

e-ISSN 2821-9074

Print-ISSN 2730-2601

RICE Journal of Creative Entrepreneurship and Management, Vol. 6, No.2, pp. 1-24,
May-August 2025

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doi: 10.14456/rjcm.2025.7

Received 7.11.24/ Revised 23.06.25/ Accepted 30.06.25

Mapping Research Agenda of Sustainable Restaurants: A Bibliometric Approach (2014-2024)

Sarakorn Pattanananchai¹

Wenqiang Peng^{2*}

Songyu Jiang³

Nutteera Phakdeephrot⁴

^{1,3,4}Rattanakosin International College of Creative Entrepreneurship
Rajamangala University of Technology Rattanakosin, Thailand

²Faculty of Humanities, University of the Thai Chamber of Commerce

* Corresponding author

¹ Email: sarakorn.pat@rmutr.ac.th

² Email: 2548302090@qq.com

³ Email: jiang.song@rmutr.ac.th

⁴ Email: nutteera.pha@rmutr.ac.th

Abstract

This study maps the research landscape of sustainable restaurants from 2014 to 2024 through a bibliometric approach, analyzing publication trends, collaborative networks, and critical themes. Using 78 publications from the Web of Science, this study applies CiteSpace to visualize author, institutional, and country-level contributions. The analyzed results show a post-2020 surge in publications, reflecting increased academic and industry interest. Countries, such as Australia, China, and England emerge as significant contributors, along with institutions like Kyung Hee University in South Korea, highlighting global collaboration. Key themes include environmental impact, waste management, consumer behavior, and the role of technologies like Artificial Intelligence (AI) and blockchain in resource optimization. This study emphasizes accessible sustainability solutions, more robust policy frameworks, and the potential for interdisciplinary and cross-regional collaborations. The obtained findings offer valuable insights for academia and industry, supporting the integration of sustainability practices in response to evolving environmental and consumer needs.

Keywords: *Sustainable restaurants, environmental impact, waste management, resource optimization*

1. Introduction

Sustainability is about meeting today's needs without limiting future generations' ability to meet theirs and emphasizes responsible resource use across three pillars: environmental, economic, and social (Ranjbari et al., 2021). Environmentally, sustainability involves conserving resources and minimizing pollution; economically, it promotes growth that does not deplete resources; and socially, it fosters equity and well-being within communities (Zhou et al., 2024). By balancing these pillars, sustainability aims to create a resilient world where resources are preserved, economies are stable, and societies are inclusive, ensuring a healthy environment for future

generations. The development of sustainable restaurants is driven by the goal of reducing environmental impact while promoting social responsibility and long-term economic viability (Bui & Filimonau, 2021). Central to this pursuit is the adoption of resource-efficient practices, such as minimizing energy and water consumption, reducing food waste through recycling and composting, and sourcing locally produced organic ingredients to lower carbon footprints and support sustainable agriculture (Luttenberger, 2020).

Additionally, sustainable restaurants aim to foster social responsibility by offering fair wages to employees, supporting local communities, and engaging in ethical business practices (Mejia et al., 2022). Moreover, these establishments focus on promoting consumer health by providing nutritious, eco-friendly meal options, often emphasizing plant-based and organic foods. The overarching objective is to balance environmental stewardship with financial success, ensuring that the restaurant remains economically viable while aligning with the growing consumer demand for sustainability in the hospitality industry (Perrigot et al., 2021).

In recent years, green restaurants have become increasingly fashionable as various industries strive to achieve sustainability goals (Liu et al., 2020). Sustainable restaurants operate in ways that minimize their negative environmental impact while contributing to social and economic sustainability (Joshua et al., 2023). These establishments reduce waste, conserve energy, and source ingredients responsibly, often emphasizing local, organic, and seasonal foods to reduce the carbon footprint associated with transportation and industrial farming. In addition to careful menu planning, composting, and recycling, many sustainable restaurants invest in energy-efficient appliances and water-saving technologies to reduce resource consumption, further enhancing their environmental contributions (Agusdinata et al., 2024).

Beyond environmental considerations, sustainable restaurants also focus on ethical business practices. This includes ensuring fair labor conditions, supporting local farmers and suppliers, and engaging with the community to promote social well-being. The goal of a sustainable restaurant is to create a balance between profitability and responsibility, ensuring that its operations benefit both the environment and society while meeting the demands of environmentally-conscious consumers. This holistic approach, which extends beyond environmental concerns, contributes to social sustainability by promoting healthy eating, enhancing community well-being, and fostering greater awareness about food ethics and sustainability among consumers (Zeng & Botella-Carrubi, 2023).

Sustainable restaurants have become a focal point in both academic discourse and industry practice due to their pivotal role in promoting environmental stewardship, resource efficiency, and ethical consumption (Huang et al., 2023). They mitigate the environmental impact of the food service industry by adopting a wide range of eco-friendly practices, such as sourcing locally-grown, organic, and seasonal ingredients, reducing food waste through innovative waste management systems, and implementing energy-efficient technologies. Additionally, sustainable restaurants often prioritize fair trade and support local economies by partnering with nearby farmers and suppliers, creating a more resilient and localized food supply chain (Wentworth et al., 2023).

Sustainable restaurants address both environmental and social sustainability concerns, positioning sustainable restaurants as crucial contributors to the broader global effort to combat climate change and promote sustainability (Heydari, 2024).

The rise of sustainable restaurants is closely tied to global environmental challenges, particularly the urgency to address climate change, reduce greenhouse gas emissions, and conserve natural resources (Lucchi et al., 2024). In response to increasing consumer demand for environmentally responsible dining options, many restaurants have shifted toward sustainability, recognizing it as a necessary step toward long-term viability (Radnitz et al., 2023). This shift has sparked a growing body of academic research that investigates various dimensions of sustainability in the restaurant industry, including business models, consumer behavior, regulatory frameworks, and the economic viability of sustainable practices.

Academically, sustainable restaurants are explored through interdisciplinary lenses, encompassing environmental science, economics, sociology, and business management. Researchers have examined the financial implications of adopting sustainable practices, the challenges and opportunities in integrating sustainability into restaurant operations, and the role of consumer perceptions in influencing restaurant sustainability efforts (Suttikun & Mahasuweerachai, 2023). Moreover, the literature has expanded to assess the social and ethical implications of sustainability, particularly how restaurants can contribute to broader societal goals, such as reducing inequality and promoting public health (Ahmad et al., 2024). Comprehensive research on sustainable restaurants is crucial for guiding policy decisions, informing industry best practices, and fostering a culture of sustainability that meets current environmental, economic, and social needs without compromising the ability of future generations to do the same.

A bibliometric analysis of restaurant sustainability is beneficial for identifying key trends, influential research, and significant contributors in the field. It allows researchers to map the evolution of sustainability practices in the restaurant industry over time and highlight the most frequently cited studies, journals, and authors. Furthermore, this type of analysis can uncover gaps in the existing literature, guiding future research toward unexplored areas, such as the integration of new technologies, consumer behavior, and policy implications in sustainable dining. It also helps in understanding the collaborative networks between institutions and countries, shedding light on the global and interdisciplinary nature of sustainability research. Ultimately, a bibliometric analysis provides valuable insights into the progression of knowledge, informing both academic discourse and practical applications in restaurant sustainability.

Therefore, this study aims to construct a knowledge map of collaboration among authors, institutions, and countries in the field of sustainable restaurant research and illustrate co-occurrence networks, clustering, and burst analysis of keywords related to sustainable restaurants. These analyses serve to explore the primary research hotspots and forecast future research trends in sustainable restaurant development. By mapping the collaborative landscape and examining key themes, this research seeks to deepen the understanding of the evolving focus areas within sustainable restaurant studies, offering valuable insights for advancing sustainability practices in sustainable restaurants and identifying opportunities for future scholarly investigation.

Next, we conducted a literature review. The third part focuses on research methods and explains the process of data collection and analysis. The fourth part is the construction and explanation of the knowledge graph. Finally, the study was discussed and summarized.

2. Literature Review

Sustainable restaurants have gained considerable attention due to the sector's significant environmental impact (Di Pierro et al., 2023). Sustainability in restaurants encompasses efforts to minimize environmental degradation through practices, such as reducing waste, conserving energy and water, and adopting eco-friendly materials (Yong et al., 2024). While some businesses see sustainability as a tool for improving operational efficiency and branding, others perceive it as a moral obligation to reduce their ecological footprint (Opoku et al., 2023).

Green practices in restaurants are characterized by strategies that reduce the environmental burden of daily operations (Kanwal et al., 2024). These can range from optimizing resource usage—such as reducing water and energy consumption—to better waste management techniques, including food waste reduction and composting (Zhu et al., 2023). Restaurants also incorporate sustainable practices in their supply chains, such as sourcing locally grown organic produce and using biodegradable packaging materials (Jia et al., 2024).

Various factors influence the adoption of sustainable practices in the restaurant industry. These include growing consumer demand for eco-friendly options, regulatory pressures, and the pursuit of a green image that can enhance brand loyalty (Chung, 2020). Additionally, sustainable practices are often driven by internal organizational commitments, with restaurant owners and managers taking the lead in embedding sustainability into their core values (Tabrizi et al., 2023).

Despite the increasing adoption of green practices, many restaurants still face significant challenges in fully integrating sustainability into their operations. The high levels of consumption intrinsic to the hospitality sector, including overreliance on disposable materials and excessive resource use, pose hurdles to achieving genuine sustainability (Ribera Jemio et al., 2024). Moreover, sustainability efforts are often constrained by financial limitations, as many restaurants operate on thin profit margins, which can hinder investment in sustainable technologies and processes (Mejia et al., 2022). Implementing sustainable practices can lead to both operational and reputational benefits for restaurants. Studies have shown that restaurants with a solid green image tend to enjoy higher customer loyalty, which in turn enhances overall firm performance (Tosun et al., 2022). Additionally, energy-saving technologies and better waste management systems can result in significant cost savings over time (Chauhan et al., 2022).

The sustainability discourse in the restaurant industry also touches on social sustainability, particularly labor practices. Issues such as low wages, high staff turnover, and precarious employment conditions are prevalent in the industry and need to be addressed as part of a holistic approach to sustainability (Jain et al., 2024). Sustainable human resource management (HRM) practices, including fair wages and employment security, are essential for fostering a stable workforce that is committed to

sustainability goals (Rahi, 2023). Sustainable restaurant practices are becoming increasingly important as both environmental and social concerns grow in prominence. While many challenges remain, including financial constraints and ingrained unsustainable behaviors, the benefits of adopting green practices—both in terms of operational efficiency and customer loyalty—are clear (Hermundsdottir & Aspelund, 2022). The restaurant industry must continue to evolve by integrating sustainability into all facets of its operations, from supply chain management to HR practices.

In conclusion, a bibliometric analysis of sustainable restaurants is valuable for identifying research hotspots, trends, and gaps in this field. By systematically analyzing existing literature, researchers can uncover critical factors influencing the adoption of sustainability practices in restaurants, such as consumer demand, regulatory pressures, and the pursuit of brand loyalty. Additionally, bibliometric analysis helps assess the implementation of green practices across different countries or regions, highlighting global variations in sustainability challenges and solutions. By incorporating dimensions, such as supply chain management, energy efficiency, and human resource management, bibliometric analysis provides scholars and practitioners with a comprehensive knowledge base, fostering interdisciplinary collaboration and innovation and further advancing sustainability in the restaurant industry.

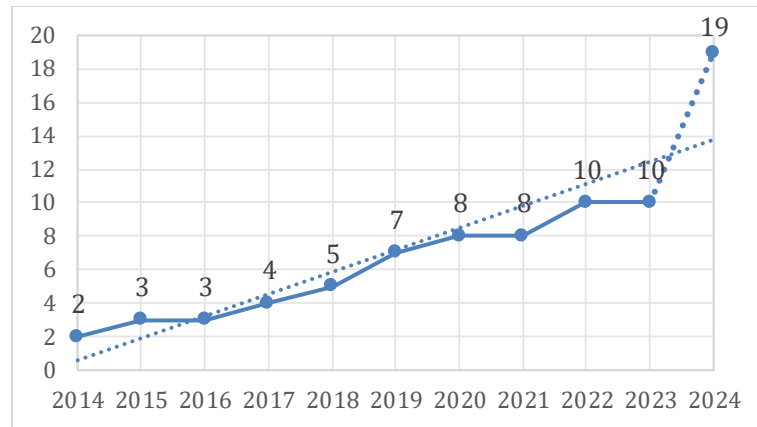
3. Research Method

This study utilizes CiteSpace to conduct bibliometric analysis to investigate the development of sustainable restaurant research over the past decade (2014-2024). Bibliometric analysis is a quantitative approach that evaluates scientific publications, citations, and co-authorship patterns to identify key trends and influential contributions in a given field (Luo et al., 2022). Data were collected from the Web of Science, using search terms, such as "sustainable restaurants," "environmental management," and "green dining." TH= "Sustainable practices in the restaurant industry." The search was limited to peer-reviewed journal articles, conference papers, and review articles, excluding non-peer-reviewed sources. The final dataset included 78 relevant publications, providing a comprehensive foundation for analyzing the intellectual landscape of sustainable restaurant research.

4. Results

4.1 Publication Trend

The publication trend over the years shows significant growth, as shown in Figure 1, especially after 2020, when the number of contributing authors increased notably. In 2023, 10 authors published research on sustainable restaurants, and this number is projected to rise to 19 in 2024, suggests a rapidly expanding interest in the topic, likely driven by increasing global awareness of environmental sustainability and the restaurant industry's role in mitigating climate change. The sharp rise in publications in 2023 and 2024 reflects not only academic engagement but also the growing societal and industry pressures to adopt sustainable practices.

Figure 1: Publication Trend for Sustainable Restaurants

4.2. Authors' Cooperation Knowledge Maps

Table 1 provides an overview of the authors and their respective publication output in sustainable restaurant research between 2019 and 2024. Batat Wided stands out as the most prolific contributor, with three articles published in 2020 indicating significant engagement in this field during that period. Several other authors, including Wijesinghe Gayathri and Higgins-desbiolles Freya, both with two publications in 2019, and Choe Ja Young (Jacey), Hwang Jinsoo, and Filimonau Viachaslau, who each published two articles in 2020, highlight 2020 as a peak year for research activity, suggests that the topic of sustainability in the restaurant industry attracted considerable academic attention during this year, likely reflecting increased global interest in environmental sustainability.

In addition to these 2020 contributions, Wellton Lotte is noted for two publications in 2021, while Cho Meehee contributed two articles in 2023, demonstrating continued research momentum in this area. The table also features newer entries, such as Hughes Allison Felix with one article in 2022 and Cheng Ranis with an upcoming publication in 2024, indicating that the research on sustainable restaurants is ongoing and continues to evolve. Overall, the table highlights the concentration of academic activity in the early 2020s, with critical authors contributing consistently over this period, and signals that research in this field is still actively progressing.

Table 1: Recent Publications by Key Authors

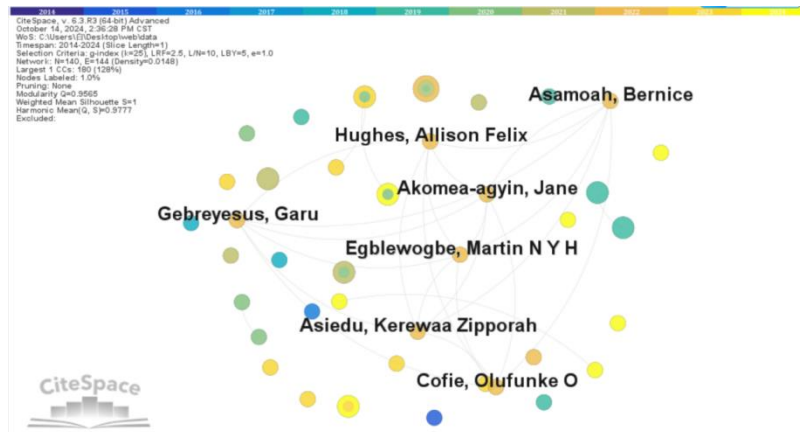
Article	Year	Author
3	2020	Batat, Wided
2	2019	Wijesinghe, Gayathri
2	2019	Higgins-desbiolles, Freya
2	2020	Choe, Ja Young (Jacey)
2	2021	Wellton, Lotte
2	2020	Hwang, Jinsoo
2	2020	Filimonau, Viachaslau
2	2023	Cho, Meehee
1	2024	Cheng, Ranis
1	2022	Hughes, Allison Felix

In analyzing the contributions of authors in the field of sustainable restaurants, the data reveals a clear distinction between core contributors and occasional participants. Batat, Wided stands out with three publications, positioning her as a central figure in the research landscape of sustainable restaurants. Other authors, such as Cho, Meehee, Filimonau, and Viachaslau, have contributed two publications, each indicating their consistent engagement with the topic. The majority of authors, however, have only one publication, suggesting either a one-time contribution or involvement in cross-disciplinary collaborations. On average, each author has contributed approximately 1.1 publications, highlighting a relatively dispersed pattern of research contributions without highly concentrated authorship.

In terms of collaboration intensity, most authors appear to work independently or in small teams, with relatively few instances of recurring collaborations between the same sets of authors. The absence of a dense collaboration network implies that the field is still emerging, with researchers likely coming from diverse disciplinary backgrounds, contributing to the broadening of perspectives in sustainable restaurant studies. However, the relatively low average number of publications per author (1.1) suggests that deeper collaborations and more prolific partnerships may develop as the field matures. The data also highlights critical publication years, such as 2020, where multiple authors published in the field, marking a peak in research activity. This surge may be attributed to a heightened global focus on sustainability in response to the U.N.'s Sustainable Development Goals (SDGs) and the food industry's critical role in addressing these challenges. The steady increase in publications leading up to 2024 demonstrates the growing recognition of sustainable restaurant research as an essential part of environmental studies, hospitality management, and consumer behavior research.

In conclusion, the author's collaboration knowledge map for sustainable restaurant research shows a field that is growing in both breadth and depth (see Figure 2). While still relatively dispersed in terms of collaborative intensity, the increasing number of contributors and publications indicates that this area is becoming more established within the academic community. Moving forward, fostering stronger cross-disciplinary and cross-regional collaborations could further enrich the research, driving innovation and practical solutions for sustainability in the restaurant industry.

Figure 2: Co-Authorship Network of Key Researchers' Studies (2014-2024)



4.3 Network Visualization of Sustainable Restaurant Agency Collaboration

Table 2 provides an overview of institutional contributions to a research network, as indicated by frequency, centrality, and year of contribution. Frequency reflects the number of times each institution has appeared in the dataset, with Griffith University and Kyung Hee University standing out for their higher frequencies (3 each), suggesting more substantial involvement in the research field. Institutions such as Bournemouth University, University of Lyon 2, and E.M. Normandie Business School also exhibit a frequency of 3, indicating consistent participation, though potentially with less influence given their lower centrality scores. Centrality measures an institution's prominence or influence within the research network, reflecting how well-connected it is to other institutions. Notably, Kyung Hee University (0.02) and Griffith University (0.01) exhibit higher centrality values, indicating that these institutions occupy more influential roles within the collaborative research network. In contrast, the remaining institutions have centrality scores of 0, suggesting their contributions, while present, are not as integrated into the broader research collaboration framework.

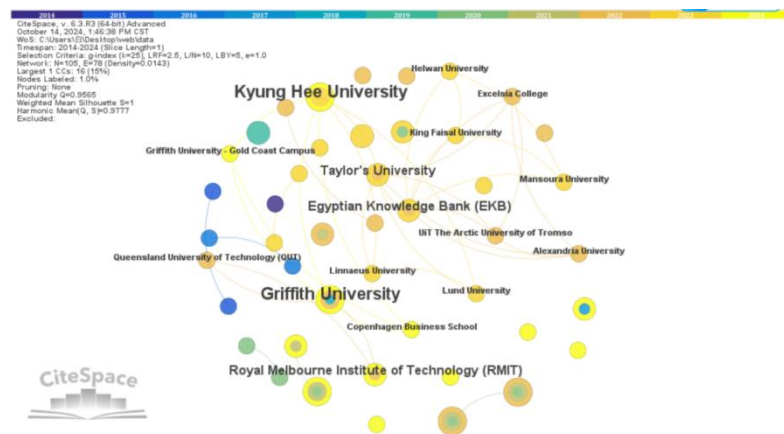
The year of contribution reveals that research activities from these institutions span from 2017 to 2023. While Griffith University is noted for its contributions in 2018, Kyung Hee University shows recent activity in 2023, highlighting its ongoing relevance in the research network. Other institutions, such as Bournemouth University and Sejong University, made significant contributions in 2020, which appears to be a peak year for research collaboration among several institutions. Overall, Table 2 highlights the central role of institutions, such as Griffith University and Kyung Hee University in sustainable research efforts while also illustrating the diverse international participation in this field, encompassing both highly influential universities and smaller institutions with more limited centrality in the network.

Table 2: Institutional Contributions to Recent Research

Frequency	Centrality	Year	Institution
3	0.01	2018	Griffith University
3	0	2020	Bournemouth University
3	0	2020	Univ Lyon 2
3	0	2020	E.M. Normandie Business Sch
3	0.02	2023	Kyung Hee University
2	0	2017	National Pingtung University Science & Technology
2	0	2021	Transylvania University of Brasov
2	0	2023	Ministry of Education & Science of Ukraine
2	0	2022	Royal Melbourne Institute of Technology (RMIT)
2	0	2020	Sejong University

Figure 3 network visualization provides a detailed representation of the institutional collaborations in sustainable tourism and hospitality research from 2014 to 2024. The size of each node reflects the prominence of an institution's research output, with larger nodes, such as Kyung Hee University, Griffith University, and the Royal Melbourne Institute of Technology (RMIT) indicating their significant contributions to this field. These institutions have played central roles in producing research and fostering international collaborations. The thickness of the connecting lines between nodes represents the strength of co-authorship relationships, with thicker lines denoting more frequent collaborations compared to thinner lines, which indicate less frequent collaborations. For instance, Griffith University and Queensland University of Technology (QUT) are well-connected, reflecting their active research partnerships. Similarly, Kyung Hee University exhibits strong connections with Taylor's University, Helwan University, and King Faisal University, indicating a broad and influential international research network.

The colors of the nodes, ranging from blue to yellow, indicate the periods during which institutions were most active in this research area. Blue and green nodes represent institutions that were active earlier in the timeline, such as Queensland University of Technology and Griffith University – Gold Coast Campus, which were critical contributors during 2014-2017. In contrast, yellow and orange nodes, including Kyung Hee University and RMIT, highlight institutions that have become more prominent in recent years (2021-2024). The network reveals significant international collaboration, with institutions like the Egyptian Knowledge Bank (EKB) and Taylor's University engaging in co-authorship relationships across diverse regions. Overall, this network demonstrates the global nature of sustainable tourism research, with long-standing institutions maintaining their influence while newer ones gain prominence, all contributing to the evolving research landscape in this critical field.

Figure 3: Sustainable Restaurant Institutional Cooperation Map

4.4 Analyzing Country-Level Contributions and Co-Authorship Trends

Table 3 provides insights into the research contributions of various countries, measured by quantity, centrality, and year. Australia and China lead with ten contributions each, reflecting their significant involvement in research output, followed closely by England (7) and South Korea (6). In terms of centrality, which indicates a country's influence within the research network, England (0.22), China (0.18), and Australia (0.15) show the highest levels, suggesting their pivotal roles in international research collaborations. South Korea (0.12) and Italy (0.09) also hold notable positions in the network, while countries like France, Sweden, Spain, and Thailand have a centrality of 0, indicating less integration into the global research collaboration framework despite their contributions.

The year column highlights peak research activities, with Australia and Brazil showing notable contributions in 2018, while China, England, South Korea, and France saw significant activity in 2020, marking it as a critical year for research collaboration. More recent contributions from Italy were recorded in 2023, reflecting its continued engagement in the research network. Overall, the data points to Australia, China, and England as central players in the research landscape, with South Korea and Italy contributing meaningfully. The diverse geographic spread of countries underscores the global nature of research in this field, with varying degrees of collaboration and influence across regions.

Table 3: Country Contributions to Research by Year and Centrality

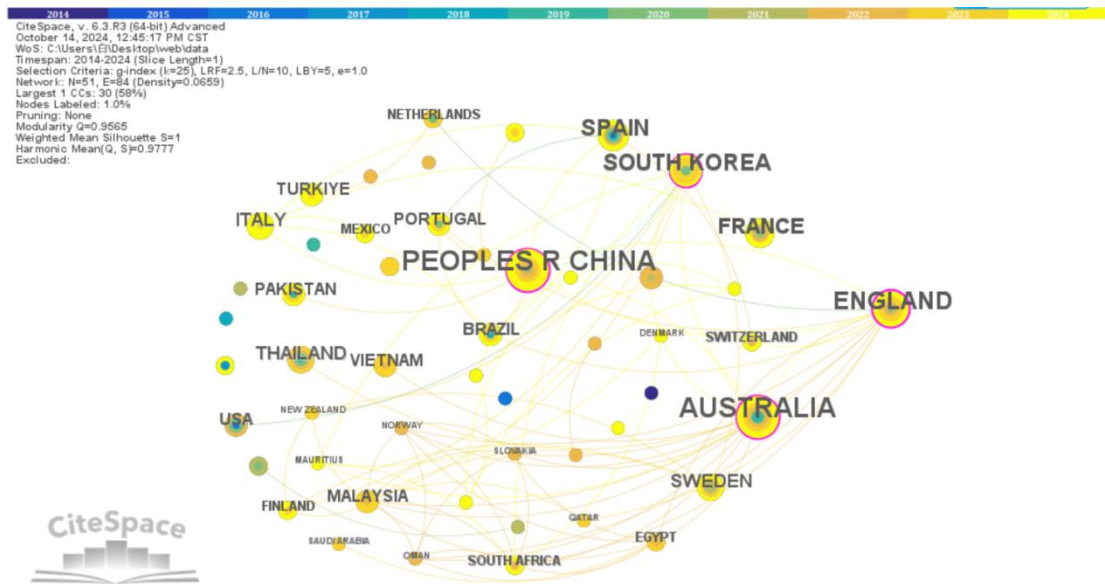
Quantity	Centrality	Year	Country
10	0.15	2018	Australia
10	0.18	2020	People's R China
7	0.22	2020	England

6	0.12	2020	South Korea
6	0.01	2015	Spain
5	0	2020	France
4	0.09	2023	Italy
4	0	2021	Sweden
4	0	2019	Thailand
3	0.03	2018	Brazil

Figure 4 provides a detailed visualization of the collaborative relationships between nations in sustainable tourism and hospitality research from 2014 to 2024. The size of each node represents the frequency of a country's research contributions, with larger nodes, such as China, Australia, England, and South Korea, indicating their prominent roles in driving research in this field. The thickness of the lines between nodes represents the strength of co-authorship, with thicker lines signifying more frequent collaborations. Strong connections, particularly between China, Australia, and England, suggest that these nations are central hubs in the global research network, fostering extensive international partnerships. Additionally, countries like Spain, France, and Thailand also demonstrate active involvement in international collaborations, reflecting the global nature of sustainable tourism research.

The color coding of the nodes indicates the temporal evolution of each country's research activity. Blue and green nodes, such as the USA and Pakistan, represent countries that were more active earlier in the timespan, while yellow and orange nodes, such as China, Australia, and England, reflect countries that have been more involved in recent years (2021-2024). The pink rings around certain nodes, including China, Australia, and England, highlight countries that have experienced significant bursts of research activity, indicating a surge in publications and collaborations in recent years. This surge points to increased research output and engagement from these countries. This growing involvement suggests an increasing focus on sustainability within these nations, making them critical contributors to the global research agenda. Overall, this network underscores the global collaboration patterns in sustainable tourism research, with significant research hubs leading the field and fostering widespread academic cooperation across multiple continents.

Figure 4: Global Collaboration Network in Sustainable Restaurant Research (2014-2024)



4.5 Keyword Co-occurrence Network

Table 4 presents an analysis of keywords in sustainable tourism and hospitality research based on frequency, centrality, and year, offering insights into the prominence, connectivity, and evolution of key themes. In terms of frequency, management (18 occurrences) is the most frequently cited keyword, highlighting its centrality in discussions on sustainable practices and strategies within the industry. Food waste (13 occurrences) also appears prominently, reflecting the sector's focus on reducing waste and improving resource efficiency, followed by behavior and industry (both with 11 occurrences), indicating a strong interest in consumer actions and the broader industrial context of sustainability. Keywords like tourism (10), restaurants (9), and green practices (7) suggest growing attention to specific applications of sustainability principles in these areas. Centrality measures the influence of keywords in connecting different research topics, with behavior (0.46) exhibiting the highest centrality, suggesting it plays a pivotal role in linking diverse areas of research, such as consumer behavior and environmental impact. Keywords like management (0.13), food waste (0.11), and impact (0.11) also show moderate centrality, indicating their importance in integrating multiple research strands.

In contrast, performance (0.02) and perceptions (0.03) are more isolated topics with lower centrality. The temporal analysis shows that food waste and performance gained prominence in 2014, reflecting early concerns with operational efficiency, while keywords like behavior (2018) and green practices (2019) emerged later, signaling a shift toward understanding consumer actions and sustainability adoption. More recently, restaurants (2022) have become a key area of focus, reflecting contemporary concerns about sustainability in the food service sector. Overall, the analysis demonstrates the evolving nature of research in this field, with early studies emphasizing operational efficiency, while recent years have seen a growing interest in

consumer behavior and specific sectoral applications of sustainability.

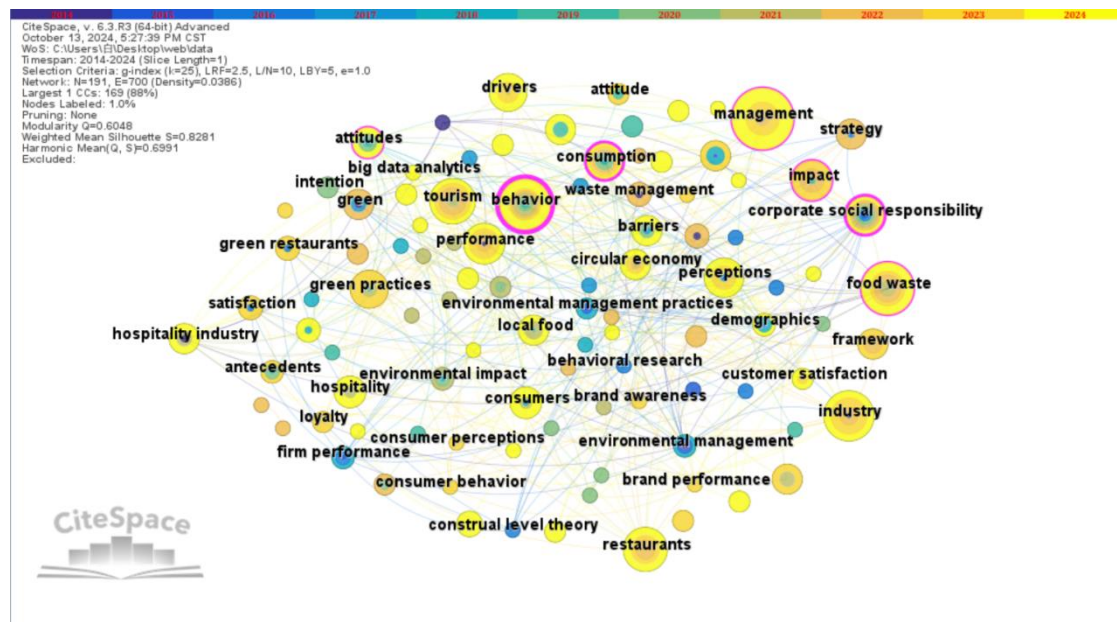
Table 4: Essential Research Keywords by Frequency and Centrality

Frequency	Centrality	Year	Keyword
18	0.13	2016	management
13	0.11	2014	food waste
11	0.05	2015	industry
11	0.46	2018	behavior
10	0.06	2017	tourism
9	0.09	2022	restaurants
8	0.03	2015	perceptions
8	0.11	2016	impact
8	0.02	2014	performance
7	0.07	2019	green practices

The keyword co-occurrence network illustrates the evolving research landscape in sustainable tourism and hospitality from 2014 to 2024 (see Figure 5). The size of the nodes in the network represents the frequency of each keyword's appearance in the literature, with larger nodes, such as tourism, behavior, corporate social responsibility (CSR), food waste, and the hospitality industry, indicating central themes in the field. These high-frequency keywords reveal the dominant areas of academic focus, particularly in understanding consumer behavior, corporate ethics, and sustainability practices. The connections (edges) between nodes reflect co-occurrence relationships, where thicker lines represent stronger associations between concepts. For example, behavior shows strong connections with tourism, CSR, and environmental management, suggesting its role as a crucial linking concept across various research areas. This interconnectedness highlights the multidisciplinary nature of sustainability research, where themes like consumer behavior, corporate responsibility, and environmental impacts are explored in relation to each other.

The color of the nodes represents the period when each keyword gained prominence, providing insight into the shifting focus of research over time. Earlier themes (2014-2018), represented by blue and green nodes, such as the hospitality industry and consumer behavior, indicate foundational areas of study. More recent topics (2021-2024), depicted by yellow and orange nodes, include emerging themes like big data analytics, waste management, and local food, pointing to the increasing importance of technology and sustainability in research. Furthermore, the pink rings around specific nodes denote burst keywords, which have seen a surge in academic attention during specific periods. Keywords, such as behavior, corporate social responsibility, and food waste indicate that these areas are growing in significance, reflecting current priorities in sustainability, corporate ethics, and waste reduction. Overall, the network reveals the central and emerging themes in sustainable tourism and hospitality, highlighting a field that is expanding from traditional topics into more data-driven and technologically innovative areas.

Figure 5: Keyword Co-occurrence Network in Sustainable Restaurant Research (2014-2024)



4.6 Critical Research Clusters and Keywords

Figure 6 illustrates the critical research clusters in sustainable tourism and hospitality from 2014 to 2024, depicting the co-occurrence relationships between various keywords in academic publications. The clusters are color-coded and numbered, highlighting distinct research themes.

The network analysis of sustainable tourism and hospitality research from 2014 to 2024 reveals several key clusters that underscore the interdisciplinary focus of the field. Cluster 0: Environmental Impact stands out as the most central, highlighting the critical importance of addressing the environmental consequences of tourism activities. This cluster emphasizes research on reducing the sector's ecological footprint, including efforts to mitigate biodiversity loss and carbon emissions. Similarly, Cluster 3 and Cluster 5 focus on operational practices within the hospitality sector, such as reducing waste, optimizing resource use, and enhancing organizational sustainability, thereby highlighting critical areas of improvement for sustainable practices in the industry. These clusters underscore the growing recognition of the need for improved resource management and corporate responsibility to ensure long-term environmental sustainability in tourism.

On the behavioral side, Cluster 2: Attitudes and Cluster 4: Cognitive Triggers explore how consumer attitudes and decision-making processes impact the adoption of sustainable tourism practices. These clusters investigate the psychological drivers, including values and beliefs, that influence tourists' sustainability choices. Expanding on this, Cluster 6: Cognitive Driver delves deeper into the motivations behind sustainable behaviors, exploring how preferences and identity shape consumer actions. Meanwhile, Cluster 8: Sustainable Tourism Measures focuses on the implementation of specific policies and practices that promote sustainability, reflecting newer research trends. Together, these clusters demonstrate a comprehensive approach to sustainability in tourism, where both operational strategies and consumer behavior play pivotal roles

in advancing sustainable practices in the industry.

Figure 6: Key Research Clusters in Sustainable Restaurant (2014-2024)

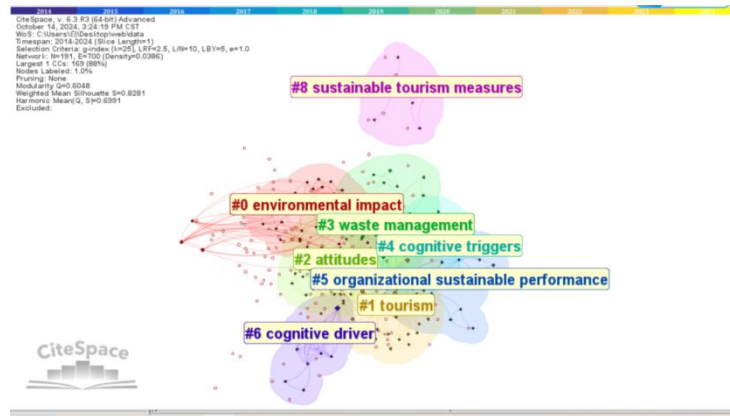


Table 5 provides an in-depth analysis of critical research clusters in sustainable tourism, hospitality, and restaurant management from 2016 to 2022, highlighting the evolving trends and focal points in academic studies. Early research, such as the 2016 cluster on sustainable holidays and ethical standards, laid the groundwork for integrating ethical principles into tourism practices. By 2020, the focus had shifted significantly toward environmental impact, food consumption, and sustainable food practices, particularly in full-service restaurants, reflects a growing awareness of environmental concerns, with keywords like green dining and holistic sustainability emphasizing comprehensive approaches to sustainability in the hospitality sector. Similarly, the 2019 cluster on waste management and circular practices highlights the industry's movement toward the circular economy, prioritizing resource management and waste reduction to meet global sustainability targets.

Corporate governance and organizational performance have also emerged as significant themes in sustainable tourism and hospitality research. In 2017, keywords such as corporate governance mechanisms, content analysis, and supply chain management suggest a focus on firm performance and the implementation of sustainable business practices. This trend underscores the importance of integrating sustainability into strategic decision-making and operational models to achieve long-term success. The 2021 cluster builds on this by exploring the role of big data analytics and online customer reviews in promoting sustainability. In particular, businesses are increasingly leveraging environmentally-framed reviews to understand consumer expectations and refine their sustainability efforts, especially in the context of sustainable restaurants and food service businesses.

Consumer behavior and psychology are also central to the development of sustainability in tourism and hospitality. The 2020 cluster on consumer attitudes, premium pricing, and satisfaction suggests that consumers' willingness to pay for sustainable options is influencing business strategies. Additionally, the 2019 cluster on behavioral intention and cognitive drivers highlights how experimental interventions are used to explore the factors that shape consumer decision-making in sustainable

environments, such as indoor innovative farm restaurants. These clusters reflect the growing focus on understanding consumer psychology and how it can drive sustainable behaviors. More recent research, such as the 2022 cluster on territorial differences and regional clusters, emphasizes the need for region-specific sustainability strategies in tourism, mainly through concepts like circular destination assessment. This regional focus signals the increasing recognition that sustainability requires context-specific solutions tailored to local environmental and cultural conditions.

Table 5: Research Clusters and Keywords in Sustainability and Hospitality (2016-2022)

Cluster	Centrality	Year	Keywords
1	0.856	2020	environmental impact; food consumption; cooking scale; sustainable food practice; full-service restaurant
2	0.873	2017	tourism companies; econometric analysis methods; corporate governance mechanisms; content analysis; situational factors
3	0.678	2021	sustainable practices; online customer reviews; environmentally-framed reviews; hospitality industry; big data analytics
4	0.761	2019	waste management; hospitality industry; resource management; circular practices; tourism research
5	0.89	2021	brand attitude; brand performance; consumer behavior; green restaurants; brand awareness environmentally-framed reviews; hospitality industry; sustainable practices
6	0.748	2020	consumer attitude; premium price; consumer satisfaction; sustainable practices; consumer willingness
12	0.991	2019	behavioral intention; demographic factor; cognitive driver; indoor smart farm restaurant; experimental intervention
6	0.948	2022	territorial differences; circular destination assessment; regional clusters; sustainable tourism measures; sustainable decision-making
4	1	2016	sustainable holiday; ethical standard; travel agent; eco-friendly certifications; green consumerism

Table 6 presents the burst keywords in sustainable tourism and hospitality research, with a specific focus on sustainable restaurants from 2014 to 2024. Each keyword reflects a period during which it gained significant academic attention, marked by its strength, beginning, and end year. The keywords highlight various themes and trends that have shaped the research landscape, illustrating how the focus of sustainability research has shifted over time.

One of the prominent themes in this table is environmental sustainability. The keyword environmental sustainability shows the most substantial burst value of 2.08 from 2020 to 2021, reflecting a heightened academic interest in this area, particularly in relation to how businesses in the tourism and restaurant industries address environmental challenges. Similarly, environmental management (1.54) was a key focus earlier, from 2014 to 2018, emphasizing how organizations were being

scrutinized for their role in managing environmental impact. This trend is continued with environmental impact (1.13), which gained momentum between 2018 and 2021, showing a sustained concern with the consequences of tourism activities on ecosystems. These bursts collectively highlight the growing emphasis on mitigating the environmental impacts of tourism and hospitality operations over the years.

Another critical theme relates to organizational performance and sustainability practices. Keywords like firm performance (1.6) and environmental management practices (1.06) between 2015 and 2018 indicate a period where academic research linked sustainable practices with business outcomes. These keywords suggest a focus on how sustainability initiatives can improve operational efficiency and competitiveness. As sustainability became more embedded within organizational practices, the keyword framework (1.29) began to gain attention from 2021 to 2024, reflecting efforts to develop structured approaches for implementing sustainability in the tourism and hospitality industries. Additionally, keywords, such as impact (1.51) and industry (1.19) signal that recent research has begun assessing the broad-scale effects of sustainable initiatives across the entire sector.

Table 6 also reflects a significant interest in behavioral and cognitive factors that influence sustainability. Keywords like attitudes (1.01) and antecedents (0.96), which saw bursts from 2018 to 2020, suggest that research during this period focused on understanding the psychological and social drivers behind sustainable behavior among consumers and businesses. The keyword demographics (1.12), relevant between 2017 and 2018, further supports this trend, indicating that researchers were interested in examining how demographic factors affect attitudes toward sustainability. These findings show a significant shift toward exploring the human dimension of sustainability, particularly how individuals and organizations respond to environmental and social issues.

In recent years, there has been a rising concern with sustainable food practices and waste management. Keywords, such as food (1.11), which gained prominence from 2018 to 2019, and food waste (0.8), which became relevant from 2021 to 2022, reflect growing efforts to reduce food waste and promote sustainability in food sourcing and restaurant operations. Additionally, the appearance of anaerobic digestion (1.03) in 2020-2021 indicates a move toward investigating advanced waste management technologies for processing organic waste in the restaurant industry. These bursts demonstrate the increasing importance of resource efficiency and waste reduction in the sustainability agenda.

Finally, the recent bursts in conservation, critical success factors, and performance from 2022 to 2024 suggest that the field is now focusing on identifying the key drivers of successful sustainability initiatives. These keywords indicate that researchers are interested in determining which factors contribute to the long-term effectiveness of sustainable practices and how performance in sustainability can be measured and improved, reflects a strategic shift in the research focus toward creating actionable solutions that can help organizations achieve their sustainability goals more effectively.

In conclusion, the burst keywords identified in Table 6 highlight the dynamic evolution of sustainable tourism and hospitality research, with initial attention on

environmental management and organizational performance giving way to more recent concerns with waste management, food practices, and the development of sustainability frameworks. These keywords offer valuable insights into the past and future directions of the field, emphasizing the growing importance of understanding both the environmental impacts and human dimensions of sustainability.

Table 6: Breaking Keywords in Sustainable Restaurants (2014-2024)

Keywords	Year	Strength	Begin	End	2014 - 2024
Environmental management	2014	1.54	2014	2018	
Firm performance	2015	1.6	2015	2018	
Environmental management practices	2015	1.06	2015	2018	
Demographics	2017	1.12	2017	2018	
Environmental impact	2018	1.13	2018	2021	
Food	2018	1.11	2018	2019	
Attitudes	2018	1.01	2018	2020	
Antecedents	2019	0.96	2019	2020	
Environmental sustainability	2020	2.08	2020	2021	
Anaerobic digestion	2020	1.03	2020	2021	
Content analysis	2020	0.72	2020	2022	
Corporate social responsibility	2015	0.31	2020	2021	
Framework	2021	1.29	2021	2024	
Tourism	2017	0.89	2021	2022	
Food waste	2014	0.8	2021	2022	
Impact	2016	1.51	2022	2024	
Industry	2015	1.19	2022	2024	
Performance	2014	0.79	2022	2024	
Conservation	2022	0.72	2022	2024	
Critical success factors	2022	0.72	2022	2024	

5. Discussion and Conclusion

This study utilizes bibliometric analysis to explore the development of sustainable restaurant research from 2014 to 2024, employing the tool CiteSpace to map the intellectual landscape of the field. Data were collected from databases like Web of Science and Google Scholar, focusing on peer-reviewed journal articles, conference papers, and review articles. The final dataset comprised 78 relevant publications, which were analyzed using techniques, such as author collaboration networks, keyword co-occurrence networks, and cluster analysis. This approach identified key contributors, research institutions, and prominent themes within the field. Significant authors like Batat Wided and Filimonau Viachaslau, as well as institutions, such as Kyung Hee University and Griffith University, were highlighted for their contributions. The analysis revealed dominant research themes, including environmental impact, waste management, and green practices.

The study identified several key trends in sustainable restaurant research. First, research output has seen a marked increase, especially after 2020, with a sharp rise in

publications in 2023, reflecting heightened academic and societal interest in sustainability practices. Core research themes, such as environmental impact, waste management, and consumer behavior, underscore the industry's focus on reducing its ecological footprint and understanding consumer attitudes toward sustainability. Additionally, emerging technologies, such as artificial intelligence and blockchain, are increasingly recognized for their potential to enhance operational efficiency and transparency in sustainable restaurant practices. The study emphasizes the interdisciplinary nature of the research, integrating perspectives from environmental science, economics, and sociology, which are essential for addressing the complex challenges of sustainability in the hospitality industry.

The bibliometric analysis also highlights vital collaborations among authors, institutions, and countries in sustainable restaurant research. Batat Wided and Filimonau Viachaslau emerge as central contributors with significant publication records, demonstrating their influence in the field. Other prominent contributors include Cho Meehee and Raab Carola, although most author collaborations remain relatively dispersed, indicating that the field is still in the early stages of forming a cohesive research network. At the institutional level, Kyung Hee University and Griffith University stand out for their substantial research output and central roles in global research networks. Countries, such as China, Australia, and England are vital players in advancing global research on sustainable restaurant practices, demonstrating a global collaboration network that spans multiple institutions and regions.

In terms of research trends, the analysis of keywords shows a distinct evolution in focus areas. Early studies from 2014 to 2018 centered on keywords like "environmental management" and "food waste", emphasizing resource efficiency and environmental impact reduction. However, after 2018, the focus shifted to keywords, such as "behavior" and "green practices", reflecting a growing interest in consumer behavior and corporate practices that drive sustainability. More recent trends highlight the importance of "digital innovation," with terms like artificial intelligence and blockchain indicating a shift toward optimizing resource use and enhancing operational transparency through technology. Future research should focus on three key areas: the application of digital technologies to optimize resources, the role of consumer behavior in fostering sustainable practices, and the development of effective policy and management frameworks to support sustainability efforts in the restaurant industry.

Countries like Australia, China, and the United Kingdom. Compared to previous studies, this research introduces new findings and contributions to the field of sustainable restaurants. Earlier works, such as those by Munir (2022), primarily focused on systematic reviews of green restaurants and sustainable food consumption, examining topics like environmental management and food waste through keyword analysis. However, as consumer behavior, digital innovation, and green practices have emerged, the focus of research has shifted.

Our study is the first to use CiteSpace to construct a knowledge map of the sustainable restaurant field, illustrating global collaborations among authors, institutions, and countries and revealing the critical influence. Finally, keyword co-occurrence analysis shows the thematic evolution from 2014 to 2024. We identified

emerging research directions, including the application of artificial intelligence and blockchain to optimize resource use and enhance supply chain transparency. Unlike Kristia & Rabbi (2023), our study highlights not only environmental impact and waste management but also the role of technology-driven innovation in advancing restaurant sustainability, offering guidance for future research.

In summary, this study extends beyond traditional analyses of sustainable practices by examining interdisciplinary and cross-regional collaboration networks. It provides novel insights that facilitate integration between industry and academia in sustainable dining, fostering advancement in this critical area.

The practical significance of sustainable restaurant practices lies in their ability to reduce the environmental impact of the food service industry while enhancing operational efficiency and responding to consumer demand for eco-friendly dining options. By implementing practices such as waste reduction, energy conservation, and sourcing locally-produced, organic ingredients, sustainable restaurants contribute to reducing carbon footprints and promoting environmental stewardship. Additionally, these practices can enhance a restaurant's brand image, attracting environmentally conscious consumers and fostering customer loyalty. Furthermore, the adoption of green technologies, such as energy-efficient appliances and digital innovations like blockchain for supply chain transparency, not only improves sustainability but can also lead to long-term cost savings, contributing to the financial viability of restaurant operations.

However, the implementation of sustainable practices faces several limitations. Financial constraints, particularly for small and medium-sized restaurants, often hinder investments in eco-friendly technologies and materials, given the high initial costs and tight profit margins (Bhatta et al., 2024). Moreover, the absence of standardized regulations and guidelines across the industry leads to inconsistent adoption of sustainability measures (Guo & Yuan, 2020). Consumer behavior also poses a challenge, as the gap between sustainability preferences and willingness to pay premium prices for eco-friendly services remains significant (Lim et al., 2023). Future research should therefore focus on developing cost-effective sustainability solutions accessible to all types of restaurants, strengthening policy frameworks and industry standards, and exploring consumer behavior to better align awareness with purchasing decisions. Additionally, investigating the integration of emerging technologies, such as artificial intelligence and blockchain to optimize sustainable operations and enhance supply chain transparency is a promising direction for advancing sustainability in the restaurant industry.

6. The Authors

Sarakorn Pattanananchai, Songyu Jiang, and Nuttera Phakdeephrot are academic staff members at Rattanakosin International College of Creative Entrepreneurship, Rajamangala University of Technology Rattanakosin, Nakhon Pathom, Thailand.

Wenqiang Peng, as Corresponding Author, is working at the Faculty of Humanities, University of the Thai Chamber of Commerce, Bangkok, Thailand.

These four authors share research interest in the areas of creative entrepreneurship and management, tourism marketing, and current issues in gastronomic tourism and the hospitality industry.

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