

Sustainable tourism: a group parsimonious analytic hierarchy approach

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Received 17 September 2025
Revised 20 November 2025
16 January 2026
29 January 2026
12 March 2026
17 April 2026
Accepted 17 April 2026

Abstract

Purpose – Tourism is one of the levers of a country’s economy. Policy makers pay particular attention to defining tourism strategies aimed at encouraging sustainable tourism in internal and peripheral areas. Our work aims to provide an adequate multi-criteria decision-making (MCDM) methodology to address group problems in the tourism sector.

Design/methodology/approach – We propose a new version of the Parsimonious Analytic Hierarchy Process (AHP) method for group choices, proposing a methodological innovation that integrates an algebraic approach for the construction of Pairwise Comparison Matrices into the Parsimonious AHP. This approach removes some drawbacks of the classical Parsimonious AHP without increasing the evaluation time or the cognitive effort required of the decision-maker (DM). The work analyses a real case study involving the DMs of six municipal administrations located in the hinterland of Campania in relation to a national project that encourages tourism to increase territorial attractiveness.

Findings – The results obtained demonstrate that the new methodological approach provides concrete support for the definition of tourism strategies shared by the various DMs involved. The application of sensitivity analysis in our study has confirmed the robustness of our results.

Originality/value – The paper is original in respect of both its method and its applications. Indeed, for the first time, we propose a methodology that integrates an algebraic approach based on Abelian linearly ordered groups into the Parsimonious AHP method, and then we apply this methodology in support of the development of tourism strategies that integrate sustainability-oriented decision criteria and promote sustainable tourism in internal and peripheral areas, foster the enhancement of the cultural and territorial heritage, and strengthen inter-municipal cooperation. In the future, our methodology could be applied to other decision-making problems in other domains of interest, and further methods that use pairwise comparisons, in addition to Parsimonious AHP, could be integrated with the algebraic approach used in this paper.

Keywords Parsimonious AHP, Group choice, Abelian linearly ordered group, Multi-criteria decision-making, Sustainable tourism

Paper type Research article

1. Introduction

Tourism is one of the main drivers of countries’ economies (Mihalic, 2002). It produces effects on employment (Nguyen *et al.*, 2025), on infrastructure investments (Yanase, 2015), and on

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This publication was supported by funds from the “Progetti di Ricerca di Ateneo (PRA) 2025” of the University of Foggia. The author Gerarda Fattoruso acknowledges the financial support received within this framework.



Management Decision
Emerald Publishing Limited
e-ISSN: 1758-6070
p-ISSN: 0025-1747
DOI 10.1108/MD-09-2025-2744

the value of land (Romão, 2018). With respect to this last aspect, in particular, tourism has a crucial role in the strategic decision-making processes (Bousset *et al.*, 2007) in local development. With regard to the differences between internal and peripheral areas (Jewell *et al.*, 2004), the latter are those in which the most significant and critical issues, such as demographic decline, the reduction of essential services (Hospers and Reverda, 2015) and, worse still, the devaluation of the landscape and cultural heritage, occur. In this context, even more than in others, strategic choices are needed that encourage tourism as a driver of socio-economic development to enhance the whole of the territorial heritage and local resources (Boniface, 2000). These considerations give a central role to political decision-makers (DMs), who must adopt strategic choices to develop tourism in internal and peripheral areas. In order to support DMs in making strategic choices regarding inland and peripheral areas and to address decision-making problems in the tourism sector (Elbelehy and Crispim, 2026), multi-criteria decision-making (MCDM) models can be adopted, and these have proved to be particularly useful for modelling complex problems (Doumpos and Zopounidis, 2002). MCDM models are known for their versatility in analysing different types of decision-making problems. They consider a plurality of alternatives and criteria (which are often in conflict with each other) (Ishizaka and Nemery, 2013), and they are useful decision support tools for a DM in different applications and contexts (see, for example, Fattoruso *et al.*, 2024; Fattoruso and Marcarelli, 2022; Cavallo *et al.*, 2014). With reference to the tourism sector, a growing number of scholars have been working in recent years to provide new MCDM methodological approaches to support DMs in defining tourism development policies, especially when these involve networks of actors and territories with heterogeneous needs. In such situations, DMs face a complex decision-making process that can be characterized as multidimensional problem. The decision-making process becomes more complex when decisions are made in groups and in a public context. Starting from these critical issues, this study aims to support group decision-making in the public context. The increased complexity of the decision-making process in group and public contexts is due to several factors. For example, group size influences decision-making timing and dynamics; smaller groups often take longer to make decisions; and leaders tend to prevail within groups (Wu, 2024). The social and organizational context can influence the way in which groups reach decisions, adding further layers of complexity without necessarily improving the quality of decisions (Mullick and Sen, 2025). At the same time, social ties can reduce costs but complicate decision-making (Selivanovskikh *et al.*, 2025). Overall, the interaction between social influence, group structure and environmental complexity makes group and public decision-making processes intrinsically more complex than individual decisions. Starting from these observations, this study aims to support group decision-making in the public context. To achieve this goal, the article, through the analysis of a real case study, aims to provide an appropriate MCDM methodology to support the development of tourism strategies that integrate sustainability-oriented decision criteria and promote sustainable tourism in internal and peripheral areas, that foster the enhancement of cultural and territorial heritage and that strengthen inter-municipal cooperation. In particular, the work involves DMs from six municipal administrations located in the Campania hinterland that have participated in national programmes to encourage and recognize tourism as a strategic sector to increase the territorial attractiveness. The problem at hand is, therefore, configured as a group decision problem. In this sense, our work proposes a methodological extension of the Parsimonious AHP method to support group strategic choices in complex and heterogeneous contexts. To this end, we propose, for the first time, the use of the aggregation of individual priorities (AIP) in a group Parsimonious AHP method.

The main originality of the methodology proposed in this paper is the integration of an algebraic approach into the Parsimonious AHP method. Traditionally, the Parsimonious AHP method uses the Saaty scale for the elicitation of preferences; this is based on verbal judgments translated into a discrete numerical scale $S = \left\{ \frac{1}{9}, \frac{1}{8}, \frac{1}{7}, \frac{1}{6}, \frac{1}{5}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, 1, 2, 3, 4, 5, 6, 7, 8, 9 \right\}$ (Saaty,

1977, 2001). It is well known that the assumption of the Saaty scale leads to a boundary problem (Cavallo and D'Apuzzo, 2009) that is caused by the consistency rule (e.g. if the DM prefers alternative A 8 times more strongly than alternative B and alternative B 8 times more strongly than alternative C, he/she should prefer alternative A 64 times more strongly than alternative C, but the upper limit of the scale is 9). Several other scales have also been proposed in the literature (Cavallo and Ishizaka, 2023), in addition to the Saaty scale, in order to represent the data in a more realistic way. However, the assumptions of any scale give rise to the same boundary problem. The problem has been addressed and solved by Cavallo and D'Apuzzo (2009), who provide a rigorous algebraic approach to Pairwise Comparison Matrices (PCMs); they propose PCMs defined over real and continuous Abelian linearly ordered (Alo)-groups.

The main methodological innovation of our paper is the integration of this algebraic approach into the Parsimonious AHP; in this way, we remove some of the drawbacks related to the classical Saaty approach, such as the shown boundary problem described above and the independence of the scale-inversion condition of the weighting vector (Cavallo and D'Apuzzo, 2012). The details of this algebraic approach are provided in Section 3.2.

The use of Alo-groups offers an elegant and rigorous way of modelling, generalizing and solving problems; moreover, by means of proper isomorphisms, PCMs defined over two different Alo-groups are formally equivalent and therefore we can naturally extend concepts and properties from one representation to another.

This algebraic structure has been widely studied and accepted in the literature for generalizing PCMs, and several authors follow this Alo-group approach. For example, Hou (2016) applies a model based on a multiplicative Alo-group to a layout planning problem for an aircraft maintenance base; Koczkodaj *et al.* (2020) stress that an algebraic structure for generalizing PCMs has to be a torsion free group (i.e. an Alo-group as proposed by Cavallo and D'Apuzzo (2009), Kulakowski *et al.* (2019) focus on the conditions for order preservation for PCMs over Alo-groups; Ramík (2015a, b) focuses on PCMs with fuzzy elements on Alo-groups; and Xia and Chen (2015) deal with consistency and consensus in PCMs over Alo-groups. Compared with the existing evolutions of the Parsimonious AHP, our approach retains all the advantages of the method while replacing the classical Saaty approach with a rigorous algebraic approach to PCMs defined over Alo-groups. This allows for better control over the consistency and reliability of judgments without increasing the cognitive load for the DMs. Furthermore, although approaches based on Alo-groups have been analysed in the literature, they have not been integrated with the Parsimonious AHP or applied to real decision problems. Our work fills this gap by providing the first real case study (since 2009) that applies this integrated method and demonstrates its operational feasibility.

The proposed extension of the Parsimonious AHP emerges as a methodologically advanced solution to addressing group decision-making problems in real-world, highly complex contexts. We point out that the choice of the Parsimonious AHP is linked to the characteristics of the decision problem, and we discuss the advantages that the method presents. We recall that the Parsimonious AHP is an evolution of the classical AHP. Unlike the AHP, the method allows the analysis of problems with a high number of alternatives and criteria by reducing the number of pairwise comparisons. Furthermore, the Parsimonious AHP also solves the rank inversion problem (Abastante *et al.*, 2018; Fattoruso and Marcarelli, 2022).

The paper is structured as follows: in Section 2, we analyse the main literature related to the use of MCDM methods in the tourism sector; in Section 3, we provide the basic notions on the Parsimonious AHP and the PCMs over Alo-groups; in Section 4, we describe our methodology; in Section 5, we describe the case study and report the main results; and in Sections 6 and 7, we discuss and conclude the paper.

of Preference by Similarity to Ideal Solution (TOPSIS) in order to evaluate social sustainability in the hospitality and tourism supply chain. A similar approach is used by [Abdelsalam and Crispim \(2026\)](#) to assess tourism supply chain resilience. By contrast, [Aria et al. \(2026\)](#) use a stochastic multi-criteria acceptability analysis (SMAA) method to improve the measurement of tourism sustainability in different regions and analyse an Italian case study. [Ciano and Ferrara \(2025\)](#) integrate explainable artificial intelligence with MCDM to evaluate the performance of tourism accommodation facilities. [Ayvaz-Çavdaroğlu et al. \(2024\)](#) use the best-worst method (BWM) and clustering methods to evaluate the quality of intelligent services in the hospitality and tourism industry. [Cavallo et al. \(2015\)](#) propose the use of the AHP method to study how the sustainable urban development of the port area of Naples can promote the development of tourism and the improvement of commercial activities. In applying the method, the authors pay particular attention to the economic, environmental and social impacts. [Liu et al. \(2013\)](#) propose a hybrid MCDM model that combines a decision-making trial and evaluation laboratory (DEMATEL), a DEMATEL-based analytic network process (DANP), and ViseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) to improve a metro-airport connection service to develop tourism. The methods are mainly used to analyse service quality, satisfaction and behavioural intentions. [Talebi et al. \(2019\)](#) carried out a study that evaluated and modified an existing road network for tourism purposes in the Arasbaran protected area. In particular, they follow a Geographic Information Systems (GIS) AHP methodology using a fuzzy logic approach. The road network was modified, taking into account the results obtained by the authors, thus encouraging tourism development in the area. By contrast, [Racioppi et al. \(2015\)](#) analyse a problem concerning the energy and environmental requalification of existing buildings which were intended to be used as innovative tourist structures. In particular, the authors use the AHP method to identify and propose different intervention scenarios to encourage tourism development. [Stević et al. \(2019\)](#) use the Simple Additive Weighting (SAW) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods to evaluate the attractiveness of six heritage sites in Porto, Portugal. Their paper sets out how to understand the attractiveness levels of cultural sites and discusses possible strategies to increase tourism. Referring to the development of policies to encourage tourism in internal and peripheral areas, [Jena and Dwivedi \(2023\)](#) propose the integrated use of Interpretive Structural Modelling (ISM) and DEMATEL methods to identify the major barriers to rural tourism in India. Their findings produce useful suggestions for increasing rural tourism. [Pazhuan and Shiri \(2020\)](#) use the fuzzy accreditation tool and a TOPSIS model to determine the main regional tourism axes by analysing the spatial distribution of tourist attractions in a GIS environment. They highlight the importance of regional tourism planning for urban and rural socioeconomic development. [Sadeghi et al. \(2024\)](#) use the VIKOR method in a GIS environment to assess the tourism capacity of peri-urban areas that require specific tourism services. They also use the AHP method for further assessment of services. [Moslem \(2025b\)](#) addresses a strategic planning problem for the sustainable development of urban areas by proposing the integration of the Parsimonious AHP with the Multi-Objective Optimization by Ratio Analysis (MOORA) method. The paper presents a real-world optimization study of the public bus system in Budapest, demonstrating the effectiveness of the model. Also in the field of urban transport, the work of [Moslem \(2025a\)](#) proposes the Z-number extension of the Parsimonious Best Worst Method. As can be seen from this analysis of the main studies, MCDM methods are useful for supporting DMs in developing tourism strategies. As evidenced by the literature, several studies have evaluated performance and service quality for the purpose of incentivizing tourism or tourism sustainability, using MCDM approaches. Our work does not aim to analyse individual aspects (performance, service quality and so on) in the tourism sector but aims to provide an integrated approach to support public DMs in defining strategic actions to analyse and resolve decision-making problems aimed at incentivizing the development and growth of territories in internal and peripheral areas, focusing on tourism strategies. Similar approaches do not emerge from the analysis of the main literature. This work aims to bridge this gap and

contribute to the academic debate on the effectiveness of MCDM approaches for group choices by describing a study that analyses group choices in the tourism sector.

3. Preliminaries

In this section, we discuss the notions of the Parsimonious AHP method and PCMs defined over an Alo-group that are relied on in what follows.

3.1 Parsimonious AHP

The Parsimonious AHP method, introduced to the literature by [Abastante et al. \(2019\)](#), arose from the need to provide a methodology capable of analysing decision problems with a large number of decision elements, such as alternatives and criteria. The method is used, in particular, for the analysis of problems that allow the evaluation of any possible alternative under consideration with respect to competing criteria (consider, for example, repetitive standard evaluation procedures such as credit score analysis; see, e.g. [Mareschal and Brans \(1991\)](#) and [Zopounidis \(1987\)](#)).

The approach essentially involves different phases.

- (1) The direct evaluation of the decision elements (e.g. alternatives, criteria) under consideration;
- (2) The definition of reference points in agreement with the analyst;
- (3) The input of the pairwise comparisons of the criteria, and the calculation of the weights using the AHP method;
- (4) The input of the pairwise comparisons of the reference points using the AHP method;
- (5) The interpolation of the values obtained by the AHP in the previous phase, to give the local priorities of all alternatives; and
- (6) The computation of the weighted sum of the local priorities to calculate the global priorities.

In the following, we illustrate the main innovations compared to the classical AHP method. As mentioned previously, the first innovation is defined in the first phase of the method, which involves the DM's direct assessment of the elements characterizing the decision problem. The assessments can be expressed using a finite and discrete scale of values (e.g. [Abastante et al., 2019](#)) use a scale from 1 to 100). This allows a decision matrix to be constructed that collects the assessments expressed by the DM for each alternative with respect to each criterion. According to [Abastante et al. \(2019\)](#), using direct ratings to construct the decision matrix simplifies the DM's preference elicitation process, as it only requires them to make pairwise comparisons only between representative points. We note that the Parsimonious AHP represents an extension of the approach proposed by [Corrente et al. \(2016\)](#) to reduce the cognitive effort required of the DM and increase the evaluation efficiency in complex contexts by obtaining final ratings through the use of interpolation. After defining the decision matrix, the method includes a second important innovation regarding the definition of some reference points in agreement with the analyst. The concept of reference points derives from Prospect Theory ([Kahneman and Tversky, 1979](#)); they represent neutral values, the starting level or status quo perceived by the DM, against which gains and losses are evaluated. DMs do not evaluate the absolute value of an outcome, but rather how far it deviates from the reference point. In the Parsimonious AHP, the concept of the reference point is reinterpreted in a technical way, but its role is similar to that in Prospect Theory. The reference point can be considered as a reference (or hypothetical) alternative that allows the other alternatives of the decision problem to be evaluated via interpolation. [Abastante et al. \(2019\)](#) suggest that the number of reference points used to build the method should be determined according to

the size of the decision problem; for example, they recommend using six reference points for a problem with at least 19 alternatives (see [Abastante et al., 2019](#), for more details). It is also worth mentioning that [Miller \(1956\)](#) observed that it is difficult for DMs to evaluate more than seven elements.

We recall that the reference points are defined on the range of ratings assigned to the alternatives for each decision criterion, as provided by the DM. These points are constructed within the rating interval $[\min, \max]$, where $\min = 0$ and \max correspond to the highest rating assigned by the DM. The reference points are defined by the DM ([Abastante et al., 2019](#)). Alternatively, they are obtained by dividing the interval equidistantly ([Ishizaka et al., 2020](#); [Fattoruso et al., 2023](#)).

The use of reference points allows the number of comparisons between alternatives to be reduced. In fact, reference points are used and treated as alternatives in the construction of the PCMs. This represents a further innovation of the Parsimonious AHP: the DM, rather than expressing a preference from the (excessively large) number of alternatives characterizing the decision problem, compares the reference points in pairs, just as if they were alternatives. Note that in the Parsimonious AHP, the alternatives are characterized by a numerical value assigned in the first evaluation phase; therefore, the DM will have no difficulty expressing her/his preferences regarding reference points that effectively simulate a reference (or hypothetical) alternative to the decision problem. The final innovation is that the priorities of all other alternatives are obtained by interpolation, based on the priority values obtained for the reference points. We highlight that the main advantage of the Parsimonious AHP over the classical AHP (besides the possibility of analysing decision problems with a large number of elements) is that it avoids rank reversal problems and the bias resulting from comparing more relevant objects with less relevant ones ([Abastante et al., 2019](#)).

3.2 PCMs over Ato-groups

Let $X = \{x_1, x_2, \dots, x_n\}$ be a set of decision elements, such as criteria or alternatives; then, in the classical approach used by Saaty, the DM expresses the preference ratio m_{ij} of x_i over x_j by means of the PCM $\mathbf{M} = (m_{ij})_{n \times n}$, with m_{ij} belonging to the Saaty scale. Strict preference of x_i over x_j , indifference and reciprocity are expressed as follows:

$$m_{ij} > 1, \quad m_{ij} = 1, \quad m_{ji} = 1/m_{ij}. \quad (1)$$

The DM is fully coherent if the following consistency condition is satisfied:

$$m_{ik} = m_{ij} \cdot m_{jk} \quad \forall i < j < k. \quad (2)$$

As introduced in [Section 1](#), the assumption of the Saaty scale restricts the possibility for the DM to be consistent; for example, if $X = \{x_1, x_2, x_3\}$ and the DM expresses the following preference ratios $m_{12} = 8$ and $m_{23} = 8$ then he/she will not be consistent because he/she should express $m_{13} = 8 \cdot 8 = 64$, but the preference ratio 64 exceeds the maximum value of 9. Thus, the maximum preference ratio that the DM can express, to be as consistent as possible, is $m_{13} = 9$, but the following PCM:

$$\begin{pmatrix} 1 & 8 & 9 \\ \frac{1}{8} & 1 & 8 \\ \frac{1}{9} & \frac{1}{8} & 1 \end{pmatrix} \quad (3)$$

Is not reliable; indeed, by using the Consistency Ratio (CR) proposed by Saaty, $CR = 46.3\%$ denotes high inconsistency and the PCM in [\(3\)](#) has to be adjusted to improve the consistency.

In order to avoid this boundary problem and to generalize the various approaches to PCMs introduced in the literature, Cavallo and D’Apuzzo (2009) propose that the PCM is defined over an Alo-group (G, \odot, \leq) , where G is a proper interval of the real line, \odot a continuous group operation and \leq the simple order on G inherited from the usual order on the real line. Within this algebraic approach, the entries m_{ij} of the PCM belong to G , and the strict preference of x_i over x_j , the indifference and the reciprocity in (1) are generalized as follows:

$$m_{ij} > e, \quad m_{ij} = e, \quad m_{ji} = m_{ij}^{(-1)}, \tag{4}$$

where e is the identity element and $m_{ij}^{(-1)}$ the inverse of m_{ij} with respect to the group operation \odot . The consistency in (2) is generalized as follows:

$$m_{ik} = m_{ij} \odot m_{jk} \quad \forall i < j < k. \tag{5}$$

Figure 2 shows the Alo-groups and the related isomorphisms proposed in the literature, and Table 1 shows the corresponding group operations and identity elements; for further details, the reader can refer to Cavallo and D’Apuzzo (2009) for $(]-\infty, +\infty[, +, \leq)$, $(]0, +\infty[, \cdot, \leq)$ and $(]0, 1[, \otimes, \leq)$, to Ramík (2015a) for $(]-\infty, +\infty[, +_f, \leq)$ and to Cavallo (2025) for $(]_{\alpha}^1, \alpha[, \odot_{\alpha}, \leq)$ and $(]-\beta, \beta[, \oplus_{\beta}, \leq)$.

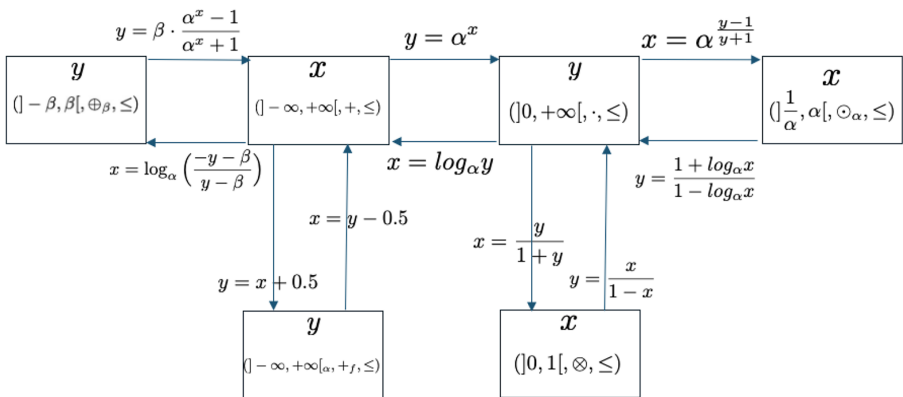


Figure 2. Real Alo-groups and related isomorphisms. Source Cavallo (2025)

Table 1. Description of the Alo-groups proposed in the literature

Alo-group (G, \odot, \leq)	Group operation \odot	Identity element e
$(]-\infty, +\infty[, +, \leq)$	$x + y, \quad \forall x, y \in]-\infty, +\infty[$	0
$(]-\beta, \beta[, \oplus_{\beta}, \leq)$, with $\beta > 0$	$(x + y) \cdot \frac{\beta^2}{xy + \beta^2}, \quad \forall x, y \in]-\infty, +\infty[$	0
$(]0, 1[, \otimes, \leq)$	$\frac{xy}{xy + (1-x)(1-y)}, \quad \forall x, y \in]0, 1[$	0.5
$(]-\infty, +\infty[, +_f, \leq)$	$x + y - 0.5, \quad \forall x, y \in]-\infty, +\infty[$	0.5
$(]0, +\infty[, \cdot, \leq)$	$xy, \quad \forall x, y \in]0, +\infty[$	1
$(]_{\alpha}^1, \alpha[, \odot_{\alpha}, \leq)$, with $\alpha > 1$	$(x \cdot y)^{\frac{1}{1 + \log_{\alpha} x \cdot \log_{\alpha} y}} \forall x, y \in]_{\alpha}^1, \alpha[$	1

By applying the well-known representation of the preferences in (1), if the DM expresses the preferences $m_{12} = 8$ and $m_{23} = 8$, used as examples in Section 1, then he/she can be consistent in both the Alo-group $(]0 + \infty[, \cdot, \leq)$ (i.e. by choosing $m_{13} = 64$) and in the Alo-group $(] \frac{1}{\alpha}, \alpha[, \odot_{\alpha}, \leq)$ (e.g. by choosing $m_{13} = 8.97$ for $\alpha = 9$). In this paper, we choose to use PCMs defined over the α -multiplicative Alo-group $(] \frac{1}{\alpha}, \alpha[, \odot_{\alpha}, \leq)$, with $\alpha = 9$, because the DMs are often confused if asked to use unlimited intervals for expressing preferences and these PCMs have entries belonging to the limited interval $] \frac{1}{9}, 9[$ that are close to the values used in the Saaty scale.

3.2.1 α -multiplicative PCMs. We provide only the notions about α -multiplicative PCMs (i.e. PCMs defined over the Alo-group $(] \frac{1}{\alpha}, \alpha[, \odot_{\alpha}, \leq)$) that are necessary for understanding STEPS 3–5 in the methodology described in the next section. For further details, the reader can refer to Cavallo and D’Apuzzo (2009) and Cavallo (2025).

The isomorphism between the α -multiplicative Alo-group $(] \frac{1}{\alpha}, \alpha[, \odot_{\alpha}, \leq)$ and the well known multiplicative Alo-group $(]0, +\infty[, \cdot, \leq)$ is as follows (see Figure 2):

$$\psi_{\alpha} : y \in]0, +\infty[\mapsto \alpha^{\frac{y-1}{y+1}} \in] \frac{1}{\alpha}, \alpha[, \quad (6)$$

And the inverse isomorphism is as follows:

$$\psi_{\alpha}^{-1} : x \in] \frac{1}{\alpha}, \alpha[\mapsto \frac{1 + \log_{\alpha} x}{1 - \log_{\alpha} x} \in]0, +\infty[. \quad (7)$$

Thus, by applying the isomorphism in (7) to each entry of an α -multiplicative PCM $\mathbf{M}_{\alpha} = (m_{ij\alpha})_{n \times n}$, we compute the isomorphic multiplicative PCM

$$\mathbf{M} = (m_{ij})_{n \times n} = \psi_{\alpha}^{-1}(\mathbf{M}_{\alpha}) \quad (8)$$

With

$$m_{ij} = \frac{1 + \log_{\alpha} m_{ij\alpha}}{1 - \log_{\alpha} m_{ij\alpha}},$$

And, by applying the isomorphism in (6), we compute the inconsistency index of $\mathbf{M}_{\alpha} = (m_{ij\alpha})_{n \times n}$:

$$I_{\alpha}(\mathbf{M}_{\alpha}) = \alpha^{\frac{I(\mathbf{M})-1}{I(\mathbf{M})+1}}; \quad (9)$$

where $I(\mathbf{M})$ is the inconsistency index of the multiplicative PCM $\mathbf{M} = (m_{ij})_{n \times n}$ in (8):

$$I(\mathbf{M}) = \left(\prod_{i < j < k} \max \left\{ \frac{m_{ij} \cdot m_{jk}}{m_{ik}}, \frac{m_{ik}}{m_{ij} \cdot m_{jk}} \right\} \right)^{\frac{6}{n(n-1)(n-2)}}. \quad (10)$$

Note that.

- (1) $I_{\alpha}(\mathbf{M}_{\alpha})$ belongs to the interval $[1, \alpha[$;
- (2) $I_{\alpha}(\mathbf{M}_{\alpha}) = 1$ if and only if \mathbf{M}_{α} is consistent;
- (3) $\mathbf{M}_{\alpha} = (m_{ij\alpha})_{n \times n}$ is consistent if and only if $\mathbf{M} = (m_{ij})_{n \times n}$ is consistent.

The weighting vector of $\mathbf{M}_{\alpha} = (m_{ij\alpha})_{n \times n}$ is computed as follows:

$$\mathbf{w}_\alpha(\mathbf{M}_\alpha) = \psi_\alpha(\mathbf{w}_m(\mathbf{M})); \tag{11}$$

That is, by applying the isomorphism in (6) to each component of the following vector:

$$\mathbf{w}_m(\mathbf{M}) = (m(\mathbf{m}_1), m(\mathbf{m}_2), \dots, m(\mathbf{m}_n)) \tag{12}$$

where $m(\mathbf{m}_i) = \sqrt[n]{m_{i1} \cdot m_{i2} \cdot \dots \cdot m_{in}}$ is the geometric mean of the elements of the i th row of $\mathbf{M} = (m_{ij})_{n \times n}$ in (8).

4. Methodology

Let $\{a_1, \dots, a_h, \dots, a_H\}$ be a set of alternatives that represent all the tourism strategies defined to encourage tourism. Let $\{g_1, \dots, g_j, \dots, g_J\}$ be a set of criteria and $\{d_1, \dots, d_i, \dots, d_L\}$ the set of DMs. Given these elements characterizing the decision problem, we perform the following steps.

STEP 1. Identification of the decision matrix. A matrix $Z = (z_{hj})_{H \times J}$ collects the evaluations expressed by all the DMs together for each alternative a_h with respect to each criterion g_j .

STEP 2. Identification of the reference points. For each criterion g_j , the following P reference points are fixed (Miccoli and Ishizaka, 2017): $\mathbf{r}_j = (r_{j1}, \dots, r_{jp}, \dots, r_{jP})$.

STEP 3. Construction of the PCMs. Fixed a value $\alpha > 1$, PCMs over the Alo-group $\mathcal{M}_\alpha = (\frac{1}{\alpha}, \alpha[, \ominus_\alpha, \le)$ are built from the answers obtained by submitting a questionnaire. In particular, for each DM d^l , with $l \in \{1, \dots, L\}$, the PCM $\mathbf{A}^l = (a^l_{ik})_{J \times J}$ pairwise compares the criteria, and J PCMs $\mathbf{B}^{jl} = (b^{jl}_{ik})_{P \times P}$, with $j \in \{1, \dots, J\}$, compare the P reference points with respect to each criterion g_j . Then, by applying (8), the following multiplicative PCMs are computed:

$$\psi_\alpha^{-1}(\mathbf{A}^l), \quad \psi_\alpha^{-1}(\mathbf{B}^{jl}).$$

STEP 4. Measurement of the inconsistency of the PCMs. For each DM d^l , with $l \in \{1, \dots, L\}$, the inconsistency index of the PCMs $\mathbf{A}^l = (a^l_{ik})_{J \times J}$ and $\mathbf{B}^{jl} = (b^{jl}_{ik})_{P \times P}$ are computed by applying (9); that is:

$$I_\alpha(\mathbf{A}^l) = \alpha^{\frac{I(\psi_\alpha^{-1}(\mathbf{A}^l)) - 1}{I(\psi_\alpha^{-1}(\mathbf{A}^l)) + 1}}, \quad I_\alpha(\mathbf{B}^{jl}) = \alpha^{\frac{I(\psi_\alpha^{-1}(\mathbf{B}^{jl})) - 1}{I(\psi_\alpha^{-1}(\mathbf{B}^{jl})) + 1}}.$$

In the case of high inconsistency, the DMs can revise their evaluations to obtain more tolerable inconsistent pairwise comparisons. The inconsistency index assumes a value in the interval $[1, \alpha[$, and it is equal to 1 only in the case of consistency (see Section 3.2.1). In order to evaluate the goodness of the inconsistency indices, as done by Saaty, we required that our inconsistency indices are less than a threshold equal to 10% of the random inconsistency indices.

STEP 5. Computation of the priorities. For each DM d^l , with $l \in \{1, \dots, L\}$, by applying (11), the following weighting vectors are computed:

$$\mathbf{w}^l = \mathbf{w}_\alpha(\mathbf{A}^l) = \psi_\alpha(\mathbf{w}_m(\psi_\alpha^{-1}(\mathbf{A}^l))) = (w^l_1, \dots, w^l_j \dots w^l_J),$$

$$\mathbf{u}_j^l = \mathbf{w}_\alpha(\mathbf{B}^{il}) = \psi_\alpha(\mathbf{w}_m(\psi_\alpha^{-1}(\mathbf{B}^{il}))) = (u_{j1}^l, \dots, u_{jp}^l, \dots, u_{jp}^l).$$

These are the priority vectors of the criteria $\{g_1, \dots, g_j, \dots, g_J\}$ and the priority vectors of the reference points $\mathbf{r}_j = (r_{j1}, \dots, r_{jp}, \dots, r_{jp})$.

STEP 6. Normalization and checking the monotonicity. We normalize the priority vectors \mathbf{w}^l and \mathbf{u}_j^l so that the sum of their components is equal to 1, in accordance with standard practices in AHP-based models. The normalization is performed by dividing each component by the sum of all components in the respective vector, thus obtaining the normalized vectors $\underline{\mathbf{w}}^l = (\underline{w}_1^l, \dots, \underline{w}_j^l, \dots, \underline{w}_J^l)$ and $\underline{\mathbf{u}}_j^l = (\underline{u}_{j1}^l, \dots, \underline{u}_{jp}^l, \dots, \underline{u}_{jp}^l)$. After that, as suggested by [Abastante et al. \(2019\)](#), we proceed to check the priorities $\mathbf{w}_\alpha(\mathbf{B}^{il})$ and the corresponding reference points \mathbf{r}_j ; that is, we check that there are no situations for which $r_{jp1} > r_{jp2}$ while $\underline{u}_{jp1}^l \leq \underline{u}_{jp2}^l$ ([Abastante et al., 2018](#); [Corrente et al., 2016](#)). If monotonicity is not met, the DMs can modify their assessments.

STEP 7. Computation of local priorities. For each DM d_l , the local priorities of the alternatives with respect to each criterion are computed with the following linear interpolation formula ([Abastante et al., 2019](#)):

$$\rho(z_{hj}, d_l) = \underline{u}_{jp}^l + \frac{\underline{u}_{jp+1}^l - \underline{u}_{jp}^l}{r_{jp+1} - r_{jp}} \cdot (z_{hj} - r_{jp}). \tag{13}$$

STEP 8. Computation of global priorities for each DM. For each DM d_l , the global priority of the alternative a_h is computed in the following way:

$$\omega(a_h, d_l) = \prod_{j=1}^J \rho(z_{hj})^{\underline{w}_j^l}. \tag{14}$$

STEP 9. Computation of group global priorities. To compute the global priority of the group, we chose to use the AIP with the weighted geometric mean method ([Ossadnik et al., 2016](#); [Ramanathan and Ganesh, 1994](#); [Forman and Peniwati, 1998](#)):

$$\Omega(a_h) = \prod_{l=1}^L \omega(a_h, d_l)^{\eta_l}, \tag{15}$$

where η_l represents the weight associated to the DM d_l ; with $\eta_l \geq 0$ and $\sum_{l=1}^L \eta_l = 1$.

The framework of the model is shown in [Figure 3](#). For STEPS 3–5, representing the integration of the Alo-group in the Parsimonious AHP, we implemented [Algorithm 1](#); this runs for each α -multiplicative PCM given as the input.

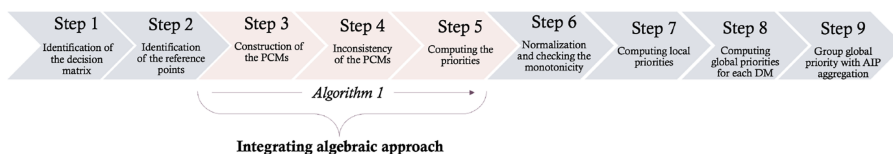


Figure 3. Framework of the model

Algorithm 1. STEPS 3–5 in methodology. R code.

Require: $n \geq 2$

Require: $\alpha > 1$

Require: α -multiplicative PCM $A = (a_{ij})_{n \times n}$

$M = \text{matrix}(1, nrow = n, ncol = n)$; ▷ Multiplicative PCM isomorphic to the α -multiplicative PCM A

for(i in 1:n) for(j in 1:n) $M[i, j] = (1 + \log(A[i, j], base = \alpha)) / (1 - \log(A[i, j], base = \alpha))$

$IM = 1$; ▷ Inconsistency index of M

for(i in 1:(n-2))for(j in (i+1):(n-1))for(k in (j+1):(n)) $IM = IM * (\max(M[i, j] * M[j, k] / M[i, k], M[i, k] / (M[i, j] * M[j, k]))) \wedge (6 / (n * (n - 1) * (n - 2)))$

$IA = \alpha \wedge ((IM - 1) / (IM + 1))$; ▷ Inconsistency index of A

$w < - \text{matrix}(nrow = 1, ncol = n)$; ▷ Geometric mean vector of M

for(i in 1:n) $w[1, i] = (\text{prod}(M[i,])) \wedge (1/n)$

$wA = \alpha \wedge ((w - 1) / (w + 1))$; ▷ Weighting vector of A

We emphasize that among the innovations presented in this work, this is the first time the AIP is used for a group Parsimonious AHP. The AIP procedure, as highlighted by [Ossadnik et al. \(2016\)](#), is more suitable than any other (such as the aggregation of individual judgments (AIJ)) for decisions of small and large groups in decision contexts with common goals; furthermore, the procedure respects the axioms of rationality. Note that AIP is not used for the rating aggregation in the PCMs.

We highlight that our proposal intentionally avoids consensus-building mechanisms because the proposed framework does not rely on group negotiation or iterative convergence. In decision-making contexts involving public administrations, imposing consensus can artificially homogenize preferences and increase the cognitive load for participants. Furthermore, it can introduce political or hierarchical biases, allowing individuals with greater influence to influence group decisions. This would contradict the goal of ensuring fair and impartial aggregation, especially in contexts with multiple DMs or where sensitive public decisions must be made, as envisaged in our real case study. In line with the Parsimonious AHP, our goal is to minimize the cognitive load on DMs and preserve the individuality of their judgments. For this reason, aggregation is performed ex post via AIP on the global priority of each DM; this avoids the need for iterative consensus rounds. Indeed, in our proposal, each DM provides independent and unconstrained judgments. The AIP is applied only to the global priorities obtained for each DM, which are combined using a weighted geometric mean as defined in [formula \(15\)](#). This ensures a rational and axiomatically sound combination of individual assessments. This is highlighted in the literature; indeed, [Forman and Peniwati \(1998\)](#) and [Ossadnik et al. \(2016\)](#) show that AIP aggregation can effectively replace consensus rounds when the goal is to combine the knowledge of DMs without forcing convergence. Similarly, [Ishizaka and Labib \(2011\)](#) emphasize that bypassing consensus mechanisms helps maintain decision-making neutrality and prevents the prevalence of bias in group contexts in which one member's influence could affect the collective outcomes.

5. Case study

5.1 Description

The decision-making problem analysed in this work concerns a real case involving six municipal administrations in southern Italy, particularly in the hinterland of Campania. The

municipal administrations are the Municipality of Paupisi (project leader) and the Municipalities of Ponte, San Lupo, San Lorenzo Maggiore, Torrecuso and Vitulano. These six territorial entities constitute a network of municipalities that occupies the geographical heart of the province of Benevento (Figure 4). In this region, which has a total surface area of approximately 121.5 km², there are just over 12.200 inhabitants, with a population density of 100.7 inhabitants/km². The administrations have focused on inter-municipal cooperation to increase the visibility and attractiveness of the territory as a whole and to overcome the limitations of the individual local entities. These municipal administrations, together, participated in a project in a national programme (FSC, 2021/2027) that encourages and recognizes tourism as a strategic sector. The local project was the *Programme of cultural, naturalistic and food and wine tourist itineraries for the tourism promotion of Campania, period June 2025 – December 2025*, as part of the *Festival of flavours and street artists* project which has among its objectives, the valorization of local resources, the promotion of sustainable tourism and the creation of new economic and employment opportunities.

For each municipal administration, we identified a DM who had a strategic role in its choices. The set $\{d_1, d_2, d_3, d_4, d_5, d_6\}$ represents our set of DMs, who correspond, respectively, to the municipalities of Paupisi (d_1), Ponte (d_2), San Lupo (d_3), San Lorenzo Maggiore (d_4), Torrecuso (d_5) and Vitulano (d_6).

A description of the DMs (role, training and expertises) is provided in Table 2.

The DMs identified a set $\{a_1, \dots, a_{68}\}$ of alternatives to be evaluated with respect to the set $\{g_1, g_2, g_3, g_4, g_5, g_6\}$ of criteria. The descriptions of the criteria are shown in Table 3 and the descriptions of the alternatives in Table 4.

5.2 Applying the methodology

In this subsection, we show the application of the methodology proposed in Section 4 to our case study, with $\alpha = 9$, $L = 6$, $H = 68$, $J = 6$ and $P = 6$. Thus, the following nine steps are performed.

STEP 1. All the DMs together provided the decision matrix $\mathbf{Z} = (z_{hj})_{68 \times 6}$ reported in Table 5.

STEP 2. The DMs, by agreement, decided that the reference points, which are reported in Table 6, should be obtained by equidistantly dividing the reference intervals $[\min(\mathbf{z}_j), \max(\mathbf{z}_j)]$, with \mathbf{z}_j being the j th column of the decision matrix $\mathbf{Z} = (z_{hj})_{68 \times 6}$ provided from STEP 1.

STEP 3. Each DM d_l , with $l \in \{1, \dots, 6\}$, provided the PCM $\mathbf{A}^l = (a_{ik}^l)_{6 \times 6}$ and the PCMs $\mathbf{B}^{jl} = (b_{ik}^{jl})_{6 \times 6}$, with $j \in \{1, \dots, 6\}$.

The DMs' preferences were elicited by giving them a questionnaire with explanations and examples for how to fill it in.

The entries of each PCM, belonging to the interval $] \frac{1}{9}, 9[$, were provided by the DMs in agreement with the representation of the preferences in (1), the DMs were asked to provide values greater than or equal to 1 (i.e. strict preference and indifference), and then the reciprocal elements were computed by applying the reciprocity in (1). An extract of the criteria questionnaire is shown in Figure A.1 in the Appendix. Thus, the DMs provided the following PCMs for the criteria:

$$\mathbf{A}^1 = (a_{ik}^1)_{6 \times 6}, \mathbf{A}^2 = (a_{ik}^2)_{6 \times 6}, \mathbf{A}^3 = (a_{ik}^3)_{6 \times 6}, \mathbf{A}^4 = (a_{ik}^4)_{6 \times 6}, \mathbf{A}^5 = (a_{ik}^5)_{6 \times 6}, \mathbf{A}^6 = (a_{ik}^6)_{6 \times 6}$$

And the following PCMs for the reference points:

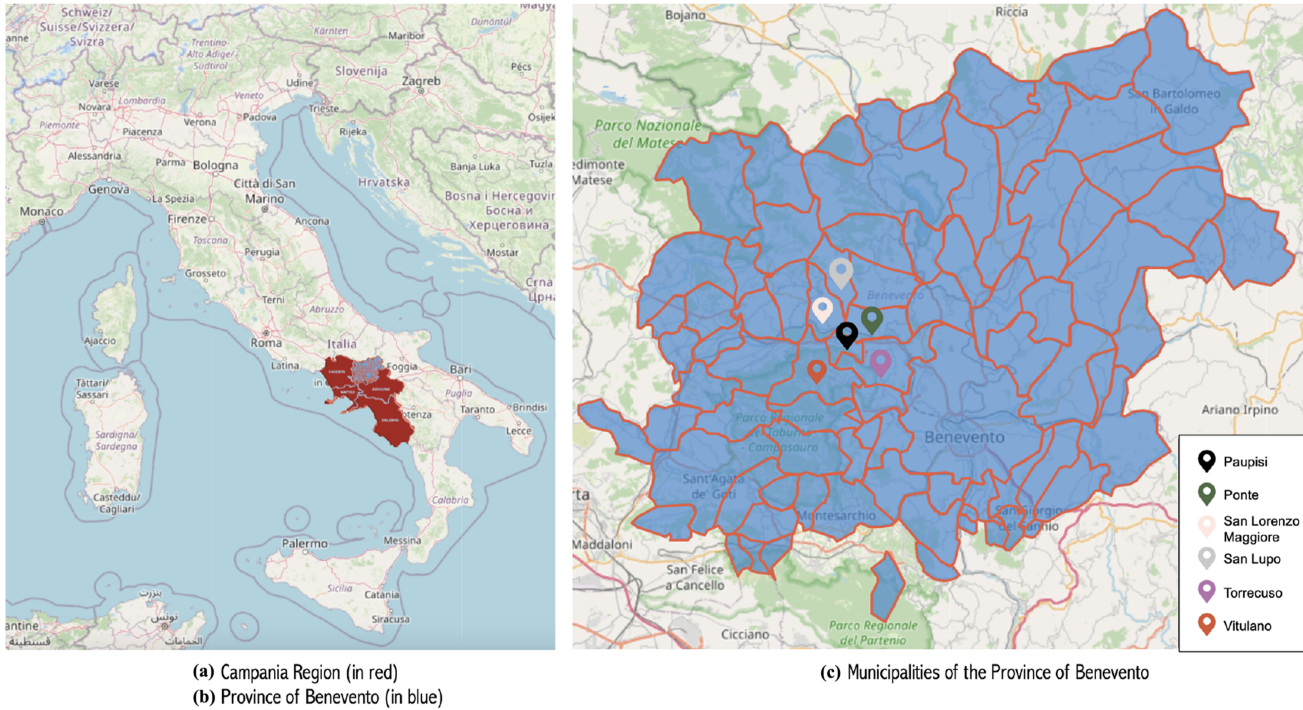


Figure 4. Map of the six municipal administrations of the province of Benevento, Italy

Table 2. Description of the DMs panel

DM	d_1	d_2	d_3	d_4	d_5	d_6
Role	City mayor	City mayor	City mayor	City mayor	City mayor	City mayor
Training	Master's degree in architecture and urban planning	Degree in engineering	Upper secondary education	Revenue agency official	Upper secondary education	Master's degree in law
Expertises	Territorial planning and land conservation	Technical feasibility infrastructure management cost and impact assessment	Procedural management and administrative support	Fiscal and administrative fields economic and financial sustainability	Construction and technical and operational evaluation of interventions	Administrative law, public procurement environmental law, cultural heritage

Table 3. Description of each criterion g_j

g_j	Description
g_1	<i>Preserve and enhance the cultural and natural heritage</i> This criterion aims to protect and maintain the tangible (architecture, monuments landscapes) and intangible (traditions, crafts, local festivals) heritage of the municipalities, enhancing thematic routes that facilitate their use
g_2	<i>Strengthen and promote experiential and sustainable tourism</i> The criterion aims to support unique and immersive experiences, such as workshops and food and wine routes, that respect the authenticity of the territory
g_3	<i>Support the local economy by increasing economic opportunities and employment</i> This refers to the possibility of creating job opportunities in tourism crafts and sustainable agriculture
g_4	<i>Strengthen and promote local training and awareness</i> This aims to encourage training courses to prepare the local community in the sectors of hospitality, sustainable management and tourism sectors
g_5	<i>Strengthen the communication and visibility of the territory</i> This aims to develop targeted communication strategies to make the territory known at a national and international level, promoting a strong and recognizable image
g_6	<i>Promote environmental and tourist sustainability through circular economy policies</i>

$$\mathbf{B}^{11} = (b_{ik}^{11})_{6 \times 6}, \mathbf{B}^{21} = (b_{ik}^{21})_{6 \times 6}, \mathbf{B}^{31} = (b_{ik}^{31})_{6 \times 6}, \mathbf{B}^{41} = (b_{ik}^{41})_{6 \times 6}, \mathbf{B}^{51} = (b_{ik}^{51})_{6 \times 6}, \mathbf{B}^{61} = (b_{ik}^{61})_{6 \times 6},$$

$$\mathbf{B}^{12} = (b_{ik}^{12})_{6 \times 6}, \mathbf{B}^{22} = (b_{ik}^{22})_{6 \times 6}, \mathbf{B}^{32} = (b_{ik}^{32})_{6 \times 6}, \mathbf{B}^{42} = (b_{ik}^{42})_{6 \times 6}, \mathbf{B}^{52} = (b_{ik}^{52})_{6 \times 6}, \mathbf{B}^{62} = (b_{ik}^{62})_{6 \times 6},$$

$$\mathbf{B}^{13} = (b_{ik}^{13})_{6 \times 6}, \mathbf{B}^{23} = (b_{ik}^{23})_{6 \times 6}, \mathbf{B}^{33} = (b_{ik}^{33})_{6 \times 6}, \mathbf{B}^{43} = (b_{ik}^{43})_{6 \times 6}, \mathbf{B}^{53} = (b_{ik}^{53})_{6 \times 6}, \mathbf{B}^{63} = (b_{ik}^{63})_{6 \times 6},$$

$$\mathbf{B}^{14} = (b_{ik}^{14})_{6 \times 6}, \mathbf{B}^{24} = (b_{ik}^{24})_{6 \times 6}, \mathbf{B}^{34} = (b_{ik}^{34})_{6 \times 6}, \mathbf{B}^{44} = (b_{ik}^{44})_{6 \times 6}, \mathbf{B}^{54} = (b_{ik}^{54})_{6 \times 6}, \mathbf{B}^{64} = (b_{ik}^{64})_{6 \times 6},$$

$$\mathbf{B}^{15} = (b_{ik}^{15})_{6 \times 6}, \mathbf{B}^{25} = (b_{ik}^{25})_{6 \times 6}, \mathbf{B}^{35} = (b_{ik}^{35})_{6 \times 6}, \mathbf{B}^{45} = (b_{ik}^{45})_{6 \times 6}, \mathbf{B}^{55} = (b_{ik}^{55})_{6 \times 6}, \mathbf{B}^{65} = (b_{ik}^{65})_{6 \times 6},$$

$$\mathbf{B}^{16} = (b_{ik}^{16})_{6 \times 6}, \mathbf{B}^{26} = (b_{ik}^{26})_{6 \times 6}, \mathbf{B}^{36} = (b_{ik}^{36})_{6 \times 6}, \mathbf{B}^{46} = (b_{ik}^{46})_{6 \times 6}, \mathbf{B}^{56} = (b_{ik}^{56})_{6 \times 6}, \mathbf{B}^{66} = (b_{ik}^{66})_{6 \times 6}.$$

All the PCMs are reported in the Appendix; as an example, we report here the PCM $\mathbf{A}^2 = (a_{ik}^2)_{6 \times 6}$ for the criteria:

Table 4. Description of each alternative a_h identified by the DMs

a_h	Description	a_h	Description
a_1	Historic churches itinerary	a_{35}	Participation in trade fairs and workshops in the sector
a_2	Castles and fortifications itinerary	a_{36}	Collaborations with specialized tour operators
a_3	Noble palaces itinerary	a_{37}	Agreements for shared promotion programs
a_4	Ancient villages and historic Squares itinerary	a_{38}	Educational tours for tour operators and travel agencies
a_5	Fountains and civic architecture itinerary	a_{39}	Development of quality promotional material
a_6	Wine and vineyards itinerary	a_{40}	Creation of partnerships with agencies for digital tourism
a_7	Oil and olive groves itinerary	a_{41}	Training for tourist reception
a_8	Cheese and farms itinerary	a_{42}	Training in sustainable agriculture
a_9	Herbs and medicinal plants itinerary	a_{43}	Training for tourist and cultural guides
a_{10}	Traditional cuisine and local knowledge itinerary	a_{44}	Cross-skills workshops
a_{11}	Panoramic and food and wine itineraries	a_{45}	Financial and tax incentives
a_{12}	Bee and honey itineraries	a_{46}	Municipal spaces for new businesses
a_{13}	Traditional cooking workshops	a_{47}	Support and mentorship programmes
a_{14}	Local craft workshops	a_{48}	Promotion of local products and food and wine tourism
a_{15}	Experiences related to popular festivals	a_{49}	Training for new entrepreneurs
a_{16}	Workshop on the use of medicinal and aromatic herbs	a_{50}	Promotion and marketing for new businesses
a_{17}	Wine production workshops	a_{51}	Creation of a dedicated website
a_{18}	Extra virgin olive oil production workshops	a_{52}	Engaging multimedia content
a_{19}	Financial and fiscal support	a_{53}	Blogs and in-depth articles
a_{20}	Information and training campaigns	a_{54}	Social media strategy
a_{21}	Bureaucratic simplification	a_{55}	SEO and digital marketing
a_{22}	Renewal and modernization programmes	a_{56}	Newsletters and email marketing
a_{23}	Staff training on tourist reception	a_{57}	Collaborations with travel bloggers
a_{24}	Encouraging eco-sustainability	a_{58}	Local culture festivals
a_{25}	Joint promotion platform	a_{59}	Local knowledge theatres
a_{26}	Conventions and integrated tourist packages	a_{60}	Craft and manual know-how festivals
a_{27}	Promotional events and relational tourism	a_{61}	Nature events and hiking trails
a_{28}	Rural B&Bs and agritourism	a_{62}	Seasonal festivals
a_{29}	Creation of a “widespread” hospitality network	a_{63}	Collaborations with cultural associations and partners
a_{30}	Wellness and well-being services	a_{64}	Partnerships with local media
a_{31}	Welcome kits and tourist guides	a_{65}	Collaborations with national media
a_{32}	Training in the narration of the territory	a_{66}	Collaborations with television and radio stations
a_{33}	Involvement of inhabitants	a_{67}	Publications and editorial collaborations
a_{34}	Development of integrated tourist packages	a_{68}	Media relations strategies and press events

$$A^2 = (a_{ik}^2)_{6 \times 6} = \begin{pmatrix} 1 & 2.3 & 2.5 & 3.2 & 1.1 & 3.5 \\ 0.43 & 1 & 1.1 & 1.5 & 0.45 & 1.8 \\ 0.4 & 0.91 & 1 & 1.4 & 0.43 & 1.6 \\ 0.31 & 0.67 & 0.71 & 1 & 0.32 & 1.2 \\ 0.91 & 2.2 & 2.3 & 3.1 & 1 & 3.6 \\ 0.29 & 0.56 & 0.62 & 0.83 & 0.28 & 1 \end{pmatrix}$$

Then, for all $j, l \in \{1, \dots, 6\}$, the following multiplicative PCMs were computed:

Table 5. Evaluation matrix $Z = (z_{hj})_{68 \times 6}$. Evaluations for each alternative a_h with respect to each criterion g_j

z_{hj}	g_1	g_2	g_3	g_4	g_5	g_6	z_{hj}	g_1	g_2	g_3	g_4	g_5	g_6
a_1	42	55	43	50	51	50	a_{35}	19	29	28	18	35	29
a_2	45	52	41	27	32	30	a_{36}	19	39	28	29	44	39
a_3	52	49	36	49	62	52	a_{37}	49	58	61	44	62	53
a_4	72	81	66	49	89	82	a_{38}	39	42	39	38	42	41
a_5	19	18	17	15	20	19	a_{39}	71	89	59	75	91	89
a_6	91	97	93	81	100	99	a_{40}	49	38	31	19	39	35
a_7	82	84	80	89	95	96	a_{41}	51	65	39	51	56	55
a_8	41	45	39	39	35	62	a_{42}	61	63	59	61	67	71
a_9	75	79	81	95	91	89	a_{43}	49	71	61	64	71	60
a_{10}	82	86	79	78	87	85	a_{44}	35	42	39	34	45	44
a_{11}	92	93	89	79	95	92	a_{45}	66	78	72	74	81	76
a_{12}	14	13	9	25	11	13	a_{46}	72	76	59	61	82	69
a_{13}	77	81	79	68	86	82	a_{47}	37	36	33	41	42	38
a_{14}	35	39	49	61	41	51	a_{48}	72	74	62	82	86	78
a_{15}	81	82	91	85	86	83	a_{49}	54	58	62	55	53	61
a_{16}	79	82	91	92	91	90	a_{50}	71	67	84	72	81	76
a_{17}	89	96	91	85	99	93	a_{51}	82	86	67	78	83	79
a_{18}	76	81	73	62	82	83	a_{52}	83	86	63	72	84	81
a_{19}	68	73	85	86	92	88	a_{53}	72	75	51	49	46	51
a_{20}	92	97	82	72	99	89	a_{54}	91	95	78	81	96	93
a_{21}	49	45	44	39	32	31	a_{55}	91	96	76	82	95	92
a_{22}	51	54	49	44	66	53	a_{56}	59	55	47	39	51	49
a_{23}	49	45	51	47	61	59	a_{57}	71	74	49	45	74	69
a_{24}	69	53	52	56	68	67	a_{58}	81	83	69	82	93	87
a_{25}	26	42	39	44	35	32	a_{59}	84	89	72	79	96	91
a_{26}	54	59	49	47	59	55	a_{60}	49	51	39	49	42	37
a_{27}	72	76	59	51	65	63	a_{61}	72	76	64	63	78	76
a_{28}	73	79	81	69	89	77	a_{62}	36	49	45	39	51	46
a_{29}	87	95	87	92	92	89	a_{63}	82	79	80	92	93	90
a_{30}	53	59	57	63	68	65	a_{64}	72	83	72	71	93	87
a_{31}	59	48	44	43	63	49	a_{65}	79	91	77	89	97	94
a_{32}	61	59	48	51	62	59	a_{66}	74	83	75	76	78	75
a_{33}	71	75	62	72	73	75	a_{67}	65	69	59	55	71	55
a_{34}	62	75	63	72	86	79	a_{68}	61	66	55	51	69	64

Table 6. Reference points

r_1	r_2	r_3	r_4	r_5	r_6
0	0	0	0	0	0
18.4	19.4	18.6	19	20	19.8
36.8	38.8	37.2	38	40	39.6
55.2	58.2	55.8	57	60	59.4
73.6	77.6	74.4	76	80	79.2
92	97	93	95	100	99

$$\psi_9^{-1}(\mathbf{A}^l), \quad \psi_9^{-1}(\mathbf{B}^{jl}).$$

As an example, we report the multiplicative PCM $\psi_9^{-1}(\mathbf{A}^2)$:

$$\psi_9^{-1}(\mathbf{A}^2) = \begin{pmatrix} 1 & 2.22 & 2.43 & 3.25 & 1.09 & 3.65 \\ 0.45 & 1 & 1.09 & 1.45 & 0.47 & 1.73 \\ 0.41 & 0.92 & 1 & 1.36 & 0.45 & 1.54 \\ 0.31 & 0.69 & 0.73 & 1 & 0.32 & 1.18 \\ 0.92 & 2.12 & 2.22 & 3.12 & 1 & 3.8 \\ 0.27 & 0.58 & 0.65 & 0.85 & 0.26 & 1 \end{pmatrix}$$

STEP 4. For all $j, l \in \{1, \dots, 6\}$, we computed the inconsistency index of each PCM $\mathbf{A}^l = (a_{ik}^l)_{6 \times 6}$ and PCM $\mathbf{B}^{jl} = (b_{ik}^{jl})_{6 \times 6}$, obtained in STEP 3.

As an example, the inconsistency of $\mathbf{A}^2 = (a_{ik}^2)_{6 \times 6}$ was computed as follows:

$$I_9(\mathbf{A}^2) = 9^{I(\psi_9^{-1}(\mathbf{A}^2)) - 1} = 1.040;$$

where

$$I(\psi_9^{-1}(\mathbf{A}^2)) = \sqrt[20]{\frac{2.43}{2.22 \cdot 1.09} \cdot \frac{3.25}{2.22 \cdot 1.36} \cdot \dots \cdot \frac{0.45 \cdot 3.8}{1.54} \cdot \frac{0.32 \cdot 3.8}{1.18}} = 1.037.$$

In [Table A.1 in Appendix](#), we report the inconsistency index $I_9(\mathbf{A}^l)$ obtained for each DM d_l , and in [Table A.2](#), we report the inconsistency index $I_9(\mathbf{B}^{jl})$ obtained for each criterion g_j and for each DM d_l . Note that the inconsistency index assumes values in the interval $[1, 9[$ and it is equal to 1 if and only if the PCM is consistent.

In order to evaluate the goodness of the inconsistency indices, and following Saaty, we required our inconsistency indices to be less than a threshold equal to 10% of the random inconsistency index for a reciprocal multiplicative PCM of order equal to 6 is equal to 10.378; thus, the threshold is equal to 1.0378. Then, by applying the isomorphism in (6), with $\alpha = 9$, we find that our threshold is equal to 1.042. Thus, as shown in [Tables A.1 and A.2](#) in the Appendix, we obtained good results; indeed, the values were always less than 1.042.

STEP 5. For all $j, l \in \{1, \dots, 6\}$, we computed the weighting vectors $\mathbf{w}^l = \mathbf{w}_9(\mathbf{A}^l)$ and $\mathbf{u}_j^l = \mathbf{w}_9(\mathbf{B}^{jl})$.

As an example, \mathbf{w}^2 was computed as follows:

$$\begin{aligned} \mathbf{w}^2 &= \psi_9(\mathbf{w}_m(\psi_9^{-1}(\mathbf{A}^2))) \\ &= \left(\psi_9\left(\sqrt[6]{1 \cdot 2.22 \cdot 2.43 \cdot 3.25 \cdot 1.09 \cdot 3.65}\right), \dots, \psi_9\left(\sqrt[6]{0.27 \cdot 0.58 \cdot \dots \cdot 1}\right) \right) \\ &= (\psi_9(2.03), \psi_9(0.914), \psi_9(0.842), \psi_9(0.624), \psi_9(1.927), \psi_9(0.533)) \\ &= (2.11, 0.906, 0.829, 0.601, 2.005, 0.512). \end{aligned}$$

STEP 6. In [Table 7](#), we report the normalized weighting vectors of the criteria for each DM d_l . In the Appendix, we report the normalized weights of the reference points obtained for each DM. All the checks concerning the monotonicity were performed and show that the monotonicity condition was met.

STEP 7. For each DM d_l , the local priorities of the alternatives with respect to each criterion were computed. These are reported in [Tables A.9–A.14 in Appendix](#).

Table 7. Normalized weighting vector \underline{w}^i for the criteria obtained for each DM d_i

\underline{w}^1	\underline{w}^2	\underline{w}^3	\underline{w}^4	\underline{w}^5	\underline{w}^6
0.288	0.303	0.189	0.187	0.142	0.221
0.135	0.130	0.172	0.136	0.258	0.145
0.058	0.119	0.112	0.081	0.083	0.076
0.066	0.086	0.119	0.087	0.098	0.086
0.390	0.288	0.205	0.411	0.205	0.363
0.063	0.074	0.205	0.098	0.216	0.109

STEP 8. For each DM d_i , the global priorities $\omega(a_h, d_i)$ were computed. These are reported in [Table 8](#).

STEP 9. In order to compute the group's global priorities, the DMs told us that the DM d_1 has a greater weight than the others, who all have the same weight. This weighting is due to the fact that the DM d_1 is the project leader, and this entails greater responsibility and a strategic role in coordination compared to the DMs from other municipalities, who have the same weight. The η_i values are, therefore, as follows: $\eta_1 = 0.25$, $\eta_2 = 0.15$, $\eta_3 = 0.15$, $\eta_4 = 0.15$, $\eta_5 = 0.15$, $\eta_6 = 0.15$. [Table 8](#) shows the group global priority $\Omega(a_h)$.

6. Discussion

From an analysis of [Table 7](#), we can see that the criterion g_5 is the most important for DMs d_1 , d_3 , d_4 and d_6 because 0.390 is the most important weight in \underline{w}^1 , 0.205 is the most important weight in \underline{w}^3 (for both criterion g_5 and criterion g_6), 0.411 is the most important weight in \underline{w}^4 and 0.363 is the most important weight in \underline{w}^6 . For DM d_2 , the most important criterion is g_1 with weight 0.303, for d_3 the most important criteria are g_5 and g_6 with weight 0.205 and for d_5 the most important criterion is g_2 with weight 0.258. In [Table 9](#), we report the rankings obtained for each DM and those of the group.

To evaluate the validity of the results obtained, we conducted a sensitivity analysis by varying the weights of the DMs by assigning the same weight to all of them ($\eta_i = 0.1666667$). As we can see from [Figure 5](#), the results obtained show stability of the final rankings of the top ten alternatives.

A sensitivity analysis was also conducted by varying the weights of the criteria (reported in [Table 7](#)) one by one, first by +10% and then by -10% (simultaneously reducing or increasing the weights of the other criteria by 2%) to further verify the stability of the results. All local and global priorities, as well as the new group rankings, were then recalculated. The results are shown in [Figure 6](#). As can be seen from the results obtained, the rankings remain stable for the top ten alternatives for all weight variations. From the analyses conducted, we can deduce that the results are stable.

The results clearly demonstrate the ability of the methodological approach proposed in this work to support DMs, both individually and as a group, in making strategic choices that enable them to operate synergistically to implement targeted actions to enhance tourism in internal and peripheral areas. The aggregate rankings of the global priorities of the alternatives ([Table 9](#)) show a clear convergence towards actions with high symbolic and strategic value. Alternative a_6 is the most relevant, followed by a_{17} , a_{11} , a_{20} and a_{54} . The resulting ranking demonstrates that DMs are inclined to implement initiatives that reconcile tradition and the local economy (a_6 , a_{17}) and also to propose panoramic and multi-sensory proposals (a_{11}).

We note that the aggregation of the preferences obtained by assigning the greatest weight to the DM d_1 (the project leader) did not distort the representation of the entire group. In fact, the

Table 8. Global priorities $\omega(a_h, d_l)$ of the alternative a_h for each DM d_l and the group global priority $\Omega(a_h)$

$\omega(a_h, d_l)$	d_1	d_2	d_3	d_4	d_5	d_6	$\Omega(a_h)$
a_1	0.100	0.099	0.097	0.101	0.097	0.100	0.099
a_2	0.075	0.079	0.075	0.074	0.072	0.078	0.075
a_3	0.125	0.116	0.104	0.118	0.105	0.116	0.115
a_4	0.279	0.263	0.256	0.277	0.267	0.273	0.270
a_5	0.050	0.054	0.052	0.051	0.047	0.054	0.051
a_6	0.433	0.420	0.430	0.430	0.438	0.421	0.429
a_7	0.372	0.362	0.376	0.377	0.382	0.370	0.373
a_8	0.074	0.079	0.085	0.079	0.081	0.082	0.079
a_9	0.331	0.329	0.341	0.342	0.346	0.336	0.337
a_{10}	0.331	0.328	0.328	0.330	0.330	0.326	0.329
a_{11}	0.404	0.395	0.395	0.397	0.398	0.391	0.398
a_{12}	0.045	0.049	0.048	0.045	0.043	0.049	0.046
a_{13}	0.300	0.298	0.294	0.302	0.295	0.298	0.298
a_{14}	0.073	0.080	0.085	0.081	0.077	0.083	0.079
a_{15}	0.328	0.333	0.333	0.331	0.334	0.328	0.331
a_{16}	0.350	0.351	0.362	0.359	0.367	0.353	0.356
a_{17}	0.422	0.409	0.415	0.419	0.424	0.410	0.417
a_{18}	0.278	0.275	0.272	0.277	0.278	0.277	0.276
a_{19}	0.304	0.302	0.314	0.321	0.314	0.311	0.310
a_{20}	0.412	0.393	0.384	0.400	0.389	0.391	0.397
a_{21}	0.077	0.082	0.077	0.076	0.071	0.080	0.077
a_{22}	0.136	0.128	0.117	0.132	0.116	0.130	0.127
a_{23}	0.122	0.117	0.108	0.117	0.106	0.115	0.115
a_{24}	0.178	0.174	0.159	0.169	0.152	0.170	0.168
a_{25}	0.063	0.054	0.049	0.050	0.062	0.047	0.055
a_{26}	0.131	0.125	0.115	0.122	0.118	0.122	0.123
a_{27}	0.198	0.194	0.177	0.181	0.185	0.185	0.188
a_{28}	0.296	0.293	0.284	0.301	0.283	0.293	0.292
a_{29}	0.390	0.384	0.391	0.388	0.403	0.384	0.390
a_{30}	0.157	0.154	0.151	0.159	0.149	0.157	0.155
a_{31}	0.136	0.128	0.110	0.126	0.107	0.125	0.123
a_{32}	0.150	0.145	0.131	0.139	0.131	0.140	0.140
a_{33}	0.232	0.232	0.230	0.230	0.232	0.230	0.231
a_{34}	0.249	0.239	0.244	0.259	0.248	0.252	0.248
a_{35}	0.056	0.060	0.059	0.060	0.053	0.063	0.058
a_{36}	0.065	0.066	0.064	0.069	0.060	0.070	0.066
a_{37}	0.131	0.128	0.117	0.127	0.118	0.125	0.125
a_{38}	0.072	0.074	0.072	0.076	0.068	0.077	0.073
a_{39}	0.307	0.289	0.302	0.313	0.314	0.306	0.305
a_{40}	0.073	0.076	0.070	0.073	0.063	0.077	0.072
a_{41}	0.126	0.120	0.114	0.119	0.122	0.120	0.121
a_{42}	0.178	0.176	0.173	0.175	0.173	0.175	0.175
a_{43}	0.169	0.164	0.162	0.174	0.168	0.171	0.168
a_{44}	0.074	0.074	0.073	0.078	0.070	0.078	0.074
a_{45}	0.250	0.250	0.252	0.258	0.254	0.255	0.253
a_{46}	0.248	0.238	0.224	0.243	0.228	0.243	0.238
a_{47}	0.068	0.070	0.068	0.072	0.063	0.073	0.069
a_{48}	0.276	0.269	0.266	0.280	0.266	0.276	0.273
a_{49}	0.127	0.130	0.126	0.123	0.124	0.125	0.126
a_{50}	0.252	0.259	0.252	0.259	0.242	0.256	0.253
a_{51}	0.305	0.300	0.293	0.299	0.297	0.299	0.300
a_{52}	0.307	0.296	0.290	0.298	0.294	0.298	0.298
a_{53}	0.143	0.149	0.138	0.130	0.140	0.140	0.140
a_{54}	0.405	0.388	0.390	0.396	0.398	0.390	0.395

(continued)

Table 8. Continued

$\omega(a_h, d_j)$	d_1	d_2	d_3	d_4	d_5	d_6	$\Omega(a_h)$
a_{55}	0.401	0.384	0.386	0.392	0.395	0.386	0.392
a_{56}	0.118	0.117	0.105	0.109	0.103	0.112	0.111
a_{57}	0.212	0.200	0.187	0.202	0.196	0.204	0.201
a_{58}	0.345	0.331	0.331	0.344	0.334	0.337	0.338
a_{59}	0.373	0.355	0.358	0.370	0.362	0.361	0.364
a_{60}	0.087	0.090	0.086	0.087	0.080	0.090	0.087
a_{61}	0.232	0.221	0.218	0.231	0.223	0.231	0.226
a_{62}	0.087	0.086	0.083	0.090	0.084	0.088	0.086
a_{63}	0.356	0.350	0.355	0.360	0.356	0.354	0.355
a_{64}	0.314	0.302	0.307	0.322	0.312	0.312	0.312
a_{65}	0.377	0.362	0.378	0.383	0.390	0.374	0.377
a_{66}	0.267	0.271	0.267	0.268	0.269	0.267	0.268
a_{67}	0.192	0.184	0.161	0.181	0.159	0.181	0.177
a_{68}	0.177	0.170	0.160	0.171	0.164	0.172	0.170

sensitivity analysis conducted revealed the same final ranking of the alternatives. Observing the results, we note that the lowest-ranked alternatives (i.e. a_{12} , a_5 and a_{25}) tend to refer to activities that are poorly integrated across the various territorial contexts. This highlights that the group preferences emphasized alternatives that were able to define synergistic solutions for all the territories involved and to generate widespread impacts across them.

We also note that integrating the algebraic approach into the Parsimonious AHP allows us to leverage all the inherent advantages of the method while addressing the critical issues associated with using Saaty's semantic scale or, more generally, with using other scales, as discussed previously. We note that the proposed approach does not increase the number of pairwise comparisons, nor does it make the decision-making process more complex. What changes is the approach used to elicit preferences, not the quantity or nature of the judgments required from the DMs. Specifically, our model uses a limited interval $]\frac{1}{\alpha}, \alpha[$ (we chose $\alpha = 9$ to reference the values used in the Saaty scale) to represent the intensity of preferences. This provides a more robust and realistic formulation, while maintaining the same number of inputs for the DM. Therefore, no additional evaluations are required from DMs than in the classical Parsimonious AHP. These aspects are summarized in Table 10. Moreover, for each PCM, the computational complexity is $O(n^3)$ for both methods (see Algorithm 1).

6.1 Managerial insights

From a managerial perspective, the findings of this study offer significant insights. Specifically, the paper builds on the established management and decision science literature, which highlights how complex it is for public DMs to reach shared decisions in contexts driven by multiple objectives, institutional constraints and sometimes divergent interests (Wu, 2024; Mullick and Sen, 2025). In such contexts, decisions often tend to be reduced to a single reference parameter, generally represented by economic criteria and, more specifically, budget constraints (Selivanovskikh et al., 2025). Through the analysis of an empirical case involving six Italian municipalities and six public DMs, the findings of this study emphasized the multi-criteria approach to group decisions, simultaneously considering multiple aspects with different weights (Kumaresan et al., 2026). The results, in this sense, demonstrate that they are based on a rational and objective model capable of supporting public DMs in structuring discussions, composing preferences and, more generally, improving the quality of the collective decision-making process. Observing the results, it emerges that the top three alternatives identified by our approach are a_6 (*Wine and Vineyards Itinerary*), a_{17} (*Wine*

Table 9. Rankings obtained for each DM and those of the group

d_1	d_2	d_3	d_4	d_5	d_6	Group
a_6	a_6	a_6	a_6	a_6	a_6	a_6
a_{17}	a_{17}	a_{17}	a_{17}	a_{17}	a_{17}	a_{17}
a_{20}	a_{11}	a_{11}	a_{11}	a_{11}	a_{11}	a_{11}
a_{54}	a_{20}	a_{20}	a_{20}	a_{20}	a_{20}	a_{20}
a_{11}	a_{54}	a_{54}	a_{54}	a_{54}	a_{54}	a_{54}
a_{55}	a_{55}	a_{55}	a_{55}	a_{55}	a_{55}	a_{55}
a_{29}	a_{29}	a_{29}	a_{29}	a_{29}	a_{29}	a_{29}
a_{65}	a_7	a_7	a_7	a_7	a_7	a_{65}
a_{59}	a_{65}	a_{65}	a_{65}	a_{65}	a_{65}	a_7
a_7	a_{59}	a_{59}	a_{59}	a_{59}	a_{59}	a_{59}
a_{63}	a_{16}	a_{16}	a_{16}	a_{16}	a_{16}	a_{16}
a_{16}	a_{63}	a_{63}	a_{63}	a_{63}	a_{63}	a_{63}
a_{58}	a_{15}	a_{15}	a_{15}	a_{15}	a_{15}	a_{58}
a_{10}	a_{58}	a_{58}	a_{58}	a_{58}	a_{58}	a_9
a_9	a_9	a_9	a_9	a_9	a_9	a_{15}
a_{15}	a_{10}	a_{10}	a_{10}	a_{10}	a_{10}	a_{10}
a_{64}	a_{64}	a_{64}	a_{64}	a_{64}	a_{64}	a_{64}
a_{39}	a_{19}	a_{19}	a_{19}	a_{19}	a_{19}	a_{19}
a_{52}	a_{51}	a_{51}	a_{51}	a_{51}	a_{51}	a_{39}
a_{51}	a_{13}	a_{13}	a_{13}	a_{13}	a_{13}	a_{51}
a_{19}	a_{52}	a_{52}	a_{52}	a_{52}	a_{52}	a_{52}
a_{13}	a_{28}	a_{28}	a_{28}	a_{28}	a_{28}	a_{13}
a_{28}	a_{39}	a_{39}	a_{39}	a_{39}	a_{39}	a_{28}
a_4	a_{18}	a_{18}	a_{18}	a_{18}	a_{18}	a_{18}
a_{18}	a_{66}	a_{66}	a_{66}	a_{66}	a_{66}	a_{48}
a_{48}	a_{48}	a_{48}	a_{48}	a_{48}	a_{48}	a_4
a_{66}	a_4	a_4	a_4	a_4	a_4	a_{66}
a_{50}	a_{50}	a_{50}	a_{50}	a_{50}	a_{50}	a_{50}
a_{45}	a_{45}	a_{45}	a_{45}	a_{45}	a_{45}	a_{45}
a_{34}	a_{34}	a_{34}	a_{34}	a_{34}	a_{34}	a_{34}
a_{46}	a_{46}	a_{46}	a_{46}	a_{46}	a_{46}	a_{46}
a_{61}	a_{33}	a_{33}	a_{33}	a_{33}	a_{33}	a_{33}
a_{33}	a_{61}	a_{61}	a_{61}	a_{61}	a_{61}	a_{61}
a_{57}	a_{57}	a_{57}	a_{57}	a_{57}	a_{57}	a_{57}
a_{27}	a_{27}	a_{27}	a_{27}	a_{27}	a_{27}	a_{27}
a_{67}	a_{67}	a_{67}	a_{67}	a_{67}	a_{67}	a_{67}
a_{42}	a_{42}	a_{42}	a_{42}	a_{42}	a_{42}	a_{42}
a_{24}	a_{24}	a_{24}	a_{24}	a_{24}	a_{24}	a_{68}
a_{68}	a_{68}	a_{68}	a_{68}	a_{68}	a_{68}	a_{43}
a_{43}	a_{43}	a_{43}	a_{43}	a_{43}	a_{43}	a_{24}
a_{30}	a_{30}	a_{30}	a_{30}	a_{30}	a_{30}	a_{30}
a_{32}	a_{53}	a_{53}	a_{53}	a_{53}	a_{53}	a_{53}
a_{53}	a_{32}	a_{32}	a_{32}	a_{32}	a_{32}	a_{32}
a_{31}	a_{49}	a_{49}	a_{49}	a_{49}	a_{49}	a_{22}
a_{22}	a_{31}	a_{31}	a_{31}	a_{31}	a_{31}	a_{49}
a_{37}	a_{22}	a_{22}	a_{22}	a_{22}	a_{22}	a_{37}
a_{26}	a_{37}	a_{37}	a_{37}	a_{37}	a_{37}	a_{31}
a_{49}	a_{26}	a_{26}	a_{26}	a_{26}	a_{26}	a_{26}
a_{41}	a_{41}	a_{41}	a_{41}	a_{41}	a_{41}	a_{41}
a_3	a_{56}	a_{56}	a_{56}	a_{56}	a_{56}	a_{23}
a_{23}	a_{23}	a_{23}	a_{23}	a_{23}	a_{23}	a_3
a_{56}	a_3	a_3	a_3	a_3	a_3	a_{56}
a_1	a_1	a_1	a_1	a_1	a_1	a_1
a_{62}	a_{60}	a_{60}	a_{60}	a_{60}	a_{60}	a_{60}
a_{60}	a_{62}	a_{62}	a_{62}	a_{62}	a_{62}	a_{62}

(continued)

Table 9. Continued

d_1	d_2	d_3	d_4	d_5	d_6	Group
a_{21}	a_{21}	a_{21}	a_{21}	a_{21}	a_{21}	a_8
a_2	a_{14}	a_{14}	a_{14}	a_{14}	a_{14}	a_{14}
a_8	a_2	a_2	a_2	a_2	a_2	a_{21}
a_{44}	a_8	a_8	a_8	a_8	a_8	a_2
a_{40}	a_{40}	a_{40}	a_{40}	a_{40}	a_{40}	a_{44}
a_{14}	a_{44}	a_{44}	a_{44}	a_{44}	a_{44}	a_{38}
a_{38}	a_{38}	a_{38}	a_{38}	a_{38}	a_{38}	a_{40}
a_{47}	a_{47}	a_{47}	a_{47}	a_{47}	a_{47}	a_{47}
a_{36}	a_{36}	a_{36}	a_{36}	a_{36}	a_{36}	a_{36}
a_{25}	a_{35}	a_{35}	a_{35}	a_{35}	a_{35}	a_{35}
a_{35}	a_5	a_5	a_5	a_5	a_5	a_{25}
a_5	a_{25}	a_{25}	a_{25}	a_{25}	a_{25}	a_5
a_{12}	a_{12}	a_{12}	a_{12}	a_{12}	a_{12}	a_{12}

production workshops) and a_{11} (Panoramic and Food and Wine Itineraries). The results suggest a strategic orientation toward experiential low-investment tourism initiatives (De Bruin and Jelincić, 2016) by the six local administrations involved. These findings suggest that DMs should prioritize development strategies based on enhancing local identity (see, for example, González, 2008; Dredge and Jenkins, 2003) rather than costly infrastructure investments. From a policy perspective, this implies that the six local administrations involved in this study should allocate resources to low-investment initiatives capable of generating sustainable tourism flows and promoting greater community participation (see, for example, Shani and Pizam, 2011).

The proposed approach allows evaluation results to be translated into operational policy recommendations, consistent with the strategic objectives of the local administrations involved in the decision-making process. In the context analysed, the DMs report that the approach proposed in this paper can be integrated into strategic planning documents that define the political actions to be undertaken in the territory, such as the strategic plan (a planning document oriented towards the development, in this specific case, of a territorial tourism system).

Integrating the algebraic Parsimonious AHP approach into the strategic plan allows coordinated promotion policies to be adopted with the aim of building an integrated and recognizable tourism offering that can overcome the fragmentation of local initiatives. In this way, public resources can be directed towards initiatives that integrate multiple dimensions (cultural, social, creative and economic), fostering the creation of replicable formats and a coordinated regional calendar that can extend visitor stays and contribute to making the offering less seasonal. Integrating our approach into the strategic plans of municipal administrations, based on the results obtained, allows policies geared towards environmental and social sustainability to be integrated together, promoting responsible planning criteria for tourism initiatives, reducing the environmental impact and adopting circular economy practices capable of transforming the area's cultural, creative and food and wine resources into tools for attractiveness, competitiveness and sustainable development in the medium and long term. Indeed, the proposed approach contributes to the improvement of public management practices, particularly in terms of quality, legitimacy and robustness of decisions, allowing transparent decision-making based on criteria directly derived from strategic planning objectives. In this sense, the policy choices are not disconnected from the planning documents but are explicitly linked to the strategic priorities defined by the public administrations.

The global priorities of the alternatives derive from preferences that are explicitly formalized and consistent with the strategic objectives, avoiding decisions based on implicit or

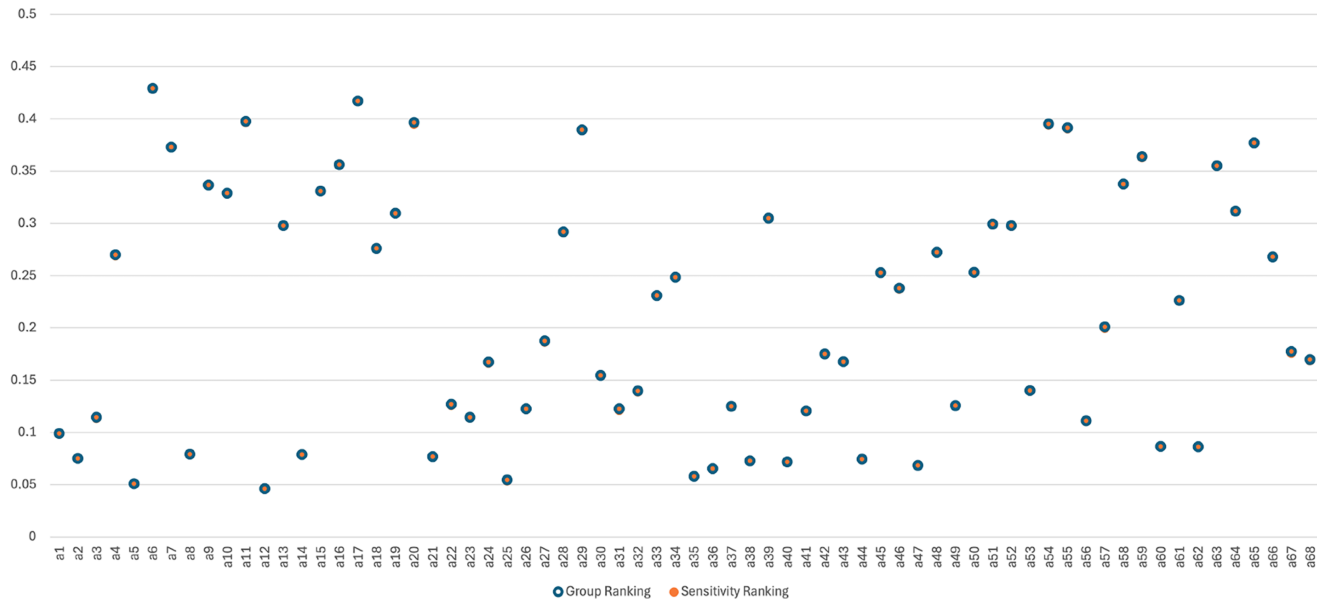


Figure 5. Sensitivity analysis of DMs' weights

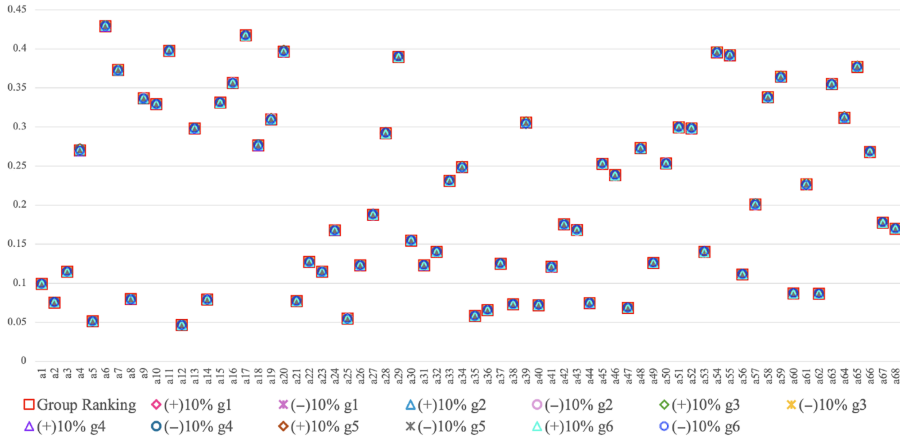


Figure 6. Sensitivity analysis of variations of criteria weights

Table 10. Number of pairwise comparisons required and input domain for a PCM $A = (a_{ij})_{n \times n}$

Methodology	Classical parsimonious AHP	Integrated algebraic approach with parsimonious AHP
Number of pairwise comparisons	$\frac{n(n-1)}{2}$	$\frac{n(n-1)}{2}$
Input domain	$S = \left\{ \frac{1}{9}, \frac{1}{8}, \frac{1}{7}, \frac{1}{6}, \frac{1}{5}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, 1, 2, 3, 4, 5, 6, 7, 8, 9 \right\}$	$[\frac{1}{\alpha}, \alpha], \alpha > 1$

contingent evaluations. This allows the alternatives to be ranked in a way that is fully aligned with public administration planning strategies, as well as being traceable and verifiable exp post, reducing the risk of ad hoc or inconsistent decisions over time. Thus, administrations can clearly justify the reasons behind the selection or exclusion of specific alternatives, even in the face of budgetary constraints, for example. From the perspective of decision legitimacy, the approach highlights the role and influence of different DMs in the decision-making process, strengthening participatory governance mechanisms. Public DMs are actively involved in the various phases of the construction of the model, from defining the criteria to expressing preferences. The resulting traceability and justifiability of the choices increase the acceptability of the strategies adopted by stakeholders and citizens and strengthen their overall robustness; this is an important aspect in public contexts in which transparency and accountability are fundamental requirements.

7. Conclusion

This study highlights the complexity of group public decisions in a sector with a high socio-economic impact, such as tourism. Through a methodological extension of the Parsimonious AHP method, applied to a group decision-making problem, a new tool is offered to support group decision-making in a public context.

From a theoretical perspective, the work helps to fill a gap in the literature on group decision-making by introducing an original and robust solution. This methodological

innovation is tested on a real-world case study involving six municipal administrations in Campania that have participated in a national programme that encourages and recognizes tourism as a strategic sector to increase territorial attractiveness. The results demonstrate that the new approach is a valid tool that is capable of managing the different preferences of the DMs involved in a structured and transparent manner, offering final group rankings of alternatives that define synergistic solutions for all the territories involved and generate widespread impacts across them. From a managerial perspective, the proposed approach enables the transparent planning of strategies to be implemented in partnership by clearly defining the decision-making criteria and the weights of the individual DMs involved. This methodological approach helps to strengthen consultation and co-decision processes, improving the legitimacy of territorial strategies and the coherence between economic development objectives and sustainability principles. Furthermore, it can be integrated into public administrations as an advanced decision-support tool capable of supporting several participatory governance policies. We note that the approach can be easily applied in contexts other than the tourism sector. Future studies may involve the use of sorting methods to classify tourism actions and identify those that may pose greater or lesser risks to the partnership. We note that our work has been validated on a real case study involving a number of DMs (six city mayors) who correspond to the DMs who are actually involved in planning a strategy to promote sustainable tourism in Campania. Although the panel size is small, it reflects the operational reality of the decision-making context and does not limit the generalization of the proposed methodological framework; in future work, we plan to extend this study to larger groups of DMs. Considering that this work is based on a real case study with only six DMs, it is therefore not suitable as the basis for experiments; a future piece of work will be to carry out an experiment (as done, for example by Cavallo *et al.* (2019)) with at least 100 DMs in order to compare our methodology with the classical one that uses the Saaty scale.

We also plan to compare our approach with other MCDM methods and to perform an experimental study using different α values. Finally, we plan to deal with some well-known limitations of the AHP; as an example, the integration of the Choquet integral in our methodology could be considered for handling interactions between the criteria. We emphasize that our proposed approach is not limited to public contexts and tourism-related problems; it can be used to analyse any large-scale decision-making problem in any context involving multiple DMs. For example, the approach can be used to analyse DM problems in several sectors, such as construction (e.g. Grošelj *et al.*, 2015), manufacturing (e.g. Ishizaka and Labib, 2011) and healthcare (e.g. Hummel *et al.*, 2014).

Acknowledgments

The authors are grateful to the municipal administrations of Paupisi, Ponte, San Lupo, San Lorenzo Maggiore, Torrecuso and Vitulano for their continued support and active involvement in the research.

Supplementary material

The supplementary material for this article can be found online.

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