

A Bibliometric Analysis of Sustainability Research in the Food Industry

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Abstract

Environmental sustainability has become increasingly critical as rising food demand intensifies pressure on land, water, and energy resources. This study conducted a bibliometric analysis of 3,295 Web of Science articles on sustainability in the food industry using VOSviewer software. Results showed that the journals Sustainability, Journal of Cleaner Production, and Foods published the highest volume of relevant research. Six major keyword clusters were identified: food consumption patterns, sustainable practices, food security, resource management, environmental impacts, and technological innovations. Thomas Kastner was noted as a central figure in co-authorship networks. The findings highlighted the ongoing need for multidisciplinary approaches that integrate agriculture, ecology, and climate science to advance sustainable food production and consumption systems.

Keywords: Food consumption; Food security; Sustainability; Environmental effects

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1.0 Introduction

Sustainability in the food industry is now a central priority. A rising global population and increasing food demand strain natural resources (Prasanna et al., 2025). Environmental pressures add to the challenge. Food production, distribution, and consumption are deeply interconnected with ecosystems and rely on land, water, and energy. They also contribute to greenhouse gas emissions, biodiversity loss, and resource depletion (Movilla-Pateiro et al., 2021; Wijerathna-Yapa & Pathirana, 2022). These challenges highlight the need for sustainable methods that boost resilience, reduce ecosystem impacts, and maintain long-term integrity (Çakmakçı et al., 2023; Halpern et al., 2022). Recent global disruptions exposed vulnerabilities in food supply chains, reinforcing the need to transition to more sustainable, climate-smart, resource-efficient systems aligned with the Sustainable Development Goals (Chandan et al., 2023; Jia et al., 2024).

As sustainability concerns grow, scientific literature on environmental impacts, sustainable production methods, green technologies, and responsible consumption has rapidly expanded (Jia et al., 2024; Movilla-Pateiro et al., 2021). This research is increasingly interdisciplinary, integrating environmental sciences (Halpern et al., 2022), food science and technology (Movilla-Pateiro et al., 2021), agricultural studies (Çakmakçı et al., 2023), economics (Malorgio & Marangon, 2021), and social sciences (Hoek et al., 2021). Understanding the evolution of this knowledge domain—its main contributors, thematic structures, and research trajectories—is essential for guiding future research and informing policy.

By evaluating publishing trends, citations, collaborations, and themes, bibliometric analysis offers a systematic, quantitative way to map scientific landscapes. These analyses identify influential authors, institutions, countries, journals, and research hotspots, providing a comprehensive view of a field's intellectual structure (Lazarides et al., 2025). Several studies have addressed sustainability-related

themes (Duong et al., 2025; Şimşek et al., 2024). However, an integrated assessment focused specifically on sustainability research in the food industry is still needed.

To address this gap, this study aimed to provide a comprehensive bibliometric analysis of food sustainability, exploring the field's evolution through major research themes, influential contributors, collaboration patterns, and relationships among key journals and concepts. Specifically, the study mapped the intellectual structure of sustainability-related research, identified core topics and emerging trends, and highlighted areas requiring future work. By offering an integrated overview of how this research area has developed, the study supported deeper scientific understanding and encouraged stronger multidisciplinary collaboration across environmental, agricultural, economic, and social domains.

2.0 Methodology

This study used a bibliometric approach to examine research on sustainability in the food industry. All data were collected from the Web of Science (WoS) Core Collection. This database contains high-quality scientific publications. The search used a predefined set of keywords related to sustainable food consumption, motivations, barriers, technology, corporate responsibility, and the connection between food consumption and production. The exact search string used in Web of Science was:

$TS = (((\text{"sustainab food consumption"} \text{ AND } \text{"motivations"}) \text{ OR } (\text{"sustainab* food consumption"} \text{ AND } \text{"barriers*"})) \text{ OR } (\text{"sustainab* food consumption"} \text{ AND } \text{"technology"}) \text{ OR } (\text{"corporate responsibility"} \text{ AND } \text{"sustainab* food systems"}) \text{ OR } (\text{"food consumption"} \text{ AND } \text{"production"})) \text{ NOT } (\text{"reaction mass spectrometry"} \text{ OR } \text{"public health"} \text{ OR } \text{"rainfall"} \text{ OR } \text{"obesity"})$

This search was designed to include studies focused on sustainability-related aspects of food consumption and food systems. It excluded unrelated topics. Only publications written in English were included. The search produced 3,295 publications. Their bibliographic information—such as authors, institutions, journals, keywords, references, and citation counts—was downloaded for analysis. Duplicate and non-relevant records were removed.

The data were analyzed using VOSviewer, a software program commonly used to visualize scientific networks. Several analyses were performed, including collaboration networks, keyword patterns, journal relationships, and changes in research focus over time. Data was cleaned before analysis to correct differences in author names, institutional names, and keyword usage.

3.0 Findings

The longitudinal analysis of publication and citation activity from 1980 to 2025 shows a clear, accelerating growth trend in the field (Figure 1). Publication output remained relatively modest and fluctuated throughout the 1980s and 1990s. Annual counts were generally below 40. A gradual upward trajectory began in the early 2000s. A pronounced surge appeared after 2010. The number of publications increased sharply from 2015 to 2022. It reached a peak of approximately 270 in 2022, before slightly declining from 2023 to 2025. Citation patterns closely mirrored this expansion. Citations remained low until the early 2000s but increased steadily thereafter. A marked acceleration occurred after 2015. Citation counts rose from fewer than 2,000 in 2010 to over 10,000 by 2022. They peaked at around 12,000 citations in 2023. Although there was a slight decrease in the most recent year, citation activity remained substantially higher than in earlier decades. The figure highlights a rapidly growing research landscape. There has been a surge in scholarly output and a rise in global visibility, particularly over the last decade. The concurrent increase in publications and citations suggests expanding scientific interest. It also shows strengthening academic impact within the field.

The distribution of research areas reveals that publication activity is highly concentrated within a few dominant fields. *Environmental Sciences* accounts for the largest share (658 publications; 19.89%), followed by *Food Science and Technology* (496; 14.99%) and *Green and Sustainable Science and Technology* (350; 10.57%). Additional substantial contributions appear in *Environmental Studies* (293; 8.86%) and *Nutrition and Dietetics* (247; 7.46%). Social science-related fields, including *Economics* (224; 6.77%) and *Agricultural Economics & Policy* (213; 6.44%), also show notable representation. This highlights the interdisciplinary nature of the research landscape. More specialized domains, such as *Marine and Freshwater Biology* (193; 5.84%), *Ecology* (159; 4.80%), and *Environmental Engineering* (155; 4.68%), contribute smaller yet meaningful portions to the overall output. The treemap indicates a strong emphasis on environmental, food-related, and sustainability-oriented research. This is complemented by interdisciplinary engagement across both natural and social science domains.

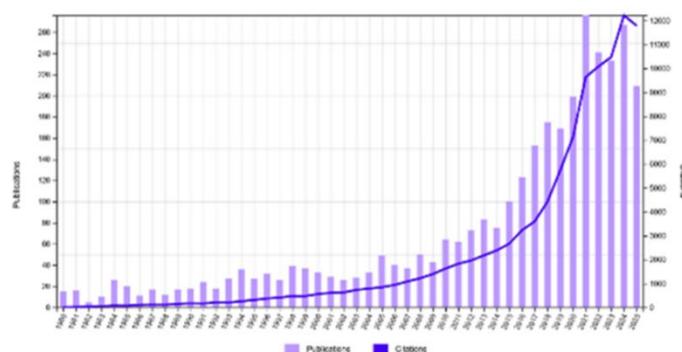


Figure 1. Number of publications related to sustainability in the food industry (1980-2025)

3.1 Authorship analysis

The authorship network reveals a well-structured and increasingly interconnected research community focused on sustainability in the food industry (Figure 2). Several prominent authors form the core of the network. This indicates their central role in shaping and advancing the field. Among them, Thomas Kastner stands out as the most influential and highly connected author. His position at the center of the largest co-authorship cluster shows that he serves as a key intellectual bridge. He links multiple research groups, particularly those working on land-use dynamics, food systems modeling, and the environmental impacts of consumption. Another central hub is formed around Peter Smith. His collaborative links connect various smaller clusters, reinforcing his role in integrating environmental science, climate research, and agricultural sustainability. These central authors contribute significantly to publication output and facilitate knowledge exchange by collaborating with diverse teams across institutions and countries.

Beyond these primary hubs, the network includes additional dense clusters revolving around authors such as Ma, Zhang, and Gu, who collectively represent a growing body of work from Asia focused on food production, environmental impacts, and sustainability assessment. Although these clusters are highly collaborative internally, their linkages to the broader network indicate expanding engagement with global sustainability research.

In contrast, several smaller and more isolated groups—such as those involving Blasco and Gephart—show fewer external connections. These authors contribute to specialized subfields but remain relatively less integrated into the global research network. The presence of such peripheral clusters suggests that while the field is expanding, specific research themes remain more narrowly focused or geographically concentrated.

When temporal information was added, earlier collaborations (2016–2019) were concentrated around the Kastner and Smith cores, indicating long-standing partnerships in these groups. More recent collaborations (2020–2022) were visible in peripheral clusters, particularly those surrounding *Belton*, *Gava*, and *Albanito*, reflecting an expansion of the network through newer research partnerships. The temporal gradients also showed increasing cross-cluster connections over time, suggesting a gradual integration among previously distinct collaboration groups.

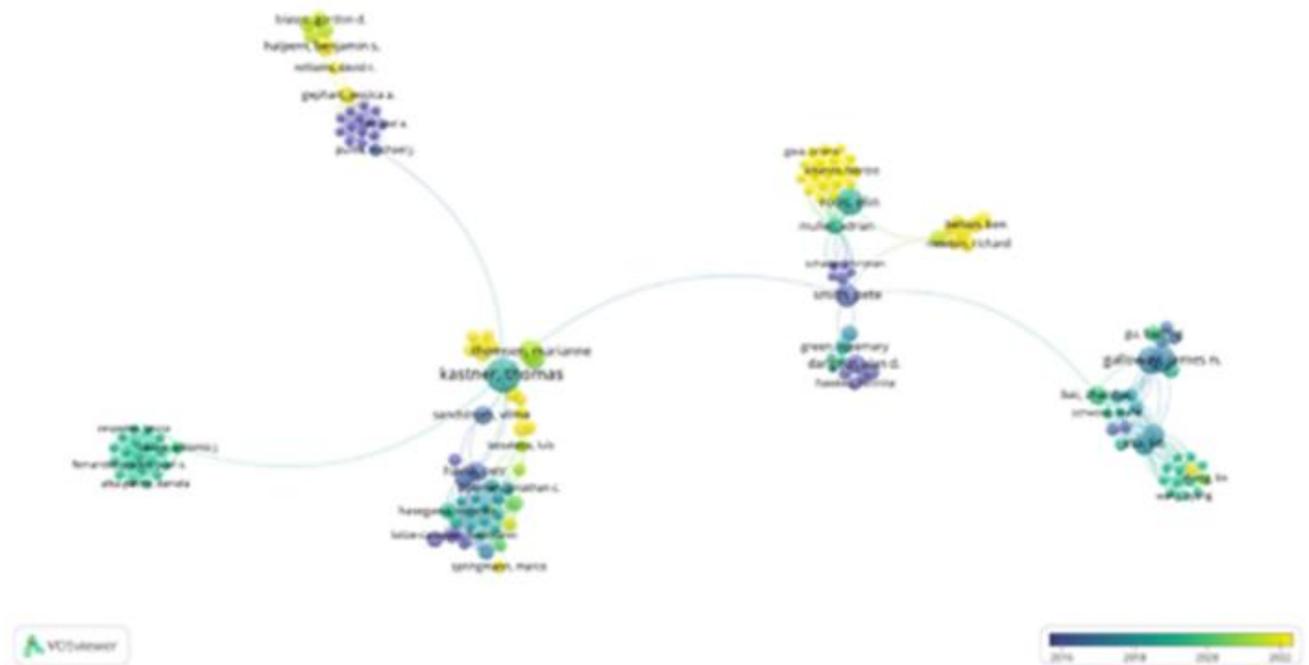


Figure 2. Overlay visualization map of authorship

3.2 Organization analysis

The institutional co-authorship network revealed several major collaboration hubs, with the Chinese Academy of Sciences and Wageningen University & Research forming the largest and most interconnected centers in the field (Figure 3). These hubs were linked to a wide range of universities across Europe, Asia, and the Americas, including strong connections with institutions such as the University of São Paulo, INRAE, the University of Milan, and the University of Bologna. Smaller but distinct peripheral groups—such as those involving MPI/RES, Bayer AG, and various Italian institutions—showed limited integration with the central network.

The temporal visualization indicated that earlier collaborations (2010–2015) were concentrated around the Chinese Academy of Sciences and Wageningen University, demonstrating long-standing institutional partnerships. More recent collaborations (2020–2025) occurred in clusters around European universities, including Aix-Marseille University, the University of Galway, and the University of Paris-Saclay, highlighting the expansion of international linkages in recent years. Newer connections also strengthened cross-regional pathways, suggesting gradual diversification and broadening of global research collaboration patterns.

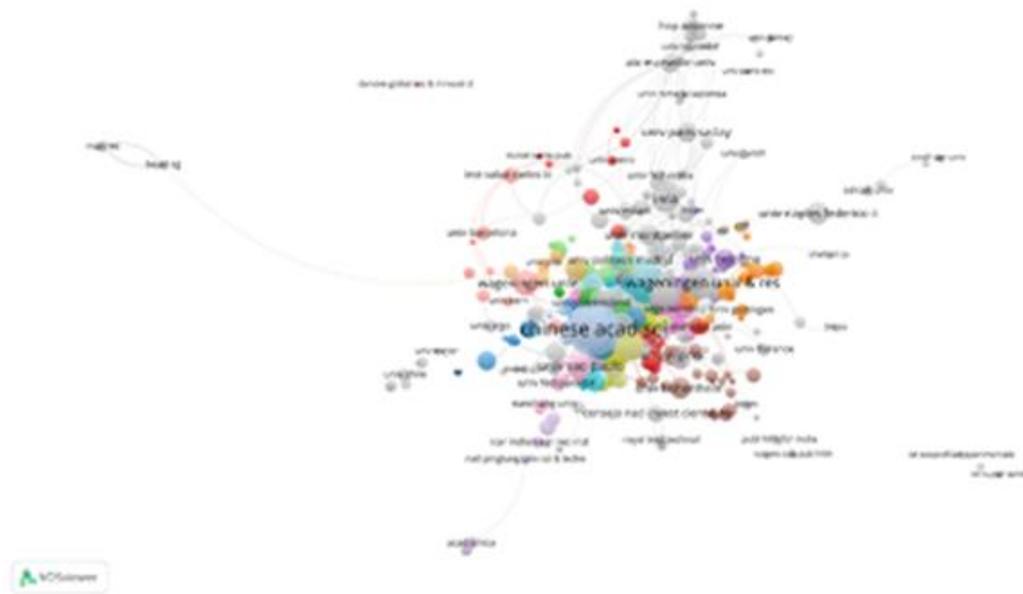


Figure 3. Network visualization map of organizations

3.3 Country

The country co-authorship network revealed a highly interconnected global research landscape dominated by a few major hubs (Figure 4). The USA, China, England, India, the Netherlands, and Australia formed the central core of collaboration, with the USA and China emerging as the largest nodes, indicating their leading roles in international research output and connectivity. European countries—including Sweden, Switzerland, Belgium, and Romania—clustered tightly, showing strong intra-regional cooperation. In the meantime, Poland, Slovakia, and the Czech Republic emerged as a separate Eastern European cluster with strong internal ties.

The temporal overlay demonstrated that earlier collaborations (2012–2016) were primarily centered around the USA, China, and established European partners. In contrast, more recent collaborations (2018–2022) expanded across emerging regions, with increased participation from countries such as Pakistan, Turkey, Kenya, and Indonesia. The widening network structure indicates not only the persistence of strong traditional research hubs but also a gradual diversification through new cross-regional partnerships, particularly between Asian, African, and European countries.

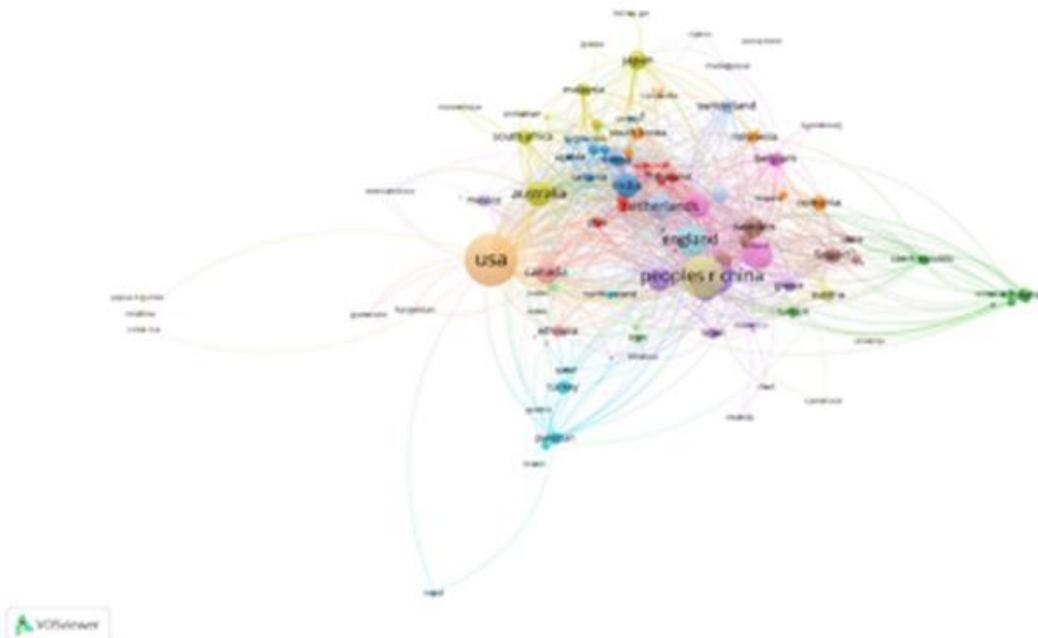


Figure 4. Network visualization map of countries

3.4 Keyword analysis

The keyword co-occurrence analysis provides a comprehensive view of the thematic structure of sustainability research in the food industry (Figure 5). The network reveals five major clusters, each representing distinct yet interconnected research streams. These clusters demonstrate the field's diverse nature, spanning environmental science, production systems, consumer behavior, public health, and socio-economic dimensions.

The blue and green clusters focus on consumer-oriented themes, including food consumption, attitudes, behavior, determinants, green products, and supply chains. The strong presence of these terms indicates a growing emphasis on understanding the behavioral and psychological drivers of sustainable consumption. Concepts linked to environmental impacts and perceptions also appear frequently, highlighting the increasing interest in how consumers respond to environmental information, eco-labels, and sustainability messaging. The prominence of these terms suggests that the research community is paying greater attention to demand-side interventions and the role of consumers in driving sustainability transitions.

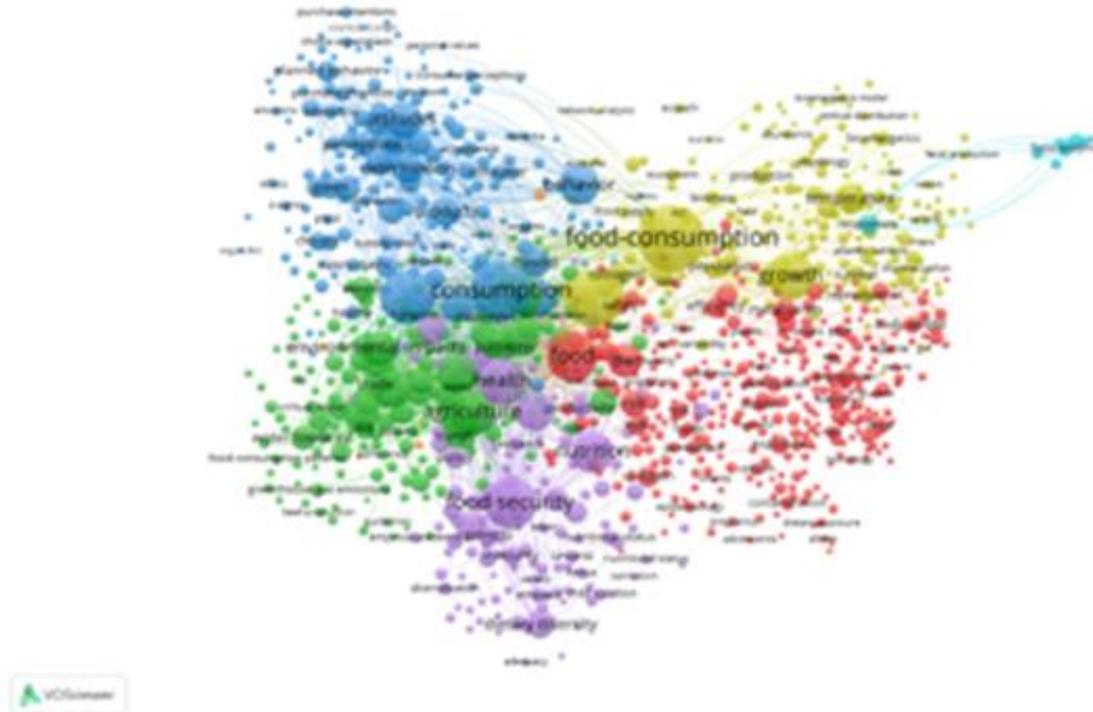


Figure 5. Network visualization map of keywords

A distinct purple cluster centers on food security, nutrition, poverty, and dietary diversity. These keywords point to global concerns regarding equitable access to food, nutritional outcomes, and the social dimensions of sustainability. This cluster reflects research that integrates sustainability with public health, food access, and socio-economic vulnerability. The presence of climate change and agriculture within this cluster indicates an awareness of the interconnections between climate impacts and food security challenges. The red and yellow clusters capture biological, ecological, and production-related terms, including growth, metabolism, temperature, stress responses, production, and environmental effects. These keywords reflect earlier research traditions focused on physiological responses, agricultural production systems, and ecological processes. Although still relevant, these themes appear less dominant in recent years, indicating a shift from laboratory- and organism-level studies toward broader systemic approaches.

The temporal overlay map demonstrated a clear shift in research focus over time. Earlier work (2010–2014) predominantly addressed biological and physiological themes, particularly those related to growth, metabolism, and stress responses. More recent studies (2016–2020) increasingly concentrated on sustainability-oriented topics, including consumer perceptions, green behaviors, environmental impacts, and food security. This transition indicates a progressive movement from laboratory- and organism-level research toward broader socio-environmental and consumption-related issues, aligning with global sustainability agendas.

3.5 Journal analysis

Figure 6 illustrates the journal co-citation structure and its temporal evolution in research on sustainable food systems. The co-citation network shows three dominant and interconnected clusters. The first and largest cluster centers on sustainability and food policy, with journals such as *Sustainability*, *Food Policy*, and *Frontiers in Sustainable Food Systems* at its core. This cluster reflects the growing emphasis in the literature on sustainability transitions, resource management, and governance. A second cluster links sustainability-oriented work with biological and animal science through journals such as *Animals*, *Scientific Reports*, and *Animal Production Science*, indicating a bridging zone between environmental and production-focused research. The third cluster comprises aquaculture and

of Sciences and Wageningen University & Research, which function as global hubs due to their extensive research capacity and international partnerships (Mi et al., 2021). The emergence of newer institutional actors, particularly in Europe and Asia, suggests a broadening global commitment to sustainability research in food systems (Sirdey et al., 2023).

At the country level, the strong presence of the USA, China, England, India, the Netherlands, and Australia reflects their longstanding investment in agricultural innovation, environmental sciences, and sustainability research (Duong et al., 2025). The increasing participation of countries such as Pakistan, Turkey, Kenya, and Indonesia in recent years indicates an important geographical shift: sustainability challenges in food systems are increasingly being addressed by emerging economies, many of which face direct impacts from climate change (Jia et al., 2024) and resource pressures (Movilla-Pateiro et al., 2021). These evolving patterns highlight the growing democratization and globalization of sustainability research (Mensah et al., 2024), suggesting a more inclusive scientific landscape in the future.

Keyword co-occurrence analysis demonstrates a clear thematic transition within the field. Earlier research was dominated by ecological and physiological topics such as growth, metabolism, and stress responses, reflecting laboratory- and biology-focused studies. Over time, the research emphasis shifted toward broader socio-environmental themes, including consumer behavior, environmental impacts, supply chain sustainability, food security, and poverty. This shift indicates a transition from micro-level analyses to holistic, systems-based investigations that integrate environmental, economic, and social dimensions (Hoek et al., 2021). The presence of high-density terms such as “food consumption,” “sustainability,” and “food security” reinforces the centrality of these topics and their role in shaping contemporary discourse (Ammann et al., 2023).

The journal co-citation analysis further supports the growing integration of disciplines. While ecological and aquaculture journals formed the foundation of the field's early structure, sustainability-oriented journals such as *Sustainability*, *Food Policy*, and *Frontiers in Sustainable Food Systems* have become increasingly influential in recent years. The convergence of environmental, food science, and policy-focused journals reflects a shift toward more interdisciplinary scholarship and the need to address sustainability from multiple perspectives (Jia et al., 2024). This evolution suggests that the field's intellectual structure is moving toward greater coherence and cross-sector collaboration.

Collectively, these findings highlight a maturing research landscape characterized by rapid growth, interdisciplinary integration, and expanding global participation. Research on sustainability within the food sector has evolved in response to both public concern and scientific inquiry into the multifaceted environmental impacts of our food systems. The observed trends suggest that future research will increasingly focus on system-level solutions, cross-sector collaboration, and the integration of production and consumption perspectives. Strengthening methodological diversity, enhancing collaboration across regions, and incorporating insights from emerging economies will be critical to advancing the field and supporting the development of more sustainable and resilient food systems (Ben Hassen et al., 2025).

5.0 Conclusion & Recommendations

This study employed bibliometric analysis to map the landscape of food industry sustainability research, charting its swift growth, collaborative character, and shifting intellectual priorities. The results showed a significant increase in both publication and citation activity over the past two decades, reflecting growing global attention toward sustainable food production and consumption. Key thematic clusters—centered on sustainability, food security, environmental impacts, and consumer behavior—demonstrated the field's shift from biological and ecological research toward broader socio-environmental and systems-oriented perspectives. Collaboration networks revealed influential authors, leading institutions, and increasing global participation, indicating the maturation and diversification of the research landscape. Together, this bibliometric analysis mapped the field's rapid, interdisciplinary evolution and provided a foundational framework to guide forthcoming efforts to build resilient, climate-smart, and efficient food systems.

Several methodological limitations should be noted. The exclusive use of the Web of Science database and English-language sources presented a potential for geographical and linguistic bias. Furthermore, the selected keywords may not capture all pertinent literature due to variations in lexical usage. To address these constraints and advance the field, future research must adopt multi-database, multi-lingual strategies supplemented by advanced computational methods. This will be crucial for thoroughly investigating emerging frontiers such as digital transformation, circular food systems, and next-generation climate adaptations, efforts that will require robust cross-disciplinary and global collaboration.

Paper Contribution to Related Field of Study

This study provides a comprehensive bibliometric overview of sustainability research in the food industry, identifying key themes, influential contributors, and collaboration patterns. The findings reveal a clear shift from biologically focused research toward broader socio-environmental and systems-based perspectives. The study offers a useful reference for guiding future interdisciplinary research and policy development in sustainable food systems.

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