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Carbon Footprint Stemming from Ice Sports on the Turkey and Lithuanian Scale

Dalia Perkumienė [1,*], Ahmet Atalay [2] and Biruta Švagždienė [3]

[1] Department of Business and Rural Development Management, Faculty of Bioeconomy Development, Agriculture Academy, Vytautas Magnus University, 53361 Kaunas, Lithuania
[2] Sport Management Department, School of Physical Education and Sport, Ardahan University, Ardahan 75000, Turkey
[3] Department of Sport management, Economics and Sociology, Faculty of Sport Education, Lithuanian Sport University, 44221 Kaunas, Lithuania
* Correspondence: dalia.perkumiene@vdu.lt; Tel.: +370-69834822

Abstract: The aim of this study is to calculate the average carbon footprint per capita from the transportation of the Ice Hockey League in Turkey and Lithuania in the 2021–2022 season. In addition, we identified the opinions of team managers of the national hockey leagues in Turkey and Lithuania regarding the problems and possible solutions related to the sustainable environment and persons' right to a clean and safe environment in the sport sector. In this study, which was limited to the Turkish Ice Hockey Intercity Super League and the Lithuanian National Ice Hockey League in the 2021–2022 Season, eight teams from Turkey and five teams from Lithuania took part in the research. The type of vehicle used by each team and the total traveled distance were used for the collection of data. Interviews were conducted using a semi-structured interview format seeking to identify problems and solutions proposed by sports managers regarding environmental sustainability and the implementation of persons' right to a clean and safe environment in the sport sector. Five managers from Turkey and two managers from Lithuania were randomly selected for the research. The average carbon footprint per person was calculated as 88.23 kg/CO_2-e due to the travels of the Ice Hockey Super League teams participating in the 2021–2022 Season matches in Turkey. The average carbon footprint per capita was calculated as 0.5229 kg/CO_2-e, as Ice Hockey Super League teams in the 2021–2022 Season traveled to participate in matches organized in Lithuania. For solving the above-mentioned problems, the sports experts offered recommendations such as energy saving, less waste generation and reducing water consumption in order to achieve the environmental protection goals of the sports leaders. Since both teams often travel due to the intense league schedules, the Ice Hockey Super League goal should be to reduce carbon emissions, especially those related to transportation. Energy conservation policies should also be implemented, and environmentally friendly practices should be emphasized.

Keywords: right to a clean environment; carbon footprint; sustainability in sport; ice hockey

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1. Introduction

The adequate protection of the living standards for present and future generations can be achieved by showing the necessary concern for the environment. Protecting the environment and natural resources and fighting environmental problems can be considered as the most important step. In order to implement this goal, it is necessary to improve people's environmental awareness by encouraging innovations and saving resources [1].

At present, the protection of the natural environment is one of the most urgent problems. Basically, the environment in which people carry out their vital activities is the basic condition for people lives. However, with the development of social life and increasing industrial pollution, people's attitudes and behavior are increasingly worsening [2]. Environmental problems are fundamentally human problems. These problems grew in

the last century, and, today, they are not limited to any ideological tendency, economic system, social structure or technological level [3,4]. The spread of human activities and the rapid increase in the production–consumption balance especially accelerate environmental problems. The environmental problems identified as being caused by human behaviors and all developments that will cause the consumption of natural resources are the "carbon footprint".

The carbon footprint can be expressed as the effects of attitudes and behaviors on the natural environment, aiming to cover the basic needs of people in the environment they live in. From a broader perspective, the carbon footprint can be defined as the decisive and important detection and solution tool for determining and comparing the impacts of the consumption activities of individuals or societies on nature and also for producing solutions to emerging global and local problems [5].

The carbon footprint is grouped into the primary carbon footprint and the secondary carbon footprint. The primary carbon footprint refers to the Carbon Dioxide (CO_2) emission that results from the burning of fossil fuels that are consumed to cover the energy and transportation needs on a global scale. The secondary carbon footprint refers to the CO_2 emission that is caused by all these products in the period from the production stage of products because of the human consumption of their consumption or decomposition. Despite this distinction, the secondary carbon footprint includes the primary one [6].

The sports sector is among the areas where human activities are increasing. An active or passive participation in leagues and organizations that are organized in many different branches is also increasing. Because of the nature of sports, human attitudes and behaviors are considered to be a part of the increasing concern regarding environmental issues as well as the determinant of competition in sports. For this reason, the carbon footprint of the sports sector, in which mass interest and participation take the lead, is growing with each passing day. In this regard, Inoue & Kent (2012) reported that the carbon footprint of sports, energy use, participation, etc. became a very important environmental concern because of these factors [7].

The International Olympic Committee associated the carbon footprint of sports with two main factors, which are sports organizations and sports facilities. These involve the production, consumption, transportation and accommodation, depending on the organizations, and the emergence of air, water and soil pollution, depending on the establishment and the energy use of sports facilities [8].

People consider all sports activities for commercial and health purposes as a lifestyle. However, the negative impact on the natural environment and the damage caused to the environment during the implementation and organization of sports events cannot be justified. Maintaining health through different sports activities and continuing sports competitions in this way deteriorates the living environment of people. This neglect of the natural environment and the growth of the carbon footprint threaten the sustainable environment and human life [9]. This negative effect is especially noticeable with the commercialization of sports in such fields as football, basketball, golf, etc.; the number of establishments increases along with the number of events and organizations. However, to cover this need, which appears in sports, natural resources are rapidly consumed, the ecological balance has deteriorated and the carbon footprint is growing [2].

Among the most fundamental factors of the carbon footprint in sports are sports organizations, leagues and tournaments. For this reason, it is inevitable for athletes and fans to travel to participate in such organizations. It is already known that sports travel causes a carbon footprint, a negative impact on the environment and intensive emissions of carbon dioxide and other greenhouse gases [10].

Travel for participation in sports activities is not limited to certain branches. Active and passive participants travel in almost all branches of sport. There are trips to sports facilities in every sport branch, especially in football [11]. As in the entire world, leagues and tournaments are organized in many different sport branches in Turkey as well. Especially with the growing interest in sports, active and passive participation in various branches is

becoming more popular. Among these branches is ice hockey. Considering the importance of competition and performance in the field of ice hockey, the number of matches and active participation are also increasing in Turkey.

Currently, national ice hockey competitions and events are organized in all age categories in Turkey and Lithuania, and participation in World Championships, Olympic Qualifications and Youth Olympic Games is provided in the relevant age categories included in the International Ice Hockey Federation program (IIHF). The "Intercity Super League" is among the leagues organized by the Turkish Ice Hockey Federation. The National Ice Hockey League is organized by the Lithuanian Hockey Federation. There are eight teams in the super league in the 2022–2023 season, which have been competing since 2010 [12,13].

Purpose of the Study

The aim of this study is to calculate the average carbon footprint per capita from the transportation of eight teams in the Turkish Ice Hockey Intercity Super League and five teams in the Lithuanian National Ice Hockey League in the 2021–2022 season. In addition, it aims to identify the opinions of team managers of the national hockey league in Turkey and Lithuania regarding the problems and possible solutions related to the sustainable environment and persons' right to a clean and safe environment in the sport sector. Calculating the carbon footprint means measuring the greenhouse gas emissions occurring depending on the activities, attitudes and behaviors of each individual. The accepted units of measurement in carbon footprint calculations are grams, kilograms or tons of CO_2-e [14–16].

2. Background

2.1. The Right to a Clean Environment and Its Legal Regulations

Rapid globalization in our living environment, society and sports sector causes various undesirable consequences: air and environmental pollution increases, natural resources decrease and disappear and climate change and depletion are promoted. The mentioned processes endanger people's health and even life, worsen the quality of life and also violate and limit the right of individuals to live and develop in a healthy and safe natural environment [17]. The modern world is characterized by a major problem of ecological security in all sectors and a reduction in the anthropogenic influence on the natural environment. The environmental safety mechanism is based on the concept of implementing the principles of sustainability [18]. Environmental sustainability and the realization of the human right to a safe and healthy environment can be achieved through the greening of ongoing activities [19]. Thorme (1991) defines the concept of the environment as a "human right" and emphasizes that it means the right to a "healthy, safe, sustainable environment" [20]. In analyzing the concept of a safe and healthy environment, we must note that the environment includes not only nature but also objects created by humans, adapting the environment to their needs. The environment adapted to the realization of human needs includes various sectors of human activity, such as the naturally formed natural environment and its elements, as well as the social, cultural, sports and economic environments [21]. The European Commission, in its Fourth Environmental Action Program, also provided a definition of the environment. The environment is defined in this program as "a set of elements, the interrelationship of which forms the context and conditions of the life of individuals and communities" [22]. It should be noted that the individual's right to a safe and clean environment is enshrined in the constitutions of most countries. For example, ın Turkey, the Constitution of the Republic of Turkey, Article 59 states that "Everyone has the right to live in a healthy and balanced environment. It is the duty of the State and citizens to improve the environment, protect environmental health and prevent environmental pollution" [23]. Lithuanian Constitutions also talk about the constitutional right to a safe and clean environment [24]. Regarding the relationship between the environment protection and human rights in international law, Lewis (2015) emphasizes that this relationship is

indisputable. The scientist also distinguishes the concept of the human right to a good environment. Lewis (2018) recognizes climate change as the biggest environmental challenge. The researcher investigates "whether the right to a good environment" can provide new perspectives for climate change [25].

The right to a clean and safe environment is enshrined in the legal acts of the European Union. This right is enshrined in the Universal Declaration of Human Rights, which emphasizes individuals' right to a safe, healthy and clean environment [26]. This right is also declared in the Maastricht Treaty; in the preamble of the Treaty, the member states undertake " ... to promote the economic and social development of their nations in order to promote greater cohesion and environmental protection ... " [27]. The right to a "healthy and fulfilling life in harmony with nature" is noted in the Rio Declaration on Environment and Development [28]. This Declaration is related to the Stockholm Declaration, which emphasizes the human right to a life of dignity and comprehensive well-being. The Stockholm Declaration, like the Rio Declaration, emphasizes that everybody has the right "to a healthy and productive life in harmony with nature" [29]. The Amsterdam Treaty [30], the Kyoto Protocol [31] and the Aarhus Convention [32] are also closely related to the implementation of the right of individuals to a safe environment. The Aarhus Convention is important in that its Article 1 establishes the duty of states to ensure citizens' rights to public participation in decision making related to environmental protection, to receive objective and timely information about the state of the environment and to apply to courts on environmental issues [32]. The Kyoto Protocol aims to reduce the greenhouse effect by limiting CO_2 emissions [31].

2.2. Carbon Footprint

The carbon footprint can be expressed as the impact of attitudes and behavior on the natural environment in order to meet the basic needs of the people in the environment in which they live. From a broader perspective, the carbon footprint can be defined as a decisive and important detection and solution tool in determining and comparing the impact of the consumption activities of individuals or societies on nature and in producing solutions to emerging global and local problems [5]. As a matter of fact, it is obvious that every activity of every individual, institution and organization has an effect on nature. In other words, the carbon footprint is defined as the carbon footprint of people's attitudes and behaviors, measured in terms of carbon dioxide, and the measure of damage to the environment in terms of the amount of greenhouse gases produced [33]. The formation of the "Footprint", which expresses the basis in naming, is the trace that occurs there as a result of the pressure applied to the point where any living being presses, depending on the mass and the size of its feet, and which may change from time to time [34]. The growing concern regarding the carbon footprint in theory and practice has opened the way for much scientific research in this field. As a result of this research, the carbon footprint has been gathered under two headings in the literature. These are personal and corporate carbon footprints [33].

Regardless of the sector in which they operate, institutions, organizations and companies carry out activities today that coincide with the objectives of environmental sustainability in all processes, from the planning of operations to the final stage. It should be noted that sport clubs, federations and international organizations try to act with the same management approach, because all areas of vital activity, sports and recreation activities are inextricably linked with the natural environment [35].

2.3. Carbon Footprint and Environmental Sustainability Threats from Ice Sports

Greenhouse gases (GHG) are mainly produced by human activities and are one of the main causes of environmental degradation. The production of greenhouse gas emissions contributes to climate change, and 82% of greenhouse gas emissions are carbon dioxide (CO_2) [36]. For this reason, regardless of the sector in which they operate, institutions, organizations and companies carry out activities today which align with environmental

sustainability goals in all processes, from operational planning to the completion phase and the transition to clean energy sources.

Clubs, federations and international organizations of the sports sector strive to operate under the same management approach. Getz (2008) points out that the environmental impact of these events and organizations should be reduced by taking into account the implementation of the sustainability policy in the sports sector when organizing events [37]. Similarly, Cornelissen and Wolfgang (2010) argued that all processes, from the planning to the completion of national and international sports organizations, should be managed with an environmentally friendly approach [38]. It should be mentioned that one of these organizations is the National and International Ice Hockey leagues.

Research on the carbon footprint caused by the sports sector, especially the reports prepared by the International Olympic Committee, has mobilized countries in this regard and accelerated the studies. For example, the Italian Association of Sports for All prepared a comprehensive "Sustainability in Sports" report in 2012 and made a systematic assessment of the sources of the carbon footprint in the sports sector. This evaluation is visually presented in Figure 1:

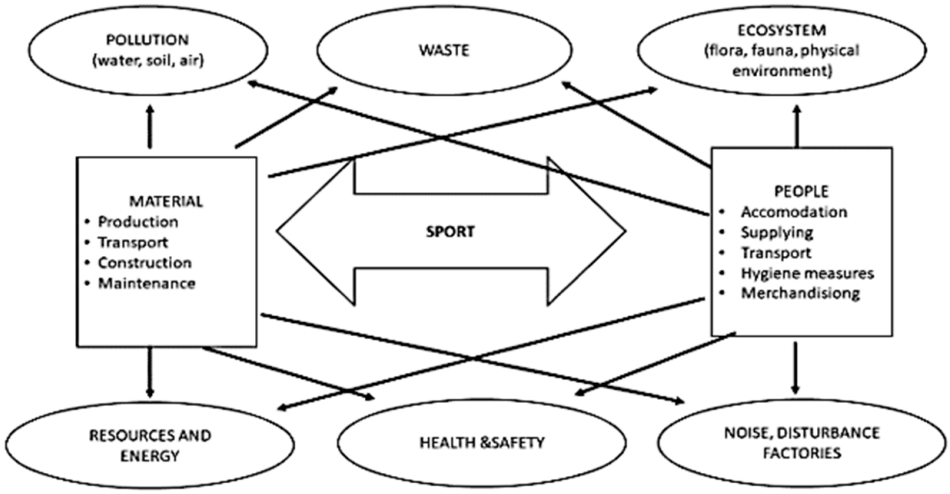

Figure 1. Systematic analysis of the carbon footprint in sport [39].

The source of the carbon footprint in sports is grouped under two subgroups. These subgroups are establishment in sports and participation in organizations. Although water, soil and air pollution arise as a result of the installation, it is understood that resource and energy consumption also play a decisive role in this process. On the other hand, attention is drawn to the negative impact of people's participation in organizations on the environment due to transportation, accommodation, purchasing and consumption [39].

With the increasing use of air conditioning, water and electricity for the heating, cooling and lighting of competition venues, it takes a lot of energy to operate active and efficient facilities [40]. This is especially true in hockey, which is an energy-intensive sport and creates a lot of carbon dioxide because of the need for energy from fossil fuels [41].

In addition to energy consumption, the estimated amount of the carbon footprint from activities such as transportation, the construction of sports facilities and the production of sports equipment and services [42] is considered a significant threat to sustainable environmental goals [43,44]. However, as in many sports branches, it can be said that one of the most important carbon footprint sources in ice hockey is the transportation preferences of active and passive participants [37,45]. Especially in large and international sports organizations, the travel of participants and spectators to the host country to participate in the organization appears as an important carbon footprint source [46].

At the same time, transportation preferences preferred for participation in local events and organizations organized within the country are another environmental threat. It should be noted that the location of organized sports events is determined by the respective

federations, and sports bases are increasingly located further away from city centers, which is why the behavior of traveling by personal transport is also increasing [47]. A study on this topic by Getz (2008) found that the carbon footprint of the transportation choice used by two community hockey teams to travel to away games in Canada in 2008 was estimated to be 20 tons of CO_2-e [37].

Difficulties and problems related to the increased participation in sports events also arise from the unplanned consumption of raw materials, traffic congestion, repeated air pollution, the depletion of local water resources and waste disposal [48–50]. In addition, the construction and operation of facilities for the league and other competitions in all branches, especially ice hockey, and the consumption of food and beverages by the audience are also factors that contribute to the carbon footprint [37,51].

2.4. The Right to a Clean Environment and Sustainability in Sport

Sports organizations in all sports branches have negative environmental effects, but at the same time, they try to contribute to the actions that need to be taken to reduce this negative impact on the environment [52]. Sports play an important social role, as they attract the attention of all sections of society. This role focuses on the environmental awareness among people in the sports industry. It can be argued that all stakeholders in sports, including the fans, athletes and managers, accept the negative effects of the environment and apparently try to take responsibility for solving this problem [7,49].

It can be stated that these responsibilities and steps taken by different leagues and organizations in different countries embody the goals of a sustainable environment and sport. For example, all teams in the United States National Hockey League have initiated several environmental sustainability efforts [44].

Recognizing the need for a clean environment in the sports sector, NHL teams have partnered with energy sector authorities and organizations such as EPA WasteWise, EPA Energy Star, Beyond Sport, Green Sport Alliance, National Defense Council and EPA Green Power Clean Energy Task Force [39]. The teams of the league also participate in various environmental programs such as electronic recycling events and the use of renewable energy in facilities. Solar energy, as a particularly clean source of energy, is seen as an important advantage in all sectors. Obtaining energy from solar energy means that it is clean, has a high potential and is almost environmentally friendly [44].

The preference for clean energy sources for a sustainable environment and sport has become an important indicator of the access to a clean environment policy. Low carbon footprint targets and access to a clean environment in all sports branches, including ice sports, should become a part of the global climate change action plans of international sports organizations. The International Olympic Committee expects that, in order for a city or country to host an organization pursuing the goals of environmentally sustainable sports, it must meet these environmental sustainability criteria and contribute to reducing the carbon footprint of sports:

- Conservation of biological diversity;
- Protection of the ecosystem;
- Correct land use and landscaping studies;
- Prevention of pollution (soil, air, water);
- Resource and waste management;
- Health and safety measures;
- Reducing environmental disturbances;
- Protection of cultural heritage [8].

Physical activity, education and sports activities have a significant impact on a person's physical and mental health, social development, quality of life and work/school efficiency. It can be said that in order to ensure a person's right to a safe and clean environment, social health and a quality living environment, the construction and environment of nature-friendly sports facilities, low energy consumption, adequate access to existing sports

facilities, environmentally friendly practices, e.g., the use of bicycles, and the continuity of sports activities for sustainability must be achieved [53].

In this regard, the United Nations Climate Change Program has included the sports sector in its climate change action plans and determined the responsibility of the sports sector regarding the following objectives:

- Achieve a clear trajectory in tackling climate change in the global sports community through commitments and partnerships according to validated standards, including measuring, reducing and reporting greenhouse gas emissions;
- Using sport as a unifying tool to build unity and solidarity among global citizens for climate action [54].

The climate action plans of the United Nations have been met, and the Chinese Government has developed an organizational management model in line with environmental sustainability targets at the Beijing 2022 Winter Games [55]. In light of this management model, the Chinese Olympic Committee has determined and implemented environmental sustainability policies for the Winter Olympic Games. According to these policies:

- The Beijing Government has committed to a neutral carbon policy at the games and has taken measures to reduce carbon emissions, including low-carbon venues and transportation solutions.
- Under the heading of carbon compensation measures, the government carries out afforestation projects in the cities of Beijing and Zhangjiakou, where the games were, and has created 47,333 and 33,000 hectares of forest and green areas in Beijing and Zhangjiakou, respectively, since 2014. Environmentally friendly landscape works are very common nowadays. This is because environmentally friendly landscape studies enrich the ecosystem in the region, support biodiversity and directly affect the absorption of carbon emissions caused by fuels [56].
- The Beijing government has committed to be the first Olympic Games to have venues powered by renewable energy, with solar and wind as the primary energy sources, in the newly built Zhangbei region for the games.
- Under the heading of natural CO_2 cooling systems, it has committed to use the R449 refrigerant, which has a low Global Warming Potential threat, in ice hockey and curling halls in most of the ice fields in the games.
- Energy-efficient and clean-energy vehicles will make up 100 percent of all passenger cars and 84.9 percent of all vehicles. Beijing's 2022 fleet will include 816 hydrogen-fuelled vehicles, 370 pure-electric vehicles, 478 natural gas-fuelled vehicles, 1807 hybrid vehicles and 619 conventional energy vehicles [8].

In this research, it is aimed to calculate the carbon footprints of the teams in the Turkish and Lithuanian national hockey leagues due to their travels in the 2021–2022 season. In addition, it is aimed to determine the views of Turkish and Lithuanian sports managers regarding environmental sustainability and a clean environment in sports. This research is limited to the ice hockey branch only. Teams in the Turkish and Lithuanian national ice hockey league were included in the study. In this context, eight teams from Turkey and five teams from Lithuania from the national leagues in the 2021–2022 season participated in the study. In the qualitative part of the research, interviews were conducted with the managers involved in the relevant sports. Within the scope of the research, interviews were held with five sports managers from Turkey and two from Lithuania. In this context, the results obtained in accordance with the aims of the research are given below.

3. Methods

3.1. Methodologic Structure

The methodological structure of this research consists of two steps. The study was prepared with the mixed method, which is frequently used in social sciences. The carbon footprint of the ice hockey teams due to their travels was calculated first. In the second step,

interviews were conducted through a semi-structured interview form to determine the opinions of sports managers regarding the problems and solution suggestions regarding environmental sustainability and the right to a clean environment in the sport. For the interviews, five managers from Turkey and two managers from Lithuania were randomly selected. The sample group of the study consists of 10 people in total.

3.2. The Dataset and Compilation of Data

In this research, which is limited to the ice hockey teams competing in the Turkish and Lithuanian National Ice Hockey League, there are eight teams in the Turkish Intercity Super League and five teams in the Lithuanian National Ice Hockey League in the 2021–2022 season. In both leagues, each team consists of 17 people on average, while the total number of people traveling for the competitions is accepted as 136 for Turkey and as 85 for Lithuania [13,57]. In the study, the type of vehicle used by the teams in both countries during the 2021–2022 season and the total distance they traveled were used as a dataset. In obtaining these data, first of all, the national league matches of the 2021–2022 season were reached. Afterwards, information about the provinces and sports facilities where the competitions are played in Turkey was taken from the "BuzNet" data bank under the umbrella of the Turkish Ice Hockey Federation [58]. Information on the provinces and sports facilities where the competitions are played in Lithuania is taken from the official website of the Lithuanian Ice Hockey Federation and the "Eurohockey" website [13,58]. The type of vehicles that were preferred by the teams and the distances they covered to go to the competitions during the season are presented in Table 1.

Table 1. The types of vehicles preferred and the distances covered by the teams in the Turkish Ice Hockey Intercity Super League.

Countries	Vehicle Type	Total Distance Covered (km)
Turkey	Airplane	57.975
	Coach (Inter-city)	2.360
	Bus (Inter-city)	7.642
Lithuania	Coach (Inter-city)	14.818

3.3. Calculating Carbon Footprint

According to the information received from the relevant sports federations and teams, it has been determined that the teams in the Turkish league travel by plane and bus throughout the season, while the teams in the Lithuanian League travel only by bus [13,58]. Therefore, the emission factors of these two transportation vehicles were used in the calculation process. The emission factors of these transportation means express the CO_2 equivalent emissions occurring when a person travels 1 km with the relevant vehicle [59]. The emission factors by vehicle, which were put forward by the German Government Federal Environment Agency, were used in the study [59]. The emission values of the German Federal Environment Agency were used to calculate the carbon dioxide equivalent emissions and carbon footprint, respectively. Table 2, which shows the emission factors according to the vehicle type prepared by the German Federal Environment Agency, is given below [59]. These values were used to calculate the individual carbon footprint of the ice hockey teams.

The seasonal average carbon footprint for each member of the teams in the 2021–2022 Ice Hockey Season was calculated by the formula developed by Wicker (2018) and arranged by the researcher in accordance with the purpose of the present study by using the emission factors of the German Federal Environment Agency according to vehicles. The formula used is given below [59].

Table 2. The emission factors and the average capacity utilization rate according to the vehicle type.

Travel Type	Emission Factor (g/CO_2-e)	Average Capacity Usage Rate
Personal vehicle	139	1.5 For Each Vehicle
Coach (Inter-city)	30	60%
Train (Inter-city)	43	50%
Train (Short distance)	72	27%
Bus (Inter-city)	74	21%
Metro	74	19%
Airplane	196	76%

$$CF = \{\sum_i [(Day-trip)_i * Emission_i] + \sum_j \Big[(Inter-city\ Distance)_j * Emission_j\Big] + \sum_j \Big[(Stopover\ destination - Airport\ Distance)_j * Emission_j\Big] + \sum_k [(Stopover\ destination - Sports\ Facility\ Distance)_k * Emission_k] + \sum_k [(Airport - Sports\ Facility\ Distance)_k * Emission_k]\} * 2$$

In the formula that was used in the study to calculate the average carbon footprint of ice hockey teams,

- i refers to the daily travel distance;
- j refers to the distance between cities and the distance between the accommodation facility and the airport;
- k refers to the distance between the accommodation facility and the sports facility where the competition will be played and the distance between the airport and the sports facility where the competition will be played.

3.4. Interview

In order to have in-depth information in line with the purpose of the research, interviews were conducted with five club managers from Turkey and two club managers from Lithuania. The names of the managers with whom the interviews were conducted and their clubs and positions are kept confidential. Managers in Turkey are coded as T1, T2; managers in Lithuania are coded as L1, L2. The interview questions consist of four open-ended questions directly related to the subject:

1. Do you know the "carbon footprint" or have any ideas about the carbon footprint or clean environment in the sports sector?
2. What are the biggest environmental and legal issues in the sports sector for sustainability?
3. How useful are innovative solutions for achieving the human right to a clean and safe environment, which means sustainability in the sports sector?
4. What are your sport's tools for clean energy and environmental protection?

The interview was preferred because it is a very effective method in obtaining information about the experiences, attitudes, opinions, complaints, feelings and beliefs of the individual [60]. In the analysis of the answers given to the interview questions, the descriptive analysis method was used. Descriptive analysis is carried out by summarizing and interpreting the data according to predetermined themes, examining cause–effect relationships and reaching results [60]. The objectives of qualitative research focus on details, nuances or processes, so the choice must be made carefully and be considered and justified. It is convenient to have a smaller number of research participants so that each case can be studied more deeply, and such participants are needed, whose special qualities provide the best reflection and knowledge about the research phenomenon [61].

4. Results

4.1. Results on Teams' Carbon Footprints

In this part of the research, the findings regarding the carbon footprint of the teams in the Turkish and Lithuanian national ice hockey league are presented. In this study, the type of vehicle used to participate in the competitions in the matches of the teams in the 2021–2022 season in the National Ice Hockey Leagues of Turkey and Lithuania and the total distance traveled were used as the dataset. In this context, teams in Turkey covered a total distance of 57.975 km by airplane, 7.642 km by urban transportation and 2.360 km by inter-city transportation (bus) in one season. Teams in Lithuania covered a total of 14,818 km in one season by bus alone. The fact that the cities where the competitions were played in Lithuania were very close to each other was decisive in the emergence of this situation. Urban and inter-city trips were evaluated separately, as the carbon emission factors of these trips are different. The calculation that was made to determine the individual carbon footprint of the teams in the Turkish Ice Hockey Super League and Lithuanian National Hockey League by using the formula above is in Figures 2 and 3:

$$57.975 \times 196 + 2.360 \times 30 + 7.642 \times 74 = 11{,}999.408 \text{ (g/CO}_2\text{-e)}$$

$$11{,}999.408 = 11.999 \text{ (kg/CO}_2\text{-e)}$$

$$11.999/136 = 88.23 \text{ (kg/CO}_2\text{-e) (Carbon Footprint Per Capita)}$$

Figure 2. Average per capita carbon footprint for Turkey.

$$14.818 \times 30 = 44{,}454.000 \text{ (g/CO}_2\text{-e)}$$

$$44{,}454.000 = 44.454 \text{ (kg/CO}_2\text{-e)}$$

$$44.454/187 = 0.5229 \text{ (kg/CO}_2\text{-e) (Carbon Footprint Per Capita)}$$

Figure 3. Average per capita carbon footprint for Lithuania.

The average carbon footprint per person was calculated as 88.23 kg/CO_2-e due to the travels of the Ice Hockey Super League teams participating in the matches of the 2021–2022 Season in Turkey. It was determined that teams in the Ice Hockey League, especially teams representing cities far from each other, preferred to travel by plane. The average carbon footprint per person was calculated as 0.5229 kg/CO_2-e per person due to the travel of the Ice Hockey Super League teams participating in the matches in Lithuania in the 2021–2022 Season. There are three main reasons why the average carbon footprint calculated for Lithuania is very low compared to that of Turkey. First, the number of teams is smaller in Lithuania compared to Turkey. Second, due to the fact that the provinces where the competitions are played in Lithuania are very close to each other, the distance covered is also very low. Third, the teams in Lithuania used only buses as a means of transportation throughout the season. Therefore, there is a significant difference between the average per capita carbon footprints of Turkish and Lithuanian ice hockey players.

4.2. Turkish Managers' Opinions on the Problems and Solution Suggestions Regarding Environmental Sustainability and the Right to a Clean Environment in the Sport

In this section, the opinions of the managers participating in the research on sustainability in sports, the right to a clean environment and solution proposals are given. Excerpts from the answers given by the managers to the questions are presented in Table 3:

Table 3. Turkish Managers' opinions on the problems and solution suggestions.

Questions	Statements
Do you know the carbon footprint or have any ideas about the carbon footprint or clean environment in the sports sector?	I know carbon footprint as the carbon dioxide caused by humans or the damage they cause to the environment. For example, pollution of the seas, air pollution caused by fuels such as coal. Sports also have a carbon footprint. For example, garbage, the fuels used and the carbon dioxides they cause. They also harm the environment (T1). Carbon footprint is waste and pollution caused by humans. Exhaust gases caused by vehicles are carbon dioxide caused by factories and facilities. As far as I know, these cause damage to the air and nature. Garbage is everywhere. When people throw away their garbage, plastic bottles cause significant damage to the environment, especially since they remain in nature for many years (T4). A clean environment means that when people come to the gym, for example, they do not throw garbage on the ground or pollute it. It does not consume water and electricity unnecessarily. Carbon footprint is the environmental pollution caused by carbon dioxide caused by vehicles and other human activities. It is a very important subject. We must build a nature that we can protect the environment and leave to our children (T5).
What are the biggest environmental and legal issues in the sports sector for sustainability?	The most important problem in clubs or federations is the absence of such a legal regulation. In fact, there should be a standard and they should be constantly audited, but there is no supervision or control. The biggest problem is supervision and control (T1, T2, T3, T4, T5)
How useful are innovative solutions for achieving the human right to a clean and safe environment, which means sustainability in the sports sector?	As far as I understand the subject, if we keep the environment we live in clean and protect it, we can leave a better future for our children. Air pollution can be prevented. Garbage does not mix with nature. Most importantly, I think if we can prevent air pollution, it will be very beneficial for our future (T5, T2). We can protect nature, forests and vegetation. We can protect our resources. Also, I would like to say this: There is also an economic side to the issue we are talking about. For example, there is a huge electricity and water expense in our halls every month. If the right steps are taken, we can also benefit economically (T4, T3).
What are your sport's implementations for clean energy and environmental protection?	Less energy should be used. We use a lot of water and electricity, this can be reduced due to the nature of sports. Solar energy is very popular these days, if it can be applied properly. Electric vehicles are things we hear often. For example, ministries or federations can switch to electric vehicles (T2, T1); we use a lot of electricity and water in the halls and there is a lot of garbage. If we reduce the use of electricity, it will also be economically beneficial. Again, water consumption is in this way. For example, we do ice cleaning, we can evaluate the snow from this cleaning in a different way. A waste water system can be installed (T5, T4).

While three of the five Turkish sports managers participating in the research stated that they had knowledge about the carbon footprint and clean environment targets in sports, two of them stated that they did not have any information on this subject. It has been understood that Turkish managers are generally knowledgeable about the carbon footprint and clean environment. All of the sports managers participating in the research stated that "the most important deficiency for sustainability in the sports sector is not any legal regulation specific to sports". Turkish managers participating in the research stated that by taking the necessary steps, nature can be protected, air pollution can be prevented, forests and vegetation can be protected and, thus, a clean world can be left for future generations. Sports managers participating in the research stated that, for a clean environment and environmental sustainability in sports, it is necessary to minimize energy and water consumption, reduce garbage production and destroy this garbage without harming the environment and publish the use of environmentally friendly transportation and environmentally friendly materials. Excerpts from the answers given by the managers to the questions are presented in Table 4:

Table 4. Lithuanian Managers' opinions on the problems and solution suggestions.

Questions	Statements
Do you know the carbon footprint or have any ideas about the carbon footprint or clean environment in the sports sector?	Ice hockey has one of the largest carbon footprints of all sports due to the infrastructure energy required to support artificial ice creation (L2). Carbon footprint is waste and pollution caused by humans. Exhaust gases caused by vehicles are carbon dioxide caused by factories and facilities. As far as I know, these cause damage to the air and nature. Garbage is everywhere. When people throw away their garbage, plastic bottles cause significant damage to the environment, especially since they remain in nature for many years (L1).
What are the biggest environmental and legal issues in the sports sector for sustainability?	Although not all of us understand yet, but this is not someone else's concern, but all of us, these problems often lack our attention and efforts (L1). The biggest problem is the release of the carbon footprint into the environment, which is poorly regulated by law, there are no special legal acts to regulate the creation of artificial ice (L2).
How useful are innovative solutions for achieving the human right to a clean and safe environment, which means sustainability in the sports sector?	To create an attractive, clean and safe living environment in the city (environmental protection, maintenance and development of the transportation system, maintenance and modernization of the city's infrastructure facilities) (L1). Ice cleaning and maintenance with electric cars, use of solar energy, for the operation of refrigeration equipment, double use of energy, the energy released during refrigeration is used for heating the swimming pool (L2).
What are your sport's implementations for clean energy and environmental protection?	Ice maintenance time is optimized to minimize the negative impact on the environment, cleared snow is used a second time to obtain ice (L2); We can reduce Energy consumption; Water consumption; Plastic consumption: We can decrease sustainable mobility;. The case of rowing: Rowing is a good example for all sports that have a relationship with nature. Thus, it can offer individuals a different context—a safer place to engage in sport—and encourage them to engage in it. In doing so, we contribute to a better environment (L1).

Two Lithuanian sports managers participating in the research stated that they had knowledge about the carbon footprint and clean environment targets in sports. It has been understood that Lithuanian managers are generally knowledgeable about the carbon footprint and clean environment. All of the sports managers participating in the research stated that "the most important deficiency for sustainability in the sports sector is not any legal regulation specific to sports". Lithuanian managers participating in the research stated that by taking the necessary steps, nature can be protected, air pollution can be prevented, forests and vegetation can be protected and, thus, a clean world can be left for future generations. Lithuanian managers stated that an attractive, clean and safe living environment can be created in cities by taking environmental measures in sports. They also stated that savings can be made in the amount of electricity and consumed water. Sports managers participating in the research stated that energy savings and less plastic use are required for a clean environment and environmental sustainability in sports. He also stated that electric vehicles should be used so that a clean and safe environment can be created.

5. Discussion and Conclusions

In this study, the carbon footprints per capita of Turkish and Lithuanian National Ice Hockey League teams from the trips of participation in the competitions were calculated. The distances covered by eight teams and 136 people from Turkey and 85 people and five teams from Lithuania were counted.

The analysis of the research data showed that teams in Turkey traveled mostly by plane during the season. The presence of teams from different and distant cities in the league was of decisive importance for this. By calculating the distances traveled by the Turkish teams, the per capita carbon footprint of the Intercity Hockey Super League was found to be 88.23 kg/CO_2-e.

The analysis of the research results showed that the teams in Lithuania prefer only the bus as a means of transportation throughout the season. The fact that cities are very close to

each other in Lithuania was decisive in this. After calculations using the distances traveled by the teams in Lithuania, it was determined that the carbon footprint per inhabitant in the National Hockey League is 0.5229 kg/CO_2-e.

The results of the interviews with Turkish and Lithuanian sports managers can be summarized as follows:

- While three out of five Turkish sports managers participating in the research stated that they had knowledge about the carbon footprint and clean environment targets in sports, two stated that they did not. However, it has been determined that two Lithuanian sports managers have knowledge about the carbon footprint and clean environment targets in sports. Summarizing the results of the research, it can be said that the participants were basically aware of the carbon footprint and clean environment.
- All of the sports managers who took part in the research stated that "the most important deficiency for sustainability in the sports sector is not any legal regulation specific to sports".
- Sports managers who participated in the study also stated that the widespread use of environmentally friendly practices in sports can prevent air pollution, protect nature and resources, protect the world and transfer it to future generations and also provide economic benefits.
- Sports managers who participated in the research stated that, for an achievement of a clean environment towards sustainability in the sports sector, there are important factors such as minimizing energy and water consumption, reducing garbage production and destroying this garbage without harming the environment and publishing the use of environmentally friendly transportation and environmentally friendly materials.

Sustainable development targets have different variables, among which the carbon footprint comes first in terms of being the subject of this study [62]. Özsoy (2015) drew attention to the fact that almost half (46%) of Turkey's ecological footprint consists of carbon footprints [63]. Eşitti & Duran (2018) noted that among the most important sources of this carbon footprint are transportation problems, and Turkey is the country with the highest transportation-related carbon emissions among European countries [64].

The present study, which focused on the carbon footprint caused by the travels of athletes as active participants themselves, focused on the negative environmental effects of sports and travel. People inevitably have to focus more on environmental protection and sustainable development, and people have to face the growing sports-related environmental problems, as participation in sports damages the natural environment and resources in different dimensions [2]. The destruction caused by sports events and organizations, the wastes produced in these organizations and the consumption of natural resources are among the environmental problems [65,66].

Travel due to sports competitions is inevitable. The carbon emission caused by such travels of individuals who show active or passive participation behavior has been frequently discussed in recent years. Participating in organized sports competitions and leagues, airplane trips for travel, the logistics of such sports competitions and the transportation of incoming and outgoing spectators emit large amounts of CO_2, which becomes even more evident in large organizations such as the World Cup. Holding competitions in different cities and countries in the same year causes everyone to travel more and causes increased carbon dioxide emissions from transportation [67]. In this respect, in a study that was conducted by Wicker (2019) on a German population investigating the travel-related carbon footprints of active sports participants, the average carbon footprint of each individual was calculated as 844 kg for a year [68]. In the study of Loewen and Wicker (2021), in which the travel-related carbon footprint of football fans in Germany was investigated, the carbon footprint was calculated as 311.1 kg CO_2-e per person during one season [69].

It is known that airplanes are used commonly in the travels of teams and athletes in sports leagues and competitions. Carbon emissions caused by airplanes are also quite high in the carbon footprint of travel. Wynes (2022) reported that it is very difficult to

reduce emissions from air travel, especially in professional sports [70]. For example, in a study conducted on the travel-related carbon footprint of teams in professional leagues in the United States, the travel-related carbon footprint of teams from four major leagues (National Basketball League, National Hockey League, Baseball and National Football League) in the 2018 season averaged 121.841 tons of CO_2. This value is considered quite high because it is the result of a study covering the four major leagues [71].

Participation in the organized leagues in sports competitions is one of the main factors of carbon dioxide and greenhouse gas emissions. For example, the top 200 stadiums in the USA attract approximately 181 million visitors every year because of the competitions, and 85% of the greenhouse gas emissions created by major sporting events are because of the travel and accommodation of the fans. In this context, five million people traveled to watch the competitions for the World Cup competitions organized by FIFA in 2018. In this process, approximately 1.6 million tons of CO_2 emissions emerged from travel, which is equivalent to the carbon dioxide emissions caused by the annual electricity consumption of 500,000 residences [72].

With the increasing mass interest and the number of organized events, the carbon footprint in the sports sector is increasing with each passing day. Sports-related environmental problems can hinder sustainable environmental targets. Travel, especially to participate in sports competitions, is the main source of this problem. In recent years, organizations, teams and even international organizations have offered different solutions to this problem. Dolf & Teehan (2015) reported that long-distance air travel must be reduced, vehicle occupancy rates must be increased and low-emission travel must be encouraged to reduce travel-related carbon emissions [73]. With increasing environmental concerns, the efforts of sports organizations and sports-related institutions to operate in more sustainable and environmentally friendly ways are improving. These efforts emphasize creating or improving sports facilities in a certain way to reduce negative environmental effects and being more sensitive about carbon emissions and the recycling of garbage [74]. Additionally, this involves the recycling of wastes that are generated by organizations, transportation, energy, etc. Taking environmentally friendly measures regarding these issues is also among the proposed solutions [75].

An analysis of the scientific literature showed that the negative environmental effects caused by sports were at the top of the priority climate problems that must be taken care of [75]. In this respect, many institutions and organizations, especially the United Nations Climate Change Program, take a series of steps to reduce the carbon footprint in sports. The United Nations Climate Change Program included the sports sector in its Climate Change Action Plans and determined the responsibility of the sports sector regarding the following objectives:

- Achieving a clear trajectory in dealing with climate change in the global sports community through commitments and partnerships according to the previously validated standards, including measuring, reducing and reporting greenhouse gas emissions;
- Using sport as a unifying means to build unity and solidarity among global citizens for climate action [76].

6. Conclusions

This study investigated the carbon footprint of sports teams traveling to compete in leagues in the sports sector. An analysis of the distances traveled by the teams during the season showed that the average carbon footprint per person was 88.23 kg/CO_2-e due to the hockey travels of the Ice Hockey Super League teams participating in the matches of the 2021–2022 season in Turkey.

It was determined that teams in the Ice Hockey League, especially teams representing cities far from each other, preferred to travel by plane.

The average carbon footprint per person was calculated as 0.5229 kg/CO_2-e per person due to the travel of the Ice Hockey Super League teams participating in the matches in Lithuania in the 2021–2022 Season. The research identified three main reasons why

Lithuania's average carbon footprint is very small compared to Turkey's. First, the number of teams is smaller in Lithuania compared to Turkey. Second, due to the fact that the provinces where the competitions are played in Lithuania are very close to each other, the distance covered is also very low. Third, the teams in Lithuania used only buses as a means of transportation throughout the season. Therefore, there is a significant difference between the average per capita carbon footprints of Turkish and Lithuanian ice hockey players.

The study confirms that reducing the carbon footprint in the sports industry is essential for a sustainable environment and sport. In order to achieve the goals of environmental sustainability while ensuring the right of individuals to a safe and clean environment, the sports sector must strive to reduce carbon dioxide emissions, especially from transport.

In order to reduce the amount of carbon dioxide emitted by transport, the following measures are proposed:

- Developing and encouraging environmentally friendly engine technologies,
- Encouraging the use of clean energy for transportation,
- Intensifying afforestation works near highways,
- Correct planning of travel habits,
- Expanding the use of clean fuel types, e.g., hydrogen and electrical energy,
- Preferring public transportation instead of using private vehicles [77].

Due to the intense competition and league schedules, teams are currently constantly traveling. For this reason, the travel-related carbon footprint problem must inevitably be handled sensitively, and the measures mentioned above must be put into practice. With the measures to be taken, it seems possible for future generations to make use of all the achievements of sports in a livable environment. Reducing the amount of carbon dioxide emitted by sports events and organizations is one of the main environmental protection problems and issues, which can partly be solved by applying the proposed measures.

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