Article

Development and Validation of a Questionnaire for Assessing Sustainability in Sporting Events in Natural Areas: A Mixed Approach with Qualitative Validation and Preliminary Quantitative Analysis

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ABSTRACT

This study presents the development and validation of a questionnaire to measure sustainability in the organization of sports events in natural areas. The research was structured into three studies: (i) item generation and validation (ii) pre-testing, and (iii) preliminary reliability assessment. In Study 1, items were generated based on a literature review. A panel of experts evaluated the items to ensure their content validity. In Study 2, cognitive interviews were conducted with sports event organizers to assess the clarity and understanding of the items. In Study 3, a preliminary reliability analysis was carried out to evaluate the internal consistency of the questionnaire. The final result was the validation of 44 items across 7 dimensions. These items were classified into non-mandatory items validated in the qualitative process and non-mandatory items validated in the quantitative process. The questionnaire provides a useful tool for event organizers to assess and improve their sustainability practices.

KEYWORDS: sustainability; sports events; natural areas; event organizers; validation questionnaire

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ABBREVIATIONS (IF ANY)

IOC, international olympic committee; IUCN, union for conservation of nature; CVR, content validity ratio; CVI, content validity index; SDGs, United nations' sustainable development goals

INTRODUCTION

In recent decades, the growing social demand for sports activities in natural areas has led to an increase in the popularity of sports events in such environments [1]. These areas, endowed with natural resources—both fauna and flora—have become essential resources for leisure and

recreation, attracting a wide variety of participants engaging in diverse nature-based activities [2]. The opportunity to practice sports in these unique settings, often offering more favorable conditions than urban environments, further enhances their appeal [3]. However, the rising popularity of these events also presents significant challenges, as such activities can threaten the authenticity, natural landscapes, and visual appeal of these environments [4].

Sports events held in protected natural areas, in particular, can have a greater environmental impact due to their higher ecological and carbon footprint, necessitating careful consideration in their planning and organization [5]. Additionally, these events can generate complex social, economic and ecological repercussions, underscoring the urgent need for effective resource management [6]. Sustainable management practices are crucial for mitigating negative impacts and generating positive outcomes for wildlife and their habitats [2]. Sustainability in the organization of sports events provides strategies and practices that ensure the protection of environmental resources while promoting mutual benefits for all involved [3].

Given the need to improve monitoring and measurement of sustainable practices, it is critical to assess the extent to which sports event organizers integrate sustainability into their planning [7]. To guide these events towards positive outcomes, it is essential to focus on strategic elements during the planning and organization stages, especially in outdoor sports events, which are particularly ecologically sensitive [8,9].

The present study aims to development and validate a proposed set of sustainability items, materialized in a questionnaire directed at sports event organizers in natural areas. This questionnaire will enable the identification of the level of sustainability in the organization of these events and provide key tools to improve their management, thus addressing the specific challenges posed by hosting sports activities in natural environments.

Literature Review

Sustainable Development of Sports Events in Natural Areas

Numerous international organizations have led the development of sustainability in sports events, initiating actions to mitigate their negative impacts. Since the 1994 Winter Olympics in Lillehammer, held partially in a natural environment and recognized as the first “Green Games,” the IOC has established sustainability as a central pillar. This is reflected in key documents such as the Olympic Movement’s Agenda 21 in 1999, Agenda 2020 in 2014, and its successor 2020 + 5 in 2021 [10,11].

Furthermore, the IOC has explicitly aligned its strategic vision with the SDGs. This was reaffirmed through the Olympism365 programme, which highlights how sport can act as an enabler for sustainable development. The IOC has identified ten SDGs as directly relevant to the Olympic

Movement: good health and well-being (SDG 3), quality education (SDG 4), gender equality (SDG 5), decent work and economic growth (SDG 8), reduced inequalities (SDG 10), sustainable cities and communities (SDG 11), responsible consumption and production (SDG 12), climate action (SDG 13), peace, justice and strong institutions (SDG 16), and partnerships for the goals (SDG 17) [12]. These initiatives, have led to an integration of sustainable practices in sports events in natural areas, providing frameworks and guidelines for a greener future in the sports field.

Organizations dedicated to nature conservation, such as the International Union for Conservation of Nature (IUCN), have also developed various strategies and collaborative programs with sports organizations. In alignment with this, the IUCN has created a guide to help sports event organizers understand potential impacts on biodiversity and offers options to mitigate these impacts [13]. Furthermore, under the United Nations Environment Programme (2022), a manual has been developed to inspire and innovate through case studies of best sustainable practices in sports events.

In this context, sustainable development is essential for natural areas; however, the lack of awareness regarding the sensitivity of these areas limits the development of a green economy. Therefore, adapting activities to the specific conditions of these areas is vital for their effective functioning [14,15].

Assessment of Sustainability in Sports Events in Natural Areas

Sustainability assessments in sports events held in natural environments emphasize the importance of considering environmental, social, and economic aspects. However, implementing these assessments is complex, and their measurement often proves challenging. For example, the 2014 World Orienteering Championship in Italy, as analyzed by [16], applied a mixed-method approach to measure the event's sustainability. This method integrated the EBI 2012 (Italian acronym for "Low Impact Events") tool to quantitatively calculate environmental impacts, along with a qualitative analysis of the activities implemented during the event's planning and management. Similarly, the Wales Rally Great Britain, part of the 2004 World Rally Championship in the United Kingdom, employed a methodology focused on analyzing both the environmental and economic impacts of the event. It applied environmental accounting techniques to estimate carbon emissions and industrial waste [17].

In addition to these case studies, a study by [18] aimed to develop and validate a research instrument based on the SDGs. Administered among event organizers in Flanders, Belgium, the survey revealed significant discrepancies between the social, economic, and environmental dimensions of sustainability, emphasizing the need for more holistic approaches to event planning. This is further supported by the study of the 2013 Tour of Qinghai Lake in China, conducted by [19], who used the Importance-Performance Analysis (IPA) methodology to identify five key

sustainability factors: legacy planning, resource consumption reduction, health and education, policies and principles, and monitoring processes. Their research suggested improvements in each of these areas to achieve more sustainable and responsible development of sports events.

At the level of mega-events like the Winter Olympics, sustainability is particularly critical due to the reliance on natural environments for their execution [20]. In this context, the study by [21] analyzed the measures taken during the planning, promotion, marketing, and operation of the Winter Olympics in Lillehammer 1994 and Beijing 2022. The study demonstrated that it is indeed possible to organize mega sports events sustainably in natural settings by adopting advanced technologies and strict environmental protection policies. These examples, across different contexts and methodologies, highlight the diverse ways sustainability can be integrated into event planning, from local events to large-scale international competitions.

Challenges in Sustainable Management in the Organization of Sports Events in Natural Areas

Achieving sustainable management of sports events in natural areas faces significant challenges. These include the direct environmental impact from the construction and operation of facilities [22], waste management generated during events [23], sustainable use of resources such as water and energy [24], carbon emissions from transportation [25], and the direct impact on natural resources, such as ecosystem alteration and biodiversity loss due to human intervention in sensitive areas [26]. Moreover, social and economic pressures on local communities arise [27], along with the inherent need to promote environmental education and awareness [28] and to adapt to variable climatic conditions [29]. To address these challenges, it is essential to adopt a comprehensive approach that balances the needs of environmental conservation with the development of sports events, ensuring that sustainability is a central pillar in the planning and execution of these activities.

GENERAL APPROACH

To develop and validate a questionnaire to measure the level of sustainability in the organization of sports events in natural areas, a sequential multi-study approach is structured. This approach optimizes each stage of the process and addresses specific objectives according to the various sample profiles, as outlined by [30].

A total of three studies were conducted, organized into six phases. The first study included three phases, the second study two phases, and the third study one phase (see Figure 1). This methodology enables a focus on the specific characteristics of each group involved—organizers, experts, and the target population—integrating their perspectives into the development of a contextually relevant measurement tool.

The following sections briefly outline the purpose of each study, offering an overview of the questionnaire development process:

Study 1: Item Generation and Content Validation

The first study focused on developing an initial set of items aimed at capturing the various aspects of sustainability in sports events held in natural areas and assessing its content validity. Sustainability was addressed through three fundamental dimensions: social, economic, and environmental [31]. In Phase 1, to ensure content validity, a scoping review of existing literature on sustainability and sports events in natural settings was conducted, identifying key items for each dimension. In Phase 2, a panel of 10 experts from fields related to the organization of sports events in natural environments evaluated these items. This expert panel assessed the clarity, relevance, and feasibility of each item, allowing for refinement and content validation of the preliminary questionnaire. In Phase 3, the authors developed a discussion on the experts' responses and recommendations.

Study 2: Pre-Test through Cognitive Surveys with the Target Population

The second study aimed to assess the target population's understanding of the items, composed of organizers of sports events in natural areas. That is, to provide evidence concerning the validity related to the response process [32].

In Phase 4, through cognitive interviews, the study identified how participants interpreted and responded to the questionnaire items. This stage was crucial for identifying potential comprehension issues and ensuring that the questions were consistently interpreted by the organizers. In Phase 5, adjustments to the questionnaire were made based on the feedback received.

Study 3: Preliminary Evaluation of the Scale (Pilot Study)

In Phase 6, taking into account the small size of the target population, this study focused on conducting a preliminary reliability analysis of the questionnaire, by assessing the internal consistency of the dimensions of the questionnaire. This step is crucial for determining the initial robustness of the scale and providing preliminary data on its suitability in the specific context of organizing sports events in natural areas.

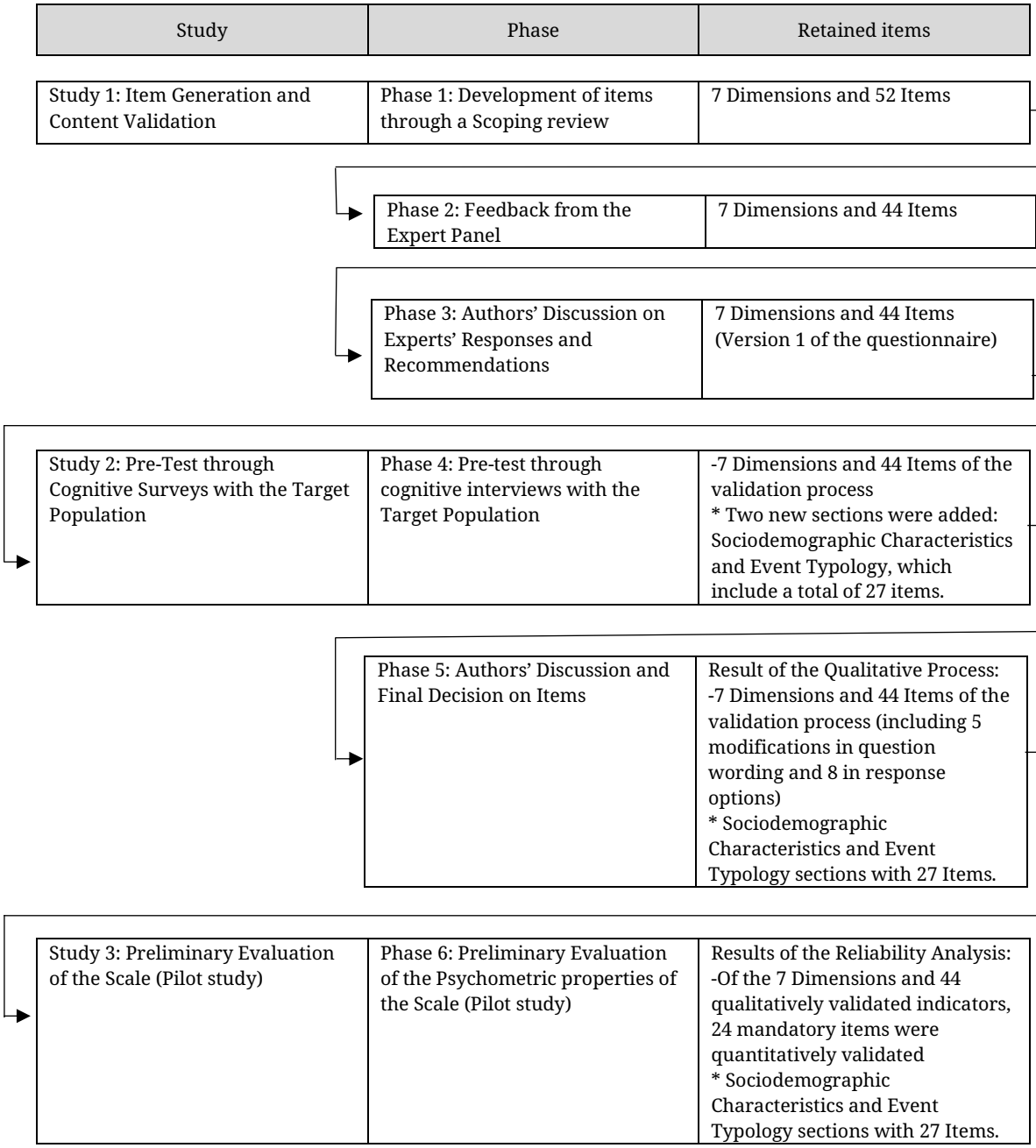

Figure 1. Description of the overall process followed in this the research. *: These sections are not part of the validation study results; they were added as complementary information to the questionnaire.

Next, the details of Study 1 will be presented, including its methodology and results, followed by a similar approach for Studies 2 and 3. Finally, the discussions and general conclusions for all three studies will be presented.

STUDIES ON THE QUESTIONNAIRE VALIDATION PROCESS

Study 1. Item Generation and Content Validation

The purpose of Study 1, which included three phases (see Figure 1), was to develop an initial set of items designed to capture the various aspects of sustainability in sports events held in natural areas. This involved defining specific social, economic, and environmental items for the questionnaire,

bearing in mind that, among the many definitions of sustainability, most agree that, to achieve sustainability, economic actions must respect the environment and be socially equitable [31]. Once the initial set of items was developed through a scoping review, content validity evidence was sought through a panel of expert academics who reviewed the related items.

Methodology Study I

Participants

This study involved two groups: the authors and a panel of 10 experts from various sectors related to sporting events in natural settings. In Phase 1, the authors conducted the scoping review. In Phase 2, the experts assessed the content validity of the initial item derivation. The panel, with ages between 37 and 63 and 7 to 30 years of experience, included specialists in event organization, biology, sport sciences, and park management (Table 1). In Phase 3, the authors refined the content based on expert feedback.

Table 1. Characteristics of the experts.

Gender	Age	Area of Expertise	Years of Experience
Male	63	Event Organizer	22
Male	51	Biologist	30
Male	52	Biologist	30
Male	38	Proffesional in Sports and Physical Activity Sciences	13
Male	40	Proffesional in Sports and Physical Activity Sciences	15
Male	42	Proffesional in Sports and Physical Activity Sciences	15
Female	37	Participant in Sporting Events in Natural Areas	7
Male	40	Participant in Sporting Events in Natural Areas	12
Male	46	Natural Park Administrator	23
Male	60	Manager of an Institution Dedicated to the Conservation of Protected Areas	30

Procedure

To ensure content validity, a preliminary scoping review of the existing literature on sustainability and sports events in natural settings was conducted. This review provided the foundation for identifying key items for each dimension. It was previously published by [33], and presented general analyses that informed the initial item development process. However, in the current study, a more detailed analysis was carried out, specifically related to detailed items, which were not included in the original publication.

In Phase 1, the authors developed the items by applying a theoretical criterion based on previous literature [34], and using a deductive approach. A scoping review and evaluation of existing scales [35] were conducted to identify relevant items in the environmental and socioeconomic areas, where the latter refers to the social and economic dimensions of sustainability. The lead researcher initially carried out the identification of items, followed by a review by the team to ensure

accuracy and consistency. Subsequently, an initial categorization was proposed and discussed in group meetings for further adjustments.

In Phase 2, an expert panel reviewed and refined the selected items, evaluating them for clarity, relevance, and feasibility on a scale from 1 to 5. Experts also indicated whether each item should be included and provided comments. The CVR was used to assess the responses, with a CVR above 0.62 indicating inclusion, as per [36] criterion. Items with a CVR below 0.62 were considered for modification or removal. The CVI was used to assess relevance, with [37] recommending modification or removal of items with a CVI below 0.78. Mean and standard deviation were calculated to guide item adjustments. These content validity processes are essential for instrument development and must be reported with the same rigor as other validation types [38].

In Phase 3, the authors reviewed the experts' comments and suggestions, discussed the items, and reached a consensus, leading to the development of version 1 of the questionnaire.

Results Study I

Phase 1. Development of Items through a Scoping Review

The development of the sustainability questionnaire began with a scoping review of existing literature, which led to the initial identification of sustainability items across broad environmental and socioeconomic areas. However, as the questionnaire progressed, these areas needed further refinement to more accurately capture specific components of sustainability [33]. Initially, 15 dimensions and 82 items were identified, categorized into 10 environmental and 5 socioeconomic dimensions (Table 2). This approach followed the recommendations of [39,40], who suggest that the initial item list should be at least twice the length of the desired final scale.

After this, comprehension criteria were applied, with each author individually reviewing each item. Items were then selected by majority consensus, focusing on those that best represented the construct (theoretical criteria) and were clearly worded (comprehension criteria). The items were then analyzed and selected based on majority consensus. This process led to the removal of two environmental dimensions (Permits and Event Oversight, and Environmental Certifications) and the reassignment of four items to the Event Planning and Design dimension. Further adjustments included reducing the number of items across several dimensions, such as Waste Minimization and Responsible Consumption (from 15 to 12 items) and Mobility and Transport (from 8 to 7 items), while expanding the Event Environmental Assessment dimension (from 1 to 2 items). In the socioeconomic domain, items were reduced from 25 to 18, with one dimension eliminated and another merged into Event Planning and Design. By the end of this process, the total number of dimensions was reduced to 12, with 66 items.

Following discussions in the first meeting, it was decided to collectively review the grouping, selection, and elimination of each item in order to further streamline the dimensions, eliminate redundancies, and improve the wording. This led to the reduction of the 12 dimensions to 9, with a total of 54 items. For example, the dimension "Event Planning and Design" was renamed "Event Typology and General Planning," and dimensions such as "Waste Minimization," "Responsible Consumption," and "Mobility and Transport" were consolidated into a single dimension with 6 items. Items previously allocated to separate dimensions, such as "Environmental and Social Evaluation," were merged into a single dimension with 3 items.

After six additional revisions in follow-up meetings, the final questionnaire consisted of 7 dimensions and 52 items (Table 2). Several dimensions were merged and renamed to improve coherence and framework effectiveness. For instance, Communication and Collaboration with Entities was renamed Communication and Strategic Partnership Building, now comprising 8 items. Additionally, the dimensions Energy Consumption and Carbon Footprint Compensation were integrated into one, with 5 items. Finally, the Environmental and Social Evaluation dimension expanded from 3 to 5 items, offering a more detailed approach.

Table 2. Evolution of dimensions and items-study I.

Study 1 Phase 1		**Study 1 Phase 2 and 3**	
Start	**Finish**	**Start**	**Finish**
15 Dimensions and 82 Items	**7 Dimensions and 52 Items**	**7 Dimensions and 52 Items**	**7 Dimensions and 44 Items**
1. Event Planning and Design (6 items)	1. Environmental Event Planning and Design (13 items)	1. Environmental Event Planning and Design (13 items)	1. Environmental Event Design (12 items)
2. Event Permits and Oversight (2 items)	2. Social Event Planning and Design (8 items)	2. Social Event Planning and Design (8 items)	2. Social Event Planning and Design (5 items)
3.Environmental Certifications (2 items)	3. Waste Minimization and Responsible Consumption (7 items)	3. Waste Minimization and Responsible Consumption (7 items)	3. Waste Minimization and Responsible Consumption (7 items)
4. Waste Minimization and Responsible Consumption (15 items)	4. Mobility and Transport (6 items)	4. Mobility and Transport (6 items)	4. Mobility and Transport (5 items)
5. Mobility and Transport (8 items)	5. Communication and Strategic Partnership Building (8 items)	5. Communication and Strategic Partnership Building (8 items)	5. Communication and Strategic Partnership Building (6 items)
6. Communication (9 items)	6. Energy Consumption and Carbon Footprint Compensation (5 items)	6. Energy Consumption and Carbon Footprint Compensation (5 items)	6. Energy Consumption and Carbon Footprint Compensation (5 items)
7. Protection of Fragile Areas (3 items)	7. Environmental and Social Event Assessment (5 items)	7. Environmental and Social Event Assessment (5 items)	7. Environmental and Social Event Assessment (4 items)
8. Energy Consumption (5 items)	-	-	-
9. Carbon Footprint Compensation (3 items)	-	-	-
10. Event Environmental Assessment (1 item)	-	-	-
11. Event Planning and Design (6 items)	-	-	-
12. Collaboration with Entities (8 items)	-	-	-
13. Regulatory Processes and Policy (2 items)	-	-	-
14. Education, Values, and Territory (4 items)	-	-	-

15. Social Event Assessment (5 items)	-	-	-

Phase 2 and 3. Expert Panel Feedback and Authors' Discussion of Responses and Recommendations

The evaluation of the selection of items was conducted by a panel of 10 experts, although typically between 5 and 7 experts are used. Increasing the number of experts, however, has been shown to enhance the robustness of scoring [35,41]. In both this stage and the subsequent author analysis in the Phase 3, certain items were modified or eliminated based on CVI and CVR values. For the CVI analysis, experts rated each item on a Likert scale from 1 to 5, assessing clarity, relevance, and feasibility. For the CVR analysis, the experts' binary responses were reviewed to determine whether each item should be included in the model (Table 3).

The following dimensions are presented with the corresponding modifications made based on the expert panel feedback and subsequent author discussion, with the following modifications made based on the CVI values first, followed by the CVR values (Table 3):

Dimension of Environmental Event Planning and Design:

i) Item 5, due to its ratings in relevance and feasibility (0.6), was reformulated as 'Prioritization of holding most event trials during daylight hours according to different routes and/or paths.'
ii) Item 6, based on its CVI scores in clarity (0.3), relevance, and feasibility (0.7), was modified to 'Implementation of actions to control the dissemination of the route and/or path.'
iii) Item 10, was changed to 'Compliance with environmental permits and/or authorizations from forest landowners when the route or path passes through areas requiring such permissions,' based on its feasibility score (0.6).
iv) Item 13, was adjusted to provide a clearer example, due to its feasibility rating (0.6), to 'Provision of specific environmental certification for sports event organization, such as the sustainable sports event seal from the COE, UNE-ISO 20121, ISO 14064, or Green Sport Flag'.
v) Item 7, based on the CVR value (0.4), was modified to 'Existence of a conservation values protocol addressing foreseeable natural impacts on water courses, flora, or fauna,' as general feedback suggested that this item could be implicitly covered by the first item in this dimension, 'Provision of an environmental protocol.'
vi) Item 11, despite its low CVR value (0.4, well below the accepted level), was not eliminated. Instead, it was completely reformulated for better clarity, based on its CVI clarity score (0.4). The revised item now reads: "Existence of regulations regarding participants' sports equipment that may impact the environment".

Dimension of Social Event Planning and Design:

i) Item 3, was revised due to its clarity score (0.4) and was rephrased as follows: 'Existence of a legacy plan for the local community that considers a social, sporting, or environmental legacy.'
ii) Item 8, was adjusted due to its CVI clarity score (0.6) and now reads as 'Existence of actions aimed at promoting one or more of the 17 SDGs,' with examples provided related to sporting events in natural areas that address these 17 goals.
iii) Item 2, was moved to Dimension 1 due to its CVR value (0.4) and expert feedback, which indicated that it was more closely related to the environmental domain. The original item, 'Compliance with regulations and legislative aspects, if required,' was thus reassigned to better reflect its relevance.
iv) Item 6, 'Inclusion of people with disabilities across different levels' (CVR 0.4), were removed. Expert comments indicated that these aspects were already embedded in Item 8, which addresses the promotion of SDGs during the event.
v) Item 7, 'Promotion of female participation at various levels' (CVR 0.6), were removed. Expert comments also indicated that these aspects were already embedded in Item 8, which addresses the promotion of SDGs during the event.

Dimension of Waste Minimization and Responsible Consumption:

i) Items 6, "Existence of measures prioritizing biodegradable products" (feasibility score: 0.6), and 7, "Existence of biodegradable materials in route signage" (feasibility score: 0.7), were combined. This decision was made following expert feedback indicating that both items referred to the same concept, resulting in a single item: "Existence of measures prioritizing biodegradable products." Additionally, based on expert comments, examples were added to all items within this dimension, and a new item was introduced: "Management of immediate cleanup of waste and/or event-specific materials."

Dimension of Mobility and Transport:

i) Item 5, was modified based on the viability (0.7) from "Existence of measures to promote the use of public transport" to "Existence of initiatives to encourage access to the event using transportation methods with lower environmental impact."
ii) Item 4, based on a CVR rating of 0.6, was eliminated and integrated into the newly revised Item 5: "Existence of measures to promote the use of electric transportation."

Dimension of Communication and Strategic Partnership Development:

i) Item 4, was modified based on the CVI rating (0.4) for viability, changing from "Existence of workshops on sustainable education and awareness for the local community and/or spectators" to "Existence of environmental awareness actions for the local community or accompanying participants."

ii) Item 7, “Involvement of private entities, whether for profit or not” (CVR 0.2), was eliminated, as its aspects are implicitly covered in the SDG item within the Event Planning and Social Design dimension.
iii) Item 8, “Involvement of public entities” (CVR 0.4), was eliminated, as its aspects are implicitly covered in the SDG item within the Event Planning and Social Design dimension.

Dimension of Energy Consumption and Carbon Footprint Compensation:

i) Item 1, it was decided to clarify (CVI 0.7 for clarity and viability) by changing its wording from “Existence of an energy consumption management plan” to “Existence of an energy consumption management plan in the event organization.” Additionally, it was considered beneficial to integrate examples across all items based on expert feedback for enhanced clarity.
ii) Item 3, (CVR 0.4), was not eliminated but rather significantly revised. The wording was changed from ‘Existence of a final evaluation report with the carbon footprint of the event’ to ‘Availability of a system for monitoring at least one carbon footprint item (direct emissions produced by activities under the direct control of the event organization).’

Dimension of Environmental and Social Evaluation of the Event:

i) Item 1, was revised due to its CVI clarity value (0.6). The wording was changed from “Existence of self-assessment items for the event” to “Existence of sustainable self-assessment items for the event concerning water conservation, local flora, and fauna.”

Table 3. CVR and CVI values of modified items.

Ítems	CVR	CVI Clarity	CVI Relevance	CVI Viability
Environmental Planning and Design				
5. Prioritization of holding the event during daytime according to the different routes.	0.6	0.8	0.6	0.6
6. Implementation of concrete actions aimed at controlling the dissemination of the route and/or its responsible use.	0.6	0.3	0.7	0.7
7. Existence of a conservation values protocol in conjunction with the management of the protected or unprotected natural area.	0.4	0.5	0.7	0.7
10. Existence of compliance with environmental permits and/or authorizations from owners of forested land (if required).	0.6	0.9	0.8	0.6
11. Existence of measures to regulate the sporting equipment of participants that may affect the environment.	0.4	0.4	0.7	0.6
13. Availability of specific environmental certification for the organization of sporting events.	0.6	0.9	0.8	0.6
Social Planning and Design of the Event				
2. Compliance with regulations and legislative aspects, if required.	0.4	0.5	0.7	0.6
3. Existence of a legacy plan in the local community.	0.6	0.4	0.8	0.8
6. Inclusion of people with disabilities within the different levels.	0.4	1.0	0.7	0.6
7. Promotion of female participation at different levels.	0.6	1.0	0.8	0.8
8. Existence of actions linked to the development of the SDGs.	0.6	0.6	0.9	0.7
Minimization of waste and responsible consumption				
6. Existence of measures to prioritize biodegradable products.	0.8	0.9	0.9	0.6

7. Existence of biodegradable materials in the signage of routes.	1.0	1.0	1.0	0.7
Mobility and Transport				
4. Existence of measures to promote the use of electric transport.	0.6	0.9	0.5	0.3
5. Existence of measures to promote the use of public transport.	0.8	0.9	0.9	0.7
Communication and Strategic Partnership Development				
4. Existence of workshops on sustainable education and awareness for the local community and/or spectators.	0.2	0.9	0.7	0.5
7. Involvement of private entities, whether for profit or non-profit.	0.2	0.7	0.7	0.6
8. Involvement of public entities.	0.4	0.8	0.7	0.9
Energy Consumption and Carbon Footprint Compensation				
1. Existence of an energy consumption management plan.	0.6	0.7	0.9	0.7
3. Existence of a final evaluation report with the carbon footprint of the event.	0.4	0.9	0.7	0.5
Environmental and Social Evaluation				
1. Existence of self-assessment items for the event.	1.0	0.6	0.9	0.8

As a result of Phase 2 of the expert evaluation and Phase 3 of the expert panel analysis conducted by the authors and Study 1, the 7 Dimensions were retained, and the number of items was reduced from fifty-two to 44 (Table 2).

Study 2. Item Generation and Content Validation

The purpose of Study 2, which included two phases (see Figure 1), was to evaluate the comprehension of the items by the target population, consisting of event organizers, through conducting interviews to test the understanding of the questionnaire and individual items, ensuring clarity and relevance for the intended respondents.

The questionnaire evaluated was the outcome of Study 1, consisting of 7 dimensions and 44 items, each with its corresponding question. Additionally, two new data points were integrated:

- Sociodemographic Characteristics of the Organizer
- Typology of the Sports Event

These additions provide essential context to understand the background of respondents, their organizations, and the specific event, ensuring more accurate interpretation of the responses. Since these data points are straightforward and do not require expert validation, they were incorporated directly into the questionnaire without the need for further expert review.

Methodology Study 2

Participants

In Phase 4, the tests were conducted with 8 event organizers from diverse sociodemographic backgrounds and different types of organizations. They were asked to respond based on an event organized in 2023. This approach provided information on various sports modalities and the scope of events held in Catalonia (local, regional, national, or international) (Table 4). In Phase 5, the authors participated in the "Authors' Discussion and Final Decision on Items" phase.

Table 4. Main characteristics of the respondent, the organization, and the event.

Gender	Age	Rol Organization	Years in the Organization	Legal Status of the Organization	Scope of the Event	Event Modality
Male	51	Event Planning and Coordination	30	Non-profit Private	Regional	Nordic Walking
Male	62	Event Planning and Coordination	24	For-profit Private	Regional	Orienteering Races
Female	51	Event Planning and Coordination	10	Non-profit Private	Regional	Trail Running
Male	53	Event Planning and Coordination	14	For-profit Private	International	Trail Running
Male	61	Event Planning and Coordination	13	Non-profit Private	National	Trail Running
Male	46	Event Planning and Coordination	15	Public	Local	Hiking
Female	45	Event Planning and Coordination	8	For-profit Private	International	Skiing
Male	69	Event Planning and Coordination	15	Non-profit Private	International	Mountain Biking

Procedure

To conduct this, in Phase 4, organizers were asked in individual interviews to verbalize the cognitive process they followed when responding to the questions. One author was present to offer support and guidance during this process. This approach allowed us to determine whether they understood the items and if their responses reflected their experience [35]. Participants were given the opportunity to provide feedback and suggestions while answering each question, if deemed relevant. At the end of the questionnaire, they were allowed to offer general feedback.

In Phase 5, following the completion of the 8 interviews, the authors conducted a detailed analysis of the collected information, following the recommendations of [42] in their article on cognitive interviewing practice. According to [43], this process often involves using a small sample of subjects to detect potential issues with the wording of items, which is a form of preliminary qualitative validation that ensures the clarity of the items and that the instrument measures what it is intended to measure. The analysis process included the following steps. The analysis process included the following steps:

(1) Comprehension Assessment: The clarity of each item was evaluated based on participants' responses and feedback.
(2) Incorporation of Suggestions: Participants' suggestions were categorized and analyzed to determine their relevance and applicability. Recommendations for rephrasing questions and adding response options were considered.
(3) Questionnaire Modification: Based on the findings, specific changes were made to the wording of certain questions to enhance clarity and precision. Additional response options were included in certain items to better capture the variety of experiences and situations reported by the organizers.

(4) Review: The revised version of the questionnaire was reviewed by the authors and preliminarily validated to ensure that the implemented changes effectively improved the instrument.

These steps ensured that the questionnaire became clearer and more relevant, facilitating better comprehension.

Results Study 2

Phase 4. Pre-Test through Cognitive Interviews with the Target Population

In the Phase 4, the 8 participating event organizers—a sample size within the ideal parameters for a pre-test [42,44], demonstrated an excellent understanding of the questionnaire items. All participants understood the questions as intended and were able to respond based on their experience. No significant confusion was reported for any of the questions.

Feedback reflected a positive perception of the questionnaire's clarity and structure. For example, some participants noted: "The questionnaire is very well structured" and "The questions are clear and straightforward." Additionally, several organizers highlighted that the wording of the items facilitated reflection and responses based on their experience, suggesting that the questionnaire effectively captured the desired information.

Phase 5. Authors' Discussion and Final Decision on Items

The suggestions provided by event organizers primarily aimed at further improving the clarity of the questions and ensuring that the response options were appropriate—two advantages of conducting interviews with the target population, as identified by other authors [35,45].

The suggestions mainly centered on refining the wording of the questions and expanding the response options to better capture the nuances of the organizers' experiences. For example, additional response options were added to questions about impact reduction plans, safety measures, and sustainability practices. In some cases, questions were reworded to focus on the dissemination of information, such as the event routes, to ensure more accurate responses (Table 5).

After analyzing these suggestions, the authors made specific changes to the questionnaire. This decision was based on the understanding that analyzing these interviews and implementing strategies are crucial steps for developing instruments and validating their content [46]. These changes were essential for refining the instrument, enhancing its clarity, and improving its ability to capture the intended data, ultimately contributing to its overall validity and reliability (Table 5).

Table 5. Modifications to the questionnaire based on organizers' suggestions.

Original Question	Suggestion	Modified Question	Original Answer Options	Modified Response Options
1.11: 'Regarding the origin of participants, indicate the predominant impact of your organization's sports events.'	It was recommended to use the term "target audience" instead of "predominant impact"	Regarding the origin of participants, what is the target audience of your organization's sports events?	Not applicable	Not applicable
1.13: "How many people work permanently in the organization?"	It was suggested to specify the question to "employees" and clarify "in the organization of sports events."	What is the number of employees permanently dedicated to organizing sports events within the company?	Not applicable	Not applicable
2.3: "Indicate the main objective of the sports event."	Include questions about the second and third objectives, as sporting events often have multiple goals.	What is the most important objective of the sports event? Please select Objective 1, that is, the primary objective in terms of importance. (Same to Objective 2 and 3)	Not applicable	Not applicable
3.1: 'Did the sports event have a plan or measures to reduce the impact on the territory?'	Add additional options to reflect different plan implementation scenarios.	Not applicable	(i) Yes (ii) No	(i) Yes, a plan was available; (ii) Yes, a plan was available but not implemented; (iii) No plan was available, but measures were in place; (iv) No plan was available
4.1: "Did the organization implement a preventive, reactive, evacuation, and continuity plan or measures to ensure the safety of participants and spectators?"	Add additional options to reflect different plan implementation scenarios.	Not applicable	(i) Yes (ii) No	(i) Yes, a plan was available; (ii) Yes, a plan was available but not implemented; (iii) No plan was available, but measures were in place; (iv) No plan was available
4.2: "Did the organization establish a plan or legacy measures for the local community?"	Add additional options to reflect different plan implementation scenarios.	Not applicable	(i) Yes (ii) No	(i) Yes, a plan was available; (ii) Yes, a plan was available but not implemented; (iii) No plan was available, but measures were in place; (iv) No plan was available.
5.1: "Did the sports event have a plan or measures for the management of product use and/or consumption?"	Add additional options to reflect different plan implementation scenarios.	Not applicable	(i) Yes (ii) No	(i) Yes, a plan was available; (ii) Yes, a plan was available but not implemented; (iii) No plan was available, but measures were in place; (iv) No plan was available
6.1: "Did the sports event have a plan or measures to rationalize transportation?"	Add additional options to reflect different plan implementation scenarios.	Not applicable	(i) Yes (ii) No	(i) Yes, a plan was available; (ii) Yes, a plan was available but not implemented; (iii) No plan was available, but measures were in place; (iv) No plan was available

7.1: "Did the organization implement a communication plan or measures focused on sustainability?"	Add additional options to reflect different plan implementation scenarios.	Not applicable	(i) Yes (ii) No	(i) Yes, a plan was available; (ii) Yes, a plan was available but not implemented; (iii) No plan was available, but measures were in place; (iv) No plan was available
8.1: "Did the organization implement an energy consumption management plan or measures?"	Add additional options to reflect different plan implementation scenarios.	Not applicable	(i) Yes (ii) No	(i) Yes, a plan was available; (ii) Yes, a plan was available but not implemented; (iii) No plan was available, but measures were in place; (iv) No plan was available.
9.2: "Did the organization implement a restoration or maintenance plan or measures?"	Add additional options to reflect different plan implementation scenarios.	Not applicable	(i) Yes (ii) No	(i) Yes, a plan was available; (ii) Yes, a plan was available but not implemented; (iii) No plan was available, but measures were in place; (iv) No plan was available

Regarding the general comments on the questionnaire, they can be divided into 5 main points:

1. Clarity of the Questionnaire: Participants found the questionnaire clear and well-structured.
2. Differentiation of Event Objectives: It was suggested to differentiate between competitive sports events and other types of sports events.
3. Studies Conducted: Various studies conducted in sports events were mentioned, including: impacts on watercourses, effects on flora and fauna, noise impact, amount of waste generated per person, and assessment of waste reduction measures.
4. Sustainability: Emphasis was placed on the importance of sustainability, highlighting the need to minimize environmental impacts, promote economic development, and benefit local communities. Sustainability was considered a central objective in the organization of sports events.
5. Others: The need for easier access to park administrations for event organization was noted.

As a result of the qualitative analysis, a total of 44 items and 7 dimensions from the previous two studies were validated, along with the data points: Sociodemographic Characteristics of the Organizer and Typology of the Sports Event, which include 27 additional items (Table 6). Of the 44 qualitatively validated items, 20 will be classified as non-mandatory and 24 as mandatory. The latter will be validated through a reliability test in the next study (Study 3), as they meet the dichotomous nature of the questions required for this type of analysis. The mandatory and non-mandatory items for each dimension are detailed in Table 7, where they are presented reorganized according to their initial area, allowing for a more detailed analysis in the type of test in Study 3. The items have been written in a clear and straightforward manner, without

examples; however, in Appendix A, the items with the examples provided to the organizer as they appeared in the questionnaire are included.

Table 6. Evolution of dimensions and items—study II and III.

Study 2—Phases 4 and 5 (Completion of Qualitative Study)		**Study 3—Phase 6 (Preliminary Quantitative Study)**		
Start	**Finish**	**Start**		**Finish**
7 Dimensions and 44 Items	-7 Dimensions and 44 Items qualitatively validated * Sociodemographic Characteristics and Event Typology with 27 Items	-7 Dimensions and 44 Items qualitatively validated * Sociodemographic Characteristics and Event Typology with 27 Items	-2 Areas Environmental (14 items) Socioeconomic (10 items)	-7 Dimensions and 24 Items quantitatively validated * Sociodemographic Characteristics and Event Typology with 27 Items
1. Environmental Design of the Event (12 Items)	1. Environmental Design of the Event (12 Items)	1. Environmental Design of the Event (12 Items)		1. Environmental Design of the Event (5 Items)
2. Social Planning and Design of the Event (5 Items)	2. Social Planning and Design of the Event (5 Items)	2. Social Planning and Design of the Event (5 Items)		2. Social Planning and Design of the Event (- Items)
3. Waste Minimization and Responsible Consumption (7 Items)	3. Waste Minimization and Responsible Consumption (7 Items)	3. Waste Minimization and Responsible Consumption (7 Items)		3. Waste Minimization and Responsible Consumption (6 Items)
4. Mobility and Transportation (5 Items)	4. Mobility and Transportation (5 Items)	4. Mobility and Transportation (5 Items)		4. Mobility and Transportation (1 Items)
5. Communication and Strategic Partnership Development (6 Items)	5. Communication and Strategic Partnership Development (6 Items)	5. Communication and Strategic Partnership Development (6 Items)		5. Communication and Strategic Partnership Development (5 Items)
6. Energy Consumption and Carbon Footprint Compensation (5 Items)	6. Energy Consumption and Carbon Footprint Compensation (5 Items)	6. Energy Consumption and Carbon Footprint Compensation (5 Items)		6. Energy Consumption and Carbon Footprint Compensation (4 Items)
7. Environmental and Social Evaluation of the Event (4 Items)	7. Environmental and Social Evaluation of the Event (4 Items)	7. Environmental and Social Evaluation of the Event (4 Items)		7. Environmental and Social Evaluation of the Event (3 Items)

Table 7. Classification of mandatory and non-mandatory items.

Dimension	**Non-Mandatory Items (*n* = 20)**	**Mandatory Items (Validated through a Reliability Test) (*n* = 24)**
Design and Planning of Environmental Aspects	-Did the sports event have a plan or measures to reduce its impact on the territory? -How many routes of the sports event were held at night? -From your point of view, was the organization aware of the environmental regulations specific to the territory where the sports event took place? -If the sports event took place in a protected natural area, was the organization aware of the required environmental permits and authorizations? -If the route crossed private properties, was the organization aware of the necessary environmental permits and authorizations? -If the sports equipment had an impact on the environment, did the organization regulate the use of this equipment? -If the route crossed fragile areas, areas of high conservation value, with rich flora and fauna, did the organization provide participants with information about the location of these areas?	-Did the sports event have measures to reduce noise pollution? -Did the sports event have measures to reduce light pollution? -Before the competition, were the routes publicly disclosed? -Did the sports event have competition rules and penalties aimed at promoting environmental care? -Does the sports event have any environmental certification?

Design and Planning of Social Aspects	-Did the organization implement a plan or preventive, reactive, evacuation, and continuity measures to ensure the safety of participants and spectators? -Did the organization establish a legacy plan or measures for the local community? -Did the organization try to hire workers from the local community? -Did the organization offer the local community the opportunity to participate as volunteers in the sports event? -If actions were taken to promote any of the SDGs, select those that were addressed in the sports event	
Minimization of Waste and Responsible Consumption	-Did the sports event have a plan or measures for managing the use and/or consumption of products?	-Did the organization implement actions to reduce product consumption? -Did the organization recycle? -Did the organization reuse products? -Did the organization prioritize the consumption of local products? -Did the organization prioritize the use of biodegradable products? -After the sports event, did the organization clean up and remove the waste from the area where the event took place?
Mobility and Transport	-Did the sports event have a plan or measures to rationalize travel? -If the route crossed fragile areas, areas of high conservation value, with rich flora and fauna, did the organization implement actions to control access and the movement of participants? -If the route crossed fragile areas, areas of high conservation value, with rich flora and fauna, did the organization implement actions to control access and the movement of spectators? -Did the organization designate vehicle parking areas?	-Did the organization implement initiatives to minimize the impact of transportation?
Communication and Creation of Strategic Alliances	-Did the organization implement a plan or measures for communication oriented towards sustainability?	-Did the organization implement communication strategies prioritizing the use of minimal materials? -Did the organization promote the environmental values of the territory where the sports event took place? -Did the organization develop environmental awareness actions for the local community or participants' companions? -Did the organization promote sustainable actions for participants during the sports event? -Did the organization promote the sustainable actions implemented after the sports event?
Energy Consumption	-Did the organization implement a plan or measures for energy consumption management?	-Did the organization implement measures to reduce fossil energy use? -Did the organization have a system to track at least one Level 1 carbon footprint item? Level 1 carbon footprint refers to direct emissions produced by activities under the direct control of the sports event organization. -Did the organization implement compensatory measures to offset the carbon footprint of the sports event derived from energy consumption? -Did the organization allocate funds from the sports event to environmental causes or environmental conservation?

Environmental Assessment	-Did the organization implement a plan or measures for restoration or maintenance?	-Once the event was over, did the organization conduct a trail degradation assessment? -After the conclusion of the event, did the organization use strategies to assess the preservation of the environment? -Once the event was over, did the organization apply or implement any socio-environmental perception survey for the participants?

Study 3. Preliminary Evaluation of the Scale (Pilot Study)

As a result of the qualitative analysis in Study 2, a total of 44 items and 7 dimensions were validated, along with data points on the Sociodemographic Characteristics of the Organizer and the Typology of the Sports Event. Of the 44 qualitatively validated items, 20 are classified as non-mandatory and 24 as mandatory. These 24 items, selected for the reliability analysis, were designed with dichotomous responses to capture key aspects of sustainability that require clear, definitive answers, ensuring consistency and reliability in the data collected. The remaining items, validated in Study 2, were not included in the reliability analysis.

This study which included one phase (see Figure 1), aimed to assess the internal consistency of the questionnaire scales in measuring the theoretical constructs. To perform this analysis, the items were reorganized back into their initial broad areas (environmental and socioeconomic), rather than the more specific dimensions, to facilitate a clearer analysis of the overall reliability (Table 9).

Methodology Study 3

Participants

The sample in this study consisted of 101 organizers of sports events held in natural areas of Catalonia. Almost 90% of participants were men, with less than 15% being women and only a few identifying as non-binary or preferring not to disclose their gender. The majority of respondents were between 41 and 60 years old (66%), and had completed some level of university studies, including bachelor (31%), master's degree (28%) or doctoral degree. Over 90% of the participants had primary roles in event planning and coordination, with nearly half (44%) having more than 10 years of experience in the field (Table 8).

Table 8. Sociodemographic profile of event organizers.

Variable	Category	N	%
Gender	Male	86	85%
	Female	13	13%
	Non- binary	1	1%
	Prefer not to respond	1	1%
Age	20–30	4	4%
	31–40	15	15%
	41–50	34	34%
	51–60	33	33%
	Over 61	15	15%
Educational Level	Secondary education	42	42%

	University education	31	31%
	Master's degree	21	21%
	Doctoral degree	7	7%
Main Role	Planning and coordination	91	90%
	Others	10	10%
Years of experience	1–5	28	28%
	6–10	29	29%
	11–15	25	25%
	16–20	8	8%
	Over 21	11	11%

Procedure

To conduct this, the 24 mandatory items were reorganized into their initial broad areas (environmental and socioeconomic), rather than the more specific dimensions, in order to facilitate a clearer analysis of overall reliability. The specific items for each dimension can be found in the results section of each dimension.

In Phase 6, a non-probabilistic convenience sampling method was employed, with the inclusion criterion requiring participants to be organizers of sports events held in natural areas across Catalonia. A database of sports events in natural environments was compiled using data from the Runedia website, a pioneering platform for sports event information in Spain since 2007. Runedia consolidates details of sports events organized by autonomous communities, including contact information. Additionally, a search was conducted on Buscametas, another event database. It was noted that within a year, Runedia registered 31.65% more mountain races and hikes, further justifying the choice of this website for gathering event data.

It is important to clarify that the database contains 622 confirmed sports events, not organizers. These events, covering various sports disciplines such as trail running, mountain biking, orienteering, hiking, and Nordic walking, were confirmed by Runedia based on their scheduled dates. The database was further enriched with additional data retrieved from official sports federation websites.

According to [35], no universal criterion applies to all questionnaire development processes. Since a single organizer can manage multiple events, the sample size was determined based on the average number of events each organizer managed, which was 4.1 events per organizer, as indicated by survey responses. Dividing the 622 recorded events by this average number, the estimated number of organizers was approximately 151. To achieve a margin of error of 6%, it was calculated that at least 98 responses were needed. This margin was considered appropriate given that organizers may oversee multiple events and that there is no formal registry of sports event organizers in Catalonia. The final sample exceeded expectations, with 101 responses collected, surpassing the threshold necessary for the desired margin of error.

Data collection took place between February and August 2024. The survey was developed in both Catalan and Spanish and administered

online via the Kobotoolbox® platform to efficiently distribute the survey to the contacts in the established database. Informed consent was explicitly requested in the written introduction of the survey, which was sent by email to the participants. The introduction clearly outlined the purpose of the study, how the data would be used, and the participants' rights, including their right to confidentiality and voluntary participation. Consent was implicitly given when participants completed and submitted their responses. No minors or vulnerable groups were involved in this study.

Data analysis was performed using SPSS version X (IBM Corp., Armonk, NY, USA). A frequency descriptive analysis was conducted to better understand the distribution and response patterns across the 24 mandatory items. Additionally, a reliability analysis using the OMEGA coefficient was performed for these items. This test was chosen due to the sample size and the binary nature of the items. Since the sample was not randomly selected and organizers could manage several events, the OMEGA reliability test was deemed appropriate to assess the internal consistency of the items in the context of the study and the sample characteristics.

Results Study 3

Phase 6. Preliminary Evaluation of the Psychometric Properties of the Scale (Pilot Study)

The descriptive analysis of the Environmental Area revealed two key differences. First, with regard to initiatives aimed at minimizing transportation impacts, only 32.7% of organizers reported implementing measures, while 67.3% did not, indicating a significant gap in actions related to this crucial aspect of sustainability (Table 9). The second notable difference was in the adoption of measures to reduce light pollution. Here, 47.5% of organizers stated they had implemented such measures, while 52.5% had not, reflecting an almost equal split in the adoption of practices to mitigate this type of pollution (Table 9). Regarding the reliability of the Environmental Area and its 14 items, the results show an Omega coefficient of 0.73, indicating acceptable reliability (Table 9).

Table 9. Descriptive analysis of environmental sustainability measures in sporting events with reliability coefficient (OMEGA (ω = 0.73)).

Environmental Area Items (*n* = 14)	**Yes**		**No**	
	N	**%**	**N**	**%**
Did the sporting event have measures to reduce noise pollution?	60	59.4	41	40.6
Did the sporting event have measures to reduce light pollution?	48	47.5	53	52.5
Does the sporting event have any environmental certification?	16	15.8	91	90.1
Did the organization recycle?	96	95.5	5	5.0
Did the organization reuse products?	93	92.1	8	7.9
Did the organization prioritize the use of biodegradable products?	61	60.4	40	39.6
Once the sporting event was over, did the organization clean up and remove the waste from the area where the event took place?	99	98.9	2	2.0
Did the organization implement initiatives to minimize the impact of transportation?	33	32.7	68	67.3

Did the organization implement communication strategies prioritizing the use of minimal material?	93	92.1	8	7.9
Did the organization implement measures to reduce fossil energy use?	54	53.5	47	46.5
Did the organization have a system for tracking at least one level 1 carbon footprint item?	5	5.0	96	95.0
Did the organization implement compensatory measures to counteract the carbon footprint of the sporting event derived from energy consumption?	11	10.9	90	89.1
Once the event was finished, did the organization conduct an evaluation of trail degradation?	27	26.7	74	73.3
After the event concluded, did the organization use strategies to assess the preservation of the environment?	21	20.8	80	79.2

In the socioeconomic area, two significant differences emerged from the descriptive analysis. The first concerns the promotion of sustainable actions for participants during the event, with only 33.7% of organizers reporting the implementation of such actions, compared to 66.3% who did not (Table 10). Second, 55.4% of organizers applied rules and sanctions to encourage environmental care during the competition, with 44.6% not doing so, suggesting uneven prioritization of sustainability in the competitive setting (Table 10). The socioeconomic area, comprising 10 items, showed an Omega coefficient of 0.69, indicating acceptable reliability for this dimension (Table 10).

Table 10. Descriptive analysis of socioeconomic sustainability measures in sporting events with reliability coefficient (OMEGA (ω = 0.69)).

Socioeconomic Area Items (*n* = 10)	**Yes**		**No**	
	N	**%**	**N**	**%**
Before the competition, were the routes publicly communicated?	90	89.1	11	10.9
Did the sporting event have competition rules and sanctions aimed at promoting environmental care?	56	55.4	45	44.6
Did the organization implement actions to reduce product consumption?	86	85.1	15	14.9
Did the organization prioritize the consumption of local products (KM 0)?	94	93.1	7	6.9
Did the organization promote the environmental values of the area where the sporting event took place?	68	67.3	33	32.7
Did the organization implement environmental awareness actions for the local community or participants' companions?	24	23.8	77	76.2
Did the organization promote sustainable actions for participants during the sporting event?	34	33.7	67	66.3
Did the organization promote the sustainable actions implemented after the sporting event?	29	28.7	72	71.3
Did the organization allocate funds from the sporting event to environmental causes or conservation of the surroundings?	12	11.9	89	88.1
Once the event was over, did the organization apply or implement any socio-environmental perception survey to the participants?	17	16.8	84	83.2

As a final outcome of Study 3, the inclusion of the 14 items from the environmental area and the 10 items from the socioeconomic area as mandatory items is upheld, providing evidence of their reliability. The items for each dimension, within the areas, are presented in Table 6.

GENERAL DISCUSSION AND CONCLUSIONS

The main objective of this multi-study was to develop a reliable questionnaire to measure the level of sustainability in the organization of sports events in natural areas, aiming to provide evidence supporting its consistency. To achieve this, a qualitative validation process was implemented in the first two studies, validating 7 dimensions and 44 items qualitatively, and a preliminary reliability assessment was conducted in the third study, which included the validation of items classified as mandatory that met the dichotomous nature required for this test. The

final result was the preliminary quantitative validation of 24 items classified as mandatory and 20 non-mandatory items, the latter being validated in the qualitative process.

This multi-study validation approach can significantly enhance the robustness of results and conclusions, as highlighted by [47]. However, its use in sports management is uncommon, with most studies relying on traditional validation methods. For example, the study by [48] focused on factor analysis and reliability testing to assess perceived quality in women's football sports management, without using a multi-study approach. Similarly, [49] validated a questionnaire aimed at understanding the opinions of sports managers and facilitators, but without integrating multiple interrelated studies.

A more specific example related to this study is the work by [50], which employed the Delphi method to identify key indicators for assessing the impact of international sports events in Taiwan, also without a multi-study design. These examples highlight the rarity of multi-study approaches in sports management.

This study, which integrates qualitative processes and preliminary quantitative analysis, demonstrates the potential of this approach in strengthening the validation of instruments in the field.

This study used a multi-study approach combining qualitative and quantitative phases. Initially, items were selected through a scoping review, a method that helps map existing evidence and identify relevant areas, as noted by [51], These items were then refined through expert evaluation with 10 experts, improving the reliability of the process, as emphasized by [41]. Interviews were subsequently conducted to further refine the questionnaire, providing qualitative feedback to improve its design, as discussed by [52]. Finally, a preliminary quantitative validation was carried out to assess internal consistency, ensuring that the items accurately measure the intended construct, as highlighted by [53].

After completing the validation process, the second significant contribution of this study lies in the resulting dimensions and their respective items. The dimension with the highest number of items (7 non-mandatory and 5 mandatory) was Design and Environmental Planning, which covers key aspects such as implementing measures to comply with local environmental regulations, reducing noise and light pollution, and obtaining environmental certifications, among others. Environmental design and planning in sports events are crucial for minimizing environmental impact and promoting ecological awareness, as highlighted by [54]. In this regard, [55] points out that event organizers are gradually adopting more sustainable formats, aligning with environmental concerns and protections in event organization.

Another relevant dimension with 7 items in this study was Waste Minimization and Responsible Consumption (1 non-mandatory and 6 mandatory), focusing on reducing product consumption, promoting recycling and reuse, and prioritizing the use of local and biodegradable

products. These items align with the recommendations of [56], who present an effective waste management framework for sports events, detailing how to manage waste throughout the various stages of an event.

The dimension Communication and Strategic Alliance Creation, with 6 items (1 non-mandatory and 5 mandatory), was also crucial, as it incorporates communication plans centered on sustainability, promoting local environmental values, and implementing environmental awareness actions for the local community and participants. These communication aspects are becoming increasingly relevant. In fact, [57] developed an evaluation model for sustainability campaigns in sports, which measures the effectiveness of communication strategies in promoting sustainable behaviors during events and their long-term impact.

With 5 items (5 non-mandatory), we find the dimension Social Event Design and Planning, which includes measures to ensure the safety of participants, preventive and evacuation plans, as well as a legacy plan for the local community and the promotion of the SDGs during the event. This approach has been widely accepted, considering that sports can be an agent of social change and a means to measure and achieve the SDGs, as highlighted by [58] in their study on the contribution of sports to the SDGs.

The dimension Mobility and Transport, with 5 items (4 non-mandatory and 1 mandatory), addresses strategies for rationalizing travel and minimizing transportation impact in sports events, as well as regulating access to high-value conservation areas and designating parking zones. Ref. [59] confirms the relevance of this dimension in the questionnaire, as they discuss a mutually beneficial relationship between event sustainability and sustainable transport, demonstrating that implementing such measures can improve both the environmental and social sustainability of events while contributing to their economic viability.

At the same level in terms of the number of items (1 non-mandatory and 4 mandatory), we find the dimension Energy Consumption, which includes measures to reduce fossil energy use, track the direct carbon footprint of the event, offset emissions, and allocate funds to environmental causes. Tracking the carbon footprint is particularly relevant in this study, as [60] mention that sports contribute to climate change through carbon emissions. However, they also acknowledge the need to address gaps in carbon accounting tools, which makes this study an important step toward implementing these mitigation measures in the sports context.

Finally, with a reduced number of 4 items (1 non-mandatory and 3 mandatory), the dimension Environmental Assessment focuses on restoring the environment before, during, and after a sports event. This dimension includes evaluating trail degradation and implementing socio-environmental perception surveys. [61] highlights the importance of post-event assessments, as they allow measuring impacts on natural

environments and applying corrective measures to mitigate the negative effects of sports events in protected areas.

When comparing some validated tools related to the measurement of sustainability in sports events with this study, we find those [18], which constructs and validates a research instrument based on the SDGs, distributed across three dimensions: social, economic, and environmental, aimed at sports organizers in Belgium.

The study by [62], where the goal was to develop a measurement tool to help determine the degree of perceived social responsibility, understood as a specific aspect of sustainability, by residents at small- and medium-scale sports events, to guide sports managers in designing events focused on the dimensions of Sustainable Sports Activity, Social Cohesion, and Well-Being. Similarly, [50], which identifies appropriate indicators for assessing the impact of international sports events in Taiwan through the Delphi study, where four areas are identified: sporting, economic, social, and environmental.

These studies show both significant similarities and differences. The dimensions of Design and Environmental Planning and Waste Minimization and Responsible Consumption in this study align with the items of [18], who also advocate for waste management and sustainability. However, this study adopts a more specific approach to reducing pollution and obtaining environmental certifications, with a greater number of items. On the other hand, the study by [62], which focuses more on Corporate Social Responsibility, notably emphasizes local impact, which is also reflected in the Social Event Design dimension of this study, related to social cohesion and local pride.

The dimension Communication and Strategic Alliance Creation in this study shares similarities with [61], in terms of social inclusion and community development, but it differentiates itself by integrating more specific strategies to strengthen environmental awareness. Regarding environmental impact, this study introduces the Environmental Assessment dimension, which is not addressed in as much detail in previous studies. While [18,62], agree on the importance of reducing emissions, this study adds a post-event approach, allowing for more comprehensive mitigation of impacts. Additionally, the Mobility and Transport dimension in this study, which includes planning for parking and eco-friendly transportation, aligns with [49], but with more detailed management.

In summary, the items related to Design and Environmental Planning, Social Event Design and Planning, Waste Minimization, Mobility and Transport, Communication and Strategic Alliance Creation, and Energy Consumption align with validated tools from previous studies but offer more detailed and specific approaches. However, this study integrates the Environmental Assessment dimension with regard to post-event management and strategic alliances for long-term sustainability, an aspect not significantly addressed in the previously mentioned studies. It is

important to note that two of these tools are primarily aimed at general sports event organizers, highlighting the limited literature available on validated tools specifically designed to measure sustainability in events held in natural areas.

This study provides valuable insights for sports event organizers seeking to implement sustainable practices in natural areas. The validated questionnaire developed in this research offers a comprehensive tool for measuring sustainability across several key dimensions. Sports managers can use this tool to assess and improve the sustainability of their events, focusing on the various dimensions and items covered in the questionnaire, which can serve as a guide to advancing in the diverse aspects encompassed by sustainability. By adopting this multidimensional approach, managers can better align their events with sustainability goals, contributing to environmental preservation and social development.

The main contributions of this study are the introduction of the multi-study approach in the field of sports management through a reliable process, and the depth provided in each dimension. A notable contribution is the Environmental Assessment dimension, which addresses post-event management and strategic alliances for long-term sustainability, an aspect not significantly addressed in the previously mentioned studies. This study also addresses a gap in the literature, as validated tools for measuring sustainability in events held in natural areas, aimed at organizers, are scarce, which helps advance this area of research.

LIMITATION AND FUTURE DIRECTIONS

The main limitation of this study was the sample size, particularly regarding sports event organizers. As mentioned earlier, a single organizer may manage multiple events, and these records are not currently formalized.

Therefore, for future studies, it would be advisable to expand the sample to include event organizers on a national level, for example, throughout Spain, or to explore other international contexts. This would allow for the evaluation of the tool's applicability and robustness across a wider range of situations and environments.

ETHICAL APPROVAL STATEMENT

This study was reviewed and approved by the *Comité de Ética de Investigación y Transferencia* of the University of Lleida (CERT-UdL). The evaluation was registered under the reference code CERT159, corresponding to the doctoral thesis entitled *"La sostenibilidad en la organización de eventos deportivos en espacios naturales (no) protegidos"*. The committee issued its report on June 9, 2025, signed by its president, Dr. Jorge Moya Higueras.

For more information on the ethical review process at the University of Lleida, please refer to:

https://www.recercaitransferencia.udl.cat/ca/gestio-de-la-rdi/comites/Comite-dEtica-de-Recerca-i-Transferencia-CERT/#presentacio.

DATA AVAILABILITY

The data will be available upon reasonable request through the University of Lleida's OneDrive storage platform or can be shared in an open data repository if preferred.

AUTHOR CONTRIBUTIONS

Conceptualization, MU-H and EIF-T; Methodology, MU-H; Validation, MU-H, EIF-T, and JS-U; Formal Analysis, MU-H; Investigation, MU-H; Resources, MU-H; Data Curation, MU-H; Writing—Original Draft Preparation, MU-H; Writing—Review & Editing, MU-H, JS-U, and EIF-T; Visualization, MU-H; Supervision, EIF-T and JS-U; Project Administration, JS-U and EIF-T.

CONFLICTS OF INTEREST

The authors declare that there is no conflicts of interest related to this study.

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APPENDIX A

Table A1. Classification of mandatory and non-mandatory items with examples.

Dimension	Non-Mandatory Items (*n* = 20)	Mandatory Items (Validated through a Reliability Test) (*n* = 24)
Design and Planning of Environmental Aspects	-Did the sports event have a plan or measures to reduce its impact on the territory? -How many routes of the sports event were held at night? -From your point of view, was the organization aware of the environmental regulations specific to the territory where the sports event took place? -If the sports event took place in a protected natural area, was the organization aware of the required environmental permits and authorizations? -If the route crossed private properties, was the organization aware of the necessary environmental permits and authorizations? -If the sports equipment had an impact on the environment, did the organization regulate the use of this equipment? For example: limiting the use of a specific type of poles in mountain races -If the route crossed fragile areas, areas of high conservation value, with rich flora and fauna, did the organization provide participants with information about the location of these areas?	-Did the sports event have measures to reduce noise pollution? For example: placing audio equipment outside fragile areas (areas of high conservation value, with rich flora and fauna) -Did the sports event have measures to reduce light pollution? For example: prioritizing natural light or using low-energy and energy-saving devices -Before the competition, were the routes publicly disclosed? -Did the sports event have competition rules and penalties aimed at promoting environmental care? For example: penalties for leaving waste in non-designated areas -Does the sports event have any environmental certification? For example: the sustainable sports event seal from the COE, UNE-ISO 20121, ISO 14064, or green sport flag, etc.
Design and Planning of Social Aspects	-Did the organization implement a plan or preventive, reactive, evacuation, and continuity measures to ensure the safety of participants and spectators? For example: measures to detect areas of spectator accumulation -Did the organization establish a legacy plan or measures for the local community? For example: sports legacy: initiatives that promote sports practice in the local community, considering aspects such as social, sports, or environmental legacy -Did the organization try to hire workers from the local community? -Did the organization offer the local community the opportunity to participate as volunteers in the sports event? -If actions were taken to promote any of the United Nations Sustainable Development Goals, select those that were addressed in the sports event	

Minimization of Waste and Responsible Consumption	-Did the sports event have a plan or measures for managing the use and/or consumption of products?	-Did the organization implement actions to reduce product consumption? For example: planning the purchase of food to avoid waste -Did the organization recycle? For example: installation of recycling points -Did the organization reuse products? For example: reuse of signage for different editions of the sports event -Did the organization prioritize the consumption of local products? For example: purchases made from local community suppliers -Did the organization prioritize the use of biodegradable products? For example: use of biodegradable materials in route signage -After the sports event, did the organization clean up and remove the waste from the area where the event took place? For example: immediate removal of signage on the same day the event ended
Mobility and Transport	-Did the sports event have a plan or measures to rationalize travel? -If the route crossed fragile areas, areas of high conservation value, with rich flora and fauna, did the organization implement actions to control access and the movement of participants? -If the route crossed fragile areas, areas of high conservation value, with rich flora and fauna, did the organization implement actions to control access and the movement of spectators? -Did the organization designate vehicle parking areas?	-Did the organization implement initiatives to minimize the impact of transportation? For example: providing buses for participants and/or spectators to access the sports event
Communication and Creation of Strategic Alliances	-Did the organization implement a plan or measures for communication oriented towards sustainability?	-Did the organization implement communication strategies prioritizing the use of minimal materials? For example: the event program and route communications in digital form -Did the organization promote the environmental values of the territory where the sports event took place? For example: providing information at the main event location about the area and its characteristics -Did the organization develop environmental awareness actions for the local community or participants' companions? For example: informational talks about recycling -Did the organization promote sustainable actions for participants during the sports event? For example: leave no trace practices, eco-messages, etc. -Did the organization promote the sustainable actions implemented after the sports event? For example: communicating through social media the strategies carried out to minimize environmental impacts

Energy Consumption	-Did the organization implement a plan or measures for energy consumption management?	-Did the organization implement measures to reduce fossil energy use? For example: planning the timing of the sports event according to sunlight -Did the organization have a system to track at least one Level 1 carbon footprint item? Level 1 carbon footprint refers to direct emissions produced by activities under the direct control of the sports event organization. For example: tracking emissions produced by event organization vehicles -Did the organization implement compensatory measures to offset the carbon footprint of the sports event derived from energy consumption? For example: conservation projects in the event area. -Did the organization allocate funds from the sports event to environmental causes or environmental conservation? For example: donating a percentage of the registration fees from participants
Environmental Assessment	-Did the organization implement a plan or measures for restoration or maintenance? For example: interventions and solutions aimed at keeping the different areas where the sports event took place in perfect condition	-Once the event was over, did the organization conduct a trail degradation assessment? -After the conclusion of the event, did the organization use strategies to assess the preservation of the environment? For example: assessing the impact of the sports event on watercourses, flora, or fauna -Once the event was over, did the organization apply or implement any socio-environmental perception survey for the participants?

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