This trajectory should not be interpreted as absolute improvement until 2021, followed by deterioration in 2022. Because min-max normalization was applied each year separately, annual changes reflect shifts in municipalities' relative positions and normalized indicator values rather than movement toward fixed external benchmarks. The results therefore support only a moderate upward shift in the distribution until 2021, followed by a downward shift in 2022 within annually defined scales.

In every year, the mean exceeded the median by 0.418-0.538 percentage points, indicating persistent right-skewness driven by a small number of high values. The interquartile range remained exceptionally narrow, between 1.384 and 1.462 percentage points, despite total ranges of 43.744-45.253 percentage points. Consequently, the overall range was approximately 30-32 times larger than the interquartile range, showing that most municipalities were highly concentrated around similar values, while a limited number of extreme observations accounted for much of the total dispersion.

The distribution reveals a clear contrast between strong central concentration and a small group of exceptionally high observations. Most municipalities remain tightly clustered within the interquartile range, while pronounced positive skewness is reflected in annual coefficients of 5.54-6.11 and high kurtosis. Accordingly, the proximity between the mean and median should not be interpreted as evidence of symmetry or homogeneity. Instead, the distribution is characterized by limited dispersion among most municipalities and substantial separation at the upper end.

Table 1. Descriptive statistics for the municipal ESG profile index, 2018–2022

Year	Mean	Median	Standard deviation	First quartile	Third quartile	Interquartile range	Minimum	Maximum	Range
2018	32.59%	32.17%	3.54%	31.64%	33.05%	1.407 p.p.	26.78%	72.03%	45.253 p.p.
2019	32.79%	32.33%	3.41%	31.76%	33.17%	1.407 p.p.	27.18%	71.50%	44.317 p.p.
2020	33.05%	32.51%	3.51%	32.04%	33.42%	1.384 p.p.	27.81%	72.62%	44.814 p.p.
2021	33.11%	32.61%	3.48%	32.05%	33.51%	1.462 p.p.	27.51%	71.95%	44.443 p.p.
2022	32.03%	31.53%	3.41%	31.05%	32.45%	1.399 p.p.	26.36%	70.11%	43.744 p.p.

Dispersion across municipalities changed very little between 2018 and 2022. The standard deviation ranged from 3.408% to 3.540%, while the coefficient of variation remained around 10.4%-10.9%. This constancy, however, does not indicate convergence. The total range exceeded 43 percentage points throughout the period, and the same municipalities remained strongly represented at both extremes. The distribution therefore combined stable overall dispersion with persistent inequality in the composition of the highest- and lowest-scoring groups.

The upper end of the ranking remained highly stable throughout 2018–2022 (Tables B1 to B5; Figures 1 and 2). Lisboa ranked first every year (70.105%–72.621%), followed consistently by Porto (54.261%–55.635%) and Sintra (43.492%–45.571%). Coimbra remained within the top five, while Vila Nova de Gaia and Cascais alternated between fourth and sixth positions. This pattern indicates a persistent group of leading municipalities rather than substantial annual turnover at the top of the distribution.

The leading municipalities were internally differentiated. Lisboa stood apart, exceeding the annual mean by 38.075-39.574 percentage points. Porto also remained clearly separated, with a gap of approximately 9.3-11.2 percentage points from third place. From Sintra onward, differences narrowed considerably, with Coimbra, Vila Nova de Gaia, and Cascais forming a more compact group. The upper distribution therefore exhibits a three–tier structure: Lisboa as an extreme case, Porto in an intermediate isolated position, and a cluster of large urban municipalities scoring approximately 41%–46%.

The five highest–ranked municipalities averaged 50.663%–52.240%, remaining 18.632–19.193 percentage points above the national mean. By contrast, the five lowest–ranked municipalities averaged 26.913%–28.021%, only 5.066-.654 percentage points below it. This asymmetry shows that the overall range is driven mainly by the upper tail. Lower-ranked municipalities remain comparatively close to the center of distribution, whereas the highest values, particularly those of Lisboa and Porto, are substantially separated from the remaining observations.

Nine municipalities remained in the top ten throughout the period: Lisboa, Porto, Sintra, Coimbra, Vila Nova de Gaia, Cascais, Almada, Braga, and Loures. Only the tenth position changed, being occupied by Leiria in 2018, Barcelos in 2019, and Oeiras from 2020 to 2022. This limited turnover confirms strong persistence at the top. However, it does not demonstrate superior ESG policy effectiveness, since many indicators are based on absolute values. Demographic, economic, administrative, and infrastructural scale may therefore directly influence the aggregate index.

The repeated presence of large urban municipalities at the top is descriptive rather than evidence of a statistical relationship between size and ESG performance. No explicit size variable, correlation, or regression analysis was used to test this association. Moreover, absolute indicators may mechanically incorporate municipal scale into the index, making causal interpretation potentially circular. The findings therefore support only the conclusion that larger municipalities consistently occupy higher positions under the current specification of the composite indicator.

The lower end of the distribution also shows strong territorial persistence. Lajes das Flores ranked last in 2018 (26.780%), Santa Cruz das Flores in 2019 (27.181%), and Vila Franca do Campo from 2020 to 2022 (27.807%–26.361%). Several Azorean municipalities, including Santa Cruz da Graciosa, Calheta, São Roque do Pico, Lajes do Pico, Nordeste, and Santa Cruz das Flores, remained among the ten lowest-ranked throughout the period. Corvo, Velas, Madalena, Lajes das Flores, and Vila do Porto also appeared frequently near the bottom.

The concentration of Azorean municipalities at the lower end of the ranking is territorially persistent but does not identify its causes. It may reflect municipal scale, territorial discontinuity, demographic structure, service availability, or the indicators selected. Because these factors are not controlled for, lower positions cannot be attributed to weaker governance, ineffective policies, or reduced sustainability commitment. The ranking therefore describes the outcome produced by the index specification but does not establish the economic, territorial, or institutional mechanisms underlying it.

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Stability at the distributional extremes coexists with substantial mobility among intermediate municipalities. Between 2018 and 2022, the median absolute change was 19 positions, while 84 municipalities moved at least 50 places and 28 moved 100 or more. However, these movements reflect the strong concentration of intermediate scores. When municipalities differ by only hundredths or tenths of a percentage point, relatively small changes in index values can generate pronounced shifts in ranking positions.

Soure illustrates how rankings can magnify relatively small score changes, rising 188 positions despite an increase of only 1.446 percentage points. Peso da Régua gained 171 positions (+1.389 points) and Silves 173 (+1.063), while Guarda fell 234 positions (–4.279) and Manteigas 168 (–3.250). These cases confirm that high distributional density can produce large ordinal movements from modest changes in index values. Substantive comparisons should therefore prioritize score differences, with ranking positions used only as supplementary information.

Between 2018 and 2022, 245 municipalities have recorded lower index values and 63 higher values. The median change was –0.566 percentage points, while the median absolute change was 0.627 points, indicating that the 2022 decline affected a broad share of municipalities rather than only the highest-ranked cases. However, because annual minima and maxima were recalculated each year, these movements represent relative changes within the normalized distributions and cannot be interpreted as absolute deterioration in municipal ESG conditions.

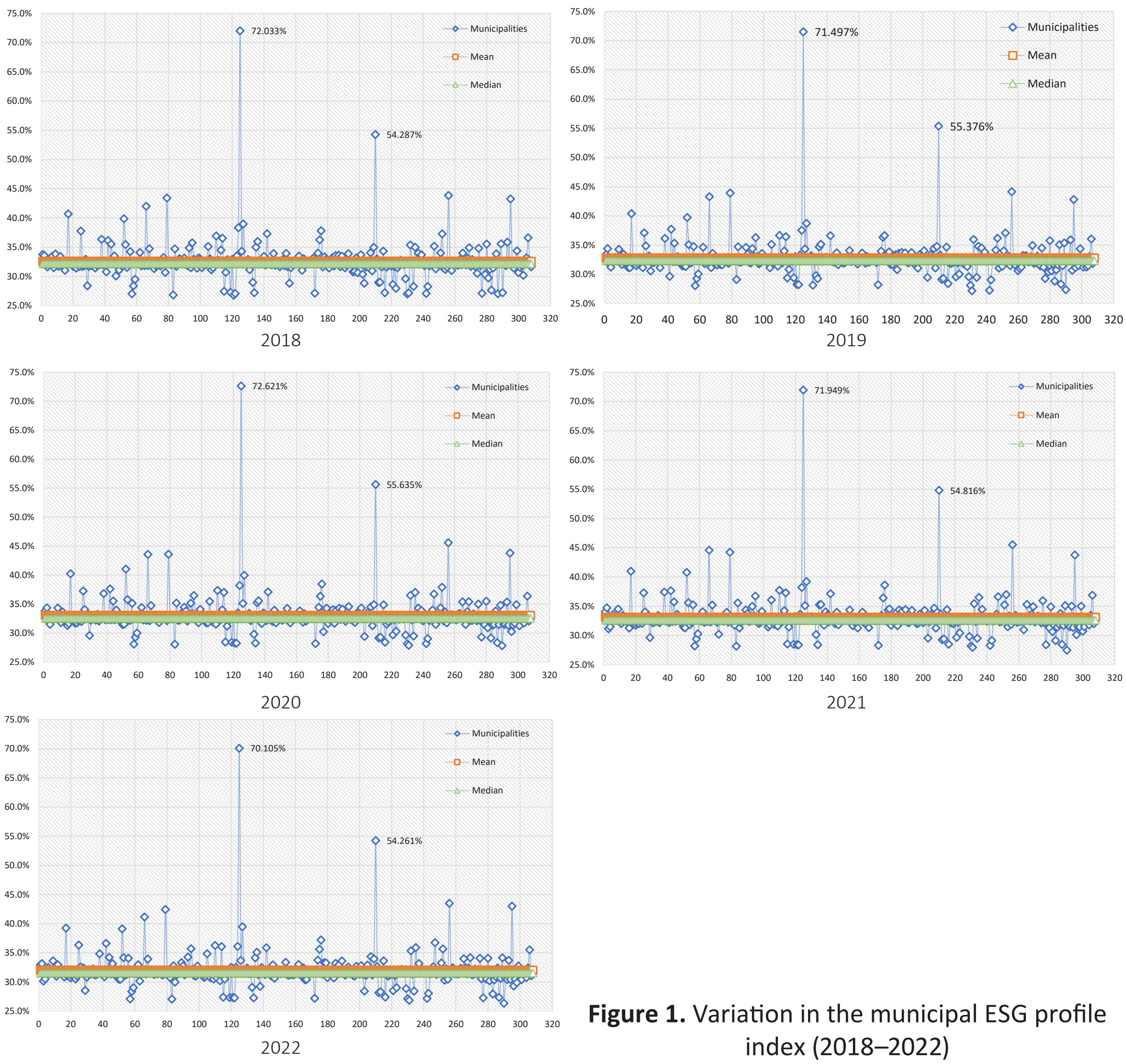
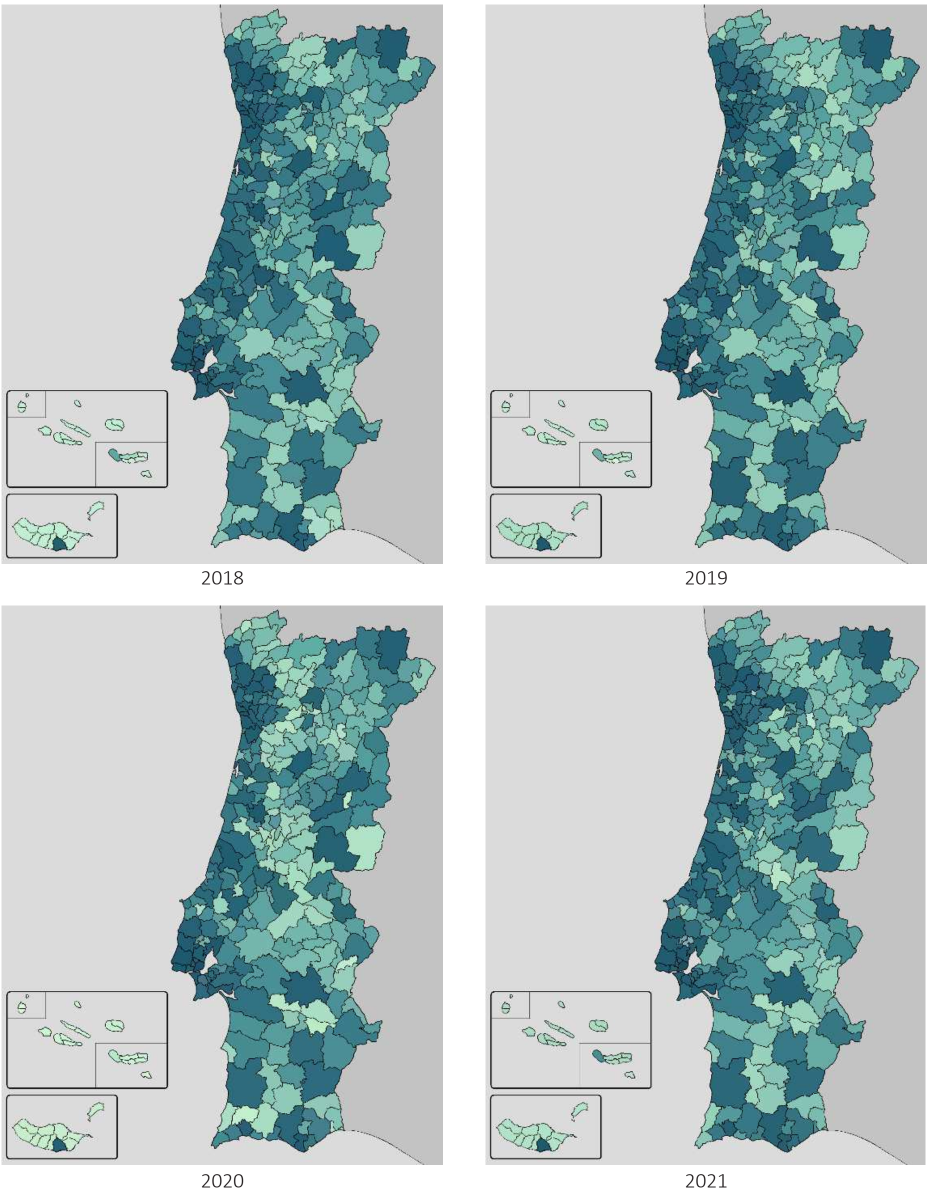
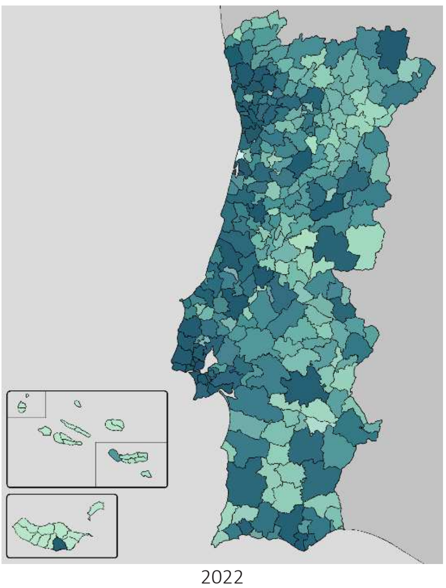


Figure 1. Variation in the municipal ESG profile index (2018–2022)





Note: Darker shades indicate a higher ESG adoption profile.

Figure 2. Choropleth maps of municipal ESG statistical profiles (2018–2022)

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The jackknife should be interpreted separately from dispersion measures. Its leave-one-out mean equals the original mean algebraically; therefore, the relevant evidence concerns the range of recalculated means and the maximum change caused by excluding each municipality.

Lisboa exerted the greatest annual influence because of its large distance from the mean, yet its exclusion reduced the average by only 0.124-0.129 percentage points. Removing the lowest-scoring municipalities increased it by approximately 0.018-0.019 points, confirming greater influence from the upper tail. Nevertheless, these effects remain small, reflecting both the distribution of the data and the sample size. With 308 municipalities, excluding a single observation is inherently unlikely to produce a substantial change in the overall mean.

The jackknife supports only a limited conclusion: no single municipality materially affects the annual mean (Table 2). It does not validate the ESG construct, indicator directions, weighting scheme, redundancy, or scale effects. Nor does it establish absolute temporal stability, since annual normalization changes the basis of comparison across years.

Overall, the index reveals concentrated intermediate values, pronounced positive skewness, persistent extremes, and substantial ranking mobility among municipalities with similar scores. These territorial differences reflect both observed municipal conditions and methodological choices concerning indicator selection, orientation, normalization, weighting, and aggregation.

The hypotheses receive different levels of empirical support within the boundaries of the proposed model. Hypothesis 1 is supported, as the index identifies persistent territorial heterogeneity, although only in statistical ESG profiles rather than policy effectiveness. Hypothesis 2 is partially supported: scores and distributions remain relatively stable, but annual normalization prevents conclusions about absolute change. Hypothesis 3 is supported only operationally, since the mean is little affected by excluding individual municipalities. However, this does not validate ESG implementation or reporting practices. Overall, the model measures municipal ESG profiles, but not the incorporation of ESG metrics into reporting or disclosure quality.

4. DISCUSSION

The findings show that municipal differences depend substantially on the methodological design of the index. Aggregating 95 ESG indicators converts heterogeneous information into a comparable measure, confirming the usefulness of composite indices identified by Mapar et al. (2020), Caldas et al. (2020), Rodrigues and Franco (2020), and Lo-Iacono-Ferreira et al. (2022). However, synthesis does not ensure substantive validity. The concentration of municipalities within a narrow score range, alongside a small number of clearly differentiated cases, suggests greater discriminatory capacity at the distributional extremes. This supports the methodological concerns raised by Greco et al. (2019), Cantone and Tomaselli (2025), Soares et al. (2026), and Wehbe and Baroud (2024), since final scores reflect both observed conditions and methodological choices.

The comparison between index values and rankings reveals important differences. Although the correlation between 2018 and 2022 scores is very high (0.977), the correlation between rankings is lower (0.800), indicating greater ordinal mobility. Municipalities with similar ESG scores may therefore experience substantial changes in rank despite only small variations in their underlying values. This finding supports Greco et al.'s (2019)

Table 2. Jackknife analysis of the annual average

Year	Observed mean	Leave-one-out mean range	Maximum variation	Jackknife standard variation
2018	32.59%	32.460%–32.607%	0.128 p.p.	0.202 p.p.
2019	32.79%	32.663%–32.808%	0.126 p.p.	0.195 p.p.
2020	33.05%	32.918%–33.064%	0.129 p.p.	0.200 p.p.
2021	33.11%	32.978%–33.123%	0.127 p.p.	0.199 p.p.
2022	32.03%	31.906%–32.049%	0.124 p.p.	0.195 p.p.

argument that rankings can amplify marginal differences and overstate the hierarchy between comparable units. Accordingly, ordinal position should not be interpreted as an autonomous measure of ESG superiority; the index score should remain the primary basis for interpretation, with rankings serving only a supplementary role.

The persistent presence of Lisboa, Porto, Sintra, Coimbra, Vila Nova de Gaia, and Cascais among the highest-ranked municipalities is consistent with Drempetic et al. (2020), who associate organizational size with ESG ratings, and with Ioannou and Serafeim (2019) and Berg et al. (2022), who identify potential advantages for larger entities. The findings suggest that size is partly embedded in the index through absolute indicators, allowing larger municipalities to obtain higher scores without necessarily exhibiting greater service intensity, efficiency, or quality.

The findings do not demonstrate that larger municipalities pursue more effective ESG policies or stronger governance. Their higher scores may partly reflect the scale sensitivity of the index, creating a risk of circular interpretation. This reinforces the distinction made by Garefalakis et al. (2025), Almeida (2024), and Yan et al. (2024) between observed territorial outcomes and policy effectiveness. Assessing the independent influence of municipal size would require scale-adjusted indicators and explicit tests incorporating population, density, area, and financial capacity.

The concentration of small Azorean municipalities among the lowest-ranked cases should be interpreted cautiously. The pattern is compatible with differences in scale, insularity, territorial dispersion, fixed service costs, and facility availability but does not demonstrate weaker sustainability commitment or institutional quality. This supports Oulasvirta (2014), Guo and He (2024), Brink and Singh (2024), and Liyanage (2025), who question the direct application of uniform ESG frameworks across heterogeneous institutional contexts. Formal comparability does not ensure substantive equivalence: identical numbers of facilities, employees, or services may have very different implications in metropolitan and sparsely populated island municipalities.

The observed temporal stability provides only partial support for previous research. Score persistence is consistent with Siragusa et al. (2021), Martins and Cândido (2015), and Petkovová et al. (2020), who emphasize data continuity and statistical consistency. However, as Mazziotta and Pareto (2025) note, annual min-max normalization may generate changes reflecting relative distributional shifts rather than actual improvement or deterioration. The findings therefore indicate positional and distributional stability, but not substantive ESG stability or absolute temporal change.

Equal weighting of the 95 indicators is transparent but does not ensure balance across ESG dimensions. The index effectively assigns 48.4% to environmental, 43.2% to social, and only 8.4% to governance. This supports Munda and Nardo's (2005) criticism that equality at the indicator level may generate inequality across constructs. Governance therefore has limited influence because it contains fewer indicators, rather than because theory or evidence establishes its lower importance.

This structure confirms concerns about compensation across dimensions raised by Arsenopoulos et al. (2021), Gao et al. (2023), and Greco et al. (2019). Weak governance performance may be offset by stronger environmental and social results, meaning that similar overall scores can reflect markedly different ESG profiles. The findings therefore support equal indicator weights only as an exploratory specification, not as a balanced representation of ESG. A more robust assessment should compare this approach with equal weighting across dimensions, statistically derived weights, and less compensatory aggregation methods.

The jackknife analysis confirms only a limited form of stability. Its small effect on the annual mean is consistent with Nardo et al. (2005), showing that no single municipality determines the aggregate result. However, it does not address methodological divergence across ESG systems identified by Escrig-Olmedo et al. (2019), Christensen et al. (2022), and Berg et al. (2022), since indicators, weights, normalization, and aggregation remain unchanged. The estimated standard error of approximately 0.20 percentage points, therefore, supports stability of the mean but not construct validity, dimensional balance, indicator redundancy, or ranking robustness.

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Comparison with ESG reporting literature requires careful delimitation. Structured metrics may support monitoring, information systems, and accountability (Gu et al., 2024; Calazans et al., 2025; Cunha et al., 2025; Lo-Iacono-Ferreira et al., 2022), but this study did not assess reporting frameworks, external assurance, or decision-making use. Accordingly, the findings do not establish reporting quality. As Marlowe (2024) notes, measurable information may facilitate disclosure without necessarily indicating transparency, institutional maturity, or information quality.

CONCLUSION

The aim of the study was to design a composite index for the multidimensional and comparable assessment of the ESG statistical profile of the 308 Portuguese municipalities between 2018 and 2022.

The results indicate relatively low and stable average index values, ranging from 32.030% to 33.105%, with moderate growth until 2021 and a decline in 2022. Most municipalities cluster around the median, although substantial territorial disparities persist at the extremes. Jackknife results confirm that the aggregate mean is only weakly affected by individual municipalities. Overall, the index identifies territorial heterogeneity and relative distributional stability, while providing a transparent and replicable comparison tool without measuring reporting quality or the causal effectiveness of public policies.

With regard to future research, it is essential to test adjustments to the scale, alternative weightings, and longer time periods to identify the factors explaining the asymmetries and to explore applications in other municipal contexts.

AUTHOR CONTRIBUTIONS

Conceptualization: Ricardo de Moraes e Soares.
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