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Sports and Climate Change: Implications and Strategies

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ABSTRACT

Climate change is an increasingly critical global issue that profoundly affects various aspects of human life, including sports. The immediate and direct impacts of climate change on sports are evident in the alteration of playing conditions. Increased frequency and intensity of extreme weather events, such as heat waves, storms and heavy rainfall, pose serious health risks to athletes. Prolonged exposure to high temperatures can lead to heat exhaustion and heatstroke, while increased humidity exacerbates respiratory issues. Outdoor sports, such as football, marathons, and tennis, are particularly susceptible to these changes. Winter sports face shorter seasons and unreliable snow cover due to rising temperatures, forcing resorts to rely on artificial snowmaking, which is both costly and environmentally detrimental. Thus the paper examines the complex relationship between sports and climate change, outlining the significant implications and proposing strategic responses to address these challenges effectively.

Key words : *Climate Change, Sports, Carbon Emission, Outdoor Sports, Mitigation Strategies*

Introduction

A long-term change in regional or worldwide climate patterns is called climate change (IPCC, 2021). Weather patterns may become less predictable as a result of climate change. Because projected temperature and rainfall levels can no longer be relied upon, these unpredictable weather patterns can make it challenging to maintain and develop crops in regions that depend on farming. Additional catastrophic weather occurrences like more frequent and powerful hurricanes, floods, downpours and winter storms have also been linked to climate change (Jamet and Corfee-Morlot, 2009). Climate change effects on the economy, society, ecology and public health are multifaceted and disastrous with crippling impacts on life and livelihood (Eichinger, 2019; Thakur and Bajagain, 2019). It should be noted that climate change has affected athletes' health to the profitability of hosting games. The effects of rising sea levels, changing weather patterns and global temperatures on sports are extensive and varied (Edgar, 2020). The modification of playing conditions is the most obvious and direct effect of climate change on sports. The frequency and intensity of extreme weather events, like heat waves, storms, and heavy rains, are rising where in all cases, the health and safety of sportsmen are seriously jeopardized (Mallen *et al.*, 2023). Thus the paper examines the complex relationship between sports and climate change, outlining the significant implications and proposing strategic responses to address these challenges effectively.

The impact of climate change on sports

Natural disasters and bad weather are interfering

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with sporting events all across the world, from typhoons and wildfires to rising temperatures. People of various ages and backgrounds are impacted by this, as it impairs the capacity of competitive and recreational athletes to engage in a variety of sports. In sports science, the problem of climate change has gotten relatively little attention. However, Due to the unfavourable effects of climate change on physical activities and sports, as well as the fact that certain places experience more intense weather events and natural disasters than others, sports performance is negatively affected (Gökçe *et al.,* 2022). The situation is predicted to have a significant impact on outdoor sports like football and tennis, as well as aquatic sports like sailing, rowing, and most winter sports (Brocherie *et al.,* 2015). Orr *et al*. (2022) adumbrated the major areas of climate impacts on organized sport,

- heat impacts on athlete and spectator health
- heat impacts on athlete performance and
- impacts on the suitability of cities for hosting an event

In addition, the observations of Orr and Schneider (2018) and Dingle *et al.* (2022) have identied the secondary climate impacts at the organizational level in the form of higher costs. Mallen *et al.* (2023) illustrated the cascading heat impacts on sports (Fig. 1). Numerous sports have shown evidence of heat impacts including baseball (Orr, 2020), tennis (Smith *et al.,* 2018), golf (Scott and Jones, 2006) and soccer (Grundstein *et al.,* 2020). There is evidence of sports/leisure-related heat illness related hospitalization for athletes (Gilchrist *et al.,* 2011).

Thus, the world of sports is profoundly impacted by climate change, which has far-reaching repercussions globally. The effects of global warming are being felt more and more in the sports sector, where they are changing playing fields and endangering

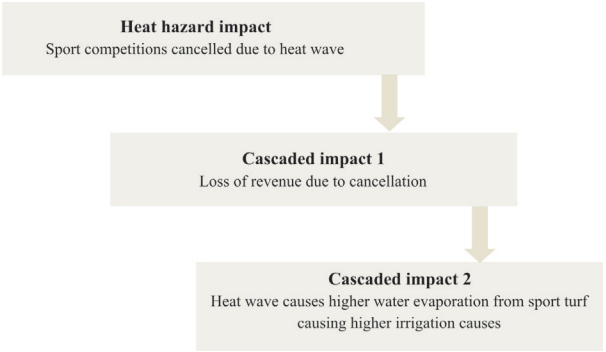

Fig. 1. Cascading heat impacts on sports

infrastructure. The major effects of climate change on sports are given below,

- **Altered playing conditions:** Extreme weather events are becoming more common and intense due to climate change, which has an impact on the playing fields of numerous sports. Athletes are at serious danger for heat exhaustion and heatstroke from extended exposure to high temperatures during heat waves (Orr *et al*., 2022). Elevated relative humidity intensifies these problems by impeding the body's ability to cool down. Particularly susceptible to these conditions are outdoor-based sports like football, tennis, and marathons. For example, in 2014, when temperatures climbed above 40 °C (104°F), several players suffered from heat-related ailments during the Australian Open (ESPN, 2014). Tennis players are particularly vulnerable to heat-related illnesses because it interferes with thermoregulation, which keeps our body temperature at approximately 37°C. Heat stress refers to the group of disorders that occur when the body temperature increases to dangerously high levels (over 39.5 °C) (Kosaka *et al.,* 2004 and Périard *et al.,* 2014).
- **Seasonal shifts in winter sports:** As global temperatures rise, winter sports will see shorter seasons and less consistent snow cover. Due to this shift, ski resorts are being forced to use more artificial snowmaking, which is expensive and detrimental for the environment. For example, the 2022 Winter Olympics in Beijing raised questions regarding energy and water use because of the heavy reliance on artificial snow (Shipenkov, 2022). The survival of winter sports and associated tourism businesses is increasingly in jeopardy as natural snowfall decreases. According to Igini (2022), around half of the former winter Olympics host cities won't be able to sponsor the Games by 2050 due to a lack of snow and ice.
- **Water availability and quality**: Seasons for water sports are directly impacted by changes in the climate. For instance, the amount of time that may be spent playing winter sports on natural lakes and rivers, such ice skating or hockey, may be shortened by rising global temperatures. Conversely, droughts and falling lake and river levels can make it more difficult to engage in water sports like sailing, kayaking, and rowing. Moreover, increasing sea levels and more intense extreme weather might put the lives of water sport

participants in danger and restrict the accessibility and availability of these activities (Çalik and Geri, 2022). Underwater activities like diving and snorkeling may also be impacted by coral bleaching brought on by rising oceans.

- **Infrastructure vulnerability:** Coastal erosion and increasing sea levels pose a threat to sports infrastructure, which includes stadiums and training centers. Numerous well-known sporting complexes, such as Australia's Melbourne Cricket Ground and Brazil's Maracanã Stadium, are situated close to coastlines and may be threatened by flooding brought on by climate change (Çalik and Geri, 2022). Heavy financial burden of maintaining and strengthening these facilities to survive severe weather events will result in severe financial liability to the authorities. Nearly a quarter of English football stadiums will be partially or completely flooded every year as per predictions (Dragoviæ, 2022).
- **Economic implications**: There is a substantial financial impact of climate change on sports. Events that are subject to extreme weather conditions may have to be cancelled or postponed, which can cost organizers, sponsors and local economies that depend on sports tourism money. As the hazards associated with climate change become more obvious, insurance prices for sporting events and facilities are also expected to increase. Additionally, there is growing demand to implement more sustainable methods due to the increased scrutiny of sports activities' environmental imprint, including travel and energy use.

Thus, continuous efforts from sport sciences and exercise physiology communities are needed for minimizing the risks of environmental-related illnesses during outdoor sports practices. For instance, at the 2014 Australian Open Tennis Tournament, four days of temperatures exceeding 41 °C resulted in over a thousand spectators experiencing heat stroke. Apart from rising average temperatures, additional severe weather phenomena including hurricanes, typhoons and sporadic torrential downpours also greatly endanger athletic contests and events. Typhoons, for example, caused the Japan Rugby World Cup to be postponed and certain matches to be cancelled in 2019 (Lyons, 2019).

Strategies to mitigate climate change impacts on sports

Increasing the resilience of sports infrastructure - which include planning and building structures that can endure extreme weather events like heat waves, storms, and flooding - is one of the main methods for responding to climate change. It is essential that these facilities be designed and run using sustainable techniques. Sports arenas can drastically lessen their environmental impact by, for example, utilizing renewable energy sources, putting in place water management systems and increasing energy efficiency. This strategy is best shown by the Mercedes-Benz Stadium in Atlanta, which has set the standard for sustainable sports infrastructure with its solar panels, rainwater harvesting systems and energy-efficient designs (MBS, 2024). Another key tactic is to update scheduling and event management procedures. Sports event planners can change the schedule of tournaments to avoid adverse weather by holding them at a cooler time of day or year. Furthermore, health hazards can be reduced by putting in place safeguards to shield competitors and spectators from the heat and other unfavourable elements, such water stations and hydration supplies. Creating thorough backup preparations in case of harsh weather can help reduce interruptions and guarantee attendance' safety. To effectively manage emergencies, these plans should contain explicit procedures for evacuations, postponements of events and communication tactics.

Encouraging sustainability in the sports sector is essential for long-term climate change adaption which entails implementing eco-friendly behaviours, like reducing travel, utilizing eco-friendly products and promoting recycling and waste reduction. Investing in renewable energy sources and improving operational energy efficiency can help sporting activities cut their carbon footprint even more. Using recycled materials, efficient waste management techniques, and renewable energy sources, the Tokyo 2020 Olympics showed tremendous development in this area.

The Mercedes-Benz Stadium in Atlanta

One of the best examples of how sports venues can incorporate sustainability into their layout and operation is the Mercedes-Benz Stadium in Atlanta. The stadium has energy-efficient designs that decrease energy use, rainwater harvesting systems that reduce water consumption, and solar panels that provide renewable energy. These actions have not only lessened the stadium's environmental impact but also established a standard that other sporting

venues can adhere to.

The Green Sports Alliance

The Green Sports Alliance is a non-profit that works to improve the environmental performance of sports teams, venues, and leagues in order to advance sustainability in the sport. In the worldwide sports sector, it is regarded as the biggest, most significant, and pioneering force behind environmental and social responsibility. The Alliance offers information, equipment, and assistance in putting green projects like waste minimization, water conservation, and energy efficiency into practice. In order to advance sustainability in the sports business, the Green Sports Alliance is essential in encouraging collaboration and knowledge-sharing.

The Tokyo 2020 Olympics: A message

Six iconic sites from the 1964 Tokyo Olympics were among the roughly 60% of the Tokyo 2020 Games venues that were already in place. Tokyo 2020 made the Games carbon neutral by creating a decarbonized society and reducing emissions while offsetting emissions that were equivalent to or greater than the quantity of emissions. Approximately, 5,000 medals from the Olympic and Paralympic Games in Tokyo 2020 were manufactured entirely of recycled metal that came from little electrical devices that the Japanese public donated. Furthermore, post-consumer plastic and recovered marine plastic wastes donated by the Japanese people were used to construct the podium for the awards presentation (IOC, 2024). The Olympic Village was powered by hydrogen fuel cells and these efforts showcased how large-scale sports events can adopt sustainable practices and reduce their environmental impact.

Race to zero: Sports for climate action

The relationship between sport and climate change is becoming more widely acknowledged because sport both contributes to and is impacted by the issue. Sporting organizations have a complicated and difficult to quantify impact on climate change, although it is widely acknowledged that their unsustainable methods have exacerbated the effects of the phenomenon (Wilby *et al.*, 2023). A medium-sized country's worth of emissions is contributed to the global sport sector. The building and usage of different sporting stadiums, the carbon footprint from travel to and from events and the supply chains for sporting goods all have a significant impact on global warming though it remain unexplored or underreported. Thus, sport contributes to climate change in a positive way through greenhouse gas (GHG) emissions associated with energy use, travel, and other types of consumption (IOC, 2018).

UN Climate Change invites sports organizations and their partners to join Climate Action for Sport, a new initiative that aims to support athletes in achieving global climate change goals through mentoring and assistance. By taking responsibility for its carbon footprint, the sports sector can encourage action on climate change outside of its own walls and increase international ambition to address the threat that climate change poses. Sports organizations have united around a set of ideals and begun an effort to steer business toward the low-carbon economic trajectory that global leaders decided upon in Paris (IOC, 2018). Thus, as one of the greatest convenors of people in our society, sport can play a role both in championing progress and leading by example where, organisations that are most innovative and that make the most progressive steps can gain a competitive advantage over their peers.

The role of sport in combatting climate change

Sports are a victim of global warming as well as one of its contributors. For a number of reasons, though, it is uniquely positioned to contribute to the answer. First, because of its wide social platform, which spans practically all regions and all classes can be used as a strategic tool to change the attitude of general public. Sport involves billions of people as participants, spectators, fans and organizers. Second, athletics is a powerful tool for spreading knowledge and understanding about environmental issues such as global warming and more generally, as well as for encouraging sustainable living.

According to Casper *et al.* (2020) sports fans are open to environmental initiatives and actively participate in minimizing environmental impact not only during sporting events but also in their daily lives and as community activists. Thus, sportsmen and teams can act as positive role models for their fan base for a deluge of climate change mitigation steps, where they can encourage people to modify their habits and lifestyle for the benefit of the environment by using their high social standing to inform people and communities about climate change and global warming. Athletes have also been actively advocating for climate action. The genuine attempts by Winter Olympians for addressing cli-

mate warming and global climate change are noteworthy (Knowles *et al.,* 2024). In short, sport is becoming more widely acknowledged as an effective, low-cost means of achieving sustainable development, which includes tackling global warming. Thus, implementing sustainability standards in the sports sector may contribute to the development of sustainable production and consumption guidelines in other sectors of the economy too.

In this background, a growing number of public and commercial initiatives have emerged in recent years to combat climate change. One of the main focuses of the International Olympic Committee's (IOC) Sustainability Strategy is climate action (IOC, 2018). The IOC wants to make the games carbon negative by 2030 for which it has established a "Strategic intents for 2030" plan that calls for reducing greenhouse gas emissions from operations and events related to the Olympic Movement as well as adapting sport facilities and events to the effects of climate change.

The role of policy and governance

Encouraging the shift to sustainable sports activities is mostly dependent on government laws and policies. Sports organizations can lessen their influence on the environment by implementing policies that support sustainable building, energy efficiency and renewable energy. Funding and incentives for research and innovation in sustainable sports technologies can also be provided not only by governments but also by international federations and organizations. To create comprehensive plans for addressing climate change in sports, cooperation between legislators, sports organizations and environmental organizations is crucial.

To conclude, the sports sector needs to take a diverse strategy in adjusting to the effects of climate change. The long-term viability and sustainability of sports can be ensured through enhancing infrastructure resilience, rearranging scheduling and event management, advocating for sustainability, encouraging education and advocacy and funding research and innovation. It should be noted that sports organizations have a great role in making a substantial impact on global efforts to tackle climate change by incorporating climate action into their basic operations. Launched in 2016 by the United Nations structure Convention on Climate Change (UNFCCC) and a number of prominent sport organizations, the UN's Sport for Climate Action Framework aims to give the numerous, disjointed projects now in place a coherent structure.

Conclusion

There are opportunities and challenges associated with the relationship between sports and climate change. Sports are at serious risk from climate change, but there is also a chance for the sector to set the standard for sustainability. The sports industry can lessen the effects of climate change and support international efforts to address this conjuring issue by improving infrastructure resilience, updating event management procedures, encouraging sustainability, fostering advocacy and education and funding research and innovation. In summary, there are many facets and a complex interaction between sports and climate change. As the effects of climate change become more apparent, the sports industry must adapt and adopt new strategies in order to remain sustainable. Sports can adapt to a changing climate and promote positive change by becoming environmental stewards and taking proactive measures. By making climate action a core component of the business, sports organizations can make a substantial contribution to building a more resilient and sustainable future for all.

Conflict of Interest- None

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