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Trends in urban edible landscapes: a comprehensive bibliometric analysis

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TOPICAL REVIEW

Trends in urban edible landscapes: a comprehensive bibliometric analysis

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Abstract

In response to the dual challenges of urbanization and population growth, urban edible landscapes have emerged as innovative green infrastructure with the potential to address ecological, social, economic, and food security issues. This study systematically analyzes 3,089 publications from 2000 to 2024, sourced from the Web of Science database, using keywords such as 'Edible Landscapes,' 'Edible Garden,' 'Rooftop Garden,' 'Community Garden,' and 'Productive Landscape.' This study adopts bibliometric and visualization tools, such as CiteSpace and R, to systematically sort out and visualize the research hotspots, knowledge structure, emerging trends, and the evolution of this field. The analysis begins with a co-occurrence network of keywords, identifying core topics and evolving research trends. Cluster analysis further delves into various research themes, elucidating the field's main directions and focal points. The paper highlights the multifaceted impacts of edible landscapes on urban ecosystems and residents' well-being, emphasizing their critical role in promoting urban sustainability. Additionally, it outlines strategic recommendations for policymakers and stakeholders to enhance the implementation and expansion of urban edible landscapes in alignment with sustainable development goals. This research provides comprehensive insights into the historical evolution, status, and future trends of urban edible landscape studies, offering valuable guidance for policy development and practical innovation in both academic and real-world contexts.

1. Introduction

What kind of landscapes would emerge from a complete transition of agri-food systems towards sustainability? Food policy experts, scientists, and stakeholders call for a holistic approach to address the rapidly intensifying crises across social, food, economic, and ecological domains. In the context of urbanization, landscape researchers are increasingly examining how concepts such as green infrastructure and brownfields can be broadly applied to rethink food production and consumption (Rupprecht *et al* 2023).

Turkkan, in his study, explores urban transformation strategies for Istanbul by altering the food supply chain (Turkkan 2018). Concurrently, a broad scientific consensus is urging a transformation of global food systems (Dengerink *et al* 2022). While industrial food production can achieve long-term systemic supply efficiency, it may undermine regional self-sufficiency (Kummu *et al* 2020). Additionally, industrial agriculture contributes to climate change, habitat destruction, and food security issues. Disruptions in industrial food supply chains could lead to catastrophic consequences (Spijkers 2010). The global food crisis triggered by the outbreak of the COVID-19 pandemic at the end of 2019 left many residents confined to their homes, unable to access sufficient food. This crisis was not merely due to a lack of food supply but rather disruptions to supply chains, agricultural activities, and trade (Mekonen *et al* 2024). The scarcity of agricultural land, the high cost of food, and the disruption of the food supply chain due to COVID-19 highlight the need to develop more reliable and ecologically resilient agricultural modules (William *et al* 2022), particularly for urban areas.

In the development of urban food systems, both research and practice emphasize two key domains: 'food production' and 'food systems.' There is an urgent need to apply socio-ecological resilience thinking to urban food systems (Hodbod and Eakin 2015). The knowledge, institutions, infrastructure, and practices related to food and agriculture are complex, often linking consumption and production in ways that impede systemic change (McGreevy *et al* 2022). Alternative methods of food production form a system that, while diverse in its underlying philosophy, aligns with the post-metabolic principles mentioned by McGreevy and colleagues (McGreevy *et al* 2022). There is a growing awareness that multiple factors are threatening food security, including food production and the networks that make up food systems (Raneng *et al* 2023).

In urban areas, food security faces additional risks. These risks are related to long and complex transportation and distribution networks, energy vulnerabilities, and the growing dominance of multinational food corporations, which impact food diversity, quality, and cost (Li *et al* 2023) (Carey *et al* 2021). However, ecological footprint analysis indicates that economic decentralization and localized food production contribute to reducing the per capital environmental burden of residents in urbanized areas (Tsuchiya *et al* 2021). Industrial food production can achieve long-term systemic efficiency and resilience but may compromise regional self-sufficiency (Kummu *et al* 2020), and in the event of disruption, can fail disastrously (Spijkers 2010). In response, many people living in cities want to grow local food. Among them, the concept of edible landscapes stands out in urban settings. Edible landscapes, viewed through the lens of landscape perspectives and methodologies, draw attention to the land, landform, residents, and their interactions. With rapid urbanization and excessively high population density, scholars around the world have emphasized the use of edible landscapes to provide ecosystem services for cities (Guitart *et al* 2012).

To further explore the concept of edible landscapes, this research reviews various studies related to edible landscapes (table 1). By analyzing and synthesizing the existing literature, the study aims to standardize the definition of edible landscapes and unveil their multiple values and potential applications in urban and rural planning, environmental design, and sustainable development. Examples of such concepts include allotment gardening, community gardening, urban agriculture, roof gardening, edible green infrastructure, edible city, and edible gardening (Rupprecht *et al* 2023). These concepts have gained significant attention as they aim to address a range of issues, from sustainability to ecosystem conservation, health, food systems, and urban planning.

Surprisingly, the relevant research not only lacks a unified definition of the concept of edible landscapes but also a comprehensive and in-depth discussion surrounding this emerging field. The term 'edible landscapes' has three predominant definitions. Fetouh defines it as a landscape design that provides healthy food, emphasizing the integration of ecological horticultural practices while meeting food needs (Fetouh 2018). Sanchez proposes that edible landscapes is a design approach that integrates agricultural science with the art of landscape beautification, grounded in specific design principles (Sanchez *et al* 2021). In contrast, Rupprecht highlights edible landscapes as combining participatory food production with sustainable, human-centered landscape design. Rupprecht further argues that these landscapes should not only meet human needs but also account for the needs of wild flora and fauna, advocating for collaborative design approaches in both urban and rural settings (Rupprecht *et al* 2023). The edible landscape thus serves four goals namely: aesthetics, functionality, health, and food sufficiency. In this study, we revisit the concept of edible landscapes—a core idea introduced before green infrastructure, proposed as a comprehensive solution to meet human needs for healthy food. It also explores the dynamic interactions between humans, plants, and animals, emphasizing participatory design that blends human and natural landscapes. By using bibliometric methods, this study provides both quantitative and qualitative analyses of edible landscapes. It specifically examines trends in the literature on edible landscapes, including geographic variations, explores their applications within urban environments, and positions the concept as central to rapidly evolving global food production patterns. Understanding current scholarly perspectives on edible landscapes helps grasp the development trends in sustainable urban edible landscape construction and related research practices.

2. Materials and methods

2.1. Research methods

This research was undertaken as a systematic review. As a research methodology, scientific metrics are important quantitative tools for analyzing the progress of a research topic from a macro to a micro perspective. This study employs rigorous bibliometric and quantitative methods to systematically analyze concepts and literature related to urban edible landscapes. Bibliometrics, an objective quantitative knowledge analysis method, involves the use of visualization tools to examine and represent the achievements and scientific structure of research fields, facilitating the understanding of intellectual patterns and developments (Chen and Song 2019). Firstly, it combines the quantitative analysis of publication source data with the qualitative content analysis of keywords,

Table 1. Analysis of concepts related to edible landscapes.

Concept	Literature reviews	Definition
Allotment Gardening	Poniży *et al* (2021)	Allotment gardening is a practice where land is allocated by local authorities to individuals or families, providing them with the opportunity to cultivate fruits, vegetables, or flowers (Poniży *et al* 2021). However, the product produced can only be enjoyed by the family itself.
Edible Landscapes	Fetouh 2018	Fetouh defines edible landscapes as a type of landscape design that brings healthy food to the table (Fetouh 2018). Cresey's definition of edible landscapes emphasizes their role in providing healthy food while integrating ecological gardening practices. Sanchez proposes that edible landscapes is a design approach that integrates agricultural science with the art of landscape beautification, grounded in specific design principles (Sanchez *et al* 2021). Edible landscapes represent a concept that transcends human species (e.g. animals, plants, fungi, microbes) co-designing landscapes across an urban-rural gradient centered around both spontaneous and cultivated vegetation and pursuing the main goals of more-than-human food production and aesthetic value for humans (Rupprecht *et al* 2023).
Community Gardening	Guitart *et al* (2014)	Community open spaces operated and managed by local community members engage in collective gardening activities of planting vegetables and flowers.
Roof Garden	Wadumestrige Dona *et al* (2021)	Planting vegetables and fruits in flower pots or on the roof where you can socialize and relax, building trellises and sheds, and automatic irrigation and lighting systems.
Edible City	Reiß and Artmann (2023)	No clear definition in the literature. The edible city constitutes a special type of Nature-based solution and Urban Agriculture as it implements edible plants in public spaces (Reiß and Artmann 2023). It integrates various forms of urban farming and sustainable resource management, thereby contributing to the development of livable and healthy urban environments (Säumel *et al* 2019).
Edible Green Infrastructure	Russo *et al* (2017)	Edible green infrastructure (EGI) highlights the role of urban landscapes in producing food while simultaneously providing ecosystem services such as biodiversity enhancement and climate resilience (Russo *et al* 2017). This concept can function as a standalone feature, such as rooftop gardens or community gardens, or be integrated into urban planning as a complementary element, including street greening or vertical greenery.
Edible Gardening	Istrate *et al* (2023)	In the design of edible plants in landscape environments, such as vegetables, fruit trees, and herbs, etc, the integration of plant aesthetic enhancement and productive functionality is emphasized.
Urban Agriculture	Teng (2024)	Cultivating crops and vegetables and rearing livestock in and around the city to supply food and other related products for urban residents.

titles, and abstracts. The scientometric approach helps to understand the evolving characteristics of research over time and key gaps (Saritas and Burmaoglu 2015) and also provides a systematic and comprehensive judgment of scientific research fields (Chen 2017). Bibliometrics methods cover hundreds of publications, offering a reproducible and reliable evaluation of the state of a research area and providing insights that cannot be obtained through purely quantitative or qualitative methods alone (Verrall and Pickering 2020).

2.2. Data sources

To ensure the scientific rigor and comprehensiveness of the research data, this study established a publication dataset sourced from the Web of Science Core Collection (WoSCC). The search formula used was TS = ('Edible landscape*' OR 'Edible Gardening*' OR 'Roof Garden*' OR 'Community Gardening*' OR 'Productive landscape*'), AND DOP = (2000-01-01/2024-08-05), AND DT = (article OR review article), AND LA = (English). This search was completed on August 5, 2024, covering the literature from 2000 to 2024, including both 'Articles' and 'Review articles.' Through this process, a preliminary set of 3426 articles was obtained. In the next phase, documents were filtered based on type, excluding any that were not classified as 'articles,' 'reviews,' or 'English.'

This study adopts strict search criteria, limiting the scope of the literature to English articles and review articles, without systematically including non-English literature. First, the Web of Science database contains a substantial amount of literature in various languages, and without such a restriction, the complexity of data organization and analysis would increase. Second, language differences may introduce translation and

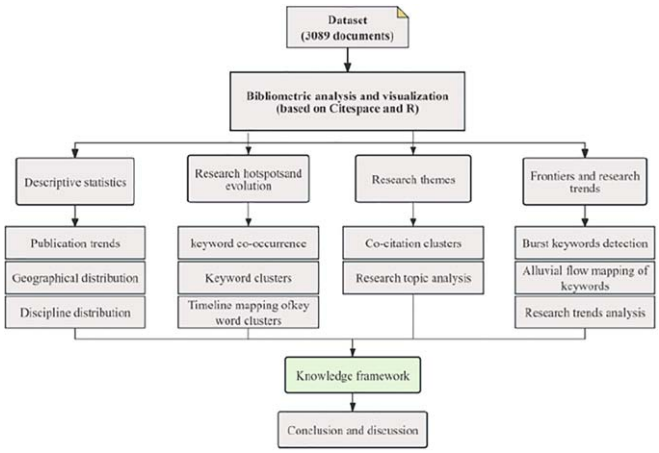

Figure 1. The framework of bibliometric analysis.

comprehension biases. Therefore, to ensure the accuracy and comparability of the research, only English-language publications were selected for inclusion. Additionally, to make the resource extraction process more targeted, electronic data types were restricted to articles and reviews from the fields of social sciences, environmental sciences, and arts and humanities published between 2000 and 2024. Finally, 3089 valid and relevant articles were selected for the study. These articles were exported in 'plain text file' format, including complete records and reference citations with information such as authors, regions, titles, keywords, journals, source files, abstracts, and references.

2.3. Bibliometric analysis process

In this study, Microsoft Excel, R4.3.2 software (Biblioshiny package), and CiteSpace 6.2 R4 were utilized to mine, quantify, process, and analyze the data, and visualize the reviewed literature (Li *et al* 2023). This study integrates traditional visualization analysis methods to completely review the existing research on edible landscapes. Figure 1 shows the specific process of this investigation. In the initial phase, we conducted a general statistical analysis of the literature dataset, encompassing publication trends, academic disciplines, and participating countries. To obtain a panoramic view of the research domain and identify geographical focal points, we employed R to capture geographical information about countries and to elucidate the developmental tracks of edible landscape-related literature. Biblioshiny facilitates the use of an interactive network interface for relevant scientific metrics and visualizations (Agbo *et al* 2021). Biblioshiny helps to systematically evaluate the research countries and institutions reported in analytical articles and documents concerning edible landscapes, as well as influential journals and prominent authors.

Secondly, a bibliometric analysis was systematically conducted using CiteSpace version 6.2.R4, and a knowledge structure map of edible landscape research was developed. By applying CiteSpace to capture snapshots of the edible landscape field based on time series data, this study provides insights into the development trends and evolutionary trajectories within this domain (Nyathi *et al* 2022). Specifically, two primary visualization modes were utilized: cluster view and timeline view (Chen 2017). The timeline view employs burst detection to cluster and displays the development trends of the edible landscape field across different periods (Chen *et al* 2010). Additionally, CiteSpace software facilitated the analysis of references cited in the documents by extracting cluster labels from cited references using the Log-Likelihood Ratio (LLR) algorithm, thereby representing the frontier knowledge base of the research. Drawing on insights from Chen (2017), this study analyzed the clusters and key nodes within the co-citation network of the knowledge structure in edible landscape research. This approach enables the identification of research frontiers from myriad sources within the literature knowledge base and reveals the critical knowledge nodes encompassed by the frontiers of edible landscape research (Zhang and Chen 2020).

3. Results and analysis

3.1. Temporal evolution of publications

Initially, 3,426 articles related to edible landscapes were identified in the Web of Science (WOS). After organizing and excluding irrelevant documents, a total of 3,089 documents and 127655 references were recorded. Figure 2 displays the temporal distribution of publications over 24 years, with a Pearson correlation coefficient value of

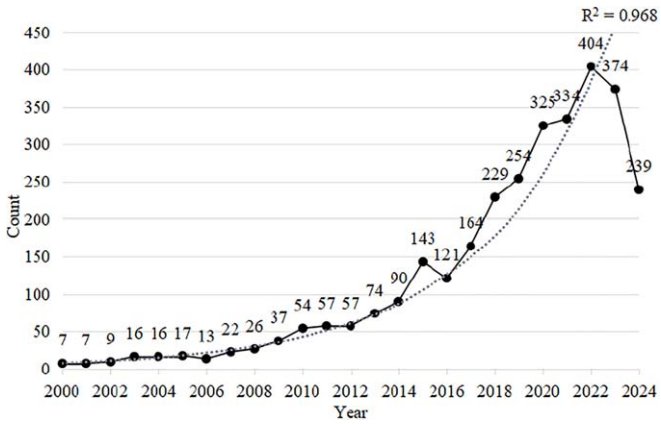

Figure 2. Annual distribution of web of science papers on edible landscape.

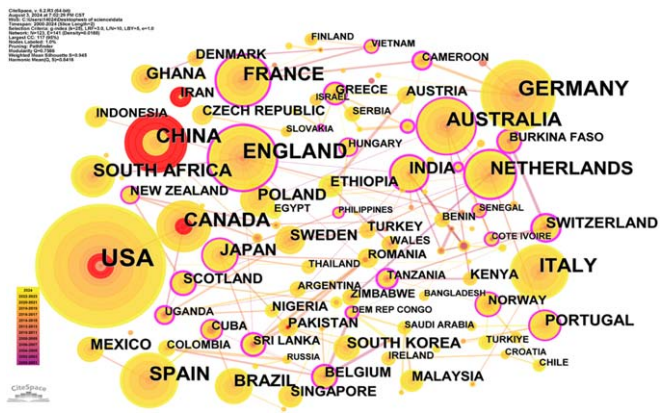

Figure 3. Edible landscapes research of country collaboration knowledge graph co-occurrence map in the web of science, 2000–2024.
Abbreviations: MCP, Multiple Country Publications.

0.968, indicating a high degree of correlation in the research data. The vertical axis quantifies the number of publications per year, while the horizontal axis corresponds to the timeline of these publications. The figure shows a gradual increase in research output related to edible landscapes. Between 2000 and 2010, the number of publications was relatively low and grew slowly. From 2010 to 2017, the volume of research articles increased steadily, reflecting growing interest from researchers in this field, though the publication rate exhibited some fluctuations due to certain uncertainties. Notably, despite the global disruption caused by the COVID-19 pandemic in 2019, the number of research articles related to edible landscapes surged significantly, reaching a total of 404 in 2022, the highest annual output on record. This surge may indicate a potential connection between edible landscapes and the COVID-19 pandemic and reflects the increasing recognition of the field's significance within the academic community. As the literature data is only available up to August 5, 2024, it may not encompass all edible landscape-related publications for the entire year, which could explain the observed decline in the number of published papers.

3.2. Country and institutional analysis

3.2.1. Analysis of research trends across countries

In CiteSpace, node size, and centrality reflect research hotspots within a given field. The Countries module in CiteSpace was employed to analyze the publishing countries of literature, with the threshold (g-index) set at 25. Figure 3 illustrates the presence of 532 nodes and 1,512 links, with a density of 0.0046. The publication volume of each country is indicated by node size; larger nodes represent higher publication volumes, while smaller nodes represent lower volumes. Centrality measures the importance of a node, indicating its significance within the network (Li *et al* 2023). Moreover, centrality is considered a critical indicator of a country's research strength, reflecting its influence and connectivity within the international scientific research network. The results reveal that, based on centrality rankings, the United States, Germany, the United Kingdom, France, and Italy occupy

Table 2. Top 10 most productive countries in edible landscape research, 2000–2024.

Rank	Country	Freq	Centrality	Rank	Country	Freq	Centrality
1	USA	847	0.21	6	CANADA	182	0.1
2	GERMANY	279	0.22	7	ITALY	172	0.12
3	UK	250	0.2	8	SPAIN	151	0.04
4	CHINA	211	0.09	9	FRANCE	151	0.21
5	AUSTRALIA	194	0.07	10	NETHERLANDS	140	0.07

Table 3. Top 10 productive institutions on edible landscapes research from 2000 to 2024.

Institution	Location	TA
University of California System	USA	112
Autonomous University of Barcelona	Spain	71
INRAE	French	67
Wageningen University & Research	Netherlands	55
University System of Ohio	USA	52
CGIAR	International	50
Agro ParisTech	French	49
CNRS	French	47
University Kassel	Germany	44
Universite Paris Saclay	French	42

Abbreviations: TA, total number of articles; INRAE, French National Research Institute for Agriculture, Food and Environment; CGIAR, Consultative Group on International Agricultural Research; CNRS, Centre National de la Recherche Scientifique.

the top five positions. These countries excel in the volume of research outputs related to edible landscapes and hold significant positions within the research collaboration network. This indicates that the study of edible landscapes has garnered widespread global attention, with relevant research being conducted in 114 countries. Research in this field is particularly active in developed countries such as the United States, Germany, the United Kingdom, France, and Australia, as well as in China. The leading positions of these countries in edible landscape research can be attributed to their abundant research resources, strong policy support, and a high level of emphasis on urban sustainability.

Among the top 10 countries (table 2), German scholars exhibit the highest proportion of international collaboration (43.9%), followed by Spain (MCP% = 41.9%), France (MCP% = 41.7%), New Zealand (MCP% = 39.5%), the UK (MCP% = 36.2%), Italy (MCP% = 29.9%), Australia (MCP% = 25.9%), and China (MCP% = 25.4%). These data suggest that countries with high academic output do not necessarily have a high proportion of international collaboration. For example, scholars from Germany, Spain, and France show a strong tendency towards international research cooperation, indicating a preference for collaborating with researchers from other countries. In contrast, the United States, despite being the country with the highest volume of academic publications, has the lowest international collaboration rate among authors among the top 10 countries (MCP% = 13.4%), implying that U.S. scholars are more reliant on domestic resources for research. This also indicates that the frequency of academic collaboration does not directly correlate with national research output, and different countries demonstrate distinct patterns of international research cooperation.

3.2.2. Analysis of academic impact of research institutions

Authors investigate specific academic disciplines by publishing papers or participating in scholarly activities. As a result, the research focus and quality of institutions are, to a certain extent, demonstrated through their academic publications. As illustrated in table 3 the publication output of the top ten core research institutions is presented. Among these publishing institutions, representative institutions include the University of California System, Autonomous University of Barcelona, INRAE, and Wageningen University & Research. The foremost institution is the University of California System, with a total of 112 publications. This university commenced research in areas such as urban agriculture, community gardens, and food security assessment as early as 2003. Following closely is the Autonomous University of Barcelona, which has produced 71 publications. This institution primarily researches the ecosystem services framework to assess the impact of urban gardens, green infrastructure, and rooftop greenhouses on residents in European cities. Research groups of this university advocate for enhancing urban food resilience through natural solutions, emphasizing the role of these green

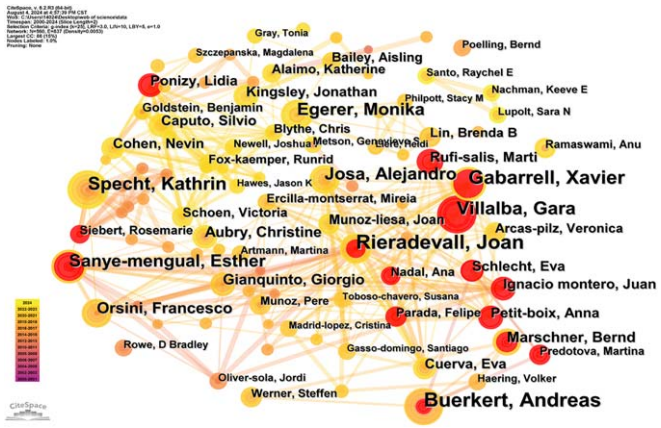

Figure 4. Author collaboration co-occurrence mapping analysis diagram.

initiatives in fostering sustainable and resilient urban environments. INRAE (French National Research Institute for Agriculture, Food and Environment) focuses its research on the influence of peri-urban agriculture on short food supply chains in European cities, exploring the contributions of edible landscapes to ecosystem services, food security, and land use. In summary, these three institutions account for 42.4% of the publications among the top ten, highlighting their significant influence in the field.

3.2.3. Analysis of author contributions

Statistical analysis based on R (biblioshiny) shows that 143 core authors have published more than 5 papers, contributing a total of 1150 papers. These articles account for 37.2% of the total number of publications in the dataset. The analysis reveals that highly productive authors are considerably fewer in number compared to less productive authors, indicating that a well-defined group of core authors has yet to form in this field. Figure 4 illustrates a co-authorship network constructed using a g-index scaling factor of 25, comprising 570 nodes and 851 links, which results in a network density of 0.0052.

Among all nodes, six relatively large and highlighted nodes represent the top six authors with the highest publication outputs. The dataset comprised a total of 3,089 publications authored by 9,168 individuals, including 378 studies contributed by 429 single-authored. On average, each document has 3.22 co-authors, and the authors exhibit a collaboration index of 3.87. Overall, each author contributed an average of 0.336 documents, and each document had an average of 2.97 authors. This suggests that edible landscape research is typically a collaborative field involving multiple authors. The author collaboration network shows an overall dispersed pattern with localized clusters, indicating that while some level of cooperation among authors exists, large-scale collaborations have yet to form. This may be due to the need for diverse disciplines and professional expertise to address issues related to food systems and environmental sustainability associated with edible landscapes.

As shown in table 4, the top 10 core authors in this field are those with 15 or more publications, while scholars with more than 25 publications are recognized as leading experts in the field. These include Andreas Buerkert (35 publications), Joan Rieradevall (29 publications), and Xavier Gabarrell (27 publications), all of whom hold significant academic influence. McClintock, Nathan stands out with the highest average citations per paper (70 citations per article), ranking first in this metric, although he is ranked tenth in terms of total publications. This suggests that his research has a substantial academic impact, with the high citation rate per article highlighting the quality and significance of his contributions to the field.

Rieradevall, Joan, Buerkert, Andreas, and Sanye-Mengual, Esther are the top three authors ranked by H-index in the research field of edible landscapes. Buerkert, Andreas, and McClintock, Nathan were among the earliest contributors to this field and have continuously produced relevant research outcomes. An analysis of co-authorship networks reveals that collaboration among leading scholars has led to the formation of small-scale research partnerships. For example, prominent scholars such as Rieradevall, Joan, Gabarrell, Xavier, and Villalba, Gara have established close collaborative relationships within the network, focusing primarily on areas such as rooftop greenhouses, rooftop farming, and vertical farming, with an emphasis on the symbiotic relationship between building energy use and urban agriculture. The research group led by Buerkert, Andreas primarily investigates land use in mobile gardens and the impact of urbanization on agriculture, including heavy metal contamination issues.

Table 4. Top 10 research authors' local impact ranked by total documents.

Authors	TD	TLC	AC	H_i	PY_start	Institution	Country
Buerkert, Andreas	35	772	22	17	2008	University of Kassel	Germany
Rieradevall, Joan	29	1165	40	20	2012	Autonomous University of Barcelona	Spain
Gabarrell, Xavier	27	743	28	16	2017	Institute of Environmental Science and Technology (ICTA-UAB)	Spain
Villalba, Gara	24	446	19	11	2019	Autonomous University of Barcelona	Spain
Egrer, Monika	23	442	19	12	2018	The University of California	USA
Specht, Kathrin	23	1121	49	16	2014	Columbia University	USA
Sanye-mengual, Esther	21	901	43	18	2012	University of Bologna	Italy
Orsini, Franecsco	18	1033	57	13	2013	University of Bologna	Italy
Josa, Alejandro	17	500	29	12	2017	Universitat Politècnica de Catalunya	Spain
McClintock, Nathan	15	1053	70	12	2010	Institut national de la recherche scientifique (INRS)	French

Abbreviations: TD, total number of documents; TLC, total local citations (this refers to the citation in the data set); AC, average citations; H_i, H index; PY_s, published year started.

Table 5. Top 30 high-frequency keywords in edible landscapes.

Keywords	Freq	Centrality	Keywords	Freq	Centrality
urban agriculture	1543	0.19	gardens	139	0.01
community gardens	470	0.05	climate change	138	0.02
City	448	0.03	urbanization	131	0.07
food security	365	0.03	benefits	119	0.04
agriculture	362	0.04	heavy metals	118	0.02
health	269	0.02	security	117	0.03
land use	254	0.06	edible landscapes	115	0.02
ecosystem services	252	0.03	peri-urban agriculture	106	0.03
systems	232	0.05	food systems	103	0.01
food	231	0.02	quality	99	0.04
impact	195	0.05	urban	99	0.03
sustainability	194	0.02	growth	98	0.04
management	188	0.06	biodiversity	94	0.05
policy	172	0.04	community	90	0.04
space	154	0.01	food production	89	0.03

3.3. Analysis of keywords

3.3.1. Keywords co-occurrence analysis

Keywords serve as terms that characterize the content of an article, often representing its core and main topics, and are substantively meaningful in expressing the central content of an article. Therefore, conducting frequency analysis of keywords enables researchers to identify research hotspots and trends within a particular field, as it reflects the evolving focus areas and the prominence of various topics over time (Narong and Hallinger 2023). This study used the keyword co-occurrence analysis template in CiteSpace, a visual analysis was performed on the keywords of significant research literature in the field of edible landscapes from 2000 to 2024. A high-frequency keyword statistics list was generated (table 5), where frequency refers to the number of occurrences of keywords in the retrieved articles. Centrality refers to the weight metric of keywords in a network, where higher centrality indicates a greater probability of co-occurrence with other keywords (Su and Lee 2010). Nodes with a value exceeding 0.1 are considered key nodes. Keywords with both high frequency and centrality are typically research frontiers in the field (Lozano *et al* 2019).

The results indicate that the research hotspots in the field of edible landscapes include urban agriculture, community gardens, land use, food security, urbanization, food production, and biodiversity. Research on topics such as food security, health, ecological services, and land use is receiving increasing attention, leading to a series of high-frequency keywords. Based on the keyword co-occurrence analysis (figure 5), research in the field of edible landscapes can be categorized into three distinct stages. The initial stage focused primarily on fundamental issues such as resource utilization in poor areas, water security, pest control, and environmental pollution. In the second stage, driven by rapid urbanization, scholars increasingly concentrated on various elements of edible landscapes, including food production, urbanization processes, environmental changes, and the development of green infrastructure. Currently, research has shifted towards more comprehensive topics

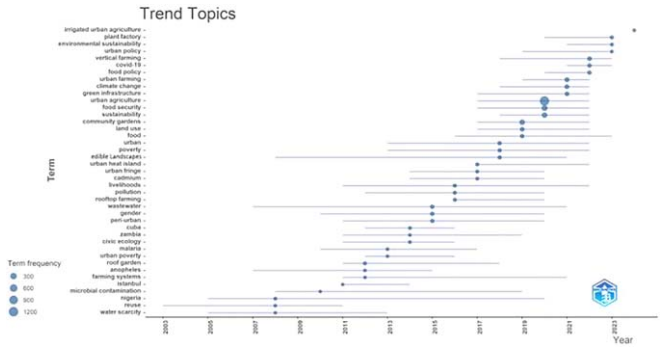

Figure 5. Keywords research trends co-occurrence mapping.

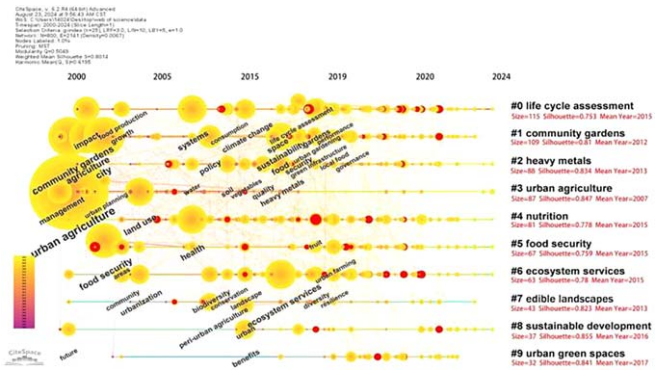

Figure 6. The timeline visualization of keyword clustering in edible landscape research from 2000 to 2024. The horizontal axis represents the year, each node represents a popular keyword, and the size of each node is proportional to the frequency of its occurrence, red tree rings represent the burst. The line between each node represents the temporal evolution of the keyword, and the line thickness represents the relevance strength; these lines reflect the relationship between transfer and inheritance among keywords.

such as vertical farming, urban policies, sustainability, and food security. The evolution of research themes from singular to diverse and from local to holistic reflects the growing recognition within the academic community of the critical role that urban agricultural landscapes play in enhancing urban ecosystems, ensuring food security, and promoting sustainable socio-economic development.

3.3.2. Critical themes for edible landscapes

Keyword clustering refers to the use of algorithms designed for complex data mining to aggregate and classify salient terms in a particular domain in a complex network. CiteSpace evaluates the mapping quality using the modularity value (Q-value), where typically, a $Q > 0.3$ indicates a significant and reasonable community structure (Xu and Tian 2015). This study applies the Pathfinder algorithm with a one-year time slice, using approximately 20 years of literature data, and the g-index ($k = 25$) as the calculation standard. This approach helps ensure the inclusion of highly cited works, reflecting key thematic shifts within the field (Liu *et al* 2014). Clustering is performed using the Log-Likelihood Rate (LLR) algorithm, resulting in a Modularity Q of 0.5049, indicating a significant clustering structure, and a Weighted Mean Silhouette S of 0.8014, suggesting strong network homogeneity and high reliability (Liu *et al* 2014). The top 10 largest clusters with silhouette values $S > 0.7$ were extracted and a timeline visualization of keyword clusters was plotted. In figure 6, the size of the circles represents the frequency of keyword co-occurrence, with red solid circles indicating keywords that have rapidly gained prominence within a short time frame, and yellow-orange outlines indicating keywords with high centrality, maintaining a significant position over a prolonged period.

Based on the keyword clustering results, research on edible landscapes consistently revolves around the three key elements: environment, humans, and food. Clusters #0 and #4 include terms such as 'life cycle assessment,' 'food insecurity,' 'health,' and 'nutrition,' highlighting a deep focus on the physical and mental health of individuals. Clusters #3, #4, #5, and #7 are characterized by terms such as 'urban agriculture,' 'food security,' 'edible landscapes,' 'urban planning,' 'sustainable agriculture,' and 'environmental education,' with a focus on urban food security, environmental education, and sustainable management of food systems. Clusters #1, #2,

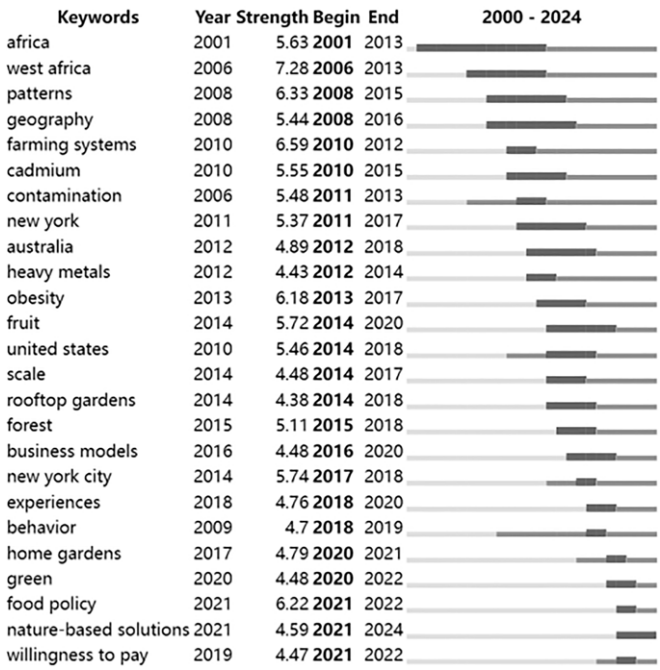

Figure 7. TOP 25 keywords with the strongest citation burst.

#6, #8, and #9 are represented by terms like 'community gardens,' 'food justice,' 'heavy metals,' 'ecosystem services,' 'biodiversity,' 'sustainable development,' 'sustainable cities,' and 'climate crisis,' emphasizing sustainable urban development and ecological conservation.

From a temporal perspective, around the year 2000, key research milestones such as 'urban agriculture,' 'community gardens,' and 'food production' began to emerge. In the subsequent five years, research directions gradually shifted toward themes like 'food security,' 'land use,' 'health,' and 'biodiversity,' indicating a growing focus on edible landscapes in urban areas, food systems, and land utilization. After 2015, research increasingly emphasized ecological design, centering on themes such as 'ecosystem services,' 'green infrastructure,' 'life cycle assessment,' 'heavy metals,' 'resilient design,' and 'sustainable development.' This trend underscores a deeper exploration of ecological and sustainable design within the field. It highlights the critical role of edible landscapes in urban sustainability and ecological preservation, with ongoing attention to urban food security, environmental education, and the sustainable management of food systems. It highlights the critical role of edible landscapes, including urban food forests and community gardens, in promoting urban sustainability, addressing climate change challenges, and enhancing food security (Shi 2023). Integrating food production into urban planning underscores the ongoing focus on urban ecology, environmental education, and the sustainable development of food systems (Plassnig *et al* 2022).

In Capacities, burst keywords identify the emergence of keywords within a specific time frame (Feng *et al* 2021). Keyword bursts typically have two attributes: the strength of the burst and the duration of the burst period. Figure 7 shows the list of burst keywords in the field of edible landscapes, which helps identify research focuses during different periods. From 2001 to 2008, keywords such as 'Africa,' 'landscape patterns,' and 'landscape geography' became research hotspots, indicating a focus on systematic studies of landscape patterns and geography. Subsequently, from 2010 to 2017, research priorities at the macro-spatial scale shifted gradually towards regions like New York and Australia. Meanwhile, on the micro-scale, studies centered on the ecological conditions and land use of farming systems and rooftop gardens. Since 2018, 'home gardens' have emerged as a new research focus, with increasing attention to themes such as experience, nature-based solutions, food policy, willingness to pay, and behavioral patterns. Moreover, nature-based solutions have gained brief research attention between 2021 and 2024, marking the latest and future research trends in the field.

4. Discussion and limitations

4.1. Discussion

This study provides a comprehensive analysis of research on edible landscapes from 2000 to 2024, employing a systematic review combined with bibliometric tools. The aim is to examine the evolution of this field, its current research landscape, and its inherent limitations, offering both theoretical insights and methodological guidance

for future studies. Research has shown that the cultivation and supply of food within urban environments, ranging from urban agriculture to edible landscapes and urban food systems, have become prominent areas of scholarly inquiry and practical implementation.

The findings indicate a significant increase in the number of peer-reviewed studies, but the related literature remains fragmented in terms of geographical distribution and institutional collaboration. The publication volume in developed regions such as North America and Europe accounts for approximately 70% of the total literature. However, in recent years, research output from developing countries, including South Africa, China, India, and Nigeria, has gradually increased. Research in Europe and North America dominates, likely due to the strong research institutions and economic power in these regions, which provide favorable conditions for systematic studies in fields such as urban planning and urban agriculture.

Meanwhile, the bibliometric analysis in this study reveals that research on edible landscapes, as well as this emerging field, intersects strongly with various themes, including sustainability, food security, environmental planning, and the future development of urban and rural areas. These findings strongly support earlier insights from several review studies, particularly those focusing on academic approaches to urban edible landscapes, nature-based solutions frameworks, and methodological trends in edible landscape research (Barthel *et al* 2015). This corroborates Çelik's study, which provides a conceptual framework for exploring the significance of urban edible landscapes and highlights the multifaceted benefits these productive landscapes offer in areas such as food security and environmental sustainability (Çelik 2017).

Keyword co-occurrence and thematic knowledge map analysis reveal that the relevant research primarily focuses on three major themes: sustainable urban development, human physical and mental health, and food security. Early studies emphasized the ecological benefits of edible landscapes and related concepts, as well as their impact on urban sustainability. This result is supported by various studies that highlight the multifaceted benefits of integrating edible plants into urban environments. First, regarding eco-efficiency, Çelik highlights that edible landscaping enhances sustainable urban ecosystems by creating interconnected green spaces that offer vital ecological services, thereby enriching urban life and biodiversity (Çelik 2017). Furthermore, the majority of studies indicate that edible landscapes, in addition to their environmental beautification and ecological sustainability benefits, also offer social interaction and therapeutic advantages for citizens. Huang discusses the psychological and community benefits of urban edible landscaping, particularly in the context of recovery from crises such as the COVID-19 pandemic (Huang 2023). In the field of landscape therapy, edible landscapes can provide horticultural therapy for the elderly and individuals with schizophrenia, contributing to their social rehabilitation (Zheng and Chou 2023). Therefore, edible landscapes appear to effectively address the reconsideration of human-centered perspectives and calls for action, such as by offering nature-based solutions that transcend human-centered thinking (Maller 2021).

Finally, research indicates that edible landscapes also involve a thorough exploration of urban food security and supply chains. The majority of the current literature suggests that the multifunctional nature of edible landscapes allows them to serve as both food sources and catalysts for social interaction and community resilience, thereby helping to address urban sustainability challenges (Maye *et al* 2021). Moreover, co-occurrence analysis of thematic keywords reveals that integrating edible landscapes into urban planning systems can facilitate dialogue between urban food policy advocates and urban planners, generating synergies that enhance the potential for sustainable development. This interdisciplinary collaboration not only supports the long-term sustainability of urban food systems but also provides innovative solutions to the increasingly pressing challenges of food security amidst global urbanization.

4.2. Research limitations

This study has a few limitations. Although the study covers literature data from around the world, it only includes publications written in English, excluding non-English publications. While this approach enhanced the comparability and consistency of the selected literature, it also limited the understanding of how the concept of edible landscapes has evolved across different cultural contexts globally. Future research should expand the language scope to include multilingual literature, aiming to explore unique perspectives and understandings of the topic within diverse cultural and linguistic contexts. In addition to broadening the scope of academic literature in other major languages, it is also crucial to acknowledge the knowledge and practices shared outside peer-reviewed journal articles.

Besides, in the analysis of concepts related to edible landscapes, this study excluded certain less-discussed terms, such as 'continuous productive urban landscapes', 'renewable agriculture' and those already represented by more commonly used concepts. This decision was made to ensure consistency and alignment with mainstream research data. While this approach simplifies the research framework to some extent, it may result in a lack of in-depth analysis of the field, particularly concerning the diversity and intersections of concepts. For instance, edible landscape types within informal green spaces or lost spaces in urban areas might lead to more

comprehensive evaluations and systematic comparisons. Compared to urban agriculture or edible green infrastructure, the conceptual and theoretical work on the roles and potential of edible landscapes remains insufficient. Although this study provides a comprehensive overview of the role of edible landscapes in enhancing food security and sustainability, it does not adequately address issues related to distribution mechanisms and accessibility within food systems. Potential challenges such as the management costs of edible landscapes, transportation of agricultural products, and conflicts surrounding the allocation of benefits could serve as barriers to the development of edible landscapes, warranting further attention and in-depth analysis.

Finally, the research methodology is primarily based on quantitative approaches such as bibliometric analysis and knowledge mapping visualization. These methods have demonstrated significant advantages in revealing research hotspots, trends, and interdisciplinary relationships, particularly at a macro level, where they provide a clear depiction of the developmental trajectory of research fields. However, these methods have certain limitations in uncovering the qualitative dimensions of the literature, such as the underlying social, cultural, and ecological contexts. Over-reliance on quantitative analysis may result in the neglect of nuanced and complex topics. For instance, issues such as the coordination between edible landscapes and existing land-use structures or the latent conflicts between management costs and benefit distribution often require a more integrated and interdisciplinary approach for comprehensive exploration and resolution. Therefore, future studies should emphasize the integration of quantitative and qualitative methods. This entails not only analyzing trends and patterns from a data-driven perspective but also delving deeply into implicit factors such as social and cultural contexts.

5. Conclusion

This study conducts a systematic bibliometric analysis of 3,089 English-language academic publications related to edible landscapes, uncovering research trends and developmental trajectories in this field. The analysis reveals that edible landscapes have garnered significant attention across multiple disciplines, particularly within the contexts of food systems, urban planning, ecosystems, and sustainable development. While the anticipated benefits of edible landscapes have been widely proposed and discussed, empirical evidence supporting these claims remains insufficient, highlighting the need for further empirical studies to validate these potentials and expectations. Notably, most of the literature considers the development of edible landscapes in urban areas as an effective strategy to enhance urban food system security, offering innovative solutions to address urban food security challenges (Grafius *et al* 2020). By integrating food production with urban environments, edible landscapes not only improve urban self-sufficiency but also provide healthier and more sustainable food options for urban residents. Meanwhile, nature-based solutions and the principles of sustainable development are increasingly emerging as core directions for the future development of edible landscapes.

Overall, the contributions of this study can be summarized in three aspects. First, it systematically reviews the fundamental attributes and related concepts of edible landscapes, providing a clear distinction and connection between edible landscapes and similar concepts. Second, through a literature review based on the Web of Science database, it identifies the research trajectory, key developments, and potential future directions for edible landscapes, with particular emphasis on nature-based solutions. Finally, employing a systematic literature review methodology, this study offers a comprehensive and in-depth analysis of the current state of research on edible landscapes, establishing a robust theoretical and practical foundation for future investigations.

Looking ahead, researchers should expand the linguistic and geographical scope of literature reviews to strengthen cross-cultural and cross-regional comparative studies. Additionally, more empirical evidence should be collected and analyzed, particularly in systematic comparative studies, to further validate the multi-functionality and potential of edible landscapes. Furthermore, exploring the roles and significance of edible landscapes across diverse social, cultural, and environmental contexts, and constructing a more comprehensive theoretical framework, will be critical directions for future research.

Data availability statement

All data that support the findings of this study are included within the article (and any supplementary files).

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