

Exploring the Financial Implications of Climate Change on Grassroots Sport

Prepared for the Department for Culture, Media & Sport (DCMS)

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About the authors



Alma Economics combines unparalleled analytical expertise with the ability to communicate complex ideas clearly.

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About the commissioning organisation



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Executive Summary

Alma Economics has been commissioned by the Department for Culture, Media & Sport (DCMS) to assess the financial and environmental challenges climate change poses to grassroots sport in the UK. This research analysed both the impacts of grassroots sport on the environment (strand 1) and the current and potential future impacts of climate change on grassroots sport (strand 2). It also explored the opportunities for reducing the impact that grassroots sport has on the environment, as well as adaptations that can be made to ensure the sector's long-term environmental and financial sustainability (strand 3).

A mixed-methods approach was used to provide a breadth of robust evidence assessing the relationships between climate change and grassroots sport. The study began with a literature review, with identified evidence gaps addressed through 20 stakeholder interviews with national governing bodies (NGBs) and grassroots sport organisations. In parallel, a system-wide carbon and financial model was developed to quantify both the impact of grassroots sport on the environment and the financial impact that climate change is likely to have on grassroots sport clubs.

Strand 1: Impact of the grassroots sport sector on the environment

The factors that make the most significant contribution to the grassroots sport sector's carbon footprint are travel to activities and energy use by sport facilities. Findings from the literature review and fieldwork indicated that travel is the primary cause of emissions, with participants and spectators often relying on cars rather than buses, trains, or other low-carbon forms of transport. Energy use by sporting facilities is another major source of emissions, as sports clubs often have significant energy requirements for the lighting, heating, and air conditioning of their facilities. Other potential impacts include emissions generated by building sports facilities and producing equipment, environmental impacts of chemical inputs and artificial surfaces, and waste from food and sportswear. It is important to note that the existing literature on the environmental impact of sport mostly focuses on professional sport, with more limited research on grassroots clubs.

Carbon footprint modelling estimates that the grassroots sport sector in England produced between 3 and 4 million tonnes of carbon dioxide equivalent emissions per year. To put these figures into perspective, this equates to roughly 1% of global sport emissions and 0.5% of total UK carbon emissions. This draws from quantitative modelling conducted as part of this project, with further information on the modelling approach outlined in the report. These figures only include certain sport types (court and field-based sports¹ and indoor swimming) and channels of impact (travel and facility energy use). The full environmental impact, including all sport and impact channels, will therefore be higher than estimated here.

¹ This includes tennis, badminton, squash, netball, basketball, handball, volleyball, football, cricket, rugby union, rugby league, hockey, lacrosse, rounders, and golf.

Strand 2: Impact of climate change on the grassroots sport sector

Climate change is having a significant impact on grassroots sport, with flooding, droughts, and heatwaves identified as the primary challenges facing community clubs.

More extreme weather leads to damaged facilities, facility closures, and substandard facility conditions. Most clubs that engaged in the research reported having to postpone or cancel events because of weather-related issues. The majority reported that extreme weather could cause significant damage to their facilities. Additionally, it was emphasised that climate-related disruptions often occur in succession, leading to cumulative long-term impacts for sport. Sport participants are also experiencing a wide range of impacts, including increased health risks, event disruptions, cancellations, and poorer-quality playing surfaces. These impacts are thought to be leading to a decline in participation in some sports, with knock-on impacts on health and wellbeing.

The key financial channels of impact include increased facility maintenance, repair costs, and lost revenue from reduced participation, event cancellations, and facility closures.

Overall, grassroots clubs acknowledge that they are increasingly allocating resources to address climate change issues.

Financial modelling estimates an annual financial impact on the grassroots sport sector of just under £320 million due to the impact of adverse and extreme weather events. This figure reflects current facility maintenance, repair costs, and potential revenue loss due to event cancellation from adverse weather. This figure focused specifically on field-based grassroots sport clubs, which are estimated to experience around £200 million in maintenance and repair costs and roughly £120 million in lost revenue associated with extreme weather events. Evidence suggests that climate change will increase the frequency and intensity of intense rainfall going forward, with a higher prevalence of flooding. Under a 2°C and 4°C rise in global temperature scenarios, the annual financial impact figure is likely to rise by a total of roughly **£95 million and £190 million, respectively.**

Strand 3: Climate change adaptation and mitigation strategies

Grassroots sport clubs are taking several measures to reduce their impact on the environment and adapt to changing weather patterns. Mitigation strategies include improving the energy efficiency of facilities, utilising renewable energy sources, promoting more sustainable travel means, reusing sport kits, implementing reuse and recycling programmes, and enhancing biodiversity. Adaptation strategies include aiding sport participation in extreme weather by providing shade, air conditioning, sunscreen, and water or changing timings of events. To the extent that mitigation and adaptation are unsuccessful, there are likely to be negative impacts on the amount of grassroots sporting activity, which is likely to have knock-on health impacts for individuals who no longer participate in sports.

Clubs face key barriers to implementing sustainability measures, with financial constraints being a primary challenge. Additional barriers include a lack of knowledge and awareness regarding climate adaptation and mitigation strategies, limited staff capacity to drive sustainability initiatives, and varying levels of commitment to net-zero goals. Furthermore, challenges arise from not owning facilities and dealing with ageing or outdated infrastructure.

Recommendations

Recommended Interventions

- **Provide guidance and support to help grassroots sport clubs understand the scale of their environmental impact.** Improved data collection is essential, which could be improved through standardised templates, including tools for measuring clubs' carbon footprint.
- **Provide support to help grassroots sport organisations overcome barriers to implementing sustainability measures.** This includes (i) providing accessible grants, (ii) providing practical information on cost-effective sustainability initiatives, and (iii) facilitating knowledge-sharing on best practice between clubs, businesses, and charities.
- **Provide targeted support to grassroots sport clubs based on their climate risk level.** This could be based on a climate risk index² for grassroots clubs to guide funding and support allocation.

Recommendations for future research

- While this research examined grassroots sport as a whole, a deeper dive into specific sports could provide more detailed insights. Furthermore, the carbon footprint and financial model could be extended to include further climate and financial impacts and sport types.

² A climate risk index is a tool used to assess the level of vulnerability and exposure of grassroots clubs to climate-related hazards, such as storms, floods, heatwaves, and droughts. This index could consider factors such as the type of sport played, club size, geographical location, and the number of climate-related issues the club has faced in the last year.

Impact of the grassroots sport sector on the environment

The key environmental impact of grassroots sport comes from travel to activities and energy use by sport facilities.

Other potential impacts include:



1

Emissions generated by the construction of sports facilities and the production of equipment



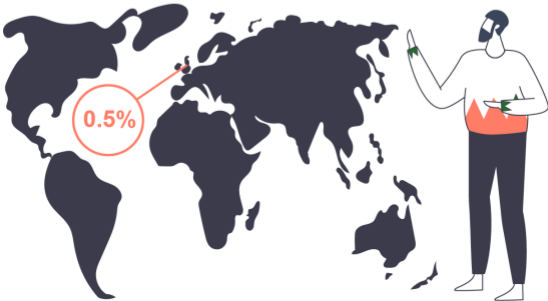
2

The environmental impacts of chemical inputs and artificial surfaces



3

Waste from food and sportswear



Carbon footprint modelling estimates that the grassroots sport sector in England produced between 3 and 4 million tonnes of carbon dioxide equivalent emissions per year

CO₂
3-4
million tonnes

This equates to roughly

1%
of global sport emission

0.5%
of total UK carbon emissions

Impact of climate change on the grassroots sport sector

Climate change is significantly impacting grassroots sport, with flooding, droughts and heatwaves identified as the primary challenges facing community clubs.



The key financial channels of impact



The key financial channels of impact include increased facility maintenance and repair costs and lost revenue from reduced participation, event cancellations, and facility closures.

Financial modelling estimations



£320
million per year

+2°C → £95
+4°C → £190
Temperature million per year

Financial modelling estimates an annual financial impact to the grassroots sports sector of just under £320 million per year due to the impact of adverse weather.

Under a 2°C and 4°C rise in global temperature scenarios, the annual financial impact figure is likely to rise by a total of roughly £95 million and £190 million respectively.

Chapter 1: Introduction

Alma Economics was commissioned by the Department for Culture, Media & Sport (DCMS) to assess the financial and environmental challenges climate change poses to grassroots sport in the UK.

Through an evidence review, stakeholder engagement, and a carbon and financial impact model, this research paper analysed both the current and potential future impacts of climate change on grassroots sport, as well as how grassroots sport, in turn, impacts the environment. It also explored the opportunities for reducing the impact that grassroots sport has on the environment, as well as the potential adaptations that can be made to ensure the sector's long-term environmental and financial sustainability.

1.1. Rationale

The climate in the UK has been experiencing changes in recent decades, including rising temperatures and increased rainfall. As a result, the grassroots sport sector is already seeing an impact ranging from more frequent waterlogged or flooded pitches to coastal erosion at many of the UK's golf courses.

These effects, in turn, have financial implications for grassroots sport, with unusable facilities and cancelled events impacting revenue streams for clubs. At the same time, grassroots clubs are incurring increasingly higher costs for maintaining and repairing facilities due to the rising frequency of adverse weather events. This places additional financial strain on grassroots clubs, which already operate on tight budgets.

As the effects of climate change increase, so will the costs of inaction. It is therefore vital that there is a robust evidence base that can inform interventions to help grassroots sport overcome existing barriers and adapt to the impacts of climate change while furthering the sector's financial sustainability.

1.2. Objectives and scope of the project

This research aimed to better understand how changing weather patterns are affecting the financial sustainability of the grassroots sport sector and how the sector is adapting to climate change.

To inform this, Alma Economics carried out primary and secondary research, including a review of the existing literature and stakeholder engagement with national governing bodies and grassroots sport clubs. Furthermore, as part of this project, Alma also produced a modelling setting out the financial impacts of climate change and the carbon footprint of grassroots clubs. This research was split into three strands.

Table 1. Project strands and research questions

Strand	Research questions
Strand 1 - explored the impact of the grassroots sport sector on the environment.	a) What is the estimated impact of the grassroots sport sector on the environment? b) What is the carbon footprint of the grassroots sector?
Strand 2 - evaluated the current and anticipated impacts of climate change on grassroots sport clubs and their facilities, with an emphasis on the financial impacts.	a) What are the current and anticipated impacts of climate change on grassroots sport and their facilities? b) What are the short-, medium-, and long-term financial implications of climate change on grassroots organisations and their facilities?
Strand 3 - determined the sustainability measures that have already been put in place within grassroots clubs to help them adapt to climate change, the measures that could be adopted in the future, and the barriers that limit grassroots clubs from implementing these adaptations.	a) What sustainability measures have already been put in place by grassroots clubs to help reduce their environmental impact? b) What sustainability measures have already been put in place in grassroots clubs and organisations to help them adapt to climate change? c) What are the benefits of these measures? d) What are the barriers grassroots sport faces to improving its environmental and financial sustainability? e) What measures could grassroots sport facilities and clubs put in place to help adapt to the impacts of climate change? How could NGBs help them? How would these measures support the long-term financial sustainability of grassroots sport?

1.3. Report structure

The remainder of the report presents the findings of the REA and interviews, organised into the following chapters:

- **Research methodology (Chapter 2).** This chapter describes the methodology used to answer the research questions, including a literature review, stakeholder engagement with national governing bodies and grassroots sport clubs, and carbon and financial modelling.
- **Impact of the grassroots sport sector on the environment (Strand 1, chapter 3).** This chapter outlines findings from the literature and interviews on how grassroots sport facilities and participants are currently impacting the environment. The results from the carbon footprint model are also included in this chapter.

- **Impact of climate change on the grassroots sport sector (Strand 2, chapter 4).** This chapter maps the existing effects of changing UK weather patterns on facilities and the ability of participants to take part in grassroots sport. It also highlights the financial implications of climate change for grassroots sport clubs, including the results from the financial model.
- **Climate change adaptation and mitigation strategies in grassroots sport (Strand 3, chapter 5).** This chapter examines how grassroots clubs are working to reduce their impact on the environment and the measures they are taking to adapt to the challenges posed by adverse weather patterns. It also outlines a set of measures that grassroots sport organisations can implement to adapt to climate change or mitigate its effects.

Chapter 2: Methodology

- A mixed-methods approach was used to provide a breadth of robust evidence assessing the relationships between climate change and grassroots sport.
- The study began with a review of the existing literature to identify relevant published evidence. This analysis included 29 papers.
- The gaps identified were addressed through stakeholder engagement with national governing bodies (NGBs) and grassroots sport organisations. In total, 20 interviews with stakeholders were carried out. This included ten from NGBs and ten from grassroots sport organisations. Additionally, two written responses to our questions from two additional grassroots sport organisations were received.
- The literature review and fieldwork addressed the research questions across all three strands of the report.
- In parallel, a system-wide carbon and financial model was developed to quantify both the impact of grassroots sport on the environment and the financial impact that climate change is likely to have on grassroots sport clubs. The carbon model quantified the impact of the grassroots sport sector on the environment (Strand 1), while the financial model monetised the impact of climate change on the grassroots sport sector (Strand 2).
- It is important to highlight that climate change is affecting all forms of movement and participation, not just traditional sports. While this research focused on specific sports due to literature and stakeholder availability, many findings from the literature review, fieldwork, and models are relevant to the broader sport and physical activity sector.

2.1. Literature review

In the first stage of the study, a literature review was carried out to explore the academic and grey literature, focusing on the relationship between grassroots sport and climate change. This developed a strong understanding of the current evidence base and meant that gaps were identified to be addressed through primary research.

Initial papers were found via online searches of academic databases and searches of relevant sporting organisations. Snowballing of relevant papers from citations was then used to extend the search and obtain a comprehensive overview of 29 papers. Most of these were published by domestic or international sporting organisations, such as the British Association for Sustainable Sport (BASIS), Sport England, and the International Olympic Committee (IOC). In addition to these grey literature sources, several academic papers relevant to the topic were also reviewed.

An online evidence map was created to provide easy access to the literature reviewed. This allows users to explore relevant studies and filter by key criteria, such as type of sport. Additionally, logic models were developed to demonstrate the key channels of the impact of grassroots sport on the environment and the financial impacts of climate change on grassroots sport.

2.2. Stakeholder engagement

Following the literature review, sector experts were engaged to explore the relationship between climate change and financial sustainability in the sports sector, as well as address the gaps identified in the literature review. Furthermore, quantitative data was gathered from stakeholders to inform the financial and carbon modelling.

NGBs and grassroots sport clubs across England were consulted. In total, 20 interviews with stakeholders were carried out. This included ten from the NGBs and ten from grassroots sport organisations. Additionally, two written responses to our questions from two additional grassroots sport organisations were received. A complete list of the NGBs and grassroots sport organisations that participated in the research is provided in Annex 1.

The interviews with NGBs focused on their role in providing funding for sustainability projects and sharing knowledge on how clubs can better adapt to climate change. NGBs were also able to provide contact details for grassroots clubs and facilitate discussions with them. Interviews with grassroots clubs then provided detailed accounts of the extent to which these organisations are impacted by climate change and the range of measures being implemented to adapt to changing weather patterns.

2.3. Sampling approach

Given that the impact of climate change is likely to vary depending on a range of factors, such as facility type, geographic location, and the socio-economic profile of surrounding areas, a diverse sample of organisations was purposely recruited. The sampling specification was based on characteristics central to understanding the financial implications of climate change across the grassroots sport sector. This included ensuring that a range of different clubs and NGBs were interviewed, including a mix of location (urban/rural), prosperity of the surrounding area, and sport typology. This report divided popular UK sports into five main typologies:

- Court Sports, such as netball and tennis
- Field Sports, such as football and cricket
- Indoor water sports, such as swimming
- Outdoor water sports, such as rowing or sailing
- Multi-use open space sports, such as running and cycling

2.4. Carbon Modelling

A carbon footprint model was developed to quantify the estimated impact of grassroots sport on the environment. The modelling focused on the three main typologies: court-based sports, field-based sports, and indoor water sports. The model primarily considered (i) the emissions generated through the travel of participants and spectators to sporting activities and (ii) the emissions generated from the electricity and gas usage in powering sports facilities. Data required for the model was obtained through both publicly available sources (found through online searches and the literature review) and data obtained through stakeholder engagement with NGBs and grassroots sport clubs.

Travel emissions were estimated by modelling the average emissions per participant in each typology, based on transport mode, emission factors, distance travelled to events, and travel frequency. These figures were then aggregated across the total number of regular sports participants in each typology. To quantify the emissions produced by facility energy used, total emissions generated by both electricity and gas usage for a single 'typical' (stylised) sports club in each typology were quantified. This considered the typical facility size, type (indoor/outdoor), and seasonal variation in energy usage. This figure was then aggregated by the total number of clubs in each typology.

2.5. Financial Modelling

For field-based sports, a financial model was constructed to calculate the two key financial implications of climate change on grassroots sport clubs. The main financial impacts come from (i) increased facility maintenance and repair costs and (ii) reduced revenues due to event cancellations.

To approximate how these costs might increase as climate change progresses, different climate scenarios, under which the frequency of extreme weather events varies, were developed. This principally involved understanding how the risk of flooding is likely to increase under different projections of rising average global temperatures over the remainder of the century. Proxies for the current and expected cost of increased maintenance and fixture cancellation were gathered through stakeholder engagement activities and searching publicly available data sources. This was then combined with the number of sports facilities by location to estimate the likelihood of extreme weather affecting grassroots sport facilities in the future and the likely implications of this on club finances.

Chapter 3: Impact of the Grassroots Sport Sector on the Environment

- The existing literature on the environmental impact of sport mostly focuses on professional sport, with limited research on grassroots clubs. Although literature focusing on non-professional sport was identified, the specific impact of grassroots sport on the environment is a clear gap. While professional and grassroots sport share some important aspects when considering environmental impact, there are also several areas where the two diverge. Key differences include the scale of participation, number of spectators, and extent of travel, including international travel.
- The literature identifies several ways in which grassroots sport may impact the environment. Travel to activities is highlighted as the primary cause of emissions, with participants and spectators often relying on cars for their travel needs. Gas and electricity use by sporting facilities is another major source of emissions, as sports clubs often have significant energy requirements for the lighting, heating, and air conditioning of their facilities. The production of waste, such as food waste at events and old sportswear, was identified as another relevant channel. Other potential impacts found within the literature include (i) emissions generated by the process of building sports facilities and producing equipment, and (ii) the impact of chemical inputs and artificial surfaces on biodiversity.
- These findings were supplemented with interviews conducted with representatives from NGBs and grassroots sport organisations to provide specific evidence on this issue within the grassroots sport sector. Overall, most stakeholders identified travel and transportation, energy use, and waste production as the main ways in which grassroots sport organisations impact the environment.
- Results from modelling suggest a significant carbon footprint for the grassroots sport sector. Central estimates give total carbon emissions produced annually as just over four million tonnes of CO₂e, equivalent to roughly 0.5% of UK carbon emissions. This is primarily driven by facility usage, particularly for court sports and indoor water sports, alongside travel emissions.

This chapter examines the negative environmental impact of sports. It begins with an overarching description of the findings of the literature before delving deeper into each specific channel of impact. The chapter reviews evidence on how emissions are generated in sport, such as through travel to activities, facility energy use, venue construction, and the production of equipment and sportswear. It also discusses additional impacts that sport has on the environment, such as the consumption of food and beverages, the production of waste, and other factors that may affect wildlife and biodiversity. To contextualise these findings within the UK, insights from the engagement with NGBs and grassroots sport organisations have been integrated into each impact channel. Finally, carbon footprint emissions are estimated for the grassroots sport sector.

3.1. Overarching findings

In recent years, the environmental impact of elite sports has been a growing focus of research. According to a report by Goldblatt (2020), global sports contribute an estimated 300 to 350 million tonnes of carbon emissions annually, accounting for approximately 0.6% of global emissions.

While the impact of elite sports has been widely documented, much less is known about the environmental impact of the grassroots sport sector. While non-professional sports clubs may not attract the large crowds seen in elite events, their cumulative impact may be significant. As Carmichael (2020) mentioned, weekly participation in grassroots sport often involves hundreds or thousands of attendees, many of whom travel to venues, contributing to greenhouse gas emissions before the games even begin (Wicker, 2019). Grassroots activities frequently involve long-distance travel by private vehicles (Wicker, 2019; McCullough et al., 2018), a factor that becomes increasingly relevant as people show a greater willingness to travel longer distances for sports and recreational activities (McCullough et al., 2018). Understanding and addressing these impacts is critical to fostering sustainable practices in the sector.

Sport England, Sport Scotland, and Sport Wales (2023) conducted a consultation in 2023 to understand current challenges, opportunities, and support needed from grassroots sport organisations to accelerate action on environmental sustainability. As part of the consultation, an online survey was distributed to grassroots clubs/organisations/groups, obtaining 475 responses from across Great Britain (GB) and encompassing 76 different sports. This was complemented by interviews and focus groups with relevant stakeholders. When asked about the environmental impacts of grassroots sport, the respondents highlighted that the main impacts include car dependency, i.e., the fact that people travel by car to get to clubs (cited by 58% of respondents) and extensive use of gas and electricity (cited by 50% of respondents). Other activities mentioned include waste-related issues, such as littering, lack of recycling facilities or collection services, short lifespans of sport kits and equipment, food and drink consumption, chemical use, and biodiversity loss and damage.

These findings align with the findings from the literature, which show that sports activities contribute to climate change through various pathways. Greenhouse gas emissions are a major contributor, driven primarily by travel, energy use (Hawkings et al., 2023; Goldblatt, 2020; Abu-Omar, 2022; IOC, 2018; McCullough et al., 2018), venue design and construction (IOC, 2018), the production of equipment and materials (Wilby et al., 2022), and food, beverage, and waste management (Schneider & Mücke, 2021; McCullough et al., 2018). In addition, some sports practices, such as the use of chemicals and artificial turf, can harm local biodiversity (Darnell & Millington, 2023; McCullough et al., 2018).

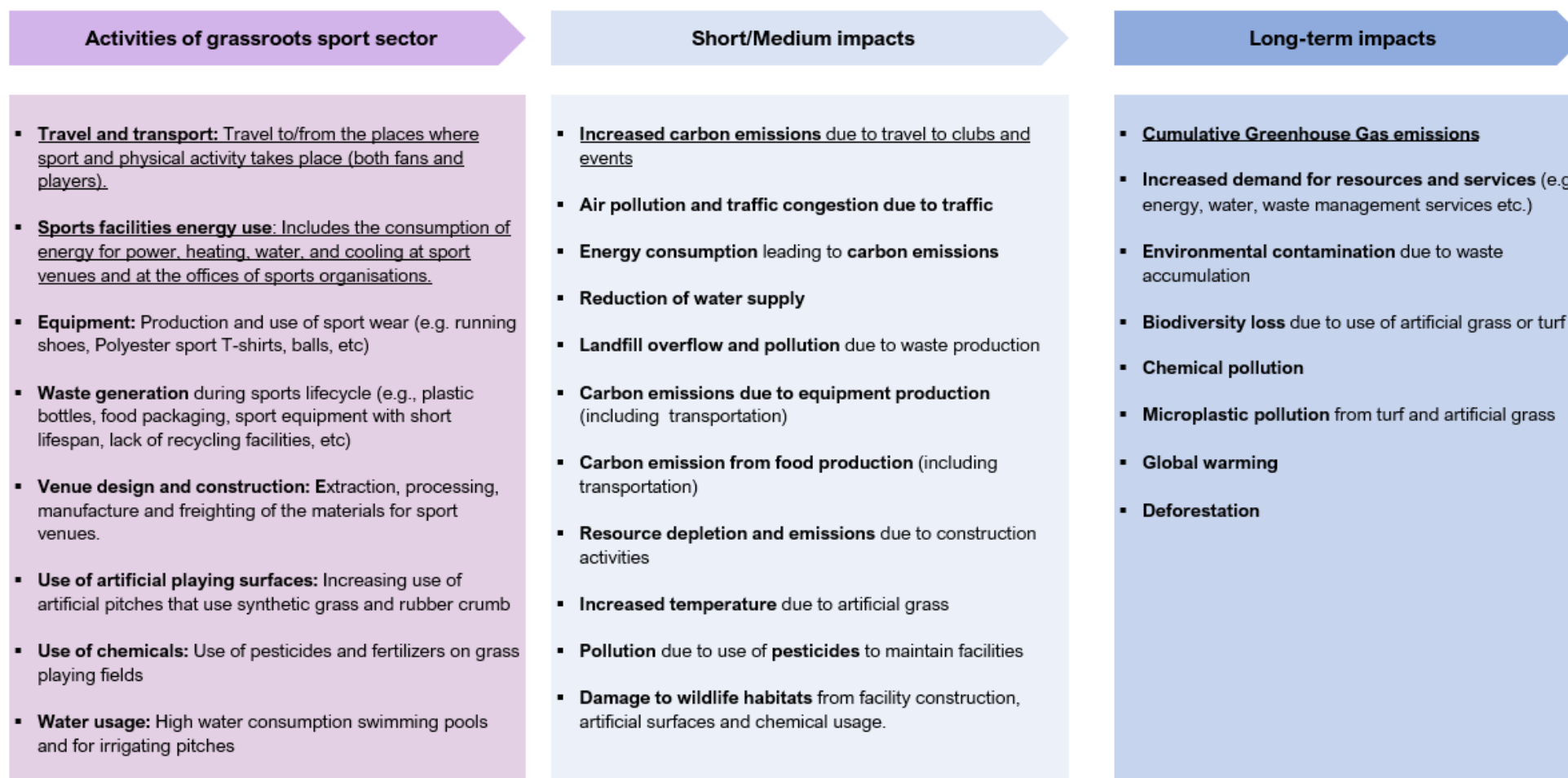
Greenhouse gas emissions in sports can be categorised as either direct or indirect within three scopes (The International Olympic Committee, 2018; New Weather Institute, 2025). The main difference is that direct emissions are fully controlled by sports organisations, while indirect emissions are not. In particular, the report identifies three main types of emissions that should be taken into account when analysing the carbon footprint of sport organisations:

- **Scope 1:** Direct emissions - this includes fuel combustion in owned machines, devices, and vehicles.
- **Scope 2:** Indirect energy emissions - due to the generation of electricity used in an organisation's buildings.
- **Scope 3:** Indirect emissions from upstream and downstream activities - this includes travel and purchased goods and services.

Figure 1 sets out a logic model, which outlines how activities undertaken by grassroots organisations impact the environment. The next section provides further details on the activities that generate greenhouse gas emissions.

Figure 1. Impact of the grassroots sport sector on the environment

This diagram shows the key channels through which grassroots sport has an environmental impact. The channels that have been underlined are included in the carbon footprint modelling analysis, discussed in section 3 of this chapter.



3.2. Activities that generate greenhouse gas emissions

As mentioned above, research on the environmental impact of sport activities has primarily focused on elite sports. Some of the impacts of professional sport may not always be relevant to the context of grassroots sport, such as the greater impact of spectators and differences in the size of sporting facilities. However, there are many areas, such as the transport of players and equipment, the production of sportswear and equipment, and the generation of waste, that are present in all forms of sport. Therefore, research on professional sport is used to supplement studies that specifically examine grassroots sport's impacts on the environment. Additionally, insights from the engagement with NGBs and grassroots sport organisations have been incorporated to provide specific evidence on this topic for the grassroots sport sector in the UK.

3.2.1. Travel and transport

Many authors have identified that in the elite and professional sector, travel and transportation by players and spectators are the primary contributors to greenhouse gas emissions associated with sports activities. In the elite sport sector, the movement of people and equipment to and from event venues represents a substantial source of emissions. For example, McCullough et al. (2018) highlighted that travel and transportation accounted for 75% of the total ecological footprint of the UK stages of the 2007 Tour de France and 12% for the 2013 European Athletics Indoor Championships in Gothenburg. The New Weather Institute (2025) provides additional examples from UK football, noting that spectator travel accounted for 85% of carbon emissions for Wolverhampton Wanderers FC in the 2021-22 season and 48% of carbon emissions for Tottenham Hotspur FC in the 2022-23 season. However, McCullough et al. (2018) note that research on the environmental impact of travel and transportation associated with grassroots sport organisations remains limited.

Focusing specifically on grassroots sport, Wicker (2019) conducted an online survey of 6,537 adult active sports participants in Germany across 20 sports to analyse their sport-related travel behaviours in 2015. Participants reported their travel activities related to regular weekly sessions, competitions, tournaments, league games, day trips, and training camps or vacations. Using the provided data on travel distances and modes of transportation, annual carbon footprints were calculated for different types of sports. The average annual sport-related carbon footprint across the full sample was 844 kg CO₂e, representing 7.7% of the average annual carbon footprint of an average German resident, estimated to be at 11,000 kg CO₂e (Table 2).

While Wicker's research seems to suggest that overall, sport-related travel constitutes a relatively small share of total emissions by residents, some sports, such as diving, golf, and surfing, had significantly higher carbon footprints, exceeding 2,000 kg CO₂e. These accounted for approximately 18% of the average annual emissions of the average German resident, highlighting that some sports have a higher environmental impact than others. Additionally, the paper highlights that individual sports have a higher carbon footprint than team/racket sports because the travel distances are usually longer to participate in individual sports, and it is more difficult to organise shared transportation.

Table 2. Carbon footprint (CF) of travel activities from different sports

Sport	CF Total³	CF regular⁴	CF competition⁵	CF league⁶	CF day trip⁷	CF vacation⁸
Surf sports	20074	176	46	-	366	1487
Diving	2841	115	-	-	135	2591
Golf	2195	566	162	-	93	1374
Figure/roller skating	1238	687	436	-	16	100
Climbing	1156	634	7	-	119	400
Hiking/walking	901	396	-	-	85	420
Field hockey	874	530	72	235	-	38
American football	842	667	11	141	-	24
Triathlon	775	183	282	-	-	310
Skateboarding	718	374	33	-	105	206
Basketball	681	442	37	198	-	5
Swimming	623	313	166	-	-	144
Handball	405	219	19	156	-	12
Volleyball (indoor)	405	248	52	95	-	10
Table tennis	393	232	47	103	-	11
Track and field	362	135	156	-	-	71
Football (soccer)	337	231	20	74	-	13
Headis⁹	267	99	168	-	-	-
Tennis	243	156	32	34	-	21
Fitness (gym)	228	159	9	-	-	60
Full sample	844	356	78	121	123	338

Source: Wicker (2019)

³ CF total: individual annual carbon footprint of sport-related travel (in kg CO₂e)

⁴ CF regular: Carbon footprint for regular (weekly) activity (in kg CO₂e)

⁵ CF competition: Carbon footprint for competitions and tournaments (in kg CO₂e)

⁶ CF league: Carbon footprint for league games (in kg CO₂e)

⁷ CF day trip: Carbon footprint for day trips (in kg CO₂e)

⁸ CF vacation: Partial carbon footprint for vacations/training camps (in kg CO₂e)

⁹ Headis is a mix of table tennis and the heading of association football.

Findings from the literature were supported by fieldwork conducted for this project, with most NGBs and grassroots sport organisations highlighting that travel and transport are significant contributors to carbon emissions in the grassroots sport sector. Travel demands vary by sport and often involve long distances to access facilities, a reliance on travel by car due to limited public transport options, and frequent air travel for events. More specifically, stakeholders mentioned that i) cricket clubs require large playing fields, which limits facility availability and results in longer travel distances for players, ii) many paddling locations are not easily accessible via public transport, making travel emissions more significant, iii) air travel is common for major athletics competitions and events, iv) while tennis players often walk or cycle to local courts, they tend to travel farther for indoor facilities, and v) transporting rowing boats is particularly energy-intensive, adding to the sport's carbon footprint.

Additionally, several factors were identified that influence the impact of travel-related emissions. For example, smaller clubs tend to have lower emissions since their matches are typically played locally. However, as clubs advance to higher leagues, travel demands may increase. It was also suggested that clubs based in rural areas, or with a predominantly rural membership, can have higher transport-related carbon emissions, as they often rely on private cars due to the difficulty of car-sharing in dispersed communities. Finally, it was highlighted during the interviews that junior teams often depend on parents for transportation, making it harder to encourage public transport use.

3.2.2. Use of energy

The second largest source of carbon emissions in sporting activities in general is related to the use and maintenance of facilities and offices managed by grassroots sport organisations (IOC, 2018). These facilities require energy for essential functions, such as lighting, heating, and air conditioning, to accommodate sport participants and staff. In some cases, specific sports require more intense use of energy. For instance, ski resorts are increasingly dependent on the production of artificial snow, which, even when powered by renewable energy, consumes a substantial amount of energy. This process not only incurs high energy consumption but can also place significant strain on water resources (Orr et al., 2022), as approximately one cubic meter of water is needed to produce around 2.5 cubic meters of artificial snow (Symonds, 2024).

Several interviewees noted that energy use from grassroots sport organisations contributes to carbon emissions through i) lighting, heating, and cooling of facilities, ii) showers, kitchens, and club amenities, iii) electronic systems such as scoreboards and iv) ground maintenance machinery, including lawnmowers, rollers, and irrigation systems. It was also highlighted that energy consumption extends beyond sporting activities. Many community facilities are also used for concerts, weddings, and other events, increasing demand for power.

Interviewees also noted that many clubs operate in outdated and inefficient buildings, which exacerbates energy challenges. For example, most swimming pools in the UK are over 40 years old, making them environmentally unsustainable. Swimming pools and ice rinks, in particular, were cited as highly energy-intensive facilities. Furthermore, some community club facilities are owned and managed by local authorities, who oversee energy costs and monitoring. As a result, clubs often lack direct control over their energy consumption, limiting their ability to implement efficiency measures.

3.2.3. Venue design and construction

The IOC (2018) report highlighted that another significant source of carbon emissions arises from the extraction, processing, manufacturing, and transportation of materials required to construct new sports venues or make improvements to existing ones. Materials such as steel and concrete are prime examples. While these emissions are associated with one-time construction projects rather than the day-to-day operation of the venues, the report mentions that it can take several years of operation for the everyday environmental impacts to match the emissions generated during the initial construction phase.

3.2.4. Equipment and materials

When a club is organising a sporting event, they will most likely require equipment and materials to prepare and set up the venue for the event day. This often involves setting up temporary structures, such as spectator stands, broadcast areas, catering facilities, toilets, and other services. While many of these items are rented, any custom-made materials purchased, used, and discarded will significantly contribute to an organisation's carbon footprint. This includes the acquisition of sports equipment and uniforms for athletes, staff, and officials. The environmental impact is particularly high when these items are designed for single use, such as event-specific branded clothing (IOC, 2018).

3.2.5. Food and beverage

The IOC (2018) highlights that sports organisations contribute to carbon emissions through the purchase of food and beverages for events. The impact is particularly significant for foods with high carbon footprints, such as meat, and when large quantities of water are distributed during the events. Food transportation and packaging are also included in this category.

3.2.6. Waste

Lots of waste can be generated during the lifecycle of sports events, including plastic bottles, food packaging, and sports equipment with a short lifespan; when this waste is disposed of in landfills, it contributes to additional greenhouse gas emissions (Schneider & Mücke, 2021; McCullough et al., 2018; IOC, 2018).

This was echoed by several interviewees, who mentioned that waste from club bars, kitchens, and general clubhouse activities is common across all types of sports, and single-use plastics are frequently used at events.

3.2.7. Sportswear

Wilby et al. (2022) noted that while individual sport equipment, such as running shoes, may seem to have a relatively small effect on carbon emissions, the impact becomes more evident when it is considered that around one billion pairs are sold globally each year (although the exact number used for sports is unclear). To this end, the authors provide estimates for the carbon footprint of the entire lifecycle of various types of sports equipment, including a pair of skis (0.045 tons CO₂e), a polyester sports T-shirt (0.082 tons CO₂e), and a pair of running shoes (0.014 tons CO₂e). For comparison, a short flight from London to Edinburgh emits 0.15 tons CO₂e (Haddon, 2020).

Some of the interviewees pointed out that sport kits and equipment used by members of grassroots sport clubs, such as balls, clothing, and footwear, are not environmentally sustainable. These items typically have short lifespans and require frequent replacement, contributing to waste.

3.2.8. Other types of environmental effects

Research has also examined the broader environmental consequences of various sports, extending beyond carbon emissions to their effects on local ecosystems, such as local wildlife, plants, and insects. Indeed, some sports activities lead to alterations in landscapes, as well as air, water, and noise pollution, and may involve the use of chemicals for maintenance and pest management (Darnell & Millington, 2023).

Artificial snow, for instance, can negatively affect biodiversity, hinder plant growth, and increase water runoff, potentially causing flooding (Orr et al., 2022). Moreover, turf maintenance often requires machinery powered by fossil fuels and the application of chemicals, which can further damage biodiversity and soil quality (Carmichael, 2020). Increased noise from machinery and vehicles, along with traffic congestion caused by participants and spectators travelling to events, can contribute to noise pollution, disrupting the behaviour of local wildlife (McCullough et al., 2018).

During the interviews, some stakeholders mentioned that the artificial turf used in some grassroots sport clubs contributes to microplastic pollution.

3.3. Carbon footprint modelling

This section outlines the results from the carbon footprint modelling. The carbon model aimed to put a figure on the total carbon dioxide equivalent emissions produced by grassroots sport in England annually and hence determine the sector's carbon footprint.

3.3.1. Approach

To estimate the carbon footprint of grassroots sport in England, two main channels were considered: (i) emissions due to participant travel and (ii) emissions for sport facility energy usage.

- Out of the eight channels of environmental impact identified earlier in this report, these two channels were selected as both the literature and stakeholder engagement identified these as key factors in grassroots sport's contribution to climate change. Furthermore, these channels were where data were most readily available, and hence they were the most practical channels to model. The data used in the modelling were obtained through both stakeholder interviews and searches of publicly available data sources. Where there was limited data, informed assumptions were made based on available evidence.
- Travel emissions of a typical participant in each typology were determined using data on a range of factors. These included the mode of transport used, distance travelled, season length, frequency of travel, and transport mode emission factors. This figure was scaled up by the total number of regular sport participants for each sport to find the travel emissions for the sector as a whole.
- The carbon footprint of sport facilities was also examined for each typology, with multiple different facility types considered. Through varying approaches, the yearly usage of

electricity and gas was calculated, and emission factors were used to find the typical carbon dioxide emissions for each facility type. This was aggregated by the estimated number of such sporting facilities in the country to determine the total emissions produced by sports facilities.

Three different sport typologies were modelled to account for differing impacts for different sport types: i) court-based sports, ii) field-based sports, and iii) indoor water sports. These were identified as sports likely producing larger quantities of greenhouse gas emissions in comparison to other types of sport, such as running, cycling, and outdoor water sports.

3.3.2. Results

The model generated three different estimates of the yearly carbon footprint of the grassroots sport sector in England, with a high, central, and low estimate calculated to account for uncertainty in some of the model parameters. The central estimate put the **estimated total carbon footprint produced by the grassroots sport sector at 4.1 million tonnes of carbon dioxide equivalent emissions per year**. This figure ranged from 3.3 million tonnes in the low scenario to 5.5 million tonnes in the high scenario.

To put these figures into perspective, the carbon footprint of global sport has been estimated at roughly 350 million tonnes annually (Goldblatt, 2020), whilst total yearly UK carbon emissions are 705 million tonnes (ONS, 2024). This puts the model's central **grassroots sport in England's carbon footprint estimate as equal to roughly 1% of global sport emissions and 0.5% of total UK carbon emissions**.

The results show the breakdown of emissions by typology and emission type. **Field-based sports are found to produce significantly lower total emissions than court-based and indoor water sport typologies**. Court-based sports emissions are particularly high when emissions are considered per participant. A typical court-based sport player will produce 640 kg of carbon emissions per year, compared to 255 kg and 330 kg for field-based and indoor water sport participants, respectively. It should also be noted that court-based sport emissions vary greatly between indoor and outdoor facilities. Whilst a typical single outdoor tennis court produces only 570 kg of CO₂e annually, an indoor tennis centre can generate nearly 160,000 kg of CO₂e, and an indoor sports hall produces close to 120,000 kg each year.

The varying environmental impact can be better understood by breaking down total emissions into travel and facility emissions. **Court-based sports and indoor water sports produce a significantly higher proportion of their emissions through facility use when compared to field-based sports**. Results suggest that facility emissions make up 86% and 71% of court-based sports and indoor water sports emissions, respectively. The figure is, however, only 51% for field-based sports. This likely reflects the significantly higher energy usage for indoor facilities, which are more prominent in court-based and indoor water sports than in field sports. It should also be noted that the high emissions produced by court-based sports come from the large number of facilities rather than from the levels of emissions per facility. Field-sports, on the other hand, typically will only have facilities that produce emissions from off-field facilities, such as clubhouses or changing rooms, or from the use of pitch floodlighting. Field-based sports, however, have the highest levels of travel emissions among all sport typologies. This is driven primarily by field-based sport participants, typically travelling larger distances to participate in sport fixtures.

3.3.3. Limitations

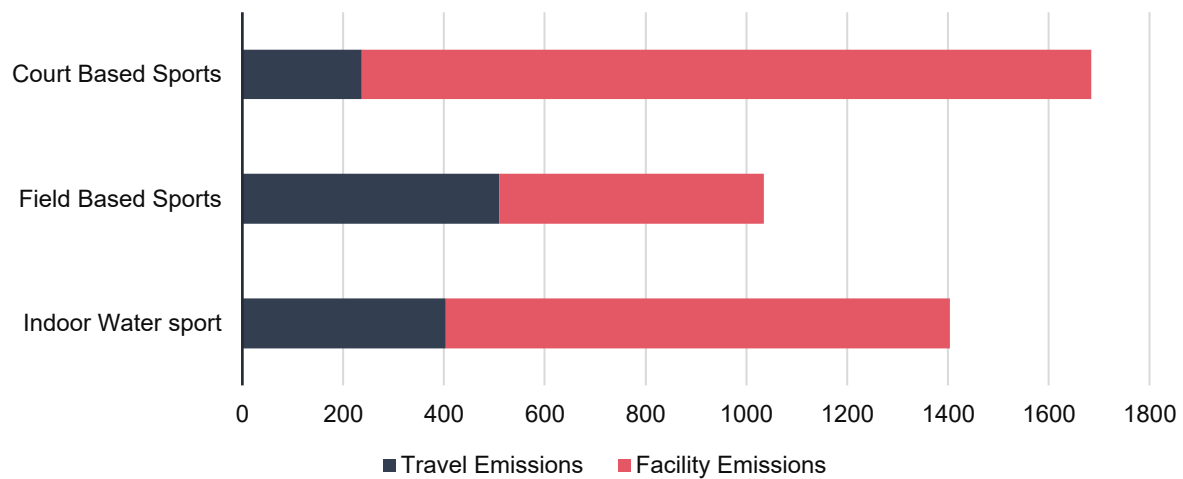
It should also be noted that the modelling aims to give a stylised estimate of the environmental impact of grassroots sport. The model provides a quantitative estimate of the main channels of impact rather than a precise or comprehensive estimate. Sports that are not typically played on courts, fields, or indoor swimming pools were not included. This includes a range of sports from athletics and cycling to boxing and motorsport. Furthermore, the model only examines the two main channels of travel and facility emissions. As identified in this report, there are several other channels through which grassroots sport impacts climate change, such as emissions produced in the construction of facilities and the manufacture of sports equipment and clothing. This model, therefore, likely provides a relatively conservative estimate of the total impact of grassroots sport on the climate.

Furthermore, in certain areas, data was limited, and assumptions and approximations had to be made based on the evidence that was available. The outputs of the model can therefore only be considered rough estimates of the climate impact of grassroots sport. The modelling, however, shed light on the approximate impact of grassroots sport on the climate and added to an area of the literature that is currently very limited. A more detailed account of how the model was constructed and its limitations is available in Annex 2.

Table 3. Aggregate Grassroots Sport Emissions ¹⁰

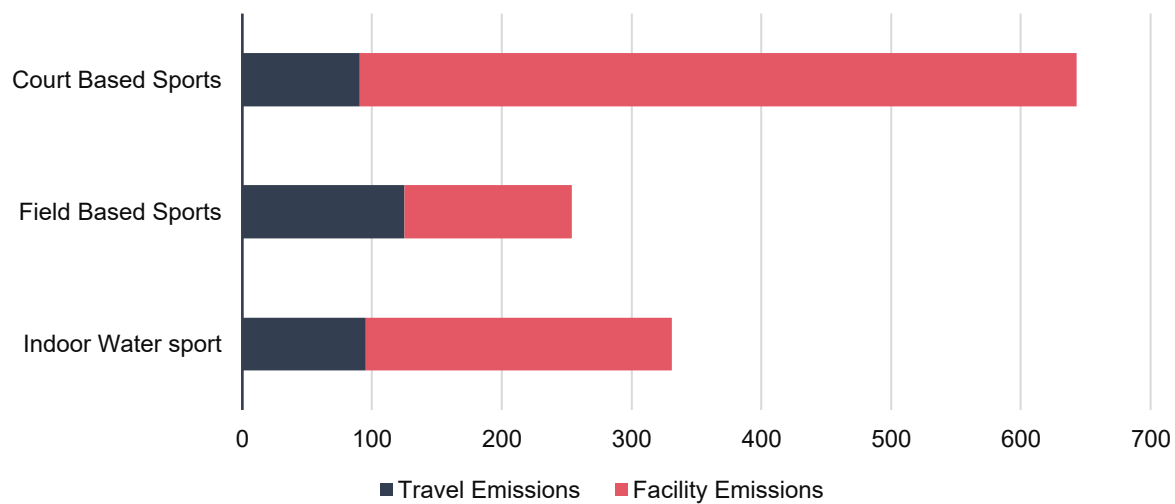
	Travel Emissions (tCO ₂ e)	Facility Emissions (tCO ₂ e)	Total Emissions (tCO ₂ e)
Central Scenario	-	-	-
Court-Based Sports	240,000	1,450,000	1,680,000
Field-Based Sports	510,000	530,000	1,030,000
Indoor Water Sports	400,000	1,000,000	1,400,000
All Sports	1,150,000	2,980,000	4,110,000
High Scenario	-	-	-
Court-Based Sports	480,000	1,450,000	1,920,000
Field-Based Sports	1,020,000	530,000	1,540,000
Indoor Water Sports	810,000	1,260,000	2,060,000
All Sports	2,310,000	3,240,000	5,520,000
Low Scenario	-	-	-
Court-Based Sports	120,000	1,450,000	1,570,000
Field-Based Sports	250,000	530,000	780,000
Indoor Water Sports	200,000	740,000	940,000
All Sports	570,000	2,720,000	3,290,000

¹⁰ Note these figures have been rounded to the nearest 10 thousand tonnes.

Figure 2. Aggregate Grassroots Sport Emissions—Central Scenario (1,000 Tonnes of CO₂e)**Table 4. Per participant, Grassroots Sport Emissions ¹¹**

Scenario – Sport Type	Travel Emissions (kg CO ₂ e)	Facility Emissions (kg CO ₂ e)	Total emissions (kg CO ₂ e)
Central Scenario			
Court-Based Sports	90	555	640
Field-Based Sports	125	130	255
Indoor Water Sports	95	235	330
All Sports	310	920	1,225
High Scenario			
Court-Based Sports	185	555	735
Field-Based Sports	250	130	380
Indoor Water Sports	190	295	485
All Sports	625	980	1,595
Low Scenario			
Court-Based Sports	45	555	600
Field-Based Sports	60	130	190
Indoor Water Sports	45	175	220
All Sports	155	860	1,015

¹¹ Note these figures have been rounded to the nearest 5 kg.

Figure 3. Per Participant, Grassroots Sport Emissions—Central Scenario (kg CO₂e)

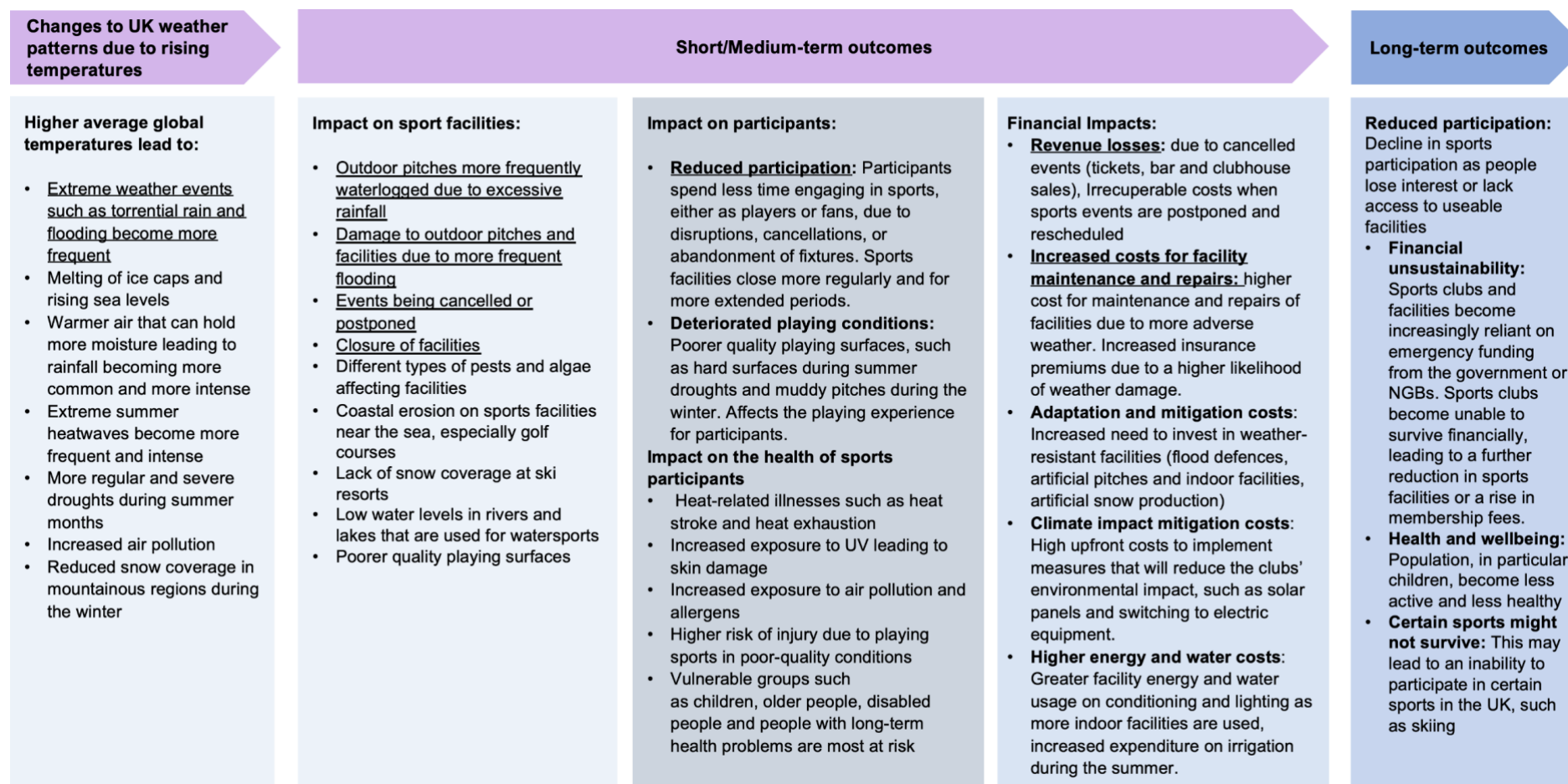
Chapter 4: Impact of Climate Change on the Grassroots Sport Sector

- Climate change is having a significant impact on UK weather patterns, with evidence showing an increase in more extreme weather, such as higher temperatures, increased rainfall, and flooding. These changing weather patterns have a significant impact on sporting facilities in the UK, as documented in the literature. Higher quantities of rainfall and flooding, in particular, damage facilities and lead to difficulty in keeping sports facilities in usable condition. Summer droughts and warmer winters are also contributing to substandard conditions in sport facilities.
- Sport participants are experiencing a wide range of impacts due to the changing weather. Increased health risks are highlighted as an important aspect, with weather contributing to heat-related illnesses, increased UV exposure, and a greater risk of injury. Additionally, event disruptions, cancellations, and poorer-quality playing surfaces are leading to a decline in participation in some sports, with impacts on health and wellbeing.
- The main channels through which climate change impacts clubs financially are reducing revenue streams, including (i) reduced participation, (ii) event cancellations, and (iii) facility closures. Increased costs to maintain facilities due to adverse weather, as well as expenditures incurred to adapt to climate change and keep facilities usable during adverse weather conditions, also contribute to the financial burden. Grassroots sport clubs are becoming increasingly reliant on funding from larger organisations, such as NGBs, in order to survive.
- These findings were echoed by representatives from NGBs and grassroots sport organisations. Most clubs that engaged in the research reported having to postpone or cancel events because of weather-related issues. However, perceptions of climate change affecting participation were mixed. While some clubs noted a decline in participation, others reported little to no change over the recent years. The majority of stakeholders mentioned that extreme weather could cause significant damage to their sports facilities. It was emphasised that climate-related disruptions are not isolated incidents that can be resolved before returning to normal. Instead, weather-related issues often occur in succession, leading to cumulative long-term impacts.
- Overall, grassroots clubs acknowledge that they are increasingly allocating resources to address the impacts of climate change. This includes expenses for hiring external facilities as well as costs for facility maintenance and repairs.
- Financial modelling estimated that the current costs of adverse weather events, such as intense rainfall and flooding, cost the sector £320 million annually. This figure reflects facility maintenance and repair costs, and potential revenue loss due to event cancellation from adverse weather. This figure is likely to rise by £95 million under a 2 °C rise in global temperatures and £190 million in a 4 °C warming scenario.

This chapter of the report examines findings from the literature, fieldwork, and financial modelling on the current and future impact of climate change on grassroots sport, including the financial impact. It focuses on the impact of extreme and adverse weather on grassroots sport facilities and sport participation. These implications were summarised in a logic model (figure 4).

Figure 4. Impact of climate change on the grassroots sport sector

This diagram shows the key channels through which climate change impacts the grassroots sport sector. The channels that have been underlined are included in the financial modelling, discussed in section 4 of this chapter.



4.1. Impact of changing weather patterns on grassroots sport facilities

The changing UK climate is already having a significant direct impact on grassroots sport facilities across the country. Various weather conditions, such as flooding, shifting rainfall patterns, and dry weather, are contributing to a wide range of challenges for clubs and facilities.

- **Flooding:** Hawkins et al. (2023) highlighted that many grassroots clubs lack facilities, such as good quality drainage, to allow them to deal with extreme weather events, such as torrential rainfall. Clubs in sports, such as golf and football, find it increasingly difficult to maintain pitches and courses with standing water and flooding becoming a significant problem, leading to sports facilities being closed and events being cancelled. Many clubs within the UK are also located in flood zones that are extremely liable to flooding. Research from the RFU (2025) found that 11% of approximately 1,000 community rugby clubs in England are located in Defra-designated flood zones, with 43 different clubs having experienced at least one flooding event since the start of 2020. They also found that the prevalence of flooding is increasing. In the past 20 years, there have been 707 on-field flooding events and 484 off-field flooding events at rugby clubs, and nearly half of these events have occurred within the past six years. IOC (2020) also mentioned that flooding, along with extreme heat and pests, can result in significant damage to playing surfaces, whilst severe storms have caused damage to the infrastructure of sports facilities.
- **Rainfall patterns:** Changing rainfall patterns, particularly increased rainfall during autumn and winter, create softer, muddier playing surfaces that are more susceptible to damage. Goggins et al. (2018) explained how these conditions degrade playing quality, resulting in unplayable pitches that require longer recovery times before they can be used again. This wetter climate also facilitates the growth of weeds, the spread of pests, and the emergence of new diseases that further impact the condition of playing surfaces and players.
- **Dry weather and droughts:** Drier summers and droughts are also causing challenges for sports facilities. Research by Sport England, Sport Wales, and Sport Scotland (2023) found that 19% of grassroots sport clubs cited droughts, water shortages, and problems with irrigating playing surfaces as a challenge they faced. The impacts of drier summers are particularly harmful to sports such as cricket, where playing surface conditions have a significant impact on how the sport is played. High-quality grass pitches require regular watering, and droughts and heatwaves are leading to cricket being played on dry and poor-quality wickets (Hawkins et al., 2023). Other cricket-playing nations, such as Australia and South Africa, are already struggling to keep pitches in a playable condition due to an increasing scarcity of freshwater limiting their ability to use irrigation (BASIS, 2019).
- **Coastal erosion:** As polar ice sheets melt, sea levels are rising, which, combined with intense storms, is causing coastal erosion of many properties of sport clubs in the UK. This is a particular problem for golf courses, with one in six of Scotland's golf courses located on the coast. Some of these courses have even lost holes on their courses as a result of coastal erosion (Goggins et al., 2018).
- **Warmer winters:** Higher average winter temperatures are also having a large impact on facilities at ski resorts (BASIS, 2019). Low-altitude ski resorts, such as those in Scotland,

are increasingly struggling to obtain adequate snow coverage during the winter. Irregular weather patterns are causing an increasing need for the use of artificially produced snow, with up to 95% of ski resorts around the world relying on snowmaking to ensure they can provide adequate conditions to ski throughout the season (Orr et al., 2022). As climate change continues, there are suggestions that the ski industry in the UK may struggle to exist within 50 years due to rising winter temperatures (Goggins et al., 2018).

These impacts of climate change on sport facilities that are being experienced today are likely to become more pronounced in the future as global temperatures continue to rise. According to Goggins et al. (2018), the UK winter rainfall may double by 2080, while summertime temperatures may be on average 4 degrees centigrade higher. By 2050, it is expected that a quarter of grounds in the English football league will be threatened by annual flooding, whilst a sixth of British Open golf courses will be lost by the end of the century (Goldplatt, 2020).

4.2. Impacts of climate change on sport participants

Research also highlights the impact of climate change on grassroots sport participants themselves. Climate change is impacting the ability of participants to partake in sports in an enjoyable and safe manner. This, in turn, limits and reduces participation in sports and has further knock-on effects for clubs, such as reduced revenues and greater financial strain.

4.2.1. Health Impacts

Participating in sport during excessively high temperatures brings about a host of potential health risks. Orr et al. (2022) explained the thermal risks that sport participants face during hot weather. They noted the dangers of physical exertion combined with prolonged periods of time spent exposed to high temperatures. During physical exercise, the body temperature of participants can rise by up to 1.5°C, which can lead to a range of health issues, such as fevers, heat exhaustion, and heat stroke. These risks may be particularly serious for those who lack physical fitness or have existing medical conditions. BASIS (2019) also noted that risks can be higher for sports such as cricket, which require participants to wear equipment, such as helmets, gloves, and padding. This equipment can restrict airflow and reduce sweat evaporation, which further increases the likelihood of thermal risks and the potential need for medical treatment.

Schneider and Mücke (2021) discussed the health risks associated with sports due to climate change. Playing sport in hot weather outdoors or in poorly air-conditioned indoor facilities puts strain on a participant's cardiovascular, respiratory, and metabolic systems. In addition to heat-related illnesses, increased UV exposure can be dangerous for both sport spectators and participants. UV exposure can lead to a host of health issues, including sunburn, sunstroke, and eventually the development of skin cancers.

Schneider and Mücke also noted the effects that increased air pollution can have on sport participants, linking it to climate change-driven events, such as heat waves, droughts, and wildfires. Poor air quality carries a range of health implications, including respiratory tract inflammation, heightened vulnerability to infections, and breathing difficulties. Furthermore, this study also identified the increased length of pollen season as a growing concern for individuals with allergies. It also points to the spread of disease through vectors such as mosquitoes as an additional health consequence of climate change.

In the snow sport industry, Orr et al. (2022) and IOC (2018) describe how a lack of and poorer quality snow heightens the risk of injury for participants. Due to global warming, rocks or vegetation on ski slopes may not be fully covered, and new crevasses can form, creating additional hazards for skiers. Moreover, shrinking skiable terrain and shorter ski periods exacerbate challenges faced by the snow sport industry. These changes also impact the physical and mental health of participants. The limited opportunities to train or compete can place additional pressure on athletes, driving them to push their limits even under suboptimal conditions. While artificial snow might seem like a solution, it presents its own risks as it creates a harder and faster surface, increasing the likelihood of severe injuries.

It has also been reported that climate change can significantly affect outdoor water sports by impacting both water availability and quality. For instance, droughts can reduce water flow, which in turn affects river-based sports, such as canoeing. Additionally, climate change can promote harmful algal blooms, affecting water cleanliness and limiting the ability of participants in outdoor water sports to engage in direct contact with the water (IOC, 2018; Goldbatt, 2022).

Finally, the issue of fixture congestion has emerged as a result of climate change, placing added strain on athletes. Postponed matches due to extreme weather must be rescheduled, leading to a crowded fixture calendar. This creates additional pressure for players, fans, and clubs as they cope with an overloaded schedule (Hawkins et al., 2023).

4.2.2. Fixture disruption and shortened sport seasons

Cancellation of fixtures due to adverse weather appears to be becoming more frequent, according to stakeholder engagement with grassroots sport clubs. This is further backed up with evidence from the professional game, with Hawkins et al. (2023) indicating that the percentage of abandoned England men's home one-day international cricket games rose from 5% to 7% over the five-year period to 2023.

According to Sport England, Sport Wales, and Sport Scotland (2023), 39% of grassroots clubs report weather conditions such as high temperatures or rainfall being a challenge, disrupting activities and events. For outdoor sports, weather-related disruption is the second biggest challenge clubs face after rising energy costs. Hawkins et al. (2023) estimated that 120,000 football matches are cancelled every year due to bad weather, and 40% of football participants and spectators report experiencing disruption due to climate change. These figures are higher for other sports such as cricket (60%) and golf (64%). In addition, climate change is also shortening the length of the season for certain sports, which can discourage participation. For example, bad weather and course closures are reducing the amount of time that golf courses are usable, whilst warmer winters and lack of snow coverage are causing the ski season to start later and finish earlier (Goggins et al., 2019).

Many stakeholders spoken to reported that community clubs frequently have to postpone or cancel games and training sessions due to adverse weather events. For example:

- It was mentioned that football matches are often cancelled or postponed in December, January, and February due to weather conditions such as snow, frost, heavy rain, and flooding.

- A stakeholder highlighted that in April 2024, for the first time in their memory, the start of the cricket season across the Northwest of England was delayed by two weeks due to weather-related conditions.
- Another stakeholder recalled that 2023 was the worst year for flooding. Some rugby clubs could not play a single match from December to March due to pitch unavailability.
- Regarding rowing, some weather-related reasons that can disrupt their training sessions were mentioned:
 - When the temperature goes below -3°C, sessions must be cancelled. One club noted that while this has not happened many times this year, it may become more common in the future.
 - Rainfall patterns can impact rowing significantly as they affect the water levels in the river, posing safety issues for participants. It was mentioned that rowing clubs adhere to guidance stating that when the river's low tide level exceeds 2.5 metres, a warning is issued, and practice is suspended. One stakeholder noted that although there have been fewer red flag warnings this year compared to last, heavy rainfall can still increase their frequency, making the river unsafe for rowing.

4.2.3. Suboptimal performance of sports participants

Physical performance and endurance can be negatively impacted when playing in the heat, which impacts the quality and experience of playing sport (Orr et al., 2022). The negative effects of extreme weather on sport performance are not only physical, as Goldblatt (2020) highlighted. High temperatures impact participants' mental abilities, such as memory, hand-eye coordination, and focus when playing sport.

4.2.4. Decline in playing experience

Climate change is also affecting the way certain sports can be played. For example, low river flow rates due to a lack of rainfall impact river sports, such as canoeing, whilst changing wind patterns have an effect on water sports, such as sailing or windsurfing. Furthermore, according to Sport England (2024a), only 16% of English rivers and lakes are classified as in good ecological health, and IOC (2018) also noted the increased presence of algal blooms in water bodies due to climate change. According to Sport England, Sport Wales, and Sport Scotland (2023), 7% of grassroots sport survey respondents are impacted by poor air or water quality in the UK.

During the interviews, it was mentioned that hot weather could introduce several risks for sport participants: i) synthetic surfaces in some sports can absorb excessive heat, making them unsafe for play, ii) the risk of heat exhaustion increases in various sports, iii) hydration becomes a critical issue, with sport participants needing extra water to stay safe (e.g., in athletics heat exhaustion is particularly common during summer races), and iv) dry, hard pitches increase the chances of injury. It was also mentioned that wet and warm weather can promote algae growth in bodies of water, making water sports unsafe.

4.2.5. Declining participation

The range of factors highlighted above has led some participants to lose interest in sports. For example, Goggins et al. (2019) observed a substantial drop in sport participation from 2006 to

2016, with 180,000 fewer weekly recreational footballers and 40,000 fewer cricket players, mentioning that one cause is the disruption to fixtures. The same authors mentioned that poor-quality playing areas and shortened or delayed matches due to weather conditions limit the opportunities for participants to enjoy playing and may result in players giving up the sport.

Data from the Active Lives Survey by Sport England (2025) somewhat supports the suggestion that sport participation has declined in recent years, although it is not necessarily true that any declines are caused by worsening weather. The Active Lives Survey indicates that the total number of adults who engaged in sporting activities in the past year has stayed roughly the same. However, as a proportion of the whole population, the percentage of people who reported having played sport in the past year declined from 59.0% to 56.1% between 2015 and 2022. The survey results also suggest that participation rates have fallen for some sports whilst rising for others. Sports such as football; rugby and hockey have all seen significant falls both in absolute numbers and as a proportion of the population. Golf on the other hand has seen rising participation over the period. It should be noted that these declines in participation diminish or disappear when examining data on participating in sports twice within the past 28 days, suggesting that reduced participation has been driven primarily by declines in casual sport participants rather than those who practice sport regularly.

If weather patterns continue to deteriorate in the future, the impact on participation may become more pronounced. Sport England (2024b) found that 60% of people who have experienced extreme weather said it contributed to a reduction in their physical activity. The report asked respondents why extreme weather impacted their activity levels and found that 54% of respondents cited low motivation, 28% cited the risk of injury, and 26% cited a lower level of enjoyment as the reason behind their reduced activity in adverse weather conditions. Furthermore, they find that younger adults are more likely to adapt or change their activities when faced with weather challenges compared to older people and those from lower socio-economic groups. This may mean that these groups become relatively more impacted in terms of their physical activity levels by climate change.

As climate change is set to continue into the future, the impacts outlined above are likely to worsen over time. Breitbath et al. (2023) even suggest that certain sports may become extinct in their current form due to the challenges of climate change. With grassroots sport facilities becoming increasingly unusable and organisations struggling to remain afloat, people are likely to become less physically active. Sport England (2024b) found that three out of ten adults and children in the UK believe their activity levels will decrease over the next five years if weather trends continue to worsen. This is likely to have a significant impact on the health and wellbeing of the population. Furthermore, there are likely to be differentiated effects for more vulnerable groups. Low socio-economic groups, older people, children, and those with disabilities or health conditions are the most impacted by climate change. These groups also often lack access to sporting facilities and live in highly polluted areas, which limits their ability to participate in sport (Sport England, 2024a). All these factors can lead to reduced physical activity, as unpredictable scheduling and suboptimal playing conditions make it harder for people to participate in sports consistently.

Findings from interviews regarding how climate change is impacting sport participation at the grassroots level were mixed. While some stakeholders noted that extreme weather conditions reduce activity levels due to safety concerns, event cancellations, and declining motivation—

leading to a drop in club membership and subscriptions—others reported no significant changes. However, some examples were provided to illustrate how weather-related cancellations can affect participation:

- A representative from a community club mentioned that their fee payments drop significantly during periods where they have to cancel or postpone events, with about 60% of members slowing or stopping payments. However, it was mentioned that usually payments are resumed when they can start training again.
- It was noted that sport participants, particularly juniors and university-level members, sometimes quit their sports because of constant disruptions.
- Outdoor swimmers often avoid swimming after heavy rain due to concerns about water contamination.
- It was suggested that heat waves can be especially harmful to individuals with long-term health conditions. It was mentioned that during the 2022 heat wave, many were advised to stay indoors, reinforcing the view that exercising in such conditions can be unsafe.

4.3. Financial impacts of climate change on grassroots sport

The literature and interviews also highlighted the significant financial impact that climate change has on different grassroots sport clubs.

4.3.1. Damage to facilities

Extreme weather can cause damage to sport facilities and infrastructure, which may require expensive repairs (IOC, 2018). The RFU (2025) collected data on the costs of the worst off-field floods that 36 grassroots rugby clubs had faced. They aggregated this data to find that these floods caused a total cost of £894,000, which included the repairs to pitches and the renovations of damaged doors, furnishings, and building fabrics in clubhouses. They estimated that this impact will increase to £1,788,000 in a future scenario where the worst flooding event occurs every five years. In addition, clubs may incur higher maintenance costs to keep their facilities usable in adverse weather conditions. These costs can be higher in indoor sports centres, which, in addition to having large initial investment costs, also likely require high upkeep costs, such as increased energy usage for air conditioning and lighting.

Interviewees agreed that extreme weather can cause significant damage to sports facilities. Flooding, in particular, was seen as a major risk to sports such as cricket, hockey, rugby, football, and rowing. Another concern is the impact of increasingly dry summers on pitch recovery. For certain sports, the summer months are essential for pitch regeneration, but prolonged dry seasons and droughts have hindered this process, leading to poor playing conditions at the start of the season.

While extreme events, such as flooding or droughts, can severely disrupt regular activities, other less severe incidents, such as strong winds or heavy rainfall, may cause physical damage to facilities without necessarily affecting day-to-day operations. Furthermore, stakeholders emphasised that climate-related disruptions are not isolated incidents that can simply be resolved before returning to normal. Instead, weather-related issues often occur in succession, leading to cumulative long-term effects. For example, one club mentioned that

their pitches and grounds have been regularly flooded since 2019. In 2023 alone, the club experienced eight floods between October and March. In January 2024, a storm blew the roof off their old clubhouse, adding yet another financial strain.

During the interviews it was mentioned how these weather-related challenges impose direct financial costs on grassroots sport clubs:

- When sport facilities become unusable, grassroots sport clubs usually hire alternative venues to train or host events, increasing their operational costs.
- Damage to playing surfaces, clubhouses, pavilions, equipment (e.g., covers, nets, screens, scoreboards), and electrical or water systems leads to additional expenses.
- Clubs are allocating more resources to facility maintenance and adaptation measures, such as improving drainage systems or using sand to absorb excess water.
- Some interviewees highlighted rising energy costs as an additional financial burden. These affect grassroots sport clubs in two ways: either through increased rental fees for those using hired facilities or higher energy bills for heating in winter and air conditioning in summer. However, most engaged clubs attributed the rise in energy bills to the wider cost-of-living crisis rather than directly to climate change.
- Many clubs also rely on volunteers for facility maintenance, making climate-related costs harder to quantify. The additional time and effort required from volunteers to address these challenges were described as significant, yet often overlooked in financial assessments.

4.3.2. Revenue losses

The cancellation of events and reduced participation in sports due to weather is having a large impact on the financial situation of sport clubs. Postponed or called-off fixtures reduce important revenue streams for clubs, such as ticket and clubhouse bar sales. Many planned events also require upfront costs to be paid, such as food costs, which cannot be recouped in the event of a cancellation (Hawkins et al., 2023). In addition, grassroots sport clubs are also likely to have a lack of funding and lower-quality facilities, which make cancellations of fixtures more likely than for elite sports clubs.

Furthermore, event cancellations and the increased prevalence of unsafe or suboptimal playing conditions will discourage people from playing sport, leading to lower participation and club memberships for grassroots sport clubs. Goggins et al. (2018) noted that the number of members of golf clubs in England and Scotland has fallen by 20% since 2005, and sport administrators suggest that poor weather has contributed to this decline. Many clubs rely significantly on the revenue streams from members and participants, and hence, reduced participation has detrimental impacts on the finances of grassroots sport clubs.

The RFU (2025) found that 36 community rugby clubs combined lost £1,096,000 in revenue through the worst floods at each club. This lost revenue consisted of mostly reduced spending in clubhouses due to cancelled training sessions and matches. Under a moderate future scenario, this could increase to £2,192,000 if the worst flood event occurred every five years.

In addition, a shortened sports season limits the time for grassroots sport organisations to generate income. As mentioned in the previous section, the ski industry in the UK is

highlighted as an industry that is particularly likely to struggle financially under climate change, with warmer winters and a lack of snow coverage shortening the ski season.

These findings were echoed by stakeholders during fieldwork. For example, one community club highlighted the impact that weather-related issues have on their annual revenue:

“The revenue drop [...] for a small club like ours, the revenue drop was [...] probably about 25% of our turnover. On top of that, we then have to invest in [...] pitch maintenance.”

Additionally, most stakeholders engaged in the research emphasised that grassroots sport organisations depend heavily on matchday income, bar sales, and event revenue, all of which can be significantly affected when events are cancelled or postponed due to weather-related issues. Some community clubs may struggle to remain financially viable if they are unable to run activities frequently enough. For certain sports, summer revenue is crucial to sustaining them through the winter months, as some sports are not played in cold weather.

During the interviews, it was also mentioned that extreme weather events can lead to the cancellation of elite events, which has knock-on effects for grassroots sport clubs, as funding from major competitions often supports grassroots-level sport. Additionally, repeated event cancellations can damage a club’s reputation, potentially reducing participation and membership, further impacting their revenue.

However, stakeholders noted that these impacts vary:

- Larger clubs, with greater financial security, are generally better equipped to absorb weather-related financial shocks.
- Certain regions are more vulnerable to specific climate risks. For example, it was mentioned that clubs in southern England face higher repair and adaptation costs due to increased flood risks.
- Some sports are less financially affected by climate change due to the nature of their activities—for instance, outdoor running can continue in most weather conditions.

4.3.3. Adaptation costs

In response to the impacts of climate change, many clubs are also being forced to make changes to their facilities and how they are run in order to allow participants to continue playing sports. Football clubs might invest in artificial pitches, for example, to keep the pitches usable during wet weather (Hawkins et al., 2023). Many of these adaptations have high costs to set up and maintain. For example, in the snow sport sector, producing artificial snow can account for up to 50% of a resort's budget (Goggins et al., 2018).

Adaptation strategies pursued by clubs are likely to add to their already high energy bills. For example, during hot weather, clubs may opt to play either in air-conditioned indoor facilities or after dark in order to play in cooler conditions. This increased requirement for air conditioning and lighting may significantly increase clubs’ electricity bills. Furthermore, drier summers and the need for more intensive irrigation raise the water bills paid by many clubs (IOC, 2018). Climate change also results in clubs finding it more expensive or even impossible to secure facility insurance against flooding and other adverse weather events. The RFU (2025)

surveyed community rugby clubs and found nine clubs that were unable to obtain flood insurance for their facilities, and another seven clubs saw increased insurance premiums directly attributed to the risk of flooding.

4.3.4. Reliance on funding

These financial impacts of climate change come at a time when clubs are already facing extensive financial challenges and often struggling to stay afloat. Many clubs already operate on very small margins and, in recent years, have had to confront rising energy prices, increased operating and maintenance costs due to ageing facilities, and budget cuts to local authority-owned facilities (Sport England, Sport Wales, and Sport Scotland, 2023). Goggins et al. (2018) highlighted that many clubs become trapped in a vicious cycle whereby reduced revenue inhibits a club's ability to maintain and adapt their facilities, which in turn further impacts the revenue received as facilities are increasingly unusable.

Therefore, grassroots sport clubs are becoming increasingly reliant on external funding to survive. NGBs are now seeing an increase in funding requests to deal with climate change impacts. For example, Sport England has seen a rise in the number of clubs applying for emergency funding for flood relief, whilst the England and Wales Cricket Board gave out £1 million worth of grants in 2016 and £1.7 million in order to save cricket clubs financially after their facilities had been flooded (Goggins, 2018). This demonstrates the increasing financial toll that climate change is placing on grassroots clubs. Crampton et al. (2024) looked at the impact of flooding on businesses in the UK and found that small and medium companies affected by flooding are significantly more likely to go out of business as their finances are impacted by damages to the property and inventories, and a lack of access to the property.

4.4. Financial modelling

The section below outlines the approach and results for the financial modelling undertaken to quantify the current and future financial impacts of climate change on the grassroots sport sector.

4.5. Approach

To estimate the financial impact of climate change on grassroots sport, the modelling **focused on two of the key channels of impact** highlighted in the above sections—the impact of adverse weather on **facility maintenance and repair costs and losses of revenue due to event cancellation**. These two channels were selected due to their significant impact on facilities and the relatively higher ease of obtaining data for the model when compared to adaptation costs.

Another key consideration made was the differentiating effects between the clubs located in areas at high risk of flooding compared to clubs in lower-risk areas. Potential increases in future costs due to worsening weather were also accounted for through the modelling of different climate change scenarios.

This model **focused on field-based sports**, given that such sports are commonly played outdoors on grass surfaces and are hence most impacted by the weather. The literature review and stakeholder engagement discussed earlier in the report highlighted heavy rainfall

and flooding as the predominant weather events impacting grassroots sport clubs. The model, therefore, examined the financial impacts of these two weather events on field-based grassroots sport clubs.

The basic **structure of the financial model** involved three key steps.

- Firstly, the current costs per club for weather-related events were calculated. This included the costs associated with pitch maintenance and facility repairs, and the revenue losses from event cancellation and facility closure.
- Secondly, this figure was aggregated by the total number of clubs impacted by these events. The modelling differentiated between the impacts on all clubs from higher rainfall and the additional impacts of flooding that primarily affect clubs in areas at a high risk of flooding.
- Finally, the model estimated the expected increase in these costs due to more frequent rainfall and flooding under two climate scenarios, a 2°C and a 4°C rise in global temperatures.

4.5.1. Limitations

As with the carbon model, the financial model aimed to provide a high-level overview of the main channels of impact and is not able to delve deeply into all the potential means through which grassroots sport clubs might be financially impacted.

The absence of accessible data also meant that a number of assumptions and approximations had to be made, and hence, the figures obtained can only be considered as a rough estimate of the current and future costs of climate change. Sensitivity analysis was carried out for some of the assumptions made, which are outlined in more detail below.

The model examines intense rainfall and flooding, as they are deemed currently the most significant events impacting grassroots sport. However, as highlighted in this report, other weather events also impact sport. Extreme heat, in particular, was identified elsewhere in the report as impacting sport. Although evidence is currently limited on its impact on sport in England, it may have an increasing financial impact in the future through event cancellations and reduced participation.

Although the model only examines the financial impact through maintenance and repair costs and lost revenues, there are likely a host of additional channels through which climate change and adverse weather are affecting sports clubs throughout the country. A major cost to clubs both now and in the future will be investments to mitigate against the impact of weather and ensure their facilities can remain usable into the future. The model was not able to capture this due to the heterogeneous nature of such investments and the lack of data. The costs are, however, likely to be large; interviews with grassroots sport clubs identified the scale of some of these costs. Estimated grass pitch drainage improvement costs were placed at £85,000 by one club, whilst resurfacing a grass pitch with an all-weather artificial grass pitch could cost in the region of £350,000. Furthermore, as highlighted in the report, if worsening weather and event cancellation contributed to declining participation levels, this presents yet another channel through which clubs will see declining revenues.

Further discussions on the assumptions and caveats of the model can be found in Annex 2 below.

4.5.2. Results

Table 5 below displays the results of the financial modelling of the costs that grassroots sport clubs are facing due to adverse weather. In the central modelling scenario, a **typical field-based grassroots club spends £7,100 on weather-related maintenance and repair costs per year and experiences revenue losses of £4,200 annually** due to fixture cancellations and facility closures. When aggregated up to all field-based sport clubs, the total figure is around £200 million in repair costs, and revenue losses are equal to roughly £120 million. This gives a **current annual financial impact to the grassroots sport sector of £320 million per year** due to adverse weather. Adverse weather has always imposed costs on grassroots sport, so this estimate should not be viewed as solely reflecting the current impact of climate change. That said, with global temperatures having already increased by approximately 1°C, it is likely that some of this baseline is attributable to climate change.

Sensitivity analysis indicated that the current costs of adverse weather to the sector range from **£165 million in the low scenario up to £835 million in the high scenario**. The breakdown shows that around three-quarters of the financial impact is due to facility maintenance and repair, with the remaining quarter due to the impact of lost revenue from cancelled events and facility closure.

As climate change continues into the future, **these costs are likely to increase**. Evidence suggests that the country will see more frequent and intense rainfall and a higher prevalence of flooding in future years. These increasing costs are captured through the modelling of different climate change scenarios. The central scenario results suggest that the annual financial impact figure is likely to rise by an **additional £95 million under a 2°C rise in global temperatures** (roughly £60 million in increased maintenance and repair costs and £35 million in greater revenue losses). This estimated annual financial impact will rise by an **additional £190 million under a 4°C change** (roughly £120 million in increased maintenance and repair costs and £70 million in greater revenue losses). These increases in costs amount to a 30% rise under the 2°C change and a 59% rise under the 4°C scenario compared to current levels.

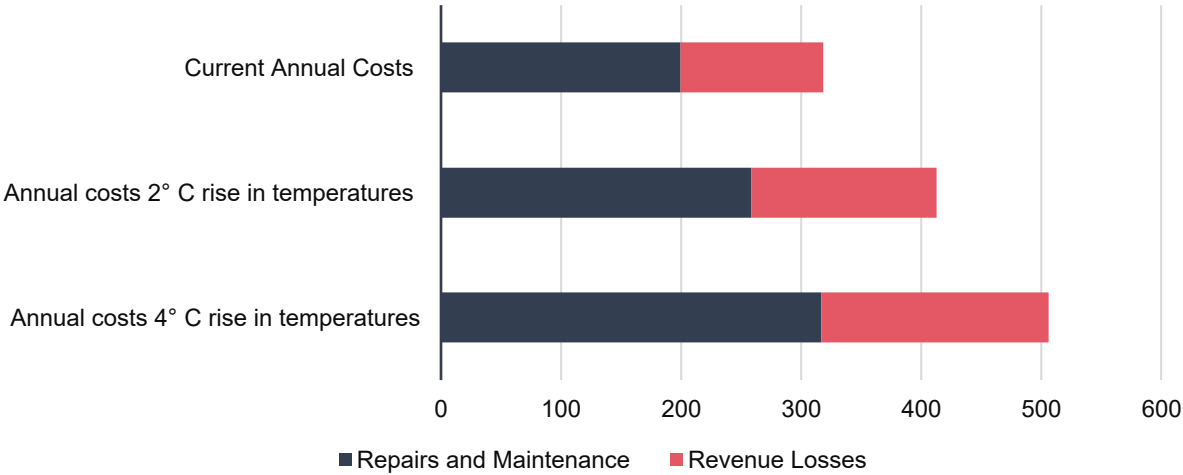
These financial impacts are significant and rising at a time when many grassroots clubs are already struggling financially to stay afloat. Recent energy price increases, in particular due to events such as the Russia-Ukraine conflict, have meant many clubs have seen rapidly rising costs, even without consideration of how climate change and adverse weather may further impact clubs financially.

Table 5. Carbon footprint of grassroots sport¹²

Impact Scenario	Maintenance and repair costs (£m)	Revenue losses (£m)	Total Cost (£m)
Central Scenario	-	-	-
Current Costs (c. 1°C rise in temperatures)	200	120	320
Total costs 2°C rise in temperatures	260	155	415
Percentage increase in costs under 2°C	29%	30%	30%
Total costs 4°C rise in temperatures	315	190	505
Percentage increase in costs under 4°C	58%	60%	59%
High Scenario	-	-	-
Current Costs	690	145	835
Total costs 2°C rise in temperatures	895	190	1,085
Percentage increase in costs under 2°C	29%	32%	30%
Total costs 4°C rise in temperatures	1,095	235	1,330
Percentage increase in costs under 4°C	58%	63%	59%
Low Scenario	-	-	-
Current Costs	60	105	165
Total costs 2°C rise in temperatures	75	135	210
Percentage increase in costs under 2°C	29%	29%	29%
Total costs 4°C rise in temperatures	90	165	255
Percentage increase in costs under 4°C	58%	58%	58%

¹² Note these figures have been rounded to the nearest £5 million.

Figure 5. Financial impact-Central scenario (£m)



Chapter 5: Climate Change Adaptation and Mitigation Strategies

- Most of the existing literature on climate change adaptation and mitigation strategies in grassroots sport focuses on four areas: (i) measures implemented by grassroots clubs to reduce their environmental impact, (ii) strategies adopted by organisations to adapt to climate change, (iii) barriers to achieving environmental and financial sustainability, and (iv) the role of public organisations, such as NGBs, in supporting grassroots sport in these efforts. Additionally, there is some literature on the financial benefits of implementing environmentally sustainable measures, although this evidence base is fairly limited.
- Literature and interviews highlight the measures that grassroots sport organisations are taking to reduce their impact on the environment. These include improving the energy efficiency of facilities, utilising renewable energy sources, switching to electric equipment and vehicles, promoting more sustainable travel means, reusing sport kits, implementing reuse and recycling programmes, and enhancing biodiversity.
- Clubs are also trying to adapt to the changing weather patterns and the challenges they pose. Sport facilities are being enhanced to aid sport participation in extreme weather, such as increased shaded or air-conditioned areas. Measures are also being implemented to protect participants from the weather, including changing timings of events, air quality alarms, and the promotion of safe practices, such as the use of sunscreen and breathable clothing. This also includes the development of emergency strategies to respond to climate-related events. This usually includes an immediate response to restore the basic functions of the club, the full restoration to rebuild permanently damaged infrastructure and making investments in the long-term climate resilience of the club.
- The main barrier to implementing sustainability measures for clubs is financial constraints. Other significant barriers, as noted in both the literature and the fieldwork, include not owning facilities, a lack of awareness and knowledge, and ageing or outdated infrastructure.
- NGBs can offer leadership, funding, guidance, and communication, which are often required by grassroots sport clubs. NGBs, however, have their own constraints and in some cases lack dedicated expertise, resources, and data on sustainability.
- During the fieldwork, grassroots sport clubs expressed the need for financial support to implement environmentally sustainable measures, access to information to identify cost-effective initiatives, and opportunities for collaboration with others to share best practices and equipment.
- A significant gap remains in understanding the broader benefits of these measures. Specifically, there is limited exploration of how such initiatives contribute to the long-term financial sustainability of grassroots sport facilities and their operations.

This section explores how grassroots sport clubs are adapting to the effects of climate change and mitigating their own environmental impact. The section first explores the measures that grassroots clubs are taking to reduce their carbon emissions and impact on the environment, as well as the potential financial benefits of such measures. The following section examines the adaptations that clubs are making to continue to play sport in the face of a changing climate and the barriers they currently face. The section concludes with the role that national governing bodies can play in supporting grassroots clubs to become more financially and environmentally sustainable.

5.1. Measures implemented by grassroots sport clubs to reduce their environmental impacts

A consultation by Sport England, Sport Scotland, and Sport Wales (2023) found that certain areas of the grassroots sport sector have been addressing environmental impacts for many years, particularly in sports closely connected to water-related issues, such as water quality, flooding, or drought. Commonly reported initiatives include improving energy efficiency in buildings, promoting sustainable travel through participant behaviour campaigns, and implementing reuse and recycling programmes. Nearly a quarter of survey respondents said they have assessed their impacts and put in place a formal environmental sustainability policy, action plan, or strategy. However, this could be biased, as people who responded to a survey about environmental sustainability are likely to be more engaged with the environmental agenda.

There are various case studies of actions that both grassroots and professional sport organisations have implemented to reduce their environmental impact.

Case Study 1: (Sport England, 2024)

[Whalley Range Cricket & Lawn Tennis Club](#), a community-focused club in Manchester, has taken environmental sustainability actions to adapt to climate change after facing severe flooding in 2012 and annually since 2016. To mitigate these challenges, the club implemented measures to enhance biodiversity and respond to environmental shocks. They planted trees to absorb excess water, allowed underutilised areas to rewild through reduced mowing, and fostered natural ground covers like daisies and clover, which improved soil health and biodiversity. These initiatives, supported by partnerships with the City Council and grant funding, have reduced flooding, lowered carbon emissions from less mowing, improved soil aeration through worm activity, and eliminated the need for pesticides. The club's environmental focus has also contributed to record membership levels, strengthening member engagement and retention.

Case Study 2: (Sport England, 2024)

[Deer Park Archers](#) in Gloucestershire has taken proactive measures to address climate impacts on their activities and encourage participation. To ensure year-round use of their outdoor grass shooting surface, they reinforced it with a plastic grid for enhanced durability in all weather conditions. The club has also made other efforts to reduce its carbon footprint. Their clubhouse is a repurposed NHS modular operating theatre, and the neighbouring recycling plant, a key sponsor, provides many of the materials the club needs. Additionally, with financial support from local councils, the club has installed solar panels, purchased a tractor, and invested in seeds for a flower meadow.

Case Study 3: (European Commission, 2024) The [PEACE+ Alps](#) project supports dispersed Alpine communities in Italy to reduce carbon emissions. These communities often lack the technical expertise and the size necessary to benefit from economies of scale. Recognising that Local Authorities (LAs) face common challenges in implementing Sustainable Energy and Climate Action Plans (SECAPs), the project provides technical assistance services free of charge to small and medium-sized municipalities. These services encompass a range of initiatives, including optimising energy management, renovating public buildings, upgrading street lighting systems, and implementing measures to adapt to climate change. The project adopts a bottom-up methodology, beginning with an evaluation of local needs and opportunities. This approach includes conducting interviews with policymakers, civil servants, and other key stakeholders to gain a firsthand understanding of the challenges faced at the community level. The insights gained were then used to develop centralised solutions that could be easily tailored to address local requirements. This approach ensures that the project's interventions are both efficient and responsive to the unique contexts of the communities it serves.

Case Study 4: (Wilby et al., 2022) Professional sports also provide examples of initiatives aimed at achieving carbon neutrality, such as [Forest Green Rovers, a football club](#) in Gloucestershire, self-defined as “The World’s Greenest Football Club”. The authors describe the club’s approach as a model of best practice, offering a valuable roadmap for other organisations. A key strength of Forest Green Rovers’ approach is its holistic focus, targeting multiple sources of greenhouse gas emissions rather than concentrating efforts on a single category. The main activities implemented by this club to achieve carbon neutrality are summarised in the following table.

Table 6. Actions implemented by the Forest Green Rovers soccer club to achieve carbon neutrality (Wilby et al., 2022)

Category	Action
Energy sources	- Stadium powered by 100% renewable energy - Use of solar panels
Energy efficiency	Automated lawn mowing with electric equipment
Travel	- Electric charging station - Team uses 100% electric vehicles - Promotion of cycling, car sharing, and public transport for home and away supporters
Waste management	- Shirts made from bamboo waste and recycled plastic - Composting and recycling of used lawn mats - Replacement of single-use plastics
Food	Providing only vegan food for fans and players
Communications	- Literal “greening” of official club colours - Promoting actions to reduce the ecological footprint and rewarding well-performing supporters - Involving sponsors and business partners with green values, plus organising joint actions and promotions

Case Study 5: “Save Your Energy for the Blues” campaign by Ipswich Town Football Club in Suffolk. This initiative invited fans to follow energy-saving actions to help offset approximately 3,000 tCO₂e, allowing the club to claim to be the “first carbon-neutral club in the UK”. Support came from fans, local businesses, and surrounding schools, who engaged in activities such as switching to energy-saving lightbulbs and buying hybrid fuel cars. The club reached the goal six months after launching the campaign.

Alongside these case studies of actions that have taken place so far, Abu-Omar et al. (2022) proposed a practical checklist designed to guide grassroots organisations in taking action in the future. This includes planning, promoting, implementing, and evaluating climate-friendly sports and exercise programmes. This checklist consists of 16 questions grouped into five key dimensions derived from the UN Sports for Climate Action Framework:

- **Active transport and carbon emissions:** To evaluate if events are conducted at locations easily accessible via active or public transportation and if the target population lives within walking or biking distance of the site.
- **Carbon footprint of exercise activities:** It assesses whether programmes prioritise activities with a low-carbon footprint.
- **Low-carbon sports clothing and equipment:** This focuses on raising participants' awareness about reducing the environmental impact of sporting goods. It includes promoting the recycling, donation, or sharing of used items, following the principles of a sharing economy to minimise resource consumption and reduce the carbon footprint.
- **Instructors as climate action champions:** Instructors can play a crucial role in fostering climate-friendly behaviours. They can inspire and support participants by modelling environmentally responsible practices and sharing their knowledge on the topic.
- **Advertising and communication:** The environmental impact of promotional activities should also be considered. Sustainable advertising methods can help minimise waste and reduce the overall carbon footprint of programme promotion.

During the interviews, stakeholders mentioned various measures implemented by grassroots sport organisations to mitigate the impact of climate change. These actions are summarised in the table below.

Table 7. Actions implemented by grassroots sport organisations in the UK to mitigate their environmental impact, interview findings

Category	Actions implemented by grassroots sport organisations to reduce climate impacts
Travel and transportation	• Encourage carpooling or public transport use among their members. • Hire coaches when club players have to travel long distances. • Provide places for members in cars owned by the club to attend events. • Invest in electric vehicle charging points and the implementation of bike racks. • Hold meetings online to reduce travel emissions at the administrative level.

Category	Actions implemented by grassroots sport organisations to reduce climate impacts
Energy reduction	• Install solar panels or solar-powered scoreboards. • Use of LED lighting or heat pumps. • Upgrade insulation of facilities and replace old windows and doors. • Replace gas shower with electric alternatives. • Monitor energy use.
Waste and sport equipment	• Use of second-hand sport kits. • Selling second-hand kits or donating them to charities. • Use of wooden medals for prizes and reuse of race numbers. • Buy sports equipment, taking into consideration environmentally friendly sellers. • Implement deposit schemes during sport events to avoid the single use of plastic cups. • Use composting systems to minimise waste production.
Management	• Use of eco-friendly turf. • Implement strategies to reduce the use of fertilisers and pesticides.
Other	• Educate local communities and engage with residents. • Lead large-scale plastic removal campaigns. • Restoration of the surrounding land through wildflowers and tree planting. • Collaboration with academics to develop net-zero strategies.

However, the main focus of other clubs has been simply to stay afloat rather than implement environmentally sustainable measures. As one grassroots club explained:

“The last few years for the club have been about survival, literally about keeping the club surviving and making it a viable place [...] so I can’t think of a single meeting where our approach to climate change has been on the agenda, other than dealing with the effects of climate change”.

5.2. Financial benefits of environmentally sustainable measures

The literature discussing the financial benefits of implementing environmentally sustainable measures is scarce. A literature review by the Institute for Sport Business (unpublished) suggested that, from a cost-benefit analysis perspective, there is a compelling case for replacing energy-intensive lighting with more efficient alternatives, recycling waste, restoring landscapes, using environmentally friendly cleaning products, opting for organic items, promoting local food and drink, and investing in building insulation. These measures not only

reduce costs but also have positive environmental impacts. In this sense, these findings highlight the potential financial benefits that environmental measures might bring to an organisation's cash flow.

Thormann and Wicker (2021) carried out a study to assess the sports club members' willingness to pay (WTP) to introduce environmental measures in their clubs. The study also examined whether WTP varied depending on the type of sport played and certain socio-economic characteristics. To gather data, the authors distributed a survey among members of German sport clubs representing sports such as basketball, football, handball, ice hockey, and tennis. The results indicated that approximately 65% of respondents were willing to pay for environmental measures in their sport clubs. On average, the WTP was €14.5 per year across the total sample, increasing to €22.6 when excluding those unwilling to pay anything. When analysing differences by sport, tennis players showed the highest WTP, averaging €21.7 in the full sample and €36 among those willing to pay. In contrast, handball players had the lowest WTP, with averages of €8.3 in the full sample and €11.7 when excluding non-payers.

Regarding socio-economic and personal characteristics, the study found that the likelihood of reporting a positive WTP was higher among individuals with greater environmental consciousness, higher educational attainment, more weekly practice hours, stronger identification with and satisfaction in their club, and higher subjective wellbeing. Additionally, age exhibited a U-shaped effect, with both younger and older members being more likely to have a positive WTP. The findings suggest that the majority of sport club members are willing to pay a modest increase in their membership fees if their clubs adopt environmentally sustainable measures. This implies that grassroots sport organisations could partially offset the costs of these initiatives through increased membership contributions.

During the stakeholder engagement, some interviewees mentioned that the primary motivations for implementing environmentally sustainable measures were cost savings and attracting or retaining members. One club shared:

"We built a new pavilion which is got modern systems in it to reduce the amount of heating it uses [...] it almost bankrupted the club doing it [...]."

When asked why they implemented these measures despite the financial risks, they highlighted that the main reason was to attract members:

"It was to attract and keep our members, essentially because before that we have the clubhouse was in [...] a poor place to invite other people. [...] Without members, we don't exist, so we need to keep our members and keep on attracting new members [...]."

5.3. Measures implemented by grassroots sport clubs to adapt to climate change

An activity check-in report by Sport England (2024b) tracked behaviours and attitudes towards sports through a survey and revealed perceptions on how well sport organisations are adapting to climate change. According to the survey, 47% of adults using sport providers feel they are adequately adjusting for extreme weather events. Among those sport participants

who noticed some climate change adaptations by providers, the most observed measures included hosting more online sessions (24%) and altering session timings (20%).

Respondents also suggested additional adaptations, such as further adjusting session times and enhancing facilities to better accommodate extreme weather conditions. Examples included installing air conditioning, providing drying or warming rooms, improving water accessibility, and upgrading heating systems.

Schneider and Mucke (2021), Orr et al. (2022), and BASIS (2019) provide a set of measures that sport organisations can implement to build resilience against climate change. The main categories of these measures are as follows.

Table 8. Measures that sport organisations can implement to build resilience against climate change

Category	Action identified in the literature
Managing heat-related risks	1. Prevention strategies • Conduct training and competition activities during cooler times of the day, such as morning or evening (Schneider & Mucke, 2021). • Promote hydration and discourage the consumption of alcohol, medication, or other substances that affect electrolyte balance (Schneider & Mucke, 2021; Orr et al., 2022). • Encourage the use of breathable clothing (Schneider & Mucke, 2021). For example, BASIS (2012) mentions that cricket authorities may consider allowing players to wear shorts when the temperature exceeds a certain threshold to maintain safe body temperatures. • Establish heat guidelines, such as temperature thresholds that trigger actions like hydration breaks or cooling activities (Schneider & Mucke, 2021; Orr et al., 2022; BASIS, 2019). 2. Infrastructure enhancements: • Implement heat warning systems to enforce heat policies (Schneider & Mucke, 2021). • Upgrade sports facilities with energy-efficient renovations and heat-resistant designs (Schneider & Mucke, 2021; Orr et al., 2022). • Incorporate cooling infrastructure, such as shaded areas, fans along marathon routes, or outdoor cooling technologies for open-air stadiums (Orr et al., 2022). 3. Participant-specific measures • Special considerations should be placed on young players, as they are less able to regulate body temperature and may feel less empowered to refuse participation in hot or humid conditions (BASIS, 2019).

Category	Action identified in the literature
Managing air pollution risks	1. Modify competition schedules: Schneider & Mucke (2021) mention that sports activities should not be scheduled to take place in the summer between 11 am and 6 pm, as ozone concentration is particularly high during this time. 2. Set air quality alarms: The same authors mentioned that the German Environment Agency recommends evaluating the need to participate in open-air sports events if the one-hour ozone value rises above 120 µg/m³. There are regulations mandating the issuing of a warning when the one-hour ozone value rises above 180 µg/m³. 3. Evaluate the air quality of the area: Playing areas near busy roads should assess the potential impact of air pollution on the health of players, particularly youth teams (BASIS, 2019).
Reducing UV Radiation Exposure	1. Encourage the use of sunscreen, sunglasses, and UV-protective clothing (e.g., long sleeves and head coverings), and limit exposure during peak sunlight hours (Schneider & Mucke, 2021). 2. Build shaded areas and provide sun shelters at sports venues (Schneider & Mucke, 2021).
Climate-Proof Planning	1. Protect sports facilities against risks such as droughts, flooding, hail, and storms through targeted climate-proofing measures (Schneider & Mucke, 2021; BASIS, 2019). 2. Whenever possible, prioritise event hosting in locations with favourable weather and environmental conditions to reduce risks (Orr et al., 2022). 3. Plan and execute climate-resilient events to mitigate financial risks from declining spectator numbers or disruptions caused by extreme weather (BASIS, 2019).

Institute of Sport Business (unpublished) highlights that the motivation to adopt these measures for some organisations often stems from cost-saving opportunities. Environmental sustainability initiatives generally begin with a focus on reducing expenses, as managers recognise that, although such efforts may incur short-term costs, they could lead to greater long-term financial savings.

During the interviews, stakeholders mentioned various measures implemented by grassroots sport organisations to adapt to climate change. These actions are summarised in the table below.

Table 9. Actions implemented by grassroots sport organisations in the UK to adapt to climate change, interview findings

Category	Actions implemented by grassroots sport organisations to adapt to climate change
Facility adaptations	• Use of porous materials in pitches to reduce slipperiness during rainy days. • Modify grass composition in pitches to make them more resistant to water and frost, ensuring they are usable throughout the whole year. • Install canopies to keep courts accessible on rainy days. • Provide shaded areas to protect players and supporters from extreme heat. • Improve the drainage system to prevent waterlogged pitches in sports. • Invest in floodproofing measures to protect buildings. • Construct boreholes to capture and store water during rainy seasons, preventing cubs from being flooded. However, it was mentioned that this initiative is expensive and potentially only an option for big clubs. • Migrate to artificial turf to prevent event cancellation, as this type of turf is more resistant to extreme events. However, it was mentioned that this initiative is not yet widely adopted in certain sports, as this type of turf can increase the risk of injury to players. • Plant trees to absorb excess water during heavy rainfall.
Sustainable management	• Schedule sports events earlier in the day to avoid peak heat hours. • Ensure water is available for proper hydration. • Implement heat policies, postponing or cancelling events when necessary. • Rent alternative sport venues when these become unavailable for practice due to weather-related events. • Develop emergency strategies to respond to climate-related events. This usually includes the following: i) immediate response to restore the basic functions of the club, ii) full restoration to rebuild permanently damaged infrastructure, and iii) making investments in long-term resilience.

5.4. Barriers to environmental and financial sustainability in grassroots sport sector

Several studies have explored the barriers that sports organisations face when implementing environmental and financial sustainability measures. The key barriers identified can be grouped into the following categories: (i) financial constraints, (ii) limited control over their facilities, (iii) state of their facilities, (iv) knowledge, awareness, and human resources gaps, and (v) volunteering and community challenges.

Financial constraints:

- Financial constraints pose significant challenges to the adoption of environmentally sustainable (ES) practices for sports organisations. The Sport England, Sport Scotland, and Sport Wales (2023) survey identified that funding was the primary barrier for sports clubs and community organisations and the second greatest obstacle for NGBs aiming to implement these initiatives. Carmichael (2020) highlighted that grassroots sport relies heavily on sponsorships and fundraising to cover essential costs, such as pitch maintenance, building rentals, and waste collection, as membership fees are often insufficient. This financial strain leaves little capacity for environmental initiatives, and regulations from NGBs, such as those related to player appearances, can further exacerbate financial pressures. Similarly, the review by the Institute for Sport Business (unpublished) noted that organisations with tight budgets tend to prioritise immediate infrastructure maintenance and revenue-generating amenities over ES initiatives. By contrast, those with greater financial flexibility are more likely to invest in sustainability efforts.
- Most interviewees considered that financial constraints are the biggest factor that prevents grassroots sport organisations from implementing adaptations to climate change. Most stakeholders agreed that these organisations are already financially stretched, making the implementation of environmentally sustainable measures a low priority. Adaptations to climate change often require high upfront costs, which, despite offering long-term benefits, are typically unaffordable for grassroots sport clubs. Additionally, it was perceived that the availability of funding for implementing environmentally sustainable adaptations is limited.

Limited control over their facilities:

- It is common for sport clubs to operate in facilities owned by third parties, such as local authorities. However, this prevents them from making modifications to facilities or changing processes related to event organisation and maintenance. For example, Carmichael (2020) found that none of the clubs in the sample of his study owned a building or had the license to manage one. The environmental impacts of sport buildings, including their energy use, water consumption, emissions, and waste generation, were acknowledged. However, clubs were unable to make changes. For example, one club mentioned being unable to adjust its gas consumption because the heating system was remotely controlled by the local authority, making any changes impossible for the club's volunteers. Another example highlighted was turf maintenance, a process that typically relies on fossil-fuel-powered machinery, fertilisers, and chemical treatments. Clubs reported that this responsibility is often managed by local authorities, leaving them unable to influence or alter these practices. Sport England, Sport Scotland, and Sport Wales (2023) survey echoed these findings, noting that organisations that own their facilities were more likely to adopt environmentally friendly actions.
- During the stakeholder engagement, it was mentioned that many grassroots sport organisations are not facility owners, which limits their ability to implement adaptations to their clubs. For example, it was noted that 99% of basketball clubs have to lease their facilities.

State of existing infrastructure:

- The condition of facilities also poses challenges to sustainability efforts. Issues such as ageing infrastructure, outdated utilities, limited space, and structural constraints can hinder the adoption of ES measures. While facility managers may be willing to invest in ES practices, their buildings often require substantial utility upgrades to support these initiatives (Institute for Sport Business, unpublished). Ross and Mercado (2020) found that sport managers usually encounter practical limitations, such as insufficient electrical capacity to install hand dryers as replacements for paper towels or a lack of space for new generators and recycling units. Similarly, Carmichael (2020) observed that even clubs owning their facilities face significant barriers to implementing ES measures, as outdated infrastructure often necessitates costly upgrades, making changes challenging despite their ownership advantage.
- Most of the stakeholders engaged noted that many clubs operate in ageing facilities, which increases the costs of implementing actions to reduce their environmental impact.

Knowledge, awareness, and human resources gaps:

- Research also highlights some sport organisations' gaps in knowledge, attitude, and inadequate staffing as barriers to adopting pro-environmental changes. Sport England, Sport Scotland, and Sport Wales (2023) survey revealed that a lack of capacity and dedicated sustainability roles were significant barriers. In particular, NGBs reported they wanted to "get their own house in order" before supporting other members. The Institute for Sport Business (unpublished) found that insufficient training on sustainability, a lack of commitment from senior managers, increased stresses associated with engaging in sustainability work, and a lack of organisational structure to deal with environmental issues were barriers to adopting ES practices.
- During the stakeholder engagement, it was mentioned that at the grassroots level, there is a lack of awareness of what needs to be done and what measures can be implemented to adapt to climate change. Additionally, it was noted that more senior club members, often those in charge of policy decisions, may not be engaged with or committed to net-zero goals. People at the governance level can have resistance to change due to a lack of knowledge or awareness of the topic.

Volunteer and community challenges:

- Clubs highlighted that threatening behaviour from some spectators and parents can discourage the implementation of climate sustainability initiatives. This negative behaviour, often stemming from parents' competitiveness and disrespect, can hinder efforts to introduce environmental changes that depend on community collaboration, such as adjustments to travel arrangements or match-day waste recycling. Specifically, it can make clubs reluctant to engage and collaborate with these members, further complicating the implementation of sustainability initiatives (Carmichael, 2020).
- During the interviews, it was mentioned that grassroots sport organisations rely on volunteers, who are not always available to support the implementation of the environmental initiatives that clubs aim to carry out. Having volunteers is seen as a great benefit. However, this can also be seen as a weakness because volunteers have to spend time on other activities and cannot fully dedicate themselves to club efforts.

5.5. The role of NGBs in supporting grassroots sport towards environmental and financial sustainability

The literature identifies the NGBs of sports in the UK as key players in driving the grassroots sport sector to become more environmentally sustainable. Many NGBs are relatively new to setting out their own environmental action plans, and there is a great opportunity for NGBs to advocate and promote environmental sustainability among sports participants, fans, and commercial partners.

NGBs at present face a number of challenges as they aim to set up their strategy to tackle sport's environmental impact. UK Sport (2023) identified a lack of time and resources, difficulties in data collection, and a lack of environmental sustainability knowledge of NGB leads as key factors inhibiting their movement towards better sustainability practices. In the report, they highlighted how NGBs can work to build and deliver sustainability action plans. This included giving individuals responsibility for certain aspects of the sustainability plan, measuring the organisations' baseline carbon footprint, and using athletes as champions for environmental sustainability.

British Rowing (2023) identifies the carbon footprint of rowing in the UK as 2,287 tonnes of carbon dioxide equivalent emissions per year, which is comparable to the emissions produced by heating 700 homes. They outline the different key performance indicators that British Rowing is aiming to meet with regard to sustainability. These include waste reduction, using sustainable and locally sourced production, using electric support boats, encouraging active travel, and engaging and teaching young people.

Many grassroots sport clubs rely on the support of NGBs to overcome the barriers they face in implementing sustainability measures. A key source of insight is the consultations conducted by Sport England, Sport Scotland, and Sport Wales (2023). This consultation highlighted various needs aimed at addressing common barriers faced by grassroots sport organisations.

- **Funding:** The most frequently cited need was external funding for environmental initiatives, with 59% of respondents identifying this as the most desired type of support.
- **Guidance and advice:** The report also emphasised the importance of non-financial assistance. This could take the form of online resources, such as templates, toolkits, and posters, as well as in-person site visits, access to experts and consultants, or free training or education sessions.
- **Measurement equipment:** The need to access free environmental measurement equipment, such as energy meters and sensors, was also highlighted.
- **Networking and collaboration:** The grassroots sport sector expressed a strong desire for opportunities to collaborate and network with peers who are on similar sustainability journeys. This includes sharing knowledge and expertise through case studies of best practices and lessons learned, as well as participating in joint initiatives or campaigns.

The consultation also identified several areas where Sport England, Sport Scotland, and Sport Wales could play a significant role. Many of these recommendations could also be adopted by NGBs to further support grassroots sport organisations:

- **Leadership and influence:** Advocate for policy change at the governmental level and inspire action among clubs and their members to take action on environmental sustainability.
- **Funding:** Introduce grants focused specifically on environmental and climate action, or include environmental criteria in the already existing sources of funding.
- **Guidance and resources:** Provide access to impartial expert advice, online templates, training, and educational resources. Develop a centralised platform to gather resources, avoid duplication, and share best practice to encourage action.
- **Facilities and planning:** Raise sustainability standards for new sports facilities through planning engagement, sector design guidance, and investment. However, this needs to ensure standards are realistic and viable based on the facility and sport type.
- **Communications and campaigns:** This includes launching campaigns to encourage action.
- **Coordination role:** Act as a convenor by establishing a sustainability network for different stakeholders.
- **Inspiration and incentives:** Encourage sustainable practices with incentives and provide inspiration, incentives, and support rather than strict requirements or criteria to comply with. Shift grassroots sport targets from purely participation-focused to incorporating environmental goals.

During the interviews, grassroots sport organisations echoed what was found in the literature and mentioned some areas where they would welcome support from NGBs to enhance their environmental sustainability and adapt to climate change. These include:

- **Financial support:** The primary concern of grassroots sport organisations was the need for greater financial resources to implement sustainability measures and improve their resilience to climate change. Suggestions included more accessible grants and subsidies for environmental improvements. Clubs also noted that NGBs could use their collective purchasing power to negotiate discounts on machinery or equipment that would help them to adapt to climate change, making it more affordable for clubs to access them. Without this support, such equipment would be significantly more expensive if purchased individually. Additionally, clubs emphasised the importance of awareness campaigns to ensure they are informed about available funding opportunities.
- **Practical information:** Many clubs lack awareness of environmentally sustainable measures and would benefit from clear, actionable guidance rather than lengthy reports. They suggested that breaking down cost-effective initiatives into manageable steps would be particularly useful. Access to expert advice on evaluating and implementing these measures was also highlighted as a desired area for support.
- **Collaboration with other stakeholders:** Clubs expressed interest in greater collaboration facilitated by NGBs, including knowledge-sharing between clubs, businesses, and charities. This could involve sharing best practices on environmental initiatives and practical steps for implementation. Additionally, fostering equipment-sharing schemes was suggested as a way to reduce costs and improve sustainability across the sector.

Chapter 6: Conclusions and Recommendations

- The grassroots sport sector impacts the environment, primarily through travel emissions and facility energy use, with additional contributions from waste generation and construction. Despite these impacts, research so far has largely focused on professional sports, leaving a critical evidence gap. The carbon modelling conducted as part of the research estimates that the grassroots sport sector produces four million tonnes of CO₂e annually, equivalent to 0.5% of UK emissions.
- Climate change is disrupting grassroots sports, with flooding, droughts, and heat waves becoming more frequent. Clubs face financial strain due to facility damage, event cancellations, and declining participation. Without action, rising costs may make grassroots sport less accessible. The sector already incurs £320 million annually in weather-related costs, projected to increase by £95 million under 2°C warming and £190 million under 4°C warming.
- Clubs are adopting sustainability measures, such as improving energy efficiency, but financial, infrastructural, and knowledge barriers persist. Policy recommendations include enhanced financial support, improved data collection, and targeted assistance.

This chapter presents the key conclusions from the research and recommendations informed by the research findings.

6.1. Conclusions

6.1.1. Impact of the grassroots sport sector on the environment

- **The grassroots sport sector has a significant impact on the environment, primarily through travel, gas and electricity use, and waste generation.** Travel to activities is highlighted as the primary cause of emissions, with participants and spectators often relying on cars for their travel needs. This was identified as the key channel in the literature covering elite sports. Gas and electricity use by sporting facilities is another major source of emissions, as sports clubs often have significant energy requirements for the lighting, heating, and air conditioning of their facilities. The production of waste, such as food waste at events and old sportswear, was identified as another relevant channel.
- **Other potential impacts include emissions from the construction of sport facilities and equipment production, as well as the impact of artificial surfaces and chemical inputs.** The literature review identified the construction phase as a particularly relevant channel, as it can take several years of facility operation for its cumulative emissions to equal those generated during initial development. Interviews also emphasised the role of artificial turf in microplastic pollution.

- **There is a significant evidence gap regarding the environmental impact of grassroots sport, with most of the existing literature focussing on professional sport.** This is an important gap to address, given that professional and grassroots sport share many characteristics, but there are also several areas where the two diverge. Notably, grassroots sport often involves more participants. Additionally, while the main environmental impact of professional sport stems from large-scale events, the grassroots sport sector's footprint is primarily driven by the cumulative emissions from everyday activities and events.
- **Results from modelling suggest a significant carbon footprint for the grassroots sport sector.** Central estimates give total carbon emissions produced annually as just over four million tonnes of CO₂e, equivalent to roughly 0.5% of UK carbon emissions. This is primarily driven by facility usage, particularly for court sports and indoor water sports, alongside travel emissions.

6.1.2. Impact of climate change on the grassroots sport sector

- **Climate change is having a significant impact on grassroots sport, with flooding, droughts, and heatwaves identified as the primary challenges facing community clubs.** Many clubs reported that these extreme events are becoming increasingly frequent, often happening multiple times within a year. Notably, while severe flooding was historically expected to happen once in 100 years in the UK, some clubs now experience it more than once a year.
- **The financial impact on grassroots sport organisations stems from three main channels: (i) facility damages and closures, (ii) event cancellations, and (iii) declining participation.** Extreme weather can severely damage sports facilities and infrastructure, leading to costly repairs and prolonged disruptions. When clubs are forced to close, they usually need to rent alternative venues to keep operating, adding further financial strain. Weather-related event cancellations also have a direct impact on club revenues, not only from lost ticket sales but also from reduced income from clubhouses, where food and beverage sales represent a significant revenue stream. While declining participation is a concern for some clubs, all agree that frequent cancellations undermine their reliability, which in turn affects long-term member engagement.
- **Climate impacts vary by type of sport, club size, and location.** Larger clubs, with greater financial security, are generally better equipped to absorb weather-related financial shocks. Certain regions are more vulnerable to specific climate risks. For example, clubs in southern England face higher repair and adaptation costs due to increased flood risks. Also, some sports are less financially affected by climate change due to the nature of their activities—for instance, outdoor running can continue in most weather conditions. In this sense, support to adapt to climate change will vary according to the characteristics of the clubs.
- **Climate change is also affecting participants, impacting both their performance and the way the sport is played.** High temperatures can reduce endurance and affect cognitive functions, such as memory, hand-eye coordination, and focus. Other risks arise in hot weather: (i) synthetic surfaces absorb excessive heat, making them unsafe for play, (ii) the risk of heat exhaustion increases across multiple sports, (iii) hydration becomes a critical issue, particularly in endurance-based activities like athletics, and (iv) dry, hardened



pitches increase the likelihood of injury. Additionally, warmer conditions promote algae growth in the water, making some water sports hazardous.

- **Climate change can pose a significant risk to the health and wellbeing of sports participants.** Rising temperatures increase the likelihood of heat-related illnesses, such as heat exhaustion and heat stroke, especially in sports that require heavy protective gear or for participants with pre-existing health conditions. Outdoor athletes also face increased exposure to UV radiation, heightening the risk of sunstroke and skin cancer. In snow and water sports, climate change can create unsafe playing conditions, as insufficient snow coverage may expose hazardous terrain, and rising temperatures can contribute to the growth of algae and bacteria in water. All these factors can affect the mental health of participants, as they may be unable to play sports as frequently as desired. Additionally, the cancellation of sporting events due to weather-related issues can reduce participation, leading to decreased physical activity and negatively impacting healthy lifestyles and overall wellbeing.
- **If no action is taken, grassroots sport risks becoming elitist.** As community sport clubs struggle to absorb the financial burden imposed by climate change, they may be forced to increase membership fees to remain afloat. This would make grassroots sport less accessible, limit wider community participation, and change the nature of the sector.
- **Financial modelling estimated that the current costs of adverse weather events, such as intense rainfall and flooding, cost the sector £320 million annually.** This figure reflects facility maintenance and repair costs and potential revenue losses due to event cancellations from adverse weather. This figure is likely to rise by £95 million under a 2°C rise in global temperatures and £190 million in a 4°C warming scenario.

6.1.3. Climate change adaptation and mitigation strategies in grassroots sport organisations

- **Grassroots sport organisations in the UK are actively working to reduce their impact on the environment.** These include improving the energy efficiency of facilities, utilising renewable energy sources, switching to electric equipment and vehicles, promoting more sustainable travel means, reusing sport kits, implementing reuse and recycling programmes, and enhancing biodiversity. The main reason identified for implementing these measures is to reduce costs and retain and keep attracting members.
- **In response to changing weather patterns, grassroots sport organisations are also adapting their facilities and strategies to ensure continued operation.** Sport facilities are being enhanced to aid sport participation in extreme weather, such as increased shaded or air-conditioned areas. Measures are also being implemented to protect participants from the weather, including changing timings of events, air quality alarms, and the promotion of safe practices, such as the use of sunscreen and breathable clothing. This also includes the development of emergency strategies to respond to climate-related events. This usually includes an immediate response to restore the basic functions of the club, the full restoration to rebuild permanently damaged infrastructure, and making investments in the long-term climate resilience of the club. Usually, clubs prioritise adapting to climate change rather than reducing their carbon footprint, as their focus is on surviving.
- **Community clubs face several barriers when considering how to implement measures**

to improve their environmental sustainability:

- **Financial constraints** – Identified as the main challenge for clubs, as many clubs lack the necessary funding.
- **Limited control over facilities** – Many clubs operate in venues owned by third parties, restricting their ability to implement sustainability measures.
- **Ageing infrastructure** – Older facilities require costly maintenance, making sustainability improvements more expensive.
- **Knowledge and resource gaps** – Many organisations lack awareness of climate adaptation strategies and struggle with limited human resources with the experience to implement these changes.
- **Volunteer and community challenges** – As grassroots sport relies heavily on volunteers, the availability of individuals to support environmental initiatives is usually limited.

6.2. Recommendations

Policy recommendations

- **Provide support to grassroots sport clubs to understand the scale of the problem.** To drive meaningful change, grassroots sport organisations need a clearer understanding of their environmental and financial impact. Improved data collection is essential for assessing this. Sport governing bodies can support clubs by providing standardised templates for data collection, including tools for measuring their carbon footprint.
- **Provide support to help grassroots sport organisations overcome barriers to implementing environmental sustainability measures.** Sport governing bodies can play a crucial role through:
 - **Financial support** - Offering accessible grants and subsidies for environmental improvements and keeping clubs informed about opportunities.
 - **Providing practical information** - Offering clear, step-by-step advice on cost-effective sustainability initiatives, making them more manageable for clubs to implement.
 - **Facilitating collaboration between different stakeholders** - Encouraging knowledge-sharing between clubs, businesses, and charities. This could include sharing best practice on environmental initiatives and providing practical implementation strategies.
- **Target support to grassroots sport clubs based on their climate risk level.** Sport governing bodies could develop a climate risk index for grassroots clubs to guide funding and support allocation. This index could consider factors such as the type of sport played, club size, geographical location, and the number of climate-related issues the club has faced in the last year.

Recommendations for future research

- **Sport-specific analysis.** While this research examines grassroots sport as a whole, a deeper dive into specific sports could provide more detailed insights. Given the relatively small sample size of interviews, future research could use surveys to gather more comprehensive data. However, this would require support from NGBs and grassroots sport organisations to facilitate data collection.
- **Exploring additional impact channels and sports.** The carbon footprint model could be updated, including sources of climate impact not covered in this report, such as the environmental impact of sports equipment and the emissions generated in the construction of sports facilities.

Anex 1. Fieldwork Materials

1.1 Stakeholder list

The national governing bodies and grassroots clubs that took part in the interviews are listed below.

Table 10. National Governing Bodies

Organisation Name	Sport	Coverage
1. Basketball England	Basketball	England
2. England and Wales Cricket Board	Cricket	England and Wales
3. England Athletics	Athletics	England
4. England Golf	Golf	England
5. England Hockey	Hockey	England
6. Football Foundation	Football	England
7. Lawn Tennis Association	Tennis	Great Britain, the Channel Islands, and the Isle of Man
8. Rugby Football Union	Rugby	England
9. Sport England	All	England
10. Swim England	Swimming	England

Table 11. Grassroots sport clubs

Club Name	Sport	Region
1. Belper Meadows Community Club	Hockey	East Midlands
2. Belper Rugby Club	Rugby	East Midlands
3. Bromley Cricket Club	Cricket	London
4. Cottingham Tigers Rugby League Club	Rugby	Yorkshire and the Humber
5. Ellingham and Ringwood Rugby Club	Rugby	Southeast England
6. Fulham Reach Boat Club	Rowing	London
7. Leicester Nirvana Football Club	Football	East Midlands
8. Stourbridge Football Club	Football	West Midlands
9. Stratford-upon-Avon Boat Club	Rowing	West Midlands
10. Whalley Range Cricket and Lawn Tennis Club	Cricket	Northwest England

Two written responses were also received from two additional grassroots sport clubs.

Table 12. Grassroots sport clubs

Club Name	Sport	Region
Rochdale Mayfield ARLFC	Rugby	Northwest England
South London Swimming Club	Swimming	London

1.2 Interview questions

1.2.1 National Governing Bodies

1. To kick us off, can you describe your organisation's main activities and your role within them?
2. Have you or any grassroots sport organisations in your network experienced any changes or challenges due to weather-related factors?
3. What financial challenges (if any) have grassroots sport organisations in your network faced due to this change in the UK weather pattern?
4. What financial risks do grassroots sport organisations within your network face if they do not take action to adapt to climate change?
5. What do you think are the main sources of environmental impact for grassroots sport organisations in your network?
6. Have you ever assessed the carbon footprint of grassroots sport organisations from your network? If yes, how was it measured? Can you share the results?
7. Have the grassroots sport organisations in your network taken any action to reduce their environmental impact?
8. Can you provide examples of grassroots sport organisations in your network that have successfully implemented climate adaptation strategies?
9. What barriers do grassroots sport organisations face in adopting climate adaptation measures?
10. What role does your NGB play in promoting environmental sustainability at the grassroots level?
11. What else could NGBs do to help grassroots organisations adapt to climate change?
12. Do you collect or have access to data from grassroots sport organisations in your network that could help us understand the impact of their activities on climate change (e.g., data on energy and water usage)?
13. Do you collect data on the financial impacts of climate change on grassroots sport organisations within your network?
14. Are you aware of any instances where grassroots sport organisations in your network have implemented adaptations to mitigate the effects of climate change? Can you provide examples?

15. On average, how many grassroots sport organisations are part of your network?
16. How many staff members or volunteers are typically involved in these organisations?
17. How many members or participants usually participate in events from these organisations?
18. What are the main facilities used by grassroots sport organisations in your network?

1.2.2 Grassroots sport organisations

1. To kick us off, can you describe your organisation's main activities and your role within them?
2. Have you noticed any challenges related to weather conditions, such as cancellations, reduced participation, or changes in event logistics?
3. Has your organisation experienced any other changes or challenges due to weather-related factors?
4. What are the financial implications of more extreme events associated with climate change?
5. Do you think that your organisation has an impact on the environment? Examples of these impacts may include energy use in your facilities, travel emissions from participants attending your events, waste generation, etc.
6. Which of the following has the most significant environmental impact: energy use, water consumption, waste generation, or travel emissions? Are there any other factors that have a greater impact on the environment?
7. Have you ever assessed your organisation's carbon footprint or environmental impact? If so, how was it measured? (If required: Carbon footprint is the total amount of carbon dioxide released into the atmosphere because of human activities. It includes things like driving cars and using electricity.)
8. Has your organisation taken any action to reduce its environmental impact? For example, reducing energy consumption, waste generation, water usage, or switching to public transport?
9. Have you implemented any changes to adapt to the impacts of climate change, e.g., extreme weather conditions?
10. Are there any measures you would like to implement to adapt to climate change, but haven't yet been able to (for example, due to financial constraints, lack of resources, etc.)?

Table 13. Grassroots sport organisation data collection table

Which sports are typically played at your facility?
Are the facilities indoor or outdoor?
Please describe the different facilities your organisation offers, such as the number of courts, pitches, pools, offices, etc.
How do staff and members normally travel to activities (e.g., cars, trains, buses, flights)?
What proportion of staff/members use each transportation mode?
Does your organisation own or operate any vehicles? If so, which type? (car/bus, petrol/diesel/electric)
If so, how many miles/kms do these vehicles travel annually?
How far do your staff and members typically travel to attend activities?
How often do members typically travel to activities?
How many members in your organisation regularly travel to activities?
How many full-time staff are employed at your organisation?
How many part-time staff are employed at your organisation?
How much does your organisation currently spend on electricity per month?
How many kWh of electricity does your club consume per month?
How much does your organisation currently spend on gas?
How many kWh of gas does your club consume per month?
Has your electricity usage increased in the past five years due to bad weather (e.g., more use of indoor facilities)? If so, by how much?
Has your gas usage increased in the past five years due to bad weather (e.g., more use of indoor facilities)? If so, by how much?
How much electricity do your facilities typically consume in a month?
How many hours per week do your facilities normally use electricity?
How much gas do your facilities typically consume in a month?
How many hours per week do your facilities normally use gas?
Do your facilities use any other energy sources? (e.g., solar, wind, other onsite energy generation). If so, what proportion of energy comes from these sources?
Does your facility employ any energy conservation measures to reduce the consumption of electricity or gas? (e.g., use of LED light bulbs, insulation, etc.)

How much water do your facilities typically consume in a month?

Does your facility use any water recycling systems, such as rainwater harvesting? If so, how much water comes from these sources?

Is there seasonal/time variation in water use?

Has adverse weather led to the cancellation of activities or the closure of facilities in recent years? If so, which weather events?

Approximately how many times per year have you had to cancel activities or close facilities?

Has this number risen in the past five years? If so, by what proportion?

Approximately what is the average loss in revenue from a cancelled event/facility closure caused by bad weather?

Are there any costs that you cannot get back when an activity is cancelled or the facility is closed? How much are these costs?

Has bad weather impacted facility maintenance costs? If so, which weather events?

What is the cost of facility maintenance per year?

Have these costs risen in the past five years due to worse weather? By what percentage?

Have your facilities been damaged by extreme weather? If so, by which event?

On average, how often are your facilities damaged by extreme weather per year?

Approximately what has been the cost of repairs due to an extreme event? (e.g., cost to repair flood damage)

Have these costs risen in the past five years due to worse weather? By what percentage?

Does your facility currently have insurance to cover damage due to bad weather?

If so, what is the cost of your insurance per month? Has this risen in the past five years due to increased bad weather?

Have you made any adaptations in the past five years to make your facilities better suited to adverse weather? (e.g., use of artificial pitches)

How much did these adaptations cost?

Anex 2. Modelling Approach

This section details the logic and approach to the modelling carried out within this project to quantify the relationships between grassroots sport and climate change. Carbon modelling was undertaken to estimate the current carbon footprint of grassroots sport in order to better understand the impact grassroots sport currently has on the environment. Financial modelling was also carried out to quantify the current financial impact of adverse weather on grassroots sport, and how this may increase due to the effects of climate change on the UK weather patterns.

The data utilised in this model originated from a range of sources, including stakeholder engagement with national governing bodies and grassroots sport clubs, as well as data that was publicly available online. Where data or evidence was lacking, carefully considered proxies and assumptions based on online evidence and stakeholder interviews were utilised and are stated in the section below.

2.1 Carbon modelling

The carbon modelling aimed to estimate the total quantity of carbon dioxide equivalent emissions produced by the grassroots sport sector in England within a year. The model focused specifically on England, as, due to the scope and timelines of the project, the fieldwork carried out to inform the model parameters was based on engagement with England-based stakeholders.

The model splits the carbon emissions produced into two broad categories. Firstly, the travel emissions caused by participants travelling to and from sporting activities and secondly, the emissions produced by sports facilities. A separate carbon model was developed for three different sport typologies to reflect how the carbon footprint may differ by sport type. The three typologies modelled were court sports, field-based sports, and indoor water sports, which were selected due to their likely significant contribution to the production of greenhouse gas emissions.

2.1.1 Travel emissions

For each typology, the emissions of a typical sport participant were first estimated by considering a number of factors that determine the carbon footprint of travel to participate in sport.

- **Mode of transport:** Data on the mode of transportation used was taken from the Department for Transport (2024a) on the miles per person for different modes of transportation used to travel for leisure purposes. Relative weights were calculated for the usage of cars, buses, trains, and active transport. For travel to indoor swimming activities, specific data on travel mode was collected from Sport England data on travel to swimming pools in Oxfordshire, which is assumed to be representative of England.
- **Extent of car sharing:** For car usage to court and field sports, car occupancy was assumed to be 1.65 persons per vehicle, in line with estimates from Angeloudis and Stettler (2019), which provided data on car sharing for leisure trips. Car sharing for indoor water

sports was assumed to be zero, as swimming is typically an individual sport.

- **Car fuel types:** Data from the Department of Transport (2024b) was used to estimate the share of petrol, diesel, and electric cars.
- **Emission factors:** The quantity of carbon dioxide equivalents produced per kilometre for each transport mode and fuel type was obtained from the Department for Energy Security and Net Zero (2024).
- **The average distance travelled to events:** Different data sources were utilised to reflect how distance travelled to events is likely to vary by sport type. For court-based sports, data from the Department for Transport (2024c) statistics on the average distance travelled to participate in sport was used. Data from stakeholder interviews was used to estimate the length of travel for field-based sports, and data from Sport England (2024c) on swimming pool provision by South Oxfordshire County Council was used for the length of travel to swimming facilities.
- **The average frequency of travel to events:** Uncertainty in this assumption meant that these figures were altered in the sensitivity analysis. Under the central scenario, it was assumed that participation was four times per month, based on the limited evidence from fixture calendars, stakeholder engagement, and the Active Lives survey estimates. The length of the season was assumed to be nine months for field-based sports, again based on fixture calendars, whilst it was assumed that court sports and indoor water sports are played all year round.

The above information was used to estimate the carbon emissions for the average participant in each typology due to travel to sporting events. This value was aggregated by the total number of sports participants in each typology, which was worked out via Sport England (2025) Active Lives survey data on the numbers of participants who have played each sport at least twice within the past 28 days.

A number of caveats should be considered alongside these estimates:

- The average frequency of travel is uncertain as this varies significantly between individual sports and participants. For this reason, travel frequency was changed during the sensitivity analysis.
- Data on travel to swimming pools is taken from estimates from a specific local authority, and it is assumed that these values hold across the country.
- Some figures, such as the extent of car sharing and mode of transport used, come from data on leisure activities in general, rather than being specifically for journeys to participate in sport.

2.1.2 Facility emissions

The second part of the carbon modelling focused on calculating emissions produced by grassroots sport facilities, such as energy use for lighting, heating, and air conditioning. The same three typologies were analysed, and within each typology, different facility types were modelled. The calculations included three key steps:

- The modelling focused on estimating gas and electricity consumption of a typical facility in kilowatt-hours (kWh) for each typology. Due to the limited availability of data on facility emissions, the approach to gathering this data differed by club/facility.
- Usage was then aggregated by the estimated total number of each facility type.
- The carbon dioxide equivalent emissions were then determined by multiplying by the emission factors for national grid electricity and gas, given by data from the Department for Energy Security and Net Zero (2024).

Further details on the method used for each typology are described below.

2.1.2.1 Court-based sports

For court-based sports, three facility types were modelled: indoor tennis centres, outdoor courts, and indoor sports halls.

- **For indoor tennis centres**, a top-down approach was used as data from Gloucester City Council (2011) was available on the costs of electricity and energy for an indoor tennis centre run by the council. Through using Department of Energy & Climate Change (2011) data on prices of electricity and gas for the relevant year, the volumes of gas and electricity usage were calculated. This was then aggregated by the total number of tennis centres in England, given by data from the ONS (2024).
- **For outdoor tennis courts**, a bottom-up approach was implemented.
 - Data from Tennis Australia (2023) provided the typical power usage for lighting an outdoor tennis court for both courts that use LED and non-LED lighting. The proportion of courts that use LED lighting was estimated from the Tennis Industry Association UK (2022), and the proportion of courts that have floodlights was estimated from data on outdoor tennis facilities in Harborough District Council (2022). Finally, data from the Lawn Tennis Association (2021) provided estimates for the number of additional hours of playing time provided by a floodlit court, which was used as a proxy for the total amount of time floodlighting is used per court. Together, the different data points were used to estimate the electricity usage for a typical outdoor court. This was then aggregated using the number of outdoor tennis courts from the ONS (2024) data.
 - Outdoor basketball and netball courts were also assumed to have similar emissions to outdoor tennis courts, and hence, the figure was also aggregated by the estimated number of outdoor basketball and netball courts. Given that data was not available on the exact number of outdoor basketball and netball courts, it was assumed that the number of courts is roughly equal to the number of clubs. Data for the number of clubs was taken from Netball England (2025) and Basketball England (2022), respectively.
- **For indoor sports halls**, a report from the UK Government's Energy Efficiency Best Practice programme provided estimates of the electricity and gas usage for a typical dry indoor sports facility, and again, this was aggregated by the total number of indoor sports halls, as given by ONS (2024) data on sporting facilities in England.

2.1.2.1 Field-based sports

For field-based sports, three different club types were modelled: a football club, a cricket club, and a golf club.

- **For a football club**, stakeholder engagement provided data on the gas and energy usage of a typical club.
- **For a cricket club**, energy bill data was also obtained from stakeholder engagement with a cricket club.
 - Using data on gas and electricity prices from the Department for Business, Energy and Industrial Strategy (2025) for the relevant time period, the usage of gas and electricity was estimated.
 - Given that the club also hosts rugby and tennis in addition to cricket (which were noted to be higher energy users), it was assumed that the cricket club is responsible for 20% of the total club energy usage.
- **For a golf club**, energy usage data from an 18-hole golf course was used from the Golf Course Superintendents Association of America (2017).

Again, emissions were calculated for each stylised club, and they were aggregated to represent the total facility emissions within the typology. The sports included in this typology were football, rugby league and union, cricket, hockey, and golf. The data on the number of clubs for each relevant sport came from several sources, including England Football (2025), the Rugby Football Union (2022), Sports Management (2013), England and Wales Cricket Board (2025), England Hockey (2025), and National Club Golfer (2022).

2.1 Indoor water sports

Data was collected on two differing types of indoor pool facilities, both of which gave the usage of electricity and gas annually.

- **For a smaller swimming pool facility**, data for Leisure Energy (2017) provided an example of a relatively small facility with a 25m pool and a small gym.
- **For a larger pool facility**, data from Wynne and McLean (2017) gave energy usage estimates for a leisure centre, which, in addition to a pool and gym, included other features, such as additional fitness suites, steam rooms, saunas, and a hot tub.

Again, emissions per facility were calculated using the relevant emission factors, and the total was aggregated by the number of swimming pools in the UK from ONS (2024) data. The weighting between the two facility types was an area of uncertainty and hence varied in the sensitivity analysis. The central assumption used estimated that most (75%) of facilities were of smaller size. This percentage changed to 100% in the high scenario and to 50% for the low scenario.

2.2.2 Sensitivity analysis

As indicated above, sensitivity analysis was employed in the carbon model to account for a number of assumptions that were made in the modelling, where exact data points were not obtained. The sensitivity analysis generated a better understanding of the impact of the key assumptions made on the final results and meant that a range of carbon footprint estimates could be found, with a low, central, and high estimate. The assumptions changed in the carbon modelling sensitivity analysis are detailed below:

- **Frequency of travel** was changed to reflect a lack of certainty of the number of times per month that typical sport participants will travel to participate in sport. In the lower scenario, travel is assumed to be once per month. This is increased to twice per month in the central scenario and four times per month in the high scenario.
- **Swimming pool facility types** were also altered in the sensitivity analysis. This reflected that the share of different types of swimming pool facilities used in England is uncertain. In the low scenario, it was assumed that all facilities are of the smaller and lower emission type. In the central scenario, it is assumed that 25% of facilities are of the larger type, whilst the proportion rises to 50% in the high-emission scenario.

2.2 Financial modelling

The aim of the financial model is to assess and quantify the financial impact that adverse weather has on grassroots clubs and how this is likely to increase due to the impacts of climate change on the UK weather patterns. The financial model focuses on the field-based sports typology, as these sports are most likely to be played outdoors on grass surfaces and hence impacted by weather events, such as intense rainfall and flooding.

The financial impacts are divided into two main channels. Firstly, the costs associated with damage to facilities due to flooding and increased pitch maintenance due to increased rainfall. Secondly, the revenue losses that clubs face due to event cancellation and facility closure.

The calculations in the financial model were split into three key steps:

- Estimate the current (baseline) per-club cost associated with facility damage, pitch maintenance, event cancellation, and facility closure.
- Estimate the number of clubs impacted by these events. The modelling differentiated between the impacts on all clubs from higher rainfall and the additional impacts of flooding that primarily affect clubs in areas at a high risk of flooding.
- Estimate the increased cost associated with more frequent rainfall and flooding for two climate scenarios, a 2°C and a 4°C rise in global temperatures.

High flood risk areas

As outlined above, step two of the financial modelling differentiated between the impacts on all clubs and the additional impacts that are likely to primarily affect clubs at a high risk of flooding, such as those located on floodplains. Two data sets were combined to determine the proportion of clubs located in floodplains. Firstly, ONS (2024) data provides the number of different sport facilities in each Middle Layer Super Output Area (MSOA) within the country. In addition, Environmental Agency (2014) data provided the proportion of area in each MSOA currently at high risk of flooding. By matching the datasets together, the proportion of grass pitches located in areas at high risk of flooding was calculated to be just over 10% of the total. The total number of field-based sports clubs was found through a number of sources, including England Football (2025), the Rugby Football Union (2022), Sports Management (2013), England and Wales Cricket Board (2025), England Hockey (2025), and National Club Golfer (2022).

Climate change scenarios

As outlined above, step three of the financial model aimed to capture not only the current impacts of weather on the finances of grassroots sport clubs but also how this is likely to change in the future. The model follows evidence from both the relevant literature and stakeholder engagement that rainfall and flooding are the main weather events impacting grassroots sport clubs in the UK. For this reason, the model focuses on the impact of rainfall and flooding on both facility maintenance and repair costs and on revenue losses due to event cancellations.

The weather scenarios used focused on predictions of how the UK climate is likely to change under differing increases in global mean temperatures relative to pre-industrial levels. This model examines two climate scenarios, a 2°C and a 4°C rise in global temperatures. A report by Surminski (2021) found that damages to non-residential properties due to flooding are expected to rise by 40% and 75% under a 2°C and a 4°C rise in temperatures, respectively. These figures were applied to estimate how damages to grassroots sport facilities and pitches will rise in line with increasing climate change. Furthermore, research from Hanlon et al. (2021) provides estimates on the increased prevalence of high-impact rainfall under both a 2°C and a 4°C temperature increase. These figures were used to derive how the number of cancelled sporting events is likely to increase under the two scenarios.

2.3 Facility maintenance and repair costs

2.3.2 Pitch maintenance costs

A key cost that field-based sport clubs face in relation to the weather is the cost of maintaining the playing pitches in a usable condition.

- **The current costs of pitch maintenance** were an area of uncertainty.
 - Although estimates were available from both stakeholder engagement and data in the public domain, there was significant variation in the typical annual maintenance costs per pitch. Therefore, this cost was varied in the sensitivity analysis, as explained further below.
 - The estimates of per-pitch maintenance costs were then aggregated by the ONS data on the total number of grass pitches in England.
- **The proportion of maintenance costs related to weather** was also uncertain, as there is limited direct evidence quantifying the extent to which weather influences pitch maintenance costs. However, key cost components such as labour, materials, and infrastructure are all linked to weather-related factors.
 - **Labour costs** – High rainfall and rising temperatures can increase the growth rates of grass, requiring more frequent mowing (Lawn UK, 2012). Heavy rain can lead to soil compaction, which requires additional aeration (Rolawn, 2022). Extreme weather can increase the frequency of pitch inspections (Front Runners, 2024).
 - **Material costs** – Extreme weather can increase the requirements for fertilisers and reseedling to help grass recover (The Grass People, 2017). Chemicals such as fungicides and pesticides are often used more frequently in wet conditions (Rutgers, 2016).
 - **Infrastructure costs** – The requirements for irrigation and drainage systems, as well

as pitch covers, are directly related to rainfall patterns (Sports Turf, 2024; ATB, 2023). The need for additional infrastructure, such as heating systems or frost protection, is driven by colder weather (Pitchcare, 2013).

- Based on the above, the model assumed that roughly 50% of pitch maintenance costs are directly related to weather-related factors. Given the uncertainty in this assumption, it is adjusted to 25% and 75% in the high and low scenarios, respectively.
- **Future pitch maintenance costs** were also estimated, taking into account the likely increase in rainfall and how this may increase maintenance costs.
 - The increased costs of grass pitch maintenance over time were assumed to rise in line with the days of intense rainfall due to rising temperatures, as discussed above.
 - The increased costs of grass pitch maintenance were calculated under both the 2°C and a 4°C rise in global temperature scenarios. Again, these increases were aggregated by the ONS (2024) data to find the total impact on the sector.

Table 14. Financial Modelling - Pitch maintenance costs (central scenario)

Baseline costs	Estimate
Annual cost of pitch maintenance (2024)	£8,000
Proportion of maintenance costs related to weather	50%
Annual cost of weather-related pitch maintenance (2024)	£4,000.00
Total number of grass pitches	46,372
Current costs of pitch maintenance	£185,488,000
Rise in temperatures	Estimate
Increase in number of heavy rainfall days under 2°C rise in temperatures	28.6%
Increase in number of heavy rainfall days under 4°C rise in temperatures	57.1%
Increases in total yearly pitch maintenance costs under 2°C rise in temperatures	£52,996,571
Increases in total yearly pitch maintenance costs under 4°C rise in temperatures	£105,993,143

2.3.3 Extreme flooding repair costs

In addition to the increased costs of maintenance due to higher rainfall, the impact of extreme weather events on sports facilities was considered. For this part of the modelling, the focus was on clubs located in areas at high risk of flooding, as these clubs will face additional impacts compared to clubs located in areas less prone to flooding. This part of the analysis

was therefore restricted to the proportion of clubs located in high-risk areas as noted above. This encompassed damages to facilities, such as pitches and clubhouses, due to bad flooding events.

- **Costs per extreme flooding event** were first calculated using data from the Rugby Football Union (RFU) on the repair costs of the worst flooding events that clubs had experienced.
 - This provided data on the aggregate costs of damage to off-field facilities for 36 rugby clubs, which came to a total of £894,000. This data was used to find the average repair cost for a club due to a bad flooding event.
- **Frequency of the extreme flooding events** was another area of uncertainty.
 - Discrepancies and uncertainty between the data sources used on how common such floods are meant that this was a parameter of the model that was changed in the sensitivity analysis. This is detailed in the sensitivity analysis below. In the central scenario, it was assumed that such events occur every 5 years or 0.2 floods per year.
 - The average cost of a flood was then multiplied by the frequency of such floods and then by the number of clubs in high-risk areas to determine the current damages to clubs due to flooding.
- **Likely future increased repair costs** were then estimated by using the climate scenarios on damages under a 2°C and a 4°C temperature rise to calculate the increased cost of damages due to extreme flooding events.

Table 15. Financial Modelling - Off-field flooding repair costs (central scenario)

Baseline costs	Estimate
Total field sport clubs (England)	28,152
Proportion of clubs in flood zone	10.2%
Number of clubs in flood zones	2,883
Frequency of flooding events (per year)	0.20
Number of clubs impacted by flooding per year	576.55
Repair cost of bad flood per club (2024)	£24,833
Aggregate annual cost for clubs in flood zones	£14,317,557
Rise in temperatures	Estimate
Increases in damages by 2080 under 2°C rise in temperatures	40.0%
Increases in damages by 2080 under 4°C rise in temperatures	75.0%
Increase in annual damage 2°C rise	£5,727,023
Increase in annual damage 4°C rise	£10,738,168

2.4 Event cancellation costs

2.4.2 Cancellations due to unplayable pitches

The next part of the model focused on the revenues lost by clubs when sporting events are cancelled due to unplayable pitches and facility closures.

- **The first step was to estimate the revenue lost per cancelled event.**
 - Data from stakeholder interviews suggested a typical match fee of £10 per participant, and assumptions were made that additional food and drink sales will be around £10 per participant.
 - It was then assumed that the average number of participants per game would be around 30 to reflect the typical size of two grassroots sport teams. By multiplying the loss per participant by the average number of participants, the total typical loss in revenue of a cancelled sport event was found.
- **The total loss due to cancelled events** was then found by aggregating the estimated total number of cancelled events.
 - This used data from the Football Association (2024), which estimated that 120,000 football matches are cancelled due to rain and flooding every year.
 - Using the relative proportion that football clubs make up of all field-based sports, the total current number of cancelled games was determined to be around 186,000 games per year for field-based sports.
- **Expected future impacts** were derived from the data from Hanlon et al. (2021) on the increase in high-impact rainfall events under the different temperature changes. This gave estimates of how event cancellations and, in turn, revenue losses will likely increase under a 2°C and 4°C rise in global temperatures.

Table 16. Financial Modelling - Cancellation due to waterlogged pitches (central scenario)

Baseline costs	Estimate
Loss in revenue per cancelled event	£600.00
Total number of cancelled events per year (excluding flood zones)	168,462
Current revenue losses per year	£101,077,064
Rise in temperatures	Estimate
Increase in number of heavy rainfall days under 2°C rise in temperatures	28.6%
Increase in number of heavy rainfall days under 4°C rise in temperatures	57.1%
Annual total lost revenue under 2°C rise in temperatures	£28,879,161
Annual total lost revenue under 4°C rise in temperatures	£57,758,322

2.4.3 Revenue loss due to extreme flooding events

Another channel of revenue loss that was modelled was the impact of major flooding events that led to the closure of facilities and event cancellations. The part of the analysis focused on only clubs located in areas at high risk of flooding.

- **Revenue losses per club** were estimated using data from the RFU report on the total losses in revenue caused by bad flooding to 36 of its rugby clubs.
 - Once again, the impact per club was calculated from the aggregated data.
 - Sensitivity analysis on the frequency of flooding was carried out due to the uncertainty in this parameter.
- **The aggregated costs** to all clubs were found using data on the number of pitches located in flood zones.
- **Future impacts** were also determined using data from Surminski (2021) on increased flooding damages.
 - The expected future increase in lost revenues due to major flooding events was calculated for a 2°C and 4°C rise in temperatures.

Table 17. Financial Modelling - Revenue loss due to extreme flooding event (central scenario)

Baseline costs	Estimate
Revenue loss from extreme flood event per club (2024)	£30,444
Number of clubs impacted by flooding per year	577
Total cost per year	£17,552,856
Rise in temperatures	Estimate
Increases in damages by 2080 under 2°C rise in temperatures	40.0%
Increases in damages by 2080 under 4°C rise in temperatures	75.0%
Increase in annual damage 2°C rise	£7,021,142
Increase in annual damage 4°C rise	£13,164,642

2.5 Sensitivity analysis

As was done in the carbon model, a further sensitivity analysis was undertaken in the financial model to test how changing some of the key assumptions would impact the final results. In the sensitivity analysis, the high, central, and low estimates of the financial impact of climate change were made by altering the assumptions made in the model. The assumptions that have changed are outlined below:

- **The frequency of extreme flood events** was not clear from the evidence, as Environmental Agency (2014) data on high flood risk areas noted a flood risk of once per 30 years. However, estimates from the RFU data suggested that the extreme flooding that their clubs face may occur every five years or even more frequently. The sensitivity analysis, therefore, allowed the frequency of bad flooding events to range from 1 in 30 years for the low scenario, to 1 in 5 for the central scenario, and 1 in 2 for the high scenario.
- **Pitch maintenance costs** were another area of uncertainty. There was data available from both stakeholder interviews and through online searches of publicly available data that gave estimates for the typical annual cost of pitch maintenance. The low estimate took figures from stakeholder interviews of annual maintenance costs of £4,800 per pitch. Data from the Cheshire Association of Groundsmen (2021) provided the central estimate of £8,000 per pitch and a high estimate of £18,860 per pitch per year.

2.6 Total financial impact

The total current and predicted increase in annual financial costs due to weather was then obtained by aggregating the figures for both event maintenance and repair costs, and revenue losses due to event cancellations. Given the use of different climate change scenarios and sensitivity analysis, this provided a range of estimates for how grassroots sport might be financially impacted by climate change, both now and into the future.

Table 18. Financial Modelling – Total costs (central scenario)

Cost type	Estimate
Total current costs (Repairs and maintenance)	£199,805,557
Total current costs (Revenue losses)	£118,629,920
Overall total cost	£318,435,477
Increase in total cost under 2°C rise in temperatures	£94,623,898
Increase in total cost under 4°C rise in temperatures	£187,654,275

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