Decoding the Nexus: A Bibliometric Review on Sustainability, Circular Economy, and Consumer Food Waste

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† This study is an extended and revised version of the paper entitled “Mapping the intersections of sustainability, circular economy, and consumer behavior: a bibliometric review on food waste” presented at the 3rd International Conference on Sustainable, Circular Management and Environmental Engineering (ISCMEE 2023) held in İzmir, Turkey on 12 July 2023.

Abstract: One of the issues that has gained importance within the scope of the United Nations Sustainable Development Goals (SDGs) is the issue of food waste. These goals, which represent very important and urgent problems to be solved at the global level, are extremely critical in terms of sustainability. Food waste, by its nature at the intersection of economic, social, and environmental sustainability goals, has become a global problem linked to key challenges in the global environment in terms of food security, climate change, malnutrition, and economic sustainability. The fact that consumers are one of the most important factors affecting food waste in the transition to a circular economy increases the importance of this study once again. Due to the lack of systematic, chronological studies showing how food waste develops over time, this study will examine the development and evolution of food waste research using a bibliometric analysis. In this way, it aims to gain a comprehensive insight into the field’s current state and shed light on this highly important area of study. In addition to informing policymakers, practitioners, and consumers with the results of this research, it is also aimed to support all relevant individuals, institutions, and organizations in the efforts to combat food waste. One of the main objectives of this study is to contribute to the achievement of the United Nations Sustainable Development Goals (SDGs). For this reason, it can be stated that the research has objectives in line with SDG 12: Responsible Consumption and Production and SDG 13: Climate Action.

Keywords: circular economy; sustainability; food waste; bibliometric analysis

1. Introduction

Sustainability is an understanding that invites people to think beyond individual needs and motivates them to consider the long-term consequences of their current actions. One of the main axes of sustainable thinking is the effective and efficient use of limited resources to meet current needs and consider future generations’ needs. This approach, which should not be limited to the sustainability of natural resources, is a holistic understanding that needs to be reflected in environmental, economic, and social spheres. While environmental sustainability emphasizes the importance and protection of the natural environment, economic sustainability underlines the need for the efficient, responsible, and effective use of economy-related scarce resources. Finally, social sustainability refers to equity and inclusiveness within society.

In recent years, there has been an increase in individual and academic interest in sustainability. Sustainability-oriented thinking and practices, which impact macro-scale practices at the level of institutions or enterprises and individual practices, have increased...
with increasing awareness on various occasions [1,2]. On the other hand, academic studies in this field have also risen significantly with increasing interest, awareness, and thus increasing examples of practice at institutional and individual levels [3,4].

The increasing interest in this field at both individual and academic levels has led to an intensification of studies in the field, which has necessitated a comprehensive evaluation of the existing studies. The field of sustainability, which is located at the intersection of many fields, is an interdisciplinary field of study with a wide range of evaluation with studies involving many sub-fields, from economics to sociology and public administration to consumer behavior. For this reason, this study aims to provide a valuable and structured framework by examining the extensive body of work in the field.

The United Nations (UN) Sustainable Development Goals Report data distinguished between food waste and food loss, highlighting 13% of food loss in production chains as well as 17% of food waste at the consumer level [5]. Food waste is a critical issue to prevent, not only in terms of economic sustainability but also in terms of the sustainability of natural resources and social justice and therefore social sustainability. Therefore, it is required to be examined in depth.

Understanding and gaining insights into the causes of food waste, which originates from consumers, is one of the most important steps to prevent it. This study, which aims to develop an in-depth understanding of the field to develop effective strategies to reduce this waste, is an important effort for a more sustainable universe by shedding light on the intersection of sustainability, circular economy, and food waste.

The bibliometric analysis method, which will be used in this study, is one of the leading tools to examine and synthesize comprehensive information in a field. Especially in intersectional fields such as this particular research study area, where many fields intersect and have rich literature, a bibliometric analysis emerges as a method that enables valuable results to be obtained. A bibliometric analysis, which differs from a traditional literature review in several respects, was chosen because of its potential for quantitative insights, its competence in visual representation, and its superiority in terms of enabling the identification of objective trends and patterns in the literature. Through this method, this study addressed the following research questions (RQs) by conducting descriptive analyses and network analyses using the R Bibliometrix package and VOSviewer, examining publications at the intersection of sustainability, circular economy, and food waste in the Web of Science (WoS) database until the end of August 2023.

RQ1. What are the variations in annual publications and citation trends within the research field?
RQ2. What keywords have shown the highest frequency of use and the most frequent co-occurrence within publications in the research field?
RQ3. Which countries demonstrate the highest research productivity, and what are the collaboration patterns among these countries within the research field?
RQ4. Who are the most prolific authors, what co-authorship patterns emerge among them, and which sources publish the most studies within the research field?

2. Food Waste, Sustainability, and Circular Economy

In line with the 2030 Agenda for Sustainable Development announced by the United Nations, our study focuses on key topics, such as responsible consumption and production (SDG 12) and climate action (SDG 13). The growing interest in these Sustainable Development Goals (SDGs) is also reflected in the literature [6]. While both are important for sustainability, food waste and food loss are distinguished from each other by definition by the UN [5]. Food loss is defined as food becoming unusable due to inefficiencies that occur during production, post-harvest processing, transportation, etc., before the product reaches the final consumer; food waste, on the other hand, is explained as the disposal of edible food as a result of consumer-induced practices such as overbuying, improper storage, etc., or personal preferences [7–9]. It has been stated that nations’ economic development is directly related to the food waste or loss they cause. It has been emphasized that developed
countries are more responsible for food waste due to reasons such as more effortless access to food.

In contrast, developing countries are more responsible for food loss due to ineffective management of inefficiency in the process [10–14]. Although food waste production varies according to countries’ development levels, the problem is characterized as a universal sustainability issue affecting the whole world [15]. The economic cost of food waste from consumers is higher than food loss due to the product’s added value until it reaches the consumer [16]. Therefore, understanding food waste at the consumer level is critical for achieving sustainability goals.

Food waste can be expressed as a holistic process that cannot be explained only by individual attitudes, intentions, and behaviors [17]. It is essential to understand its multifaceted nature to reduce food waste, which is influenced by social norms, cultural practices, and structural variables. It has also been stated that efforts to raise awareness and consciousness only at the individual level do not have a significant effect if other structural factors are ignored [9,17]. Despite the existence of individual awareness or positive attitudes or intentions to avoid food waste [18,19], the inability to prevent food waste suggests the importance of focusing on structural solutions with a macro approach. It is clear that studies that point to interdisciplinary collaboration and guide policymakers toward systemic change will contribute to a more sustainable food ecosystem.

Once it is accepted that individual factors do not fully explain food waste behavior, systemic influences must be closely examined. Culture is a phenomenon that should not be ignored when discussing food waste. For this very reason, studies indicate that taking steps to prevent food waste by considering local dynamics and using culturally adapted language that avoids giving generalized messages yields more meaningful results in the fight against food waste [20]. It is known that food culture patterns that differ from region to region, sometimes even within the same country, will lead to diversity in approaches to food waste and related behaviors [21,22]. Within the scope of individual practices related to food waste, contextual factors such as family composition, income level, and individual differences need to be considered alongside structural influences, such as culture [21,23,24]. Even time-based differences such as holidays and celebrations have the potential to create variability in wastage due to shopping and preparations [25,26]. Therefore, delivering a standard message about food waste to all consumers, even if they are located in the same geographical region, would reduce effectiveness, so it is crucial to provide consumers with customized messages that are appropriate for their segment [27].

Studies on food waste can be quite complex as they adopt a wide range of methodological approaches, focusing on various stages of waste and using measurement methods without adhering to a standard [28]. As a result of this situation, it can be stated that although there are a large number of studies in the field, the studies are disconnected from each other. Therefore, the synergistic potential of the research in the field is not realized. Because of the importance of analyzing this extensive literature in a structured way and with a common framework, it is crucial to organize the research in such a way that a greater synergy can be achieved. The present study aims to provide a clear view to researchers, practitioners, and policymakers working in this field by structuring the various studies on food waste around emerging themes, trends, and concepts.

Since existing studies on sustainability and consumer behavior are based either on traditional literature analysis [9,17] or consumer data [7,8,13], the current study addresses the lack of a comprehensive bibliometric analysis focusing on quantitative insights in the field.

3. Materials and Methods

This study employed a systematic approach to address the research questions posed. Initially, each set’s search sets and relevant keywords were defined, and searches were conducted within WoS, one of the most widely utilized databases in the literature. The retrieved studies were subsequently selected in accordance with the research area, and
datasets were prepared for analysis through the cleaning and standardization processes. Following this, bibliometric analyses were conducted using the R Bibliometrix package and VOSviewer.

### 3.1. Data Selection and Preparation for the Analysis

To systematically cover the breadth of academic research conducted within the scope of this research, three specific search categories were identified: “Circular Economy and Sustainability”, “Food Waste”, and “Consumer”. On 21 August 2023, scientific studies that included at least one of the predefined keywords from these three different categories were found, as summarized in Table 1. The data were imported from the WoS database.

#### Table 1. Search sets.

<table>
<thead>
<tr>
<th>Sets</th>
<th>Search Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food waste</td>
<td>“Food waste*” OR “Food loss*” OR “Food disposal*” OR “Food recovery*” OR “Food supply*” OR “Food consumption*” OR “Food recycling*” OR “Food redistribution*” OR “Sustainable food*” OR “Food packaging waste*”</td>
</tr>
<tr>
<td>Consumer</td>
<td>“consum*”</td>
</tr>
</tbody>
</table>

The search was refined within the WoS categories, excluding research areas outside the scope of this study. Within the obtained dataset, duplicated studies were eliminated, and the expressions of terms were standardized. For instance, terms such as “LCA” and “life cycle assessment (LCA)” were changed to “life cycle management”, while “consumer behavior” was changed to “consumer behavior”. Following the editing process, a dataset comprising 1448 studies, spanning 1994 to 2023, was compiled. The main details about the studies encompassed within the analysis are presented in Table 2.

#### Table 2. Summary of the analysis data.

<table>
<thead>
<tr>
<th>Main Information about Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Timespan</td>
<td>1994:2023</td>
</tr>
<tr>
<td>Sources (Journals, Books, etc.)</td>
<td>440</td>
</tr>
<tr>
<td>Documents</td>
<td>1448</td>
</tr>
<tr>
<td>Document Types</td>
<td></td>
</tr>
<tr>
<td>Article</td>
<td>1147</td>
</tr>
<tr>
<td>Book Chapter</td>
<td>19</td>
</tr>
<tr>
<td>Data Paper</td>
<td>1</td>
</tr>
</tbody>
</table>
### Table 2. Cont.

<table>
<thead>
<tr>
<th>Main Information about Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Access</td>
<td>42</td>
</tr>
<tr>
<td>Proceeding Paper</td>
<td>71</td>
</tr>
<tr>
<td>Book Review</td>
<td>1</td>
</tr>
<tr>
<td>Correction</td>
<td>2</td>
</tr>
<tr>
<td>Editorial Material</td>
<td>5</td>
</tr>
<tr>
<td>Meeting Abstract</td>
<td>3</td>
</tr>
<tr>
<td>Review</td>
<td>157</td>
</tr>
<tr>
<td>Authors</td>
<td></td>
</tr>
<tr>
<td>Authors</td>
<td>4799</td>
</tr>
<tr>
<td>Author Appearances</td>
<td>5637</td>
</tr>
<tr>
<td>Authors of Single-authored Documents</td>
<td>101</td>
</tr>
<tr>
<td>Authors of Multi-authored Documents</td>
<td>4698</td>
</tr>
<tr>
<td>Authors Collaboration</td>
<td></td>
</tr>
<tr>
<td>Single-authored Documents</td>
<td>103</td>
</tr>
<tr>
<td>Co-Authors per Documents</td>
<td>3.89</td>
</tr>
<tr>
<td>Collaboration Index</td>
<td>3.49</td>
</tr>
</tbody>
</table>

The dataset mainly comprises articles, accounting for approximately 79% (1147), followed by reviews at 11% (157), Proceeding Papers at 5% (71), and Early Accesses constituting 3% (42). The studies within the dataset were published in 440 different sources and authored by 4799 authors. Among these studies, 103 were single-authored, while 1345 were collaboratively authored. One of the indicators that illustrates the extent of collaboration among authors in the research field is the average number of co-authors per study, which is 3.89. Meanwhile, the collaboration index indicator, calculated by dividing the total number of authors in multi-authored studies by the total number of multi-authored studies [29], yields a value of 3.49.

### 3.2. Bibliometric Analysis

The bibliometric methodology, which involves applying various quantitative techniques to bibliometric data, has seen a significant rise in popularity, especially in recent years. This increase can be attributed to several factors, including the availability of large-scale databases like WoS and Scopus that provide bibliometric data. Moreover, numerous software tools such as R version 3.6.3, VOSviewer version 1.6.19, and Gephi (accessed date: 21 August 2023) enable the analysis of bibliometric data to be more accessible, further fueling the growing utilization of bibliometric analysis [30]. Bibliometric analyses encompass the descriptive analysis of bibliometric data and examining networks encompassing keywords, authors, citations, countries, and their connections [31]. In this study, various aspects of research within the field have been investigated, including how the annual scientific production within the research field evolved over the years, the annual citation patterns within the research field, the most frequently used keywords and their co-occurrence patterns, the most prolific countries and authors in the research field, collaboration patterns among countries and authors within the research field, and the leading sources within the research field.

### 4. Results

As a result of the bibliometric analyses applied to the dataset within the scope of this research, various insights have been obtained on the research field. These insights include
the year-by-year evolution of publications in the field up to the end of August 2023, annual citation patterns within the research area, the most frequently used keywords and their co-occurrence patterns, the most productive countries and authors within the research domain, collaboration patterns among countries and authors in the research area, and the primary sources contributing to the field. This section presents all of these findings.

4.1. Annual Scientific Production

The yearly publication figures within the research field are illustrated in Figure 1. The number of publications gradually increased, especially in the last ten years [14,32]. Between 1994 and 2008, the yearly number of studies within the research field remained below 10. However, starting from 2009, the annual number of studies in the field began to surpass 10, and by 2018, it had exceeded 100. In the research field, where the number of studies has been on the rise since 2014, an analysis of the last ten years shows that the most substantial increases compared to the previous year took place in 2015 and 2021, respectively. This increasing trend in annual study counts continued, and as of August 2023, the number of publications in 2023 reached 67% of the total number of publications produced in 2022.

Figure 1. Annual scientific production.

4.2. Annual Citations

The yearly citation patterns within the research field are analyzed through the indicators of total publications (TPs), total citations (TCs), and Citations per Paper per year (CPY = Citations per Paper/Citable years). Citations per Paper are calculated by dividing the TCs by the TPs. In Figure 2, the annual variations in the TCs and TPs are depicted, while in Figure 3, the annual changes in the CPY and TCs are illustrated.

In the field of research, the number of publications has consistently increased each year since 2014, while the citation numbers have exhibited a fluctuating trend. Decreases in citation counts were observed in 2019, 2021, and 2022 compared to the previous year. The most significant decline occurred in 2022.
Figure 2. Annual publications–annual citations.

Figure 3. Annual citations–citations per paper per year.

Figure 3 indicates that although TCs have generally followed a similar path to the CPY, TCs increased in 2015, 2016, and 2018, while the CPY declined and TCs decreased in 2020, and the CPY increased. The CPY indicator, which provides a comprehensive viewpoint by considering the number of studies and the years cited together, reveals that 2006 was the most productive year. The article “Sustainable food consumption: Exploring the consumer’ attitude–behavioral intention’ gap”, authored by [33] and published in the Journal of Agricultural and Environmental Ethics, has received 1258 citations in the WoS database. This study, which has the highest citation count among the publications covered in the research, played a crucial role in achieving the top position within the citation indicators for the year 2006.

Based on the CPY indicator, 2006 is followed by 2014 (CPY = 11.1) and 2008 (CPY = 9.64), respectively. In terms of the total citation count, the studies of [34–36] push these years to the top positions.
4.3. Co-Occurrence Analysis of Keywords

The most frequently used keywords were determined, and a keyword co-occurrence analysis was conducted to uncover recurring keywords and research patterns at the intersections of sustainability, circular economy, and food waste. The most frequently encountered terms include “food waste”, “sustainability”, “circular economy”, “sustainable consumption”, and “food”, all of which are part of the search sets. Beyond the terms within these sets, words such as “life cycle assessment”, “ecological footprint”, “food supply chain”, “environment”, “organic food”, “sustainable food”, and “food security” have also demonstrated noteworthy usage.

Figure 4 displays the co-occurrence network, which encompasses keywords mentioned at least ten times within the Author Keywords sections of all the documents in the dataset. The co-occurrence analysis of these keywords resulted in seven primary clusters. Figure 5 presents the clusters and corresponding keywords within the clusters with their frequencies.

Figure 4. Co-occurrence network of most used keywords.

<table>
<thead>
<tr>
<th>Cluster 1 (red)</th>
<th>Cluster 2 (green)</th>
<th>Cluster 3 (dark blue)</th>
</tr>
</thead>
</table>
| • food waste (238)  
• circular economy (168)  
• life cycle assessment (76)  
• waste management (68)  
• waste (56)  
• industrial ecology (26)  
• management (26)  
• recycling (22)  
• anaerobic digestion (19)  
• material flow analysis (17)  
• food waste management (15)  
• resource recovery (14)  
• energy (13)  
• bioeconomy (12)  
• biogas (12)  
• composting (11)  
• solid waste management (11) | • food (105)  
• food consumption (51)  
• ecological footprint (39)  
• carbon footprint (26)  
• agriculture (21)  
• environmental impact (21)  
• nutrition (17)  
• china (16)  
• footprint (15)  
• environmental impacts (14)  
• water (14)  
• assessment (13)  
• sustainable diets (13)  
• water footprint (13)  
• diet (10) | • sustainability (181)  
• sustainable consumption (156)  
• consumer behaviour (57)  
• organic food (34)  
• consumer (23)  
• sustainable food consumption (21)  
• climate change (19)  
• meat (12)  
• aquaculture (11)  
• organic (11)  
• survey (11)  
• local food (10) |

Figure 5. Cont.
The first cluster, named Waste and Sustainability, centers around food waste, circular economy, life cycle assessment, and waste management. The keywords co-occurring in this cluster implied a holistic exploration of waste management, circular economy principles, and the potential for value extraction from waste. The second cluster, Food and Consumption, focuses on food, incorporating food consumption and diet. The cluster collectively emphasizes evaluating the overall sustainability of food choices, providing a concise exploration of intersections between food, environmental impact, and sustainability.

Consumer and Sustainability, the third cluster, focuses intensely on sustainability and addresses sustainability in consumer behavior, emphasizing food choices, organic practices, and their broader implications for climate and local economies. The cluster that concentrates on the food supply chain, emphasizing sustainability and key themes within food systems, is cluster four, named Food Chain and Goals. This cluster comprehensively examines sustainable practices within the food supply chain, encompassing waste reduction, adherence to development goals, and promoting resilient food systems.

The fifth cluster, Environment and Security, delves into ecological considerations with the environment at its core. It centers on the intersection of environmental concerns, food security, and sustainable development, exploring various sustainability dimensions. The sixth cluster, Consumption and Policy, reflects the effects of the COVID-19 pandemic on consumption dynamics. It provides a perspective on the interplay between consumption, sustainability, the COVID-19 pandemic, and policy influences. The last cluster, Production and Packaging, focuses on sustainable production, particularly addressing the environmental impact of food packaging.

4.4. Co-Authorship Analysis: Countries

Patterns of collaboration, indicative of a more intense form of interaction, can be explored by creating co-authorship networks at the level of authors, organizations, or countries, thus facilitating the study of interactions within the collaborative realm [37,38]. The country analysis and the dynamics of collaborations are very important in terms of showing which countries are most interested in the field of research and shaping the dissemination of knowledge worldwide.

The analysis is based on co-authorship among countries considered to have participated in at least ten studies within the research field. A total of 44 countries met this criterion. Table 3 presents information about the top 10 countries with the most publications in the research field. It includes the TPs, TCs, Citations per Paper (CPs), and Total Link Strength (TLS) values. The TLS represents the collective intensity of the co-authorship connections between a specific country and others [39].
Table 3. Publication, citation, and collaboration indicators for top 10 productive countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>TP</th>
<th>TC</th>
<th>CP</th>
<th>TLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>211</td>
<td>6529</td>
<td>30.94</td>
<td>187</td>
</tr>
<tr>
<td>England</td>
<td>172</td>
<td>6036</td>
<td>35.09</td>
<td>198</td>
</tr>
<tr>
<td>USA</td>
<td>162</td>
<td>4805</td>
<td>29.66</td>
<td>187</td>
</tr>
<tr>
<td>Peoples R China</td>
<td>160</td>
<td>3205</td>
<td>20.03</td>
<td>158</td>
</tr>
<tr>
<td>Germany</td>
<td>102</td>
<td>2488</td>
<td>24.39</td>
<td>117</td>
</tr>
<tr>
<td>Spain</td>
<td>92</td>
<td>2565</td>
<td>27.88</td>
<td>128</td>
</tr>
<tr>
<td>India</td>
<td>81</td>
<td>1154</td>
<td>14.25</td>
<td>70</td>
</tr>
<tr>
<td>Netherlands</td>
<td>75</td>
<td>3770</td>
<td>50.27</td>
<td>70</td>
</tr>
<tr>
<td>Sweden</td>
<td>72</td>
<td>2042</td>
<td>28.36</td>
<td>75</td>
</tr>
<tr>
<td>Australia</td>
<td>67</td>
<td>1791</td>
<td>26.73</td>
<td>75</td>
</tr>
</tbody>
</table>

Italy, England, and the USA have the highest TPs and TCs in the research field. However, a different result emerges among the top three countries when considering the CP metric. In this case, Belgium, Austria, and Finland, which fall within the range of 20 to 30 in the TP-based ranking, are leading in CPs. Even though these countries have not contributed to as many collaborative studies as the countries at the top of the list, the research produced by the authors from these countries has received many citations. Of the top 10 countries based on TPs, India, China, and Germany have the lowest CP scores. This result suggests that despite these countries producing a substantial number of studies, the average number of citations per publication is comparatively lower.

Country co-authorship networks are highly relevant as they visually represent global research collaboration for understanding countries’ efforts in a field that transcends geographical boundaries. This information is particularly valuable for researchers, institutions, or policymakers to identify potential collaborations. Furthermore, to build broader research relationships in the future, it is critical to recognize the existing strong links between countries. Through analyzing collaborative authorship relationships between countries, five distinct clusters were identified, each containing countries frequently participating in collaborative research. The visual representation of these clusters is shown in Figure 6. In the network depiction, countries with the highest productivity are shown with larger nodes. According to the TLC metric, which shows the strength of the co-authoring links between authors from different countries, the top three countries with the strongest co-authorship relationships are England, Italy, and the USA, in descending order.

Figure 6. Co-authorship network of countries.
4.5. Co-Authorship Analysis: Authors

A co-authorship analysis was undertaken to investigate the collaborative patterns observed among authors who have contributed significantly to the research field under consideration. A total of 4797 authors were identified as contributors, of whom 57 individuals had participated in a minimum of four studies. Notably, the authors with the highest TPs are Filimonau, Viachaslau; Laso, Jara; Margallo, Maria; and Sala, Serenella, as presented in Table 4. It is important to recognize the most influential names in the field and identify individuals who have made highly influential contributions to enhance the collaborative nature of the discipline. These authors have significantly impacted the field through their publications and citations. Therefore, the values associated with the citations are also of great importance.

Table 4. Publication, citation, and collaboration indicators of the most productive authors.

<table>
<thead>
<tr>
<th>Author</th>
<th>TP</th>
<th>TC</th>
<th>CP</th>
<th>TLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filimonau, Viachaslau</td>
<td>14</td>
<td>402</td>
<td>28.71</td>
<td>2</td>
</tr>
<tr>
<td>Laso, Jara</td>
<td>13</td>
<td>375</td>
<td>28.85</td>
<td>39</td>
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<tr>
<td>Margallo, Maria</td>
<td>10</td>
<td>356</td>
<td>35.60</td>
<td>35</td>
</tr>
<tr>
<td>Sala, Serenella</td>
<td>10</td>
<td>1360</td>
<td>136.00</td>
<td>0</td>
</tr>
<tr>
<td>Hoehn, Daniel</td>
<td>9</td>
<td>304</td>
<td>33.78</td>
<td>34</td>
</tr>
<tr>
<td>Aldaco, Ruben</td>
<td>8</td>
<td>361</td>
<td>45.13</td>
<td>28</td>
</tr>
<tr>
<td>Vazquez-Rowe, Ian</td>
<td>8</td>
<td>159</td>
<td>19.88</td>
<td>21</td>
</tr>
<tr>
<td>El Bilali, Hamid</td>
<td>6</td>
<td>134</td>
<td>22.33</td>
<td>1</td>
</tr>
<tr>
<td>Galli, Alessandro</td>
<td>6</td>
<td>272</td>
<td>45.33</td>
<td>1</td>
</tr>
<tr>
<td>Mangla, Sachin Kumar</td>
<td>6</td>
<td>157</td>
<td>26.17</td>
<td>0</td>
</tr>
<tr>
<td>Martens, Pim</td>
<td>6</td>
<td>50</td>
<td>8.33</td>
<td>7</td>
</tr>
<tr>
<td>Rousta, Kamran</td>
<td>6</td>
<td>218</td>
<td>36.33</td>
<td>5</td>
</tr>
<tr>
<td>Woolley, Elliot</td>
<td>6</td>
<td>131</td>
<td>21.83</td>
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</tbody>
</table>

Furthermore, it is worth highlighting that Verbeke, Wim (TC = 1977, CP = 395.4) and Vermeir, Iris (TC = 1969, CP = 393.8) emerged as the authors with the highest TCs and CPs, although they are not among the authors listed with the highest TPs. Following them in terms of TCs is Sala, Serenella (TC = 1360, CP = 136), who also has a position within the top three authors based on TPs. Sala, Serenella’s position in TCs can be attributed to her significant role as a co-author in several highly cited works, most notably the studies of [35] with 595 citations and [40] with 338 citations.

Figure 7 visually represents the co-authorship density among authors involved in at least four studies. In this depiction, authors with strong co-authorship connections are represented by dark yellow shading, while dark blue shading represents those with weaker co-authorship links. The TLS metric, which signifies the strength of the co-authorship connections, highlights Laso, Jara; Margallo, Maria; and Hoehn, Daniel as the top three contributors.
This finding highlights the fine distinction in evaluating journals, pointing to the complex interplay between productivity and impact. Within the subset of journals ranked in the top 10 based on TPs, an internal CP ranking reveals that Waste Management (CP = 61.81), the Journal of Cleaner Production (CP = 51.43), and Science of The Total Environment (CP = 40.44) take the top three positions.

Table 5. Publication and citation indicators of 10 sources with the highest TPs.

<table>
<thead>
<tr>
<th>Source</th>
<th>TP</th>
<th>TC</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainability</td>
<td>178</td>
<td>2643</td>
<td>14.85</td>
</tr>
<tr>
<td>Journal of Cleaner Production</td>
<td>149</td>
<td>7663</td>
<td>51.43</td>
</tr>
<tr>
<td>British Food Journal</td>
<td>45</td>
<td>654</td>
<td>14.53</td>
</tr>
<tr>
<td>Foods</td>
<td>41</td>
<td>768</td>
<td>18.73</td>
</tr>
<tr>
<td>Science of The Total Environment</td>
<td>39</td>
<td>1577</td>
<td>40.44</td>
</tr>
<tr>
<td>Waste Management</td>
<td>37</td>
<td>2287</td>
<td>61.81</td>
</tr>
<tr>
<td>Resources Conservation and Recycling</td>
<td>36</td>
<td>1426</td>
<td>39.61</td>
</tr>
<tr>
<td>Sustainable Production and Consumption</td>
<td>29</td>
<td>430</td>
<td>14.83</td>
</tr>
<tr>
<td>Journal of Industrial Ecology</td>
<td>26</td>
<td>860</td>
<td>33.08</td>
</tr>
<tr>
<td>Frontiers in Sustainable Food Systems</td>
<td>23</td>
<td>105</td>
<td>4.57</td>
</tr>
</tbody>
</table>

All the sources in the top ten list are journals. Sustainability, the Journal of Cleaner Production, and the British Food Journal are the top three journals with the highest TPs, respectively. On the TCs side, the Journal of Cleaner Production, Sustainability, and Waste Management are in the top three. The CP metric resulted in a different picture. The journals Ecological Economics (TP = 5, CP = 124.50), International Journal of Production Economics (TP = 5, CP = 18.40), and Food Policy (TP = 11, CP = 76.18), while not having positions within the TP-based top 10 rankings, emerged as the top three in the CP list. This finding highlights the fine distinction in evaluating journals, pointing to the complex interplay between productivity and impact. Within the subset of journals ranked in the top 10 based on TPs, an internal CP ranking reveals that Waste Management (CP = 61.81), the Journal of Cleaner Production (CP = 51.43), and Science of The Total Environment (CP = 40.44) take the top three positions.
Cleaner Production (CP = 51.43), and Science of The Total Environment (CP = 40.44) take the top three positions.

The number of articles published by these ten journals in the last ten years on an annual basis is depicted in Figure 8. Until 2019, the journal with the highest number of publications in the intersection of sustainability, circular economy, and food waste was the Journal of Cleaner Production. However, starting from 2020, Sustainability took the lead. In 2022, both journals saw a decrease in published studies in the research area. The publication-based rankings of other journals have shown variability.

![Figure 8. Annual publications of the top journals.](image)

These journals demonstrate distinct scopes based on the most frequently occurring keywords and their co-occurrence. Sustainability has a broad focus encompassing circular economy, food waste, sustainable consumption, and other related topics. In contrast, the Journal of Cleaner Production emphasizes food waste, sustainable consumption, life cycle assessment, circular economy, and waste management. The Science of The Total Environment journal focuses on the circular economy, life cycle assessment, food waste, and related environmental aspects. Foods covers sustainable consumption, food waste, circular economy, food security, and various food production and consumption aspects. Similarly, the British Food Journal shares similar focus areas, emphasizing sustainable consumption, food waste, circular economy, and consumer behavior, including meat consumption. The comparison highlights the subtle thematic orientations of these journals in the context of this research field.

5. Conclusions and Future Research

As mentioned in the introduction, the present study, which examines consumer food waste in the context of sustainability and circular economy, aims to provide a meaningful and structured framework by analyzing the extremely rich content of the field. The intersection of sustainability, circular economy, and food waste brings with it the advantage of the rich diversity of the field and the need to analyze and standardize this rich content that speaks different languages. Our study aims to provide a structured examination of the interaction of these fields by aiming to take advantage of this diversity.

With the current study focusing on the intersection of sustainability, circular economy, and consumer food waste, we prioritize the UN’s goal of action to mitigate climate change (SDG 13) and responsible consumption and production (SDG 12).
Beyond the traditional literature review, employing a bibliometric analysis, which allows for quantitative insights into the broad and interactive nature of the field, this study prioritizes evaluating the findings from a unique perspective.

By identifying the publication trends and the most co-occurring keyword clusters, revealing co-authorship patterns, identifying prolific authors, and revealing the field’s leading sources and their focal points, the current study’s findings contribute to understanding the development of the field, identifying related concepts in the field, and articulating models of collaboration on a global scale.

Publication indicators reveal a continuous growth trend in the research field, consistent with the studies by [12,41]. Their findings indicate a surge in annual publications from 2017 to 2021, particularly in circular economy and food waste and losses. Publications through August 2023 suggest this upward trend will continue, underscoring the continued importance and expansion of research in these areas.

A co-authorship analysis of countries indicates that, in the field of research, Italy is the most productive country with the most publications, as stated in the study by [41]. Ref. [12] stated that India, one of the countries that stands out in collaborative publications in the research field, has publications in the research field. The most dominant journals in the research field with the most publication numbers are *Sustainability* and the *Journal of Cleaner Production*, in line with [41,42].

Also, by analyzing trend topics and frequently used words in recent research and examining recent studies conducted by authors with the highest collaboration in the research field, this study attempts to identify the research trends. One key trend centers around the imperative to ensure food security and enhance the sustainability of seafood production systems. Researchers are actively addressing the challenges arising from the escalating global demand for seafood, analyzing supply chains, and exploring ways to support sustainability merits. Another focal point is the comprehensive approach to addressing contamination issues in fish and aquaculture products, emphasizing the fishing sector’s short- and medium-term sustainability and the critical goal of ensuring food safety. Additionally, there is a growing emphasis on understanding consumer attitudes and behaviors related to the environmental impact of seafood packaging, with a concerted effort to explore consumers’ willingness to actively contribute to reducing this impact.

Furthermore, the field explores the nuanced interplay between objective and subjective knowledge and its impact on organic purchase intentions. It reflects a heightened interest in understanding consumer choices in sustainable and organic food preferences. Collectively, these research trends underscore a multifaceted approach aimed at fostering sustainability, environmental responsibility, and informed consumer decision-making in seafood and related industries.

However, the reliance on the WoS database represents a significant limitation of this study. Future studies are thought to improve their scope by including publications in databases, such as Scopus.

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