

RESEARCH ARTICLE

An exploratory study of stakeholder views on the sustainable development of mountain tourism

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Abstract

Sustainable tourism can combine recreation for people, economic opportunities for entrepreneurs, and environmental protection, but for mountain tourism, climate change and the predicted reductions in snowfall require urgent action. Therefore, this study aims to identify sustainable mountain tourism strategies and consumption patterns using a multi-criteria decision methodology and data collected through an online survey and expert opinions. The results show the importance of stakeholder engagement and the relevance of three strategies: (i) zero-emission lodges; (ii) energy communities, and (iii) zero-emission ski lifts. As well as pointing out the need for sustainability awareness and education. While respondents pay a great deal of attention to sustainability, the analysis highlights three policy interventions to safeguard mountain tourism: (i) financing the conversion of facilities; (ii) expanding infrastructure to reach mountain resorts, and (iii) rewarding consumers for choosing a certified zero-emission resort.

KEYWORDS

decision analysis, mountain, stakeholder engagement, survey, sustainability, tourism

1 | INTRODUCTION

The 17 Sustainable Development Goals (SDGs) set the benchmark for an ecological transition that combines social prosperity, economic opportunity, and environmental protection. Some countries have made arbitrary choices about which actions to prioritise, favouring the SDGs that are easier to achieve over those that require deep transformation (Allen et al., 2019). However, there are complex interactions between the SDGs (Dawes, 2020) that need to be mapped to avoid pathways that make them incompatible (Huan et al., 2022), overcome

trade-offs, and harness synergies to achieve the goals by 2030 (Kostetckaia & Hametner, 2022). In addition, evaluating and monitoring SDGs is crucial to measuring national progress (Allen et al., 2021). Among the 17 SDGs, particular emphasis is placed on SDG 2 (zero hunger) and SDG 3 (good health and well-being), while less attention is given to SDG 14 (life below water) and SDG 16 (peace, justice and strong institutions) (Ali et al., 2023). Several authors highlight the key role of SDG 15 (life on land) for overall progress on sustainability (Huan & Zhu, 2023; Reyers & Selig, 2020), others the need to assess the interactions with the other SDGs (Huan & Zhu, 2023), and still

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others the need for cross-sectoral collaboration, given the negative impact of some of the goals on SDG 15 (Adhikari et al., 2023).

SDG 15 is one of the UN SDGs that focuses on the conservation of terrestrial biodiversity. Mountains are home to 30% of all key biodiversity areas (UNEP et al., 2020), and humanity benefits from mountain biodiversity in many ways, from food and medicine to regulating climate and air quality. However, mountain biodiversity is under pressure from land use and climate change, overexploitation, invasive species, pollution, and demographic changes. The management of mountain biodiversity has been identified as a global priority, with SDG 15 Target 4 dedicated to its conservation (Makino et al., 2020). In particular, this target and its support for the sustainable development of mountain regions is seen as crucial in the transition process (Bian et al., 2022; Zhang et al., 2022). Given the scarcity of water, food, and fodder in the mountain regions of the Global South, an analysis of the supply and demand of ecosystem services is needed, as well as urgent solutions for the sustainable management of mountain ecosystems (Grêt-Regamey & Weibel, 2020).

After a period of economic success, mountain tourism is evolving due to climate change (Denning, 2014), the new needs and behaviours of tourists (Zhang et al., 2023), their perception of natural and environmental resources (Wu et al., 2018), and a shift from mass tourism to more responsible tourism (Camilleri, 2014). However, a recent systematic review of mountain tourism studies has highlighted some gaps, such as the lack of adequate data and indicators, the analysis of all-weather opportunities, the socio-economic impacts and policy decisions for mountain communities, and the need for better science communication (Steiger et al., 2022). This is also emphasised in a study highlighting the need to assess the different boundaries of sustainability, the availability of infrastructure and services, livelihoods, and the management of tourist destinations (Yang et al., 2023).

Sustainable development strategies can be promoted through tourism in mountain resorts (Sgroi, 2020), but the development of long-term strategies is hampered by limited human and technical resources (Torres-Delgado et al., 2021). In particular, local politicians need to be supported by higher-level public administrators. Legislation needs to adapt to the changing ecosystem, and products from forest areas need to be protected (Melnykovich et al., 2018). Furthermore, sustainable transition goes hand in hand with digital transition, and some analyses show that communication on responsible tourism management is most effective when delivered through interactive channels. Interaction with stakeholders improves the reputation of hospitality businesses (Camilleri, 2018; Zorpas et al., 2021). Other studies show that the environmental dimension generates more perceived brand equity than the social and economic dimensions. One possible reason is that mountain tourists prefer to be in close contact with nature (Bigné et al., 2020).

Another interesting aspect is that green culture can have multiple effects. Indeed, customer engagement tends to stimulate tourism employees to generate and implement new green service solutions (Luu, 2022), and tourism hotels to develop service differentiation strategies based on sustainable practices (Wang et al., 2019). However, stakeholders do not always converge. For example, the production of artificial snow is a preferred strategy for local tourism businesses, but

this is not the case for customers and residents. Indeed, tourists look for a unique atmosphere, a variety of activities, and year-round facilities. The diversification of products and activities is also appreciated by local residents (Cholakova & Dogramadjieva, 2023). Consequently, a major sustainability challenge is stakeholder alignment. In particular, in some resorts, there is a gap between tourists' demand for more sustainable resorts and the resorts' actions. At the same time, market dynamics influence these decisions, as snow is a resource that is only available in certain parts of the world (Spandre et al., 2019).

The rise in health and wellness tourism in the mountains is leading to increased competition among destinations (Zeng et al., 2021). For millennials, the main drivers of the choice of mountain destination are the availability of good quality local food, a nature-oriented approach, economic aspects, opportunities for relaxation, and trendy locations (Giachino et al., 2020). However, among college students, a higher degree of altruism corresponds to more sustainable behaviour, and contact with nature is always important, particularly at weekends where there are fewer scholastic commitments (Biancardi et al., 2023).

Using surveys, focus groups, workshops, and a theory of planned behaviour model, some analyses show an increasing tendency to go to refreshing mountain areas (Juschten et al., 2019), with the combination of social and subjective norms driving visits to these destinations (Juschten et al., 2019). Landslides are considered the most threatening consequence of climate change in such areas (Liu et al., 2021), and future tourism will need to adapt to increasingly unfamiliar ecological environments (Knowles, 2019).

Specifically, the literature highlights a gap in consumer analyses related to sustainability issues in mountain areas (Yang et al., 2023), and some studies suggest looking at the stakeholder perspective (Ebner et al., 2022) using multi-criteria decision analysis (MCDA) (Fontana et al., 2023). Therefore, in this study, we aim to address two research objectives:

- RO1: Through MCDA, identify the most appropriate alternatives to fight climate change in mountain areas with the support of different categories of stakeholders.
- RO2: Through an online questionnaire, assess the habits and opinions of a specific category of stakeholders (consumers) on sustainability issues in mountain areas.

2 | METHODS

The two ROs require two different methodologies. MCDA is used to assess the perspective of different stakeholder categories to investigate RO1, while an online survey is used to address RO2.

2.1 | Multi-criteria decision analysis

MCDA is a method used to evaluate multiple and conflicting alternatives in the field of sustainability (D'Adamo, Dell'Aguzzo et al., 2023a; Koshim et al., 2023). The sustainability score is obtained by the product of a row vector $(1, n)$, which proposes the weight of the criteria,

TABLE 1 List of alternatives.

Number	Alternative	Description
A1	Zero-emission ski lifts	Powered by renewable energy sources
A2	Zero-emission lodges	Renewing and restoring outdated huts and chalets
A3	Sustainable transport system (transport community)	Creating an infrastructure capable of linking up mountain areas
A4	Vehicle access restriction	Maximum number of vehicles allowed in certain locations
A5	Energy community	Sharing energy among communities
A6	Sustainability awareness and education	Increasing education and awareness at the school level
A7	No action	

and a column vector $(n,1)$, which consists of the value (score) assigned to the criteria. This value should identify the most appropriate alternative to address the climate crisis in mountain regions.

2.1.1 | Description of alternatives

We selected seven alternatives (Table 1). The first alternative (A1) is building zero-emission ski lifts powered by renewable energy sources. This step is crucial, as many existing ski lifts rely on polluting energy sources. Considering that many huts and chalets are obsolete, the second proposed alternative (A2) is to renovate and restore these. In fact, there are mountain lodges where the generator sets (gensets), useful for the maintenance of the building, are still powered by petrol. There is also growing demand for convenient transport options that allow people to explore these natural areas without the burden of organising car trips and meticulously planning routes, which is addressed by the third alternative (A3). In addition, these sites currently suffer from overcrowding and the presence of numerous cars causing damage and disfigurement. To solve this problem, a fourth alternative includes restrictions on vehicle access (A4). The concept of an energy community is a growing theme. This fifth alternative emphasises the importance of sharing resources and offers a way of tackling climate-related crises by linking up neighbouring communities (A5). Finally, the current situation is also a consequence of insufficient awareness and education on sustainability. It is therefore essential to seriously consider this alternative as part of the overall solution (A6). These six alternatives highlight the strategies to be implemented, which are instead rejected in the seventh alternative (A7) that maintains the status quo.

2.1.2 | Description of criteria

To our best knowledge, the literature does not provide a framework of useful criteria for comparing these alternatives. Therefore, we used

TABLE 2 List of criteria employed in the analysis.

Criteria	Alternative	Description
C1	Customer experience	How the customer experience may change
C2	Social responsibility	Ethical responsibilities
C3	Savings on implementation cost	Implementation costs of an idea/innovation in action
C4	Stakeholder engagement	Involvement of ski area managers, municipalities, policymakers, and residents
C5	Ability to adapt	Ability to adapt to initiatives aimed at improving the overall well-being of the area
C6	Ecosystems innovation	Collective efforts to create new value, promote systemic change at the ecosystem level
C7	Economic opportunities	Profitability
C8	Resilience to climate change	Prevention/mitigation of negative impacts (temperature increase, snow scarcity, extreme weather events)
C9	Environmental improvement	Greenhouse gas reduction, biodiversity conservation, pollution reduction

the analytic hierarchy process (AHP) (Saaty, 2008) to assign weights to the nine criteria selected and described in Table 2. The aim of these criteria is to best describe all the components that may influence the best choice, without running the risk of having redundant criteria.

2.1.3 | Selection of academic experts

The selection of experts is crucial for the quality of an AHP in terms of their expertise and the reduction of subjectivity (Tsyganok et al., 2012). The literature suggests that a congruent number of experts is equivalent to 10 academics (D'Adamo, 2022), and we follow this approach.

We selected the experts by identifying academics from the Scopus database who had published on the SDGs topic related to natural resource management issues, and had at least 10 years of experience. We sent an email explaining the objectives of the project and the methodology used, emphasising that only the first 10 positive responses would be analysed. The resulting sample is mainly European with 30% female (Table S1). In accordance with the literature (D'Adamo, 2022), two of these experts would carry out an initial screening of the alternatives and the criteria to highlight any critical issues. We implemented the various observations and sent an Excel file to all experts for pairwise comparison. Each expert was able to request an online meeting to resolve any concerns or provide some thoughts. The survey was conducted in July 2023 and the worksheet included an automatic calculation of the consistency ratio (CR), which measures the reliability of the judgements.

2.1.4 | Aggregation of weights

We used a 9×9 comparison matrix equal to the number of criteria evaluated, and each expert had the possibility to assign a score between 1 and 9 (Table S2). In addition, we performed a score normalisation process (Subramoniam et al., 2013). The analysis is considered adequate if the CR does not exceed 0.10 (Saaty, 2008). The comparison matrices are shown in Tables S3–S12, where the number of experts is causal to ensure anonymity. For example, expert 1 (E1) identified criterion C4 (stakeholder engagement) as the most relevant with 0.22, followed by criterion C6 (ecosystems innovation) with 0.19. On the other hand, expert 2 (E2) ranked criterion C6 ahead of criterion C7 (economic opportunities). The advantage of this analysis is therefore the combination of different perspectives.

2.1.5 | Selection of non-academic experts

In the absence of objective data on these elements, it is also necessary to select experts in the field to assign the scores. It is useful at this stage to ask for support from other categories of stakeholders, different from the academic experts. We sent out several invitations via social channels (e.g., LinkedIn) to individuals who work or have experience in these realities, such as ski resort managers, mountaineers, mountain hut managers, and tour operators. Again, we specified that only the first 10 respondents would be accepted, and they had to have at least 10 years' experience in the field. The survey took place in July–August 2023, with equal participation of men and women (Table S13).

2.1.6 | Aggregation of values

Unlike AHP, the scoring approach does not include a tool to measure the reliability of the score, but assign a score from -5 (negative influence) to $+5$ (positive influence) because, compared to the 1 (worst)–10 (best) method, it tends to emphasise alternatives that are considered unsustainable. Again, there is no correlation with the number of experts, for example, expert 1 (E1) assigned a maximum score of 3 to all alternatives for criterion C9 (environmental improvement) with the exception of A7 (no action), while expert 5 (E5) assigned a maximum score of 3 to A1 (zero-emission ski lifts). All scores are shown in Tables S14–S23 and were collected using an Excel spreadsheet, without knowing the weight assigned to the criteria.

2.2 | Online survey

According to the literature, web-based surveys have many advantages (Menegaki et al., 2016). For this study, we developed a structured questionnaire and distributed it to a large sample of Italians (D'Adamo, Gastaldi, Piccioni et al., 2023c). We used a simple random sampling method to collect our data. In order to reach a large number of participants, we shared the questionnaire on various social media platforms

(e.g., LinkedIn, Instagram) and also sent it by email. The aim of the questionnaire was to understand respondents' attitudes towards sustainability in mountain areas. It also sought to explore the links between personal interests and environmental sustainability, particularly in mountain areas, and consumers' perceptions of a future influenced by climate change. Before sending the questionnaire to consumers, we asked two colleagues with decades of experience in social surveys in the field of sustainability to validate it and suggest improvements.

The survey contained a total of 23 questions and was divided into three sections. The first focused on socio-demographic information, which allowed us to profile the respondents. In this section, respondents were also asked if they were in the habit of going to the mountains in order to split the sample into regular and non-regular visitors. The questions in the second section were only asked of regular visitors to assess their habits and understand consumers' views on the increasingly evident impact of sports and leisure activities in mountain environments. To this end, we sought to quantify respondents' willingness to contribute financially to various initiatives to reduce the impact of the above activities. Specifically, four environmental sustainability initiatives were presented, and respondents were given the opportunity to decide their hypothetical financial contribution to each initiative as a percentage from 0% to 40%. These initiatives were: (1) the reduction of emissions from ski lifts through a contribution added to the ski pass/summer pass; (2) a contribution added to the cost of a meal to encourage the conversion of catering facilities to zero emissions; (3) a surcharge on an overnight stay in a certified zero-impact accommodation facility; and (4) a contribution added to equipment rental (winter/summer) to support virtuous retailers in terms of reuse, recycling, and recovery. The third section, administered to all respondents, aimed to assess consumers' opinions on the most effective approach and the relevant parties to implement environmental conservation projects. It also aimed to help ski resort operators identify strategies to address climate change. To allow for a comprehensive and multi-faceted analysis, the survey deliberately included two final open-ended questions designed to elicit diverse and valuable insights from participants, thereby adding to the richness of the study's findings.


The questionnaire is available in the supplementary file. A total of 356 valid responses were collected between May and June 2023. The objectives of the study were explained at the beginning of the questionnaire and anonymity was guaranteed. The sample is slightly more male than female (60% male). The average age is 40 divided as follows: gen Z (18–27 years) 40.6%, gen Y (28–41 years) 15.7%, gen X (42–57 years) 24.3%, and baby boomers (58–75 years) 19.4%. The sample is mainly concentrated in central Italy (68%), which is to be expected as the study took place in the Lazio region. In terms of employment, 51% of the sample are employed, 33% are students, and 11% are retired.

3 | RESULTS

The results are presented according to our two research objectives: RO1 based on MCDA considering sustainable strategies in mountain

TABLE 3 Aggregation of expert weights (row vector).

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	AVG
C1	0.033	0.051	0.035	0.050	0.028	0.040	0.034	0.032	0.037	0.066	0.041
C2	0.053	0.043	0.060	0.070	0.047	0.048	0.041	0.037	0.056	0.077	0.053
C3	0.039	0.037	0.042	0.042	0.033	0.056	0.056	0.027	0.032	0.056	0.042
C4	0.220	0.159	0.305	0.112	0.219	0.147	0.072	0.275	0.158	0.189	0.186
C5	0.046	0.079	0.060	0.073	0.112	0.096	0.088	0.055	0.053	0.104	0.076
C6	0.186	0.184	0.108	0.149	0.186	0.128	0.161	0.173	0.248	0.090	0.161
C7	0.160	0.216	0.158	0.129	0.160	0.111	0.119	0.152	0.211	0.120	0.154
C8	0.122	0.124	0.094	0.173	0.086	0.202	0.197	0.094	0.099	0.138	0.133
C9	0.139	0.108	0.139	0.204	0.129	0.172	0.232	0.155	0.106	0.161	0.154

Note:  Max weight;  Min weight.

resorts, and RO2 considering consumer evaluations and opinions on sustainability in mountain resorts.

3.1 | Sustainable strategies in mountain resorts

A strategy is the result of a decision-making process that identifies the most appropriate alternative to be applied in a future context. Climate change is imposing immediate decisions in mountain areas, and although the panel of non-academic experts is Italian, the analyses can be extended to other contexts, given the international support of academics in assigning weights. In this respect, the different contributions are aggregated (Table 3), where the last column indicates the row vector obtained from the average score of the different interviews.

The AHP results show that criterion C4 “stakeholder engagement” stands out with a score of 0.186 and is the first choice for half of the experts. The literature has shown that this criterion is also considered to be very important in other sustainability contexts (D’Adamo, 2022; Ruiz et al., 2023), because it is believed that natural contexts, such as mountain areas, are resilient when people work together towards a common goal and are characterised by real involvement. However, this aspect should not be associated with an identity-based view of ideas. In fact, some experts pointed out that participatory models are characterised by listening to different perspectives, but also by a final choice towards a strategy aimed at providing opportunities for future generations. This ranking is followed by criterion C6 “ecosystems innovation” with a score of 0.161, and is closely related to the concept of stakeholder engagement as explained by Granstrand and Holgersson (2020), who define an innovation ecosystem as a dynamic interaction of actors, activities, and artefacts that evolve over time. High scores are also assigned to criteria C7 “economic opportunities” and C9 “environmental improvement” with a weight of 0.154, and criterion C8 “resilience to climate change” with 0.133. These criteria are the first choice for an expert (in the case of criterion C9 there are two) and influence about 80% of the total weight. These criteria refer to two dimensions of sustainability (economic and environmental) and to the concept of resilience,

which is a key element for those experiencing mountain realities (Chioni et al., 2023). Indeed, academic experts point to the urgent need to find solutions to the current state of our mountain environment.

Criterion C1 “customer experience” is deemed the least important, as this parameter is considered to have the least influence on the final choice. With a score of 0.04, half of the experts rated this criterion as least important in absolute terms. There was also no consensus on another social parameter, namely criterion C2 “social responsibility” with a score of 0.053. However, if these figures suggest that less attention is paid to this specific dimension of sustainability, this is contradicted by the weight given to criterion C3 “savings on implementation cost”. Here too, half of the experts gave it the lowest score or close to the bottom (0.042). This criterion is clearly economic in nature, so it can be assumed that the experts did not evaluate the dimension to which the criterion is linked, but considered that the description characterising this criterion could influence the final choice. Finally, criterion C5 “ability to adapt” has a score of 0.076, because a winning strategy is based on the ability to adapt to external changes, and this is not always available.

Having obtained the row vector, we calculated the column vector. At this stage of the analysis, it is useful to measure the distribution of the scores assigned to the alternatives for each criterion in order to assess whether or not there is bias. The distribution shows that for the first six alternatives, the most clicked is the highest rating of 5, so that it accounts for a third of the total weight (31%) (Table S24). The high value also appears for scores 4 and 3 (29% in total), showing that all these alternatives are considered important. For alternative A7, we see the dominance of either a strongly negative (−5) or the neutral rating (0). Experts from different stakeholder categories also gave the same weight in the score assignment stage. The column vector for each alternative is shown in Table 4.

One clear result emerges from this analysis: All experts gave the lowest score to the A7 alternative (no action), in line with the academics’ suggestion that action is needed. Moreover, the A7 column vector always has negative values. However, all 54 combinations of the remaining six alternatives and the nine criteria result in a positive score. In particular, alternative A6 (sustainability awareness and



education) and alternative A5 (energy community) excel on four (including C8) and three (including C4 and C7) criteria respectively. Looking specifically at the five criteria that account for 80% of the total weight, alternative A2 (zero-emission lodges) excels on criterion C6, and alternative A4 (vehicle access restriction) on criterion C9.

At this point, the sustainability score is calculated by multiplying the row vector by the column vector (Table 5) to construct a ranking among the different alternatives. However, for robustness, we also consider an alternative scenario in which the weights are not assigned by the AHP but are all given the same weight (Table 6). Thus, in contrast to the baseline scenario, there is no difference of 0.145 between criterion C4 and C1, and both have a weight of 0.111.

The results of these rankings are similar for some alternatives, but also reveal significant differences. For example, in the alternative scenario, where the criteria are not assigned specific weights, alternative A6 ranks first. Interestingly, the same alternative ranks fourth in the baseline scenario where the criteria are weighted. The difference in terms of value (3.19 vs. 3.29) is minimal. In this context, it is useful to analyse the results of the decomposition analysis (Figures S1, S2). In the alternative scenario, alternative A6 (sustainability awareness and education) scores highest in four of the nine criteria: C1, C2, C5, and C8. This result conveys a profound and meaningful message, emphasising the urgent need to instil a deep sense of respect and environmental awareness in every individual on our planet and to take action to benefit the environment. The lesson is that the environment and its resources, which currently provide essential global benefits, may not always remain in the same state or provide the same benefits.

TABLE 4 Aggregation of expert values (column vector).

	A1	A2	A3	A4	A5	A6	A7
C1	1.70	2.60	1.90	0.10	2.40	3.90	-0.70
C2	3.20	3.40	3.00	2.80	3.10	3.50	-3.90
C3	0.20	1.20	1.40	1.00	2.20	1.10	-0.90
C4	4.00	3.90	3.80	0.90	4.30	3.50	-2.20
C5	3.20	3.20	2.80	0.50	1.60	3.50	-2.20
C6	3.30	3.50	3.00	1.70	3.00	3.40	-3.00
C7	3.20	3.00	3.40	1.30	3.60	2.30	-1.80
C8	3.40	3.10	2.60	2.90	3.60	3.70	-4.50
C9	4.30	4.40	4.20	4.50	4.00	3.80	-4.50

Note:  Max value;  Min value.

Alternative	Name	Value	Ranking
A2	Zero-emission lodges	3.42	1
A5	Energy community	3.41	2
A1	Zero-emission ski lifts	3.37	3
A6	Sustainability awareness and education	3.29	4
A3	Transport community	3.22	5
A4	Vehicle access restriction	1.95	6
A7	No action	-2.96	7

TABLE 5 Sustainability score—baseline scenario.

This particular alternative, which focuses on education and promoting sustainability, can be viewed as a long-term commitment. A society with a deep understanding of sustainable practices will inevitably cultivate an informed population that will act on these principles over time. For non-academic experts and those closely involved in mountain life, sustainable education and awareness are key to the long-term conservation of these areas. The academic perspective, with its different weighting of the criteria, leads to a change in the top ranking. A more pragmatic approach seems to emerge, evaluating what is currently within reach. They also have a practical mindset, focusing on solving problems in the shortest possible time. For this reason, A2 (zero-emission lodges), A5 (energy community), and A1 (zero-emission ski lifts) take the top three rankings, as these are the most immediate and effective solutions available. In particular, criterion C4, which emerged as the most relevant, achieves a very high performance result when combined with alternative A5. The same applies to criterion C7. Similarly, the other most relevant criteria allow the other alternatives to achieve high scores: criterion C6 for alternative A2, and criterion C9 for alternative A4.

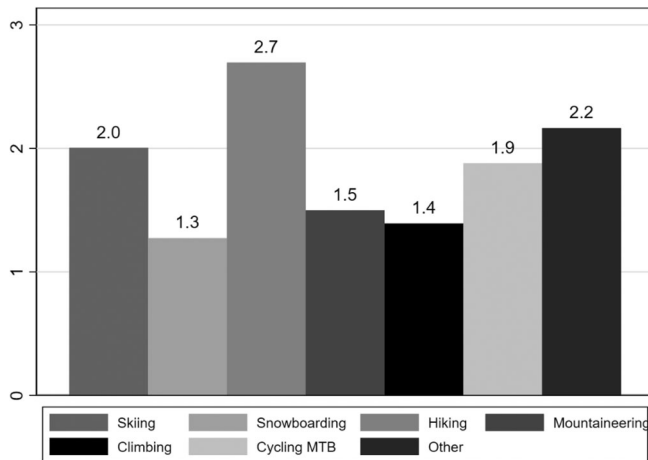
The numerical value of the alternative scenario, which equalises all the values of the alternatives, leads to their general reduction. However, the range between the first and the fifth place is 0.2, with alternative A2 leading the way with 3.42, just ahead of alternative A5 (3.41), followed by alternatives A1 (3.37), A6 (3.29), and A3 (3.22). In the alternative scenario, the range is 0.29, so it seems that all these alternatives are not seen as conflicting but rather as individual components of a sustainable strategy for mountain resorts. The aspect of restricting vehicle access (alternative A4) does not receive a positive response. Finally, the last figure to be highlighted is the negative score given to alternative A7, as the static choice of doing nothing, of not taking action, is considered not only a weaker strategy but also detrimental to stakeholder interests. As mentioned, chalets and lodges are still heavily dependent on fossil fuels and need to be supported in the transition process.

3.2 | Consumer evaluations and opinions on sustainability in mountain areas

As mentioned above, the question on habits related to mountain activities was useful to divide the sample into the following categories:

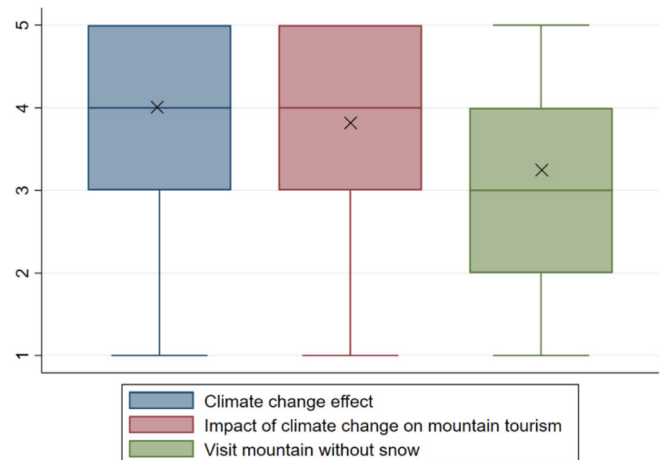
TABLE 6 Sustainability score—alternative scenario.

Alternative	Name	Value	Δ Value	R (kg)	ΔR (kg)
A6	Sustainability awareness and education	3.19	-0.10	1	+3
A2	Zero-emission lodges	3.14	-0.28	2	-1
A5	Energy community	3.09	-0.32	3	-1
A1	Zero-emission ski lifts	2.94	-0.43	4	-1
A3	Transport community	2.90	-0.32	5	0
A4	Vehicle access restriction	1.74	-0.21	6	0
A7	No action	-2.67	+0.29	7	0

**FIGURE 1** Average responses to the question “How often do you practice the following sports?”.

1. Mountaineers: those who practice mountain sports or activities and/or often visit mountain areas (63.8% of the total sample).
2. Non-mountaineers: those who neither practice mountain sports nor frequently visit mountain resorts (36.2% of the total sample).

Only mountaineers answered the questions included in the second section of the questionnaire. The Apennines and the Alps offer a vast number of ski resorts with many slopes and unique landscapes, although the majority of the 300 Italian ski resorts are located mainly in the northern regions. In the first question, respondent were asked to rate, on a Likert-type scale from 1 (never) to 5 (very often), how often they practiced each of the following sports: skiing, snowboarding, hiking, mountaineering, climbing, cycling/MTB, or other activities (Figure 1). Hiking is the most common activity (average 2.7). In contrast, activities such as mountaineering (1.5), climbing (1.4), and snowboarding (1.3) received low scores. Skiing slightly outweighs cycling/MTB (2.0 vs. 1.9). This leaves room for two possible interpretations. On the one hand, activities like cycling or hiking are not influenced by seasonality. On the other hand, as snow disappears, mountain biking may become a popular alternative to skiing in the mountains. This suggests that mountains are no longer just associated with skiing, and that cycling needs to be promoted by providing suitable bike trails for those who practice this activity. A good example is the Dolomiti Bike Galaxy project. Another example is the Abruzzo Bike Tour project,

**FIGURE 2** Average answers to the questions: “Did you notice changes in the climate and/or snow conditions in the mountain resorts you visit?” (blue box); “How worried are you about the impact of climate change on winter tourism and on your use of these places?” (red box), and “How likely are you to continue visiting the mountains in winter even if there is no snow?” (green box). The horizontal lines represent the median values, and x the mean values.

which makes it possible to go from the mountains to the sea and at the same time promotes seasonal adjustment.

When asked specifically about the factors that motivate people to go to the mountains, those related to pleasure (77.5%) predominate, but passion (51%) and hobby (38%) are also important. The responses to a specific question on whether mountaineers consider the environmental impact of their activities, show that 57.5% do care, 27% only sometimes, and the remaining 15% do not care at all. We also asked three other questions to assess respondents' concerns and opinions about the impact of climate change on mountain activities. Again, respondents were asked to express their opinion on a 5-point scale. As shown in Figure 2, respondents indicated that they would go to the mountains even if there was no snow (3.3), confirming that people's perceptions of mountains are changing and attracting other activities besides skiing. Respondents are well aware of the impact of climate change on mountain resorts (3.8) and expressed their concern about the future of winter tourism (4.0). We can conclude that mountaineers enjoy visiting these areas, even though they are aware of the risks associated with the effects of climate change. This could be a

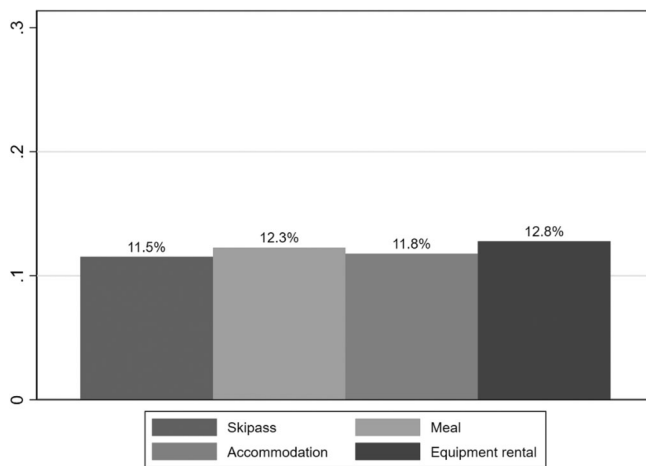


FIGURE 3 Average willingness to pay for the four alternatives to mitigate the impact of climate change on mountain tourism: (1) a contribution added to the ski pass (11.5%); (2) a contribution added to the cost of a meal (12.3%); (3) a surcharge on accommodation (11.8%); (4) promoting equipment rental to encourage its reuse/recycling and recovery (12.8%).

wake-up call for business models to take appropriate measures to mitigate the potential impact on consumer demand for mountain sports.

In order to help decision-makers deal with the negative effects of climate change on mountain activities, respondents were asked to quantify whether and how much they would be willing to pay for some specific interventions. Indeed, as mentioned, mountain tourism includes a wide range of activities, such as hiking, mountain biking, and climbing, but also restaurants and cultural events. For this reason, the alternatives proposed were: (1) a contribution added to the ski pass; (2) a contribution added to the cost of a meal; (3) a surcharge on accommodation; and (4) promoting equipment rental to encourage its reuse/recycling and recovery. The four alternatives were revised according to the suggestions of the two experts in order to consolidate the heterogeneity of proposals. On average, respondents expressed the same willingness to pay (WTP) for the four alternatives, and thus valued their impact equally. Although the mean WTP values shown in Figure 3 are not significantly different (ANOVA: $F(3, 855) = 0.521, p = .668$), we discuss each in detail below.

1. A contribution added to the ski pass would act as an emission reduction levy on ski lifts. A carbon offsetting strategy could be used where the revenue from this levy is invested in alternative projects that offset emissions (e.g., planting trees in deforested areas). Alternatively, lift emissions could be reduced through the use of renewable energy or energy efficiency measures. The (average) additional WTP is around 11%, the lowest of the four options. This choice may also be influenced by the recent increase in the cost of ski passes.
2. The contribution added to the cost of a meal could help to convert lodges to zero-emission or consider converting lodges to reduce energy waste and/or use green sources, but without generating green economy rebound phenomena. In addition, this option

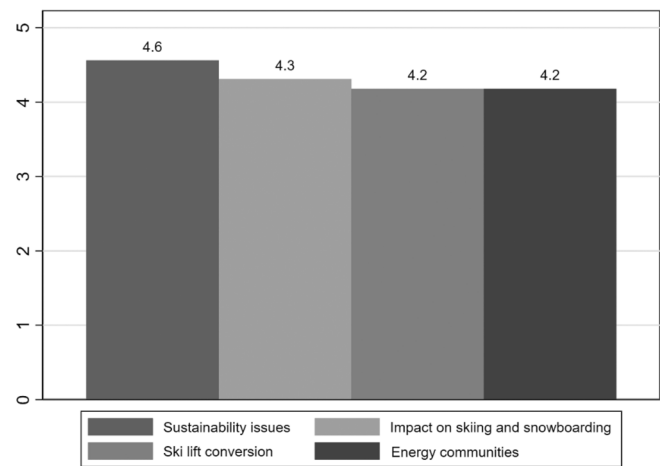


FIGURE 4 Average answers to the following questions: “How important do you think it is to give priority and importance to environmental sustainability (conservation of natural resources and the ecosystem for future generations) in mountain communities?” (4.6); “Do you think that climate change could soon have a (negative) effect on sports such as skiing and snowboarding?” (4.3); “How relevant do you think energy conversion (renewable energy) of ski lifts is?” (4.2); “How relevant do you consider the establishment of (renewable) mountain-level energy communities (synergy between neighbouring communities)?” (4.2).

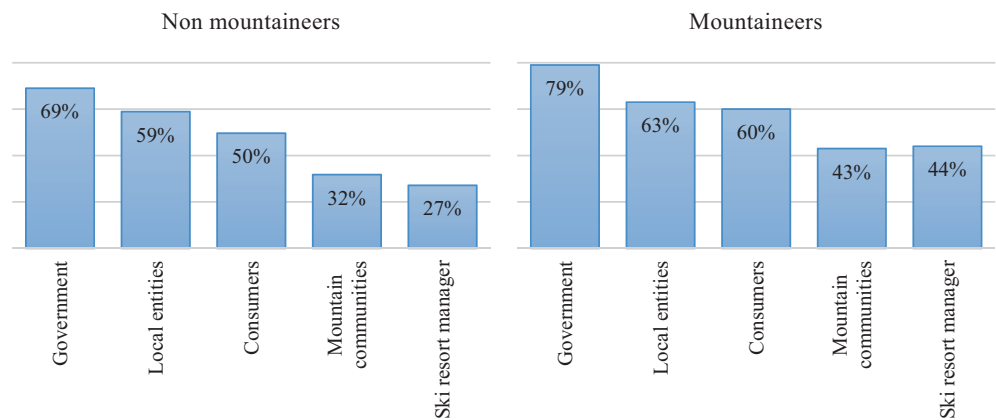
requires an increase in waste collection to support circular economy models. In this case, the average WTP is 12%, thus similar to the previous option, but generates less revenue, since meals are a small part of the total expenditure.

3. A surcharge on accommodation, applicable only to zero-impact certified facilities, has an average WTP of 12%. This would encourage accommodation providers to pursue sustainable goals, with potential added value recognised by consumers. This levy could finance the use of green and circular technologies and put consumers at a crossroads: choosing sustainable accommodation, even if more expensive, or canonical accommodation that is not modernised to fight climate change. In this case, the cost of an overnight stay changes significantly depending on the time of year.
4. Promoting equipment rental to encourage its reuse/recycling and recovery can ensure less reliance on exorbitant investment in new equipment and encourage the proper disposal of old equipment. This option received the highest WTP, with an average of around 13%. The issue of transparency is crucial, so that stakeholders are informed about where the levy is going and how it is being used. The value of this option is closely linked to the equipment used.

These four proposals, although different, require a contribution that consumers would pay and entrepreneurs would reinvest in their facilities to modernise them. However, the costs may be too high, and while there is a willingness to adopt green and circular technologies, this may not be feasible without government intervention.

In the third section of the questionnaire, we sought to assess the sustainability concerns of both mountaineers and non-mountaineers

FIGURE 5 Answers to the question: “Who should take action to address the impact of climate change?” (multiple answers allowed).



through Likert-type scale questions. The issue of sustainability is widely recognised as very important in mountain resorts, with around 65% of respondents emphasising this aspect. Indeed, the average score of 4.6 is the highest (Figure 4). Considering that 60% of the sample is at least 28 years old, this shows a widespread awareness of the problem and a collective recognition of the deteriorating state of the environment. However, the other questions also received high scores. The energy crisis that has hit Europe (including Italy, a country heavily dependent on energy imports) has led many companies to close or propose significant price increases. As climate change has a negative impact on skiing/snowboarding (4.3), renewables are key to counteracting this phenomenon by promoting the green energy conversion of ski lifts (4.2). In this respect, mountain-level energy communities (4.2) are an opportunity not to be missed.

A degree of non-choice emerges in the question where ski resorts were asked whether they were implementing solutions to counter climate change, as the overwhelming majority of the sample answered neither positively nor negatively (84%). For the final questions in the third section of the questionnaire, we deemed it useful to break them down into the two analysis groups in order to assess any differences. Central government (75%) followed by local government (61%) are seen as the entities that should take action on climate change (Figure 5). In this context, the NextGenerationEU (NGEU) projects appear to be relevant, as they can be implemented consistently and strengthen the image of a Made in Italy that links the ski industry to mountain tourism, without neglecting the fundamental role of religious tourism, cultural realities, and Italian food. Indeed, the mountaineers group attached increasing importance to all stakeholder categories considered. This finding can be explained by the fact that this group pays more attention to a place they are used to visit and therefore do not want to lose this privilege. Consumers, on the other hand, feel responsible for this change (56%) and attribute less importance to mountain communities (39%) and ski resort managers (38%).

As the WTP question could have led to a non-indicative result, the third section of the questionnaire proposed alternative solutions to promote sustainable mountain tourism but without attaching an economic value. Although multiple answers were allowed, consumers clearly indicated their priorities (Figure 6). In this case, the action considered most relevant is zero-emission ski lifts (61%), followed by

improving the energy efficiency of mountain dwellings (54%). Thus, in line with the previous questions, the issue of energy is seen as fundamental to the sustainable transition of mountain resorts. The issue of waste is considered less relevant (36%). The transport issue shows, as before, that accessibility can be improved through sustainable collective transport (e.g., by rail) with around 40%, while low scores were obtained both for car-free locations (28%) and the use of hybrid vehicles (25%). This issue illustrates that the transition to electric vehicles, which are potentially sustainable only under certain conditions (D'Adamo, Gastaldi et al., 2023b), has not yet fully convinced Italian consumers. On this question too, the mountaineers group shows higher scores, with the exception of the demand for hybrid/electric vehicles.

The questionnaire then asked a specific question about ski lifts in the absence of snow. Only 12% of respondents were in favour of dismantling them, but surprisingly, the mountaineers were more in favour than the non-mountaineers (Figure 7). The only reason we could identify is that a proportion of respondents see the change as a given, and knowing that they will have to give up this activity, have changed their interest/hobby. Conversion is supported by 65% of respondents, and almost half (46%) believe that the energy conversion of such facilities is feasible.

An additional aim of this study is to provide policy implications. Therefore, we proposed four different interventions, again validated and improved in the pre-survey by the two experts. The statistical test confirms that there is a difference between the groups based on the Kruskal-Wallis test ($\chi^2 = 19.66$, $p < .001$). The post-hoc Dunn's test, with a Bonferroni-corrected alpha of 0.0083, indicates that the mean rank of the following groups are statistically different: (1) “non-repayable loan for ski resort management” and “financing the conversion of facilities”, and (2) “expanding infrastructure to reach mountain areas” and “rewarding consumers for choosing a certified zero-emission area”. In contrast, there is no significant difference between the two mountaineers and non-mountaineers groups for each of the four policy proposals (Figure 8).

1. Funding for managers received the lowest score of 3.1. While the intervention may provide relief to those who own these assets, respondents are unlikely to see its usefulness in the future, as such

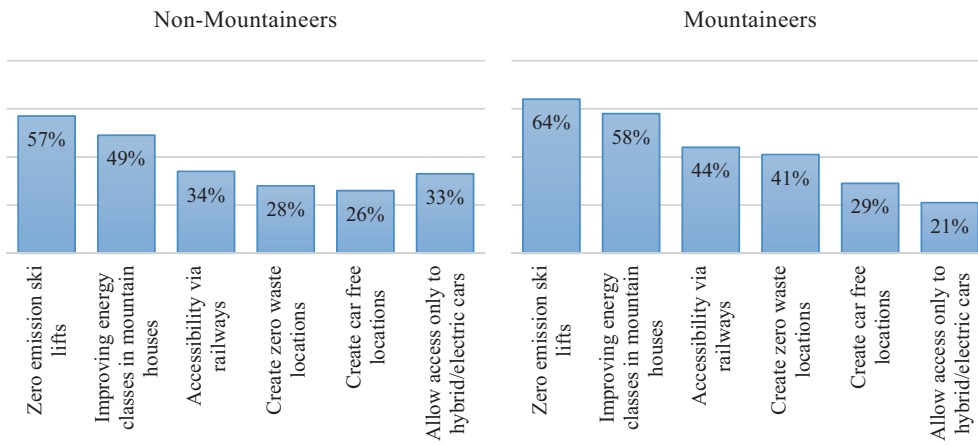


FIGURE 6 Answers to the question: “How do you think sustainable tourism (low environmental impact and its protection) can be promoted at the mountain level?” (multiple answers allowed).

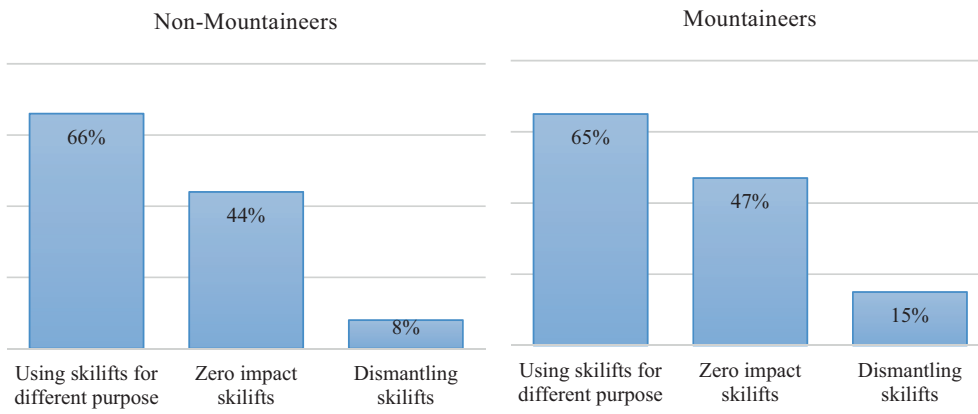


FIGURE 7 Answers to the question “In a future scenario, where there is no snow on our mountains, how could existing ski-lifts be converted?” (multiple answers allowed).

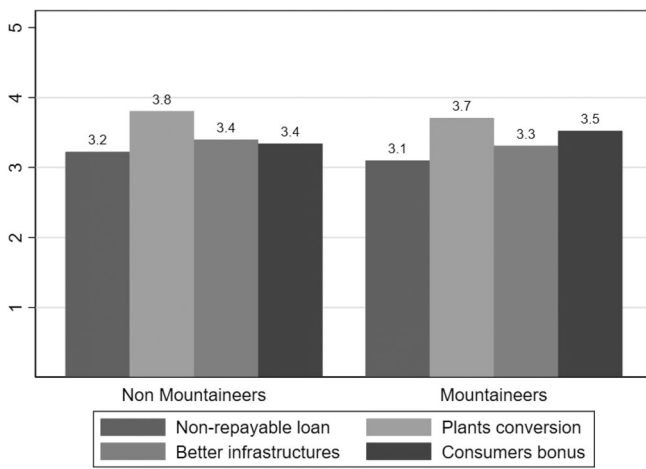


FIGURE 8 Average willingness to pay for the proposed interventions: (i) “non-repayable loan for ski resort management” (non-repayable loan); (ii) “Financing the conversion of facilities” (ski lift conversion); (iii) financing the conversion of facilities” (better infrastructure); (iv) “Rewarding consumers for choosing a certified zero-emission area” (consumers rewards).

- Financing the conversion of facilities is the proposal that received the highest score of 3.7, confirming that public intervention to support sustainable transition in this sector is useful, but it is desirable to support investments that have a spill-over effect both in terms of employment and restarting supply chain production.
- Expanding infrastructure to reach mountain areas confirms the results of the previous questions with a score of 3.3, thus considered a useful measure, but not of strategic importance. It can be assumed that consumers believe that the level of emissions depends mainly on on-site activities and not on supporting activities.
- Rewarding consumers for choosing a certified zero-emission area obtained a score of 3.5. This intervention, which affects consumers personally, shows their vision is not only focused on their own interests. This initiative could offset the higher costs associated with investments in converting facilities and transit housing by not burdening consumers and indirectly supporting entrepreneurs.

interventions could be used to offset higher costs due to external factors (e.g., commodity price inflation) and not for interventions that look to the future.

4 | DISCUSSION

This study continues a line of research combining different methodological approaches in order to propose useful management and policy implications for stakeholders (D’Adamo, Gastaldi, et al., 2023b;

D'Adamo, Gastaldi, Piccioni et al. 2023c). The perspectives of the different stakeholders involved in this study confirm the findings in the literature on the important role of mountain biodiversity in achieving the SDGs (Makino et al., 2020). This study shows that the pursuit of SDG 15 can have a positive impact on SDG 7, SDG 12, and SDG 13, and therefore needs to be monitored and managed (Ali et al., 2023; Allen et al., 2021). Sustainable development also requires the contribution of mountain tourism (Huan & Zhu, 2023; Zhang et al., 2023).

However, interventions are needed to achieve these goals (Grêt-Regamey & Weibel, 2020). To provide a comprehensive picture, we highlight some of the observations that emerged from our open-ended questions: 1) improving the transport system to and from mountain resorts, but from an energy sustainability perspective; 2) raising public awareness and education; 3) developing energy community models; and 4) creating plastic-free zones in ski resorts. There are also ideas for combining policy measures. For example, 40% could be allocated to financing the conversion of facilities, 40% to reward consumers for choosing a certified ski area, and 20% for transport measures that reduce the use of private cars. Green policies can reduce public distrust towards the energy-intensive economy (Caferra et al., 2021).

In particular, our study tends not to propose funding, because from a public spending perspective, it is necessary to ensure the money is reinvested in the economic system. Central and local governments are called upon to take mutually consistent steps (Melnykovich et al., 2018). Similarly, specific interventions are envisaged, as the consumer analysis shows that the needs of mountain tourists can be diverse, and a differentiation strategy should therefore be pursued (Cholakova & Dogramadjieva, 2023). In this sense, cooperation between different territorial realities can make it possible to seize opportunities and deseasonalise the sector. The depopulation of these areas in favour of large urban centres has two very negative effects. The first is the serious risk of losing historicity and therefore the uniqueness of some traditions, while the second is related to the maintenance work that typically takes place where people live. Therefore, in the case of some natural disasters, not taking care of the environment would cause greater damage. However, science communication is called upon to provide answers to current problems (Steiger et al., 2022), and the methodological contribution of this work supports the literature (Fontana et al., 2023). MCDA is a strategic tool for selecting the best alternatives by evaluating different contributions. The results of this work, considering different options, suggest that change in this regard is complex because it requires multiple interventions. From a managerial perspective, consumer analyses are essential (Yang et al., 2023), but need to be calibrated with other stakeholders (Ebner et al., 2022). The issue of green product development concerns businesses (Mariani et al., 2023; Miroshnychenko & De Massis, 2022), but also the service level (Loizia et al., 2021; Streimikiene et al., 2021). For businesses, this study provides two types of guidance. First, it suggests the strategy for implementing green and circular practices, for which there appears to be a WTP. However, this has to be verified in the actual purchasing decision. It is

clear that the need for contact with nature and stress reduction has increased as a result of the pandemic. There is, therefore, potential in this direction, as this aspect emerges in both consumer groups considered in this study. Second, it suggests assessing which aspects should be given more attention. Here, the results show that it is essential to attract customers with different alternatives to those that have characterised mountain tourism in recent years. Flexibility of choice, integration between different activities, and respect for the environment seem to appeal.

For example, the issue of stakeholder engagement, which emerges as the most relevant criterion, highlights the need not only to involve stakeholders but also to emphasise the skills and resources of the territory. In this respect, a decisive push for green and circular investments is needed, as well as the involvement of young people in entrepreneurial activities. Without young people and their ideas, the market may not have a future because it will not be able to understand their needs.

5 | CONCLUSIONS

Using a multidisciplinary approach, this study provides answers to the important question of the role of mountains in sustainable tourism. RO1 aimed to evaluate sustainable strategies in mountain resorts, and the results show that the panel of academic experts gave greater weight to the stakeholder engagement criterion, followed by ecosystem innovation, which can support decisions that also take into account economic opportunities and environmental improvement. These data, combined with those from non-academic experts (ski resort managers, mountaineers, mountain lodge managers, and tour operators) identify zero-emission huts as the best performing alternative. However, energy communities and zero-emission ski lifts also obtained very relevant scores. When the contribution of academic experts is excluded, the most important alternative is sustainability awareness and education. This shows that the perspective changes according to the categories of stakeholders involved in the decision-making process.

RO2 studied the opinions and choices of consumers with regard to sustainability issues in mountain resorts. It should be noted that our sample, with an average age of 40, tends to be dominated by mountain and/or sports enthusiasts (64%). Focusing only initially on those who visit the mountains, their WTP for the following actions included: (1) contribution added to the ski pass; (2) contribution added to the cost of a meal; (3) surcharge on accommodation; and (4) promoting equipment rental to incentivise reuse/recycling and recovery. However, the differences between these measures are not taken into account, with a WTP of 11%–13% compared to the baseline. This highlights the first limitation of our study, where it might be useful to conduct a field experiment and assess the real differences.

There is also a strong focus on the environmental sustainability issues in mountain resorts as places that need to be preserved, and this finding emerges from both mountaineers and non-mountaineers. National policymakers are seen as the most relevant to address the

sustainability issues, followed by local policymakers and consumers. Zero-emission ski lifts are considered the most appropriate measure, followed by improving the energy class of mountain dwellings, indicating that this complex issue cannot be solved by a single action.

Finally, the two groups (mountaineer and non-mountaineer) tend not to differ on the policy proposals to be implemented:

1. Financing the conversion of lifts
2. Rewarding consumers for choosing a certified ski area
3. Transport initiatives to reduce the use of private cars

This constitutes the second limitation of our study, as such proposals could be studied from an economic perspective to optimise the cost–benefit analysis. Expert panels could also include policymakers, and their involvement alongside other stakeholders could lead to different results. However, one outcome is clear: there is a growing focus on sustainability and a common desire to safeguard mountain landscapes. Sustainable tourism can be the driving force behind a nation that welcomes tourists from all over the world and aims to demonstrate the opportunities that new generations, not just local ones, can have by investing in the sector. In addition, tourism should enhance the specific characteristics of the territory, adopting a pragmatic approach to sustainability. Preserving nature doesn't result from non-intervention but rather from adopting practices and actions that support its integrity and promote a growing appreciation of its benefits for human health among citizens.

AUTHOR CONTRIBUTIONS

All authors equally participated in the definition and writing of this paper.

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CONFLICT OF INTEREST STATEMENT

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.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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