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Research article

# Analysis of tourism sustainability synthetic indicators. A case study of Aragon

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ABSTRACT

Tourism sustainability is a long-term exploration process of human beings seeking to coexist harmoniously with the ecological environment. The core of sustainable tourism development is to achieve the harmonious development of the economy, society, and environment. Aragon's rich tourism resources attract many tourists, and the local government has formulated a sustainable development strategy to develop tourism vigorously. This paper constructs a tool to assess the sustainable development of tourism in Aragon based on the theory of sustainable tourism development and related methods. It proposes the construction of synthetic indicators based on the environmental-social-economic triad model, identifies individual indicators suitable for the study of the region based on indicators that appear more frequently in related studies, and defines and evaluates these indicators. We construct the matrices by questionnaire and expert consultation method and find that environmental and social factors significantly impact sustainable development. The indicators are then standardized and weighted using hierarchical analysis to determine the level of sustainable development of the local tourism industry based on the standard for assessing sustainable tourism development. The steps and methods of constructing synthetic indicators proposed in this paper can guide future analysis of the strengths and weaknesses of tourism development in Aragon and similar areas under different conditions, as well as for the study of factors affecting tourism development, and provide targeted suggestions for improving the competitiveness of local tourism, taking into account regional tourism characteristics and actual conditions.

## 1. Introduction

Sustainable tourism is an industry committed to having a low impact on the environment and local culture. By developing sustainable tourism, it can increase public awareness of environmental protection [1]; it can also foster a sense of identification with local traditional culture and help residents improve their income by creating local jobs [2]; since the tourism chain contains multiple industries, sustainable tourism can help promote a holistic transformation of various industries in a region towards green and low-carbon

*Abbreviations:* AHP, Analytical Hierarchical Process.

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development [3,4]. Destinations must have instruments to measure the degree of sustainability to know their real state in terms of their development model [5], thus improving their political action and achieving tourism sustainability.

However, the number and complexity of factors involved in the study of tourism sustainability make it challenging to obtain more detailed results from a qualitative analysis. Thus, this paper uses a systematic analysis method that combines qualitative and quantitative aspects, which allows a quantitative evaluation of the complex influencing factors so that the necessary actions to implement a sustainability plan can be identified [6]' and correctly diagnose the factors that cause the destination to wear out and transform it into a more sustainable one [7,8]. This study considers the appropriate tools to carry out an approximate survey of Aragon's tourism sustainability, with no recent studies or references yet. In Aragon, the leisure industry is generating significant income in areas that are developed for tourism, especially in the north of the region (in certain valleys of the Alto Aragon's region), religious attractions (as is the case of El Pilar in Zaragoza capital and Torreciudad), and some areas of Zaragoza and Teruel, although to a lesser extent. There are several figures on the tourism sector's contribution to the regional GDP, the result of various macroeconomic studies according to Aragon's Economic in 2021. Promoting local tourism is a critical way to improve the local environment, promote economic development, and enhance residents' quality of life [9]. However, there needs to be a corresponding evaluation and analysis of the current local sustainable development situation, which can result in insufficient knowledge of regional tourism development, unclear development positioning, and inappropriate tourism planning.

This paper uses synthetic indicators as a tool for the multidimensional measurement of tourism sustainability to evaluate the sustainable development of tourism in Aragon, analyse the development stage and current problems of local tourism based on the evaluation results, and propose corresponding planning strategies from several dimensions. The integrated index has been used more widely worldwide. Many scholars have applied this tool in ecotourism development research [10], research on the evaluation of forest tourism development [11], and research evaluation of the public service [12].

Referring to the systematic process designed by Xu [13] to measure the sustainability of tourism, this paper adds the questionnaire method and expert consultation method. We changed the resource-environment-economy-society four-component model to the environment-economy-society three-component model. The three essential elements for promoting sustainable development are the environment, economy, and society. Quantifying resource indicators (resource carrying capacity, climate resources, biological resources, etc.) is challenging. The specific stages are as follows (Fig. 1).

(i) Analysis of the synthetic indicators, which includes analysis of their definitions and advantages, the requirements and methodology for their construction [14].

(ii) Construction of a synthetic indicator to measure the sustainability of Aragon: In the second phase, we need to construct a synthetic indicator containing five established steps. Expert consultations on selecting partial indicators are required to analyse the partial indicators' measurability and stability using existing tools and build a matrix of the selected indicators [15]. In this stage, we distribute questionnaires to several teachers of tourism management in Zaragoza and the directors of three local travel agencies, as well as to students with relevant tourism expertise. Based on the results of the questionnaires and consultation with experts, we finally create the matrices (shown in the annex). Due to the strong subjective nature of building the matrices, a consistency check is also required, and when the CI $< 0.10$, no adjustment of the matrices is required.

(iii) Analysis of the sustainability of tourism: In the third phase, we analyse the degree of sustainability of Aragon by referring to the Tourism Sustainability Criteria Scale developed by Mei [16].

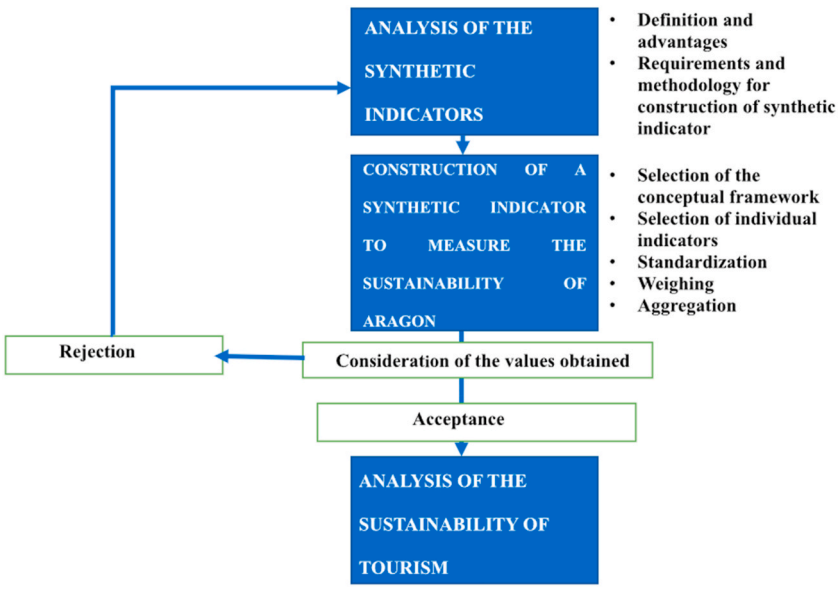


**Fig. 1.** The systematic process for measuring tourism sustainability. Source: Own elaboration.

The paramount theoretical significance of this research is to construct a comprehensive index evaluation system for local, sustainable development based on the actual tourism development in Aragon using qualitative and quantitative methods. The evaluation results propose corresponding planning strategies to promote sustainable development, providing a theoretical basis for tourism cities of the same type of development.

## 2. Theoretical framework

The indicators provide *synthetic information on certain phenomena or areas by giving an additional value that expands the parameter's significance considered individually* according to the Organization for Economic Co-operation and Development (OECD) in 1993 [17]. In other words, an indicator consists of a grouping of quantitative and qualitative information, can be one-dimensional or multi-dimensional [18] then produce a value or magnitude that has the function of evaluating the different policies and their management [19]. The indicators should also have three essential functions [20,21]: (i) simplification, where an indicator must be an empirical representation of reality in which the number of components is reduced; (ii) quantification, where the indicator can be expressed as a specific data set and evolves to show the real state of affairs at any given moment; and (iii) communication, where the indicator must be used to convey information on the subject under study.

In turn, indicators can also be classified into partial or individual indicators and synthetic indicators. An *individual indicator is obtained immediately from the variables it represents* [22]. It is usually expressed as a ratio or quotient relating to one or two variables through immediate measurement. A synthetic indicator is any combination of individual indicators [23]. It is subject to various criticisms, the main criticism being that they constitute a purely empirical approach to the problem of measuring the level and pace, in this case, of tourism activity [24]. The synthetic indicator is a simplified representation that seeks to summarize a multi-criteria concept formed by the aggregation of several individual indicators into a final expression based on an underlying conceptual framework [25]. An excellent example of a synthetic indicator is the Environmental Sustainability Index (ESI), devised by Esty [26], and measures indicators related to the socio-economic, environmental, and institutional dimensions that make it possible to quantify the level of environmental sustainability on a national scale.

The creation of a synthetic indicator gives the researcher the possibility to choose the tools that he or she believes fit the desired objective [27], through equations based on the coefficients derived from the partial indicators. Finally, creating a synthetic indicator facilitates the evaluation of policies' effectiveness because it facilitates a comparison between units of analysis and their evolution [28]. Thus, synthetic indicators are instruments with great potential to evaluate and manage political action, whose primary requirement is methodological rigor in their construction through certain stages.

The construction of a synthetic indicator is essential in terms of measuring sustainability [29]. The stages develop a conceptual framework, selecting indicators, standardization of indicators, the weighting of information, and data aggregation [30]. A conceptual framework is an analytical tool fundamental for organizing simple information and determining the necessary criteria or indicators [31]. When we design a synthetic indicator, the main requirements are considered to be scientific, holistic, operational, oriented, hierarchical, dynamic, and stable [32]. Thus, (i) the methods and formulas used in the research must be explicitly described, as well as the specific data that have been applied in it so that any other researcher can carry out a repetition of the research to verify the rigor and soundness of its development and conclusions; the indicators selected are expressed in different units of measurement, and if it is not standardized, it may cause inconsistencies [33]; (ii) a synthetic indicator should fully reflect the general characteristics of the system [34]; (iii) the method of calculation should be simple, and the data should be easy to obtain [35]; (iv) it should play a specific role in the tourism sector, regulating and guiding the direction of sustainable tourism development; (v) the synthetic indicator can be broken down into a hierarchical structure, making the synthetic indicator reasonable and clear; (vi) a synthetic indicator is a parameter that changes over time. Tourism sites with different levels of development should use different indicators, but at the same time, the indicator should remain stable over a certain period, which is convenient for the assessment of the sustainability of tourism.

Through literature analysis, the following researchers have constructed synthetic indicators for studying tourism sustainable development based on the requirements of producing synthetic indicators mentioned above: HwanSuk Chris et al. [36] constructed 125 individual indicators, including policy, social, environmental, and economic related indicators for establishing synthetic indicators for tourism sustainable development; James.T.G.Ko [37] made synthetic indicators for tourism sustainable development from cultural, economic, social and environment, and Liu [38] used AHP to construct integrated indicators from both social and environmental aspects; Xu [13] used AHP method to build a quadratic model (four-component model) for sustainable tourism development, this type of model combines resource development, environmental, social and economic indicators. Most researchers have chosen to construct a triadic framework for selecting individual indicators in three dimensions: economic, social, and environmental. According to the Aragon Sustainable Tourism Strategy 2030 report, sustainable tourism is to maintain the integrity of ecological resources, strengthen people's awareness of environmental protection, and improve the quality of life of the population by promoting local economic development and maintain social harmony. Therefore, this paper will also choose environment-society-economy as the framework to select individual indicators.

Aragon now attracts many tourists because of its rich natural resources, and by studying the local environmental indicators, we can better promote the protection of the environment [39]; the local tourism industry has a complex structure and combines transportation, entertainment, commerce, food and beverage, and many other elements. The industry significantly contributes to local employment opportunities and is vital to national economic income. By studying economic indicators, we can better stimulate consumption and, thus, economic growth; tourism also influences personal lifestyles and values. Social indicators can be studied to understand residents' attitudes towards tourism so that tourism can be developed to ensure the safety of residents and not disrupt their regular lifestyles. Therefore, to study the sustainable development of tourism in Aragon, a three-dimension model is needed to analyse

tourism's positive and negative impacts on the local environment, economy, and society [40].

The construction should comprise several suitable individual indicators, and experts should be consulted on their selection [31]. Once the conceptual framework is defined, we can start searching and accurately selecting indicators [41]. We study more than 150 individual indicators of sustainable development related to economic, social, environmental, cultural, and policy proposed by Hwan Suk Chris, Choia [36], and Liu [38], as well as 232 indicators covering economic, social, and environmental aspects proposed by the 2030 Agenda for Sustainable Development (the "2030 Agenda") [42]. Based on the frequency statistics, we have identified the most frequently used indicators in recent years in tourism sustainable development research (Table 1, Table 2, Table 3). We exclude some individual indicators because the data of these indicators are difficult to collect, or the collected data has a large change within a certain period. According to the current situation investigation method, by investigating the development status of Aragon tourist attractions, we can understand the characteristics of local tourism resources and the factors restricting local development to select individual indicators in a targeted manner. Therefore, we decide 12 indicators from the indicators with a high frequency of use to construct synthetic indicators for Aragon. Because in the process of statistical data, the data of these 12 indicators are straightforward to obtain, and it is convenient for researchers to update continuously. It will remain stable for a certain period, ensuring that the local, sustainable development can be accurately evaluated. This avoids the possibility that selected indicators may not be available due to a lack of information or uncertainty in the data collected.

The indicators selected for the construction of the synthetic indicator are usually expressed in different measurement units [43], so if they are not standardized, certain inconsistencies may occur, i.e., they cannot be aggregated comparably. For this reason, it is necessary to unify the data so that they have the same unit. Therefore, we achieve the purpose of unifying the data by calculating the weight. Weighting of standardized information or the indicator's weight is one of the most important tools in the construction process, referring to an indicator's relative importance in the overall assessment [44]. Some methods that can be used to calculate the weight of the indicator are.

(A) The Analytical Hierarchical Process (AHP) is a method of decision making proposed by the American researcher Tomas L. Saaty to respond to concrete problems in decision making. According to Moreno, Escobar, and Aguarón [45], when making decisions about the characteristics of complex problems, such as uncertainty, complexity, irreversibility, and consideration of future generations, they cannot be based on a single criterion [46]. However, they should use what is known as multi-criteria, and it is also necessary to break down complex problems into smaller-scale components. Today, the AHP is a classic applied in almost all areas worldwide to help make decisions of a certain complexity through each decision's weight and different social, economic, technological, tourism planning, and other areas [47].

(B) The Multi-Attribute Utility Theory (MAUT) this theory was specially developed by Keeney and Raiffa based on Von Neumann and Morgenstern's one-dimensional utility theory and aimed to express the preferences of the decision-making center in terms of the utility it brings to it [48]. The multi-attribute utility function consists of associating a real number (representing utility) with each alternative [49]. In this way, a complete classification of alternatives can be derived, where the differences between the alternatives will be evaluated.

(C) Artificial Neural Network refers to a complex network structure formed by many processing units' interconnection [50]. It is an abstraction, simplification, and simulation of the structure of human brain tissue [10]. The artificial neural network (ANN), a mathematical model that simulates neural activity, is an information processing system based on imitating the brain's neural network's structure and function [51].

This article will choose AHP as the tool for calculating the weight because its calculation formula is not complicated and can be calculated by writing and software. The reason for using the AHP tool will be introduced in the section on the Methodology.

Finally, according to Mei [15] and consulting experts' opinions, we formulate an assessment standard for the degree of tourism sustainable development to calculate the level of sustainable development of Aragon's local tourism industry.

In conclusion, as the scale of tourism and activities continues to expand, the tourism chain becomes more and more complex. Studying the local sustainable development level can help practitioners and scholars recognize the factors that hinder local tourism

**Table 1**
Economic aspects of sustainable tourism.

| Aspects of tourism sustainability | Basic issues |
|---|---|
| Tourist satisfaction | Overall visitor satisfaction |
| | Fidelity of the demand |
| | Overnight stays in tourist accommodation. |
| | Length of stay |
| Product promotion | Marketing activities for sustainable tourism |
| | Offers and variety of experiences |
| Control of infrastructure and superstructures | Transport |
| | Accommodation |
| | Restaurant |
| Exploiting the economic benefits of tourism | Employment at the destination |
| | Investments in the sector |
| | Real estate investment |

Source: Own elaboration.

**Table 2**
Social aspects of sustainable tourism.

| Aspects of tourism sustainability | Basic issues |
|---|---|
| Conservation of tourist resources | Cultural diversity<br>The cultural heritage |
| Quality of local services | Sports center<br>Educational institute<br>Health services |
| The welfare of the inhabitants | Resident satisfaction<br>Aging<br>Life expectancy |
| Safety at destination | Criminal activities<br>Traffic accidents |

Source: Own elaboration.

**Table 3**
Environmental aspects of sustainable tourism.

| Aspects of tourism sustainability | Basic issues |
|---|---|
| Protection of natural resources | Biological diversity and natural areas<br>Seawater quality |
| Limiting the environmental impact of tourism | Waste generation and management<br>Atmospheric pollution<br>The volume of treated wastewater<br>Electricity consumption |
| Environmental awareness and education | The involvement of educational training related to tourism sustainability |
| Environmental Management | Compliance with environmental regulations |

Source: Own elaboration.

development from helping improve tourism development-management strategy.

## 3. Methodology

This section will use Stage 2 of Fig. 1 to build our composite indicator as a tool for analysing the sustainability of Aragon. To meet the requirements in terms of construction, we have carefully selected all the methods we will use, and we will also explain why they are being used.

(1) Literature review method

The literature review method is a convenient, accessible, safe, and free investigation method without time and space limitations [52]. By reading literature, books, national policy documents, and national statistics network, summarize the development status of Aragon tourism industry, the statistical data comes from National Institute of Statistics, Aragon's institute of Statistics and other authoritative website. By reading and analysing relevant materials on the evaluation of tourism sustainable development, individual indicators can be selected. Then the matrices can be constructed based on the collected local tourism development status combined with expert consultation methods, and the standard for assessing sustainable development can be determined.

(2) Expert consultations and questionnaire

By distributing questionnaires, different scholars and experts are asked to analyse the impact of each independent indicator on the development of local tourism, compare the indicators in pairs, and construct a matrix. This method can be closely combined with the specific local conditions for evaluation, making the assessment more pertinent and implementing the principle of the minority obeying the majority, which has a clear scientific basis [53]. The advantage of this method is that it has a single step, strong operability, and easy promotion. However, this method also has limitations because this method mainly relies on the knowledge and experience of experts to make judgments, which is highly subjective and insufficiently objective.

(3) Standardization of indicators

Due to the different properties of each evaluation index, it usually has different dimensions and orders of magnitude in the multi-indicators evaluation system. When the levels of the indicators differ significantly from each other, if the analysis is performed directly with the original indicator values, it will highlight the role of the indicators with higher values in the comprehensive study and relatively weaken the position of the indicators with lower value levels. Therefore, to ensure the results' reliability, it is necessary to standardize the original indicator data. This article will use Min-max normalization to scale the data so that it falls into a small specific

interval. The unit restriction of the data can be removed and converted into a pure dimensionless value, which facilitates the comparison and weighting of indicators of different units or magnitudes [13].

(4) AHP

People always use weighting methods to strengthen decision-making that is more in line with their objectives. The following method is used to achieve the objective of determining a synthetic indicator: The AHP methodology proposed by Saaty [54] as a tool for constructing an evaluation model and calculating the weight of each indicator. The greater the weight, the more important this indicator is. It should be noted that it is always used in combination with formulas that are easy to use.

Therefore, the AHP is an effective instrument for calculating the weight of the three dimensions and the partial indicators that make up our synthetic indicator. The numerical weight reflects each indicator's level of importance, which makes the synthetic indicator valid and conclusive.

When calculating the weight, it is necessary to compare the indicators pairwise. The matrix formed by the result is called the judgment matrix [54]. Then the eigenvector of the largest eigenvalue of the judgment matrix needs to be normalized (making the vector The sum of each element is equal to 1) and is denoted as *W*. Finally, a consistency check is required [55].

Below is the relevant information on the advantages and disadvantages of applying the AHP method.

Due to its characteristics of processing various factors in decision-making and the advantages of its flexible and concise system, this method has received great attention. It is applied in various fields of society and economy in Spain and in the analysis of the energy system, urban planning, economic management, and the evaluation of scientific research. This method is formed by a hierarchical structure model, expressing human thought in digital form, which has a high degree of effectiveness, reliability, viability, simplicity, and wide adaptability. We describe its advantages in detail.

### *3.1. Concise and practical*

This method does not use very advanced mathematics and does not focus on analogy and one-sided reasoning, applying it can usually simplify multi-criteria problems by decomposing it into a multi-level structure, mathematize and systematize people's thought processes, which is easy for most to accept [56]. After confirming the decision criteria and objectives, they are divided into a high, medium, and low scale, according to their mutual relationship, and a hierarchical structural framework is designed. Finally, a mathematical formula is used for the calculation, which can be simplified by the corresponding software. The results obtained are clear and easy to understand for a large majority of the public.

- Systematic analysis

This method allows different factors to be measured on the same scale. The effect of each factor on each scale is quantified, so the results obtained will be very clear and unequivocal and allow the creation of our general and holistic synthetic indicator, applied in this case to measure the degree of sustainability of the autonomous community of Aragon.

- Multidirectional analysis

The AHP allows different people or interest groups to participate and generate a consensus that generates a synthetic analysis. Besides, it can be complemented with other tourism information that broadens the scope of the study. It is applied at different scales: local, municipal, and regional.

However, this method has certain disadvantages. In particular, if the comparison matrix is poorly designed or not all research factors or indicators are considered, each attribute's weight may be distorted, leading to an incorrect result. The information obtained must be known and assumed, and its authenticity maintained to avoid this difficulty. Also, if the data obtained is very unstable over short periods, it can be expected that the data will be updated periodically to monitor movements if conditions allow.

Finally, the lack of coordination between the different tourism managers should be considered when implementing a system of indicators. We contact the experts to discuss the relevant data, negotiate and reach a consensus to make corrections and calculations.

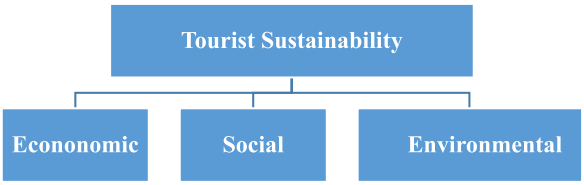


**Fig. 2.** Three-component model. Source: Own elaboration based on Rusong&Zhiyun (2012) [57].

## 4. Selection of the conceptual framework for sustainable tourism development

As we mentioned in the previous point, it is necessary to plan and manage tourism activities correctly in order to have a balance between the three fundamental pillars of sustainability: economic, social, and environmental; all of this in order to achieve tourism sustainability (Fig. 2).

According to researchers such as Hwan Suk Chris [36] who proposed more than 150 individual indicators of sustainable development related to economy, society, environment, culture, and politics, we counted the indicators that have been used frequently in tourism sustainable development research in recent years.

In the economic dimension, the issues related to tourism's economic impacts, as measured by the benefits and costs generated by tourism activity in the long term [58], are shown in Table 1.

Several factors affect the tourist destination's economy, such as seasonality or the attractiveness of the offers for tourists, which make the economic income variable and unstable. The volume of tourism expenditure in the destination and the existence of a tourism policy oriented towards tourism services are a function of economic development.

The social impacts are grouped into four fundamental aspects, which are shown in Table 2. Excessive traffic, individual behavior, security levels, moral conduct, and traditional culture could break the destinations' sociological balance. On the other hand, tourist satisfaction is related to satisfaction with guiding service, satisfaction with tour services, and satisfaction with the overall tour experience [59,60]. First, the tour guide needs to have a comprehensive understanding of information, such as the information about accommodation and services, the history of the place. In addition, the local should also pay attention to the protection of historical and cultural heritage, to provide tourists with a rich tourism experience, as more care is taken of the heritage, the population and local governments are enriched. Finally, the attitude of residents towards tourists will also affect the experience of tourists. When tourism brings a quality of life to residents (environmental protection and increased profits), residents will treat tourists more friendly.

Concerning the environmental dimension, issues related to the protection and conservation of biological diversity, natural resources, and cultural heritage are included. These aspects are shown in Table 3.

Some territories, mainly rural areas, are very vulnerable to human activities. Concerning the environmental impact, tourism's main risks are pollution, the disappearance of natural spaces, and the environment's erosion and degradation.

## 5. Selection of individual indicators

After consulting with experts, combined with the actual situation of local tourism development, we have selected twelve partial indicators from this list based on the conceptual framework of the three most suitable components for collecting and updating data. As the tourism industry is deeply affected by the COVID-19 pandemic, we did not consult the data during the epidemic for updating to get closer to the true sustainability of tourism in Aragon. We have also considered the availability and stability of statistical data for quantification.

## 6. Analysis of results

The description of all the selected elements appears in Table 4.

The economic indicator is subdivided into the following sub-criteria, we have obtained the following data from the Government of Aragon [61,62].

### *6.1. Overnight stays in tourist accommodation*

The result of the overnight stays of tourists in a particular destination is considered as a basic indicator. Overnight stay markets usually make the highest contributions due to the need for accommodation, food, and entertainment [63]. By observing tourist overnights, we can track tourists. The higher the overnights, the higher tourism related revenues, which would increase funds for

**Table 4**
Indicators selected by dimensions.

| Dimensions | Theoretical partial indicators (Sub-criteria) |
|---|---|
| Indicators Economic | Overnight stays in tourist accommodation. |
| | Length of stay |
| | Employment at the destination |
| | Gross investment intangible goods |
| Indicators Social | Life expectancy |
| | Criminal activities |
| | Aging |
| | Traffic accidents |
| Indicators Environmental | The natural areas |
| | The volume of treated wastewater |
| | Electricity consumption |
| | Special collection centres |

Source: Own elaboration.

implementing sustainable development policies.

According to Table 5 of overnight stays in tourist accommodation in Spain and Aragon in 2019, we can see an increase between 2018 and 2019 in the number of overnight stays in hotels and campsites in Aragon.

### 6.2. Length of stay

It is an approximation of the average number of days a tourist spends in tourist accommodation. It is calculated from each period's quotient by the number of overnight stays between the number of admissions in the same period. The longer the tourists stay, the higher the income for local tourism, which shows that local tourism resources attract tourists.

As it can be seen in Table 6, the percentage of year-on-year variation with the greatest increase between 2018 and 2019 focuses on rural tourism accommodation, with a 4.4% percentage. On the contrary, we can also observe a decrease in the hostels' category's inter-annual variation, with a percentage of −7.4%.

### 6.3. Tourism employment in the destination

According to Table 7, it can be seen that the occupation of Hotel and Catering Businesses and Travel Agencies in Aragon grew by 3.8% in 2019 compared to 2018, with 40,837 employees. The tourism industry has a vast chain, and there is a demand for jobs, including transportation, catering, and accommodation. The threshold for jobs varies from high to low, providing outstanding opportunities for socially disadvantaged groups. The higher the employment rate, the higher the participation of residents in tourist destinations, and the more significant the income. It also shows that the demand for local tourism is excellent, which can effectively promote the development of the local economy.

### 6.4. Gross investment intangible goods

Improving the tourism sector's material assets leads to a better stay of the tourist in the region and increases the chances of his return or increased duration.

As can be seen in Table 8, concerning gross investment in material goods in the hotel and catering sector, the amount for 2017 has risen by 32.6% compared to 2016 in Aragon. In contrast, the number of premises fell by 0.9%. Finally, the percentage of turnover and salaries has risen considerably.

With the tourism industry's continuous development, the hotel industry is rapidly developing, and competition in the hotel industry increases. With economic development, the demand for tourists has increased, and the hotel industry has continuously improved its service and infrastructure. Tourism development is inseparable from the hotel industry; the two need coordinated development to move forward together.

### 6.5. Life expectancy

The population's life expectancy is an important indicator for measuring economic and cultural development and is also a statistical indicator of the quality of life. It is also a statistical indicator of the quality of life. This indicator summarizes the mortality rate and allows us to compare by generations and analyse trends. It is more widely interpreted and can provide key information on developing the welfare state in a region.

The average life expectancy is 83.24 years (Table 9), Aragon ranks sixth among all autonomous communities. The factors affecting life expectancy are complex. It can be divided into two categories: human biological factors and socio-economic factors. Considering that this article studies a region in Spain, the biological factors generally do not differ much. So, we analyse mainly from socio-economic factors that we are going to explain the following:

In the first place, health depends largely on good eating habits and a reasonable diet. As people's standard of living improves, spending on a diet will also increase, greatly improving the population's health. Hence, personal income as a measure of living standards. Second, average life expectancy in many African countries is still around 55 years, largely due to poor medical conditions, leading to the inability to control many infectious diseases and affect the population's life expectancy. Thirdly, if the population level is

**Table 5**
Overnight stays in tourist accommodation in Spain and Aragon in 2019.

| Last available data | | Spain | | Aragón | | |
|---|---|---|---|---|---|---|
| | | Nº | Inter-annual variation | Nº | Inter-annual variation | Market shares % |
| Hotels | Dec-19 | 16.906.376 | 1,5 | 425.481 | 13,2 | 2,5 |
| Campsites | Dec-19 | 1.224.258 | 3,8 | 26.898 | 13,9 | 2,2 |
| Tourist apartments | Dec-19 | 4.024.430 | −2,2 | 60.131 | 27,2 | 1,5 |
| Rural tourism | Dec-19 | 874.807 | −0,2 | 57.320 | −1,8 | 6,6 |
| Hostels | Dec-19 | 134.845 | −4,8 | 7.441 | 15,2 | 5,5 |
| Total | Dec-19 | 23.164.716 | 0,9 | 577.271 | 12,8 | 2,5 |

Source: National Institute of Statistics, 2019 [62].

**Table 6**
Average length of stay in Aragon in 2019.

| | Hotels | Campsites | Tourist Apartments | Rural tourism | Hostels |
|---|---|---|---|---|---|
| Average stay (no. Of days) | 1,94 | 3,05 | 3,03 | 3,00 | 2,85 |
| Year-on-year change (2018 and 2019) | −0,2 | 1,7 | −0,7 | 4,4 | −7,4 |

Source: National Institute of Statistics, 2019 [64].

**Table 7**
Affiliated workers in the hotel and catering industry and travel agencies, by Autonomous Community.2019.

| Total | | Inter-monthly variation | Inter-annual variation |
|---|---|---|---|
| **Total** | **1.658.824** | **−1,5** | **4,4** |
| Andalucía | 276.882 | −2,0 | 6,2 |
| Aragón | 40.837 | 1,7 | 3,8 |
| Asturias (Pr. de) | 33.418 | 0,7 | 2,8 |
| Islas Baleares | 62.076 | −26,6 | 6,8 |
| Canarias | 154.885 | 2,2 | 1,2 |
| Cantabria | 19.875 | −1.0 | 3,0 |
| Castilla - La Mancha | 49.275 | 2,2 | 4,5 |
| Castilla y León | 74.577 | 0,5 | 2,3 |
| Cataluña | 270.505 | −2,8 | 4,2 |
| C. Valenciana | 179.295 | −1,3 | 5,6 |
| Extremadura | 26.544 | 2,3 | 4,3 |
| Galicia | 79.739 | 0,5 | 4,0 |
| Madrid (C. de) | 243.857 | 2,0 | 4,6 |
| Murcia (Región de) | 42.761 | 2,2 | 6,4 |
| Navarra (C. Foral de) | 19.178 | 0,5 | 3,6 |
| País vasco | 70.818 | 0,8 | 3,9 |
| Rioja (La) | 10.430 | 0,8 | 4,0 |
| Ceuta y Melilla | 3.872 | 0,8 | 4,6 |

Source: Ministry of Employment and Social Security, 2019 [65].

**Table 8**
Structural indicators in Spain and Aragon.

| Last available data | | Spain | | Aragón | |
|---|---|---|---|---|---|
| | | Total | Inter-annual variation | Total | Inter-annual variation |
| Structural Statistics of Companies: tourism | 2017 | | | | |
| Number of locals | | 324.121 | 3.4 | 8.798 | −0.9 |
| volume of business (thousands of euros) | | 72.941.051 | 9.5 | 1.600.474 | 11.3 |
| Wages and salaries (thousands of euros) | | 17.663,582 | 10.7 | 385,278 | 11.8 |
| Gross investment in tangible goods (thousands of euros) | | 3.651.256 | 19.9 | 54.270 | 32.6 |

Source: National Institute of Statistics, 2017 [66].

high and people's knowledge tends to be more extensive, understanding the influence of various factors on health will be deepened, which will help form good living habits and increase the population's life expectancy. In conclusion, life expectancy depends on medical facilities, personal income, and public education.

### *6.6. Aging index*

Population aging refers to the dynamic process of increasing the older population within a given region's total population. Population aging has two meanings: firstly, it refers to the process of the relative increase in the older population, and its share in the total population continues to rise; secondly, it refers to the structure of the social population, which shows a state of aging and an aging society.

The aging index result is the ratio of people aged 65 and over to under 15, multiplied by 100.

According to Fig. 3, we can see 122 over 65 years old for every 100 under 15, 22.88% in the Spanish population. It should be noted that the rate for Asturias is much higher than the other categories, with a percentage of 218.65%. Aragon has a difficult aging situation due to its aging index; it has a 143.52% percentage, which has exceeded the national average index. Consequently, the process of population aging is advanced in Aragon.

We believe that the population is aging for the following reasons. People's standard of living has improved significantly. In 2018, the Aragonese community's average income was 21,750 euros per year, 4.39% more than in 2017. With the rapid development of the economy, the level of social pension for the elderly is also improving continuously. On the other hand, the ecological environment's

**Table 9**
Life expectancy at birth in Spain in 2020 (by Autonomous Community).

| Position | Autonomous community | Years |
|---|---|---|
| 1 | Comunidad de Madrid | 84.83 |
| 2 | Comunidad Foral de Navarra | 84.18 |
| 3 | Castilla y León | 83.94 |
| 4 | País Vasco | 83.65 |
| 5 | La Rioja | 83.62 |
| 6 | Castilla-La Mancha | 83.52 |
| 7 | Aragón | 83.46 |
| 8 | Cataluña | 83.45 |
| 9 | Cantabria | 83.31 |
| – | National Average Life | 83.24 |
| 10 | Islas Baleares | 83.11 |
| 11 | Galicia | 83.10 |
| 12 | Región de Murcia | 82.84 |
| 13 | Principado de Asturias | 82.63 |
| 14 | Comunidad Valenciana | 82.58 |
| 1 S | Extremadura | 82.S2 |
| 16 | Canarias | 82.26 |
| 17 | Andalucía | 81.86 |
| 18 | Ceuta | 80.76 |

Source: National Institute of Statistics, 2020 [67].

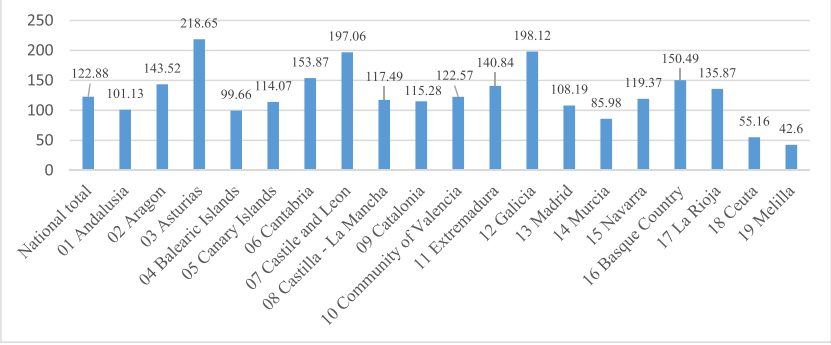


**Fig. 3.** Ageing index by autonomous community in 2019 (units: Percentage). Source: National institute of statistics, 2019 [68].

improvement has created good conditions for the elderly and has improved the elderly's living space of the elderly and their quality of life.

Furthermore, the elderly is provided everywhere in society, such as parks, free museums, *fitness* centres, and entertainment places. Elderly tourism has been increasing over the last ten years. According to the personal preferences of the elderly, various tourism

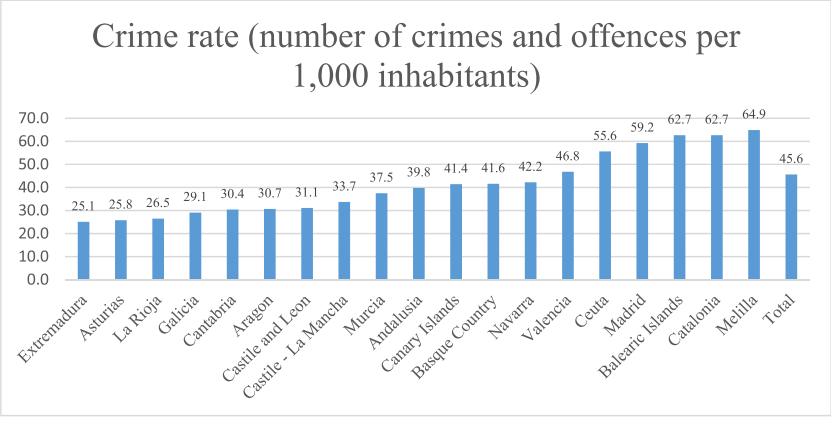


**Fig. 4.** Crime rate (number of crimes and offenses per 1000 inhabitants) in 2018. Source: Statistical Portal of Crime. Ministry of the Interior, 2018 [69].

activities can be designed, such as landscape photography tours, hiking, and plant collecting, Etc.

### 6.7. Crime rate

Criminal activities are also a factor to be taken into account when selecting a tourist destination since by reducing the levels of these activities, we improve the environment and strengthen tourist interest. A safe environment can facilitate the smooth development of tourism activities. Fig. 4 shows crime rates in Spain by region. Aragon is one of the six lowest in this rate.

The Ministry of the Interior pointed out that Aragon was ranked the sixth safest community in the country in 2018, and the crime rate is much lower than the countries. As a result, 45.6 crimes were committed per 1000 inhabitants in the country, while in Aragon, the number fell to 30.7.

The crime rate has a great impact on the development of tourism. If the rate cannot be reduced while the tourism industry develops, tourism's sustainable development will be hampered. Conclusion: there is no doubt that the local government should take several measures to reduce the crime rate, thus protecting tourists' rights and interests and creating a comfortable tourism environment for tourists. Besides, promoting a good image of the destination will also play an important role in reducing the crime rate, such as establishing tourist destination security structures.

### 6.8. Traffic accidents

Transport is a requirement for tourists to complete their tourist activities. When tourists travel, they must solve the transport problem and reach the tourist destination using the appropriate traffic. Every tourist puts safety first when leaving on a trip. Concern about unpredictable factors during the trip makes people pay more attention to the safety of tourist traffic. About Table 10 of traffic accidents with victims, the number of traffic accidents decreases between 2017 and 2018, but there are still victims. When the tourist's safety during the trip is threatened, tourists may consider changing the route or the tourist destination, so traffic safety is a basic and important requirement for them to maintain tourists' safety when choosing a tourist destination.

Environmental indicators: they take into account the environmental impact that the following sub-criteria may have.

### 6.9. Protected natural areas

The abundance of cultural landscapes and the unique resources and culture can improve tourist satisfaction and thus increase the revisit rate. Against more natural areas, it means that the government is paying more attention to protecting natural resources, which leads to improved sustainable tourism. Therefore, this indicator is an essential factor in measuring the sustainable development of tourism resources.

According to Table 11 of the surface area protected by natural spaces, there is a total of 13% of protected land area in Spain. The percentages of the protected land area among the autonomous communities vary greatly, with the percentage of the Canary Islands' protected surface area taking first at 42%. It is closely followed by the two categories of Catalonia and La Rioja, with 34% and 33%, respectively. Aragon only obtains a percentage of around 3%; it occupies the last place among the autonomous communities.

As can be seen in Table 12 and in Map 1, there are 18 protected natural areas, with 164,074 ha in Aragon. There is also 198 Natura 2000 Network; the network is currently made up of more than 1400 Sites of Community Importance (SCI), which are places with natural habitat types or species of special value at the European Union level, and more than 650 Special Protection Areas for Birds (SPA) which are places inhabited by wild bird species, which comprise 30% of the Spanish territory.

It can be clearly seen from the Natura 2000 Network Table 13. The Aragon's territory has many habitats and species of flora and fauna protected in Aragon under the Natura 2000 Network's European umbrella.

As it can be seen in Table 14, in Aragon there is a Natural Monument, Mallos de Riglos (Fig. 5) and a Protected Landscape (Figuer 6).

The Mallos de Riglos are geological formations located in Riglos, in the Pyrenees, about 45 km northwest of Huesca (Spain). They have a maximum height of 275 m and are characterized by their enormous vertical and even collapsed walls, making them ideal for climbing. It occupies 88 ha in the area of Aragon.

This mountain range is located in Zaragoza's province's Cinco Villas region and is of great ecological and geological value. It has 9678 ha of surface area in the area of Aragon.

### 6.10. Special waste collection centres

Special collection centres are places where neighbours can dispose of certain types of household waste free of charge so that they can recycle it and avoid polluting the environment. They are also called clean points. Having many collection points provides more

**Table 10**
Traffic accidents with victims in 2018 per 10,000 inhabitants.

| | Accidents of traffic for each 10,000 inhabitants (the year 2018) | Accidents of traffic for each 10,000 inhabitants (the year 2017) |
|---|---|---|
| Spain | 21,80 | 21,86 |
| Aragon | 16,28 | 18,32 |

Source: National Registry of Traffic Accident Victims, 2018 [70].

**Table 11**
Surface area protected by protected natural areas in 2016 by the Autonomous Community.

| Autonomous community | Total surface of protected area (ha) | Terrestrial protected area (ha) | Marine protected area (ha) | Terrestrial protected area |
|---|---|---|---|---|
| Andalucía | 1.784.922 | 17.33.295 | 51.697 | 20% |
| Aragón | 164.074 | 164.074 | – | 3% |
| Cantabria | 149.604 | 147.736 | 1.868 | 28% |
| Castilla y León | 796.427 | 796.427 | – | 8% |
| Castila-la Mancha | 584.066 | 584.066 | – | 7% |
| Cataluña | 1.095.360 | 10.12.575 | 82.785 | 34% |
| Comunidad de Madrid | 120.964 | 120.964 | – | 15% |
| Comunidad Foral de Navarra | 86.449 | 86.449 | – | 8% |
| Comunidad Valenciana | 264.769 | 250.632 | 14.137 | 11% |
| Extremadura | 315.552 | 315.552 | – | 8% |
| Galicia | 398.609 | 352.059 | 46.550 | 12% |
| Islas Baleares | 99.367 | 74.194 | 25.173 | 15% |
| Islas Canarias | 347.298 | 310.147 | 37.151 | 42% |
| La Rioja | 166.545 | 166.545 | – | 33% |
| País Vasco | 106.228 | 102.294 | 3.934 | 14% |
| Principado de Asturias | 223.968 | 219.890 | 4.078 | 21% |
| Región de Murcia | 61.969 | 61.849 | 120 | 4% |
| Ministerio (Área Marina Protegida El Cachucho) | 234.950 | | 234.950 | |
| **Total 2016** | **7.001.121** | **6.498.748** | **502.443** | **13%** |

Source: The state of protected areas in Spain – Europarc-Spain launches Yearbook. (2016) [71].

**Table 12**
Protected areas in Aragon.

| Aragón Surface area protected | Number | Percentage | Total surface area (ha) | Terrestrial area (ha) | Marine area (ha) |
|---|---|---|---|---|---|
| Protected natural area | 18 | 3% | 164.074 | 164.074 | – |
| Natura 2000 network sites | 198 | 29% | 1.361.724 | 1.361.724 | – |
| **Summary: protected natural area** | | **Number** | **Total surface area (ha)** | **Terrestrial area (ha)** | **Marine area (ha)** |
| Natural Monument | | 6 | 4.329 | 4.329 | – |
| Protected Landscape | | 4 | 28.461 | 28.461 | – |
| National Park | | 1 | 15.696 | 15.696 | – |
| Natural Park | | 4 | 119.212 | 119.212 | – |
| Natural Reserve Directed | | 3 | 3.623 | 3.623 | – |

Source: The state of protected areas in Spain – Europarc-Spain launches Yearbook. (2016) [71].

**Table 13**
Number and area of natural 2000 network sites in Aragon.

| | Number of spaces | Surface area (ha) |
|---|---|---|
| L.I.C. Alpine | 37 | 230.938 |
| L.I.C. Mediterranean | 120 | 814.841 |
| Total L.I·C. | 157 | 1.045.779 |
| ZEPA | 34 | 843.338 |
| Total natural 2000 network sites | 171 | 1.354.854 |

Source: Government of Aragon [72].

**Table 14**
Protected natural areas declared in the period 2014–2016.

| Autonomous community | Legal figure | Name | Total surface area (ha) | Year |
|---|---|---|---|---|
| Aragon | Natural Monument | Mallos de Riglos | 55 | 2016 |
| | Protected Landscape | Sierra de Santo Domingo | 9678 | 2015 |

Source: The state of protected areas in Spain – Europarc-Spain launches Yearbook (2016) [71].

convenience in disposing of material that could damage the environment, so it would help preserve the environment and preserve the area's natural resources.

As it can be seen in Table 15, in Spain, there are two types of clean points: fixed and mobile. This set of facilities is around 1900 collection centres; there is one clean point for every 24,445 inhabitants, Aragon ranks 15th among Spain's autonomous communities.

**Fig. 5.** Mallos de Riglos. Source: Mallos de Riglos y Agüero, 2019 [73].

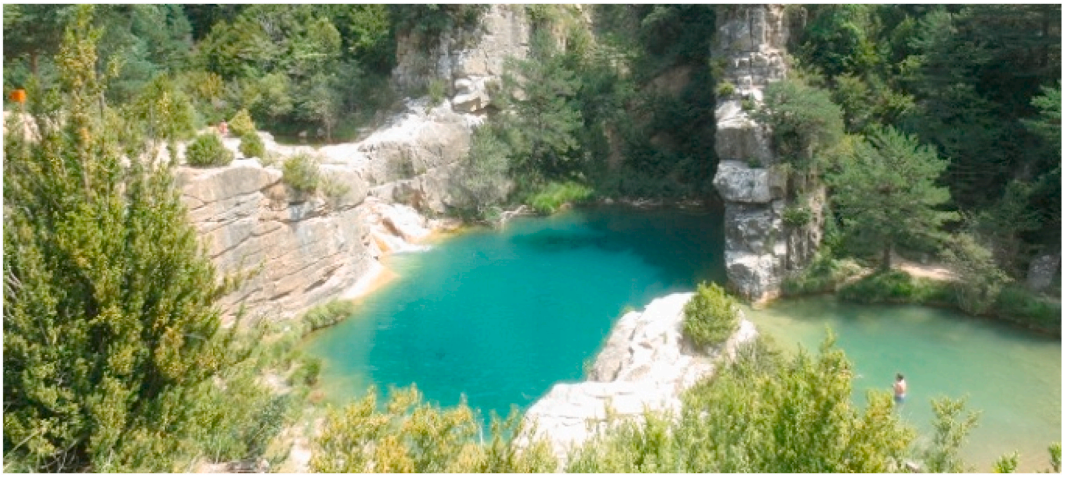

**Fig. 6.** Sierra de Santo Domingo. Source: Sierra de Santo Domingo [74].

### *6.11. The volume of treated wastewater*

Wastewater treatment represents the local pollution control situation. By selecting this indicator, we can understand the degree of local environmental protection. When the level of treated water increases, it means that the government places more emphasis on recycling wastewater, leading to improved environment.

According to the investigation of the volume of wastewater treated and water reused in 2016, we have had the conclusions indicated in Fig. 7 showing that the volume of wastewater has been 526,337 cubic meters per day, there is approximately 8% of wastewater recycled in the autonomous community each day.

Due to the increase in the municipal population's quality of life, the problem of domestic wastewater treatment has become increasingly prominent. Pollution from industrial wastewater is also serious. Communities such as Valencia and Murcia addressed issues related to reused water with great care, the reuse of wastewater is greater than in other areas.

### *6.12. Electricity consumption*

Excessive use of electricity leads to environmentally unfriendly production and harms the environment, so reducing the use of electricity or investing in renewable energy could correct this impact.

According to the Energy Consumption Survey (INE) (Table 16), Aragon spent 457.5 million euros on energy in 2017, a change of −9.7% compared to 2015. Expenditure on electricity accounted for 64.3% of total energy consumption, followed by natural gas, which accounted for 24.6%.

According to Fig. 8 on the evolution of energy expenditure, electricity expenditure increased between 2013 and 2017. Carrying out tourist activities and improving the communications network's coverage level in tourist locations are closely related to electricity use.

**Table 15**
Special waste collection centres in Spain (By Autonomous Region) Year 2014.

| Autonomous community | Population | Clean points | | Ratio (habitancy/Clean points) | |
|---|---|---|---|---|---|
| | | Fixed | Mobile[a] | Clean points fixed | Clean points mobile |
| Andalucía | 8.440.330 | 182 | 5 | 46.375 | 45.135 |
| Aragón | 1.347.150 | 24 | 3 | 56.131 | 49.894 |
| Asturias | 1.068.165 | 34 | 1 | 31.417 | 30.519 |
| Baleares | 1.111.674 | 76 | 5 | 14.627 | 13.724 |
| Canarias | 2.118.679 | 30 | | 70.623 | 70.623 |
| Cantabria | 591.888 | 35 | 5 | 16.911 | 14.797 |
| Castilla la Mancha | 2.100.998 | 326 | | 6.445 | 6.445 |
| Castilla león | 2.519.875 | 109 | 10 | 23.118 | 21.175 |
| Cataluña | 7.553.650 | 310 | 73 | 24.367 | 19.722 |
| Comunidad Valenciana | 5.113.815 | 145 | 25 | 35.268 | 30.081 |
| Extremadura | 1.104.004 | 43 | 2 | 25.675 | 24.533 |
| Galicia | 2.765.940 | 139 | | 19.899 | 19.899 |
| La Rioja | 322.027 | 6 | 5 | 53.671 | 29.275 |
| Madrid | 6.495.551 | 132 | 34 | 49.209 | 39.130 |
| Navarra | 644.477 | 4 | 7 | 161.119 | 58.589 |
| País Vasco | 2.191.682 | 104 | 2 | 21.074 | 20.676 |
| Región de Murcia | 1.472.049 | 38 | 11 | 38.738 | 30.042 |
| Ceuta | 84.180 | 1 | 1 | 84.180 | 42.090 |
| Melilla | 83.679 | 1 | | 83.679 | 83.679 |
| **Total** | **47.129.783** | **1739** | **189** | **27.102** | **24.445** |

Source: National Institute of Statistics, 2014 [75].
[a] There is a lack of updated data or absence of data on the clean points mobile among several Autonomous Community.

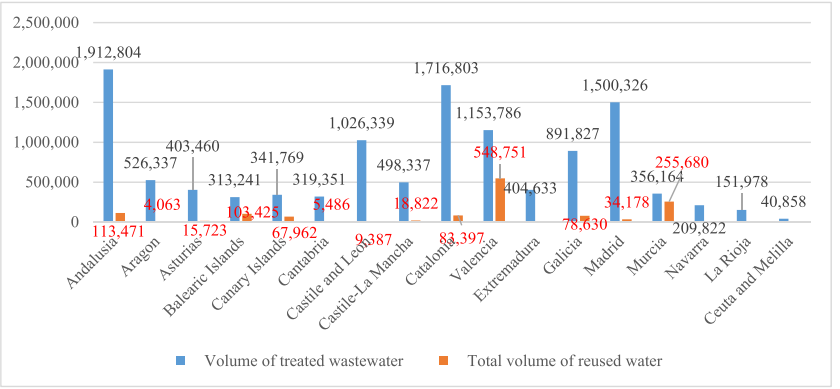


**Fig. 7.** Wastewater collection and treatment by communities in 2016. Source: National Institute of Statistics, 2016 [76].

**Table 16**
Industry expenditure by type of energy product Aragon. The year 2017.

| Unit: thousands of euros | | | | | |
|---|---|---|---|---|---|
| **Total expenditure** | **457.525,1** | | | | |
| Electricity | 294.327 | 64 3% | Other energetic products | 3973 | 0,9% |
| Gas | 112.729 | 24,6% | Fuel oil | 3.636 | 0,8% |
| Diesel oil | 32.044 | 7,0% | Biomass | 1.466 | 0,3% |
| Coal and derivatives | 7032 | 1,5% | Heat | 67 | 0,0% |
| Other petroleum products | 2251 | 0,5% | | | |

Source: Aragon's Institute of Statistics, 2017 [66].

Therefore, preferential policies for the use of electricity must be improved, thus promoting the tourism sector.

### *6.13. Standardization of indicators*

A synthetic indicator is made up of individual indicators expressed by different measurement units, rates, or percentages. Due to the different units of measurement, it is often difficult to achieve consistency in aggregation. The most important thing is that the data will be aggregated so that there are no differences between them. For this reason, what is known as the normalization of variables is

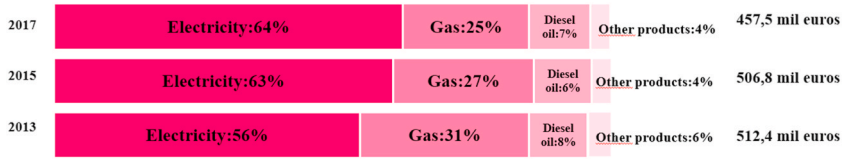


**Fig. 8.** Evolution of expenditure on energy products by the Aragon's industry. Source: Aragon's Institute of Statistics (INE), 2017 [66].

required. The indicators are comparable and can be analysed, thus obtaining a synthetic scientific indicator. It is characterized by the range of values obtained by the variables, fluctuating between zero and one.

Therefore, at this stage, we will standardize the indicators selected in the previous point. We have consulted a standardization method used by the World Travel & Tourism Council (WTTC), the only international body that brings together major private tourism companies. The WTTC works with governments to raise awareness among the world's population about tourism and travel has potential in terms of wealth creation and job creation. In 2001, the organization established a Tourism Competitiveness Monitor that seeks to assess the extent to which each country provides a competitive environment for tourism development.

In this study, we will use the two formulas that form part of this monitor's normalization method to normalize our indicators. Each normalized indicator will represent the relative state of the Community of Aragon concerning other communities.

Each standardized indicator is calculated using the following formulation to carry out the standardization. (Min-max normalization)

$$I_{j=}\frac{a_{j-}\ min\ (a_j)}{max\ (a_j) - min\ (a_j)} \tag{1}$$

For the present study, Ij represents the standardized value of the indicator j-ésimo for the community of Aragón; $_{aj}$ is the original value of the indicator j-ésimo for the community of Aragón. Max ($_{aj}$) is the maximum value of this indicator for all the Autonomous Communities. Min ($_{aj)\ is\ the}$ minimum value of this indicator for all the autonomous communities.

The result of the standardization of indicators has a value between zero and one, interpreted in this way: The value of one indicates the indicator with the best degree and zero with the worst degree.

It should be pointed out that the above equation should be applied to indicators of the "more is better" type. In other words, the greater the value of an indicator, the better Aragon's behavior will be about other autonomous communities in the concept measured by the indicator.

Otherwise, some tourism variables are defined as "less is better," the following standardization should be used (Xu, 2018) [12]:

$$I_{j=}\frac{max\ (a_j) - a_j}{max\ (a_j) - min\ (a_j)} \tag{2}$$

It ensures that the value of a standardized indicator of the most competitive autonomous community is equal to 0, and the value of a less competitive area is equal to 1.

Table 17 shows theoretical and evaluated partial indicators relevant to sustainability at the local level and their concrete values after standardization. In this sense, we must obtain information on the evaluated indicators from all the autonomous communities, which guarantees constant and real information on the tourist destinations studied.

**Table 17**
Assessment of indicators through standardization.

| Theoretical Indicators | Indicators Evaluated | Ij |
|---|---|---|
| Overnight stays in tourist accommodation | *The annual rate of change in overnight stays in tourist accommodation* | *0.79* |
| Length of stay | *The average length of stay* | *0,26* |
| Tourism employment in the destination | *The year-on-year rate of change in tourism employment* | *0.52* |
| Gross investment in tangible goods | *Annual rate of change in gross investment in tangible goods in the tourism sector* | *0.87* |
| Life expectancy | *average life expectancy* | *0.69* |
| Criminal activities | *Crime rate* | *0.86* |
| Aging | *Aging index* | *0.42* |
| Traffic accidents | *The year-on-year rate of change in road accidents with casualties* | *0.75* |
| The natural areas | *Number of natural areas* | *0.72* |
| The volume of treated wastewater | *The volume of wastewater received* | *0.79* |
| Electricity consumption | *Energy expenditure* | *0.83* |
| Special collection centres | *The ratio of inhabitants/clean points* | *0.33* |

Source: Own elaboration.

## 7. The weighting of standardized information

### 7.1. Weighting methodology

Below, we describe the following necessary steps applied to the AHP method to determine each criterion's weight.

Step 1: Establish a multi-scale hierarchical model and divide it into several scales according to different objectives and functions.

One of the most relevant parts of the AHP is the structuring of the hierarchy. In this sense, the issue must be broken down into relevant components. The basic hierarchy consists of an overall goal or objective, criteria, and alternatives. The steps to follow in structuring the hierarchical model are (i) A diagram is visually constructed with a basic hierarchy composed of the general objective, criteria or indicators and the alternatives [77].

Scale 1: The overall purpose or objective of the problem is at the top.
Scale 2: The different criteria and sub-criteria (partial indicators) that define the alternatives are in the center.
Scale 3: The alternatives are at the bottom.

In this paper, by looking at Fig. 9, we define the criteria chosen based on a conceptual framework of three components. The hierarchical scheme's objective will be to determine each criterion and sub criterion's weight to construct the synthetic indicator. As this work investigates the Aragon's region, the 3 (alternative) scale is omitted because it is not compared with other regions.

Fig. 10, where: R1 = overnights in tourist accommodation, R2 = entry of non-resident tourists, R3 = employment at the destination, R4 = gross investment in material goods, R5 = life expectancy, R6 = crime rate, R7 = aging index, R8 = traffic fatalities, R9 = protected natural areas, R10 = volume of wastewater, R11 = electricity consumption, R12 = collection centres.

#### 7.1.1. Second step

Values (1–9) are attributed to the experts' priorities involved in the AHP applications process. The degree of preference is generally divided into five levels: 1, 3, 5, 7 and 9 respectively (intermediate values: 2, 4, 6, 8), representing the degree of importance, where one would indicate that both factors are equally important, and nine would indicate that one factor is much more important than the other. Subsequently, the experts construct different decision (comparison) matrices (Table 17), make peer-to-peer comparisons between the criteria, the partial indicators, and provide assessments regarding the relative importance.

Square matrices have paired comparisons of criteria. We propose an A matrix (Table 18) that has the element aij (i = 1, 2, 3, … n; j = 1, 2, 3, … n), and is a matrix of n-criteria comparisons. Aij is a measure of the selection preference in row i-th compared to the selection in column j-th. When i = j, the value will be equal to 1, because the alternative is being compared with itself.

### 7.2. Weighting applied in this study

Firstly, in order to make a more reliable comparison on our study, we prepared a survey (See Annex) on the preferences of the respondents regarding which of these economic, social, and environmental indicators are more important concerning sustainable tourism in Aragon, also on the preferences regarding the economic, social and environmental dimensions. The survey structure is as follows: first, we asked respondents to give us their degree of preference for these three dimensions, and second, we asked them to indicate the intensity of their preferences regarding the four indicators that make up each dimension.

Second, respondents prepare four comparison matrices according to this survey and develop a correlation matrix related to the

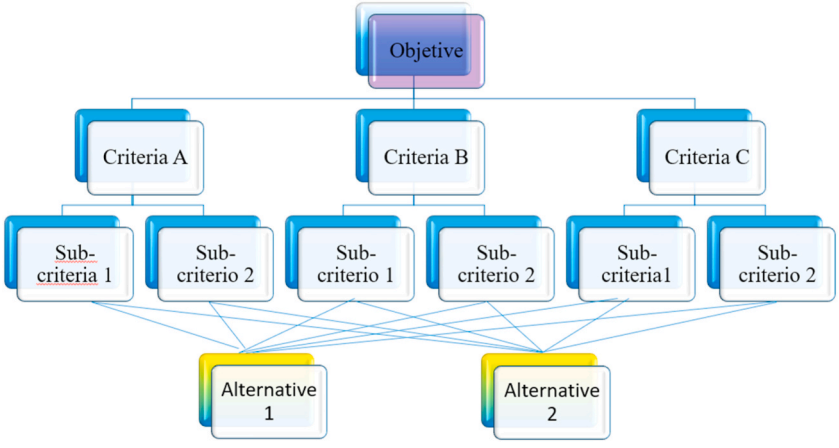


**Fig. 9.** Example of a hierarchical scheme. Sources: Own elaboration.

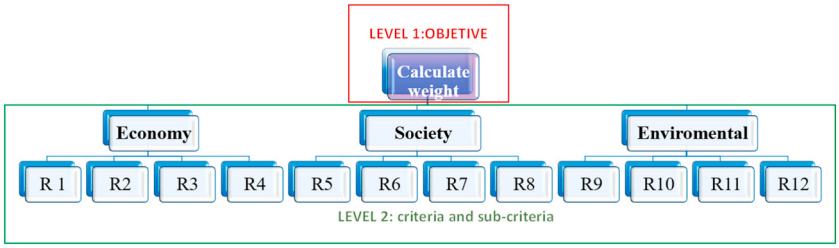


**Fig. 10.** Hierarchical scheme. Sources: Own elaboration.


**Map 1.** Natura 2000 network. Source: World wide fund for nature [78].

**Table 18**
Example of Matrix of paired comparisons.

| aj | ai | | | |
|---|---|---|---|---|
| | a1 | a2 | … | an |
| a1 | a11 | a12 | … | a1n |
| a2 | a21 | a22 | … | a2n |
| … | … | … | … | … |
| an | an1 | an2 | … | ann |

Source: Own elaboration.

three dimensions (the three criteria) and the three matrices related to each dimension's four partial indicators based on the survey. We get the result based on the results of the questionnaire and consulting experts. Thus, according to the Hierarchical Analytical Process (AHP) principles, we constructed four correlation matrices to calculate the weight.

$$\text{Matriz A} = \begin{bmatrix} 1 & 1 & 1/3 \\ 1 & 1 & 1/3 \\ 3 & 3 & 1 \end{bmatrix}$$

$$\text{Matriz B} = \begin{bmatrix} 1 & 9 & 7 & 5 \\ 1/9 & 1 & 1/3 & 1/5 \\ 1/7 & 3 & 1 & 1/3 \\ 1/5 & 5 & 3 & 1 \end{bmatrix}$$

$$\text{Matriz C} = \begin{bmatrix} 1 & 1/9 & 1/5 & 1/3 \\ 9 & 1 & 5 & 3 \\ 5 & 1/5 & 1 & 3 \\ 3 & 1/3 & 1/3 & 1 \end{bmatrix} \quad (3)$$

$$\text{Matriz D} = \begin{bmatrix} 1 & 1/5 & 1/7 & 3 \\ 5 & 1 & 1/3 & 5 \\ 7 & 3 & 1 & 7 \\ 1/3 & 1/5 & 1/7 & 1 \end{bmatrix}$$

Next, we propose the equations to calculate the value of each coefficient needed to achieve the weight [32]. We give an example of the calculations of Matrix A. We denominate the economic dimension = W1, the weight of the social dimension = W2, the weight of the environmental dimension = W3.

Step 1: sum of each column

$$A = \frac{\begin{matrix} 1 & 1 & 1/3 \\ + & + & + \\ 1 & 1 & 1/3 \\ + & + & + \\ 3 & 3 & 1 \end{matrix}}{5 \quad 5 \quad 5/3} \quad \text{..... (4)}$$

Step 2: calculation of the average ($an_{ij}$/sum) …

$$\text{Promedio A} = \begin{Bmatrix} 1/5 & 1/5 & (1/3)/(5/3) \\ 1/5 & 1/5 & (1/3)/(5/3) \\ 3/5 & 3/5 & 1/(5/3) \end{Bmatrix} \quad (5)$$

Step 3: calculation of the weight (average of each row)

$$\text{Peso } W_j = \begin{Bmatrix} 1/5+1/5+(1/3)/(5/3) \\ 1/5+1/5+(1/3)/(5/3) \\ 3/5+3/5+1/(5/3) \end{Bmatrix} \div 3 = \begin{Bmatrix} 1/5 \\ 1/5 \\ 3/5 \end{Bmatrix} = \begin{Bmatrix} W1 \\ W2 \\ W3 \end{Bmatrix} \text{..... (6)}$$

Step 4: Consistency check:

After calculating the correlation matrices' weight, the consistency of the whole hierarchical scheme must be checked. The method consists of calculating the Consistency Index (C·I.) value of each comparison matrix.

When C.I. $\geq$ 0.1: Inconsistency, it is necessary to restructure the pair-wise comparison matrix.

When C.I. $<$ 0.1: Reasonable consistency, the weight value can be used.

First of all, we can use the following system of equations to calculate the value of ƛmax:

$$ƛmax = AW/W \tag{7}$$

Where A means the matrix A= (aij)of pair-wise comparisons, ƛ represents the maximum proper value of the matrix A, and W= (W1, W2, …, Wn) is the weight. The estimated weight we notice by ΣW = 1, which means that the weights add up to 1. According to matrix A, W1 = 1/5, W2 = 1/5, W3 = 3/5, therefore.

$$A \times W = ƛ\ W$$

$$\begin{Bmatrix} 1 & 1 & 1/3 \\ 1 & 1 & 1/3 \\ 3 & 3 & 1 \end{Bmatrix} \times \begin{Bmatrix} 1/5 \\ 1/5 \\ 3/5 \end{Bmatrix} = \begin{matrix} 3/5 \\ 3/5 \\ 9/5 \end{matrix}$$

$$ƛ_{max} = \begin{Bmatrix} 3/5 \\ 3/5 \\ 9/5 \end{Bmatrix} \div \begin{Bmatrix} 1/5 \\ 1/5 \\ 3/5 \end{Bmatrix} = 3$$

The following is the equation for calculating the Consistency Index (CI)

$$C.I. = \frac{\lambda\ max - n}{n - 1} \tag{8}$$

N is the number of criteria involved in the comparison. Therefore:

C.I. (Matrix A) = 3-3/3-1 = 0 < 0.1 (Reasonable consistency)

We concentrate on calculating each coefficient's values, and after checking the consistency, we develop the relevant tables. We can also use mathematical tools such as Yaahp and Matlab, to carry out the weight and I.Q. Calculations (Table 19 and Table 20).

## 8. Aggregation of data

We have reached the point where the data obtained in a synthetic indicator should be aggregated once the weighting factors have been finalized. For this reason, we use linear summation as a multi-criteria assessment tool to combine the assessment factors by applying each one's weight and adding the results of the three dimensions according to the following equation [16].

$$Y = \left( \sum_{i=1}^{m} \left( \sum_{j=1}^{n} Ij * Rj \right) * Wi(m = 3, n = 12) \right) \tag{9}$$

Where Y is the value of the synthetic indicator which is between zero and one, Ij represents the normalized value of the indicator j-ith for Aragon, and as there are twelve indicators in total in this study (n = 12, n is the number of the selected indicators), Rj is the weight of indicator j, and $_{Wi}$ is the weight of each of the three dimensions. (m = 3, m represents the number of dimensions).

According to Table 21, we conclude that the integral score of the region is 0.77. According to the weight of each dimension, we can infer the maximum score of the three dimensions. The values obtained are within a certain adjusted range (from zero to one) and are accepted by the experts.

## 9. Discussion

By reviewing the relevant literature and consulting expert opinions, we developed a standard for assessing the degree of sustainable development in tourism that is divided into four stages: the preparatory stage for sustainable development, the preliminary sustainable development stage, the basic sustainable development stage, and the sustainable development stage [16].

Since we only selected the Autonomous Regions of Spain to carry out our synthetic indicator, we did not analyse the relevant data from other countries' regions. Therefore, this standard is advisable to be applied only to Spain.

It is also considered that according to the different junctures of the region, the weight of the three economic, environmental and social aspects should change, which would lead to changes in the results of the Y/Ymax Ratio and the value of our synthetic indicator.

Firstly, environmental protection must meet the needs of human development. As the driving force behind human development, economic development will make the relationship between human beings and nature more harmonious and closer, gradually making human beings aware of the importance of environmental protection. So, several measures and legal systems have been formulated for the protection of the environment.

**Table 19**
Weights of the three economic, social and environmental criteria according to matrix A.

| | Q1 (economic) | Q2 (social) | Q3 (environmental) |
|---|---|---|---|
| Weight (Wj) | 0.2 | 0.2 | 0.6 |
| C.I. = 0 < 0.1 ƛmax = 3 | | | |

Source: Own elaboration.

**Table 20**
Weights of relative indicators according to matrices B, C, D.

| economic indicators | R1 | R2 | R3 | R4 |
|---|---|---|---|---|
| Weight (Rj) | 0.6427 | 0.0480 | 0.1010 | 0.2083 |
| C.I. = 0.0652 < 0.1 | ƛmax = 4.1740 | | | |
| social indicators | R4 | R5 | R6 | R7 |
| Weight (Rj) | 0.0498 | 0.5706 | 0.2404 | 0.1392 |
| C.I. = 0.0990 < 0.1 | ƛmax = 4.2643 | | | |
| environmental indicators | R8 | R9 | R10 | R11 |
| Weight (Rj) | 0.0990 | 0.2802 | 0.5655 | 0.0553 |
| C.I. = 0.0891 < 0.1 | ƛmax = 4.2379 | | | |

Source: Own elaboration.

**Table 21**
The ratings of the alternatives.

| | Y1 (Economy) | Y2(Society) | Y3 (Environment) |
|---|---|---|---|
| Rating(Y) | 0,15 | 0,15 | 0,47 |
| Maximum rating (Ymax) | 0,2 | 0,2 | 0,6 |
| Y/Ymax ratio | 0,75 | 0,75 | 0,78 |
| Y= Y1+Y2+Y3 = 0.77 | | | |

Source: Own elaboration.

Secondly, in areas where the economy is relatively developed, the inhabitants have enjoyed a good quality of life (benefit of economic development) to put environmental protection first while developing the economy. In contrast, in some areas where the economy is relatively backward, people have not yet enjoyed economic development achievements, even their region is in a state of poverty with problems of lack of food and clothing. It will lead to the inability to ensure the economy's development while protecting the environment. Because the environmental problem is still being solved, people are still hungry, without work.

Therefore, the weight of the economy, society, and the environment should be analysed according to the country or region's current situation. For example, Spain's different autonomous communities in an epidemic situation may put the economy and society first. In our work, we analysed Aragon's area's information before the COVID-19 situation, so we believe that environmental protection is important.

So, following Table 22, the standard for assessing sustainable tourism development, can be described.

- Y<40% (stage 1)

Tourism resources have not been protected, natural landscapes and ecology have been damaged; environmental pollution, traffic restrictions, and low quality of work for employees have been damaged.

- Y = 40%–60% (stage 2)

The protection of tourist resources is not sufficient; the environmental quality is not high; the construction of the infrastructure and the tourist image is insufficient; tourism's fundamental role is not fully exercised.

- Y = 60%–80% (stage 3)

**Table 22**
The standard for assessing sustainable tourism development.

| Comprehensive evaluation | <40 | 40–60 | 60–80 | > 80 |
|---|---|---|---|---|
| Level of sustainable development | Very low | under | normal | high |

Source: Own elaboration.

Tourist resources are protected, socio-economic development, ecological stability, the environment, high passenger satisfaction, improvement of residents' lives, and the fundamental role of tourism is put at stake.

- 2% (stage 4)

The tourist resources are protected, the socio-economy is developed, ecological stability is presented, the environment is pleasant, the passengers' high satisfaction, the improvement of the residents' lives, and the fundamental role of tourism are important. With the results obtained, we know that Aragon's in the medium-high level of sustainable development in the field of tourism (stage 3), obtaining a final score of around 76%. We will now develop the analysis and opinions on the Aragon tourism industry and its sustainability based on the calculated data.

In our study, the field of economics ranks second in terms of the qualification ratio (Y/Ymax) (see Table 21) among the three dimensions: assuming considerable economic development thanks to the increase in the number of tourists, and investment in technological resources, human and material capital that helps to improve productivity, i.e., companies aim to improve the quality of resources, which generates the greatest amount of sales, both in services and in tourism products.

Regarding communication in the means of transport, firstly, although this area has convenient transport in most parts of Aragon, it still lacks the ease of access to some villages, and there are a large number of abandoned railways. Secondly, the region needs to increase road construction investment to stimulate economic prosperity and society's development in areas close to the road.

As it is a very strong tourist economy, this industry is one of the province's pillars. They must make an effort to increase the total income from tourism and the level of consumption, increase tourist arrivals, and optimize consumption structure. Comprehensive tourism can be created that combines culture, entertainment, shopping, and other experiences to meet current tourist consumption needs. Furthermore, it is necessary to increase tourists' length of stay and consumption to improve economic development. Amongst these, inbound tourism is one of the essential ways to increase tourism consumption, and therefore diversified and multilingual advertising and marketing channels should be established to increase the opportunities for such tourism. Finally, the local area needs to speed up the digital development of the tourism industry, such as: improving the construction of the local tourism data statistics website, hotel reservation network, travel agency management network, tourism talent information network, etc.; vigorously developing a global hotel room reservation system to increase tourists In addition to convenient conditions, it is also possible to understand the preferences of tourists, thereby promoting the informatization construction of the tourism industry.

The social aspect has the same ratio score (Y/Ymax) (see Table 21) as the economic aspect. On the one hand, the inhabitants have a high life expectancy due to improvements in life quality. On the other hand, the region is currently facing a severe problem: the aging of the population, which leads to a reduction in the labour force.

We think that the relevant institutions should enable older people to participate fully and effectively in economic, political, and social life through income-generating work and voluntary work. Older people have the capacity not only to maintain their health but also to improve society's situation.

To ensure sustainable tourism development, the government must also pay attention to tourism employees' skills and professionalism. Improving employees' quality can be achieved through training and education, continuously instilling knowledge about sustainable development. By improving their professional management level, it reduces the loss of tourism resources and the industry's operational costs.

In recent years, "Natural Aragon" has been chosen as being related to sustainable development as the image of tourism in Aragon. It indicates that the government has a strong awareness of environmental protection during developing tourist resources, and has established the strategy plan for sustainable tourism, including advertising and promoting awareness promptly so that both residents and tourists realize the fundamental requirements of sustainable tourism development in this territory.

Managing the tourism environment refers to the use of administrative, legal, educational, and other means to restrict the activities of people who damage the environment. Its central task is to ensure that the development, planning, construction, and use of tourism resources follow ecology laws and promote the tourism industry's healthy development. To strengthen the environmental management of tourism, it is necessary.

(1) Strengthen comprehensive pollution prevention and control measures
(2) Strengthening ecological protection, Etc.

According to its weight (maximum qualification), we know that in the process of sustainable development of tourism, environmental factors dominate, also occupying the first place in terms of the qualification ratio (Y/Ymax) (See Table 21) among the three dimensions,

Biodiversity is well-conserved thanks to the restrictions on hunting managed by the Aragon's Institute of Environmental Management for big game and small game and the establishment of protected natural areas, such as the Red Natural 2000, natural park, natural monument, Etc. Woodlands and forests abound in Aragon, where there is a diversity of fauna and flora.

The Aragon's territory has insufficient special waste collection centres compared to other autonomous communities. In this sense, the relative entity must provide services and solutions in terms of waste collection. In addition to promoting the activity of green purchases, which is equivalent to purchases in a reasonable manner, in other words, it is advisable to buy products that help to protect the environment, and wastewater contaminated by urban and industrial uses should improve the rate of reuse. In good part, control networks have been put in place to assess water quality and reduce pollution.

Concerning the increase in electricity consumption, energy must be saved, and waste avoided in this area; on the contrary,

economic development is inseparable from electricity consumption.

In conclusion, the protection of the environment is the common goal of all humankind. Therefore, we believe that there should be financial compensation for people who contribute to maintain the environment. Secondly, the government should design relevant systems to restrict excessive natural exploitation and place the rational use of tourism resources. Finally, an effort should be made to increase investment and actively maintain the destination's natural tourism image.

## 10. Conclusion

The measurement of sustainable tourism is essential to improve political actions to achieve the SDG (Sustainable Development Goals) set out in the United Nations Agenda 2030, adopted by all United Nations Member States in 2015. In the past few years, the Aragon government has become more and more aware of the importance of sustainable development. The Aragon region has improved employment rates, improved residents' living standards, and reduced negative impacts on the environment and local culture through sustainable tourism development [79]. However, in the current process of regional tourism development, due to the lack of local evaluation tools for sustainability, there may be problems such as insufficient awareness of local tourism, improper future planning, and corrective measures. Therefore, this paper conducts an in-depth analysis of the theory of sustainable tourism development and builds a tool to evaluate tourism sustainability in Aragon to strengthen the understanding of local tourism and provide a reference for formulating development strategies.

The conclusions drawn in this paper mainly include the following points.

(1) This article determines the level of sustainable development in the Aragon area and summarizes the countermeasures to promote local sustainable development:

The sustainable development of tourism requires the mutual coordination and balanced progress of the economy, society, and environment, which is a dynamic process and requires careful consideration of various factors. Therefore, we construct a three-dimension model to select individual indicators. We also use the literature review method combined with the tourism characteristics of Aragon and explain each indicator so that the selected indicator is pertinent and practical. It is advisable to exploit popular cultural resources and develop special tourism products, including promoting traditional dance, continuing the commitment to regional gastronomy, and rural tourism with growing demand, as has been seen during the COVID-19 pandemic scientifically and rationally. In addition, it is necessary to strengthen the protection of the environment, strengthen the control and treatment of pollutants, improve residents' living standards, and appropriately increase investment in the tourism industry.

(2) The synthetic indicators constructed in this paper through the expert consultation method, literature review method, and AHP have the following advantages and innovations:
   (A) This is the first time anyone has studied the evaluation tools in the Aragon region. We have constructed the evaluation tools in this paper by analysing the evaluation tools created by research scholars for different countries and territories and the sustainable management experience and strategies of other tourist areas: "Comprehensive Indicators."
   (B) We used the questionnaire and expert consultation methods to construct the matrix. This method is very convenient for data collection and ensures fairness.
   (C) Individual indicators are selected from the three aspects of economy, society, and environment, with precise classification, logic, and strong integrity. Therefore, the assigned individual indicators can meet the evaluation needs of this paper.
   (D) The method of constructing the synthetic indicators in this paper is simple and easy to operate, and relevant software can also be used to calculate the updated data. It will not significantly increase the management cost of the local tourism industry.

From the perspective of the methods used in this work, our synthetic indicator is a powerful tool in aggregating information through different types and magnitudes of indicators. This synthetic indicator has fulfilled all the requirements: scientific, holistic, operational, oriented, hierarchical, dynamic, and stable in its creation, and thanks to it, we can transform different types of magnitudes into a unique indicator that measures sustainability.

There are specific problems and limitations in this work that deserve further discussion and research.

1. Different scholars discuss the concept of sustainable tourism development slightly differently, so the concept of tourism sustainability needs to be more specific and clearer. However, with the continuous improvement of people's cognitive levels and the gradual deepening of relevant research, a clearer concept of sustainable tourism development will be obtained in the future.
2. In selecting indicators, some indicators are difficult to quantify, such as the carrying capacity of tourism resources, the attractiveness of tourism resources to tourists, the degree of satisfaction of tourists with tourism products, etc. It is necessary to design more powerful measurement tools to obtain accurate statistics.
3. During the research process, we found that establishing synthetic indicators is hugely complex and more challenging to grasp. This is because many factors affect the sustainable development of tourism, and it is difficult to determine which factors are the main influencing factors. Moreover, the sustainable development of tourism has layers (Fig. 9), with different characteristics at different levels, so that various researchers will have other choices of indicators. At the same time, the importance of the indicators identified

in different situations will change. Therefore, further research is still needed on the selection of individual indicators and the determination of weights.

## Author contribution statement

Conceived and designed the analysis: Huang, Sanagustín-Fons, Galiano, and Moseñe-Fierro.
Analysed and interpreted the data: Huang and Sanagustín-Fons.
Contributed analysis tools: Huang, Sanagustín-Fons, Galiano, and Moseñe.
Wrote the paper: Huang, Sanagustín-Fons, Galiano, and Moseñe.

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## Data availability statement

No data was used for the research described in the article.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Annex

*Survey on the preference of economic, social, and environmental indicators for sustainable tourism in Aragon*

Dear experts:
Thank you very much for taking the time to complete this form. This study aims to establish synthetic indicators through the assessment of criteria and indicators concerning the economic, social and environmental dimensions to evaluate sustainable tourism and to carry out empirical research. To this end, comparisons will be made (indicator by indicator) with the scale detailed below.

| |
|---|
| 1 Equally important |
| 3 Slightly more important |
| 5 Significantly more important |
| 7 Demonstrably more important |
| 9 Absolutely more important |
| (Intermediate values 2, 4, 6, 8). |

Example: if you consider that the economic dimension of the blue column is absolutely more important than the social dimension of the yellow row, fill in the first row with a 9, the second column.
If you consider that the economic dimension of the yellow row is absolutely more important than the social dimension of the blue column you fill in the 1/9th in the second row, the first column.

*MatrixA of the three dimensions*

| Criterion | Economic | Social | Environmental |
|---|---|---|---|
| Economic | 1 | 1 | 1/3 |
| Social | 1 | 1 | 1/3 |
| Environmental | 3 | 3 | 1 |

*MatrixB of economic indicators*

| Criterion | Maximise overnight stays in tourist accommodation | Maximise the entry of non-resident tourists | Maximising employment at the destination | Maximising gross investment in material goods |
|---|---|---|---|---|

(*continued on next page*)

(*continued*)

| Criterion | Maximise overnight stays in tourist accommodation | Maximise the entry of non-resident tourists | Maximising employment at the destination | Maximising gross investment in material goods |
|---|---|---|---|---|
| Maximise overnight stays in tourist accommodation | 1 | 9 | 7 | 5 |
| Maximise the entry of non-resident tourists | 1/9 | 1 | 1/3 | 1/5 |
| Maximising employment at the destination | 1/7 | 3 | 1 | 1/3 |
| Maximising gross investment in material goods | 1/5 | 5 | 3 | 1 |

*Matrix C of the social indicators*

| Criterion | Maximising life expectancy | Minimising the crime rate | Minimising the rate of ageing | Minimize fatal traffic accidents |
|---|---|---|---|---|
| Maximise life expectancy | 1 | 1/9 | 1/5 | 1/3 |
| Minimising the crime rate | 9 | 1 | 5 | 3 |
| Minimising the rate of ageing | 5 | 1/5 | 1 | 3 |
| Minimize fatal traffic accidents | 3 | 1/3 | 1/3 | 1 |

*Environmental Indicators Matrix D*

| Criterion | Maximising protected natural areas | Minimize the volume of wastewater | Minimising electricity consumption | Maximising collection centres |
|---|---|---|---|---|
| Maximising protected natural areas | 1 | 1/5 | 1/7 | 3 |
| Minimize the volume of wastewater | 5 | 1 | 1/3 | 5 |
| Minimising electricity consumption | 7 | 3 | 1 | 7 |
| Maximising collection centres | 1/3 | 1/5 | 1/7 | 1 |

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