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Academic Research Paper

Evaluating Sustainable Tourism: A Composite Index for European Destinations

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Abstract: This paper focuses on the analysis of sustainable tourism indicators for the 27 European Union (EU) countries to address the challenges faced by the tourism sector. The impact of sustainable tourism indicators on destination competitiveness was evaluated using the EU Tourism Dashboard, a scheme funded by the European Commission. The Mazziotta-Pareto Index was used to construct the indicator of sustainability by incorporating the three pillars of indicators: Environmental impact, Digitalisation, and Socio-economic vulnerability. The proposed approach provides greater tractability and flexibility for decision-makers to adjust the number of indicators to meet specific case conditions. The sustainable tourism indicators aim to provide critical information for resource allocation and policymaking in the conservation of tourism sites, as well as improving the welfare and inclusiveness of local communities. The findings of the analysis highlight significant disparities among destinations in terms of the examined indicators, emphasizing variations in sustainability profiles and performance within the tourism sector. These disparities underscore the need for personalized and targeted approaches to address the specific challenges and opportunities faced by each destination in achieving sustainable tourism development. Furthermore, the proposed ranking system, updated at regular intervals, can enhance the image and reputation of European areas as high-quality and sustainable destinations, attracting increased tourism demand. Additionally, the ranking system can foster knowledge sharing and the adoption of benchmarking practices, incentivizing countries to maintain and improve their position in the ranking. This work contributes to addressing the evidence gap in tourism sustainability policymaking and provides a comprehensive framework for the development of sustainable tourism analysis in the EU context.

Keywords: *sustainable tourism indicators; European Union (EU); destination competitiveness; Mazziotta-Pareto Index.*

JEL Codes: L83; Q56; O18; C43; R58

1. Introduction

Tourism is widely acknowledged as a pivotal economic activity that engenders job creation and fosters development in numerous countries (Lee & Chang, 2008; León-Gómez et al., 2021). Nonetheless, the adverse effects of tourism have underscored the pressing necessity for sustainable tourism practices (Budeanu et al., 2016). A prevalent strategy for managing sustainability performance in tourism sites is the formulation of indicator sets. These sets are tailored to the requirements and circumstances of each location and are influenced by the geographical location of the site (Franzoni, 2015). Europe has held the top spot as the world's premier tourist destination for several years. This is primarily due to the region's rich cultural and natural heritage, which is complemented by the political instability in competing countries in North Africa and the Middle East that discourages travel. However, the tourism industry, by its very nature, has the potential to adversely affect Europe's cultural and natural heritage, traditions, and contemporary cultures. This emphasizes the essential significance of incorporating sustainability into the tourism industry, making it crucial for all destinations to embrace its principles to effectively handle and alleviate the impacts of tourism. (De Marchi et al., 2022). In addition, the complex and multidimensional nature of sustainability, combined with the pervasive impact of tourism, poses inherent difficulties. However, there is a clear intention to create composite indicators that facilitate the comprehensive evaluation of the variables influencing and determining the sustainability of tourist destinations (Torres-Delgado & Lopez Palomeque, 2018).

The COVID-19 pandemic has played a significant and critical role in the ongoing transition towards sustainability, as it has resulted in unprecedented socio-economic consequences and heightened our awareness of the imperative role sustainability must assume in our daily lives and economic activities. The crisis has underscored the necessity of enhancing the resilience of the tourism industry and fostered a sense of unity and interconnectedness among various stakeholders. It has shed light on the vulnerability of the natural environment and the pressing need for its preservation, while also revealing unprecedented intersections between tourism, economics, society, and the environment. This juncture presents an opportunity to expedite the adoption of sustainable consumption and production patterns and facilitate the reconstruction of a more robust tourism sector (UNWTO, 2020). Despite these circumstances, the European Union continues to be a prominent global destination, attracting millions of domestic and international visitors annually. While the economic impacts of tourism may vary among EU member countries and regions, tourism also serves as a catalyst for promoting European culture and heritage, enhancing the well-being of both residents and tourists, and facilitating cultural and economic exchanges.

The United Nations World Tourism Organization (UNWTO, 1993) has long emphasized the need to manage destinations to achieve long-term sustainable tourism. The goal is to reconcile the development of tourism activities with the protection and conservation of the natural and cultural resources that support this activity. In practice, assessing the sustainability of a country's tourism is a widely employed approach globally, with rankings established based on indicators derived from pertinent demand-related information that influences the selection of specific regions as tourist destinations. In 2021, the European Union (EU) Industrial Strategy was updated to accelerate the green and digital transitions, particularly in sectors heavily impacted by the COVID-19 pandemic, such as tourism. Specifically, the European

Council requested that the Commission collaborate with Member States and relevant international organizations to design a flagship tool for the tourism ecosystem, called the EU Tourism Dashboard (European Commission, 2022).

This paper aims to accomplish the following objectives. Firstly, we describe and quantify the "EU Tourism Dashboard" a sustainable tourism indicator system proposed by the European Commission for evaluating the sustainability of tourism in European destinations. Secondly, to enhance the understanding of the tourism industry and to promote sustainable management, leading to improved competitiveness of the destinations, we propose to create a ranking of European tourist destinations based on sustainability. This ranking will be determined using a composite indicator, which offers an overall evaluation of each destination's situation, eliminating the need to evaluate the initial indicators separately. To derive the composite indicators, we will employ a methodology based on non-substitutability and introduce a penalty term for variability. This approach aims to reduce subjectivity and provide synthetic indicator values that are easily interpretable by industry operators. Unlike previous studies, our proposed composite indicator does not use a weighting system derived from a panel of experts in sustainable tourism. Finally, using the values of the composite indicator, we establish a system of sustainable tourism rankings that characterizes the destination country's sustainability. This system allows potential tourists to assess the sustainability of the destination and make informed decisions, influencing their behavior as consumers and the choice of destination. The article's structure comprises a description and quantification of the sustainable tourism indicator system in the following section; the proposed methodology for the composite indicator is presented in section 3, while section 4 analyzes and discusses the primary outcomes. The last section presents the conclusions.

2. A sustainable tourism indicators system for European destinations: EU Tourism Dashboard

2.1. Operationalizing sustainable tourism: The role of indicators in achieving sustainability goals

The United Nations World Tourism Organization (UNWTO), previously known as the World Tourism Organization (2004), defines sustainable tourism development as the provision of present tourists' and host regions' needs while preserving and enhancing opportunities for the future. This definition seeks to establish a framework for the management of resources in a manner that satisfies economic, social, and aesthetic needs, while concurrently preserving cultural integrity, ecological processes, biological diversity, and life support systems. It emphasizes that the development and management of tourist destinations must not inflict harm upon their cultural or natural resources in the pursuit of sustainability. Therefore, sustainable tourism development is not only a future-oriented system but also an inward vision that encompasses all aspects of the economy, environment, and society to achieve its objective. Hence, touristic policies ought to be worked out to safeguard the protection of natural, social, and cultural resources that uphold the activity and their ability to fulfil the requirements of both present and future tourists and residents' populations.

According to the European Commission, the use of sustainable tourism indicators is essential to foster sustainable tourism and increase competitiveness in the European market (European Commission, 2003, 2007). Indicators of sustainable tourism can be defined as a set of measures that offer valuable information to comprehend the interrelationships between the impact of tourism on the cultural and natural environment on which it depends (UNWTO, 1996). It is posited that the information gathered from such indicators can serve as a suitable tool to enhance the socioeconomic understanding of the

tourism sector and its connection to the environment. This panel of indicators furnishes details on various aspects that enable to evaluate a complex and multifaceted phenomenon with no universally recognized definition. Additionally, the components of the system help us identify the different factors that influence the sustainability of tourism, resulting in operational knowledge that more than compensates for the conceptual ambiguity. According to the UNWTO (op.cit.), sustainable tourism indicators are a collection of measures that provide necessary information to comprehend the impact of tourism on the cultural and natural environment, which it heavily depends on. Sustainable tourism indicators are used to indicate the state or level of a particular activity, identify and measure results. The indicators must focus on the triple-bottom-line, which includes environmental, economic, and social goals (Swarbrooke, 1999), to address sustainability. The UNWTO highlights the need for a set of indicators that enables tourism management to establish priorities and gain forward-looking perspectives. The selection of indicators can be performed through stakeholder agreement, experts' recommendations, or related studies (Tanguay, 2013). Multiple sustainable tourism indicator sets have been proposed in the literature, with most of them derived incrementally from previous sets, such as the one established by the UNWTO, while other organizations have also tried to develop similar sets.

The European Union has recently taken a series of initiatives to promote sustainable and responsible tourism. To maintain Europe's leading position in tourism, the EU encouraged the development of new tools to promote a more intelligent and sustainable approach to tourism planning and management based on consumer trends, dynamic monitoring, and indicators. In this regard, the EU has collaborated with member states and relevant international organizations to design an EU Tourism Dashboard, which will function as the primary tool for the tourism ecosystem.

2.2. The EU Tourism Dashboard: indicators and policy pillars

The EU Tourism Dashboard, as envisioned by the European Commission, functions as an online repository of tourism-related information, serving as a knowledge tool. Its purpose is to offer insightful visualizations and analysis of specific indicators, thereby providing valuable information that aids policy actions aimed at fostering a tourism ecosystem that is both sustainable and resilient. Notably, the dashboard encompasses all 27 EU Member States, along with Iceland, Norway, and Switzerland, enabling the profiling and comparison of countries and regions based on their tourism activities. The data utilized in the dashboard are collected from various sources and harmonized to ensure consistency and reliability. Furthermore, the EU Tourism Dashboard monitors the advancement of tourism destinations over time in terms of their environmental impacts, digitalization efforts, and socio-economic vulnerability. The current set of indicators integrated into the dashboard spans from 2019 (or the most recent available year) to 2021 (or the nearest available year). In this study we use the latest value available for each indicator. However, future updates are planned to extend the time series by incorporating additional years. The primary audience for the dashboard comprises policy makers at national and regional levels, tourism industry managers, researchers, statistical officers, as well as individuals from the public sphere with an interest in the tourism ecosystem. The fundamental objectives of the EU Tourism Dashboard are to provide guidance for policy formulation and strategic decision-making within the tourism ecosystem, furnish valuable insights, and facilitate the effective dissemination of information to relevant stakeholders.

The figure (Fig.1) below shows the structure and main elements of the EU Tourism Dashboard.

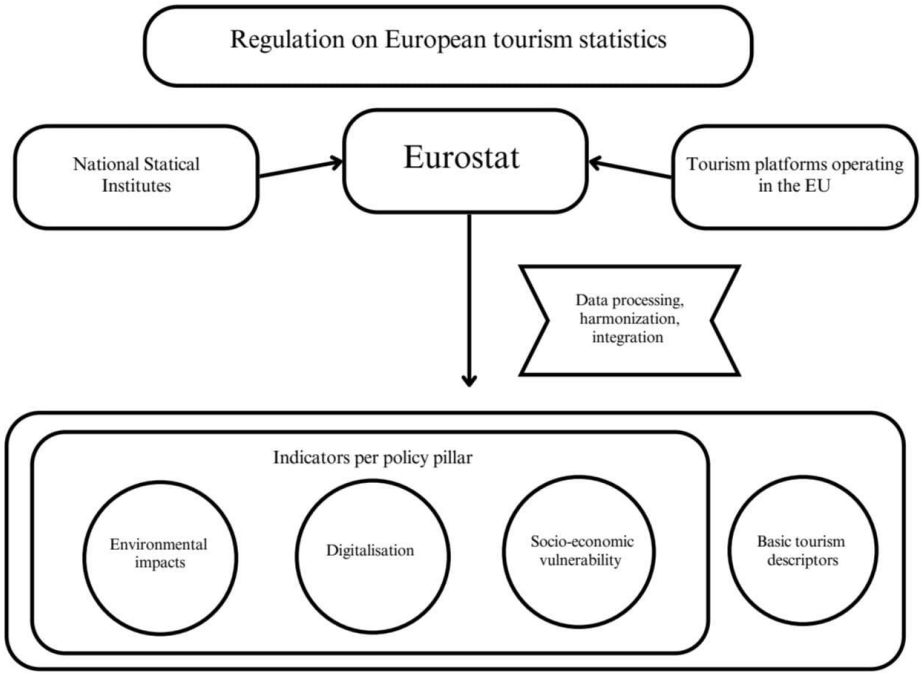

Figure 1. EU Tourism Dashboard structure. *Source: Author elaboration*

In the context of the EU Tourism Dashboard, indicators play a crucial role by going beyond mere data records or statistics. They serve as measures or estimations that depict the current state of a phenomenon by quantifying its alignment with specific objectives, thresholds, or targets (Maggino, 2017). These indicators are essential for conducting meaningful analyses across different time periods and geographical areas. To ensure comparability and consistency in the analysis, it is necessary to develop indicators in a manner that mitigates the influence of varying reporting unit sizes, such as countries or regions. This consideration is crucial to enable accurate and fair assessments of tourism sustainability across diverse contexts. By employing indicators that are carefully designed to account for such variations, the EU Tourism Dashboard aims to provide reliable and robust insights that can guide policies and strategies within the tourism ecosystem. The EU Tourism Dashboard utilizes the Nomenclature of Territorial Units for Statistics (NUTS), a hierarchical framework employed to delineate the economic territory of the European Union (EU) into distinct divisions. This framework facilitates the collection, development, and harmonization of regional statistics. While the primary focus of the dashboard is on national-level indicators (NUTS0), it also incorporates regional-level (NUTS2) and sub-regional-level (NUTS3) indicators for specific measures when detailed data is accessible. It is important to note that the analysis was conducted at the NUTS0 level due to considerations of data availability and comprehensiveness. By utilizing the NUTS framework, the dashboard ensures a consistent and standardized approach to regional analysis while accounting for varying levels of granularity based on the data availability and scope of the indicators. Currently, the dashboard encompasses a total of 18 indicators, classified under three policy pillars: environmental impacts, digitalization, and socio-economic vulnerability. The underlying conceptual framework posits that destinations demonstrating consistently higher scores across these pillars are more likely to possess a sustainable and resilient tourism ecosystem. A fourth pillar, referred to as Basic Tourism Descriptors, complements the dashboard with additional data and statistics to provide context and further characterization of tourism activity in countries and regions. This pillar includes relevant information related to tourism supply, demand, and offerings. The current version of the dashboard includes 12 tourism descriptors within this pillar. The

development of the indicator framework primarily involves the definition and selection of indicators. The European Commission identifies individual indicators by considering conceptual and policy factors and consulting key stakeholders, while also assessing data availability. Subsequently, data is collected from relevant sources and prepared for analysis. By adopting this structured framework, the EU Tourism Dashboard aims to provide a comprehensive and comparable suite of indicators, enabling the evaluation of tourism dynamics and facilitating informed decision-making within the tourism sector. The complete list of indicators and tourism descriptors is provided in Annex 1.

3. Sustainable tourism composite indicator

3.1. Data collection

The indicators employed in the development of the EU Tourism Dashboard were derived from data and statistics obtained from reputable sources, ensuring the highest attainable level of territorial and thematic granularity. The primary data source for the dashboard was Eurostat, the statistical agency of the European Union, renowned for its reliability, consistency, and authoritative nature. Eurostat was chosen as the preferred provider of data to ensure the robustness and credibility of the dashboard. In addition to Eurostat, several supplementary data sources were employed, including: Eurocontrol; European Commission Joint Research Centre; European Environment Agency; Foundation for Environmental Education; Ookla; TripAdvisor and UNESCO. Below (Tab.1) are presented the descriptive statistics pertaining to the 18 indicators associated with the tripartite dimensions (Environment, Digitalization and Socio-economic) of tourism sustainability, as outlined in Annex 1.

Table 1. Descriptive statistics of sustainability tourism indicators.

Indicator	Mean	Median	Dev. Std.	Min	Max
Air travel emission intensity	120,52	99,83	44,22	76,69	225,79
Tourism GHG intensity	418,75	405,42	244,72	71,66	1200,16
Tourism energy intensity	7,46	6,28	4,18	1,72	19,42
Share of trips by train	7,03	6,24	4,42	0,34	19,39
Excellent bathing water	84,78	86,90	10,79	55,17	100,00
Dependence on distant origins	12,42	8,33	12,43	3,10	66,28
E-commerce sales	43,31	43,45	10,68	23,92	60,24
Enterprises using social media	40,90	41,13	14,16	13,42	65,00
Personnel training on digital skills	10,63	10,52	4,67	3,00	18,91
Enterprises seeking ICT specialists	3,31	3,12	2,31	0,36	10,53
Internet speed at tourism destinations	75,37	74,30	21,75	44,60	117,50
Accomodations listed online	-0,56	0,83	38,37	-68,37	100,84
Tourism intensity	4,62	3,36	3,49	1,08	17,38
Tourism seasonality	0,80	0,76	0,21	0,50	1,45
Dependence on top3 countries of origin	23,65	19,74	13,41	4,46	53,66
Tourism diversity	0,72	0,78	0,19	0,30	0,97
Contribution of tourism to employment	11,37	11,72	4,47	3,72	18,62
Average tourism expenditure	85,55	85,46	17,60	52,98	112,42

Source: Author elaboration EU tourism Dashboard data

In terms of environmental impact, the average air travel emission intensity shows significant variation, with values ranging from 76.69 (Croatia) to 225.79 (Luxembourg), indicating differences in the amount of CO2 emitted per air passenger across destinations. Similarly, the tourism GHG intensity and tourism energy intensity indicators exhibit considerable variability, reflecting differences in the amount of greenhouse gas emissions and energy consumption in the tourism sector. The share of trips by train indicates the extent to which train travel is favoured in tourism activities. The results demonstrate variations among destinations, with values ranging from 0.34 (Greece) to 19.39 (France), suggesting differences in transportation preferences and infrastructure. Assessing the quality of bathing water is crucial for ensuring a positive tourism experience. The excellent bathing water indicator reveals variations in water quality, with values ranging from 55.17% (Hungary) to 100% (Cyprus), indicating disparities in the share of sampled bathing water sites classified as "excellent" across destinations.

Examining the dimension of digitalization, the indicators reflect the level of technology adoption within the tourism ecosystem. The indicator of e-commerce sales indicates the percentage of tourism ecosystem enterprises that engage in online sales. The findings reveal a range of values, with the percentage ranging from 23.92% (Greece) to 60.24% (Denmark). This suggests variations in the extent to which tourism enterprises have embraced online sales channels as a means of conducting business. Similarly, the indicator on enterprises using social media assesses the share of tourism ecosystem enterprises that utilize two or more social media platforms. The results demonstrate variability across destinations, with values ranging from 13.42% (Bulgaria) to 65.00% (Finland). This variation indicates differences in the level of engagement and utilization of social media platforms for marketing, communication, and customer engagement purposes. The indicator of personnel training on digital skills examines the share of tourism ecosystem enterprises that provide ICT (Information and Communication Technology) training to their personnel. The findings reveal variations in training efforts, with values ranging from 3.00% (Bulgaria) to 18.91% (Norway). This suggests disparities in the commitment of tourism enterprises to enhancing the digital competencies and skills of their workforce. The indicator on enterprises seeking ICT specialists measures the percentage of tourism ecosystem enterprises that actively seek ICT specialists. The results indicate differences in the demand for ICT expertise across destinations, with values ranging from 0.36% (Slovakia) to 10.53% (Spain). This reflects variations in the recognition and prioritization of ICT skills within the tourism industry. The maximum available internet speed at tourism destinations provides insights into the level of connectivity in terms of fixed and mobile networks. The values range from 44.60 (Greece) to 117.50 (Denmark), indicating differences in the quality and speed of internet connections across destinations. Higher values suggest better infrastructure and connectivity, enabling smoother digital interactions and online experiences for tourists and tourism businesses. The indicator of accommodations listed online examines the disparity between the observed number of tourist accommodation rooms listed on a key online platform (TripAdvisor) and the expected number of listed rooms based on known tourism demand. The results show a wide range of values, with disparities ranging from -68.37 (Sweden) to 100.84 (Bulgaria). This discrepancy indicates variations in the degree to which accommodations are effectively represented and marketed online, potentially affecting their visibility and competitiveness in the digital marketplace.

The results related to socio-economic vulnerability in the tourism sector provide insights into several key aspects. The indicator of tourism intensity measures the number of nights spent at tourist

accommodations by the resident population. The findings indicate variations across destinations, with values ranging from 1.08 (Poland) to 17.38 (Croatia). This suggests differences in the level of tourism activity and engagement within the local population, highlighting destinations with higher resident participation in tourism-related activities. Tourism seasonality, represented by the coefficient of variation of nights spent at tourist accommodation establishments per month, examines the degree of fluctuation in tourist activity throughout the year. The results show values ranging from 0.50 (Estonia) to 1.45 (Croatia), indicating differences in the extent of seasonal variations. Higher values suggest greater fluctuations in tourist demand over the course of the year, potentially impacting the stability and sustainability of tourism-related businesses. The indicator of dependence on the top three countries of origin measures the share of nights spent by tourists from the top three countries of origin relative to the total nights spent in a destination country. The results demonstrate variations across destinations, with values ranging from 4.46% (Poland) to 53.66% (Luxemburg). This reflects differences in the level of reliance on specific source markets, with destinations exhibiting varying degrees of diversification in terms of visitor nationalities. Tourism diversity, assessed using the Shannon diversity index (1949), examines the distribution of tourism accommodation establishments across five geographical zones within a destination. These zones include cities, coastal areas, rural areas, natural or mountainous areas, and snowy mountains. The results reveal a range of values, from 0.30 (Malta) to 0.97 (France), indicating differences in the diversity and dispersion of tourism accommodations across these zones. Higher values suggest a more balanced and diversified distribution of tourism facilities. The indicator of the contribution of tourism to employment assesses the net overall effect of tourist arrivals at accommodation establishments along the value chain, including direct, indirect, induced, and catalytic effects within related activities and the entire tourism ecosystem. The results demonstrate variations across destinations, with values ranging from 3.72% (Romania) to 18.62% (Croatia). This indicates differences in the extent to which tourism contributes to employment generation and economic opportunities within the destinations. Finally, the average tourism expenditure represents the average economic value generated per night spent at the tourist destination. The findings reveal values ranging from 52.98 (Netherlands) to 112.42 (Estonia), indicating variations in the average spending patterns of tourists. Higher values suggest destinations with a higher economic impact per visitor, indicating the potential for greater revenue generation and economic benefits.

Overall, the findings reveal significant disparities among destinations in terms of the examined indicators, highlighting the diverse sustainability performance and profiles within the tourism sector. These outcomes emphasize the necessity for approaches to tackle the distinctive challenges and prospects encountered by each destination in their endeavor to achieve sustainable tourism development. The observed heterogeneity underscores the significance of adopting a comprehensive viewpoint facilitated by composite indicators when examining sustainable tourism. By integrating multiple indicators, we can obtain a comprehension of the varied sustainability profiles and performance levels exhibited by distinct destinations.

3.2. Aggregation procedure: Mazziotta-Pareto Index

The indicator system presented in the preceding section is a valuable source of information regarding the impacts of tourism and their connection to the environment. However, on its own is not very practical due to the large number of indicators it encompasses. The size of the system creates

difficulties in obtaining a comprehensive evaluation of the status of each analysed destination.

To address this limitation, we propose augmenting the initial system by incorporating the information it contains into a composite indicator of sustainable tourism. In computing terms, a composite indicator refers to mathematical combinations or aggregations of individual indicators that represent the various aspects of the concept being measured, in our case, sustainable tourism. This composite indicator provides a multidimensional assessment of the concept, allowing for a more comprehensive evaluation. The international literature on composite indicators has demonstrated that the final outcomes are highly sensitive to the methodology employed (Saisana & Tarantola, 2002; OECD, 2008). This sensitivity is particularly pronounced when methodologies involve weighting criteria and/or conflicting aggregations. However, this limitation associated with constructing a composite indicator can be mitigated by carefully selecting the methodology.

The choice of methodology should be based on the intended purpose of the composite indicator and the requirements it must fulfil. In this work, we utilize Mazziotta-Pareto Index (MPI). The MPI is a non-linear composite index which transforms the individual indicators in standardized variables and summarizes the data using an arithmetic mean adjusted by a 'penalty' coefficient related to the variability of each unit. The aim is to penalize the units with 'unbalanced' values of the indicators in a non-compensatory perspective. The Mazziotta-Pareto Index (Mazziotta & Pareto, 2017; Mazziotta & Pareto, 2013) is a composite index based on the assumption of 'non-substitutability' of the indicators, i.e., they have all the same importance and a compensation among them is not allowed (De Muro et al., 2011). The index is designed to satisfy the following properties: (i) normalization of the indicators by a specific criterion that deletes both the unit of measurement and the variability effect; (ii) synthesis independent from an 'ideal unit', since a set of 'optimal values' is arbitrary, non-univocal and can vary with time; (iii) simplicity of computation; (iv) ease of interpretation. Let us consider a set of individual indicators positively related with the phenomenon to be measured. Given the matrix $X=\{x_{ij}\}$ with *n* rows (in our study, the European countries) and *m* columns (sustainability indicators), we calculate a standardized matrix $Z=\{z_{ij}\}$ as follow:

$$z_{ij} = 100 + \frac{\left(x_{ij} - M_{x_j}\right)}{S_{x_j}} 10;\ if\ indicator\ j\ has\ a\ positive\ polarity$$

$$z_{ij} = 100 - \frac{\left(x_{ij} - M_{x_j}\right)}{S_{x_j}} 10; if\ indicator\ j\ has\ a\ negative\ polarity$$

where M_{x_j} and S_{x_j} are, respectively, the mean and the standard deviation of the *j-th* indicator.

Denoting with M_{z_i} and S_{z_i}, respectively, the mean and the standard deviation of the standardized values of the *i-th* unit, the generalized form of MPI is given by:

$$MPI_i^{+/-} = M_{z_i} \pm S_{z_i} * cv_i \quad (1)$$

where $cv_i = S_{z_i}/M_{z_i}$ is the coefficient of variation of the *i-th* unit and the sign ± depends on the kind of phenomenon to be measured. If the composite index is 'increasing' or 'positive', i.e., increasing

values of the index correspond to positive variations of the phenomenon, then $MPI_i^-$is used. Vice versa, if the composite index is 'decreasing' or 'negative', i.e., increasing values of the index correspond to negative variations of the phenomenon, then MPI_i^+ is used. In the EU tourism dashboard conceptual framework, it is assumed the tourist destinations scoring consistently higher across pillars likely have a more sustainable and resilient tourism ecosystem so MPI_i^- will be used for each policy pillar (domain). The Mazziotta-Pareto index approach is characterized using a function (S_{z_i}* cv_i) to penalize the units with 'unbalanced' values of the indicators. The 'penalty' is based on the coefficient of variation and is zero if all the values are equal. The purpose is to favour the units that, mean being equal, have a greater balance among the different indicators. In our study, starting from the dashboard of m tourism sustainability indicators, depending on the polarity of the measured phenomenon with respect to the analysed domain, we distinguish between positive and negative indicators. This notation is marked with a (+) when the indicator is positive and with a (-) if it is negative, as shown in Annex 1.

4. Results

The table below (Tab. 2) shows the Mazziotta-Pareto indices calculated for each sustainability domain. The table includes the simple arithmetic mean of these indices, allowing for a holistic evaluation of the overall sustainability performance.

Table 2. Mazziotta-Pareto indices sustainability domain 27 EU countries.

EU country	MPI's mean	Environmental impact	Digitalisation	Socio-economic vulnerability
Austria	102,15	107,89	97,74	100,82
Belgium	97,41	96,42	97,20	98,62
Bulgaria	92,75	88,16	93,26	96,83
Cyprus	99,09	94,43	104,94	97,90
Czechia	97,34	99,28	95,98	96,75
Germany	102,10	105,06	98,77	102,47
Denmark	100,40	98,13	105,80	97,26
Estonia	98,28	96,13	95,73	102,99
Greece	96,19	97,77	95,86	94,93
Spain	104,38	102,19	110,73	100,21
Finland	100,19	95,65	102,70	102,22
France	100,22	102,37	96,79	101,49
Croatia	100,60	101,69	105,67	94,44
Hungary	96,02	93,80	96,57	97,70
Ireland	101,68	100,30	105,62	99,13
Italy	***99,30***	***104,35***	***92,18***	***101,35***
Lithuania	99,88	100,16	99,69	99,80
Luxembourg	94,34	98,69	92,00	92,33
Latvia	96,22	90,68	98,94	99,03
Malta	102,90	102,83	104,82	101,05
Netherlands	97,05	95,15	97,31	98,71
Poland	99,86	100,93	101,43	97,22

Portugal	98,98	97,25	99,55	100,13
Romania	98,90	102,78	93,31	100,59
Sweden	104,31	104,23	104,50	104,21
Slovenia	102,40	102,91	101,34	102,94
Slovakia	94,18	97,77	90,95	93,83
EU mean	***99,15***	***99,15***	***99,24***	***99,07***

Source: Author elaboration EU tourism Dashboard data

These rankings provide valuable insights into the overall performance of European Union (EU) countries in the tourism sector across different dimensions. Higher values in the respective indicators indicate better performance in specific areas.

In terms of environmental impact, Austria (107.89), Germany (105.06), Italy (104.35), Sweden (104.23), and Slovenia (102.91) stand out as the top performers. These countries demonstrate a relatively high level of environmental sustainability in their tourism practices. On the other hand, Bulgaria (88.16), Latvia (90.68), and Hungary (93.80) rank lower in environmental impact, suggesting the need for greater attention to environmental sustainability practices in their tourism sectors. These countries may face challenges related to pollution control, resource management, and conservation efforts. Higher-ranking countries are likely implementing eco-friendly policies, promoting renewable energy sources, adopting sustainable waste management practices, and encouraging responsible tourism behaviour. In contrast, lower-ranking countries may need to enhance their efforts to address environmental concerns such as carbon emissions, resource preservation, and biodiversity conservation.

Spain (110.73) emerges as the top performer in digital sustainability in tourism, indicating a strong focus on leveraging digital technologies and platforms to enhance the tourism experience. Denmark (105.80) and Croatia (105.67) also demonstrate high digital performance, reflecting their commitment to digital transformation in the tourism sector. Conversely, countries like Slovakia (90.95), Luxembourg (92.00), and Italy (92.18) rank lower in digital sustainability, suggesting a need for improvement in their digital infrastructure, digital services, and adoption of innovative digital practices in the tourism industry. The leading countries in digital sustainability are likely providing visitors with enhanced digital experiences, seamless transactions, personalized services, and innovative solutions. On the other hand, lower-ranking countries may face challenges in implementing digital strategies, impacting their competitiveness in attracting tech-savvy tourists and offering cutting-edge digital services.

In terms of socio-economic vulnerability, Sweden (104.21), Estonia (102.99), and Slovenia (102.94) rank highest, indicating their robust and resilient tourism ecosystems with lower vulnerability to economic fluctuations. Conversely, Luxembourg (92.33), Slovakia (93.83), and Croatia (94.44) rank lower, suggesting challenges related to economic dependence on tourism, limited economic diversification, or weaker social safety nets for tourism-related employment. Higher-ranking countries are likely to have diversified economies, robust social welfare systems, and effective policies in place to mitigate risks associated with fluctuations in tourism demand. In contrast, lower-ranking countries may have a higher degree of economic reliance on tourism, making them more vulnerable to external shocks, seasonality, or disruptions in the tourism sector. These countries could benefit from strategies promoting economic diversification and enhancing the resilience of their tourism industries. These rankings underscore the significance of environmental

sustainability, digital transformation, and socio-economic stability in the tourism sector. Countries that excel in these areas are more likely to attract environmentally conscious tourists, offer enhanced digital experiences, and build resilient and sustainable tourism economies. Policymakers can leverage these insights to identify areas for improvement, develop targeted strategies, and promote sustainable tourism development in their respective countries.

The use of an aggregate composite indicator, such as the arithmetic mean of the sustainability pillars, enables a comprehensive assessment of countries' performance in achieving sustainable tourism. This engenders a more comprehensive and cohesive evaluative framework, facilitating cross-country comparative analysis of sustainability in the tourism sector. In this regard, Spain (104.38), Sweden (104.31), Malta (102.90), Slovenia (102.40), and Austria (102.15) exhibit higher mean scores across the MPI's indicators. These nations showcase superior overall tourism sustainability performance in relation to their European counterparts. Conversely, countries such as Bulgaria (92.75), Slovakia (94.18), and Luxembourg (94.34) attain lower rankings, highlighting the imperative to enhance their overall sustainability performance within the tourism sector. The adoption of a unified composite indicator, derived from the mean of the previously calculated sustainability pillars, provides a lucid and comparable perspective on the sustainability performance of European countries in the domain of tourism. However, it is crucial to acknowledge that a singular indicator may obscure significant variations within each sustainability pillar, warranting further analysis and understanding of specific aspects within the broader framework of tourism sustainability.

5. Conclusions

This paper aims to develop a framework for assessing the sustainability levels of tourist destinations and addressing the future challenges faced by the European tourism sector, as emphasized by the European Commission. Within the context of the tourism sector, two primary requirements are identified as deserving particular attention. Firstly, the European Commission recognizes the importance of acquiring a better socio-economic understanding of tourism and its interactions with the environment. Enhancing this knowledge is fundamental for promoting the sector's competitiveness and fostering the development of responsible tourism characterized by quality, diversity, and sustainability. In response to this need, the "EU Tourism Dashboard" has been developed and is currently maintained by the Joint Research Centre of the European Commission and the DG GROW, in compliance with the invitation of the Council of the European Union on May 27, 2021. This system has been comprehensively quantified, enabling the utilization of statistical information available from European governmental entities. One of the key findings highlights significant disparities among destinations in terms of the considered indicators, underscoring diverse performance and sustainability profiles within the tourism sector. These conclusions emphasize the necessity of adopting personalized and targeted approaches to address the specific challenges and opportunities encountered by each destination in pursuing sustainable tourism development. The observed heterogeneity underscores the importance of taking a holistic approach facilitated by the use of composite indicators to analyse sustainable tourism. By integrating multiple indicators, a comprehensive understanding of the various sustainability profiles and performance levels exhibited by different destinations can be achieved. On the other hand, the European Commission places significant emphasis on enhancing Europe's image and reputation as a collection of high-quality and sustainable tourist destinations. Progress in this area is crucial to strengthen the attractiveness of

destinations and increase the flow of demand, both by attracting non-European visitors and consolidating domestic demand. To address this need, this article proposes a ranking which enables the evaluation of each destination in terms of sustainability, dividing this assessment into three dimensions: environmental impact, digitalization, and socioeconomic vulnerability. To define this ranking, a composite indicator based on the Mazziotta-Pareto index is adopted. The continuous use of the proposed indicator system and its associated aggregation methodology could contribute to the establishment of a standard for assessing the sustainability performance of the 27 European Union countries in the tourism sector. The proposal of a Sustainable Tourism Ranking and its regular updates could contribute to improving the image of European areas as high-quality and sustainable destinations, aiming to attract a greater flow of tourist demand. Furthermore, this tourist demand could differentiate various European destinations based on their position in the sustainability ranking. Countries would be incentivized to maintain and improve their position in the ranking, thereby promoting the exchange of experiences and the adoption of benchmarking practices. The analysis presented in this article serves as a starting point for the study of a key issue in the sustainable development of European tourism. Further research is crucial to delve deeper into the evaluation system and study its implications and the enhancements it brings to destination activities. Furthermore, although the proposed indicator aggregation system is designed to manage the ranking at the national level, it can also be applied at lower territorial levels, such as small urban cities, rural and coastal tourist destinations, regions, and other territories that share common tourism resources. In any case, the availability of statistical information to quantify the initial indicator system is a key element for the success of this type of analysis.

Conflict of interest

All authors declare no conflicts of interest in this paper.

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Supplementary

Annex 1. Description and polarity of sustainability indicators divided by pillars.

ENVIRONMENTAL IMPACT

INDICATORS	Polarity with pillar	Description
Air travel emission intensity	*(-)*	Average amount of CO2 emitted per air passenger
Tourism GHG intensity	*(-)*	Amount of greenhouse gas (GHG) emissions produced by the tourism ecosystem per Million Euro of Gross Value Added (GVA) in the tourism sector
Tourism energy intensity	*(-)*	Amount of energy used in tourism-related economic activities per Million Euro of Gross Value Added (GVA) in the tourism sector
Share of trips by train	*(+)*	Share of trips taken by train
Excellent bathing water	*(+)*	Share of sampled bathing water sites that are classified as "excellent" within a tourist destination
Dependence on distant origins	*(-)*	Share of nights spent at accommodation establishments by foreign tourists arriving from distant origins (more than 2000 km)

DIGITALISATION

INDICATORS	Polarity with pillar	Description
E-commerce sales	*(+)*	Percentage of tourism ecosystem enterprises with online sales
Enterprises using social media	*(+)*	Share of tourism ecosystem enterprises using two or more social media
Personnel training on digital skills	*(+)*	Share of tourism ecosystem enterprises providing ICT training to their personnel
Enterprises seeking ICT specialists	*(+)*	Percentage of tourism ecosystem enterprises seeking ICT specialists
Internet speed at tourism destinations	*(+)*	Maximum available speed of internet connection at tourism destinations (municipality level), considering both fixed and mobile networks
Accomodations listed online	*(+)*	Difference between observed number of tourist accommodation rooms (in hotel and short-term vacation rentals) listed on a key online platform (TripAdvisor) with the expected number of listed number of rooms given known tourism demand

SOCIO-ECONOMIC VULNERABILITY

INDICATORS	Polarity with pillar	Description
Tourism intensity	*(-)*	Number of nights spent at tourist accommodations by the resident population
Tourism seasonality	*(-)*	Coefficient of variation of nights spent at tourist accommodation establishments per month
Dependence on top3 countries of origin	*(-)*	Share of the nights spent from the top three countries of origin for each destination country in relation to the total nights spent in the destination country
Tourism diversity	*(+)*	Shannon diversity index of the distribution of tourism accommodation establishments across five geographical zones within a destination: cities, coastal areas, rural areas, natural or mountainous areas, and snowy mountains

Contribution of tourism to employment	*(+)*	Net overall effect of tourist arrivals at accommodation establishments along the value chain (direct, indirect, induced and catalytic effects in related activities) and the whole tourism ecosystem
Average tourism expenditure	*(+)*	Average economic value generated per night spent at the tourist destination

BASIC DESCRIPTORS

INDICATORS	**Polarity with pillar**	**Description**
Night spent	*(+)*	Total number of nights spent at tourist accommodation establishments in a destination (country or region) in a given year, from both domestic and foreign tourists
Arrivals	*(+)*	Total number of arrivals at tourist accommodation establishments in a destination (country or region) in a given year, from both domestic and foreign tourists
Tourism capacity	*(+)*	Number of beds available at tourism accommodation establishments available at a destination (country or region) in a given year
Occupancy rate	*(+)*	Percentage of time within a year that available beds within a tourist destination (country of region) are occupied by tourists
Average duration of stay	*(+)*	Total number of nights spent divided by the total number of tourist arrivals
Tourism density	*(+)*	Total number of nights spent over a year in a tourist destination (country or region) per square kilometre of land of the tourist destination
Dominant tourism typology	*(+)*	The classification is first determined at NUTS3 level based on the proportions of tourism capacity (i.e., no. of rooms) across different geographical zones. The NUTS3 classification is then aggregated to NUTS2 level by selecting the category with the highest aggregate tourism demand (nights spent).
Share of foreign tourists	*(+)*	Share of nights spent by foreign tourists in relation to the total number of nights spent (domestic and foreign) in accommodation establishments
Progress of tourism recovery	*(+)*	Proportion of nights spent in a given year in relation to the equivalent period in 2019 (baseline)
Presence of blue flags	*(+)*	Number of “Blue Flag” awarded to beaches, marinas and tourism boats operators
UNESCO sites	*(+)*	Number of World Heritage Sites designated by UNESCO
Share of protected/designated land	*(+)*	*Share of protected/designated land belonging to the European networks Natura 2000 or Emerald Network in relation to the total area of the country or region*

Source: Author elaboration EU tourism Dashboard data