RESEARCH FRONTIERS AND TRENDS IN SUSTAINABLE PUBLIC COOPERATION: A BIBLIOMETRIC ANALYSIS FROM 2001 TO 2024

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Abstract. Sustainable public cooperation is a prominent topic, yet comprehensive research on its status and processes is lacking. This study analyzes articles from the Web of Science Core Collection between 2001 and 2024 using CiteSpace for visual bibliometric analysis to understand the general landscape, interaction dynamics, research hotspots, and future research trends on sustainable public cooperation. Our results indicate rapid growth in sustainable public cooperation research. Interdisciplinary studies in environmental science, medicine, and economics are particularly prominent. Key global challenges such as climate change, food safety, and public health are central topics of interest. Public cooperation models include public-private partnerships, cross-sectoral collaboration, and stakeholder engagement. These models can help achieve global sustainable development by establishing cooperation networks, creating new cooperation mechanisms, forming innovation alliances, building integration platforms, and designing innovative solutions to global challenges. Future research should focus on addressing humanity's future by employing effective strategies for public cooperation to tackle global health issues and environmental challenges while fostering socio-economic development. In conclusion, this study enhances scholars' understanding and is a valuable reference for future research.
Keywords: *sustainability, public cooperation, CiteSpace, visualization, sustainable development goals*

Introduction

In 2015, the United Nations adopted the 2030 Agenda for Sustainable Development and 17 Sustainable Development Goals (SDGs) to address the climate crisis, improve human health, and promote a circular economy. Goal 17, "Partnerships for the Achievement of Goals," highlights that no single entity—public, private, or individual—possesses all the knowledge and resources needed for sustainability. It calls for collaboration among states, businesses, civil society organizations, and individuals to set common goals and support sustainable development (Koessler et al., 2021; Macedo et al., 2020; Nielsen et al., 2024). Public cooperation involves joint efforts by governments, companies, individuals, and Non-Governmental Organizations (NGOs) to tackle significant social challenges such as climate change, environmental issues, social problems, and health concerns through public-private partnerships, stakeholder collaboration, and cross-border cooperation (Zhang et al., 2022).

Public cooperation is essential for sustainable development. In health, it helps address epidemics, improve communication, train professionals, build sustainable systems, and promote well-being. For instance, responding to health emergencies like COVID-19 requires collaboration across healthcare sectors (Fossouo and Mouliom, 2024). Ecologically, public

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cooperation enhances sustainability by uniting the public sector, private enterprises, and civil society to combat environmental degradation and social inequality while promoting sustainable urban development (Carlton and Vallance, 2023). Economically, it supports the circular economy by enabling businesses, the public sector, and social actors to use waste resources efficiently (Patala et al., 2022). In summary, sustainable public cooperation leverages collective wisdom and resources, sharing information, technology, and experience to tackle challenges and drive social progress and prosperity.

In the past two decades, countries worldwide have conducted practical explorations into sustainable public cooperation. The USA fosters new cooperation mechanisms in developed nations through incentives (Santos et al., 2021), integrating government, business, and society to address the global climate crisis (Espinoza and Aronczyk, 2021). It also promotes a circular economy, improves transportation, and supports the development of sustainable smart cities (Lee et al., 2023). Germany focuses on stakeholder collaboration by studying trilateral networks among businesses, universities, and governments to build sustainable innovation alliances (Dembski et al., 2020). It also encourages citizen participation in urban planning for smart city development (Song et al., 2020). China studies issues and solutions for PPP project sustainability in developing countries, and enhances environmental cooperation to improve air quality (Liu et al., 2024; Xu and Wu, 2020). Brazil fosters public cooperation in agriculture between academia and social groups (Vargas et al., 2023) and maintains ecological balance through a network for pest management (Garcia et al., 2022). The efforts of these countries offer valuable insights into achieving the Sustainable Development Goals (SDGs) through public cooperation.

Researchers from various disciplines have worked to promote sustainable public cooperation across different areas. Economics researchers explore fintech collaboration and economic innovation. They explore enhancing collaboration among the private sector, banks, and other stakeholders to build digital infrastructure and improve access to financial technologies and services (Danladi et al., 2023), facilitate international capital flows (Slimani et al., 2024), and achieve product and business model innovation (Kalkanci et al., 2019). Environmental researchers proposed establishing the Ecosystem Services Partnership (ESP) and a multi-level governance framework involving government, academic, and NGO experts (Kronvall et al., 2024). They also recommended building a cross-sector collaborative management platform to enhance stakeholder participation (Basak et al., 2022), promoting collaborative environmental governance (CEG) where governments, NGOs, private enterprises, and the public jointly address environmental challenges (Chen et al., 2024). Medical researchers suggest improving health equity and strengthening healthcare systems through community participation in decision-making (Thomson et al., 2024) and collaboration across social services, public health, and healthcare sectors (Lanford et al., 2022; Weimann and Weimann, 2022). Other researchers from management and sociology have explored collaborative approaches to achieving the SDGs by emphasizing the importance of multi-stakeholder partnerships (Leal et al., 2024) and developing frameworks that link PPP network characteristics to public values (Li et al., 2023). They also identify partners' roles and collaboration mechanisms to guide policymakers in finding innovation opportunities and designing collaborative models for sustainable development (Mariani et al., 2022).

Some scholars have systematically reviewed research outcomes related to sustainable public cooperation. Reviews include community participation in value chain frameworks (Ohnishi et al., 2024), sustainability of PPP governance (Liu et al., 2024), the role of

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agricultural cooperatives in sustainable agriculture (Candemir et al., 2021), optimal synergies among entrepreneurs in cooperation (Minhas and Sindakis, 2021), collaborative experiences for local collaborative transformation (Macedo et al., 2020), new community-academic partnerships (Stampfer et al., 2019), and the impact of automation on PPP (Public-Private Partnership) infrastructure projects (Hoeft et al., 2021). However, these reviews often focus on specific disciplines or practical issues without utilizing visual bibliometric analysis to provide a comprehensive overview of research progress and knowledge framework on sustainable public cooperation (Gao et al., 2024b). In addition, the following questions remain unanswered:

Q1. Is sustainable public cooperation widely studied?

Q2. Who collaborates more frequently, and what are their favorite topics?

Q3. What are the current research topics, and where do they originate from?

Q4. What are the research hotspots and frontier topics?

To address the above questions, this study employs CiteSpace software to conduct a bibliometric analysis of articles on sustainable public cooperation over the past 23 years. We also provide a thorough and thoughtful review of the research area, focusing on:

(1) We collect statistical data on publications, journals, and categories from the Web of Science (WOS) to analyze publishing trends in this field. It explains the broadness of the research in this field, addressing question 1.

(2) Collaboration networks analysis author, regional, and institutional collaboration, helping scholars understand current interaction trends and choose suitable partners. It identifies frequent authors, institutions, and regions in collaborations, as well as key research topics they have explored together, addressing question 2.

(3) Co-citation analysis of authors, journals, and literature to explore current research topics and their origins. It identifies the co-cited authors, journals, and references that contributed to this field's research, addressing question 3.

(4) Co-occurrence analysis of keywords and categories reveals research hotspots, while keyword burst analysis helps trace frontier topics. It highlights the current research hotspots and future directions, addressing question 4.

Based on the above focus, this article is organized as follows: The second part discusses data sources, the selection process, and bibliometric analysis methods. The third part analyzes the research status, trends, hot topics, and evolution through visual charts using publication statistics, cooperation analysis, co-citation analysis, and co-occurrence analysis (Gao et al., 2024a). Based on this analysis, the fourth part presents a theoretical framework and suggests future research directions to help scholars understand the emerging topics in this field. Finally, the conclusion, innovations, and limitations are presented in the fifth part.

Materials and methods

Data sources and selection processes

Web of Science (WOS) is ideal for bibliometric research due to its accessibility and status as a key academic repository. We selected the core collection in WOS, including the Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI), and Arts and Humanities Citation Index (AHCI), for the following reasons: (1) The database contains high-quality, peer-reviewed articles, ensuring authoritative and comprehensive data across multiple subjects. (2) It is user-friendly, providing easy access to detailed author information, institutional affiliations, journal impact factors, citation counts, and other valuable data

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(Yang et al., 2021). (3) SCIE, SSCI, and AHCI are recognized for their technical reputation, especially in public cooperation, and include the latest research breakthroughs, making them suitable for literature analysis (Geng et al., 2024a). This study employed specific strategies to gather literature on sustainable public cooperation from the WOS:

Topic = [sustainable*] and "[public NEAR cooperate*] or [public NEAR collaborate*]"

Language = English;

Document type = ["Article" and "Review"];

Time range = 2001-01-01 to 2024-08-16.

To ensure research accuracy, we thoroughly screened and excluded articles not closely related to the topic. For example, some papers may mention cooperative transportation but focus primarily on public transportation, which is irrelevant to public cooperation. Retraction announcements were also removed. Two researchers independently reviewed the manuscripts, with disagreements resolved by a third party. Initially, 1375 documents were retrieved; ultimately, 1259 were selected through this retrieval and screening process. Data was exported in "Full record with citation" format.

Research methodology

Bibliometrics is widely used in literature research to reveal publication trends, research collaboration, evolution, and identify research hotspots in a specific field. Various bibliometric software tools, such as COOC, VOSviewer, Sci2, and CiteSpace, are available. COOC is user-friendly and supports cross-database analysis but lacks citation analysis capabilities (Geng et al., 2024d). VOSviewer handles various database formats with strong graphical features, but struggles with large-scale data. Sci2 provides robust data processing and visualization options but requires high computer specifications (Geng et al., 2024c). After careful comparison, CiteSpace 6.3. R1 was deemed the most suitable choice due to its advantages:

(1) It is easy to obtain and use from the website, allowing researchers to learn its functionalities quickly.

(2) It facilitates multi-dimensional literature analysis (authors, institutions, countries), enhancing a comprehensive understanding of research progress.

(3) It visualizes clusters, timelines, and burst statuses, helping researchers understand the field and identify core issues more intuitively.

(4) It is widely used in bibliometric studies and has been validated. For example, some scholars have used CiteSpace to analyze the research progress, cooperation status, and hot topics in fields such as sustainable rural tourism (Geng et al., 2025), cooperation in social dilemmas (Gao et al., 2025), sustainable smart grid (Geng et al., 2023b), and tourism marketing (Geng et al., 2024b). Besides, some influential articles, such as those on sustainable tourism (Geng et al., 2024e), clean energy production (Geng et al., 2024c), and sustainable smart cities (Xia et al., 2022), are highly cited and published in Q1 journals with a 5-year IF over 10, indicating that CiteSpace-based bibliometric analysis is widely recognized and impactful.

Research procedures

This study analyzed the statistics, cooperation, co-citation, and co-occurrence of publications in this field to establish a knowledge framework. The main research content steps are as follows, as shown in *Figure 1*.

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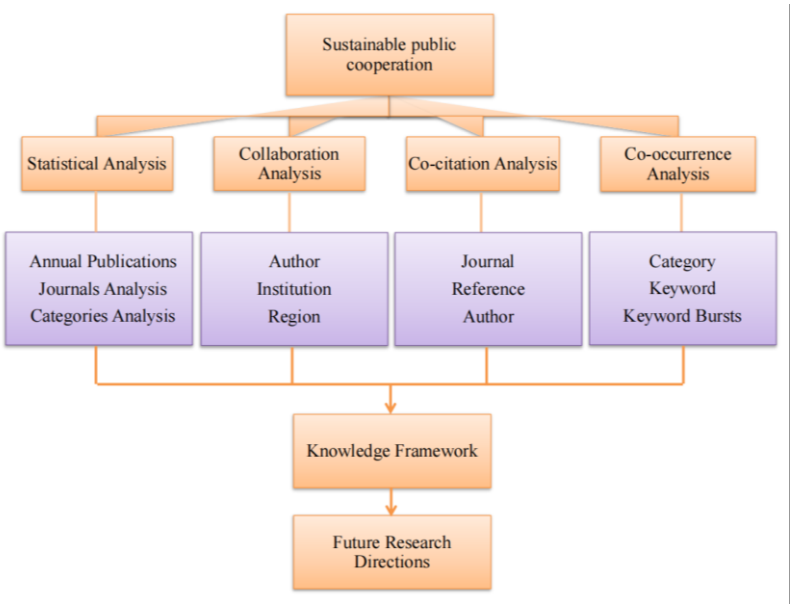

Figure 1. *Study steps*

(1) Statistical analysis: Analyze publication trends in sustainable public cooperation by examining time, major journals, and category distribution to establish a research foundation.

(2) Cooperation analysis: Evaluate collaboration among institutions, regions, and authors to assess interactions, identify potential partners, and suggest collaborative research directions.

(3) Co-citation analysis: Conduct co-citation analysis on journals, references, and authors to highlight research progress, current topics, and knowledge sources in sustainable public cooperation.

(4) Co-occurrence analysis: Keyword co-occurrence and burst analysis assess the evolution of sustainable social cooperation and forecast future research trends (Geng et al., 2024e).

(5) Knowledge Framework: Integrating results from publication statistics, collaboration, co-citation, and co-occurrence metrics to create a systematic knowledge framework that provides scholars with comprehensive insights.

In addition, based on the research content steps, this study used CiteSpace software to analyze literature data for the results on statistics, collaboration, co-citation, and co-occurrence. The data preparation and parameter settings for this study are as follows:

(1) Export selected literature data of sustainable public cooperation from WOS and remove duplicates to create the final dataset.

(2) Create a new project titled “Sustainable Public Cooperation” and set the data and result storage paths (*Figure 2*). Researchers can control node connections, the number of nodes in the literature network, minimum citation counts for nodes, the quality of cited literature, and visual label display ratios by adjusting the parameters highlighted in yellow (Chen, 2006).

(3) Set the time range from January 2001 to August 2024 and select node types: author, institution, country, reference (*Figure 3*).

(4) Set the selection criteria to the Top 50, that is, each slice contains the 50 most frequently cited documents (Xie et al., 2021) (*Figure 3*).

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(5) Set the pruning options to "pathfinder," "slice," and "merge networks" to simplify the network visualization and highlight the key points (*Figure 3*).

(6) Finally, select the desired node type and click GO! Wait for the analysis results (*Figure 3*).

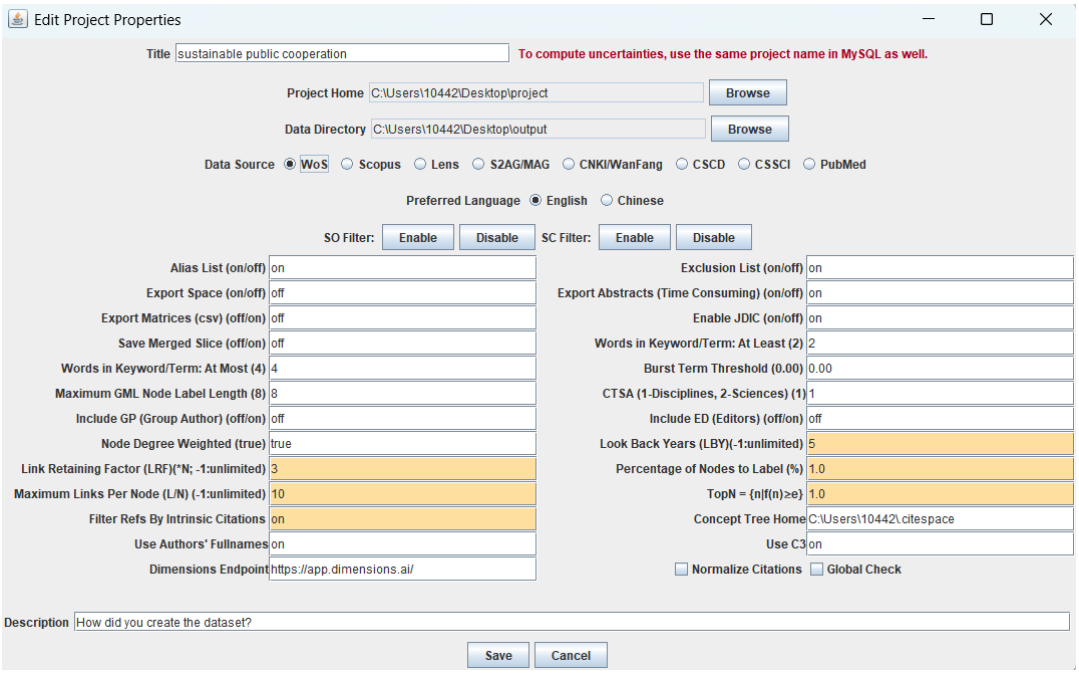

Figure 2. *New project settings*

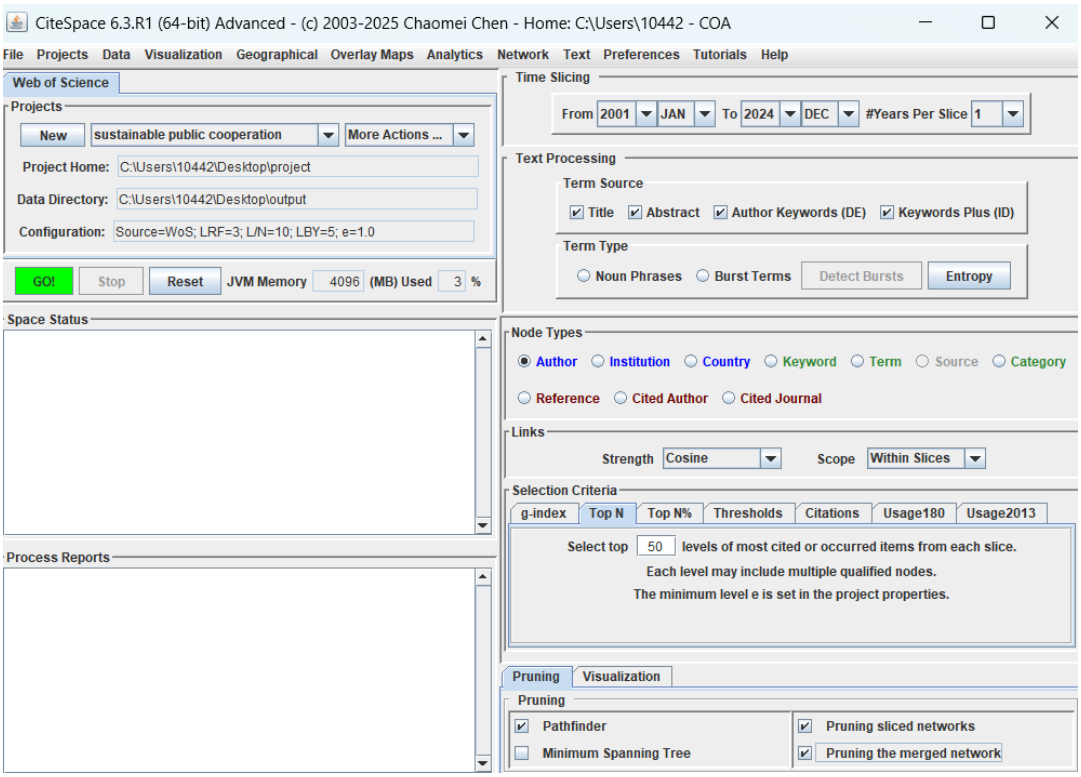

Figure 3. *Operating interface*

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Results

Publication statistical analysis

Publishing statistical analysis shows the publishing status, core journals, and disciplines, helping scholars understand field popularity and predict future trends. This section answers Q1: Is sustainable public cooperation widely studied?

Annual publication numbers

Figure 4 shows trends in publications on sustainable social cooperation from January 1, 2001, to August 16, 2024. Overall, the number of publications has increased over time. By analyzing the annual trends and characteristics, we can divide this growth into three distinct periods:

(1) From 2001 to 2008, annual publications were fewer than 20, indicating the field's early stage. During this period, researchers focused on achieving multiple important goals through collaboration among the sustainable public sector, various administrative institutions, and economic entities. These goals included establishing an environmental management system (Hong and Xue, 2006), managing ecosystems (Webb, 2005), funding healthcare (Regenstreif et al., 2004), preventing public health issues (Rog et al., 2004), and promoting children's mental health (Atkins et al., 2003).

(2) From 2009 to 2018, the number of publications gradually increased from 20 to 100 annually. In 2017, the annual growth rate reached 75%. During this period, researchers explored how public collaboration networks can facilitate long-term sustainable development. They focused on areas including bio-digital technology (Gartland and Gartland, 2018), low-carbon economic transformation (Johansson, 2018), renewable energy (de Carvalho, 2018), public health (DeSisto et al., 2017), and health systems (Story et al., 2017). That may be due to the adoption of the 2030 Agenda for Sustainable Development (SDGs) in 2015 and the launch of the Paris Agreement in 2016, which provided a clear global framework for sustainable development and encouraged researchers to explore public cooperation mechanisms.

(3) From 2019 to 2024, publications rose significantly, exceeding 100 each year. The average annual volume reached 131, accounting for 62.59% of the total output. Researchers have studied public collaboration in various fields, including training new doctors (Story et al., 2017), building sustainable cities (Neuman et al., 2022), optimizing drug therapy management (Thompson et al., 2020), addressing global health issues (Addo-Atuah et al., 2020), improving waste management efficiency (Mostaghimi and Behnamian, 2023), and enhancing transportation infrastructure (Smith, 2023). This trend reflects a growing interest in sustainable public collaboration, driven by COVID-19 (Thomson et al., 2024), geopolitical crises, and environmental pollution (Starzynska and Kuna-Marszalek, 2023). These challenges have intensified the demand for sustainable cooperation practices worldwide, prompting researchers to explore practical public cooperation. Early 2024 publication numbers, despite being lower than 2023 due to data collection ending in August, still exceed those of 2019. We are confident the upward trend will continue and remain optimistic about future research prospects.

Additionally, we used regression analysis to create a predictive trend line for the future growth of sustainable public cooperative publishing. To accurately present and predict annual publishing trends, we excluded January to August 2024 data from the regression analysis (as the data for that year was incomplete and could not reflect the total publishing volume for the entire year). The regression model is: $y = 0.5034x^2 - 5.4209x + 20.191$,

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where y represents annual publications and x denotes the year. The R^2 value (0.9556) indicates an intense goodness of fit, with values closer to 1 suggesting higher prediction reliability. This analysis supports our hypothesis that publications on sustainable public cooperation will continue to grow steadily. That reflects increasing scholarly interest in this field and promising innovative research outcomes that advance theory and practice in sustainable public cooperation.

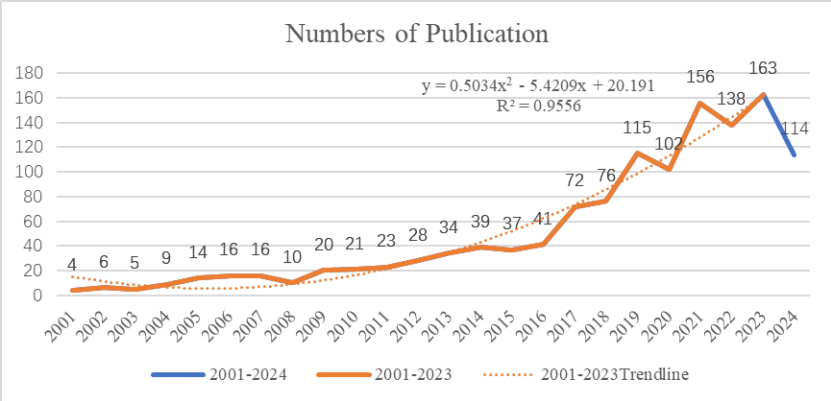

Figure 4. *Number of publications by years*

Publication journals

Journal statistical analysis helps researchers select high-quality journal papers for reading and appropriate journals for submission. From 2001 to 2024, 1259 papers on sustainable public collaboration were published across 200 journals. *Table 1* shows this field's top ten journals, 5-year impact factors (IF), and quartiles. Our findings are as follows: (1) Sustainability has the highest number of publications among all journals, highlighting its emphasis on sustainability collaboration and making it a key target journal in this research field. (2) Nine of the top ten journals have an impact factor above 3.3 and are primarily classified in Q1 and Q2, indicating higher quality overall. Notably, the Journal of Cleaner Production (IF = 10.5) and the Journal of Environmental Management (IF = 7.9) lead in impact factors within Q1, underscoring their importance in the field; scholars should aim to submit high-quality papers to these journals. (3) The titles of the top ten journals often include "sustainable" (3), "environment" (3), and "public" (2), suggesting that public cooperation related to environment and energy is a central research focus worth exploring further; themes like sustainable economic development and public health also merit attention.

Publication categories

Category analysis highlights the disciplines involved in sustainable public cooperation. *Table 2* lists the top 10 categories in this field. There are some key results: (1) Research on sustainable public cooperation is mainly concentrated in "Environmental Sciences," which has the highest number of papers (343) and represents 27.244% of the total. That is followed by "Environmental Studies" (268 papers, 21.287%), "Public Environmental Occupational Health" (175 papers, 13.900%), and "Engineering Environmental" (42 papers, 3.336%). (2) Although categories like "Economics", "Management", and "Engineering Environmental" contribute to this area, their overall

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impact remains limited—e.g., "Green Sustainable Science Technology" (250 papers), "Economics" (58), and "Management" (51) account for 19.857%, 4.607%, and 4.050%, respectively. That shows that "Environmental Science" and interdisciplinary categories like "Public Environmental Occupational Health" and "Engineering Environmental" also emphasize research in this area.

Table 1. *Publication journal statistics*

Ranking	Journals	5-year IF	Count	Quartile
1	Sustainability	3.6	148	Q2
2	Journal of Cleaner Production	10.5	32	Q1
3	International Journal of Environmental	4.799	17	Q1
4	Journey of Public Health Management and Practice	2.1	16	Q2
5	Frontiers in Sustainable Food Systems	4.6	12	Q2
6	Frontiers in Public Health	4.6	11	Q2
7	Journal of Environmental Management	7.9	11	Q1
8	Land	3.4	11	Q2
9	Environment Development and Sustainability	4.7	10	Q2
10	PLoS One	3.3	10	Q1

Table 2. *Publication category statistics*

Ranking	Categories	Count	Percentage
1	Environmental Sciences	343	27.244%
2	Environmental Studies	268	21.287%
3	Green Sustainable Science Technology	250	19.857%
4	Public Environmental Occupational Health	175	13.900%
5	Economics	58	4.607%
6	Management	51	4.050%
7	Health Policy Services	43	3.415%
8	Engineering Environmental	42	3.336%
9	Water Resources	38	3.018%
10	Ecology	36	2.859%

Collaboration analysis

Collaboration analysis examines connections among institutions, regions, and authors in sustainable public cooperation. It helps scholars understand collaboration status, select suitable partners, and generate new ideas. This section answers Q2: Who collaborates more frequently, and what are their favorite topics?

Author collaboration

Author collaboration analysis identifies the most collaborative authors. *Table 3* lists the top 15 most collaborative authors. Our findings include: (1) Most authors began their research collaboration relatively late, emerging around 2010. Five scholars began collaborating in 2023-2024, showing a recent increase in author collaboration. (2) The frequency of author cooperation is low; only Badulecu A and Badulescu D collaborated

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three times, while others collaborated fewer than three times. Their joint paper 2013 discusses public construction projects in New Europe and advocates for sustainability in cross-border cooperation via shared public services (Badulescu et al., 2013). (3) All 15 authors have a centrality of 0, indicating limited connections and low collaboration. We recommend enhancing collaboration through dedicated platforms and interdisciplinary efforts.

Table 3. *Author collaboration*

No.	Authors	Count	Centrality	Year	No.
1	Badulescu A	3	0.00	2013	1
2	Badulescu D	3	0.00	2013	2
3	Zhao F	2	0.00	2023	3
4	Sianes A	2	0.00	2020	4
5	Liang Y	2	0.00	2023	5
6	Cai J	2	0.00	2021	6
7	Kothari A	2	0.00	2014	7
8	Green LW	2	0.00	2011	8
9	Lambin EF	2	0.00	2020	9
10	Liu Y	2	0.00	2017	10
11	Chen T	2	0.00	2017	11
12	Lam ME	2	0.00	2010	12
13	Sarac FE	2	0.00	2024	13
14	Liang X	2	0.00	2023	14
15	Narin M	2	0.00	2024	15

Figure 5 illustrates the collaborative network of authors in this field, consisting of 1047 nodes and 1774 links. It shows five clusters that reveal the author's collaboration teams and themes.

Specifically, (1) Green LW and Herbert CP's team focuses on sustainable public collaboration practices (#0 practice), highlighting that Participatory Research (PR) enhances cross-sector and cross-field collaboration for practical solutions to health issues (Jagosh et al., 2012). (2) Chan JL and Murphy RL emphasize academic collaboration to promote sustainable healthcare (#1 translating academic collaboration). They propose significant potential for sustainable healthcare through collaboration between academic and medical institutions to address critical illnesses and injuries (Jagosh et al., 2012). (3) The Reed H and Brownson R collaboration to tackle various challenges associated with community design decisions (#2 community design decision). Their primary research focuses on cross-sectoral collaboration among multiple departments, aiming to jointly develop community policies and plans that foster the sustainable development of communities (Goins et al., 2013). (4) Roy K and Yin W advocate for enhancing sustainable collaboration in methadone treatment programs (#3 national methadone maintenance treatment program) through intersectoral partnerships. They believe such collaborations can overcome barriers to success and provide valuable insights for countries advancing their methadone initiatives (Yin et al., 2010). (5) The collaborative group led by Rog D and Cardwell J focuses on ensuring the sustainability of community partnerships to prevent violence-related issues (#4 violence prevention). They found that

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local collaborative violence prevention programs funded by the NFCVP can effectively prevent violence through strong community collaboration, adequate funding, and resident participation (Rog et al., 2004). To summarize, each team has unique research interests and topics. We recommend that scholars explore collaboration frameworks between teams and actively seek more partnership opportunities.

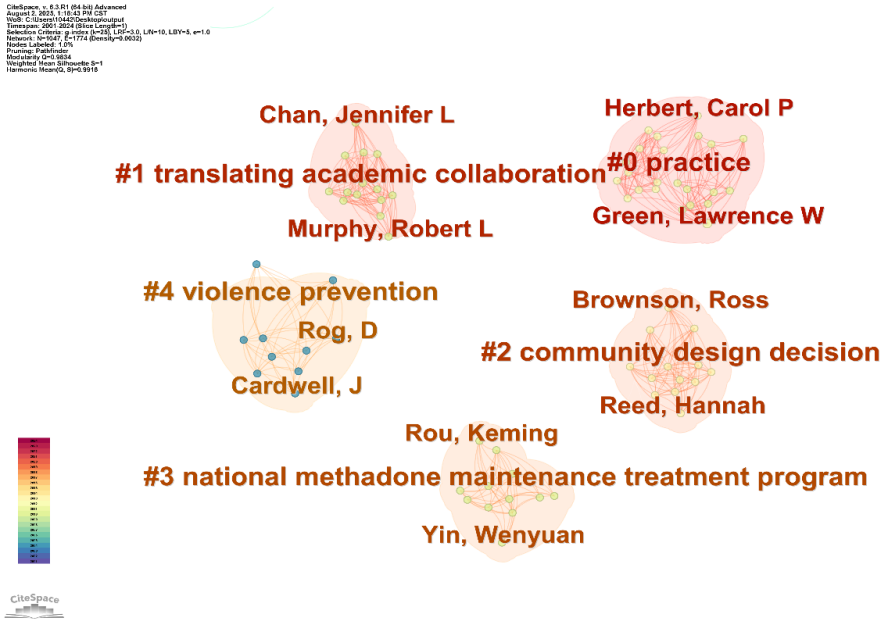

Figure 5. *Authors collaboration network (note = 1047, link = 1774)*

Institutional collaboration

Table 4 shows collaboration among global institutions in sustainable public cooperation, listing the top 10 most collaborative institutions. Nine are from developed regions: six are from North America, three are from Europe, and only one is from a developing region. That underscores the dominance of institutions in developed regions in collaborative research. Key findings include: (1) U.S. institutions are the most active and influential, having started their research earlier. Five of the top 10 institutions are in the U.S., with key collaborations between the University of California System and Arizona State University since 2001. The University of California System leads with 25 cooperative publications and a centrality score of 0.24, reflecting its extensive collaborative network and strong academic influence. Recently, it has focused on promoting sustainable public cooperation for agricultural water use, exploring multidisciplinary approaches to foster global collaboration on mitigating water scarcity risks, and proposing strategies for sustainable utilization of treated wastewater (TWW) in food production (Yalin et al., 2023). (2) Most cooperation institutions are in developed regions, with limited participation from developing countries. The Chinese Academy of Sciences is the only representative from a developing country, contributing 15 collaborative articles but showing low centrality (0.04). This suggests that collaborating with a broader range of partners is recommended to enhance cooperation quality and expand academic influence. Their key article focuses on public cooperation for sustainable community development, emphasizing public participation as an effective

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method and providing valuable references for community governance in developing countries (Yang et al., 2022a). (3) Consultative Group on International Agricultural Research (CGIAR) is the only international organization among the top 10 institutions, which consists of 47 member countries (25 industrialized and 22 developing), 13 international/regional organizations, and four private foundations. CGIAR coordinates efforts among member nations to promote global sustainable agricultural development. Their latest research utilizes a public-private partnership (PPP) model to sustainably improve the hatching quality of GIFT (tilapia) fry in Timor-Leste, which can be adapted for similar agricultural systems to foster sustainable agro-ecological development (Pant et al., 2024).

Table 4. *Top 10 most collaborative institutions*

Ranking	Count	Centrality	Year	Country	Institution
1	25	0.24	2001	USA	University of California System
2	25	0.19	2001	Britain	University of London
3	15	0.04	2011	China	Chinese Academy of Sciences
4	14	0.02	2001	USA	Arizona State University
5	13	0.05	2003	Canada	University of Toronto
6	13	0.06	2008	USA	Harvard University
7	12	0.01	2001	USA	Arizona State University-Tempe
8	11	0.03	2018	Netherlands	Wageningen University & Research
9	10	0.03	2005	Netherlands	Erasmus University Rotterdam
10	10	0.07	2005	USA	CGIAR

A visual network cluster highlights research topics on sustainable public cooperation among various institutions. *Figure 6* shows the first eight collaboration clusters, demonstrating close partnerships and shared themes.

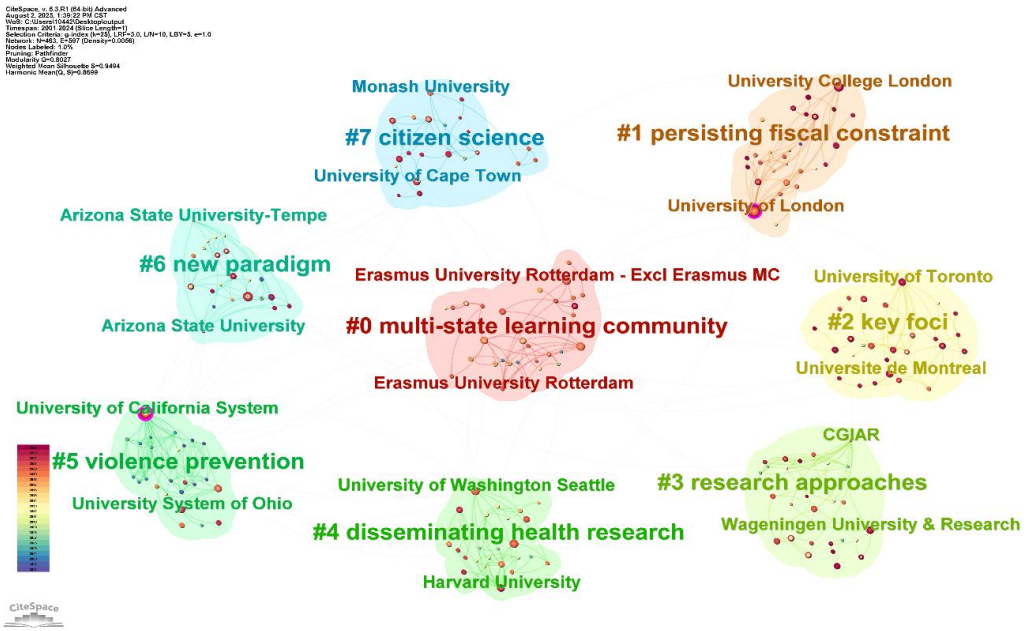

Figure 6. *Institutional collaboration network (note = 483, link = 597)*

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(1) Some clusters focus on methodologies to promote sustainable public cooperation. The cluster #0 (multi-state learning community) shows that diverse stakeholders enhance public cooperation through collaborative learning fueled by shared research goals. For example, Erasmus University Rotterdam recently studied how communities and local governments can collaborate to develop a sustainability framework that addresses past stakeholder tensions for a sustainable future (Macedo et al., 2020). Additionally, Wageningen University & Research, the representative institution of cluster #3 (research approaches), focuses on social network analysis, using the Canadian Arctic Research Network to illustrate how social networks promote sustainable public collaboration within an open and inclusive framework (Pigford et al., 2022). Arizona State University, the representative institution of cluster #6 (new paradigm), developed a new epidemic response model that integrates policymaker and health professional efforts to enhance sustainable prevention, detection, and treatment of epidemics (Fefferman et al., 2023). These studies primarily focused on public cooperation within specific regional fields and offered methodological support.

(2) Some clusters study social issues requiring sustainable public cooperation. For example, cluster #1 (persisting fiscal constraint) addresses fiscal constraints through partnerships; cluster #4 (disseminating health research) enhances health communication via collaborations, and cluster #5 (violence prevention) aims to reduce violence through public cooperation. The University of London, representing cluster 1, studies overcoming financial bureaucracy to address collaborative communities' lack of sustainable funding. It suggests communities build strong partnerships by sharing control over financial resources and decisions equally with partners to ensure a steady funding source (Thomson et al., 2024). Harvard University, representing cluster #4, finds that establishing the Global Health Service Partnership (GHSP) can effectively promote cross-border and regional cooperation, spread health knowledge, optimize global health resource allocation, and address global health challenges together (Kerry et al., 2022). Cluster #5's key institution, the University of California System, focuses on school-university partnerships that promote understanding among diverse students through cooperative education while aiming to reduce school violence (Kang and González-Howard, 2022). These studies provide case studies and strategies for addressing specific issues in sustainable public cooperation. Most issues are handled by specific regions within the country. However, cross-regional collaborative research focuses more on health issues and offers strategies for tackling global health challenges.

(3) Other clusters examine factors influencing sustainable public cooperation. Cluster #2 (key foci) focuses on key determinants. Université de Montréal studies show that interdisciplinary and interinstitutional collaboration, such as that among geochemists, government officials, and international projects, can address urgent issues like catastrophic weather events and epidemics (Bianchi et al., 2021). The University of Cape Town, representing cluster #7 (citizen science), shows that public participation in scientific research can accelerate solution innovation and promote sustainable healthcare system development as it transforms towards a net-zero goal (Weimann and Weimann, 2022). Research on factors influencing sustainable public cooperation includes both domestic and international collaboration. International efforts focus more on the global climate crisis, proposing relevant countermeasures.

The above analysis shows that various institutions focus on cooperation in economic, medical, social, and other fields. That highlights the diverse nature of sustainable public cooperation and extensive partnerships among research institutions to promote

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collaborative research. Most institutions prioritize domestic cooperation over international collaboration. Domestic efforts emphasize strengthening public cooperation to tackle regional challenges like financial constraints and violence prevention. In contrast, international cooperation mainly addresses health and climate issues. Future researchers are encouraged to enhance cross-regional and cross-border collaboration to develop more solutions for global problems.

Regional collaboration

Table 5 lists the top 15 regions for sustainable public cooperation across the USA, Asia, Europe, Oceania, and Africa, indicating significant global interest in this research field. Developed regions initiated research earlier and showed stronger collaboration, with 11 developed regions compared to only four developing ones. That is mainly because the developed regions typically have advanced social systems, technology, and industrial diversity, prioritizing sustainable public cooperation. Additionally, there are specific findings: (1) The United States leads in publication output with 340 co-authored papers—more than double China's second-place total of 159. However, its low centrality (0.03) indicates the need for research collaboration with different regions to boost impact. (2) China's high centrality (0.17) and early start date (2006) highlight its importance in the field. Recent articles emphasize sustainable water resource management in the Yangtze River Basin through multi-sectoral cooperation within an ecologically sustainable development framework (Zhou et al., 2024). (3) Germany, Sweden, Switzerland, and South Africa show high centrality but low publication counts, with 63, 58, 43, and 36 papers and centrality exceeding 0.1 (0.28, 0.12, 0.21, and 0.16, respectively). That shows a strong impact of collaborative research in these regions while highlighting the potential to increase research volume. It is recommended that these areas boost their cooperative articles without compromising quality to enhance research efficiency.

Table 5. *Top 15 most collaborative regions*

Ranking	Count	Centrality	Year	Regions
1	340	0.03	2001	USA
2	159	0.17	2006	China
3	123	0.03	2001	England
4	97	0	2002	Canada
5	87	0.06	2002	Australia
6	77	0	2008	Spain
7	74	0.04	2004	Netherlands
8	67	0.03	2003	Italy
9	63	0.28	2004	Germany
10	58	0.12	2005	Sweden
11	43	0.21	2004	Switzerland
12	42	0.03	2009	France
13	39	0.03	2009	India
14	36	0.16	2009	South Africa
15	34	0.01	2009	Brazil

Figure 7 presents a cluster map of regional cooperation in sustainable public collaboration, featuring 129 nodes and 268 links. The clusters highlight inter-regional

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cooperation and the region's primary research interests, with larger nodes indicating key cooperative areas. Key findings include:

(1) Some clusters focus on public collaboration for SDGs, including cluster #0 (sustainable development goals) and cluster #8 (potential public-private partnerships). The USA and Colombia represent cluster #0. One of their articles examines how intersectoral collaboration in public health can reduce alcohol-related issues and support the SDGs (Jernigan, 2023). England and Ghana represent cluster #8. Their research explored strengthening sustainable water management through public-private partnerships to support the SDGs (Rosely and Voulvoulis, 2024).

(2) Some clusters explore sustainable public cooperation in specific regions, including cluster #1 (transition countries) and cluster #6 (indian subcontinent). Germany and Romania represent cluster #1. German researchers study public cooperation for sustainable national transformation through corporate partnerships in Sweden, aiming at long-term climate governance. That provides insights for small towns globally to achieve climate goals (Kronvall et al., 2024). Canada and India represent cluster #6, emphasizing state involvement. They investigate sustainable public partnerships in the Indian subcontinent (including India, Pakistan, Bangladesh, and the Maldives) (Ali et al., 2009). One of their articles discusses collaborative efforts between Indian steel companies and government agencies to facilitate the transition to green steel production (Mallett and Pal, 2022).

(3) Some clusters are linked to public health, represented by Switzerland and Italy cluster #2 (public hospital) and Belgium and Portugal cluster #7 (health european). Researchers from Italy emphasize sustainable cooperation among hospital-related sectors. Belgium and Portugal, in cluster #7, focus on sustainable collaboration in European health. They propose strengthening cooperation among public health, hospital, and veterinary organizations across Europe by promoting the "one health" concept to ensure sustainable care (Taylor et al., 2024).

(4) Several clusters address practical social challenges through sustainable public cooperation, including cluster #3 (building capacity), cluster #4 (air pollution), cluster #5 (professional education), and cluster #9 (public health postgraduate programme). Netherlands and Australia, as representatives of cluster #3, focus on sustainable public collaboration in urban development, encouraging active citizen participation to improve infrastructure and achieve smart city transformation (Lee et al., 2023). China and Japan, representing cluster #4, focus on global collaboration to combat air pollution, raise environmental awareness, and mitigate its effects (Chen et al., 2024a). France and Spain represent cluster #5, focusing on technology for sustainable public cooperation in education. A Spanish study explores how open hardware models can facilitate collaboration between researchers and the public (Oellermann et al., 2022). The representatives from Israel and Ethiopia in cluster #9 aim to develop public health research talent. Their study highlights African CDCs' (Centres for Disease Control and Prevention) collaborative efforts to train professionals in pathogen genomics and bioinformatics, strengthening disease prevention across Africa (Onywera et al., 2024).

Co-citation analysis

Co-citation analysis helps researchers identify key journals, literature, and scholars, thereby improving their grasp of current research trends and hotspots, as well as the relationship between the past and future of the research areas. This section aims to answer Q3: What are the current research topics, and where do they originate from?

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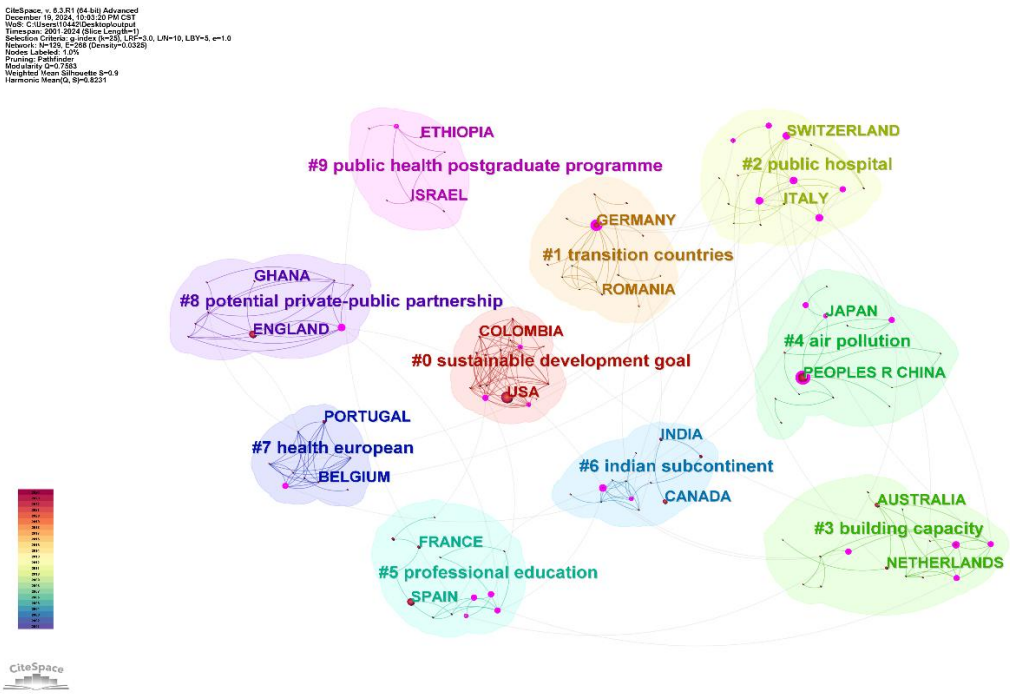

Figure 7. *Regional collaboration network (note = 129, link = 268)*

Author co-citation

Table 6 lists the top 15 authors with the most co-citations (excluding anonymous authors). Author co-citation occurs when two or more authors' works are co-cited, indicating their authority in the field. Here are some specific findings:

(1) Institutional authors have significant influence. Among the top 15 co-cited authors, six are international organizations: World Health Organization (WHO), United Nations (UN), European Commission (EU), Organization for Economic Co-operation and Development (OECD), World Bank (WB), and Food and Agriculture Organization of the United Nations (FAO). They account for more than one-third of the list, with co-citation counts of 125, 82, 68, 51, 45, and 32, respectively, highlighting the significant role of international organizations in sustainable public cooperation. Notably, the WHO leads with 125 co-citations and a centrality score of 0.12, highlighting its significant impact on the field. It has been consistently co-cited since 2005, indicating long-standing scholarly interest in its publications. The WHO focuses on improving public health governance by fostering sustainable collaboration between national public health institutes (NPHIs) and the private sector to strengthen NPHIs' roles in public health systems (Abou-Taleb et al., 2024). (2) Among individual authors, Ostrom E stands out with the highest co-citations (79) and centrality (0.15), highlighting this author's significant role in the field. She has been co-cited since 2010, indicating early recognition of the author's research compared to others. *Figure 8* shows this author's co-citation frequency from 2010 to 2024. From 2010 to 2017, this author's co-citations were inconsistent, with some years having zero co-citations, reflecting lower attention. Since 2018, this author's co-citations have shown a fluctuating increase, indicating continuous attention and growing peer recognition in sustainable public cooperation. This author's representative papers highlight that climate change is a global issue, and polycentric efforts can reduce the risks from greenhouse gas

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emissions (Ostrom, 2010). In summary, these highly co-cited authors show high co-citation frequencies and maintain centrality above 0.1, indicating the quality of their literature and substantial impact recognized by researchers in the field.

Table 6. *Top 15 most co-cited authors*

Ranking	Count	Centrality	Year	Co-cited authors
1	125	0.12	2001	World Health Organization
2	82	0.06	2009	United Nations
3	79	0.15	2010	Ostrom E
4	68	0.10	2013	European Commission
5	54	0.06	2011	Yin RK
6	52	0.02	2017	Ansell C
7	51	0.02	2016	Organization for Economic Co-operation and Development
8	45	0.01	2015	World Band
9	38	0.06	2015	Emerson K
10	32	0.03	2013	Food and Agriculture Organization of the United Nations
11	27	0.13	2016	Bryson JM
12	26	0.05	2014	Creswell JW
13	25	0.02	2011	Eisenhardt KM
14	24	0.02	2020	Braun V
15	22	0.04	2015	Geels FW

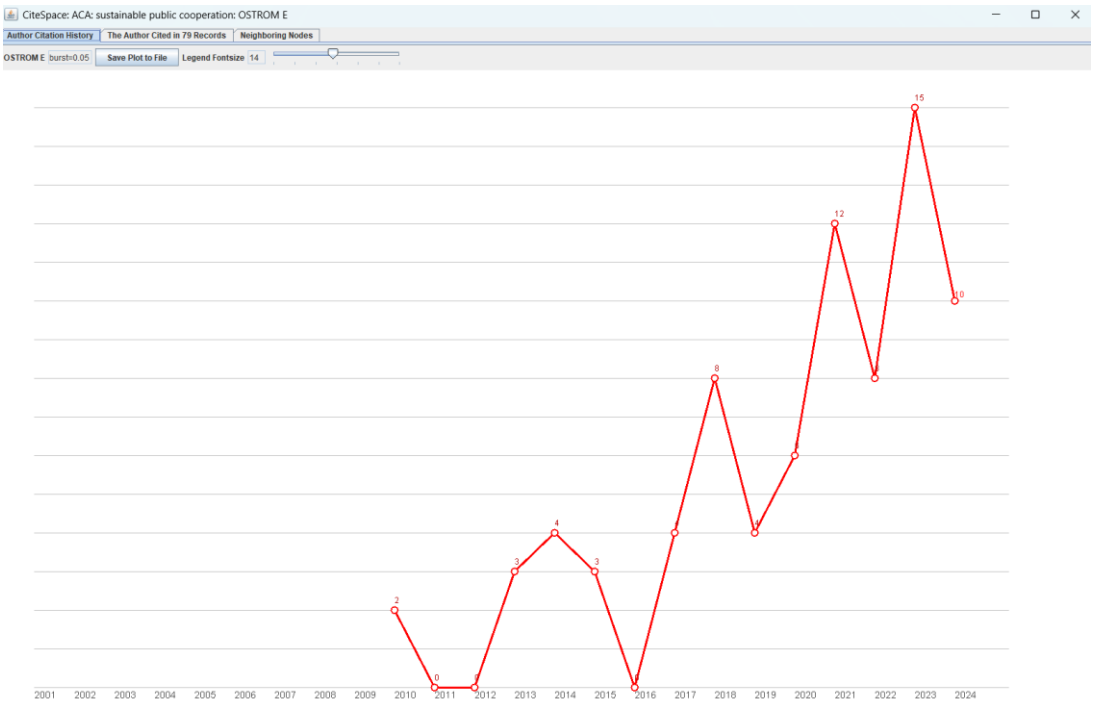

Figure 8. *Co-citation frequency of Ostrom's literature over years*

Figure 9 shows the author's co-citation network, displaying the top 10 clusters. We have some specific findings.

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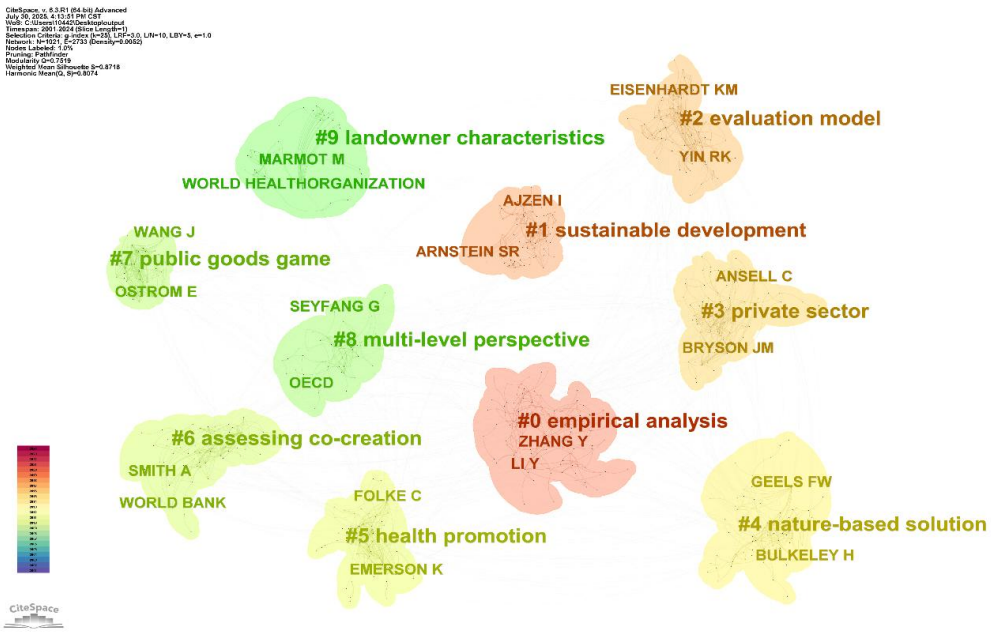

Figure 9. *Co-cited authors network (note = 1021, link = 2733)*

(1) Some clusters focus on stakeholders in sustainable public cooperation. For example, cluster #3 (private sector) emphasizes partnerships with the private sector to achieve SDGs. Cluster #9 (landowner characteristics) highlights landowners' collaboration with the environmental sector to improve social health and sustainability. The representative co-cited author of cluster #3, Bryson JM, advocates for joint participation among public, private, and non-profit organizations to strengthen cross-sector partnerships and multi-stakeholder interests (Nonet et al., 2022). In addition, the representative co-cited author of cluster #9, Marmot M, emphasizes improving social well-being through empowerment. He believes healthy and sustainable community development can be achieved through collaboration between the national government and local communities to empower residents (Marmot, 2016).

(2) Some clusters focus on solving specific sustainability issues through collaboration. Cluster #1 (sustainable development) promotes social sustainability through public engagement; cluster #5 (health promotion) examines public health issues within the framework of sustainable cooperation; and cluster #6 (assessing co-creation) addresses co-creation challenges to achieve mutual economic and social benefits. Arnstein SR, the representative author of cluster #1, explored types of citizen participation to enhance community-benefiting social projects' sustainability (Arnstein, 2019). In cluster #5, Folke C combined evolutionary theory with Social-Ecological Systems (SES) research through interdisciplinary collaboration to understand human-society-environment interactions and address health challenges arising from SES changes (Currie et al., 2024). Smith A from cluster #6 found that optimizing stakeholder co-creation in sustainable innovations can transform innovation models and ensure scientifically sound development for a better living environment for current and future generations (Leach et al., 2012).

(3) Some clusters focus on sustainable public cooperation solutions, including cluster #0 (empirical analysis), cluster #2 (evaluation model), cluster #4 (nature-based solution), cluster #7 (public goods game), and cluster #8 (multi-level perspective). Through empirical analysis, Li Y, a co-cited author in cluster #0, emphasizes the strong link between urban

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dynamics and sustainable transformation, stressing the importance of urban governance and public participation (Li et al., 2024b). In cluster #2, Eisenhardt KM introduces the "diplomat" model to help enterprises evaluate potential partners' reputations and collaboration prospects. This approach improves understanding of partner characteristics (Volmar and Eisenhardt, 2024). Bulkeley H from cluster #4 argues that collaborative nature-based solutions provide cities with new methods to tackle complex challenges and enhance resilience to climate change (Frantzeskaki et al., 2019). Wang J of cluster #7 developed a public goods game model to explore how initial wealth distribution influences public cooperation. The results indicate that involving wealthy individuals can enhance problem-solving outcomes in cooperative efforts (Wang et al., 2010). Seyfang G from cluster #8 advocates considering policy, societal, economic, and technological factors in cross-border collaborations for innovative waste disposal solutions (Acheson et al., 2024).

The findings highlight key research topics in sustainable public cooperation, guiding scholars and fostering field development.

Journal co-citation

Table 7 shows the top ten most co-cited journals in sustainable public cooperation research. All are Q1 journals co-cited over 100 times, highlighting their strong reputation. Key findings include: (1) Highly co-cited journals typically have high impact factors, with eight journals exceeding a 5-year IF of 6. Some leading journals, such as Science (IF = 50.3), Nature (IF = 54.4), and The Lancet (IF = 106.9), are included in the list, showcasing significant breakthroughs in this field. (2) Sustainability was co-cited 337 times since 2017. Recently, this journal has attracted significant attention from researchers focusing on sustainable public cooperation, serving as a reference and a target publication venue. A recent article highlights that collaboration between the public and private sectors is crucial for achieving healthy city targets and enhancing the efficiency of sustainable urban development (Wu, 2024). (3) Science and The Lancet are the earliest co-cited journals. Science has been co-cited since 2001, with a 5-year IF of 50.3 and the highest centrality (0.14) among the top ten journals. That underscores its importance in publishing quality articles on sustainable public cooperation and its widespread co-citation across various journals. A journal article revealed that various stakeholders are unwilling to collaborate to solve common environmental issues. It suggests promoting joint environmental governance through collaborative management and governance approaches (Bodin, 2017). A highly co-cited article in The Lancet analyzes Brazil's unified health system (SUS), highlighting the importance of private-public sector cooperation to improve universal health coverage and promote sustainable health system development (Castro et al., 2019).

Table 7. *Top 10 most co-cited journals*

No.	Count	Centrality	Year	Co-cited Journals	5-year IF
1	337	0	2017	Sustainability	3.6
2	296	0.04	2009	Journal of Cleaner Production	10.2
3	220	0.14	2001	Science	50.3
4	200	0.02	2011	PLoS One	3.3
5	159	0.03	2004	Nature	54.4
6	158	0.09	2001	Lancet	106.9
7	148	0.04	2008	Ecological Economics	6.9
8	147	0.03	2006	Journal of Environmental Management	7.9
9	129	0.03	2012	Proceedings of the National Academy of Sciences of the United States of America	10.8
10	129	0	2017	Science of the Total Environment	8.6

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Co-citation journal clustering enhances our understanding of research topics in co-cited journals, enriching the field's knowledge base. In *Figure 10,* we identified nine key clusters and made the following observations.

(1) Some clusters investigate various research methods for sustainable public cooperation. Cluster #0 (nature-based solution) and cluster #4 (case study) use case studies to explore sustainable public cooperation in natural solutions. Cluster #3 (public goods game) primarily employs experimental methods, such as public goods game tasks. The representative co-cited journal of cluster #0 is Sustainability, whose recently co-cited article found that urban planning is critical in promoting the application of nature-based solutions (NBS) in urban development, proposing innovative solutions for green space through public and private collaboration (Högström et al., 2021). The representative journal of cluster #3 is Nature. A notable paper from this journal suggests that social diversity enhances cooperative behavior in scenarios like global warming by challenging the assumption of individual equivalence in traditional game theory (Santos et al., 2008). Cluster #4's representative journal, Public Administration Review, focuses on collaborative governance theory and practice. Recently, the article analyzed cases to pinpoint key variables (such as cooperation history, incentives, power dynamics, and institutional design) and critical factors (communication, trust, commitment, and shared understanding) influencing successful collaborative governance (Ansell and Gash, 2008).

(2) Some clusters focus on solution strategies for sustainable public cooperation. For instance, cluster #5 (collaborative governance) aims to reduce carbon emissions through public-private partnerships in environmental governance, while cluster #6 (public technology) fosters sustainable collaboration in public technology. The representative journal for cluster #5 is the Science of the Total Environment. A highly co-cited paper from this journal explores the synergistic effect between public demand, air pollution control policies, and carbon emission reduction. It finds that stronger public environmental advocacy improves collaborative governance efficiency for reducing carbon emissions among local governments and enterprises (Yang et al., 2022b). The representative journal for cluster #6 is the Journal of Business Research. A highly co-cited paper from this journal explores the synergistic effects of public demand, air pollution control policies, and carbon emission reduction. It finds that stronger public environmental advocacy improves collaborative governance efficiency for reducing carbon emissions between local governments and enterprises (Ribasaukiene et al., 2024).

(3) Some clusters focus on sustainable public cooperation across various fields. Cluster #1 (public health) focuses on sustainable public cooperation in health. Cluster #2 (sustainable development) aims at sustainability goals through collaboration. Cluster #7 (promoting urban children) addresses urban children's development via public partnerships. Cluster #8 (agri-food system) emphasizes sustainable cooperation in agriculture and food. The representative journal for Cluster #1 is PLoS One, where a highly co-cited article shows that collaboration between public health policymakers and experts enhances policy effectiveness (Makkar et al., 2018). For cluster #2, the representative journal is the Journal of Business Ethics. Key papers examine cross-sector social partnerships and their role in achieving sustainable development goals (Yin and Jamali, 2021). The representative journal for cluster #7 is the American Journal of Community Psychology. A highly co-cited paper in this journal emphasizes that collaborations between university public health schools and community-based organizations (CBOs) significantly enhance long-term public cooperation for urban children's development (Ozer et al., 2008). The representative journal for cluster #8 is

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Agriculture, Ecosystems & Environment. A notable co-cited paper discusses challenges in urban agriculture, particularly nature conservation, concluding that local governments can achieve sustainable development goals by fostering cooperation, encouraging innovation, establishing regulatory frameworks, and showcasing successful examples (Royer et al., 2023). In summary, these clusters encompass diverse fields such as sociology, agriculture, health, and the environment. We recommend that scholars focused on sustainable public cooperation follow high-impact journals like Nature and The Lancet to stay updated on cutting-edge research.

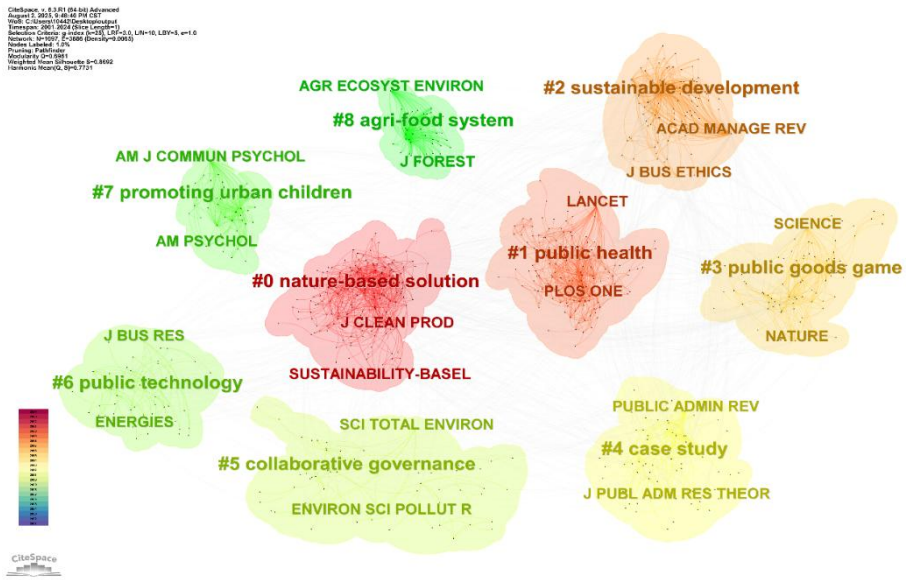

Figure 10. *Co-cited journals network (note = 1097, link = 3886)*

Reference co-citation

Table 8 presents the top 13 most frequently co-cited references in this field. This analysis helps researchers identify valuable key references. Notably, the second and fourth co-cited references in *Table 8* are Yin RK's case study books, highlighting the importance of case studies in this field and their significance to researchers. In addition, there are some findings. (1) There are four co-cited references on sustainability. The most co-cited reference outlines sustainable transformation's current and future directions, emphasizing the need for interdisciplinary collaboration across all societal sectors (Köhler et al., 2019). Another reference suggests that "smart, sustainable city" is a more precise term than "smart city," highlighting the need to further develop the smart city framework (Ahvenniemi et al., 2017). Willett W. advocates global cooperation to promote environmental sustainability and develop healthy diets and sustainable food systems (Willett et al., 2019). Hueskes M's research indicates that integrating sustainability into public-private partnership management remains an unresolved challenge (Hueskes et al., 2017). (2) Collaboration is a key theme in the co-cited references, emphasized by three notable co-citations. Emerson K proposes a framework for collaborative governance, integrating social cooperative learning and institutional arrangements to aid scholars in analyzing complex policy issues (Emerson et al., 2012). Bodin Ö highlights the role of collaborative governance in tackling environmental challenges through an interdisciplinary network that demonstrates cooperation within ecosystems (Bodin, 2017). Rand DG examines human cooperative

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behavior via five mechanisms: direct reciprocity, indirect reciprocity, spatial selection, multilevel selection, and kin selection, concluding that humans naturally favor cooperative strategies offering rewards (Rand and Nowak, 2013). (3) Two co-cited references from the last three years rank among the top ten articles, highlighting current research directions in sustainable public cooperation. Page MJ's article summarizes the methods for literature review identification, selection, evaluation, and synthesis (Page et al., 2021). Donthu N's latest article examines the impact of artificial intelligence on organizational purchasing behavior, revealing that AI enhances coordination and cooperation among members while reducing conflicts (Osmonbekov et al., 2024). These references help scholars build a knowledge base on sustainability, collaboration, and cooperative strategy, inspiring future research directions.

Table 8. *Top 13 most co-cited references*

No.	Count	Centrality	Year	Reference
1	8	0.01	2019	Köhler J, 2019, ENVIRON INNOV SOC TR, V31, P1
2	7	0	2014	Yin RK, 2014, CASE STUDY RES DESIG, V0, P0
3	6	0	2021	Page MJ, 2021, BMJ-BRIT MED J, V372, P0
4	6	0	2014	Yin RK, 2014, APPLICATIONS OF CASE STUDY RESEARCH, V2nd, P0
5	6	0	2022	Bezner Kerr R, 2022, CLIMATE CHANGE 2022: IMPACTS, V0, P713
6	5	0	2017	Ahvenniemi H, 2017, CITIES, V60, P234
7	5	0	2012	Emerson K, 2012, J PUBL ADM RES THEOR, V22, P1
8	5	0	2017	Bodin Ö, 2017, SCIENCE, V357, P659
9	4	0	2013	Rand DG, 2013, TRENDS COGN SCI, V17, P413
10	4	0	2021	Donthu N, 2021, J BUS RES, V133, P285
11	4	0	2018	Rüegg SR, 2018, FRONT VET SCI, V5, P0
12	4	0	2019	Willett W, 2019, LANCET, V393, P447
13	4	0	2017	Hueskes M, 2017, INT J PROJ MANAG, V35, P1184

Figure 11 highlights the eight most critical clusters in the reference's co-citation network. Among them, "case studies" remain the same as the previous clustering topic and are important in the field. Here are some details:

(1) Some clusters focus on sustainable public cooperation development. For example, cluster #1 (prospect) focuses on public collaboration in sustainable energy technology, highlighting key global projects in storage technology (Wolf, 2002). Cluster #3 (structural context) examines sustainable public cooperation within specific structural contexts, showing that "new" cooperatives focus more on common interest goals than traditional ones. These cooperatives have emerged globally in renewable energy (Huybrechts and Mertens, 2014).

(2) Some clusters focus on achieving and researching methods for sustainable public cooperation. For instance, cluster #4 (participative approach) focuses on participatory methods for sustainable public collaboration, highlighting the importance of diverse interest group involvement and cooperation to improve planning quality and achieve sustainability goals (Berke and Manta, 1999). Cluster #6 (case study) examines case studies on sustainable development cooperation, emphasizing the integration of Circular Economy (CE) and Industry 4.0 (I4.0) to achieve SDGs and highlighting the need for further research in this area (Dantas et al., 2021).

(3) Certain clusters explore sustainable public cooperation in specific contexts. For example, cluster #0 (adaptive co-management) focuses on adaptive co-management systems. The representative reference found that group development depends on mutual

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adaptation and member collaboration. Environmental sustainability conservation programs can be promoted through joint group management of resources (irrigation, microfinance, forest protection, integrated pest management) (Pretty and Ward, 2001). Cluster #2 (start-up collaboration) focuses on sustainable public cooperation in innovation and entrepreneurship. Key reference highlights that effective partnerships foster trust, communication, collaboration, and innovation while reducing inefficiencies in the food supply chain (Bustos and Moors, 2018).

(4) Some clusters focus on public participation in sustainable cooperation. Cluster #5 (Morice) focuses on sustainable public cooperation under the Morice Innovative Forest Practices Agreement (IFPA), supporting British Columbia's Public Engagement Model for forest management. Representative reference indicates that the public's ability to participate in environmental policy and achieve environmental justice can be improved by providing suitable platforms and educational resources to help vulnerable groups better understand and engage with policy issues (Overdevest, 2000). Cluster #7 (accountability) highlights the importance of public accountability in national forest planning through sustainable collaboration. The reference underscores the changing relationship between the public sector and citizens in forest management, highlighting ongoing public commitment and responsibility (Coulombe, 2004).

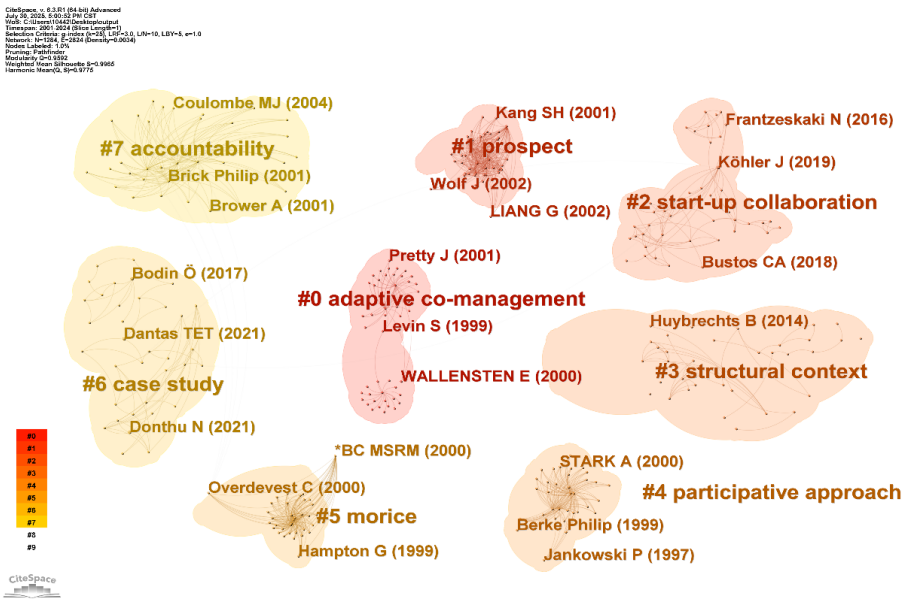

Figure 11. *Co-cited references network (note = 1284, link = 2884)*

Co-occurrence analysis

Co-occurrence analysis helps researchers understand the evolution and trends of research hotspots, enabling more efficient research planning and execution. This section aims to answer Q4: What are the research hotspots and frontier topics?

Co-occurrence categories

Table 9 lists the top ten co-occurrence categories in sustainable public cooperation research, with key findings: (1) All top ten categories emerged before 2010. The earliest, "Public, Environmental & Occupational Health," appeared in 2001 with a centrality of

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over 0.19, highlighting its ongoing importance. Recent studies within this category focus on public health responses to CBRN (chemical, biological, radiological, and nuclear) terrorism in the Middle East and North Africa, emphasizing the need for better emergency preparedness, improved response systems, sustainable health policies, and international cooperation to mitigate CBRN effects (Mani et al., 2024). (2) Both "Economics" (0.44) and "Ecology" (0.43) exhibit high centrality values exceeding 0.4, indicating their significant influence in this field. However, "Engineering" and "Environmental" have a higher occurrence frequency of 42 but a centrality of 0, indicating numerous results that are not as effectively linked across different disciplines compared to "Economics" and "Ecology." A recent article in "Ecology" stresses that governments and the public must collaborate in global environmental governance for sustainability (Gao et al., 2024d). (3) After comparing *Tables 2* (number of classified publications) and *9* (co-occurrence of categories), the most published categories remain consistent, underscoring their importance in this multidisciplinary field. Researchers are encouraged to focus on these key categories in their studies.

Table 9. *Top 10 most co-occurrence categories*

Ranking	Count	Centrality	Year	Categories
1	343	0.06	2003	Environmental Sciences
2	268	0.18	2002	Environmental Studies
3	250	0.22	2009	Green & Sustainable Science & Technology
4	175	0.19	2001	Public, Environmental & Occupational Health
5	58	0.44	2005	Economics
6	51	0.22	2007	Management
7	43	0.27	2004	Health Policy & Services
8	42	0.00	2005	Engineering, Environmental
9	37	0.11	2005	Water Resources
10	36	0.43	2002	Ecology

Figure 12 shows seven clusters of category co-occurrences across various disciplines. Based on the theme, they can be divided into three categories.

(1) Some clusters focus on sustainable public cooperation in transportation, such as cluster #3 (public transport) and cluster #4 (mobility information service). Cluster #3 includes the categories of "Economics" and "Business". A representative paper from cluster #3 discusses enhancing local public transport services through crowdsourcing and digital collaboration, improving citizens' travel experiences, and promoting sustainable transport development (Tiglao et al., 2023). Cluster #4 encompasses "Management" and "Management Science." The representative paper proposes an off-hour delivery (OHD) plan that encourages collaboration between private and public sectors and academia to provide accurate traffic data and predictions. This strategy aims to effectively reduce urban traffic pressure while enhancing citizens' quality of life (Holguín-Veras et al., 2018).

(2) Some clusters focus on forms of sustainable public cooperation, such as cluster #2 (public-private partnership) and cluster #6 (community action). Cluster #2, represented by "Public Administration" and "Geography," highlights a study on how public-private partnerships promote sustainable economic development in rural areas. By collaborating

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with public authorities, enterprises can build trust, achieve economies of scope, address rural challenges, and unlock their full potential for rural sustainability (Steiner and Teasdale, 2019). Cluster #6 includes "Nursing" and "Psychiatry." A key study highlights the importance of community action and identifies public health organizations' limitations in organizational capacity, economic resources, and professional expertise. It argues that partnering with the private sector can enhance community health services' economic quality and sustainability (Giusti and Persiani, 2023).

(3) Some clusters focus on applying sustainable public cooperation in specific areas: cluster #0 (public health), cluster #1 (bioinformatics application), and cluster #5 (urban agriculture). Cluster #0, represented by the categories of "Ecology" and "Environment," discusses how environmental governance through public cooperation can improve health outcomes. Key papers indicate that interdisciplinary collaboration can tackle wastewater pollution and help achieve UN sustainable development goals such as clean water, public health, and climate action (Khanzada et al., 2023). Cluster #1, represented by the "Biotechnology" category, promotes the bioeconomy through sustainable public collaboration. The bioeconomy depends on land and marine resources. New collaborations between businesses and public institutions can ensure sustainable marine resource use and boost bioeconomic growth (Refsgaard et al., 2021). Cluster #5, represented by "Environmental Sciences" and "Environmental Studies," focuses on strategies for fostering sustainable public cooperation to protect agriculture and the environment. A study found that farm pond protection in developing countries is inadequate. Sustainable pond conservation can be achieved through public participation, collaboration, and top-down regulation (Chen et al., 2019).

In summary, this research field is multidisciplinary, encompassing cooperation across various fields, forms, and scenarios. We encourage researchers to expand their focus within existing frameworks and explore new ideas in other disciplines.

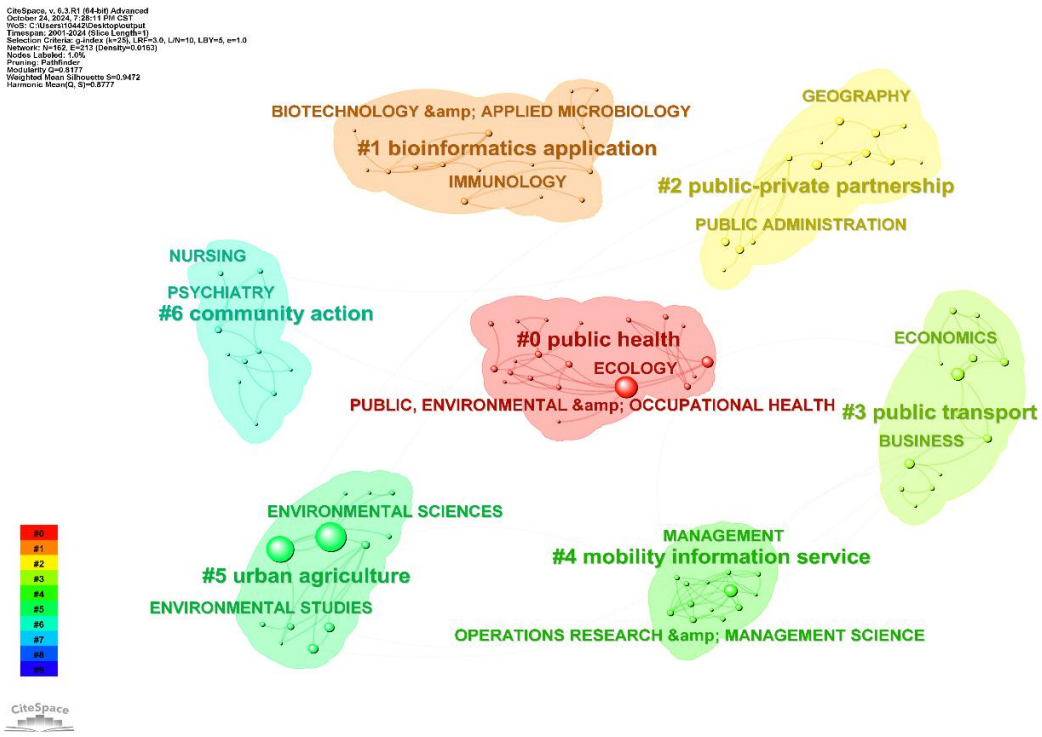

Figure 12. *Category co-occurrence network (note = 162, link = 213)*

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Co-occurrence keywords

Table 10 presents the top 15 co-occurring keywords in sustainable public collaboration, highlighting key topics. The analysis is as follows: (1) "Management" is the most prominent keyword, with the highest frequency (142) and centrality (0.12), attracting significant scholarly attention. For example, Ortega M's paper highlights challenges in sustainable collaboration in public management. It advocates for systematic training and incentives for managers to promote such cooperation, particularly in anti-corruption initiatives (Onyango, 2024). (2) Most keywords emerged after 2009, particularly "public health" (63 times) and "climate change" (53 times). The centrality of "public health" is 0.1, indicating its significant role as a key research topic. Suarez-Herrera JC's paper discusses global health challenges and WHO strategies, emphasizing cross-sector collaboration, public-private partnerships, and social participation as essential approaches to address emerging health crises and improve public health indicators. Additionally, two keywords from 2012— "sustainability" (72 times) and "policy" (67 times)— ranked among the top five. Researchers are now focusing on sustainable development by enhancing community leadership and encouraging diverse participation (Ohnishi et al., 2024). In addition, we can achieve sustainable transport in integrated planning through intergovernmental cooperation, public participation, and proactive communication (Soliz et al., 2024). (3) The keyword "governance" deserves attention. Emerging in 2014, it ranked as the third most frequent term (82 times), highlighting its significance in recent scholarly research. Researchers recently found that a strong collaborative governance framework can promote cooperation among actors and stakeholders, effectively addressing livestock production and environmental challenges (Avalos et al., 2024). These high-frequency keywords highlight key research topics across disciplines, offering valuable insights into primary research focuses on different development stages.

Table 10. *Top 15 most co-occurrence keywords*

Ranking	Count	Centrality	Year	Keyword
1	142	0.12	2003	Management
2	83	0.08	2010	Impact
3	82	0.05	2014	Governance
4	72	0.04	2012	Sustainability
5	67	0.05	2012	Policy
6	64	0.05	2006	Sustainable development
7	63	0.11	2009	Public health
8	60	0.01	2015	Framework
9	57	0.03	2015	Performance
10	56	0.05	2002	System
11	53	0.05	2009	Climate change
12	51	0.09	2004	Cooperation
13	47	0.06	2013	City
14	45	0.06	2008	Innovation
15	41	0.05	2014	Model

Figure 13 presents a time-series co-occurrence keyword clustering chart, illustrating the evolution of research hotspots over time. Key findings include:

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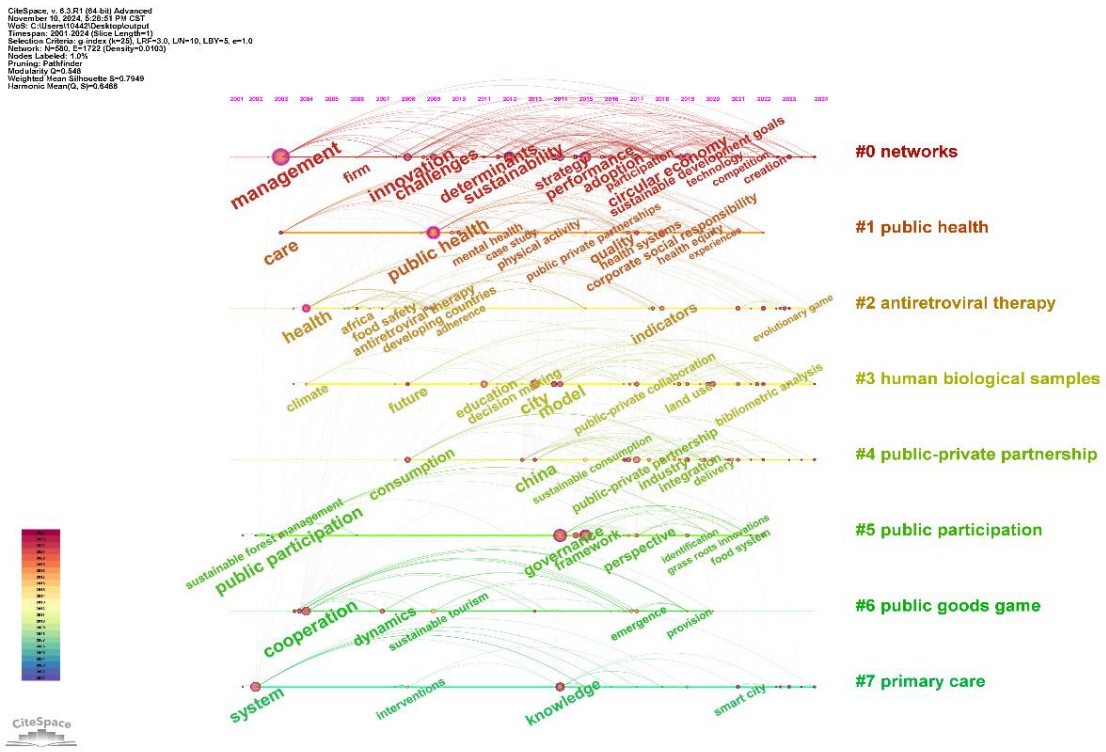

Figure 13. *Keyword co-occurrence time-series*

(1) Cluster #0 (networks) is central to discussions on sustainable public collaboration networks. It covers two key areas: research on cooperation networks, including management, performance, and circular economy, and the role of electronic network technology in supporting sustainable collaboration, highlighted by innovation. Initially (from 2001 to 2009), researchers emphasized managing public cooperation networks. The keyword "management" has emerged as a key node since 2003, indicated by its distinct purple outer circle and ongoing relevance in the network. Recent studies highlight the crucial role of non-profit organizations in managing sustainable collaborative innovation for cultural dissemination, relationship building, service provision, and advancing the 2030 Agenda for SDGs (Mariani et al., 2022). In the intermediate stage (from 2010 to 2019), researchers focus on enhancing network innovation projects through public cooperation and improving governance performance. The study on the keyword "innovation" shows that cross-border network projects enhance SMEs' innovation strategies through collaboration with universities, public institutions, and research organizations (De Giorgi et al., 2015). The keyword "performance" underscores combining big data and environmentalism to enhance environmental governance. Recent studies show that environmental organizations using big data promote green social capital, fostering collaboration among public, private, and voluntary sectors (Xu and Zhang, 2020). Recent studies from 2010 to 2024 have highlighted the role of networked governance in improving "circular economy" collaboration. Public leaders can leverage partnerships to drive green transformation and achieve sustainable development goals (Nielsen et al., 2024).

(2) Cluster #1 (public health) emphasizes the need for participatory and collaborative research across sectors to provide evidence for policy and address complex public health challenges. From 2001 to 2009, researchers focused on keywords such as "care" and

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"public health." The latest research highlights improving refugee cultural safety through localization and cross-sectoral cooperation, showing deep concern for the refugee community (Hawkins et al., 2023). From 2010 to 2019, the representative keyword was "health systems." A recent study indicates that collaboration between private healthcare institutions and public health sectors can improve the sustainability of health systems and universal health welfare in low-income countries (Ali et al., 2022). In recent years (from 2020 to 2024), the keyword "corporate social responsibility" (CSR) has highlighted factors influencing CSR levels in marine tourism enterprises and restaurants. Collaboration with public administrations is crucial for reducing business barriers and promoting sustainable tourism development (González-Morales et al., 2023).

(3) Cluster #5 (public participation) emerged earlier, emphasizing social participation in sustainable public collaboration. The keyword "public participation" first appeared in 2003 and gained traction among researchers in 2016. Recent studies highlight the role of mass media in enhancing participatory landscape revitalization. Collaboration between landscape architecture firms and public media can further promote sustainable urban transformation (Zhao et al., 2023). Keywords that emerged in the middle (from 2010 to 2019) phase discussed public participation in management. The keyword "governance" highlights the importance of ICT and Public Participation in Geographic Information Systems (PPGIS) in urban management within smart cities. Studies show that collaboration between government and citizens, ICT use, and social engagement are essential for smart city development (Szarek-Iwaniuk and Senetra, 2020). Recently, researchers have focused on the "food system." Studies show that charitable foundations foster collaboration among the food industry, agriculture, public health, and nutrition via multi-stakeholder funding and research. This cooperation addresses key challenges like food safety and nutritional sustainability (Nurkolis et al., 2024).

(4) The latest keyword cluster #4 (public-private partnership) focuses on using PPP to develop infrastructure projects that meet social and economic needs and promote sustainable development (Wegrzyn and Wojewnik-Filipkowska, 2022). From 2001 to 2009, research focused on leveraging public-private partnerships to promote consumption. Research on the keyword "consumption" shows that tourism enterprises can partner with public institutions and non-profits to promote initiatives linking consumption to social responsibility (Truong and Hall, 2017). From 2010 to 2019, research shifted toward how emerging economies in China manage risks through public-private partnerships. Recent studies under the keyword "China" show that public-private partnerships in China promote green bond project development by sharing risks, resources, and technology (Fu and Ng, 2021). From 2020 to 2024, research on "public-private partnership" examines stakeholders' attitudes toward successful PPP projects and introduces a benefit-engagement model to help partners identify stakeholders more effectively (Wegrzyn and Wojewnik-Filipkowska, 2022).

(5) Cluster #7 (primary care) includes fewer keywords. From 2002 to 2024, despite only four co-occurrence keywords, they highlight evolving research hotspots. "System" is one of the earliest keywords in the cluster. Research on "system" examines primary care and public health integration in 45 U.S. states, highlighting key success factors like financial adequacy, stakeholder engagement, and leadership. Future research should further investigate the importance and interrelationships of these determinants and assess the sustainability and effectiveness of integration (McVicar et al., 2019). In the mid-term, researchers focused on cross-organizational cooperation in primary healthcare. Studies explored the life cycle modeling of inter-organizational collaborations (IOC) in health,

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divided into five non-linear phases: contemplating, connecting, planning, implementation, and maintenance or dissolution. This model offers practical guidance for IOC implementers, evaluators, and researchers (Aunger et al., 2023). The latest keyword in the cluster is "smart city," highlighting public sector collaboration with external stakeholders to address socio-economic and sustainability challenges in smart cities (Buyannemekh et al., 2023).

In summary, the complexity and diversity of these themes indicate that research on sustainable public cooperation should integrate disciplines such as public health, environmental science, management, and sociology for interdisciplinary exploration.

Keywords bursts

Keyword bursts help understand shifts in research hot spots, and *Figure 14* displays the top 20 breakout keywords from 2001 to 2024. These keywords highlight evolving research focus over time. Here are some specific findings:

(1) The earliest burst keyword is "children" (2004), associated with sustainable public cooperation for their healthy development. The 11-year burst duration reflects sustained researcher interest. The first keywords to appear are not necessarily the ones that burst first. Although "system" first appeared in 2002, it did not gain significant attention until 2015, when its burst intensity reached 3.54, ranking fifth.

(2) The five most intense keywords are "public health" (5.11), "sustainable tourism" (4.86), "services" (4.18), "networks" (3.68), and "system" (3.54). This indicates that these words greatly interest researchers, revealing shifts in trending topics and popular subjects within the field.

(3) Recent keywords in this field include "smart city," "services," and "circular economy," indicating key research frontiers. Current studies of "smart city" focus on sustainable urban governance within smart contexts, highlighting the importance of collaboration among governments, individuals, and local communities through information and communication technologies (ICTs) to advance smart city initiatives (Barancelli et al., 2024; Hilal et al., 2022). Research about "services" shows that the public and community sectors address vulnerabilities marginalized migrants face through cross-sectoral cooperation, offering comprehensive services to refugees and asylum seekers (Gautier et al., 2023). In addition, public-government partnerships can promote the "circular economy" to improve plastic waste management services, thereby enhancing urban quality of life and sustainability (Prabawati et al., 2023).

(4) By analyzing keyword trends over time, we observe a shift in research focus from early topics like "children" and "public health" to recent ones such as "smart city" and "circular economy," highlighting evolving research trends. Before 2010, there were fewer burst keywords with longer durations, concentrating on sustainable public cooperation related to "children," "conservation," and "sustainable tourism." From 2010 to 2015, the focus shifted to promoting sustainable development in areas like "public health," "education," and "biodiversity" through public cooperation. Between 2016 and 2020, more frequent but shorter bursts of keywords emerged, focusing on "cooperation networks," "indicators," "resilience," and achieving SDGs via public-private partnerships. Since 2021, continuous bursts of keywords suggest that "smart city," "services," and "circular economy" will likely be future priorities for sustainable public cooperation.

These keywords span multiple disciplines, reflecting the interdisciplinary nature of this research field and its evolving trends. Scholars should engage in interdisciplinary studies to address practical problems in sustainable public development.

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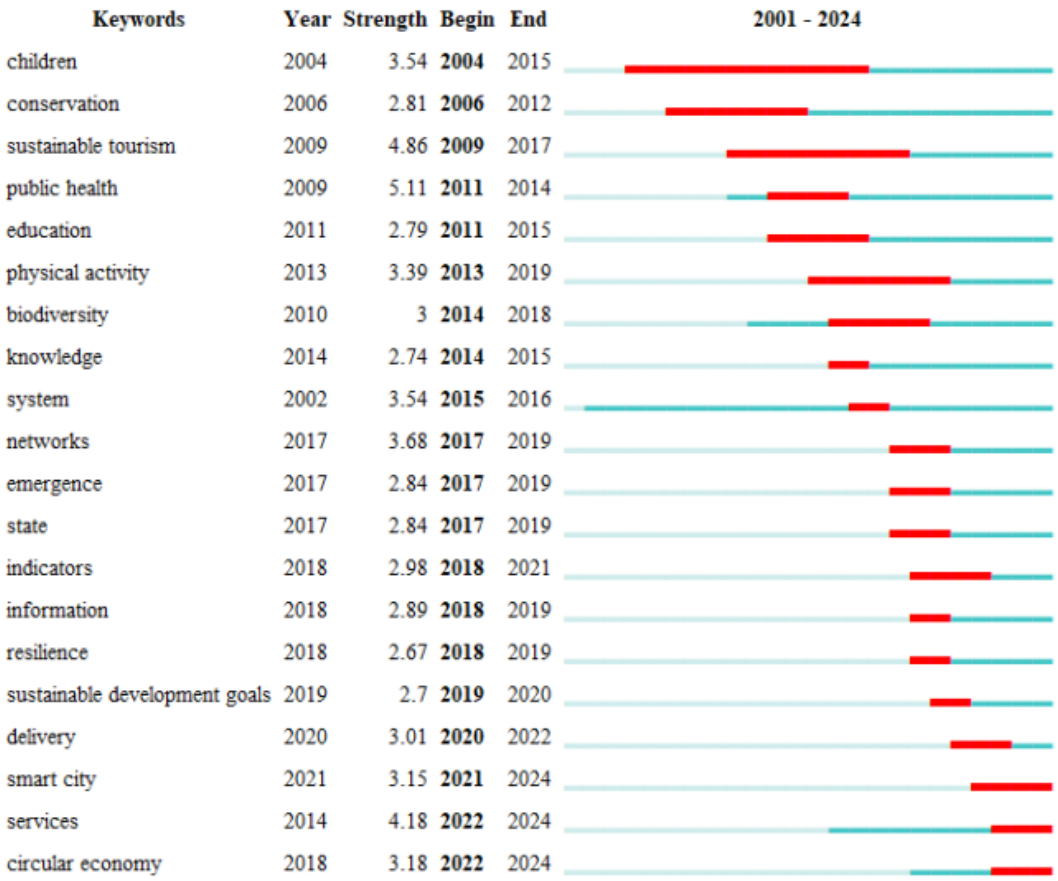

Figure 14. *Top 20 keywords with strong bursts*

Knowledge framework

This study systematically analyzed previous research on sustainable public collaboration, creating a comprehensive knowledge framework through publication statistics, cooperation analysis, co-citation analysis, and co-occurrence analysis. This framework outlines the knowledge base, collaboration relations, current status, and evolutionary progress in the field. Publication statistics highlight the fundamentals of the field, addressing "Q1: Is sustainable public cooperation widely studied?" That helps researchers grasp research trends and dominant disciplines. Collaboration analysis shows who collaborates frequently and their preferred topics, addressing "Q2: Who collaborates more frequently, and what are their favorite topics?" That aids in identifying key authors, regions, institutions, and subjects for collaboration. Co-citation analysis details current research topics and their origins, using co-cited journals, references, and authors, addressing "Q3: What are the current research topics, and where do they originate from?" Co-occurrence analysis tracks the field's evolution by examining frequent keywords, disciplines, and trends, helping future scholars understand research hotspots and frontiers at different stages. That answers "Q4: What are the current research topics, and where do they originate?" This framework helps readers quickly access key information about the field—offering valuable insights for future research (Geng et al., 2023a). *Figure 15* illustrates this knowledge framework. Here are some details.

Statistical analysis shows the publication trends and identifies the key journals and primary categories in this research field. Specifically, there is an overall increase and

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diversification in publications. The top five journals by the number of articles published are Sustainability, Journal of Cleaner Production, International Journal of Environmental Research, Public Health Management Practice, and Frontiers in Sustainable Food Systems, with Sustainability leading significantly. Besides, key categories include "Environmental Sciences," "Environmental Studies," "Green Sustainable Science Technology," and "Public Environmental Occupational Health Economics," showing the field's multidisciplinary nature covering environment, medicine, and economics.

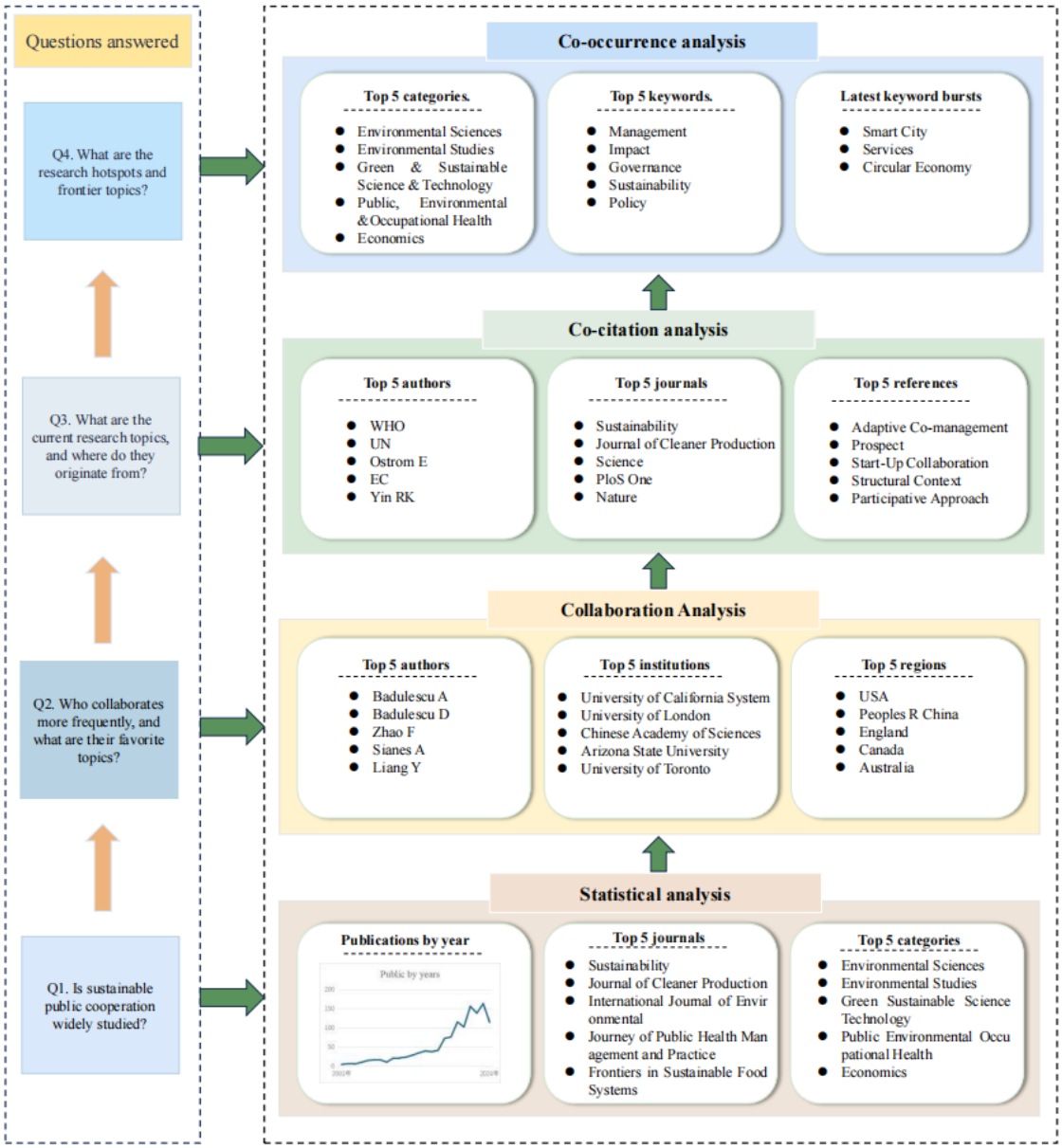

Figure 15. *Knowledge framework*

Collaboration analysis reveals key institutions, regions, and authors, enhancing our understanding of collaborative relationships. This analysis offers researchers references for potential partners and joint research areas while helping scholars find future collaborators with shared interests. Overall, collaboration is most frequent among the

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USA, the People's Republic of China, England, Canada, and Australia. The University of California System, University of London, Chinese Academy of Sciences, Arizona State University, and University of Toronto are the most active institutions. Notable collaborating authors include "Badulescu A," "Badulescu D," "Zhao F," "Sianes A," and "Liang Y." Additionally, the topics of collaborative research span economics, medicine, and society, encompassing partnerships, cross-border and regional cooperation, learning exchanges, and education. Research methods include case studies and bibliometrics. These collaboration dynamics serve as valuable resources for future scholars in this field.

Co-citation analysis of authors, journals, and references can provide insight into field topics and the sources of their knowledge. Highly co-cited authors include "WHO," "UN," "Ostrom E," "EC," and "Yin RK." They focus on empirical analysis, sustainable development, evaluation models, the private sector, and nature-based solutions. In contrast, highly co-cited journals include Sustainability, Journal of Cleaner Production, Science, PLoS One, and Nature. These journals focus on nature-based solutions, public health, sustainable development, public goods games, and case study. Co-cited references highlight adaptive co-management, start-up collaboration, structural context issues, and participative approaches.

We can identify current research hotspots and predict future directions by analyzing category co-occurrence, keyword trends, and bursts. The key categories of co-occurrence include "Environmental Sciences," "Environmental Studies," "Sustainable Science," "Health," and "Economics." The most frequent keywords co-occurrence reveals core themes, including management, impact, governance, sustainability, and policy. Future research will focus on promoting sustainable development in smart cities, services, and the circular economy through cooperative networks. These areas are crucial for advancing this field.

Discussion on future research directions

Research on sustainable public collaboration has recently gained significant traction among scholars. As the field evolves, emerging trends and hot spots are shifting. This study analyzes existing literature to identify future research directions in sustainable public cooperation, offering valuable insights for researchers. The specific areas of focus include:

(1) Future studies will cover various aspects of sustainable public cooperation. In environmental research, there will be a focus on collaborative governance to reduce carbon emissions (Keita and Kourouma, 2023), achieve carbon neutrality (Lu et al., 2022), mitigate air pollution (Yang et al., 2022b), address climate change (Li et al., 2024a), and explore strategies for ecological sustainability. In agriculture, topics may involve the sustainability of agricultural water supply (Shin et al., 2023), agri-food systems (Salazar et al., 2020), urban agricultural development (De Jesus and Borges, 2024), and agroecology (Zerbian and López-García, 2024). For example, enhancing collaboration between users and water suppliers ensures the long-term sustainability of the public water supply (Shin et al., 2023). In healthcare, attention will shift to collaborations between public health organizations and private entities for epidemic control (Fefferman et al., 2023), enhancing health communication (Kerry et al., 2022), transforming the healthcare system (Lin et al., 2024), addressing global health challenges influenced by globalization, and promoting equitable, sustainable health systems (Suarez-

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Herrera et al., 2024). Based on the above analysis, the environment, agriculture, and health care in sustainable public cooperation are key future topics, with interdisciplinary research emerging as a trend.

(2) Future research should adopt new theories and methods to address challenges in sustainable public cooperation (Gao et al., 2024a). Approaches such as case studies, bibliometric analysis, public goods games, empirical analysis, and evaluation models can offer fresh insights. For instance, researchers might use case studies to enhance environmental cooperation performance (Bonfils, 2022), identify public cooperation and its challenges (Large, 2024), expand partner scope, examine public-private partnership dynamics (Guo and Li, 2022), and outline collaborative governance paths (Nielsen et al., 2024). Additionally, they could apply public goods game theory to analyze interactive factors and changes in cooperative behavior (Fang et al., 2019), understand strategic evolutionary equilibria among actors (Gong et al., 2024), or establish quantitative evaluation models to explain complex cooperation relationships (Marques and Teixeira, 2023). Researchers can propose a cooperative governance framework (Avalos et al., 2024) and develop implementation strategies for sustainable public cooperation (Ma et al., 2023). We encourage scholars to embrace the latest theories and methods while expanding research scenarios to tackle emerging issues in sustainable public collaboration.

(3) Future research may focus on the "future" of humanity. The Future Study aims to tackle emerging challenges through innovative approaches, including information infrastructure, smart education, improved healthcare, and sustainable urban development like smart and green cities (Keita and Kourouma, 2023; Ng et al., 2022). It will specifically explore achieving SDGs related to human health (Goal 3) (Forbat et al., 2024), clean water and sanitation (Goal 6), climate action (Goal 13) (Khanzada et al., 2023), decent work and economic growth (Goal 8) (Sankaran, 2023), life below water (Goal 14) and life on land (Goal 15) (Hsu and Chen, 2023), and responsible consumption and production (Goal 12) (Nielsen et al., 2024) via new public-private partnerships. The future institute will also examine collaboration between public and private sectors to integrate modern information technologies with traditional urban infrastructure for sustainable smart city development. Key areas include enhancing urban information systems through sustainable cooperation (Buyannemekh et al., 2023), developing smart projects, improving governance capacity in smart cities (Siokas et al., 2022), addressing digital divides in urban settings, fostering sustainable partnerships in public administration, and managing information risks (Zhang and Zhang, 2023). Moreover, the circular economy is a significant future research direction. Potential topics include resource recycling through sustainable cooperation (Lee et al., 2023), circular urban agriculture, redistribution of surplus food, and management of plastic and medical waste (Prabawati et al., 2023).

(4) Future research should emphasize the "subjectivity" of stakeholders in sustainable public cooperation, focusing on motivations, behaviors, outcomes, and influences of subjective participation. Specifically, studies may explore individuals' motivations for involvement. For example, public engagement in urban environmental issues might arise from the "Not-In-My-Back-Yard (NIMBY) effect," which aims to protect personal health (Lee et al., 2024). Government participation could be motivated by a desire to gain influence within collaborations, secure project benefits, and minimize costs (Wu et al., 2023). Additionally, future research may examine outcomes related to subjective participation—such as citizens fulfilling social responsibilities and governments meeting election promises while enhancing local environmental protection (Gao et al., 2024c).

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Some studies might also investigate long-term impacts like improving sustainable urban service quality (Zhang and Zhang, 2023), achieving carbon neutrality, increasing transparency in policy development and regulatory processes, and enhancing human well-being (Keita and Kourouma, 2023).

In conclusion, we recommend that researchers broaden their knowledge base and engage in interdisciplinary studies. Scholars should address future challenges with innovative approaches so that their findings can effectively inform ongoing efforts in sustainable public cooperation.

Conclusions

We conducted a bibliometric analysis of SCI, SSCI, and AHCI literature on sustainable public cooperation using CiteSpace software and presented the results in visual charts. Our exploration covered the fundamental situation, current collaborations, research advancements, and future trends through collaboration, co-citation, and co-occurrence analyses. We developed a knowledge framework for sustainable public cooperation and pointed out future research directions to assist scholars in understanding the research landscape. The key conclusions drawn from this study are as follows:

(1) Statistical analysis shows this field is experiencing rapid development with a rising publishing trend and high overall quality of papers and journals. “Sustainability” is the journal with the most publications. Other journals focus on energy, environment, and health. This research field integrates “environmental studies,” “economics,” and “management,” showcasing its interdisciplinary nature.

(2) Collaborative analysis shows that regional and institutional collaborations occur more frequently than author collaborations. Author partnerships are relatively independent and occur infrequently. Developed countries participate more in research collaboration, with U.S. institutions being the most active and central. These regions and institutions focus on cross-border cooperation, partnerships, and public participation to address disasters, epidemics, and urban development.

(3) Co-citation analysis identified key knowledge sources in this field. The highly co-cited journals, Science (IF = 50.3) and The Lancet (IF = 106.9), were among the earliest cited and have significant influence. Many of the highly co-cited articles originate from these journals, focusing on addressing environmental challenges through public cooperation and enhancing medical systems for sustainable development. These are fundamental issues in this field that have received extensive and continuous attention from researchers. Over a third of highly co-cited authors are affiliated with the WHO, UN, and EC. Common themes among the co-cited journals, authors, and references include environment, health, carbon emissions, sustainability in healthcare, and fostering collaboration.

(4) Co-occurrence analysis reveals that research primarily focuses on sustainable cooperation in public administration, public health, public services, and the circular economy. Over time, themes have shifted from early emphasis on children, health, and education to mid-term focus on cooperative networks, information, and goals, and recently to smart cities, services, and circular economies. Additionally, common categories show that environment, health, economics, and management disciplines pay significant attention to this area.

This study introduces innovations: (1) It analyzes progress and trends in sustainable public cooperation using statistics, collaboration, co-citation, and co-occurrence. It

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provides a more objective understanding through visual charts than traditional qualitative methods. (2) It develops a knowledge framework that lets readers and scholars quickly grasp the field's dynamic evolution. (3) It identifies future research features and hotspots, offering clear directions for scholars to understand frontier dynamics and conduct more effective research.

There are limitations in this study: (1) It only includes English literature, which may have left some findings uncovered. (2) The literature is limited to publications until August 2024, excluding more recent studies. (3) The study focuses solely on the WOS Core Database, potentially overlooking important works from other sources. Future research can be improved in the following aspects: (1) Incorporate multilingual literature for a broader perspective. (2) Regularly update data to improve accuracy and reliability. (3) Enhance bibliometric methods for cross-database analysis to prevent missing important works.

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