

DEFINITION AND CONSTRUCTION OF A COMPOSITE INDICATOR OF SUSTAINABLE TOURISM

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SOMMARIO

In questo lavoro si propone di misurare il turismo sostenibile attraverso un indicatore composito, uno strumento che consente la comparazione di performance territoriali ed è sempre più riconosciuto come mezzo utile per l'analisi di politiche e la comunicazione pubblica. Nello specifico, viene esaminata la sostenibilità turistica delle venti Regioni Italiane con lo scopo di individuare i territori con maggiore propensione al turismo sostenibile e di sperimentare e confrontare i diversi metodi di aggregazione per costruire un indicatore sintetico. Tale strumento è formato quando indicatori individuali sono messi insieme in un unico indice sulla base di un modello sottostante; dovrebbe idealmente misurare concetti multidimensionali che non possono essere catturati da un indicatore singolo. Dato che il turismo e la sostenibilità rientrano in tale categoria di fenomeni articolati, la loro misurazione attraverso un indicatore composito risulta idoneo. A fronte della complessità del fenomeno turistico e della vastità delle variabili che lo caratterizzano, si assiste sempre di più all'esigenza di disporre di un insieme comune e robusto di dati, fondamentale per i governi e le parti interessate al fine di progettare, attuare e monitorare adeguate ed efficaci politiche di turismo sostenibile.

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1. Introduction

Tourism is a social, cultural, and economic phenomenon that has an increasingly important role for countries: it contributes to economic growth, social development, and worldwide mutual understanding. It involves many sectors and for this reason it impacts the economy, the environment, and the local population, as well as the visitors themselves. In the past seventy years the number of tourists in the world has grown exponentially and according to the World Tourism Organization (UNWTO) international arrivals will reach 1.8 billion in 2030 (UNWTO, 2019) ². It is evident that a movement of this magnitude requires careful planning and consequently it is in the interest of stakeholders to maintain and sustain the basis for tourism's prosperity, that is destinations.

Tourism is a mixed reality that is made up of tangible and intangible elements; it consists of a variety of activities and it involves different actors. An indication of its complexity is the absence of a precise and clear definition that satisfyingly grasps all of its facets. Since it can be analysed from multiple points of view, its definitions are heterogenous and have been conceived to meet various needs and situations.

To better understand the fragmented and multifaceted nature of tourism, it may be useful to consider it as a system, based on the model proposed by Leiper (Leiper, 1979) and taken up by other scholars (Cooper *et al.*, 2008). Tourism can be considered as a set of individuals, companies, organisations, and places that combine and mix in different ways to produce a travel experience. There are three fundamental elements that contribute to form the phenomenon of tourism: the human, the geographical and the industrial element. These three macro dimensions are interdependent, and tourism develops from their dynamic interaction. Because of this multidimensional, transversal and interdisciplinary nature, an analysis of tourism is inevitably complex. Nonetheless, this should not lead to analysing its single parts separately or considering it as an extension of other activities. It is important to think of and examine tourism in a systemic prospective since this takes into consideration the different elements that interact and can be used as an analytical basis for creating policies. With the large-scale and widespread configuration of tourism, it is important to have a central governing body that will consider the structure of the system when decisions are to be made. Furthermore, given the importance and extent of tourism and its influence in other fields, there is the need to quantify and measure it, despite the potential risk of oversimplification.

2. The growth and the impacts of tourism

In the last seventy years, tourism has gone from not even appearing as an entity and as a separate industry on national indices (Becker, 2013) to generating 10.4% of the world's GDP (8.8 trillion USD in 2018). According to the World Travel & Tourism Council (WTTC, 2019b), the travel and tourism industry employs one person out of ten, for a total of 319 million. The number of international arrivals in 1950 was 25 million; from that moment on it has grown exponentially, hitting 1 billion in 2012 and reaching 1.4 billion in 2018, two years ahead of UNWTO's forecast.

By looking at these numbers, it is easy to understand why tourism is considered one of the fastest growing economic sectors in the world and why it is seen as a key factor for socio-economic development, thanks to its contribution to employment, infrastructure development and export revenue. Tourism today is the world's third largest export category after chemicals and fuels, ahead of automotive products and food. It has become one of the major players in international trade and it also represents one of the main sources of income for many developing countries. Due to its impact on other sectors of the economy, it generates additional demand in terms of services and professions and therefore of direct and indirect employment.

² [Ed: This paper was written before the crisis caused by COVID-19. Clearly, the pandemic has had and will continue to have a major impact on tourism, decelerating the forecasted growth and causing a temporary contraction of the sector. However, as demonstrated by previous traumatic events (e.g. 9/11 or the 2008 financial crisis), tourism has the resiliency to rebound and most likely it will recover. Nonetheless, the COVID-19 pandemic has highlighted the problems of the sector and the need to implement practices of sustainable tourism is more evident than ever].

The reasons for such sustained growth are manifold and some reflect the general changes and evolution of society. Among the main causes it is possible to list:

- demographic growth: global population has gone from about 3 billion people in 1960 to more than 7 billion currently. If the number of people in the world increases, then so does the number of people in the world who travel;
- the increased level of general well-being: with rising average living standards, with higher spending power and with new emerging middle classes in different countries (primarily in China), there is a greater inclination to travel for a larger amount of people;
- lower transportation costs: low-cost airline companies have made travelling accessible to more people. Additionally, the offer of the low-cost flights to many minor airports has increased the number of reachable destinations, especially in places where the access to big hubs in the past was limited or difficult. This has enabled to reach new market segments, both for income and for location;
- the expansion of sharing economy: Airbnb, Uber and other similar platforms have made it easier to find accommodation and means of transport at a moderate price, allowing more people to travel and move around. Sharing goods and services among individuals is not a novelty. However, the development of internet and the creation of online platforms have made sharing easier than ever;
- the increased use of social media: in recent years, social media has changed how people connect and communicate with each other, how they express and share ideas and how they interact with products, brands and organizations. This has had consequences also in the tourism sector and social media is increasingly connected to tourism in several ways, such as seeking information and making decisions for the consumer, and for promoting and marketing on behalf of companies and destinations. It has been demonstrated that the effective use of social media increases the number and length of travels, as well as visitor satisfaction. Research on social media in tourism and its quantitative and qualitative impact is a field in full development. There is still a lot to investigate, but undoubtedly Instagram, TripAdvisor and many others have played a role in the change and expansion of tourism (Zeng-Gerritsen, 2014).

It is therefore evident that some significant economic, social, cultural and technological transformations of the general environment have stimulated the spread and growth of tourism. In turn, however, it is also the phenomenon of tourism itself that is accountable for change: the movement of millions of people and the amount of business that this entails (and also for the very nature of tourism that affects so many aspects and different fields) inevitably cause a series of economic, socio-cultural and environmental impacts. If tourism is really to be used as a key factor for socio-economic development and well-being, it is important to first identify these impacts and then understand how to maximise the positive and minimise the negative ones.

From an economic point of view, the potential benefits that tourism can create consist in: the exportation of goods and services that strengthen local economies and attract investments, with consequent intensification of monetary flows; the enhancement of infrastructures and services with the goal of improving accessibility and internal mobility; the increase in employment in sectors directly and indirectly related to tourism. However, there is a downside and, just as in any market, if development is out of control and not managed with appropriate policies, it may cause side effects. The main negative economic externalities include:

- tourism dependency: if the local economy is not diversified and linked only to tourism, it is exposed to great risks and the economy could collapse if events negatively affect tourism. The risks associated with subordination to a single economic activity are higher in tourism given the elasticity and uncertainty of the demand and since circumstances, such as natural disasters or economic recessions, can be disastrous for a tourist destination;
- tendency towards specialization: if financial and human resources are concentrated only on the development of tourism, there is more of a likelihood for a “tourism monoculture”, which causes a distortion within the local economy and capital is removed from other important sectors. For example, the building of tourism infrastructure (such as airports and highways), whose costs in many cases are supported by public entities, may represent an opportunity, but these expenditures may also mean a loss for other public services (such as healthcare or education) (Cicerchia, 2009);

- seasonality: tourist flows are amassed in certain periods of the year. This destabilises the regularity of revenues and employment rates for the local economy (Sciuto-Cicirello, 2010);
- inflation: at a local level, the presence of tourists can generate a significant variation in economic values, with a higher demand for some specific goods and services which causes the increase in prices, with negative consequences especially for residents;
- leakage: this refers to the way in which revenue generated by tourism is lost to other countries' economies, usually to those with a higher rate of economic development than that of the tourist destination. This happens because not all benefits generated by tourist expenditures remains in loco. Leakage occurs through different mechanisms, mainly of two types: import leakage and export leakage. In the first case, to satisfy their visitor's demand, many countries must import goods and services. It should be emphasized that, in most cases, foods and beverages consumed by tourists are imported from industrialized countries not due to the scarcity of local products, but because hotel chains and restaurant offer international products. The second type of leakage occurs when foreign investors, such as large multinational companies, fund the construction of tourism infrastructure and then take back the profits to their home countries. Leakage is calculated by the combination of these negative factors. It is estimated that in all-inclusive travel packages, 80% of the cost that a traveller pays does not generate any income for the hosting country (Confalonieri, 2013);
- enclave tourism: this refers to tourism development that generally operates within a clearly demarcated, self-contained environment, segregated from the community outside. Tourist activities and movements are arranged to facilitate maximum expenditures within the enclave while access to locales outside the enclave is often restricted and regulated. That means that enclave forms of tourism play a significant role in creating dependencies and adverse impacts, such as lack of local control and local ownership, marginalisation of local benefits, and prevention of meaningful interactions between residents and tourism. This is usually in the context of all-inclusive environments, such as cruise ships or resort complexes.

When these mechanisms occur, the profit for the host community decreases significantly. Furthermore, these dynamics trigger social issues between tourists and residents, who have to share the same territory but interact with it differently, creating the potential for conflictual interactions. In fact, tourism may considerably alter the quality of life of the host population, both for the better or for the worse. Negative socio-cultural impacts can be:

- competition for the use of resources: the pressure of the tourists' physical influence may lead to social tensions due to the difficulty in accessing infrastructure, services and local resources that are shared between the community and the tourists. This may cause a general discontent and stoke a feeling of hostility, since neither side is able to meet their different needs in a satisfying way;
- alienation of residents: an excessively high number of visitors compared to inhabitants may change the features of a residential area, making it less suitable for them and causing "touristification" of the place, for which it becomes an object of tourist consumption;
- loss or change of cultural identity: in order to meet visitors' expectations and to adapt to their requests, it may occur that local traditions are transformed into purely commercial activities, deprived from their authentic meaning. This causes the community to detach from their typical cultural values and the spirit of belonging to a community is lost;
- cultural conflicts: the phenomenon of tourism brings people with different cultural backgrounds and social models into contact. These differences can lead to clashes and influence the interaction between visitors and locals. Conflicts can worsen due to major income disparities, which manifest themselves in diverse consumption patterns. Another possible source of hostility may be caused by tourists' behaviour who, out of ignorance or disinterest, do not respect local customs.

On the other hand, a different kind of tourism contributes to the development of an area and generates opposite results to those described, creating opportunities for the host community. For example, the interest shown by tourists for local customs may help consolidate and enhance traditions, strengthening the bonds within the community and increasing pride of their culture. Furthermore, tourism may lead to greater openness

and enhance social dynamics of peace and communication, due to a better understanding and knowledge between different cultures. Also, new employment opportunities and consequently mitigation of poverty is one of the most positive aspects of tourism. This can be a way to curb urbanisation and the depopulation of rural areas or small villages. Additionally, according to a research conducted by the WTTC (WTTC, 2019a), the travel and tourism sector offers women greater opportunities for participation, leadership, entrepreneurship and empowerment compared to other sectors, thus contributing to gender equality. However, often jobs in tourism (regardless of whether they are covered by men or women) are not specialised and are subjected to seasonality, thus resulting in low paying jobs. Therefore, it may happen that tourism, while it helps to solve a country's employment issues, at the same time it replaces them with new conflicts and problems.

This underlying ambivalence of tourism becomes even more evident when examining the impacts it has on the environment and the territory. If on one hand it may increase awareness of the importance and conservation of natural, cultural and artistic heritage as a fundamental tool for tourist development, on the other hand an excessive and incorrect use of an area causes environmental pressure and triggers an impoverishment and consumption of resources. From an environmental point of view, the most serious damages that tourism can cause are:

- over-exploitation of raw materials: due to the concentration of more people in one place, tourism may increase the demand for energy and water disproportionately to what the area is able to offer. Hence, drastic and devastating solutions are often used to meet the needs of consumers. For example, tourism doubles the population of the island of Rhodes in peak season, which roughly doubles energy demand. Because peak demand during the hot Greek island summers drives energy plants past their supply limit, Greece gave the green light to finance a new diesel-fired power plant in Rhodes to stem the energy deficits and supply growing tourism demand (Epler Wood *et al.*, 2019). Also, water consumption, which is very high in the tourism sector, leads to major problems, especially because most of the demand occurs during periods of the year or in places in which water is already scarce, such as coastal regions and islands or in summer months. The UNEP (United Nations Environment Programme) has estimated that tourist consumption of water per capita in developing countries exceeds ten to fifteen times the use by the local population (UNEP, 2005);
- increase of waste production: obviously, with more people in a certain area, there is more waste production; however, it seems like an individual produces more waste when on vacation compared to a context of daily life (UNEP, 2003). Moreover, hotels contribute significantly to waste production due to the nature of their facilities and services. All this aggravates the issue of waste disposal, which is already a problem in many places, regardless of tourism;
- pollution: pollution caused by tourism is similar to pollution caused by any other productive activity, namely: air, water, sound and visual pollution. The global carbon footprint of tourism represents 8% of global greenhouse gas emissions and most of this footprint is exerted by and in high-income countries (Malik *et al.*, 2018). Ground and air transport are significant contributors, but also activities linked to shopping and food have their share. This confirms that tourism is a category with a high carbon intensity;
- decay of natural and cultural heritage and loss of biodiversity: with an improper management of tourism flows and by adopting a perspective that favours short-term economic profits, the natural and cultural resources run the risk of being completely depleted because of their overuse. This consequently leads to changes in the landscapes, like soil erosion, reduction of flora and fauna species and collapse of historic and archaeological buildings.

Therefore, the question is how to create the right balance between use and conservation. The possibility of tourism to develop in the long term and the ability to establish a virtuous relationship between tourism and a territory depend on the capability to preserve and enhance the resources that stoke the touristic attraction and use.

3. Sustainable tourism

In light of the above, it is clear that tourism has a dual nature: on one hand it creates opportunities and benefits, on the other it causes conflicts and struggles. This is a feature that is common to almost all economic and production activities, which is why a sustainability paradigm has been developed as a means to address the contradictions.

The concept of sustainable tourism was introduced more than twenty years ago, and it is more and more relevant in national and international agendas. The definition of sustainable tourism given by the World Tourism Organization closely resembles the idea of sustainable development: «Sustainable tourism acknowledges the needs of today's tourists and host communities while protecting and improving the opportunities for the future. It is capable of managing resources in such a way to respond to aesthetic, social and economic needs, while maintaining cultural integrity, essential economic processes, biological diversity and life support systems».

Therefore, sustainable tourism takes into account its present and future impacts on economy, society and environment, by meeting the needs of visitors, industries and host communities (UNEP, 2005). Its goal is to nullify the negative effects that an excessive and out of control tourism development can cause. The result is that sustainable tourism should:

- Make optimal use of environmental resources that constitute a key element in tourism development, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity.
- Respect the socio-cultural authenticity of host communities, conserve their built and living cultural heritage and traditional values, and contribute to inter-cultural understanding and tolerance.
- Ensure viable, long-term economic operations, providing socio-economic benefits to all stakeholders that are fairly distributed, including stable employment and income-earning opportunities and social services to host communities, and contributing to poverty alleviation.

Essentially, pursuing sustainable tourism development objectives means to put together economic profitability, local prosperity, quality of work and employment, social equity, local control, community well-being, cultural wealth, physical integrity, biodiversity, efficiency in the use of resources and environmental purity, resulting in visitor satisfaction. These are ambitious goals, but they are necessary to make tourism a key factor for local development and to prevent a destination from becoming a victim of its own success. The economic, environmental and sociocultural impacts of tourism become aspects to consider in a synergical and systemic way in order to implement strategies and actions that go beyond profit. Therefore, sustainable tourism is not a type or a choice of tourism, but rather it is *the* tourism, the only form of tourism that should exist, subsequently expressed in all of its different varieties (cultural tourism, seaside tourism, eco-tourism, congress tourism, etc.).

Sustainable tourism development guidelines and management practices are applicable to all forms of tourism in all types of destinations, including mass tourism and the various niches and tourism segments. This means that tourism is sustainable when it is professionally managed and planned by following specific principles that aim at the maximisation of the positive impacts, creating benefits that are equally distributed among all stakeholders. Implementing citizen participation becomes a fundamental step towards sustainable management; it is necessary to summon, listen and involve all the stakeholders of a destination to come up with solutions that offer and supply more integrated services (Magliulo, 2012). Tourism businesses and the territory must "become a system", which means operating in an integrated way with a common strategy for specific purposes. In this way, destinations will portray a network of different players and governance tools. The presence of a governing body that is able to ensure the general direction of the system and make decisions for territorial planning is essential. Also, there must be a management body that promotes and effectively links supply and demand. Destination governance and destination management are therefore fundamental tools for an accurate planning and management of tourism systems. Sustainable tourism development requires the informed participation of all relevant stakeholders, as well as strong political leadership to ensure wide participation and consensus building. Achieving sustainable tourism is a continuous process and it calls for constant monitoring of impacts, introducing the necessary preventive and/or corrective measures whenever necessary.

4. Measuring sustainable tourism with indicators

Having understood and emphasized that sustainability is the only long-term path tourism can undertake, the issue that follows is how to measure it in order to know if the selected direction is the right one. Measuring sustainability is essential for making informed decisions on all scales so that tourism can be a positive contributor to development. Without valid and effective measures, it is not possible for policy makers to extract the necessary information to make correct choices and to manage tourism in a sustainable way.

One of the most common approaches to measure and quantify complex phenomena, such as tourism and sustainability, is to develop and use indicators. An indicator can be defined as «an instrument that indirectly determines the level of a complex social phenomenon, which cannot be measured statistically in a direct way, but it is measured instead through other phenomena that have a high semantic content in common» (Delvecchio, 1995, p.54). In other words, indicators evaluate phenomena by observing similar or related phenomena whose measures *indicate* the concept of interest. They are measures of the existence and/or of the severity of issues or problems to be utilised as a means to identify and assess the result of mitigating actions or measures.

Related to indicators are indices. While indicators imply a complex of relations, an index is a pure numerical entity, the result of the ratio between two phenomena (Iezzi, 2009). It is therefore a merely mathematical transformation that links two or more raw data but creates information and knowledge. An index becomes an indicator when it is closely linked to a conceptual referent that is part of a research model (a priori) or an interpretative scheme (a posteriori) (Aureli Cutillo, 1994). The concept of indicator is therefore more complex than the concept of index: while the index measures the level of a calculable phenomenon, the indicator is related to a multi-faceted phenomenon whose evaluation can also take place in multiple dimensions.

Therefore, indicators represent a tool for reading the complexity of phenomena and are used to understand problems that do not have an immediate interpretation by providing an "indication relationship" between a more general concept and specific and analytical aspects. An articulated phenomenon can be looked at through a series of simple concepts which get broken down and quantified to represent and facilitate the communication and understanding of the phenomenon itself. The indicator must illustrate a certain feature or characteristic of the phenomenon. Seen in this light, indicators can also be used as criteria and evaluation methods. This is why, from an operational point of view, indicators have become important in the support for policies and management decisions.

Most social phenomena can be expressed by a multiplicity of variables, each empirically observable, but which only together represent the complex phenomenon. A complex social phenomenon can therefore be defined as "that described by k number of variables ($k > 1$)", different from a simple social phenomenon that is delineated instead through one single attribute (Iezzi, 2009). The variables are the elementary indicators that together recompose the general picture. Consequently, indicators can be divided into three levels:

1. Simple indicators: these are conveniently constructed variables that concern specific aspects. They are used if the empirical referent is associated with one single feature or instead, they can be considered the first step in the construction of more complex measures.
2. Thematic indicators: these are derived from the combination of simple indicators into thematic groups, that express different aspects of the same dimension to which they refer to but are not combined yet into one single indicator.
3. Composite indicators: these are assembled by combining thematic indicators into a single synthetic measure following established criteria or rules; it is a set of features observed on the same statistical unit, synthesised by means of a logical-mathematical operation.

A composite indicator is therefore the measure of the level of a multidimensional concept that cannot be established by a single indicator, but rather is formed by an appropriate combination of elementary indicators in a single synthetic index. Simplistically, a composite indicator summarises the information collected in a set of varied indicators.

The use of composite indicators as tools for policy makers and for communication is increasingly common since they provide an immediate and straightforward interpretation of complex and sometimes elusive

problems. In fact, often it is easier to interpret composite indicators rather than to search and find a common trend in many separate indicators; moreover, they have proven useful in benchmarking territorial performances (Saltelli, 2007). The application of a composite indicator to a series of countries can result in a ranking with performance scores regarding the analysed phenomenon. However, if a composite indicator is constructed incorrectly or misinterpreted, it can send misleading and deceptive messages. The "general picture" they provide as a result can lead to simplistic conclusions and often doubts are raised about their robustness and the meaning of the associated interpretations. This scepticism is mostly due to the lack of transparency of some existing indicators, especially as far as methodologies and basic data are concerned, and to the large dose of subjectivity that the construction process presents. On the other hand, a sound process of construction cannot remedy an inadequate framework or poor-quality data. Thus, the creation of a composite indicator requires balance between different aspects, all equally important in defining the quality and the usefulness of the composite (OECD, 2008).

Another common misconception is that a league table, which is the result of a composite indicator, does not have universal legitimacy: scores are only valid within a given set of hypothesis, thus the use of league tables, albeit appealing in attracting public attention, is not to be intended as final and definitive results. Rather, composites should give a set of reference points towards which to benchmark the performance of a single country and should be seen as a starting point for initiating discussion and attracting public interest.

5. Proposal and application of a composite indicator for sustainable tourism of the Italian Regions

As previously stated, tourism is a complex and multifarious phenomenon; the same can be said for sustainability, which refers to multiple dimensions. For this reason, indicators are suitable for measuring sustainable tourism and helpful for the definition of political priorities, comparative analysis between territories and monitoring performances. Consequently, the use of a composite indicator to assess the sustainability of the tourism phenomenon is here proposed, focusing specifically on measuring the sustainability of tourism in the twenty Regions in Italy.

First of all, though, it is necessary to stress a few essential and fundamental points: sustainability is not related only to the environment, as it is often believed, but instead it refers to four dimensions:

- 1) Institutional dimension
- 2) Economic dimension
- 3) Social dimension
- 4) Environmental dimension

Also, it is important to keep in mind the sprawling nature of tourism and the impacts it can generate in multiple spheres. Maximising the positive effects and minimising (if not cancelling) the negative externalities of tourism means managing and implementing sustainable tourism. For this reason, sustainable tourism is not a type of tourism (as eco-tourism can be, with which it is frequently confused), but rather it is the tourism towards which it is important to strive.

The first step taken for building a system that evaluates sustainable tourism was to identify a precise theoretical framework and to select relative variables. Simple indicators were chosen by observing the impacts of tourism, translating them into quantifiable phenomena and determining in what area they had an effect. This was done also by considering the type of destination examined, i.e. the Italian Regions, since the territorial entity has an important role in the analysis. A study conducted at a regional level will have different parameters than one carried out at national or municipal level. Furthermore, different destinations involve different "categories" of tourism: for example, the type of tourism that takes place in a city is not the same as the one in a ski resort, and the same applies for the different impacts that are generated. Although it is unthinkable to have a set of indicators universally pertinent to all destinations, some common themes and macro areas can still be identified, and a table of basic indicators was drawn up.

The decision to analyse the sustainability of tourism at a regional level was driven by the fact that tourism jurisdiction in Italy is mostly entrusted to the Regions. Furthermore, the possibility of having homogeneous

and recent data was considered. Unfortunately, this availability proved to be quite limited, as most of the needed data was not up to date. As a consequence, the year 2017 was taken as reference to have the most homogeneous data possible. Some indicators though only had data referring to preceding or subsequent years; in any case, they were still taken into account in order to avoid an incomplete picture and for the purposes of the analysis. In fact, this work has didactic and experimental objectives; this necessarily implies limits due to the impossibility of access and availability of information. On the other hand, it was actually the lack thereof that caused the limits. Therefore, certain indicators considered at the beginning were discarded due to the absence of data and they were instead replaced with others that related to the same phenomenon, but with a different measurement.

5.1. Indicator selection

Indicators were selected also by taking a cue from the indicators of the UNWTO (UNWTO, 2004) and ETIS (European Union, 2016); based on the subdivision of the latter, they were distributed into four dimensions:

- 1) Destination management: due to the transversal nature of tourism in many sectors and the multiplicity of actors and stakeholders involved, local governance has a central and fundamental role in the path towards sustainable tourism and in sharing the values of sustainability. Therefore, the main goal was to identify the institutional orientation towards these principles.
- 2) Economic sphere: given the strategic role that tourism can play for the economy, it was essential to understand what benefits it can produce compared to the damage it can cause.
- 3) Social dimension: tourism is a social phenomenon; for a tourist visiting a destination, it is an activity that takes place in a different context from the normal everyday routine, while for the resident that lives in that destination, the activity occurs in the daily context. In order to guarantee quality for both, it was important to analyse and evaluate the type of relationship that is generated as a result of the contact and overlap of these two contexts. Additionally, tourism can be an opportunity to improve the living conditions of residents and consequently also the tourist experience. New jobs, for example, are one of the most interesting aspects of tourism, but not all jobs are the same: decent yearlong employment that guarantees gender equality contributes more substantially to a better quality of life of the residents.
- 4) Environmental dimension: tourism can be a double-edged sword for the environment; if on one hand it can be used as a means of safeguarding environmental assets, on the other it can be the cause of its deterioration. Therefore, it is necessary to know how much tourism represents a threat or an opportunity for the territory to avoid causing irreversible damage and to allow interventions aimed at conservation.

After having verified the correlation between the variables in order to identify and eliminate redundant elements, a total of 22 simple indicators were selected:

1. Investments in tourism: The indicator measures the percentage of investments in the tourism sector compared to the total of investments, therefore indirectly measures the Region's commitment to the development of tourism activities. In fact, it is important to identify the local planning ability and commitment towards the development of tourism in order to understand the value that is attributed to it and the possibility of implementing sustainable tourism practices.
 - Dimension: Destination management
 - Measure: % of capital expenditure in tourism
 - Source: ISTAT
 - Year of reference: 2017
2. Sustainable development and environment protection: The indicator represents the percentage of current expenditures for sustainable development compared to the total current expenditures of the Region. The calculated expenses for sustainable development are for: soil protection; environmental

protection, enhancement and recovery; waste management; integrated water service; protected areas; natural parks; nature and forest protection; sustainable development of mountain areas and small municipalities; air quality; pollution reduction. The aim of the indicator is to quantify the local will and interest in a type of development that respects the territory and implements the principles of sustainability. Its relation to tourism: sustainable development expenditures make a region more attractive to tourists and it also promotes tourism. Therefore, expenses in sustainable development contribute to creating more sustainable tourism.

- Dimension: Destination management
 - Measure: % of current expenditure for sustainable development and environment protection
 - Source: ISTAT
 - Year of reference: 2017
3. Cultural heritage: The indicator measures the percentage of current expenses for the protection and enhancement of cultural assets compared to the total current expenses of the Region. Cultural heritage is a tourist attractor, but it can easily be impoverished if not adequately safeguarded. Sustainable tourism takes into account long-term objectives and triggers a positive virtuous circle: by spending for the maintenance and proper management of a cultural asset, this is preserved for a longer period of time and is enriched with value, and, as a consequence, the number of visitors increases over time. The objective is to identify the local interest in conservation and protection of cultural heritage, but also to evaluate the acknowledgment of the local cultural identity.
- Dimension: Destination management
 - Measure: % of current expenditure for the safeguard and enhancement of cultural heritage
 - Source: ISTAT
 - Year of reference: 2017
4. Agritourism farms: The indicator measures the number of agritourism farms per 100 km². Some studies (Paniccia *et al.*, 2017) have shown that agritourisms are able to contribute to the sustainable development of rural areas, as well as to the development of the tourism sector, by having a positive impact on three dimensions of sustainability: economy, society and environment. In fact, agritourisms enhance rural areas which are often located outside classic tourist routes; they convey authentic experiences through the places, the services and the people involved in their reality; they economically support the activity of the farm and the local economy. Agritourism farms represent a business model oriented towards sustainability, create virtuous processes and improve the territory's and the competitiveness amongst the agritourism establishments. Therefore, it is important that decision and policy makers promote, encourage and support this type of activity and provide adequate support for agricultural businesses and their entrepreneurs.
- Dimension: Destination management
 - Measure: number of agritourism farms per 100 km²
 - Source: ISTAT
 - Year of reference: 2017
5. Tourist satisfaction: Visitor satisfaction is an important factor since a satisfied tourist can trigger, for example by word of mouth, virtuous circles of economic return for the destination. A satisfied tourist is indicative of good tourism management and can therefore represent an indicator. In the absence of appropriate surveys that evaluate visitor satisfaction and the lack of data that measures the percentage of tourists returning, the Regional Tourism Reputation Index (RTR) (Demoskopika, 2019) was used as an indicator. Developed by the Demoskopika Institute, it is itself a composite indicator. Its aim is to measure the level of reputation of the regional tourism system by observing some simple indicators, such as the visibility, the interest and social appeal of regional institutional tourist portals, the popularity and trends of each regional destination and the reputation of the accommodation system.
- Dimension: Destination management
 - Measure: RTR Index score
 - Source: Demoskopika Institute

- Year of reference: 2019
6. Environmental certifications: A locally widespread presence of environmental management systems indicates a certain level of responsiveness to sustainable development. The goal is to identify to what extent companies incorporate sustainability principles into their activities. The UNI-EN-ISO 14001 is a certificate of compliance with certain requirements that show that the certified business has an adequate management system to keep the environmental impacts of its activities under control and systematically seeks to improve them in a coherent, effective and sustainable way. The number of UNI-EN-ISO 14001 certifications can be considered an indicator of awareness towards the environment by companies and organizations. Having available data relating to the total number of certifications for all generic companies, a hypothetical estimate was made on how many of these could be attributable to tourism companies by keeping the same percentage between the total number of companies and the number of certifications.
 - Dimension: Destination management
 - Measure: estimated % of tourism companies with environmental certifications
 - Source: ISPRA; ISTAT
 - Year of reference: 2017
 7. Tourists' cultural expenditure: The indicator measures the percentage of tourist revenue generated by the cultural and creative production system, meaning how much tourists spend in the cultural sphere. The aim is to identify how much the cultural resources are used as an opportunity and as a production factor. Therefore, it indirectly assesses how much a Region can manage and benefit from its heritage, increasing its quality and increasing the competitiveness of the area.
 - Dimension: Destination management
 - Measure: % of tourist expenditures in the cultural system
 - Source: UNIONCAMERE
 - Year of reference: 2017
 8. Companies' eco-investments: Observing how many companies have invested in green technologies and products that can ensure energy savings and/or less environmental impact, means assessing the general inclination and incentive towards sustainability. The value of the indicator was deducted from the total number of companies that made eco-investments in green technologies between 2015 and 2019.
 - Dimension: Destination management
 - Measure: estimated % of tourism companies that made eco-investments
 - Source: UNIONCAMERE
 - Year of reference: 2015-2019
 9. Tourism businesses: The indicator is the percentage of businesses operating in the tourism sector compared to the total businesses operating in the area; the aim is to identify how much tourism contributes to generating revenue and economic wealth. In fact, indirectly, the indicator also gives an idea on the added value of tourism and its ability to create jobs.
 - Dimension: Economic sphere
 - Measure: % of tourism businesses
 - Fonti: FIPE & FEDERALBERGHI; ISTAT
 - Year of reference: 2017
 10. Wages: Tourism creates and offers many work opportunities, but often they are low-level and low-paying jobs. Sustainable tourism aims to build fairer opportunities. The indicator measures the ratio between the average wage in the tourism sector and the general average wage; the closer this ratio is to 1, less is the difference between the two salaries.
 - Dimension: Economic sphere
 - Measure: ratio between wages in tourism and average wage
 - Source: FIPE & FEDERALBERGHI; ISTAT
 - Year of reference: 2016

11. Net occupancy rate: The occupancy rate of bed places in a reference period is obtained by dividing the total number of overnight stays during the reference period by the total number of the bed places on offer. The result is multiplied by 100 to express the occupancy rate as a percentage. It is a way to estimate how much a tourist facility is used compared to its maximum potentiality. The goal is to quantify the accommodation capacity of hotels, bed & breakfasts and other complementary facilities in order to assess their economic contribution.
 - Dimension: Economic sphere
 - Measure: net occupancy rate
 - Source: ISPRA
 - Year of reference: 2016
12. Seasonal employment: Jobs in the tourism sector are often seasonal and precarious, reflecting the trend of tourist flows. Addressing tourism planning towards seasonal adjustment is one of the main morals of sustainable tourism to guarantee more work continuity. The indicator uses the coefficient of variation as a measure of the variability of the monthly distribution of employees compared to the average annual value; the lower the value, there is less variability and consequently there is less seasonal employment; the indicator is therefore discordant (higher values correspond to worse situations).
 - Dimension: Economic sphere
 - Measure: coefficient of variation of the variability of the monthly distribution of employees compared to the average annual value
 - Source: FIPE & FEDERALBERGHI
 - Year of reference: 2017
13. Airbnb accommodations: According to many studies (Peeters *et al.*, 2018; Goodwin, 2019; Koens *et al.*, 2018; Milano *et al.*, 2019; Epler Wood *et al.*, 2019; UNWTO 2018), the development of sharing economy in general, and of Airbnb in particular, is one of the causes of the phenomenon known as “overtourism”: «Overtourism describes the situation in which the impact of tourism, at certain times and in certain locations, exceeds physical, ecological, social, economic, psychological, and/or political capacity thresholds» (Peeters *et al.*, 2018, p. 22). The main negative effects of Airbnb are associated with its spatial distribution and uncontrolled growth within destinations, which create problems in the real estate market and increase rents and in general the cost of living, causing frustration among residents. In addition, Airbnb is in constant conflict with pre-existing hotels and other types of lodging because it is accused of unfair competition in the absence of common regulatory rules. The indicator measures the number of Airbnb ads in relation to the population; the aim is to assess the extent of contact and the problematic consequences that derive from it. The indicator is discordant since a higher value indicates a more intense relation.
 - Dimension: Social dimension
 - Measure: number of Airbnb ads per 1.000 residents
 - Source: FEDERALBERGHI
 - Year of reference: 2018
14. Airbnb accommodation density: A greater concentration of Airbnb accommodation in an area may increase traffic jams, congestion and pressure on infrastructure. Furthermore, it may cause gentrification and rise prices in city centres and new neighbourhoods. For this reason, it is important to evaluate the number of Airbnb ads in relation to the area of geographic extension of the Region to understand how much competition there is between residents and tourists for the use of the territory. Therefore, the indicator measures the density of the accommodations and is discordant.
 - Dimension: Social dimension
 - Measure: number Airbnb ads per km²
 - Source: FEDERALBERGHI
 - Year of reference: 2018

15. Tourism pressure: The indicator is the ratio between the number of tourists and the number of residents, with the aim of quantifying the relational impact that tourists have in a given location. The indicator measures how many tourist presences occur in one year for every 1.000 inhabitants. It is therefore a discordant indicator.
 - Dimension: Social dimension
 - Measure: number of tourists per 1.000 residents
 - Source: ISTAT
 - Year of reference: 2017
16. Gender equality: Travel and tourism can provide women with more opportunities for workforce participation, leadership, entrepreneurship and empowerment than many other sectors. In fact, at a macro level, there is a stronger representation of women in the tourism sector and this has, across the world, almost twice as many female employers than other economic areas, proving that significant opportunities exist in the sector for women to run their own businesses. This reflects the principle of equity, a fundamental point for sustainable development. Therefore, sustainable tourism proves to be a possible avenue for creating equal opportunities. The indicator represents the percentage of women relative to the total number of employees in the tourism sector.
 - Dimension: Social dimension
 - Measure: % of women working in the tourism sector
 - Source: FIPE & FEDERALBERGHI
 - Year of reference: 2017
17. Territory use: The indicator is the ratio between the number of people present in the territory (given by the sum of the residents and the tourists) and the geographic extension of the Region. The objective is to measure the degree of physical use of a territory and consequently the pressure on its resources. A higher value indicates a more intense use; therefore, the indicator is discordant.
 - Dimension: Environmental dimension
 - Measure: residents+tourists/km²
 - Source: ISTAT
 - Year of reference: 2017
18. Local road transit: Tourism is strongly linked to mobility; therefore, an indicator that measures the effectiveness of movement (both of tourists and of residents, who share services) within the destination is needed. The “seat-km” value is the product of public transport vehicles/km² and the average capacity of the supplied public vehicles. Dividing the value by the total number of potential users (i.e. all residents plus tourists), it is possible to obtain the total number of public transport seats offered to the users throughout the year. A higher value indicates less congestion for the use of public transportation.
 - Dimension: Environmental dimension
 - Measure: seat-km offered by LRT (values per residents+tourists)
 - Source: ISTAT
 - Year of reference: 2017
19. Waste: The indicator detects how much the tourism sector contributes to the production of municipal waste, highlighting how much the waste produced per capita is affected by the tourist movement. The indicator is calculated as the difference between the per capita production of urban waste in relation to the residents and the per capita production of urban waste in relation to the so-called "equivalent population", obtained by adding the number of tourists recorded in the year and spread over 365 days. The aim is to provide the impact of the tourism sector on the production of municipal waste: the higher the indicator the higher the bearing (discordant indicator).
 - Dimension: Environmental dimension
 - Measure: per capita distribution of municipal waste attributable to tourism (kg/residents+tourists)
 - Source: ISPRA
 - Year of reference: 2016

20. Electricity consumption: The indicator provides an estimate of the amount of energy used by tourism businesses. Having the data on the consumption of all private enterprises in the tertiary sector, the indicator represents the amount of consumption corresponding to the percentage of tourism companies compared to the total number of companies in the tertiary sector. This is an important element for quantifying the pressure that tourism exerts on the resources of a territory. This indicator is discordant.
 - Dimension: Environmental dimension
 - Measure: electricity consumption attributable to tourism businesses in Gwh for one hundred million euros of added value
 - Source: ISTAT
 - Year of reference: 2017
21. Bike paths: Bicycling is the form of transport with the least impact on the environment and traffic. Tourism based on bicycle mobility is sustainable since it has enormous advantages for both tourist and destinations, but this obviously depends on the presence and quantity of bicycle infrastructure, like bike paths. The indicator measures the density of bike paths in km per 100 km².
 - Dimension: Environmental dimension
 - Measure: km of bike path per 100 km²
 - Source: ISTAT
 - Year of reference: 2017
22. Protected areas: The indicator is the percentage of land labelled Natura 2000 with the aim of identifying the value of biodiversity in the destination. Natura 2000 is the EU's main tool for the conservation of biodiversity. It is a network of core breeding and resting sites for rare and threatened species, and some rare natural habitat types. It stretches across all EU countries, both on land and at sea. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats. Natura 2000 is not a system of strict nature reserves from which all human activities would be excluded. While it includes strictly protected nature reserves, most of the lands are privately owned. The approach to conservation and sustainable use of the Natura 2000 areas is much wider, largely centred on people working with nature rather than against it. Private entities can be owners of Natura 2000 sites, ensuring sustainable management from both an ecological and economic point of view. The Directive recognizes the value of all those areas in which the presence of man and his traditional activities has allowed the maintenance of a balance between anthropic activities and nature. Sustainable tourism can be a tool to help conserve biodiversity as an asset to be enhanced.
 - Dimension: Environmental dimension
 - Measure: % of land part of Natura 2000 network
 - Source: ISTAT
 - Year of reference: 2017

5. 2. Aggregation

The selection of the indicators led to the definition of a x_{nm} data matrix, consisting of 20 statistical units (the Italian Regions) and 22 variables (the selected indicators), which are all quantitative:

$$x_{nm} = \begin{Bmatrix} x_{11} \cdots x_{1j} \cdots x_{1m} \\ x_{i1} \cdots x_{ij} \cdots x_{im} \\ x_{n1} \cdots x_{nj} \cdots x_{nm} \end{Bmatrix} \quad [1]$$

where n is the number of statistical units, m is the number of elementary indicators and x_{ij} is the value of the indicator j for the statistical unit i . In order to avoid adding more elements of subjectivity, it was decided to not assign different weights to the indicators. Therefore, the following step was the aggregation, for which various techniques were used with the aim of later comparing the results. The synthesis of indicators uses the values of the variables for each statistical unit by applying appropriate mathematical formulas. The synthesis

procedure tends to "measure" the phenomenon by then classifying the units in rankings and calculating the distances between them.

In total, nine methods of aggregation of the elementary indicators were used, whose techniques and main features are summarised as follows:

-) Normalisation: the values of the elementary indicators for each statistical unit were substituted with new values which were re-proportioned in such a way that they ranged between the lowest value in the distribution (x_{min}) and the highest one (x_{max}). The formula used to transform an x_{ij} value (original value) into a r_{ij} value (normalised value) was:

$$r_{ij} = \frac{x_{ij} - x_{min}}{x_{max} - x_{min}} \quad [2]$$

For discordant indicators, the numerator was changed to $x_{max} - x_{ij}$. The new values of each indicator ranged between 0 and 1: the worst value corresponded to 0, the best value to 1 and all the others occupied intermediate positions between these two extremes. The mean of the normalised values of the 22 indicators was then calculated for each statistical unit. The result of this calculation was the value of the composite indicator. With normalisation, the interpretation of the results and the comparative evaluations are simple, but the method is affected by outliers since the range of variation depends on extremes.

-) Standardisation: the values of the elementary indicators were transformed into standard scores or z-scores, namely the number of standard deviations by which the value of the indicator is above or below the mean value. The scores were calculated by subtracting the mean (\bar{x}) from an individual value (x_{ij}) and then dividing the difference by the standard deviation (σ). The used formula was:

$$z_{ij} = \frac{x_{ij} - \bar{x}}{\sigma} \quad [3]$$

For discordant indicators, the numerator was modified to $\bar{x} - x_{ij}$. Practically, the elementary indicators were converted into new values expressed within a common scale whose mean was equal to 0 and standard deviation equal to 1. The composite indicator for each statistical unit was given by the average of the z-scores of the original indicators. The main advantage of standardisation is that the results are clear of the variance, but they are difficult to interpret.

-) Ranks: this method focuses on the order of the statistical units (n) in reference to the elementary indicators (m). The value of the indicator for each statistical unit was substituted with the rank number that the unit occupies in the distribution. As a first step, the statistical units were ordered in rankings according to the single indicators, from the biggest to the smallest value for concordant indicators and from the smallest to the biggest for discordant indicators. Then, each indicator value was replaced with the rank number of the unit in the corresponding league table. Ultimately, these new values were summed together to obtain one final ranking:

$$S_i = \sum_{j=1}^m r_{ij} = 1, 2, \dots, n \quad [4]$$

The composite indicator (S_i) is the sum of the ranks that each statistical unit obtains for every simple indicator: r_{ij} is the rank that the unit i holds in the ranking of the indicator j . It is then possible to make the composite indicator relative in order to have it range between 0 and 1 by applying normalisation. With this technique the unit of measurement is eliminated, the calculations are very simple and the results easily interpretable; however, information regarding the elementary indicators and the distance between units is lost.

-) Mazziotta-Pareto (Mazziotta-Pareto, 2011): first, the elementary indicators were standardised and transformed into new variables with mean equal to 100 and standard deviation equal to 10; then, the aggregation occurs by calculating the arithmetic mean of the new values which is however adjusted by a "penalty" coefficient: the indicators' variability in relation to the mean. It is called the "horizontal" variability because it is identified per row, namely for each statistical unit, and it is measured with the coefficient of variation (the ratio between the mean and the standard deviation of the standardised values). The value of the composite indicator is given by the following formula:

$$MPI = M_{zi} (1 - cv_i^2) = M_{zi} - S_i cv_i \quad [5]$$

The composite indicator (*MPI*) is given by subtracting the product of the standard deviation of the standardised variables (S_i) and the coefficient of variation (cv_i) from the mean of the standardised variables (M_{zi}). The aim is to penalise the statistical units which present a greater imbalance (therefore more variability) among the values of the various indicators. In this way, the units with similar standardised values (that is, in the same proportion compared to the mean vector) are less penalised.

-) Wroclaw: this method is based on the concept of "ideal unit": a hypothetical statistical unit which has as variable values the best among those observed for each of the indicators considered. The Euclidean distances of all the "real" statistical units are calculated from the "ideal" one. Thus, it is possible to build a ranking in which the different units are ordered on the basis of the greater or lesser distance from the optimal situation. First, the values of the indicators are transformed into new values through standardisation. Then, the ideal unit is defined with the ideal vector by taking the maximum values among those observed for each considered indicator. After that, the distances from this vector are calculated for each unit:

$$D_{oi} = \sqrt{\sum_{j=1}^m (z_{ij} - z_{oj})^2} \quad [6]$$

The bigger D_{oi} is then greater is the distance of the unit i from the ideal unit. Since D_{oi} is still an absolute measure, it is favourable to transform it into a relative measure by dividing it with the mean and the standard deviation of all distances. The result of this operation will be the composite indicator and the parameter according to which the units are ordered: the closer it is to 0, the more a unit is close to the "ideal" model.

-) Mean-Min function: an intermediate method between arithmetic mean, according to which no unbalance is penalised, and min function, according to which the penalisation is maximum. It depends on two parameters that are respectively related to the intensity of penalisation of unbalance (α , $0 \leq \alpha \leq 1$) and the intensity of complementarity (β , $\beta \geq 0$) among indicators. The function penalises downwards, and all other possible cases are intermediate. MMF index can be expressed as:

$$MMF_i = M_{z1} - \alpha(\sqrt{M_{z1} - \min_j(z_{ij})} + \beta^2 - \beta) \quad [7]$$

Z is the normalised matrix of the data and M_{z1} is the mean of the normalised value per the unit 1. The function reduces to the arithmetic mean for $\alpha=0$ (in this case β is irrelevant) and to the minimum function for $\alpha=1$ and $\beta=0$. Moreover, with $\alpha=1$ the function has incomplete compensability; with $\beta=0$ and $0 \leq \alpha \leq 1$ it has proportional compensability.

-) Principal component analysis: since principal component analysis can summarise information held in a set of indicators, it was used in this case for the construction of synthetic indicators. In fact, with principal component analysis, it is possible to classify units according to their distance from a reference unit. After having computed the principal components of the dataset, the scores of each unit along the first component only (which held approximately 27.6% of information) were taken into account and on the basis of this the reciprocal positions of the units were assessed. Therefore, the units were ordered by their location on the first axis and the associated synthetic indicator was the coordinate on the axis. The advantages of considering only the first component are the simplicity and the immediacy of the criterion, but at the same time it has big limits. In fact, it is rare that the latent structure underlying the data can be accurately expressed only by the first principal component and this can lead to distortions of reality. Therefore, all principal components were considered to compute a second type of composite indicator and see how it differed from the first type. The Euclidean distance of each statistical unit was calculated from the origin, in a reference system of space of k dimensions generated by k principal components (Aureli Cutillo, 1996). The index evaluates to what extent the units are decentralised compared to the barycentre and they are ordered on the basis of their distance from the general average situation. The value of the indicator is given by the square root of the sum of the squares of the units' coordinates on all components:

$$D_i = (\text{sgn}C_{i1})[\sum_{r=1}^k c_{ir}^2]^{1/2} \quad [8]$$

In the formula, c_{ir} are the coordinates of the principal components associated with the statistical unit i and $\text{sgn}C_{i1}$ indicates the sign of the first principal component related to the statistical unit i which is given to the indicator that, being a sum of squares, would otherwise always be positive.

-) Weighted normalisation: this is a proposal for considering the variability within the distribution of the values of the elementary indicators. In this case, the variability that is examined is the “vertical” one because it is computed per column, meaning for the variables. The reason for this is because, if there’s more variability within the distribution of the values of an indicator, it should be more meaningful for a statistical unit to have the highest value compared to the cases in which the values of an indicator are similar and the units close to each other. In other words, it should “count” more to have a higher position in the ranking when the values of a certain indicator are more dispersed from the mean. For this reason, the coefficient of variation was used as a measure of variability to identify in which indicators it was more significant to have higher values and as a consequence “reward” the performance of the units in relation to those indicators. The first step was to calculate the coefficient of variation for every indicator. Then, the single coefficient of variation of each indicator was divided by the sum of all the coefficients in order to identify which indicator weighed the most, i.e. the one with most variability. This resulted in a vector of “weights” of the indicators. This meant that it was more relevant and it had more weight to be first in the rankings of those indicators that had more variability within their distribution of values. Consequently, this criterion of importance was transferred to the values of the statistical units: their normalised values were "corrected" according to the internal variability of the indicator by multiplying them with the calculated vector of weights. The aggregation function is again the arithmetic mean, but of the new normalised values weighed on the basis of variability. The aim was to “reward” the units that have higher values in relation to the indicators which have a greater variability in their distribution.

In Table 1 the indicators are ordered decreasingly according to the internal variability of their values. The measure of the variability is given by the ratio between the coefficient of variation of each indicator and the sum of all the coefficients of variation. This means that, for example concerning bike paths, the Regions present more diverse conditions, whereas regarding tourist satisfaction, the situation is more homogenous.

Table 1 – Variability of indicators

Bike paths	0,12687
Waste	0,097188
Investments in tourism	0,07854
Airbnb accommodation density	0,078502
Agritourism farms	0,074824
Local road transit	0,069679
Airbnb accommodations	0,067946
Territory use	0,064238
Protected areas	0,044047
Cultural heritage	0,040299
Seasonal employment	0,038373
Electricity consumption	0,038313
Environmental certifications	0,030258
Tourism pressure	0,027864
Tourism businesses	0,025569
Sustainable development and environment protection:	0,022606
Tourists’ cultural expenditure	0,022252
Net occupancy rate	0,017369
Wages	0,011414
Gender equality	0,011166
Companies’ eco-investments	0,00773
Tourist satisfaction	0,004953

5.3. Result analysis

Almost all methods have pros and cons; however, the goal was not to identify the best synthesis technique, but rather to analyse the similarities and differences of the results. The rankings and values of the different synthetic indicators measuring the Region's sustainability of tourism are shown in the following tables.

Table 2 – Normalisation

1	Trentino-Alto Adige	0.576796
2	Friuli-Venezia Giulia	0.554029
3	Piemonte	0.539899
4	Veneto	0.519522
5	Molise	0.511427
6	Emilia-Romagna	0.509165
7	Lombardia	0.495139
8	Basilicata	0.493681
9	Lazio	0.482047
10	Marche	0.466605
11	Umbria	0.457577
12	Toscana	0.443847
13	Abruzzo	0.443466
14	Liguria	0.428132
15	Calabria	0.427306
16	Puglia	0.420144
17	Campania	0.418824
18	Sardegna	0.418108
19	Sicilia	0.417824
20	Valle d'Aosta	0.366477

Table 3 – Standardisation

1	Trentino-Alto Adige	0.394919
2	Friuli-Venezia Giulia	0.316206
3	Piemonte	0.259173
4	Veneto	0.185265
5	Molise	0.145087
6	Emilia-Romagna	0.136343
7	Basilicata	0.107546
8	Lombardia	0.095747
9	Lazio	0.054851
10	Marche	-0.02326
11	Umbria	-0.06417
12	Abruzzo	-0.09496
13	Toscana	-0.10683
14	Liguria	-0.11315
15	Calabria	-0.17956
16	Puglia	-0.18066
17	Campania	-0.18186
18	Sardegna	-0.18781
19	Sicilia	-0.18964
20	Valle d'Aosta	-0.37323

Table 4 - Ranks

1	Trentino-Alto Adige	0.629187
2	Friuli-Venezia Giulia	0.624402
3	Piemonte	0.590909
4	Veneto	0.566986
5	Molise	0.555024
6	Emilia-Romagna	0.526316
7	Lombardia	0.521531
8	Lazio	0.509569
9	Basilicata	0.504785
10	Marche	0.485646
11	Toscana	0.471292
12	Liguria	0.4689
13	Abruzzo	0.4689
14	Sardegna	0.464115
15	Campania	0.456938
16	Umbria	0.449761
17	Sicilia	0.447368
18	Calabria	0.444976
19	Puglia	0.435407
20	Valle d'Aosta	0.399522

Table 5 – Mazziotta-Pareto

1	Friuli-Venezia Giulia	102.2189
2	Piemonte	102.1355
3	Trentino-Alto Adige	101.6677
4	Veneto	101.2317
5	Molise	100.6825
6	Emilia-Romagna	100.4517
7	Basilicata	100.0246
8	Lombardia	99.35229
9	Marche	99.2237
10	Lazio	99.18417
11	Umbria	98.70066
12	Abruzzo	98.56955
13	Toscana	98.32368
14	Liguria	98.24163
15	Puglia	97.79021
16	Campania	97.37308
17	Sicilia	97.35377
18	Calabria	97.19812

Table 6 – Wroclaw

1	Veneto	0.777354
2	Friuli-Venezia Giulia	0.779448
3	Trentino-Alto Adige	0.787471
4	Piemonte	0.791804
5	Liguria	0.833261
6	Emilia-Romagna	0.844291
7	Toscana	0.860592
8	Basilicata	0.861213
9	Marche	0.871633
10	Molise	0.872759
11	Lombardia	0.876717
12	Lazio	0.880291
13	Umbria	0.891393
14	Abruzzo	0.8918
15	Puglia	0.90609
16	Sardegna	0.924341
17	Campania	0.936017
18	Sicilia	0.947404

Table 7 – Mean-Min

1	Piemonte	93.60016
2	Friuli-Venezia Giulia	92.58730
3	Emilia-Romagna	91.26006
4	Liguria	90.20084
5	Veneto	90.08060
6	Basilicata	89.47455
7	Trentino-Alto Adige	89.18955
8	Lombardia	88.92310
9	Molise	87.42206
10	Abruzzo	87.28352
11	Umbria	87.11827
12	Toscana	87.06947
13	Marche	86.15234
14	Lazio	85.88324
15	Sicilia	85.54945
16	Campania	85.08401
17	Valle d'Aosta	84.69914
18	Puglia	84.42669

19	Sardegna	97.19096
20	Valle d'Aosta	93.86878

19	Calabria	0.981413
20	Valle d'Aosta	1.002998

19	Calabria	83.14980
20	Sardegna	83.11770

Table 8 – First principal component Table 9 – All principal components Table 10 – Weighted normalisation

1	Trentino-Alto Adige	6.009702
2	Valle d'Aosta	3.434701
3	Emilia-Romagna	2.518700
4	Veneto	2.218029
5	Lombardia	1.603476
6	Friuli-Venezia Giulia	1.586771
7	Toscana	1.103954
8	Umbria	1.067805
9	Liguria	0.304434
10	Marche	0.201704
11	Piemonte	0.143423
12	Lazio	-0.87557
13	Abruzzo	-1.12063
14	Sardegna	-1.42005
15	Basilicata	-1.51647
16	Molise	-2.45719
17	Puglia	-2.70685
18	Campania	-2.94444
19	Sicilia	-3.00963
20	Calabria	-4.14183

1	Trentino-Alto Adige	7.459299
2	Valle d'Aosta	7.344818
3	Lombardia	5.987811
4	Friuli-Venezia Giulia	4.853277
5	Emilia-Romagna	4.55479
6	Veneto	3.827717
7	Umbria	3.799484
8	Liguria	3.728375
9	Toscana	3.669563
10	Marche	3.457763
11	Piemonte	3.431501
12	Puglia	-3.07502
13	Abruzzo	-3.26769
14	Sicilia	-4.11915
15	Molise	-4.19667
16	Campania	-4.26828
17	Sardegna	-4.56741
18	Calabria	-4.73741
19	Basilicata	-4.86264
20	Lazio	-5.49474

1	Friuli-Venezia Giulia	2.602822
2	Piemonte	2.547584
3	Lombardia	2.467516
4	Basilicata	2.384006
5	Emilia-Romagna	2.376787
6	Veneto	2.292128
7	Molise	2.243173
8	Trentino-Alto Adige	2.233652
9	Marche	2.222087
10	Umbria	2.097794
11	Abruzzo	2.08558
12	Lazio	2.074024
13	Calabria	2.01804
14	Sardegna	1.964838
15	Toscana	1.963717
16	Puglia	1.927731
17	Sicilia	1.871168
18	Liguria	1.834073
19	Campania	1.813578
20	Valle d'Aosta	1.435516

The rankings and the values obviously change depending on which indicator is considered, as they are based on different approaches from a logical point of view and are the result of different mathematical operations. However, the order of the units in the various tables is quite similar. Specifically, the first four rankings are more alike, with the same groups of Regions occupying similar positions with small changes related only to the order, while bigger differences emerge in the other rankings.

An analysis of the correlation between the values of the various composites was carried out to verify their internal correspondence, as shown in Table 11.

Table 11 – Composite indicators' correlation

	<i>Norm.</i>	<i>Stand.</i>	<i>Ranks</i>	<i>MPI</i>	<i>Wroclaw</i>	<i>W. Norm</i>	<i>Mean.Min</i>	<i>FPC</i>	<i>APC</i>
<i>Norm.</i>	1.00000	0.99770	0.96781	0.96204	-0.86008	0.87488	0.76243	0.45627	0.33480
<i>Stand.</i>	0.99770	1.00000	0.97237	0.96222	-0.87590	0.86697	0.78264	0.46189	0.33508
<i>Ranks</i>	0.96781	0.97237	1.00000	0.92729	-0.86197	0.80599	0.75730	0.46064	0.34331
<i>MPI</i>	0.96204	0.96222	0.92729	1.00000	-0.90858	0.90496	0.79597	0.30115	0.22838
<i>Wroclaw</i>	-0.86008	-0.87590	-0.86197	-0.90858	1.00000	-0.74165	-0.85184	-0.50462	-0.43874
<i>W. Norm</i>	0.87488	0.86697	0.80599	0.90496	-0.74165	1.00000	0.72697	0.19510	0.18643
<i>Mean.Min</i>	0.76243	0.78264	0.75730	0.79597	-0.85184	0.72697	1.00000	0.49507	0.52814
<i>FPC</i>	0.45627	0.46189	0.46064	0.30115	-0.50462	0.19510	0.49507	1.00000	0.88908
<i>APC</i>	0.33480	0.33508	0.34331	0.22838	-0.43874	0.18643	0.52814	0.88908	1.00000

The closer the correlation coefficient is to 1 or -1, higher is the correlation between two techniques. For Wroclaw, the values are negative since the correlation is negative, given that the best situation corresponds to a smaller value as it means that there is less distance from the ideal vector. Thus, it appears that there is a strong correlation between the first six indicators. For the indicator resulting from the Mean-Min function, the correlation with the first six indicators is slightly lower, but still present. The only ones that do not have a

correlation with the rest of the indicators are those produced by the principal component analysis, which are though, on the other hand, very correlated with each other.

Regarding normalisation and standardisation, the results are practically identical, given that they are based on very similar logics: only Basilicata with Lazio and Tuscany with Abruzzo are inverted in their respective positions.

There is also a lot of affinity between the two cardinal and the ordinal methods: the first six regions are the same and in identical order, while the major differences can be seen further down in the rankings, for example in the case of Umbria which from eleventh becomes sixteenth.

It is interesting to observe that also with the Mazziotta-Pareto index the first part of the league table is very similar to the previous ones (Friuli-Venezia Giulia is first, Piemonte second and Trentino-Alto Adige third and the following three stay the same), while for the remaining part of the ranking there is similarity especially with the ones of normalisation and standardisation: some Regions swap places, but a part from that there aren't major changes.

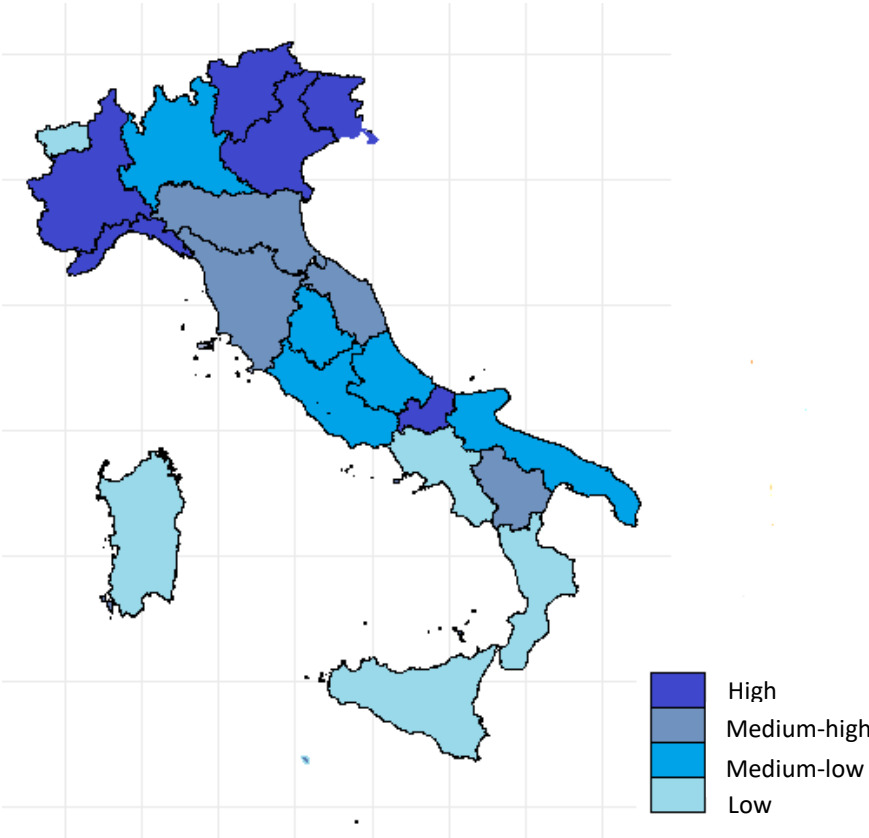
The outcome of the Wroclaw method presents some bigger differences, being the only one in which Veneto is first and other Regions gain or lose many positions, such as Liguria that becomes fifth and Lombardia eleventh. The ranking of the Mean-Min technique is rather curious as Trentino-Alto Adige, first or in the top three in most of the rankings, is seventh and Valle d'Aosta is no longer the tail-end.

Moving on to the two rankings of the principal components analysis and comparing them initially only with each other, the differences are caused by the chosen criterion, that is whether to consider only the first principal component or consider them all. When comparing them to the other rankings, the most obvious differences can be seen with Valle d'Aosta which is second, Piemonte eleventh and Lazio last (in the case of the league table pertinent to all the principal components). These large dissimilarities are probably due to the different logic on which principal components analysis is based on and to the complex mathematics behind it.

As for the ranking resulting from weighted normalisation, it is curious to observe that Trentino-Alto Adige is eighth, the lowest place in which it appears compared to the other league tables. It is also noteworthy that the first two units, namely Friuli-Venezia Giulia and Piemonte, are also the first two in the ranking of the Mazziotta-Pareto index. This probably occurs because both techniques, although in a different way, both take into account the variability of the elementary indicators.

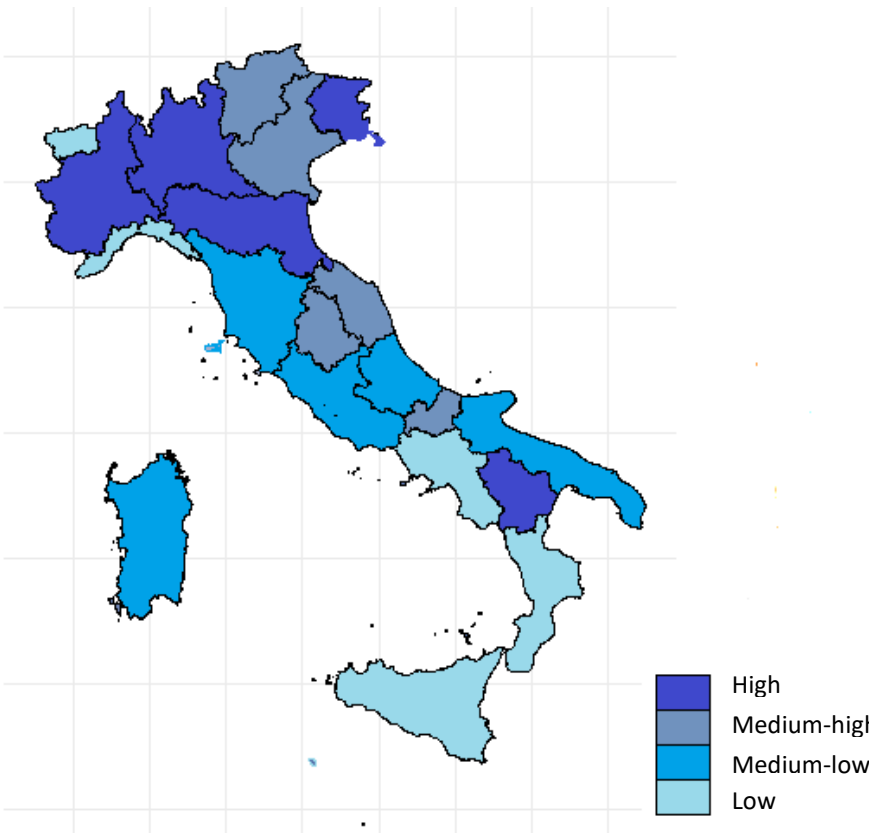
In any case, there are no major discrepancies in the nine rankings and the statistical units which are at the top, mid-table and bottom are more or less the same. The outcoming picture reflects quite accurately the reality and the situation of each Region concerning tourism and sustainability. The following cartograms may be observed for an overview of the inclination towards sustainable tourism; they were made by taking as a reference the results of the Wroclaw method and of the weighted normalisation. These two techniques were chosen as an example, but obviously it is possible to build a cartogram for each synthetic indicator. The Wroclaw indicator was selected for the peculiarity of the method and its logic, while the weighted normalisation was chosen as it is a new proposal. Furthermore, the rankings of the two techniques are quite different from each other and although the correlation between them is high, it is not excessively high, which allows to visualise these differences. The Regions are divided into four groups, which were identified thanks to the distribution quartiles.

Figure 1 – Propensity to sustainable tourism according to Wroclaw index



Source: own construction and processing of data

Figure 2 – Propensity to sustainable tourism according to weighted normalisation index



Source: own construction and processing of data

The Regions that stay in the same group, therefore with a practically unchanged rank, are nine: Valle d'Aosta, Piemonte, Friuli-Venezia Giulia, Lazio, Abruzzo, Campania, Puglia, Calabria and Sicilia. The most obvious differences can be seen in the cases of Lombardia and Liguria: in the Wroclaw method cartogram, Lombardia has a medium-low propensity and in the weighted normalisation cartogram it is high, while Liguria moves from the high propensity group with the Wroclaw method to the last group in the second cartogram, therefore with low propensity for sustainable tourism. From this example, it is easy to see how the value of a composite indicator can change depending on the used aggregation method and how this can become a problem when decisions are to be made and strategies planned.

It is necessary to make a clarification on the position of Valle d'Aosta: in six of the nine rankings it is in the last position. If, on the one hand, this is presumably due to poor sustainability performance, on the other hand it must be borne in mind that it is a particular and unique Region and it's likely that it was penalised by the choice of the elementary indicators which weren't able to consider this peculiarity.

6. Conclusions

The aggregation of many simple indicators, inherent to different dimensions of tourism and sustainability, opens new perspectives for analysis and meets the need to make comparisons with more intuitive and instantaneous tools, such as composite indicators.

However, the evaluation of a complex phenomenon, such as tourism sustainability, with a one-dimensional measurement presents numerous problems. First, the whole process is permeated with subjectivity, from the selection of the elementary indicators to the choice of the ponderation and aggregation method. Furthermore, the selection of the simple indicators implies an in-depth knowledge of the analysed phenomenon in order to guarantee an internal coherence within the indicators, i.e. that they are all pertinent and relevant to the phenomenon. In fact, it may easily occur that, in the attempt of preserving as much information possible, marginal or irrelevant aspects are considered and this necessarily has repercussions on the synthesis. In addition, the absence or lack of reliable raw data also plays a fundamental role in the validity of the final measure.

Given these limits, but also considering how useful these measurements can be, several scholars have developed and deepened the methodological aspects, in the attempt to obtain increasingly robust composite indicators. The debate within the scientific community seems to converge towards the idea that there is no universally valid index and that its validity depends on the strategic objectives of the research.

In this case, the goal was to test the main aggregation techniques, not to then determine the best one, but rather to observe how much the results changed according to the used method. Thus, it was possible to observe that, despite the distinct logic that underlies the different criteria, there are no enormous dissimilarities between the various outcomes.

Trentino-Alto Adige turns out to be the most sustainable Region in terms of tourism, ranking first in several league tables; but looking at the methods that consider the variability of the simple indicators (Mazziotto-Pareto and weighted normalisation), the Region ranks third in one and eighth in the other. This means that its elementary indicators values were not so much greater and far from those of other Regions. Instead, Friuli-Venezia Giulia ranks first in both the cases in which the variability was analysed and in the other rankings it still occupies top positions; thus, it stands out for its constancy and its tourism can be considered as sustainable as much as Trentino-Alto Adige's. On one hand, this line of reasoning is useful for drawing conclusions, but on the other, it underscores all the limits in the application of a composite indicator: although the rankings produced by the different aggregation techniques are similar and it's possible to identify the Regions that most frequently occupy top, middle or bottom ranks, there is no single and definitive solution. This becomes a problem when important decisions must be made based on the obtained scores and positions. For example, if awards were assigned to the Region with the most sustainable tourism, which ranking should be considered? It is clear how any decision would result once again from subjectivity.

This leads to the conclusion that composite indicators, although fascinating from a technical point of view and certainly useful for various reasons, must be used with knowledge of the facts and not in a superficial way.

Also, uncertainty and sensitivity analysis should be undertaken to assess the robustness of the composite indicator and improve its transparency. Uncertainty analysis focuses on how the sources of uncertainty propagate through the structure of the composite indicator and affect the composite scores. Sensitivity analysis studies how much each individual source of uncertainty contributes to the variance of a country's composite indicator score or rank.

The limits of this work emerge from what has been stated so far: the lack of robustness analysis and the verification of internal coherence of the simple indicators. This is mainly due to the used data, which refers to different time periods, comes from various sources (which are reliable, but not part of a single statistical information system) and above all has been adapted based on availability. To be truly functional there is a need for reliable and shared information to refer to and which is coherent with the complexity of tourism and its sustainability. In any case, the study can provide new insights and valuable information for future research and further developments.

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ABSTRACT

Tourism is one of the most important economic sectors worldwide in terms of income generation and employment creation. However, it has major impacts which can be devastating for the environment and for the wellbeing and culture of societies. If well managed, though, tourism can generate economic and social benefits for local communities and support the conservation of the environment. Consequently, it can be a key factor for sustainable development. Sustainable tourism is about controlling and minimising the negative impacts of the industry, while increasing and maximising its benefits. Many effects of tourism are the result of actions taken by the private sector, but it's up to governments to provide an environment that enables and incentivises stakeholders to respond to sustainability issues. This can be achieved by implementing policies for tourism management with sustainability at the core. In order to do so, it's necessary to have valid and effective measures that enable the extraction of necessary information for decision-making and for developing tourism in a sustainable way. To measure and quantify complex phenomena, such as tourism and sustainability, composite indicators can be used.

As an experiment, the performance in tourism sustainability of the twenty Italian Regions was evaluated. First, a theoretical framework was defined and subsequently broken down into several dimensions. Thereafter, the elementary indicators were selected by observing the impacts that tourism generates and translated into measurable and quantifiable phenomena. A large quantity of data was analysed in order to obtain a well-defined and consistent set of indicators. For the synthesis, different aggregation methods (normalisation, standardisation, ordinal method, Wroclaw taxonomic method, Mazziotta-Pareto, mean-min function and principal component analysis) were used with the aim of experimenting multiple techniques and comparing the results, i.e. rankings in which the Regions were ordered on the basis of their respective tourism sustainability. Although the application of the composite indicator presents limits, it allows a comparative study and a starting point for discussions and further research.