Corfu 2022 Conference

Life Cycle Assessment (LCA) of a professional football match

Tiberio Daddi, Luca Marrucci, Niccolò Maria Todaro, Fabio Iraldo
S.Anna School of Advanced Studies
GOALS is a project funded by EU Commission through the ERASMUS+ Sport Programme.

**Duration:** 01/01/2021 - 30/06/2023 (30 months)

**Total budget:** 398,983.00 Euro

**Lead partner:** Sant’Anna School of Advanced Studies

**Partners:** Portugal Football Federation (FPF), Real Betis Balompié Foundation, Romanian Football Federation (FRF), Football Federation of Kosovo (FFK), European Stadium & Safety Management Association (ESSMA)

**Supporting entities:** UEFA.
Introduction

• Environmental management in sport is in its early stage but the interest and concrete applications are increasing fast

• Sport organizations are more readily adopting environmental practices (McCullough et al., 2016, 2020; Todaro et al., 2021, in press)

• Such practices are becoming more sophisticated to include fan engagement campaigns (Casper et al., 2021), sponsors (Trail & McCullough, 2020), and strategies to address climate risks (Kellison & Orr, 2021; Orr & Inoue, 2018)

• The advancement of select individual organizations is also reflected in their collective efforts to forward practitioner organizations (e.g., Green Sports Alliance, Sport and Sustainability Initiative) and governing body programs (e.g., UN Sport for Climate Action Framework)

• Academic literature in environmental management in football is a complete green field, very few studies published, studies about the application of LCA has been never applied
Research questions

Question #1
*Antecedent:* the interest about football and environmental sustainability is increasing strongly in the last years.
*Question:* Is the environmental impact of a football match relevant?

Question #2
*Antecedent:* some football clubs are looking to carbon footprint as a tool to measure the impact and to plan environmental improvement actions.
*Question:* Why only carbon emissions? Is it sufficient to look at the carbon footprint or we should look to the environmental footprint?

Question #3
*Antecedent:* after the assessment clubs want to plan environmental improvement actions.
*Question:* where to start? What are the main contributors of the environmental impact of a football match?
Environmental footprint of a football match of Real Betis for the season 2018/2019

- The stadium (Benito Villamarín) of the club has a capacity of 60,000 seats
- Average number of fans in the considered season (2018/2019): 43,455 per match
- Matches played in the season: 20
- The club has also its training centre that is part of the environmental footprint calculation
Methods:  
- ISO 14040:2006 - Environmental management -- Life cycle assessment -- Principles and framework,  
- European Commission Recommendation 179/2013/EC “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations”, PEF (Product Environmental Footprint) and OEF (Organization Environmental Footprint).

The **functional unit** is the quantified performance of a product system, to be used as a **reference unit**. It provides a reference to which the inputs and outputs can be related, thus enabling comparison of alternative systems.

Functional unit of our study: **1 played match**
Environmental footprint: data collection

The data collected were referred to the season 2018/2019 (to avoid covid impact).

The data collected for the targeted season were referred to:

- **Environmental data of the stadium**: electricity, natural gas, water consumption, waste;
- **Environmental data of the training centre**: electricity, natural gas, water consumption, waste;
- **Food and beverage bar and kiosks**: kg of sandwiches, litres of beverages
- **Food and beverages VIP area**: kg of served food, litres of beverages
- **Cleaning products**: kind and quantity of products used in the season
- **Sport suits and equipment**: number of shirts, shorts and balls of the first male team;
- **Merchandising**: number of shirts, shorts and balls sold by the stores
- **Fans mobility**: km of the fans in the season, means of transport
- **Turf maintenance**: materials and chemicals
Environmental footprint: data collection – examples

Electricity consumption in the season: 1,910,000 kwh (stadium + training centre)

Water consumption: 28,000 m3 (stadium + training centre)

Waste from matches: 172,800 kg (0,15 kg per fan)

Catering VIP area: 18,090 kg of food (VIP area capacity: 1,400 guests); 52,800 litres of beer; 22,700 litres of Coca Cola;

Kiosks and bar: 9,664 kg of sandwiches (2,313 kg remaining); 28,384 litres of water; 34,110 litres of Coca cola;

Sport apparel first male team: 2,575 shirts (home, away, third)
Results
Environmental footprint results overview

All impact categories, impacts per single match (functional unit)

<table>
<thead>
<tr>
<th>Impact category</th>
<th>Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change</td>
<td>kg CO2 eq</td>
<td>71,519.25</td>
</tr>
<tr>
<td>Ozone depletion</td>
<td>kg CFC11 eq</td>
<td>0.009</td>
</tr>
<tr>
<td>Ionising radiation, HH</td>
<td>kBq U-235 eq</td>
<td>19,903.01</td>
</tr>
<tr>
<td>Photochemical ozone formation, HH</td>
<td>kg NMVOC eq</td>
<td>312.077</td>
</tr>
<tr>
<td>Respiratory inorganics</td>
<td>disease inc.</td>
<td>0.002</td>
</tr>
<tr>
<td>Non-cancer human health effects</td>
<td>CTUh</td>
<td>0.010</td>
</tr>
<tr>
<td>Cancer human health effects</td>
<td>CTUh</td>
<td>0.0003</td>
</tr>
<tr>
<td>Acidification terrestrial and freshwater</td>
<td>mol H+ eq</td>
<td>466.031</td>
</tr>
<tr>
<td>Eutrophication freshwater</td>
<td>kg P eq</td>
<td>12.62</td>
</tr>
<tr>
<td>Eutrophication marine</td>
<td>kg N eq</td>
<td>138.07</td>
</tr>
<tr>
<td>Eutrophication terrestrial</td>
<td>mol N eq</td>
<td>1,336.50</td>
</tr>
<tr>
<td>Ecotoxicity freshwater</td>
<td>CTUe</td>
<td>43,816.27</td>
</tr>
<tr>
<td>Land use</td>
<td>Pt</td>
<td>1,431,246.45</td>
</tr>
<tr>
<td>Water scarcity</td>
<td>m3 depriv.</td>
<td>70,315.49</td>
</tr>
<tr>
<td>Resource use, energy carriers</td>
<td>MJ</td>
<td>1,189,633.54</td>
</tr>
<tr>
<td>Resource use, mineral and metals</td>
<td>kg Sb eq</td>
<td>0.021</td>
</tr>
</tbody>
</table>
To better understand the relevance of our results...

The **carbon footprint** of a professional football match is equivalent to:

- 499,075 km with an average car
- i.e. 41 times the street distance between Rome and Hong Kong
- The CO2 absorbed by 2,405 trees in 1 year

The **water footprint** of the match is equivalent to:

- The water needed to fill in 28 times an olympic swimming pool
- The water needed to irrigate 27.5 hectares cultivated with tomatoes
Other comparisons

The yearly amount of produced waste is equal to the weight of 199.7 Fiat 500.

Comparison with manufacturing sectors:

The yearly water consumption of a football club is the amount needed by a paper production company to produce 1,076.92 tons of paper.

The yearly electricity consumption is the amount needed by a tannery to produce 612,179.4 m² of finished leather. i.e. the yearly production of 3.5 of this plant.
Key question #1

**Antecedent:** the interest about football and environmental sustainability is increasing strongly in the last years.

**Question:** Is the environmental impact of a football match relevant?

**Answer:** YES
## Environmental footprint results overview

### Impact categories converted in unique unit comparable (Pt), single match

<table>
<thead>
<tr>
<th>Impact category</th>
<th>Unit</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change</td>
<td>Pt</td>
<td>2.05</td>
<td>31.83</td>
</tr>
<tr>
<td>Ozone depletion</td>
<td>Pt</td>
<td>0.03</td>
<td>0.47</td>
</tr>
<tr>
<td>Ionizing radiation HH</td>
<td>Pt</td>
<td>0.25</td>
<td>3.88</td>
</tr>
<tr>
<td>Photochemical ozone formation</td>
<td>Pt</td>
<td>0.39</td>
<td>6.06</td>
</tr>
<tr>
<td>Respiratory inorganics</td>
<td>Pt</td>
<td>0.26</td>
<td>4.04</td>
</tr>
<tr>
<td>Acidification terrestrial and freshwater</td>
<td>Pt</td>
<td>0.56</td>
<td>8.70</td>
</tr>
<tr>
<td>Freshwater eutrophication</td>
<td>Pt</td>
<td>0.15</td>
<td>2.33</td>
</tr>
<tr>
<td>Marine eutrophication</td>
<td>Pt</td>
<td>0.15</td>
<td>2.33</td>
</tr>
<tr>
<td>Terrestrial eutrophication</td>
<td>Pt</td>
<td>0.30</td>
<td>4.66</td>
</tr>
<tr>
<td>Land use</td>
<td>Pt</td>
<td>0.09</td>
<td>1.40</td>
</tr>
<tr>
<td>Water resource depletion</td>
<td>Pt</td>
<td>0.55</td>
<td>8.54</td>
</tr>
<tr>
<td>Resource use, energy carriers</td>
<td>Pt</td>
<td>1.63</td>
<td>25.31</td>
</tr>
<tr>
<td>Resource use, mineral and metals</td>
<td>Pt</td>
<td>0.03</td>
<td>0.47</td>
</tr>
</tbody>
</table>

According to this table, the main environmental impact of a professional football match are: climate change (carbon footprint), Water scarcity (water footprint), resource use and terrestrial and freshwater acidification.
**Key question #2**

*Antecedent:* some football clubs are looking to carbon footprint as a tool to measure the impact and to plan environmental improvement actions.

*Question:* Why only carbon emissions? Is it sufficient to look at the carbon footprint or we should look to the environmental footprint?

*Answer:* climate change impacts of football are important but they are “only” the 32% of the whole environmental impact.
Contribute to the environmental footprint from each considered activity

- Energy consumption (stadium)
- Turf maintenance
- Sports apparel & equipment

- Energy consumption (sport city)
- Cleaning chemicals
- Mobility

- Water consumption (stadium)
- Food & beverages

- Water consumption (sport city)
- Waste management

<table>
<thead>
<tr>
<th>Energy consumption (stadium)</th>
<th>Energy consumption (training center)</th>
<th>Water consumption (stadium)</th>
<th>Water consumption (training center)</th>
<th>Turf maintenance</th>
<th>Cleaning chemicals</th>
<th>Food &amp; beverages</th>
<th>Waste management</th>
<th>Sports apparel &amp; equipment</th>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.75%</td>
<td>11.18%</td>
<td>3.63%</td>
<td>1.96%</td>
<td>0.8%</td>
<td>0.38%</td>
<td>13.14%</td>
<td>-1.75%</td>
<td>2.48%</td>
<td>40.44%</td>
</tr>
</tbody>
</table>
Focus on environmental impacts of mobility (climate change impacts)
Focus on environmental impacts of Food & beverages (climate change impacts)

- Food - catering: 39%
- Beverages - catering: 10%
- Packaging - catering: 14%
- Plastic glasses - catering: 1%
- Beverages - bar & kiosk: 10%
- Packaging - bar & kiosk: 7%
- Food - bar & kiosk: 1%
- Beverages - staff: 5%
- Packaging - staff: 2%
- Plastic glasses - bar & kiosk: 1%
- Packaging food - bar & kiosk: 3%
- Packaging food - bar & kiosk: 8%
Key question #3

**Antecedent:** after the assessment clubs want to plan environmental improvement actions.

**Question:** where to start? What are the main contributors of the environmental impact of a football match?

**Answer:** mobility, energy consumption, food & beverages are 3 areas to focus on to plan the environmental improvements.
Thank You

Tiberio Daddi

tiberio.daddi@santannapisa.it