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Overview of Sustainable Solutions to Improve the Environmental Impacts of Mega Sporting Events

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The International Olympic Committee, as the main sports organization in the world, has several criteria for handing over the Olympic Games to the host city. One of the most critical concerns in hosting sports events is paying attention to environmental aspects and sustainable development. In fact, the applicant cities must have practical environmental goals and action plans. Basically, the host cities have made significant initiatives to improve the environment in previous Olympic Games, but according to the data and studies, this major sporting event has also had detrimental consequences on the environment. Given the importance of sustainable development and environmental protection, this study examines the negative impacts of mega-sporting events on the environment. Therefore data were collected from qualitative interviews, library studies, and previous research. Fifteen experts in the sports and environment field were selected as a sample by snowball distribution method and the interview steps were performed until the theoretical saturation was reached (20-40 min in 3 sessions). After summarizing and analyzing the data, it was found that the negative environmental externalities mainly occur in the Infrastructure and construction, Transportation, and Waste management domains. Emphasizing the findings, the result of this research can be used to identify key local environmental concerns, and pressure points and provide part of the solution for organizers seeking to use their time and resources as efficiently as possible in achieving environmental goals.

Keywords: *environmental factors, sustainable development, sport management, mega-sporting events, Olympic Games*

Introduction

Climate change has already had impacts on event tourism. For instance, the Golden Rainbow Ice Fishing Contest was suspended in 2002 for the first time in its 20-year experience due to unpredictable and risky ice conditions induced by above-average winter temperatures in recent years. The annual Cordova Shorebird Festival (Alaska) has altered its schedule due to changes in the timing of bird migrations to the north as a result of recent climate change (Jones et al. 2006). Sports events can increase short-term, visitation-related advantages and long-term economic benefits for host cities. Simultaneously, these events have frequently faced opposition for their potentially detrimental effects on the environment and local communities. Adverse impacts on natural ecosystems by bringing pollution and waste into the most biologically and culturally rich areas; using nonrenewable natural resources; releasing greenhouse gases emission contributing to climate

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change and high consumption of energy and water during the event are examples of environmental impacts. For this purpose, the FIFA World Cup's "Green Goal" and Olympic Games' "Green Games" are presented as visual examples of efforts to raise environmental awareness and education among nations hosting future large sporting events (Ahmed and Pretorius 2010). Any major sports event has a significant environmental impact, including constant travel of teams and spectators by planes, buses, and cars, a massive amount of waste at competitions, and the destruction of natural areas for the construction of sports facilities such as stadiums (Wicker 2019). The majority of previous studies have focused on the positive effects of sporting events on the environment, society, economy, culture, and politics. Given that the negative effects of sporting events have been less discussed. Accordingly, in the current paper, we aim to Overview sustainable solutions to improve the environmental impacts of mega sporting events.

Literature Review

Environmental Issues and Sport Events

Environmental protection and climate change are long-debated problems that have only recently attracted transnational concern mainly due to a tremendous rise in international media coverage (Zhang et al. 2022, Dickson and Arcodia 2010). In recent years, several governmental and civic organizations have officially announced the necessity to address the environmental externalities of their actions. Many international agreements have led to national, regional, and local governments committing to act in more ecologically friendly ways (Collins et al. 2009). Environmental protection has evolved from a matter of social and political concern to communal and international responsibility. Environmental issues have been demonstrated to be an important priority not just due to the extent of changes to the natural environment, but also because of the rapid pace at which these changes are occurring (Dickson and Arcodia 2010). Events are an important element of the tourism industry since they provide significant economic, social, cultural, and educational advantages and the opportunity for tourism expansion in many international destinations (Schut and Glebova 2022). By their very nature, events generate waste. If events are well-managed, they may recycle surplus supplies and materials in relevant and productive ways with minimum impact on the environment (Dickson and Arcodia 2010, Glebova et al. 2022).

During the 1970s, concerns about environmental protection and sustainable development emerged far more prominently regarding the Winter Olympic Games than their summer games (Chappelet 2008). The Declaration of the United Nations Conference on the Human Environment was released at the first UN human environment congress in June 1972 (UN 1972), accompanied by the World Conservation Strategy in 1980 (IUCN 1980). Later in 1987, the World Commission on Environment and Development (WCED) indicated sustainable development in Our Common Future, which described the competitive and collaborative connection between humans and nature (WCED 1987).

The Olympic Games, as the world's largest social event, has chosen the green Olympic as its best environmental strategy. The promotion of environment and environmental protection started in 1994 with the debate on 'sports and environment' and the environmentally friendly hosts between the International Olympic Committee (IOC) and UN Environment Programmed. This debate led to a sign of collaboration to strengthen the organizations' cooperation on environmental protection. Since 1996, IOC identified environmental protection as one of its duties and highlighted that the Olympic Games should be responsible for any environmental issues and mind people of this concern. Moreover, based on the Olympic Movements Agenda 21, Olympic Games must seek to promote global sustainable development and environmental consideration and all hosts must adhere to rigorous environmental protection requirements when hosting the event (Yang and Xu 2014). Therefore, several sports now provide event coordinators with environmental management guidelines and plans intending to host events (Woodside and Martin 2008).

According to Steiner (2006) from the Lillehammer Games (1994) to the Torino Games (2006), the environment has progressively been a crucial and a victorious competitor in the Olympic Games. IOC now considers the environment, along with sport and culture, to be the third pillar of the Olympic movement (International Olympic Committee 1996).

This commitment has been conveyed to local Organizing Committees for Olympic Games (OCOGs), who have agreed to examine the environmental impacts of their activities since the Lillehammer Winter Games in 1994, albeit with varying degrees of success. Plans for the Torino Winter Games in 2006, for instance, included initiatives to eliminate greenhouse gas emissions, reduce water consumption in snowmaking, support environmentally friendly accommodations and mitigate carbon emissions associated with the events. In 2008, the Beijing Organizing Committee committed to zero net emissions games by the implementation of a Green Olympics with the help of environmental NGOs. In 2012, London's strong commitment to sustainable Games, along with its initiatives for youth engagement and a lasting legacy, contributed to the city's successful bid to host the Summer Olympics. In February 2004, the London 2012 team announced that environmental quality and sustainability are essential components of the London bid. Early on, the Olympic Delivery Authority (ODA) in London developed a Sustainable Development Strategy to reduce carbon emissions, waste, and water consumption while increasing the use of eco-friendly transportation and products (Collins et al. 2009).

Sustainability has been enshrined in the official claims of mega sporting events, and scholarly debates persist on how to achieve environmental stewardship and a prolonged legacy. Revitalizing the public transportation system with alternative fuel bus technologies has speculated significant environmental and socio-economic benefits to the host nation (Elagouz et al. 2022). The effects of sports mega-events on the host communities could be categorized into positive and negative ones. Most studies have explored subjects inferred from the findings, including socio-economic impacts, tourism, heritage, image, media, hygiene, cultural, and environmental effects. However, other affected has implications by

prostitution-related, psychological, spatial, commercial, voluntary, financial and recreational issues have been rarely considered. Understanding the carbon implications of mega sporting events (MSEs) is critical for the hosting country or city, if they are to tackle climate change challenges. Taking the case of the 2014 Nanjing Youth Olympics (NYO), examining the impacts on the host's local carbon emissions during the 'preparatory-hosting-after' stages of a MSE. By adopting a synthetic control method (SCM) and logarithmic mean divisia index (LMDI) decomposition, the following findings are reached: (1) from 2010, when the city of Nanjing announced the decision to bid to host the NYO, the NYO increased the carbon emissions of Jiangsu (the province to which Nanjing belongs) in every year from 2010 to 2019. The total increase in the emissions caused by the NYO was approximately 584.63 million tons. That figure is 1.65 times the total carbon emissions of the United Kingdom in 2018. (2) The annual amount of increased emissions also rose during the preparatory and post stages of the NYO, but the amount of increased emissions during the hosting year was relatively lower, at 53.36 million tons. (3) The NYO improved the energy intensity of the industrial sector, and thereby partially decreased local carbon emissions. Conversely, the NYO induced continuous impacts on local per capita output, the energy intensity of the transportation sector, the scale and energy structure of the industrial sector, and thus promoted emissions, even after the games (Zhang et al. 2022).

Negative Impacts of Mega-sporting Events on the Environment

From the moment an athlete begins to utilize equipment, clothing, or facilities, there is an "ecological footprint" – an impact on the natural ecosystem. At first glance, a leisure runner's impact may seem insignificant. However, when she joins others on the same pathways, participates in local races, drives to events to participate in or watch, and purchases shoes and clothing, her footprint expands. Mega-events, on the other hand, are frequently considered as accelerators for tourism and regional development; despite having detrimental environmental and social consequences. Thus, the environmental sustainability of these events has been a major concern in recent years. Generally, UNEP cites the following as some of the most prevalent negative environmental externalities (Zhang et al. 2022, Qi 2009, Chernushenko et al. 2001a, Chernushenko et al. 2001b, Dingle and Mallen 2017, Knott et al. 2015, McCullough and Kellison 2017, Preuss 2011, Preuss 2007):

- Degradation of sensitive ecosystems or scarcity of land for sport.
- Noise and light pollution caused by sport.
- The exploitation of non-renewable resources (fuel, metals, etc.)
- The exploitation of natural resources (water, wood, etc.)
- Greenhouse gas emissions caused by the consumption of electricity and fuel.
- Depletion of the ozone layer due to refrigerants.

- Soil and water contamination from pesticide usage.
- Soil degradation while construction and from attendees.
- Waste accumulation from facility buildings and visitors.

Recent studies have looked at the negative environmental consequences of events and ways to make them more environmentally friendly. According to Yang and Xu (2014), adopting a green theme can help to bring some ecological benefits. However, the environmental consequences of mega-events are still significant. Schmied et al. (2007) discussed the negative environmental impacts of large sporting events in Table 1 based on the type of the sport and event.

Table 1. *Environmentally Related Elements of the Large Athletic Event (Adopted from Schmied et al. 2007)*

Mega sporting event	Environmental Impacts									
Marathon/ Triathlon/ Runs	Climate	Transport	Energy	Waste	Consumption of resources	Water/ Wastewater	Nature and Landscape	Noise	Catering	Merchandising
Cycling and Motor Sport										
Skiing										
Riding										
Football										
Water Games										
Golf										
Beach Volleyball										
Athletics										
Boxing										
Tennis										
Others										

According to this study, refurbished and new buildings including sports facilities are extremely detrimental to the environment, which increases greenhouse gas emissions. The event's carbon emissions can be significant, prompting some organizers to acquire carbon offsets in an attempt to mitigate the impact (Porteshawver 2009). For the first time, the greenhouse gas emissions were intended to be offset by projects in India and South Africa at the 2006 FIFA World Cup in Germany, (Schmied et al. 2007). In addition, mega-events also generate massive amounts of trash and food waste from attendees and increase energy and water consumption for restrooms and irrigating fields and surrounding regions. Outdoor sports facilities use millions of gallons of water, putting pressure on local water supplies, as well as using hazardous pesticides can pollute soil and contaminate run-off into the water, threatening employees, players, and animals. This is in addition to the energy use, deforestation, pollution, and waste associated with the construction of parking spaces, houses, and other long-term constructions. Construction required raw materials, freshwater, energy, and wood harvested for non-fuel purposes. Non-recycled steel is also still utilized in conventional stadiums. Moreover, many adhesives and paints include hazardous compounds such as lead and isocyanates (Porteshawver 2009). Transfers made by athletes, teams, and fans (Schmied et al. 2007), and construction materials carried long distances on a truck to and from venues release an enormous amount of greenhouse

gases (Porteshawver 2009). Tweeter and the audience's bustle and water sports such as water skiing and motorboat racing can cause noise and water pollution, respectively (Kou and Shen 2014). Collins et al. (2007) examined the environmental impact of a large event- the Football Association Challenge Cup Final. According to the study, the average visitor creates a footprint seven times larger than an individual doing normal activity. The primary cause of this dramatic rise is the changes in consumption patterns of participants and event guests, with travel to and from the event being the most significant change and consumption of food and drink and producing waste, accounting for the next largest share of the footprint.

Müller et al. (2021) observed that there is no systematic evaluation of Olympic sustainability. They assess the long-term sustainability of the summer and Winter Olympics from 1992 to 2020. The overall sustainability of the Olympic Games, according to their research, is moderate and has decreased over time. During this timeframe, Salt Lake City (2002) had the most sustainable Olympic Games, whereas, Sochi (2014) and Rio de Janeiro (2016) had the least. Interestingly, cities including Vancouver and London, which have portrayed themselves as sustainable Olympic Games models and have counseled other Olympic hosts on sustainability, were ranked below average. Finally, they recommended that reducing the size of the event, rotating the Olympics among the same cities, and enhancing sustainable governance can contribute to improvements in sustainability. Considering the complexity of social and environmental issues caused by mega sporting events, Warren (2020) believed that a one-size-fits-all solution is impossible to implement. Rowberg and Rincker (2019) reviewed Rio 2016's nine sustainability dimensions, which include water purification and conservation, environmental consciousness, consumption, and renewable energy management, carbon-neutral games, air quality and transportation, soil and ecosystem protection, environmentally-friendly design and construction, biodiversity, reforestation and culture, shopping and environmental certification and waste treatment. They concluded that the dimensions are not separate from one another. Reflecting on the environment itself, there is spillover from one negative dimension to another, such as Tokyo 2020 not obtaining its timber sustainably.

Sustainable Solutions for Sport Events

Given the fact that the negative effects of sporting events on various parts, including the environment, are not visible in the short term, and scientific research on operational strategies is limited, scholars have recently proposed the following solutions for organizing and maintaining climate-friendly sporting events. According to Ma and Kaplanidou sports event legacies are summarized as economic, social, and environmental. Although the majority of legacy categories have a positive connotation, negative event legacies such as financial, social, political, and environmental should also be considered. since failing to pay attention to them may have an impact on people's quality of life in the future (Ma and Kaplanidou 2016). Over the years, various events have attempted but failed to

develop the image and reputation of truly green events. The 2004 Olympic Games in Athens, for example, were called the green event by the Organizing Committee, although this was only partially accurate because, for instance, neither wind farms were employed nor was the solar energy be used in the buildings (Griese et al. 2017). Based on the review of relevant event marketing journals, Griese et al. (2017) compiled guidance on current approaches that can help avoid future greenwashing activities. However, they focused on the sustainability of the event itself rather than addressing a sustainable agenda that could be communicated to the audience and influence their values. That is why it is necessary to investigate whether events can raise awareness of climate change. Sports activities are one way to accomplish this purpose. Traditionally, the call for climate change has been conveyed through tourism as part of place branding (Jayawardena et al. 2013, Capstick et al. 2017, Spector 2017). When it comes to sporting events, researchers tend to concentrate on the sport's environmental sustainability (Dingle 2009, Paul and Lowes 2009). For instance, Dingle (2009) investigated the advantages of implementing green technologies into racing cars. Paul and Lowes (2009) discussed the fairness of holding racing events and their impact on the sustainability of the city and its residents in general. However, over the recent decades, the sport has already become a platform for addressing key social concerns and has proven to be an engaging platform, such as promoting equal rights for men and women in tennis (Orr et al. 2020) or protesting racism in the National Football League (NFL) and other sports (Schmidt et al. 2018). Swart et al. (2021) investigated the sustainability of major sports events in Dubai, they only contributed to the development of Dubai's overall branding and the image of sports events from a tourism viewpoint, nevertheless, and they did not cover the public's awareness of global issues. At the dawn of the Olympic Games, snow was not an issue for winter competitions. However, since the mid-50s, natural snow has been in short supply, forcing organizers to use artificial snow (McCullough et al. 2020, Sports 2020). Before the 1964 Olympics, thousands of tons of artificial snow were transported from different regions to the ski slopes of Innsbruck by army trucks and Austrian troops trampled it with their boots for several days. Since the late 1980s, special equipment has been extensively used for the production of artificial snow. In addition, in the 1950s and 1960s, the Olympic competitions of hockey players and figure skaters were moved from open-air sites to the premises to prevent difficulties with melting ice (McCullough et al. 2020, Sports 2020). In the 70s, bobsleigh and luge tracks were artificially cooled. In Vancouver 2010, further cooling of the jumping jumps was required (McCullough et al. 2020). Even well-known athletes were trying to draw public attention to environmental issues. "Something that terrifies every winter athlete daily is the fact that the conditions are not as good as they used to be. You see videos of people skiing on glaciers back in the '80s and '70s, and half of that glacier doesn't even exist anymore"- admits world champion in ski acrobatics Jon Lillis. Actually, Environmental Sustainability (ES) is at the forefront of the focus of governments, international organizations, and industries, associated with the motoring industry. Chernushenko et al. (2001b, p. 4) point out that any sport can be considered as sustainable if "it meets the needs of today's sporting communities while contributing to the

improvement of future sports opportunities for all and the improvement of the integrity of the natural and social environment on which it depends". Motorsport marketing seeks strategies to make the sport truly sustainable (Robeers and Bulck 2018). The most obvious solution to reduce the final combustion product (CO_2) is to replace combustion engines in automobiles with electric ones. The electric racing series, ABB FIA Formula E was designed to implement and promote such sustainable practices (Robeers and Bulck 2018, Sports 2020a). Pointing out that air pollution is the most serious environmental threat to human health today, the series has been both a marketing and experimental ground for electric vehicles since 2012, promoting electric mobility and clean energy solutions to help decrease air pollution and combat climate change worldwide (Robeers and Bulck 2018, Sports 2020). All Formula E cars are powered by lithium-ion batteries, which there is less noise and no carbon emissions. The energy used to charge the batteries must be "clean", thus all the electricity for Formula E cars is generated by glycerin generators that operate on biodiesel derived from plant waste. This enables racing on temporary city-center circuits or even in existing pavilions (Kew 2021, Robeers and Bulck 2018) and possibly educates attendants of all ages about the future and benefits of electric vehicles, addressing the problem raised by Orr et al. (2020).

Finally, Thomson et al. (2013) highlighted that it is critical to remember that inadequate planning of the events' legacies in host cities (Glebova and Desbordes 2022) or regions may lead to long-term negative economic, social, and environmental effects. Hence, it is necessary to assess, evaluate and manage both positive and negative legacies, while considering all stakeholders in order to maximize the positive and minimize the potential negative results inherited (Glebova et al. 2022).

Methodology

Data Collection

This paper explores the sustainable measurements against the negative externalities of the Olympic Games through qualitative interviews synthesized with literature review. Face-to-face interviews with experts might be a beneficial technique for gathering important data. In order to talk with the experts who provide the most value to this research, the snowball sampling approach was adopted in which respondents put you in touch with other experts (Baker 2006, Baker and Edwards 2012). As a sample, fifteen experts (N=15) from diverse backgrounds and sectors (government, universities, sports associations and environmental institutions) were selected and the interview processes were carried out until the theoretical saturation was attained. Due to the COVID-19 pandemic, all the interviews were performed remotely through skype or messenger (call/chat). It should be noted that the language of the interview was English and also each interview lasted between 20 to 40 minutes, and the primary question was addressed: "What is your opinion about sustainable initiatives for mitigating the negative environmental effects of mega-sporting events?"

Data Analysis

Data were then transcribed verbatim using a voice recorder. The qualitative approach enables us to present detailed textual explanations of how we might advance towards sustainable mega-sporting events. For the next step, the data from previous research and interviews were coded inductively. Finally, after reviewing the transcripts to ensure the relevance and meaning of these concepts and themes, they were synthesized and analyzed in order to finalize the research findings.

Results

Based on previous studies, we assumed that mega-sporting events were harmful to the environment since the economic effects will ultimately exceed the environmental ones. A huge event such as the Olympics will always have an environmental impact; this study highlighted some of the ecologically beneficial alternatives, which are outlined in Table 2.

Table 2. *Extracted Components through Interviews and Investigation of Past Research*

	Domain		
1	Infrastructure and construction	Keeping games out of protected areas, wilderness and agricultural land	(Chernushenko et al. 2001b, Kou and Shen 2014)
		Shifting Winter Games away from mountain resorts towards cross-country ski venue	(Chappelet 2008, TUNZA 2012)
		Installing physical barriers to protect vulnerable ecosystems, plants and water bodies	(Chernushenko et al. 2001b, Yang and Xu 2014)
		Construction of multiple-use facilities	(Chernushenko et al. 2001b, Kou and Shen 2014, Stadhouders 2010, TUNZA 2012)
		Depending on the climate, design structures to optimize solar gain or to protect against it	(Chernushenko et al. 2001b, Kou and Shen 2014, Schmied et al. 2007)
		Implementation of green roofs	(Porteshawver 2009, Warren 2020, TUNZA 2012, Zhang et al. 2022)
		Rotating the Olympics among the same cities	(Müller et al. 2021)
		Construction of ecological shelter forest belt and green belt	(Yang and Xu 2014, Karlsson 2009, TUNZA 2012)
		Enhancing the quality of the sidewalks surrounding stadium by using recycled rubber asphalt	(Porteshawver 2009)
		Carbon neutrality by reforestation	(Rowberg and Rincker 2019)
		Providing temporary accommodation by using cruise ships in the harbors	(Stadhouders 2010)
		Implementation of movable pool floor	(Stadhouders 2010)
		Avoid events during breeding season	(Schmied et al. 2007)
		Installation of nesting boxes for bats and birds	(TUNZA 2012)

2	Transportation	Encouraging carpooling, and human-powered commuting	(Chernushenko et al. 2001b, Stadhouders 2010, Schmied et al. 2007)
		Free or special prices offer for public transport	(Chernushenko et al. 2001b, Porteshawver 2009, Yang and Xu 2014, Karlsson 2009, Schmied et al. 2007, TUNZA 2012)
3	Waste management	Composting organic waste	(Chernushenko et al. 2001b, TUNZA 2012)
		Construction waste and materials removed during renovation can be reused, sold or donate	(Chernushenko et al. 2001b, Schmied et al. 2007, TUNZA 2012)
4	Materials management	Reduce the use of materials that deplete natural resources or pollute the environment	(Chernushenko et al. 2001b, Collins et al. 2009, Kou and Shen 2014, Schmied et al. 2007)
		Avoid ozone-depleting chemicals	(Chernushenko et al. 2001b)
		Use of plasticized signboards with removable printed mark that van be reused	(Chernushenko et al. 2001a, TUNZA 2012)
5	Energy and water conservation	Installing or updating to energy-efficient equipment such as heat pumps or geothermal technology or utilizing wind and biomass energy	(Chernushenko et al. 2001b, Collins et al. 2009, Kou and Shen 2014, Porteshawver 2009, Stadhouders 2010, Warren 2020, Yang and Xu 2014, Schmied et al. 2007, TUNZA 2012)
		Shifting from electricity or oil to natural gas	(Chernushenko et al. 2001b, Yang and Xu 2014, Karlsson 2009, Schmied et al. 2007)
		Minimizing air leakage by closing off any unnecessary openings (doors, windows)	(Chernushenko et al. 2001b, Porteshawver 2009, Schmied et al. 2007)
		maximizing natural light and installing energy-efficient lighting and/or solar panels	(Chernushenko et al. 2001b, Porteshawver 2009, Warren 2020, Yang and Xu 2014, Schmied et al. 2007, TUNZA 2012)
		Installing low-flow showerheads and faucet aerators	(Chernushenko et al. 2001b, Porteshawver 2009, Yang and Xu 2014, Schmied et al. 2007, TUNZA 2012)
		Storing rainwater and gray water for irrigation purposes	(Chernushenko et al. 2001b, Porteshawver 2009, Stadhouders 2010, Karlsson 2009, Schmied et al. 2007, TUNZA 2012)
		Establish vegetation buffers surrounding bodies of water to effectively absorb runoff and decrease erosion.	(Chernushenko et al. 2001b, Stadhouders 2010, TUNZA 2012)
6	Merchandising and procurement	Paperless games	(Chernushenko et al. 2001b, Stadhouders 2010)
		Use recycled paper and vegetable-based inks in case of printing	(Chernushenko et al. 2001b, Schmied et al. 2007, TUNZA 2012)
		Providing ecologically friendly packaging or returnable packaging	(Chernushenko et al. 2001b, Schmied et al. 2007)
		Designing giveaways to be reusable at future events	(Chernushenko et al. 2001b, Schmied et al. 2007)
		Alternative gifts such as a service or a gesture instead of material objects	(Chernushenko et al. 2001b)
		Creating Olympic medals out of recycled metals from donated gadgets	(Rowberg and Rincker 2019)
		Using recyclable materials to create team uniforms	(Warren 2020, TUNZA 2012)
7	Catering and food services	Use reusable coffee filters	(Chernushenko et al. 2001b)
		Donating acceptable food to food banks or local kitchens	(Chernushenko et al. 2001b, Schmied et al. 2007, TUNZA 2012)
		Use of a durable mug for all participants (athletes, spectators and employees)	(Chernushenko et al. 2001b, Schmied et al. 2007, TUNZA 2012)
		Using waxed paper instead of plates for fast food	(Chernushenko et al. 2001b, TUNZA 2012)
		Preparation of biological and healthy food	(Stadhouders 2010, Schmied et al. 2007, TUNZA 2012)

Discussion and Conclusion

Key Findings and Theoretical Implications

Based on the analysis, now it is possible to answer the main research question. The basic research question aimed at finding out what factors may negatively influence the environment through sport event. To the best of our knowledge, there are few studies on how events, in a particular mega sporting event, can negatively affect the environment. Consequently, due to the novelty of the phenomenon studied and the basis of the literature related to the topic under study, suggestions, and solutions for improving the environment and reducing the negative effects of sporting events were extracted. These data were collected through the library research method and interviews with experts (Table 2).

One of the most important and influential findings on improving the environment was infrastructure and construction. In fact, unprincipled constructions and poor quality infrastructure are among the negative and influential factors on the environment which should be considered by the Managers of sporting events. This factor agrees with (Porteshawver 2009, Yang and Xu 2014, Rowberg and Rincker 2019, Warren 2020, Müller et al. 2021).

One of the important suggestions for improving the environment is energy and water conservation since these strategies can be used to prevent the wastage of resources and energy. Installing or upgrading energy-efficient equipment such as heat pumps or geothermal technologies or utilizing wind and biomass energy, shifting from electricity or oil to natural gas, minimizing air leakage by sealing any unnecessary openings (doors, windows), and planting vegetation buffers surrounding bodies of water to effectively absorb runoff and decrease erosion are examples of water and energy conservation at host venues.

Managerial Implications

Mega sporting events, from the Olympics to the World Cup, provide entertainment for tens of thousands of people but can also provoke intense debate and controversy. One of the most important challenges is the negative impact of sporting events on the environment, which is less addressed.

Simply, reducing the amount of environmental damage caused by an event does not always suggest a long-term benefit to the environment. Beyond the event itself, this would necessitate a transformation in understanding, attitudes, and/or behaviors (Glebova et al. 2022). As a result, the major challenge is determining how the event might encourage such improvements. The eco-friendly measures taken by the event organizers serve as examples and messages in and of themselves. Environmental stewardship may be demonstrated by implementing environmentally-friendly regulations and practices. Using environmentally friendly products or policies to limit greenhouse gas emissions, for instance, are examples of efforts to highlight those solutions and their benefits. Simple environmental suggestions, such as recycling bins for event visitors or promoting public transport to the events, can also help to raise awareness of the need for environmentally

responsible behavior. The emerging environmental challenge is to identify synergies between the environmental regulations of the event and the message (including lessons) it conveys, whether on-site or through advertising and reporting (Woodside and Martin 2008).

In order to achieve successful sustainable Games, the organizing committee must establish a strategy that is appealing to the IOC, the host community, and major interest groups in the city before the Games. Moreover, creating multiple functions buildings can serve as long-term examples of sustainable development.

Providing a legislative framework that includes critical features such as full disclosure and transparency of procedures and data; full social inclusion in decision-making; continuous interaction and commitment to sustainability; and the sustainability of community investments. Implementing these fundamental aspects will develop community engagement prior to, during, and after the event, provide a sense of ownership over the event, promote sustainable environmental and energy policies and prevent event seizure. In addition, procedural requirements for public disclosure, debate, involvement, and potentially even veto power should be included in host cities. However, in the absence of a pre-existing legal framework, host cities will remain subject to potentially negative environmental and social externalities (Warren 2020). In a general, we may say: First, research has shown that while sporting event is a good way to address environmental improvement, it is still unknown to the fan community and even managers, so their downsides should not be overlooked. Additionally, throughout data collection, we were unable to find negative remarks in research and interviews for any mega sports event related to the environment. To reduce the negative impacts of sports events on the environment the first step might be to conduct market research on fans and spectators to ensure they understand the series and the environmental message transmitted within it.

Second, even if the mega sporting events are considered to have any negative effect on the environment, they have the potential to raise awareness of environmental change. It is a good sign that environmental topics are possible to be addressed and should be considered within the sports event. For practitioners, this implies that other series may invest time and financial resources in addressing sustainable/climate innovations/ agenda. Climate change and environmental concerns are relevant to the fan community, which is why the sports event can incorporate actions to address these issues into their sustainability strategy to inspire fans by acknowledging the important role they can play in combating climate change.

It seems managers and authorities of sports and the environment do not care about environmental issues due to a lack of knowledge and awareness of the negative impacts of sporting events. More practical actions such as partnering with climate organizations during race weekends or representing athletes as long-term ambassadors who not only talk about climate change and environmental issues, but also promote environmentally friendly technology and sustainability as F1 world champions Nico Rosberg and Sebastian Vettel do (Baldwin 2021, Lewin 2021).

To this end, sport, in general, may play a significant role in tackling climate change. Over the last few decades, sports have already made a positive contribution to resolving major societal challenges such as racial equality and justice. Since sports broadcasts have a larger audience than environmental documentaries, they would help people understand what is happening on the planet. The sports community may also create a positive climate legacy by setting up global and local marketing campaigns in collaboration with fan communities led by famous athletes. But the words are not enough. Practical initiatives may include using of sustainable materials and electric vehicles for major sports events such as the Olympic Games.

Limitations and Further Research Directions

The following points represent the pitfalls of this study which may also be considered areas for future research.

First of all, this study mainly focused on the negative impact of mega sports events on the environment. Although this issue and its study can help the research literature and organizers of sporting events, particularly managers and environmental researchers, very limited information and research have been conducted in this field. In addition, due to the coronavirus pandemic and distance restrictions between countries face-to-face interviews with most experts were not possible. Therefore, a more diverse and statistically stronger sample of the population, as well as the opinions of managers and experts of other nationalities, needs to be examined.

Secondly, the study explores addressing environmental challenges only within the context of mega sports events. However, due to the different impacts of sports on the environment, more disruptive sports must be studied in this scenario. Taking into account that sports have already succeeded as an engaging platform for addressing major social issues, such as supporting equal rights for men and women in tennis (Orr et al. 2020) or protesting against racism in the National Football League (NFL), future studies may focus on how these sports may cope with environmental hazards.

Thirdly, it is recommended that the scores of those related to sustainability and environmental awareness among the criteria taken into consideration when giving the Olympic Games or major sports organizations.

Finally, due to time and resource constraints, alternative methodologies could not be used within the collecting and analysis stage. Future studies may test the same constricts to reveal more sophisticated and interesting outcomes based on advanced soft and analysis techniques.

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