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Football and climate change: what do we know, and what is needed for an evidence-informed response?

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ABSTRACT

Association football is popular and influential globally. Interest in how football relates to climate change, and the climate policy required for football, is growing. Clubs, players and fans increasingly call for action to reduce football's impact on the climate, and for plans to adapt to climate impacts on football. However, well-intentioned actions must be underpinned by robust evidence. This synthesis reviews research at the interface of football and climate change. After summarizing the main climate actions identified for fans, players, clubs and organizing bodies, the review looks in-depth at four areas: impacts of football on climate; impacts of climate on football; football as a driver for pro-climate actions; and the relationship between football and carbon-intensive industries. The review then outlines research gaps for an evidence-driven response to climate change in football: adaptation across different geographical contexts; understanding what climate change means for community-level football; understanding how carbon-intensive industries relate to sense of place identity in football under a just transition; developing principles for phasing-out fossil fuel financing; and considering how climate change relates to women's football.

Key policy insights

- Football is a forum for galvanizing societal action in support of climate policy. However, football also contributes to, and is impacted by, climate change, and hence requires policy support under a changing climate;
- Reducing transportation emissions, especially flying, is a key climate policy requirement for football. Institutional policy, with government support, may enable more efficient scheduling and use of surface transport;
- Institutional policies, and public health policies, should develop standards and guidelines for football under extreme heat. Football also ought to be integrated within local, regional and national climate adaptation policy to ensure climate resilience;
- Clubs and players can lead by example on climate-positive actions, and energize wider action through fan bases. Alignment of initiatives with national or international climate policy may raise public awareness of climate policies and targets;
- Institutional policies for clubs, tournaments and associations should regulate fossil fuel financing. Football also offers an avenue to understand relations between local identity and carbon-intensive industries, and thus to identify socio-cultural factors for regional just transition policies.

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1. Introduction

Football¹ is one of the most popular sports globally. It is also a significant driver of popular culture, as well as an activity with major financial and commercial power. Football can hence be a focal point for societies and

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¹This paper takes 'football' to refer to association football, also known as 'soccer'.

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countries in responding to the climate challenge. Due to its size and reach, the response of football to climate change will also have financial and environmental implications. Internal drivers for a fuller and faster climate change response from football include clubs themselves, such as Forest Green Rovers in England and Real Betis Balompié in Spain, who position themselves as pro-environmental clubs and embed emissions reduction into their institutional policies and operations. Individual players, such as Spain's Hector Bellerin, New Zealand's Katie Rood, and Denmark's Morten Thorsby, have used their social media platforms to raise awareness of climate issues and campaign for football to reduce its climate impact. Organizations including Football for Future² and Fossil Free Football³ are lobbying governments, football associations, and leagues and clubs to implement policy towards climate change and environmental sustainability. Fan-led organizations, such as the Football Supporters' Association in the UK, are similarly beginning to call on clubs, leagues and associations to do more towards environmental sustainability.⁴

Externally, governments and policy-focused international organizations are beginning to acknowledge the relationship between football (and indeed sport more broadly) and the climate, as illustrated through the UN's Sports for Climate Action Framework (UNFCCC, 2021). High-profile media coverage of events, such as the takeover of Newcastle United by the Saudi Arabian Public Investment Fund,⁵ a fund supported largely by oil and gas revenue, and the sale of Chelsea following the sanctioning of owner Roman Abramovich, who made at least some of his wealth through oil and gas activity,⁶ have sharpened scrutiny of football's climate impacts.

Against this growing enthusiasm for greater engagement of football with climate change, however, is a need to ensure actions are guided by the best available evidence. The Intergovernmental Panel on Climate Change (IPCC) warns of the danger of 'maladaptation', whereby badly planned actions that are intended to cope with the impacts of climate change can inadvertently end up exposing people to greater risks (IPCC, 2022). Similarly, decisions taken today about infrastructure and large capital expenditure can, if not considered carefully, 'lock in' society to high carbon emissions in the long term (Seto et al., 2016). It is therefore vital that the actions football clubs, leagues, associations and fans are taking today to plan their responses to climate change are informed by scientific understanding of how football affects climate change, and how climate change affects football. Similarly, it is also important to identify knowledge, evidence and policy needs relating to football and climate change which can be addressed through scholarly research.

The purpose of this review is therefore to synthesize existing scholarly evidence relating to the multiple ways football and climate change interact, and to identify emerging research directions and knowledge gaps to support an evidence-driven response to the climate challenge for football. The paper builds on extant academic reviews into the relationship between climate change and sport more widely, and also reviews recent research into how football relates to specific aspects of the climate challenge. The review begins by summarizing the principal areas of research into football and climate change to date, outlining the main high- and low-impact climate mitigation and adaptation actions that have been identified for fans, players, clubs, and governing bodies. The review then provides a more in-depth synthesis of four themes in extant football and climate change research: impacts of football on climate change; football and climate change adaptation; football as a driver for pro-environmental actions; and the relationship of football to fossil fuels. Finally, the review appraises the main knowledge requirements and research gaps that exist for an evidence-driven response to climate change in football.

2. Method

This review synthesizes research into football and climate change across disparate disciplines and topics. It does so following an integrative approach, meaning the aim is to synthesize the literature in a way that allows new perspectives and frameworks to emerge (Torraco, 2005). Snyder (2019) explains that integrative reviews are appropriate for topics where – as is the case with football and climate change – an emerging yet diverse

²<https://footballforfuture.org/>.

³<http://www.fossilfreefootball.org/>.

⁴<https://thefsa.org.uk/news/sustainability-a-challenge-for-football>.

⁵<https://www.theguardian.com/commentisfree/2021/oct/23/saudis-newcastle-united-odd-relationship-football-club-fans>.

⁶<https://platformlondon.org/2022/03/23/time-to-kick-oil-out-of-football-the-economic-war-part-4/>.

knowledge base already exists, and where the objective is to overview the existing evidence and produce taxonomies, classifications or new conceptual approaches. Snyder adds that integrative approaches are also appropriate for topics where the knowledge base exists in 'grey' literature – such as books, edited collections and reports – as well as in peer-reviewed journals. With an initial literature search showing that much evidence about football and climate change indeed exists in such 'grey' literature, an integrative review was hence considered more appropriate than a more strictly controlled and tightly structured systematic review.

Furthermore, again recognizing that enquiry into football and climate change is a nascent field, evidence from other sports is also included where relevant. References to popular media or club/organisational websites are additionally provided to give context or examples of actions and policies where relevant.

Studies were collated by searching Google Scholar⁷ for the keywords 'football' OR 'soccer' and 'climate change' OR 'sustainability' or 'environment'. The search was then repeated by searching again for the keywords 'sport' AND 'climate change' OR 'sustainability' or 'environment'. Additional texts were collated through 'snowball' sampling (i.e. following up references in relevant studies returned by the initial search), and through searching the web pages of well-known organizations promoting sustainability in football to identify relevant reports and web links.

For each identified text, the key arguments and main points were noted alongside the citation to the study or report, paying particular attention to any recommendations for policy made by the authors. Identified texts were then read in more depth to identify and code different aspects of the relation between football and climate, and then grouped into themes and sub-themes following an inductive coding approach (Saldana, 2009). This process was undertaken iteratively, with additional sub-themes being added and research gaps/follow-on research needs being noted as the texts were read in greater depth. A summary of the themes and sub-themes identified is shown in Table 1.

An important limitation to note is that the review drew only on English-language sources. Further review work may therefore wish to encompass scholarly research and grey literature published in languages other than English.

3. Results

The following review is structured around four main themes (Table 1): (a) the impact of football on the climate; (b) football and adaptation to climate change impacts; (c) football as a point of departure for societal and behavioural change; and (d) football and relationships to fossil fuels and carbon-intensive industries.

Table 2 summarizes some of the actions that were identified in the review, and which may be taken by different actors involved in football to both mitigate the extent of climate change and adapt to climate change impacts. Each of these is discussed in more depth across Sections 3.1.–3.4. Categorizing activities as 'lower-impact' is not intended as a criticism of the research cited or, indeed, the underlying initiatives. Rather, Table 2 is a heuristic to distinguish between shorter-term actions that may be taken within or in response to the status quo but which may ultimately be more limited in their ability to reduce emissions or adapt to climate impacts (lower-impact); versus those which may entail more long-term and fundamental changes to how football is conducted but which may ultimately yield bigger emissions reductions or more climate-resilient operations (higher-impact).

3.1. Football and its impact on the climate

A major contribution of football to climate change is emissions associated with travel, especially travel to and from tournaments or individual matches (Goldblatt, 2020). Much of the reviewed literature in this area relates to leagues in England. This may be due to this review's focus on English-language research, however it may also

⁷Web of Science is often considered to be a more robust tool for reviewing peer-reviewed evidence, as it searches only journals which are considered the most reliable and trustworthy. However, bearing in mind the fast-moving nature of football and climate change scholarship and the role that book chapters, monographs and reports play in the field, Google Scholar was considered to offer a fuller overview of the literature for the purpose of the study.

Table 1. Main areas of climate impact and research, and relevant disciplines identified during review.

Theme	Sub-themes	Relevant research fields identified in review
Football and its impact on the climate	Transportation Other travel Operation of facilities Waste Food and diet	Life-cycle analysis Carbon accounting Civil engineering Food systems
Football and adapting to climate change impacts	Health impacts on players, officials and spectators Effects on athlete performance Operational impacts on facilities from extreme weather Resilience and contingency planning	Public health Sports science Climatology Environmental science Law Management Disaster studies
Football as a point of departure for societal and behavioural change	Football clubs leading by example on pro-climate behaviours Football clubs galvanizing fan action on pro-climate behaviours Players and clubs as opinion leaders on climate change	Psychology Marketing Management Economics
Football and relationships to fossil fuels and carbon-intensive industries	Sponsorship and financing of football by carbon-intensive industries Historical relations between carbon-intensive industries, football and local identity Ethics for climate-friendly football	Anthropology Human geography Sociology Media studies Ethics Philosophy

reflect the significant position that English football, especially the men's Premier League, occupies in sport and by extension in research about football due to its global audience and financial resources. Pereira et al. (2019) summarize that, for the English Premier League at least, travel is the largest contributor to football's carbon footprint. On the spectator side, Dosumu et al. (2017) estimate that the total greenhouse gas emissions of spectators across tiers 3–10 of the English league structure in the 2012/13 season was 56,237 tonnes of CO₂ equivalent (CO₂e), or less than 0.05% of transport emissions in England. The average travel emissions among participants surveyed by Dosumu et al. was 4.74 kgCO₂e per game. In Germany, meanwhile, Loewen and Wicker (2021) calculate that the average carbon footprint of a Bundesliga fan for a whole season was 311.1 kgCO₂e, with car travel accounting for 70% of these emissions. As far as clubs are concerned, Pereira et al. (2019) calculate that each of the twenty English Premier League club generates an average of 56.7 tonnes CO₂e per season due to travel. Pereira et al. find that transportation (as opposed to accommodation) makes up just over 60% of clubs' travel-related emissions, with most of this transportation footprint (around 85%) generated through teams flying to and from fixtures.

In England, Dosumu et al. (2017) note that football matches in higher league tiers had significantly higher emissions, due to the emissions associated with building, running and maintaining larger stadia (e.g. concrete for construction, electricity for lighting), whereas at lower levels, virtually all emissions were transport-related. Loewen and Wicker (2021) meanwhile identify three distinct clusters of fans: devoted travellers (19% of their sample); home fans (30%); and casual visitors (51%). Loewen and Wicker find, perhaps unsurprisingly, that the level of commitment to the club and membership of a supporters' club significantly increased fans' carbon footprints. Likewise, use of air travel and upmarket hotels means that elite clubs' emissions are likely to be significantly higher than teams employing more cost-efficient forms of travel and accommodation, which tend to have fewer energy-intensive luxury features and hence lower emissions (Pereira et al., 2019).

Other sources of emissions noted – and hence opportunities for emissions reduction – include waste produced by fans at stadia, which can be reduced by diverting waste from landfill (Dosumu et al., 2014); and meat-based diets from athletes, which may (in the context of sport more broadly) be reduced by promoting plant-based diets (Meyer & Reguant-Closa, 2017). An additional emergent area is the relative climate impacts of grass versus artificial playing surfaces. Grass playing surfaces require water (sprinkler systems), energy (floodlights, mowers) and food (fertilizers) to maintain, all of which have emissions implications and

Table 2. Examples of higher-impact and lower-impact mitigation and adaptation actions which may be undertaken by football actors at different levels.

Actor	Higher-impact mitigation	Lower-impact mitigation	Higher-impact adaptation	Lower-impact adaptation
International tournaments and organizations	Resisting commercial pressures for larger and more frequent tournaments (Gammelsæter & Loland, 2022).	Promoting energy efficiency at new-build tournament stadiums (Al-Hamrani et al., 2021).	Establishment of international climate impact funds to support adaptation in vulnerable nations (British Association for Sustainable Sport, 2021).	Altering timings of matches and/or building water breaks into matches (Nybo et al., 2021).
National leagues	Regionalisation of leagues and national/regional tournaments to reduce travel (Bernard et al., 2021; Gammelsæter & Loland, 2022).	League-wide initiatives or competitions to encourage fans to compete with each other in pro-environmental behaviours (Amann, 2022).	Altering seasonal timings of leagues/ tournaments to avoid weather extremes (Nybo et al., 2021).	Region-specific guidelines and regulations on training and playing in weather extremes (Kerr et al., 2019; Orr, Inoue, et al., 2022)
Larger professional clubs	Divestment from fossil fuel / carbon-intensive financing and sponsorship (Tricarico & Simms, 2021). Eliminating domestic air travel to away fixtures (Pereira et al., 2019).	Engagement of fans in waste recycling and energy reduction campaigns (Francis et al., 2016). Reducing energy consumption of stadia on matchdays, and/or switching to net-zero energy generation (Manni et al., 2018).	Cognisance of whole system impacts of playing surfaces, diets etc on increasingly scarce water resources (British Association for Sustainable Sport, 2021).	Changing maintenance regimes for playing surfaces to cope with extreme heat and rain (Dingle & Mallen, 2021).
Smaller community clubs	Support for preserving local identity and sense of place grounded in carbon-intensive industries, whilst also encouraging a just transition (Ferguson, 1993; Wambach, 2022).	Encouraging active travel to and from games among fans and athletes (Moser et al., 2019).	Collaboration with local authorities to enhance resilience of facilities to weather extremes (Carmichael, 2020a; Mallen & Dingle, 2017).	Protecting and educating fans against weather extremes (Lee et al., 2022).
Athletes	Making changes to personal lifestyle (e.g. reducing/ eliminating air travel or meat consumption), and using profile and platforms to exemplify these lifestyle changes (Orr, Murfree, et al., 2022).	Using profile and platforms (e.g. social media presence) to raise awareness about climate change among fans and wider society (Amann & Doidge, 2022).	Redesigning training schedules and conditioning to be able to cope with weather extremes, encompassing psychological as well as physical effects (Bernard et al., 2022).	Altering tactics and playing style to maintain performance under weather extremes (Lichter et al., 2017; Zacharko et al., 2021).
Fans	Reducing/ eliminating high-emitting travel to support teams (Loewen & Wicker, 2021; Pereira et al., 2020). Urging clubs and players to adopt more sustainable lifestyles (Daddi et al., 2021).	Participation in club-led recycling and energy efficiency programmes (Baldwin, 2010; Francis et al., 2016).	Fan groups working together to support clean-up and community recovery after weather extremes (Amann & Doidge, 2022).	Altering spectating behaviours to be better prepared for air pollution and extreme heat/rainfall (Watanabe et al., 2019).

may indeed require more intensive maintenance under a warming climate (Dingle & Mallen, 2021; Dingle & Stewart, 2018). Conversely, concerns have been raised about the resources required to periodically replace synthetic pitches, and about pollution from rubber pellets and grass fibres entering water courses (Bø et al., 2020). However, comparative – and especially quantitative – research into the climate impacts and benefits of hosting football on grass versus synthetic surfaces is to date limited.

The climate impacts of periodic mega-events such as World Cups have also drawn attention. Emissions from long-distance air travel associated with athletes, officials, media and supporters mean World Cups have a large carbon footprint (Pereira et al., 2020). Media and commercial pressures for more frequent tournaments involving a larger number of teams (e.g. World Cups and regional championships such as the CONCACAF Gold Cup, plus continental club tournaments such as the UEFA Champions League), will in turn lead to an increase in long-distance travel and a soaring carbon footprint for football (Gammelsæter & Loland, 2022; Orr, Murfree, et al.,

2022). Other significant climate impacts from mega-events include emissions associated with construction materials for new stadia, energy to power stadia, and in-country transportation (Diederichs & Roberts, 2016); as well as energy for visitor accommodation in-country (Pereira et al., 2020). However, Diederichs and Roberts (2016), discussing the 2010 men's World Cup in South Africa, believe the 'real climate impacts of mega-events [...] remain poorly understood, and the costs associated with comprehensive mitigation largely unaffordable for most cities, particularly those in the global South' (p. 382). Diederichs & Roberts explain this complexity is due to difficulties in measuring and reporting all emissions associated with mega-events and different standards for offsetting, plus the fact that international travel is commonly omitted from mega-event carbon offset targets. There are also questions of fairness associated with placing a burden of expectation for responding to climate impacts of mega-tournaments onto hosts in less wealthy nations, who have historically contributed less to climate change (see e.g. Bernard et al., 2021; British Association for Sustainable Sport, 2021).

Although it may be challenging to calculate precise emissions from footballing mega-events, available evidence indicates that higher-level leagues and international tournaments are responsible for higher emissions. High-profile footballing events can also draw attention to the climate impacts of football, and act as a departure point for individuals and smaller organizations to reflect on how their own behaviours and actions in relation to football may impact on the climate (Otto & Heath, 2010). Bernard et al. (2021) hence note, for sport more generally, that international and national competitions ought to be reorganized to decrease the carbon footprints of competitors. Bernard et al. continue that doing so may involve selecting locations based on accessibility and future climate scenarios, or replacing short-haul flights to and from events with surface transport. Gammelsæter and Loland (2022) likewise hold that elite sport, including football, can be compatible with climate-friendly policies if actions such as reducing the frequency of major events or regionalizing the earlier stages of tournaments are taken.

Strategies to reduce emissions need not decrease the spectacle or competitiveness of elite football. Wynes (2021) finds that, if the travel adjustments introduced by the four major sports in North America (American football, baseball, basketball, ice hockey) during COVID-19 for player safety were adopted on a permanent basis (e.g. sorting schedules by region and more back-to-back games), then reduction in air travel emissions of 22% annually could be achieved due to reduced frequency of flying, while still allowing for a fully competitive season. Competitiveness could even be increased through more strategic scheduling, due to reduced stress and injury risk for players from less intensive travel (Gammelsæter & Loland, 2022; Wynes, 2021). On the other hand, whilst Dosumu et al. (2017) argue that football authorities should have robust travel plans in place and educate spectators to employ more sustainable travel, Carmichael (2020a, 2020b) notes that at the level of community clubs, the ownership structure of football facilities (where stadia and training grounds may be rented from, say, a local authority) means smaller clubs have less agency or opportunities to adapt facilities to reduce climate impacts.

3.2. Football and adapting to climate impacts

There is also recognition in the literature that football will be affected by climate change. Especially in temperate climates such as the UK, sport has traditionally adopted a reactive rather than pro-active approach to weather extremes, where changing weather is seen as 'part of the contest' and something to be endured by players and spectators alike as part of the experience (Kay & Vamplew, 2006). Nonetheless, a growing body of literature argues for full and early consideration of how to adapt to climate impacts in sport more broadly.

A first area of scholarship concerns the impacts of extreme weather, especially heat, on athlete performance as well as athlete and spectator health (Orr, Inoue, et al., 2022). In addition to literature specific to football, there is no shortage of empirical research from other sports, especially American Football. Ross and Orr (2022) predict the key climate threats on football World Cups up to 2032 will be heat conditions unsuitable for competition, and poor air quality. Schneider and Mücke (2021) summarize that climate change will increase risks to athletes from heat stress; exposure to UV, allergens and air pollutants; and faster disease vectors. Nybo et al. (2021), specific to football, argue that footballers' technical capabilities are preserved and may even improve under high heat conditions, but that different players may be affected differently by heat. Kerr et al. (2019), in the

context of US high school football, note a risk of heat illness for training athletes, but argue that guidelines from sporting organizations on reducing heat risk have proved to be effective in reducing incidences of heat illness. Craig et al. (2016) find, in the American National Football League (NFL), that higher ambient temperatures lead to more penalties for aggressive behaviour, especially for teams playing in front of their home fans. Perhaps less dangerous but also of interest in terms of effects on performance, Wiart et al. (2011) model the dynamic properties of footballs and find that the time available to the goalkeeper from a penalty kick is 7 per cent shorter at 40°C in comparison to that at 0°C, and hence that the time available for a goalkeeper to save a penalty decreases as temperature increases.

Orr et al. (2022) call for further consideration of benchmarking and boundary conditions, to define what is a safe environment for sport, and what the limits and parameters are to safe playing conditions. Kerr et al. (2019) propose heat health protection plans for training athletes. Specific to football, Nybo et al. (2021) hold that competitive football can be sustained under a heating climate, but that adjustments such as more time for acclimatization, scheduling games for cooler times of the day, allowing breaks during games, and adapting training schedules ought to be adopted. At a local level, Bernard et al. (2021) believe physical activity and sport communities should be involved in, and considered as part of, regional preparedness planning for disasters. However, Bernard et al. (2022) call for enquiry into the psychological as well as physical dimensions of climate change for athletes across all sports. Such psychological dimensions, Barnard et al. argue, include the emotional consequences of changing landscapes or extreme weather-induced event cancellations, the coping strategies used by athletes during extreme conditions, and the implications of short-notice disruptions to training or competition schedules due to weather extremes.

A second research area concerns impacts of extreme weather on football operations. Dingle and Stewart (2018) identify four key impacts: organizational uncertainty; greater management complexity; cost risks associated with water and energy resources; and waste outputs. Extreme weather events such as storms and hurricanes mean an increasing likelihood of cancellations, which implies an increased need to consider contracts, cancellation costs, and definitions of *force majeure* (Murfree & Moorman, 2021). Stadia close to coasts or rivers may be at risk of flooding due to sea level rise and extreme rainfall, with Goldblatt (2020) estimating that nearly one in four English league clubs can expect partial or total flooding of their stadium by 2050, and similar risks to stadia globally in low-lying countries and regions.

Dingle and Stewart (2018) believe most physical impacts on sporting venues are manageable, but that the potential for negative business and operational impacts will move clubs to take action ahead of any government regulation or policy for climate change. Taking action may involve considering suitability of host cities for events (Orr et al., 2022); planning for climate-resilient infrastructure (Ross & Orr, 2022); and goal-setting for resilience, measurement and monitoring towards goals, and worst-case scenario planning (Orr, 2021). Engagement of sports teams and venues with wider disaster and contingency planning for extreme climate events is also important to ensure threats to sports communities are accounted for (Bernard et al., 2021), as well as to maximize use of sports facilities as emergency response sites and locations for environmental and social resilience (Orr & Kellison, 2020).

There is also potential for football to take positive steps towards addressing the underpinning causes of climate change vulnerability. One possibility could be to follow the *Hit for Six* report into the impacts of climate change on cricket, which advocates for international authorities to consider the political risks associated with access to water in warmer sporting nations, and to set up a global climate disaster fund to support communities in vulnerable regions (British Association for Sustainable Sport, 2021). It may also be possible to draw on the sense of collective identity of fan groups to support community resilience in the aftermath of climate-related extreme events. Amann and Doidge (2022) discuss how ‘ultras’ fan groups, including groups from rival teams, have come together to support clean-up and recovery operations after floods in Livorno (Italy) and the Rhineland (Germany).

3.3. Football as a point of departure for societal and behavioural change

A third area of scholarship concerns the extent to which football clubs and personalities can encourage supporters to think about how their own lifestyles contribute to climate change, and whether clubs, players and

organizations can energize pro-environmental actions among fans. Francis et al. (2016) hold that football, as an important driver of popular culture, has the potential to transform how we view and practice sustainability. This section also illustrates, however, that there may be limits to this ‘encourage and exemplify’ approach, especially when it comes to addressing underlying structural issues or the largest climate impacts of football.

As far as clubs are concerned, one way to support pro-climate behaviours is through ‘leading by example.’ Major League Soccer clubs in the USA have been positively evaluated for promoting sustainability initiatives on their own websites (Francis et al., 2016), and for using their stadia to demonstrate and promote renewable resource use, resource minimization, and recycling (Mallen et al., 2013). Real Betis Balompié represents a high-profile case of a club that has adopted climate-friendly actions, re-aligning its institutional policies and corporate strategy to show support for the environment and climate with a commitment to running the club in a carbon-neutral manner, and becoming a source of pride for fans as a result (Lobillo-Mora et al., 2021). Clubs may even align their internal environmental policies with international agreements and standards. Indeed, Real Betis Balompié’s *Forever Green Initiative*⁸ makes mention of the Paris Agreement. US club Vermont Green has sought to embed the language of environmental justice in its club mission, and to align its operations with the Net-Zero Standard of the Science-Based Targets Initiative.⁹

Football clubs can also act as a focal point for community-wide actions. Baldwin (2010) finds that a club-led energy-saving campaign run by Ipswich Town in England engaged a section of society perhaps less readily associated with pro-climate behaviours. Similarly, Amann’s (2022) study of Whitehawk FC, again in England, and its involvement in the ‘Pledgeball’ initiative, where fans of different teams competed against each other to make the biggest emissions savings, suggests that club-led environmental initiatives can help fans to think about the impact they can have as a group, and thus the role that they as individuals and a community have in tackling climate change. In Aarhus in Denmark, the logo and name of AGF, the local football team, was used in a climate-related public artwork as a means of drawing people towards the artwork and thus engaging them in the climate change debates and issues that were discussed in the work and adjacent ones (Fritsch & Brynskov, 2011). Moser et al. (2019) also find that engaging with sports clubs can be a useful intervention point for encouraging local active travel within a community.

However, despite multiple scholarly studies into how football may engage sections of society who may be less likely to engage directly with pro-climate actions, the extent to which club initiatives influence fan behaviour – and in turn emissions – beyond specific campaigns has not been so fully assessed (Moser et al., 2019). Moreover, the actions that have mostly been evaluated in the scientific literature – raising ‘awareness’ of climate change and encouraging fans to participate in recycling, energy-saving, and low-carbon transport such as cycling – arguably do not address the major climate impacts of football outlined in Sections 3.1. and 3.2., especially reducing air travel or promoting comprehensive approaches to climate change adaptation.

Indeed, Lobillo-Mora et al. (2021) for Real Betis Balompié find that, although fans take pride in Betis’ environmental initiatives, they do not necessarily feel a sense of involvement or participation in the club’s actions. Fans are also becoming increasingly climate-conscious, and may be prepared to pressure their favoured clubs to adopt pro-environmental actions (Todaro et al., 2022). Fans and the wider football community may likewise become sceptical of club- or league-led environmental initiatives that they perceive as insincere or ineffective. This was illustrated by the response to Manchester City encouraging fans to recycle plastic waste in return for air miles from its title sponsor Etihad Airways. The campaign was widely seen as ‘sportswashing’ by environmental organizations and local media, due to its encouragement of a high-impact behaviour in flying and the fact that Manchester City is funded by a sovereign fund from an oil-rich nation.¹⁰

A second channel through which football may influence fans and wider society is players themselves. Personalities in football, and professional sport more widely, are increasingly willing to speak out on environmental issues, not only due to personal motivation or concern but also because climate change is affecting their sports (Falt, 2006). There is evidence in the wider climate change literature that high-profile public figures who undertake pro-climate behaviours and actions (e.g. flying less or not flying at all) can influence others and shift what is

⁸<https://forevergreen.es/>.

⁹<https://vermontgreenfc.com/mission/>.

¹⁰<https://www.manchestereveningnews.co.uk/news/greater-manchester-news/green-campaigners-slam-hilariously-wrong-23368461>.

viewed as ‘normal’ (Westlake, 2017). Initiatives such as Football Ecologie France¹¹ seek to enhance climate literacy among footballers, with the aim of empowering them to act as climate ambassadors and energize wider societal change. Players such as Morten Thorsby, Katie Rood and Hector Bellerin have been evaluated positively in this regard for using their platform to speak out on climate change (Amann & Doidge, 2022; Orr, Murfree, et al., 2022). Examples of specific pro-climate or pro-environmental actions undertaken by players include switching to plant-based diets (Alex Morgan), cycling to and from home games (Arjen Robben), supporting tree-planting campaigns (Hector Bellerin), and establishing climate change NGOs focussed on football (Morten Thorsby).

Conversely, reflecting the rising awareness and expectations of football fans (Todaro et al., 2022), it is also worth emphasizing two incidents which, whilst not yet discussed in the scientific literature, show how high-profile football figures may face criticism for a perceived lack of concern or action towards climate change. In 2022, then-Chelsea manager Thomas Tuchel was mocked after complaining that his coaching staff could not fly to Leeds for an away fixture and had to travel the 350 km journey by bus.¹² Several weeks later, Paris St Germain star player Kylian Mbappe and club coach Christophe Galtier drew anger from fans and from the mayor of Paris after being seen to giggle at a press conference in response to a question about their team taking a private jet to a fixture in nearby Nantes.¹³

There is hence potential for football players to exemplify and normalize the individual lifestyle changes that are required for an effective climate change response. There may also be rising societal expectation that high-profile figures will adopt these behaviours. However, it is worth noting that, with the possible exception of plant-based diets, many of the pro-climate actions which players have promoted to date reflect the ‘lower impact’ climate actions outlined in Table 2. Equally, however, it may be unfair to expect individual athletes to tackle structural questions of fossil fuel financing or emissions-intensive scheduling, especially when their careers rely on working within these structures.

3.4. Football and relationships to fossil fuels and carbon-intensive industries

The financing of football with money generated through carbon-intensive activities has received ever-more attention in the media (Tricarico & Simms, 2021), and is an emergent area of scholarly interest. Miller (2018) describes such ‘greenwashing’ – or ‘sportswashing’ as it is also known for states or companies using sport to launder their reputations (Miller, 2020) – as a situation where oil and gas sponsorship of football imbues extractive corporations with a positive image. Companies involved in carbon-intensive activities may, for example: (a) sponsor clubs’ shirts or stadia (e.g. the Emirates airline sponsoring a number of teams including Arsenal and AC Milan; car maker Toyota sponsoring Nagoya Grampus); (b) buy teams outright (e.g. petrochemicals giant INEOS owning OGC Nice); or (c) sponsor leagues and tournaments (e.g. Gazprom sponsoring the UEFA Champions League prior to the Russian invasion of Ukraine). Sovereign wealth funds (or subsidiaries) from countries whose economies are based heavily on fossil fuel resources may similarly purchase clubs outright, for instance Saudi Arabia’s Public Investment Fund acquiring Newcastle United, and Qatar Sports Investments’ ownership of Paris St Germain. The effects of sportswashing vary from enhancing the public image of big polluters through positive association with football (Miller, 2020), to normalizing the presence of fossil fuels and high-emitting activities in society (Tricarico & Simms, 2021), or even deflecting attention away from fundamental criticisms about fossil fuel financing by instead emphasizing low-impact individual behaviours through targeted campaigns (see the example of Manchester City and plastic recycling in Section 3.3).

Attention has focused on fossil fuel sponsorship and ownership in top-level international or elite league football (e.g. Goldblatt, 2020; Miller, 2018; Tricarico & Simms, 2021). However, Millington et al. (2021) also show how extractive industry sports sponsorship can have negative effects at the community level. In the context of indigenous communities and mining in Australia, Millington et al explain that extractive industries use support for local sports teams and facilities in host communities to offset the negative effects of their

¹¹<https://www.football-ecology.org/>.

¹²<https://metro.co.uk/2022/08/21/leeds-vs-chelsea-thomas-tuchel-blames-travel-arrangement-for-3-0-loss-17219842/>.

¹³<https://www.independent.co.uk/sport/football/psg-mbappe-galtier-flight-climate-change-b2160723.html>.

operations. As well as prolonging the negative environmental impacts of extractive practices through practices of 'sportswashing', Millington et al also argue that extractive industries' continued presence prolongs deleterious impacts on Indigenous communities, particularly regarding land use and traditional land-based activities. Mabon (2022) similarly calculates that in the Highland League – a semi-professional league in Scotland centred on a region traditionally reliant on the North Sea oil and gas fields – just under half of teams in the 2021–22 season received sponsorship from firms involved in the oil and gas supply chain.

At the same time, however, a number of detailed ethnographic studies illustrate the strong and galvanizing links that can exist between carbon-intensive industries, football and sense of community identity. Such studies offer a pathway into a deeper understanding of football's historical relationship with fossil fuels and high-emitting industries, and include Ferguson (1993) on Cowdenbeath in Scotland (coal); Wambach (2022) on Schalke 04 in Germany (coal); Thissen and Cornips (2021) on Roda JC Kerkrade in the Netherlands (coal); and Nayak (2019) on Middlesbrough in England (steel, petrochemicals). Careful consideration of a 'just transition' for localities reliant on carbon-intensive activities for jobs and economic continuity may thus be able to use football to gain insight into how carbon-intensive activities can act as a source of local pride and identity, and hence what is worth protecting in the transition to a sustainable net-zero-carbon locality. Understanding this historical context is also important for being clear on what associations with carbon-intensive industry ought to be removed from football, and which aspects ought to be preserved as a source of strength, when distancing football from high-emitting industries more generally.

Nonetheless, despite growing scrutiny towards the role of football in normalizing and prolonging a fossil fuel economy, Bunds and Casper (2018, p. 2) believe 'there remains a need for critical engagement from the field of sport sociology examining the larger concerns for the interaction between sport, physical culture, and the environment.' Breivik (2019, p. 63) similarly identifies a need for humanities engagement at the interface between sport and climate change, arguing that 'sport philosophers, with few exceptions, have not discussed what an ecologically acceptable sport would look like.' With evidence that normative practices can be important in supporting football clubs to pursue environmental sustainability and environmental governance (Daddi et al., 2021), fields such as ethics and philosophy could support football clubs and leagues in developing principles and institutional policies for ethical sponsorship and financing under a climate emergency.

At least three specific policy actions could be taken to reduce the reliance of sport on fossil fuel money. Firstly, building on the precedent set by organizations such as *Fossil Free Football*, international football authorities and national associations can develop principles to guide new sponsorship and investment decisions for teams and leagues (e.g. no new sponsorship or investment from organizations who are not committed to bringing their practices in line with the Paris Agreement). Secondly, clubs, shareholders and/or fan groups can push for commitments to divest from fossil fuel revenue, along the lines of movements which are gaining traction in the arts and culture sectors (Motion, 2019). Thirdly, major leagues and tournaments – especially those who have historically benefitted from fossil fuel sponsorship – could establish funding mechanisms to support host cities and countries whose economies are reliant on carbon-intensive industries to diversify and initiate local just transitions.

4. Key research gaps and evidence requirements

Going forwards, a key research gap and evidence requirement concerns climate change adaptation and resilience for football across different geographical contexts. There is a good body of literature from football and sport more widely summarizing climate change impacts on players, venues, events and spectators, and the policy actions that can be taken in response (e.g. Dingle & Stewart, 2018; Orr et al., 2022). However, the nature and extent of climate change impacts – and hence the appropriate adaptation and resilience strategies – will vary across different regions globally, and even across different regions within countries (Ross & Orr, 2022). There is hence a need for finer-scale understanding and a fuller evidence base of how climate change may impact upon football in different ways according to geographical context. As Bernard et al. (2021) hold, there is a particular need for evidence from low-to-middle-income countries, which are often located in the parts of the world which will be affected earliest and most strongly by climate change, yet have the least financial capacity to adapt. One potential avenue of enquiry could be to develop a typology of climate impacts on stadia, players and spectators according to climate zone or geographical location, which may

facilitate exchange and knowledge-sharing between clubs in different countries that are facing similar climate impacts and adaptation challenges. From a policy perspective, there may also be a need for capacity-building actions to support football clubs and associations in low-to-middle income countries, who are affected by climate change but have limited resourcing and capacity to respond.

A second emerging research and policy area concerns the growing societal scrutiny towards the prevalence of financing from fossil fuels and other carbon-intensive activities in elite football. The humanities, arts and critical social sciences may support a robust response to questions over fossil fuel money in football in at least two ways. First, the arts have a vital role in drawing societal attention to the presence of financial arrangements that are not compatible with global climate obligations, and can provide a space where dialogues between different actors towards imagining transformative outcomes outside of the ‘status quo’ can happen (Galafassi et al., 2018). Second, areas of study such as applied philosophy and ethics can help to think through the breadth of ethical issues associated with fossil fuel financing, and may support clubs, leagues and tournaments in developing institutional policies for ethically-sound decisions on funding and sponsorship. The arts, humanities and social sciences may thus be especially valuable in helping to envision new and transformative business models for football under a climate emergency, which embed principles such as environmental justice, community ownership and fossil fuel divestment into football operations.

A third research gap and evidence requirement concerns the question of scale. Carmichael (2020b) argues the scholarly literature on sport and sustainability focuses extensively on elite professional organizations, and that scholarship ought to pay greater attention to the other ways in which sport is defined, understood and played. Carmichael suggests that social science approaches such as practice theory can develop a richer understanding of how sports are experienced in everyday life, and hence what sustainability may mean for the ways in which most people engage with sport. Although it is true that elite-level sport has the highest emissions and climate impacts, Carmichael’s argument reminds us that there is a need to consider what climate change means for local- and community-level interactions through which the vast majority of people experience football globally. In turn, there may be a need for local, regional and national governments to consider more deeply what policy actions are required to ensure grassroots football can continue under the climate crisis. Further research and policy avenues in this area may include supporting lower-level clubs to mitigate and adapt to climate change in situations where they may be financially constrained or have limited control over their playing environment; exploring whether the sense of community and greater accessibility associated with smaller teams may offer greater opportunities for fan engagement in clubs’ pro-climate actions; and considered reflection on what fossil fuel sponsorship means for smaller clubs in carbon-intensive regions, and how questions of fossil fuels and sense of club identity may be handled as part of a just transition. Noting Bernard et al. (2021), however, existing qualitative and in-depth research into community-level sports teams in the scholarly literature is largely skewed towards European or north American cases, and would benefit from drawing in evidence (which may already exist but is not recognized in English-language scholarly exchange) from other regions of the world.

A fourth – and especially critical – research and policy requirement for football and climate change is that of gender. The majority of studies reviewed in this paper are implicitly concerned with men’s football (although see, for example, Orr and Ross (2022) who explicitly consider the climate implications of the 2027 Women’s World Cup). Across the climate policy literature, it is now well understood that people’s experiences of, and relation to, climate change can vary according to gender, across areas such as vulnerability to climate impacts, responsibility for emissions, unequal access to climate change governance and decision-making, and relations to knowledge and social action (e.g. Pearse, 2017). There is hence an urgent need for empirical research into how climate change may affect all aspects of women’s football specifically. In a policy context (e.g. league or tournament regulations or public health policy), this means not assuming impacts or responses will be the same as for men’s football, and developing regulations and protocols for managing extreme conditions that are sensitive to gender differences.

5. Conclusion

This review has identified four main areas where research has so far sought to make policy recommendations for a climate change response for football. The first of these is football’s impact on the climate. Evidence

suggests that travel, especially transportation, causes the bulk of football's greenhouse gas emissions, and that these emissions are disproportionately skewed towards larger clubs and tournaments. Reducing emissions through scheduling and better use of land transport is thus a climate policy priority for football. The second area is the climate's impact on football. Evidence indicates that extreme weather – especially heat – may have implications for player welfare. Planning and infrastructure investment is also necessary for venues and tournaments to cope with future weather extremes. A second climate policy priority area for football is thus protocols and standards to protect player welfare, and to plan for the resilience of venues and tournaments under weather extremes. The third area is the role of football as a catalyst for wider societal and behavioural change. Existing research illustrates that clubs and players can engage people who may not readily identify with pro-climate behaviours, and that the shared identity of fans around a team is something that clubs can tap into to promote climate awareness and action. It may be possible to align these campaigns with national or global climate policy objectives, in order to make an explicit link between football clubs' and fans' actions and climate policy objectives. The fourth area concerns the relations between football, fossil fuels and carbon-intensive industries. With growing public scrutiny of the role that fossil fuel money plays in elite football, there is a need for pathways and principles to address the role that activities harmful to the climate have in financing football. At the same time, though, as part of a just transition to a sustainable society, it is important to pay attention to and understand the links between fossil fuels, local identity and football in places that have traditionally relied on carbon-intensive industries for jobs and economic sustainability. A fourth climate policy priority for football is hence to develop principles for ethical financing under a climate crisis, and also to link football and regional identities into just transition policies for carbon-intensive regions.

Football and climate change is a new and fast-moving field of study. Potential avenues for further enquiry include greater explicit consideration of what climate change means for women's football; deeper engagement with evidence from countries whose first language is not English, and also/especially the Global South; and the development of robust principles for the rapid removal of fossil fuel money from football. Underpinning all of this is the need to remember that football is not a homogenous entity, and that as well as exemplars or best practices from elite clubs, it is imperative to understand what climate change means for the smaller-scale and community-level practices through which the majority of people globally experience football.

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