

## **THE DEFINITION OF SUSTAINABILITY IN FREIGHT TRANSPORT LITERATURE?**

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## **Abstract**

Sustainability has been a hot topic in freight transport literature for years. However, what authors mean when they refer to 'sustainability' is not always well defined. As a first step to formulating a clear definition, this paper analyses the existent literature to create an inventory of the definitions used. We found a strong focus on environmental sustainability rather than social sustainability. Within environmental sustainability, the most common definitions refer to GHG emissions and air pollution. Within social sustainability, the most common definitions refer to health and safety issues (accidents and pollution induced illness). We conclude that many different definitions exist, complicating the task of both academics and practitioners to take steps toward a sustainable transport system, as it is not clear what this entails.

## **1. Introduction**

'Sustainability' has been a hot topic in many debates, from politics and academics to the kitchen table. However, the exact meaning of the term remained undefined. In freight transport literature, sustainability has gotten increased attention over the past 2 decades. However, it is not a new topic. The earliest literature on sustainability in freight transport that was retrieved, dates back to the 1990s. The earliest review papers bundling the research on sustainability in logistics were found were published during the second half of the 2000s. As there was no formal definition of 'sustainability' however, the definition differs among these papers. In many of the earlier reviews, authors focussed solely on CO<sub>2</sub> or, more in general, greenhouse gas (GHG) emissions (Centobelli et al., 2017; Herold & Lee, 2017; Bask & Rajahonka, 2017; Ellram & Murfield, 2017). From these, only Herold & Lee, (2017) specifically state their focus on CO<sub>2</sub> in their title ("Carbon Management in Logistics [...]"). The others refer to 'sustainability' or 'environmental sustainability' in general. In addition, we noted that social sustainability is underrepresented in the extant literature. This was first stated by Mangiaracina et al. (2015) and Marchet et al. (2014) who mention both social and environmental aspects, but find little to no literature addressing social aspects, resulting in reviews mainly focussing on environmental aspects. A similar conclusion holds for the more recent review by Mrabti, Hamani, and Delahoche (2022), who find social sustainability is still largely underrepresented in literature. Ren et al. (2020) and Aloui et al. (2021) further specify 'employment' and 'health and safety for employees' to be the only social aspect regularly considered in freight transport research.

## **2. Method**

A search was conducted in the Scopus and Web of Science databases using the key words 'freight' and 'sustainability' (date: 19/6/2023). The key words were chosen very broad specifically to capture all aspects of freight transport literature addressing any form of sustainability. We limited the selection to journal papers published in English. We excluded review papers as they already bundle different views rather than introducing new aspects themselves. Next, the papers were selected based on title and abstract contents. We excluded papers based on the following criteria:

- Papers addressing only economic sustainability;
- Papers related to the manufacturing of freight vehicles;
- Papers related to infrastructure construction;
- Papers related to the entire lifecycle of a specific product, in which transport was only one of the studied aspects.

Next, we analysed the title, abstract and (if needed) main text of each paper to analyse which aspects of sustainability were discussed. For each paper, we used the following classification:

- Economic sustainability
  - For this topic, we did not make further divisions as this was not the main topic of our research. However, we did find it relevant to note which papers included economic sustainability next to other aspects and which did not.
- Environmental sustainability
  - Greenhouse gas emissions (GHG): the authors mention CO<sub>2</sub> or CO<sub>2</sub>-equivalent emissions, greenhouse gas emissions or climate change as an impact;
  - Air: the authors mention air pollution as an impact;
  - Water: the authors mention water pollution or water use as an impact;
  - Biodiversity: the authors mention the impact on biodiversity as an impact;
  - Resource use: the authors consider the amount of resources (including energy) used and/or the amount of waste produced as an impact;
  - Landuse: the authors consider the amount of land used as an impact;
  - Noise: the authors consider the amount of noise produced during operations as an impact;
  - Unspecified: the authors mention environmental sustainability, but do not specify which aspects exactly they take into consideration;
- Social sustainability
  - Equality: the authors consider equal treatment of employees and/or non-discrimination during the hiring process as an impact;
  - Health & safety: the authors consider health and safety aspects as an impact (including disease caused by pollutants and traffic accidents);
  - Working conditions: the authors consider the working conditions of the employees as an impact;
  - Education: the authors consider the education possibilities of the employees and/or support for local schools as an impact;
  - Well-being: the authors consider the impact on the general well-being of employees and/or local communities as an impact;
  - Ethics: the authors consider the general ethical behaviour (or lack thereof) of the companies involved as an impact;
  - Stakeholders: the authors consider the amount of stakeholder participation (customers, local authorities, local communities,...) as an impact;
  - Unspecified: the authors mention social sustainability, but do not specify which aspects exactly they take into consideration.

### 3. Bibliographic overview

The preformed search returned 1020 unique papers. After the selection process, 431 of those fitted our criteria. A first finding is that many authors use the word 'sustainability' without specifying what they mean exactly. For 12% of the papers selected, it could not be derived from the abstract whether they were talking about economic, social or environmental sustainability. For these papers, we analysed the full text to be able to classify them into our three main categories. For 13 papers (3%) the definition of sustainability they considered remained unclear, even after examining the whole text. Of those papers that did specify the type of sustainability they considered, 235 (55%) focussed solely on environmental sustainability and 4 papers (1%) focussed solely on social sustainability. 66 papers (15%) combined economic and environmental sustainability, 2 (0,5%) combined economic and social sustainability. Finally, 50 (12%) papers combined environmental and social sustainability and 61 (14%) papers combined all three of the main aspects of sustainability. The relative importance of each aspect is represented in figure 1 below.

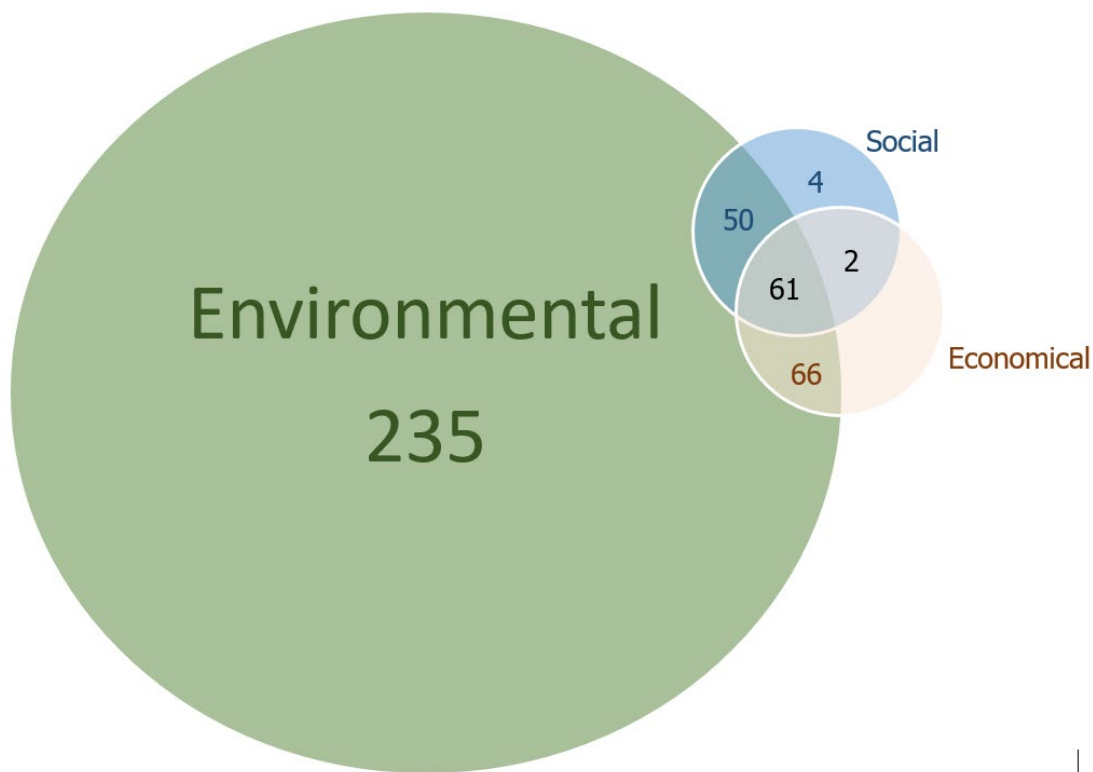


Figure 1: overview of the number of papers for each aspect of sustainability

Looking at the publication date of the selected papers, we can clearly see a first rise in interest from 2012-2013 and a second increase from 2018 onwards, as can be seen on figure 4 below. The share of papers where 'sustainability' is unspecified, diminishes over the years, from 33% to 100% share in the early years (1995-2005) to 3% to 9% in the last 5 years considered (2019-2023). Papers only discussing social sustainability only occur from 2019 onwards.

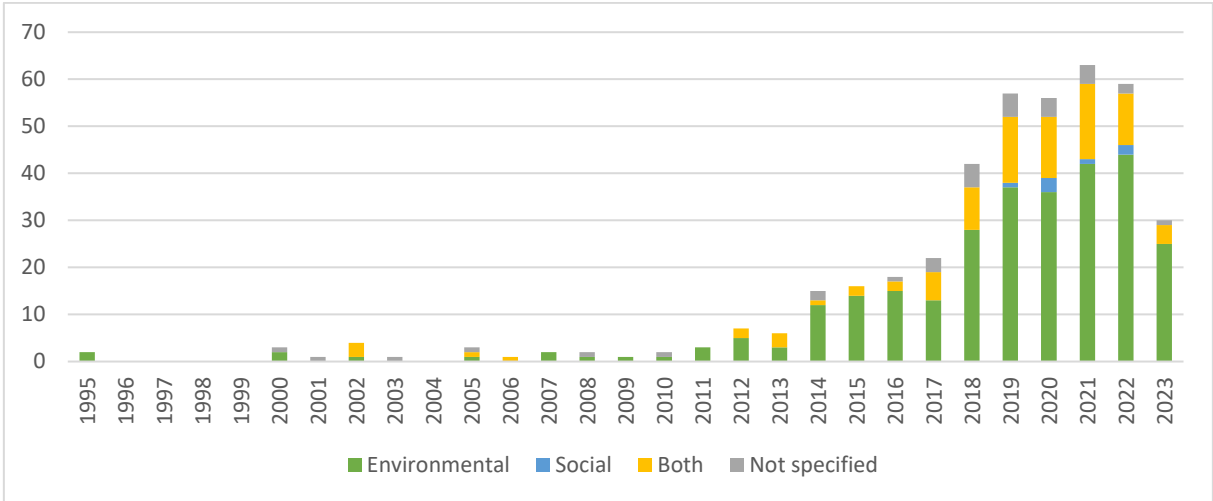


Figure 2: papers by publication year and aspect of sustainability considered

If we consider the continent of the university with which the first author is affiliated, we can clearly see that the majority of papers is written in Europe (39%-100%, depending on the year), with a strong increase in papers written in Asia from 2015 onwards (13%-39%). Although some of the early papers were written at North American universities, their share in the past 10 years (2013-2023) was relatively low (5%-20%). In total, 51% of papers was written in Europe, 29% in Asia, 9% in North America, 5% in Latin America and 3% each in Africa and Oceania.

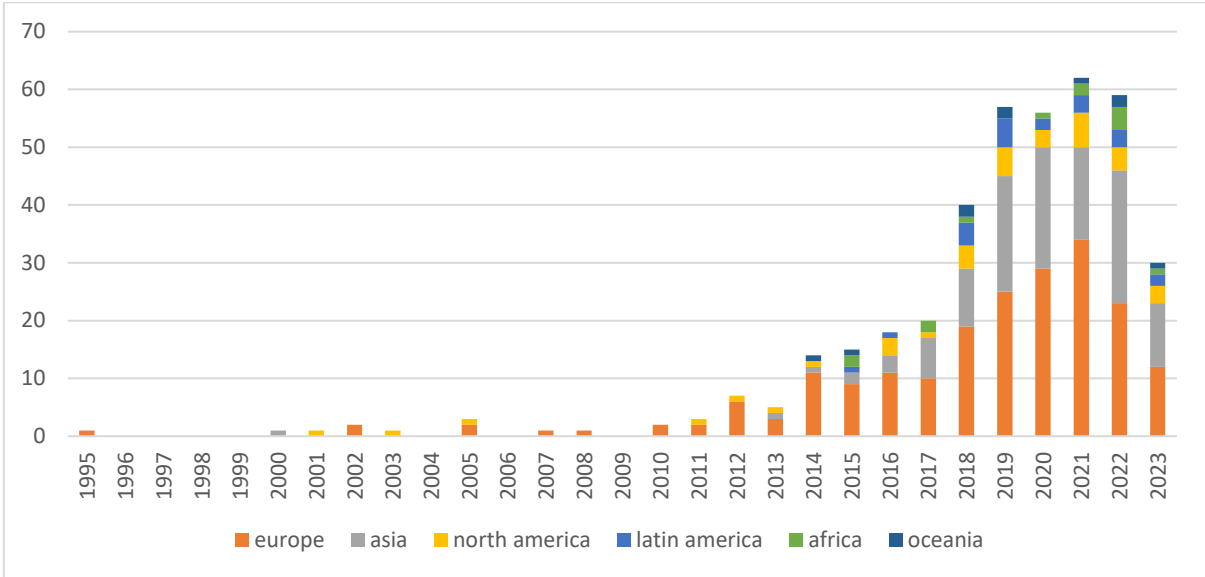


Figure 3: papers by continent of the first authors affiliation and year

An interesting pattern arises when considering the topics discussed in relation to the continent of the first authors affiliated university, as can be seen in figure 6 below. The share of papers considering environmental sustainability only is much higher in Africa (77%) than in Latin America (43%). Also the share of papers looking at social sustainability only is relatively high in Africa (8%) in comparison with

only 4% in Latin America and even less for the other continents. Papers considering both aspects are most common in Latin America and Oceania (both 30%). Authors from Latin America are most likely not to specify the aspect of sustainability they consider (22%), which is considerably more than in the other continents (13%-7%).

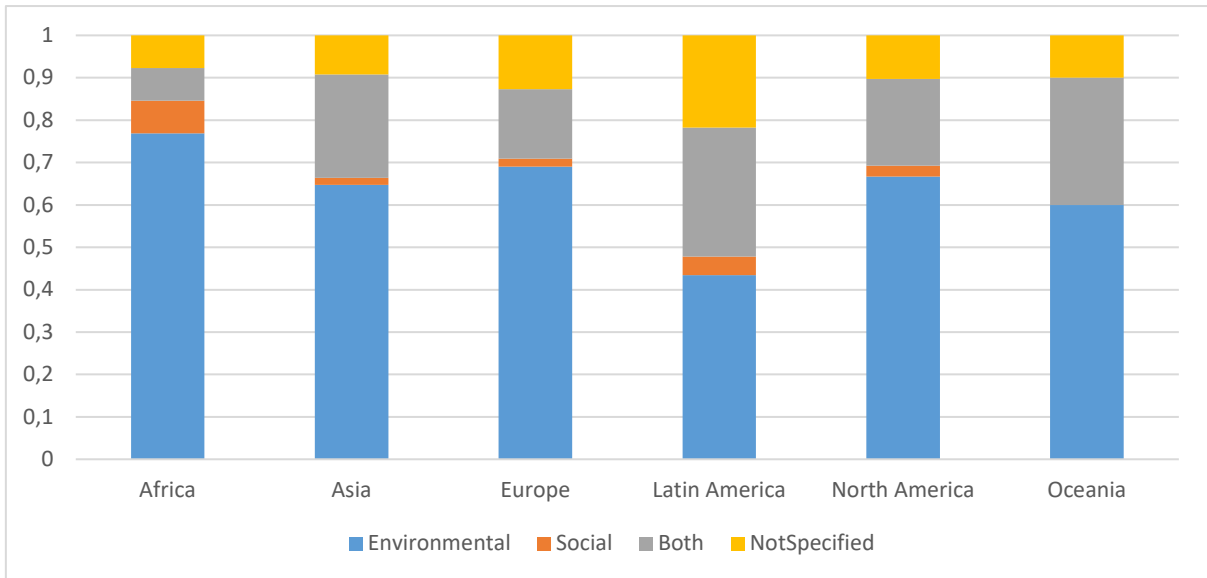


Figure 4: papers by continent and aspect of sustainability considered

#### 4. Aspects of sustainability considered

Papers considering environmental sustainability mainly focus on greenhouse gas emissions and/or CO2 emissions (87%), next to air pollution (36%). Resource use (7%), water (5%) and biodiversity (2%) where considered least. 8% of the papers did not specify which aspect of environmental sustainability the considered specifically. This is shown in figure 5 below.

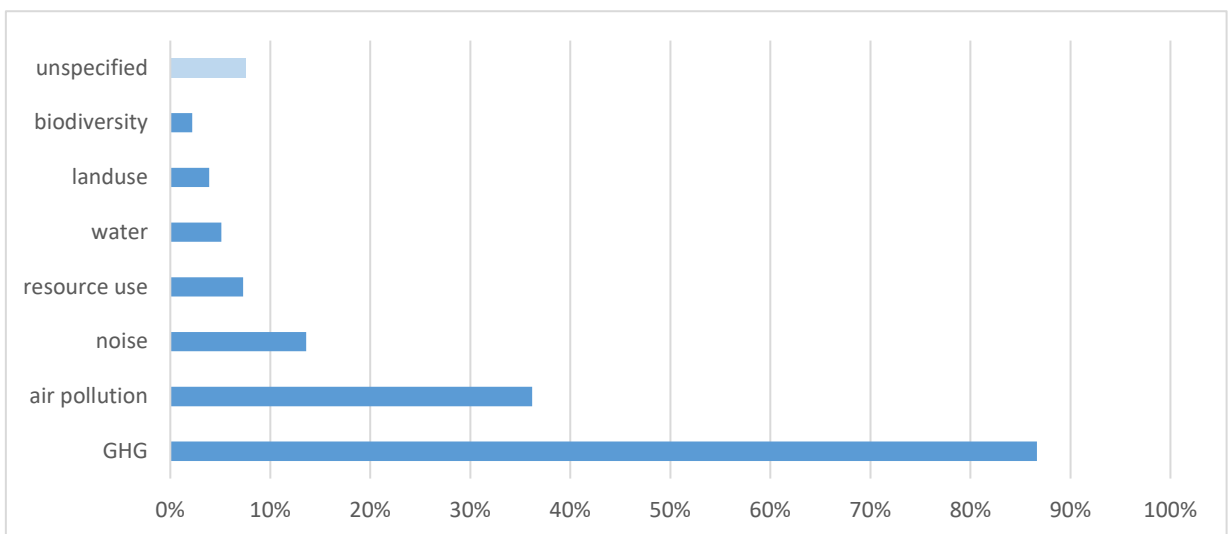


Figure 5: frequency of occurrence of the aspects of environmental sustainability considered (each aspect considered is counted, total sum is higher then the number of papers)

As shown in figure 6, papers considering social sustainability have a strong focus on health and safety aspects (62%). Education (10%), ethics (8%) and stakeholder engagement (8%) are considered least. The difference in focus on the different aspects is less for social sustainability then for environmental sustainability. About 9% of the papers did not specify what aspects of social sustainability they considered.

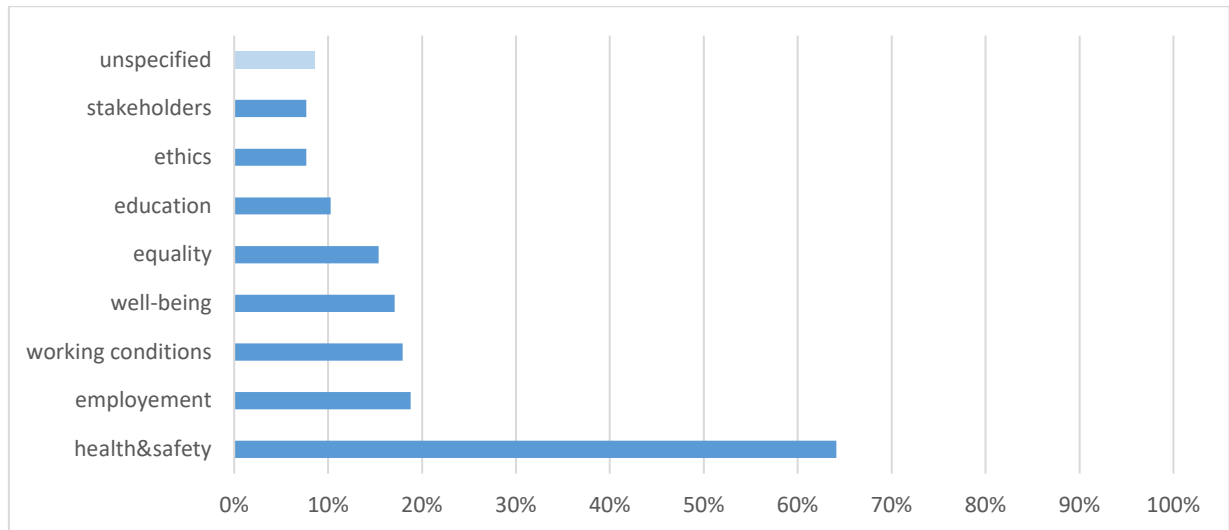


Figure 6: frequency of occurrence of the aspects of social sustainability considered (each aspect considered is counted, total sum is higher then the number of papers)

## 5. Conclusions and further research

As expected, we confirmed the findings of Mangiaracina et al. (2015), Marchet et al. (2014) and Mrabti, Hamani, and Delahoche (2022) with regards to the very strong focus on environmental aspects of sustainability in literature. In our sample, 56% (or 235 papers) considered only environmental sustainability, with only a small percentage considering only social sustainability (1% or 4 papers). The share of papers considering social sustainability did increase over the years, mainly from 2017 onwards. The same is true for the share of papers from non-European countries. Specifically Asian countries contributed significantly to the sustainable freight transport literature from 2015.

Next, we analysed how sustainability was defined in the selected papers. We found a large variation in the way 'sustainability' was defined, although some aspects are mentioned far more than others. For environmental sustainability, GHG emissions, air pollution and (to a lesser extent) noise, are the mentioned most. Of those papers who did consider social aspects of sustainability, the vast majority



analysed aspects related to health and safety. In most cases this translates to traffic accidents or disease induced by air pollution.

We found a great variety in the definition of 'sustainability' in literature. Given the recent Corporate Social Responsibility Directive (CSRD) issued by the EU, it would be beneficial to analyse to what extent the definitions used in literature match those used in this legislation. Additionally, this legislation will require companies to report on their sustainability, creating the need for a more uniform definition of sustainability in freight transport and additional academic research into those aspects that are now underrepresented in literature. Stronger and more flexible cooperations, as envisaged by novel concepts such as Physical Internet, Internet of Logistics,... further increase the need for clear definitions. This is also true for those aspects who might be less crucial for freight transport as such, but might be relevant for their partners up and down the chain.

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