http://dx.doi.org/10.18623/rvd.v23.5010

DIGITAL TRANSFORMATION AND SUSTAINABLE DEVELOPMENT: ARE THEY RESHAPING LOCAL GOVERNANCE? A SCOPUS AND WOS BIBLIOMETRIC EXPLORATION

TRANSFORMAÇÃO DIGITAL E DESENVOLVIMENTO SUSTENTÁVEL: ESTÃO REMODELANDO A GOVERNANÇA LOCAL? UMA EXPLORAÇÃO BIBLIOMÉTRICA SCOPUS E WOS

Article received on: 11/9/2025
Article accepted on: 2/9/2026

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The authors declare that there is no conflict of interest

Abstract
Purpose. This study provides a comprehensive synthesis of global research on local governance in the context of digital transformation and sustainable development, thereby identifying emerging research trends and themes. Methods. The data utilized for this analysis comprises a pooled dataset from two primary databases: Scopus and Web of Science, with analysis conducted using RStudio and Biblioshiny. A comprehensive analysis of all 48 peer-reviewed documents reveals that global research on local governance in the context of digital transformation and sustainable development began relatively late, with the first publications emerging in 2021. Findings. The findings highlight several trend topics within this subject area, including: "digital transformation", "local governance", "sustainability", "smart city", and "sustainable development". Frequently used keywords encompass: “sustainability”, “digital transformation”, “smart city”, ‘cities”, “digitalization”, “e-governance”, “smartness”,

Resumo
Propósito. Este estudo fornece uma síntese abrangente da investigação global sobre governação local no contexto da transformação digital e do desenvolvimento sustentável, identificando assim tendências e temas de investigação emergentes. Métodos. Os dados utilizados para esta análise compreendem um conjunto de dados agrupados de duas bases de dados primárias: Scopus e Web of Science, com análise conduzida usando RStudio e Biblioshiny. Uma análise abrangente de todos os 48 documentos revistos por pares revela que a investigação global sobre a governação local no contexto da transformação digital e do desenvolvimento sustentável começou relativamente tarde, com as primeiras publicações a surgirem em 2021. Descobertas. As conclusões destacam vários tópicos de tendência nesta área temática, incluindo: “transformação digital”, “governança local”, “sustentabilidade”, “cidade inteligente” e “desenvolvimento sustentável”. As palavras-

"e-government", "green growth", "industrial structure", "innovation", "local authorities", and "public administration". Value. This study represents the first systematic effort to evaluate global research on local governance in the context of digital transformation and sustainable development, employing a bibliometric approach.

Keywords: Local Governance (LG). Digital Transformation (DT). Sustainable Development (SD). Bibliometrics. Scopus. Web of Science (WoS).

chave frequentemente utilizadas abrangem: "sustentabilidade", "transformação digital", "cidade inteligente", 'cidades", "digitalização", "governança electrónica", "inteligência", "governo electrónico", "crescimento verde", "estrutura industrial", "inovação", "autoridades locais" e "administração pública". Valor. Este estudo representa o primeiro esforço sistemático para avaliar a pesquisa global sobre governança local no contexto da transformação digital e do desenvolvimento sustentável, empregando uma abordagem bibliométrica.

Palavras-chave: *Governança Local (GL). Transformação Digital (DT). Desenvolvimento Sustentável (SD). Bibliometria. Scopus. Web of Science (WoS).*

1. INTRODUCTION

1.1 Local governance

Both the rapid advance of digital technology and the increasing demand for SD are bringing about major changes to the world of governance today. Nowhere is this transformation more stark than at the local level- the tier of government closest to citizens and the level that is most impacted by technological change and sustainability pressures (Rodrigues, M., & Franco, M. , 2021). LG refers to the institutional arrangements and systems used by local authorities for exercising power, conducting local affairs and solving problems within defined areas has created a very significant vantage point for the confrontation of complex societal problems and to use technological assets as a means for better service provision and democratic input (Megawati, S. et al, 2025). Outcomes of such trends require the renewal of governance models for resilience, inclusiveness and effectiveness towards evolving social needs (Palos-Sánchez et al., 2023).

Despite its historical roots, local governance has only recently gained widespread academic and practical attention, driven by globalization and the information revolution that have reshaped the roles of citizens, states, and various government tiers. However, this concept remains underexplored in development economics literature. This is largely due to a traditional focus on local governments or community organizations, often overlooking the comprehensive institutional environment that critically influences cooperation for the public good at the local level (World Bank, 2006). Theories have

moved beyond hierarchical bureaucratic service delivery to networked governance, citizen participation and collaborative problem solving (Faguet, 2014). Faguet's theory posits that optimal local government is achieved through a 'balance' between political markets (democratic representation), economic markets (efficient resource allocation) and the dynamics of civil society (citizen engagement) (Faguet, 2014). There are several challenges for current LG, in these including issues of globalization, urbanization, resource limitation, social cohesion in multicultural community, and to encourage meaningful citizen participation (Megawati, S. et al, 2025). Irrespective of the institutional model in place, local democracy depends on how much the citizens trust and participate in the process (Rodrigues, M., & Franco, M. , 2021). The democratic part is very important since local government is the government closest to the people. Local government ensures the proximity of services, public processes and human rights to each citizen. This closeness leads to democratic innovation, including direct democracy, participatory budgeting and citizen co-governance. Structural and procedural challenges must however be addressed if this potential is to be realized: bureaucratic resistance must be overcome, stakeholders mobilized inclusively, participatory governance capacity enhanced, and meaningful policy influence secured (Palos-Sánchez et al., 2023). Successful participatory democracy requires technical capacity, political will from elites, active citizenry and strong social capital (Faguet, 2014)

1.2 Digital transformation

DT involves far more than the mere use of technology; it deeply reorients organizational processes, authorities and the interaction between citizens and the state. Described as an organizational change journey towards digitization of digital economy, public sector DT is a composite and holistic reform process of government operations, service delivery, and democratic process through the strategic use of e-Government, or Information and Communication Technologies (ICT) (OECD, 2020), (Wang et al., 2024). Literature reveals that DT in local government may focus on various goals, such as improved operational efficiency, support for democratic practices (Rodrigues, M., & Franco, M. , 2021), (Palos-Sánchez et al., 2023). The OECD's digital government governance framework emphasises that successful transformation requires strong

institutional structures, well-coordinated processes, and policies that empower government to use the potential of digital technologies and data to enhance productivity, the quality of services, and accountability (OECD, 2020). This shift demands decisive leadership, whole-of-government strategies underpinned by systems of arrangement and system-based decision-making. The most recent analysis suggests that DT in LG is not only about digitisation, but also reflects extensive changes in the way local authorities understand and provide services (Megawati, S. et al, 2025), (Rodrigues, M., & Franco, M. , 2021). The role of emerging technologies like IoT, AI, Blockchain, Digital Twins is paramount in this revolution; leading to the development of smart urban systems, improved governance, and inclusive service delivery (Kwilinski et al., 2023). The COVID-19 pandemic has accelerated this revolution and the importance of digital resilience and adaptive service delivery (Palos-Sánchez et al., 2023). The reality is that implementation is extremely problematic, especially in the Global South, as municipalities face skills shortages, lack of infrastructure and cle and socio-economic factors, as well as governance issues (Megawati, S. et al, 2025). The digital divide is not only an obstacle to the effective implementation of digital solutions but also to the extent of existing gaps (Kwilinski et al., 2023). Overcoming these barriers will require rigorous consideration of equity, governance capacity, and sustainable financing (Wang et al., 2024)

1.3 Sustainable development

SD, which is development that meets the needs of the present without compromising the ability of future generations to meet their own needs, has taken the form of a far-reaching, international framework in response to the combined social, economic and environmental challenges presented (United Nations, 2015); (Kwilinski et al., 2023). The 2030 Agenda, with 17 Sustainable Development Goals (SDGs) and 169 targets adopted in 2015, represents a milestone, moving towards holistic development strategies that recognize the complex interlinkages between human well-being and planetary boundaries (United Nations, 2015). Sustainability development theory has three interconnected dimensions, economic, social and environmental, which are sourced in a holistic framework, evidencing an alternative view to common approach based on

sectorial lines. This requires improving institutional coordination, engaging stakeholders, and integrating policies (Megawati, S. et al, 2025). Sustainability, for all its ambiguity, is increasingly perceived as a necessary holistic concept requiring balanced integration in a multi-faceted governance framework (Kwilinski et al., 2023). Methods of SD have significant implications for governance at all levels. Local governments have a key responsibility in the countries' agenda in terms of sustainability, as they manage the services and the functions that closely affect environment, society and economy (Rodrigues M.; Franco M., 2021). Scientific studies show that these systems provide a kind of innovation lab wherein practices can be developed and trialed, and, then upscaled for use elsewhere (Megawati, S. et al, 2025). The relationship between SD and governance is especially noticeable in the localization of the SDGs. Local actors translate and adapt global aims to the local context in contending with local challenges, opportunities and stakeholder preferences (Palos-Sánchez et al., 2023). Successful multi-level governance is key, to coordinate across various tiers of government and have local voices and priorities reflected in planning and implementation of sustainability (OECD, 2020).

1.4 Local governance in the context of digital transformation and sustainable development

DT in the field of SD has been an increasing important aspect of the local government.The research on DT and SD in the city governance is an emerging but crucial field fortheoretical research and practical application. This meeting point provides local governments the chance to use digital technologies to further sustainability, using sustainable frameworks at the same time, to guide responsible digital transition (Megawati, S. et al, 2025), (Kwilinski et al., 2023). This integration has been suggested to have the power to transform LG in terms of transparency, resource saving, innovation and democratic engagement (Rodrigues, M., & Franco, M. , 2021); (Palos-Sánchez et al., 2023). Studies show digital resources can significantly contribute to SD along various paths. By promoting real-time collection and analysis on environmental conditions, resource utilization, and social effect, digitalization helps base decision-making at evidence and adaptive governance (Wang et al., 2024). The use of IoT sensors, big data

analytics, and AI systems can, for instance, optimize energy consumption, help manage water more efficiently, or improve waste management (Kwilinski et al., 2023). The smart cities model illustrates this integration and has its echo in several of the goals, especially Goal 7 (Affordable and Clean Energy), Goal 9 (Industry, Innovation, and Infrastructure), and Goal 11 (Sustainable Cities and Communities) (United Nations, 2015). In fact, researchs demonstrate that smart city initiatives enforce movement towards public transport and soft mobility, thus depleting the amount of CO2 that is released into the environment, as the as the air pollution and noise are being lowered (Kwilinski et al., 2023); (Wang et al., 2024). However, combining DT and SD faces challenges, such as enhancing the digital divide, privacy, digital infrastructure's environmental impact, and the danger that "technocratic" approaches would sideline community voices (Palos-Sánchez et al., 2023). It is based on a people-centered literature focusing on equity, inclusion, and environmental sustainability (Megawati, S. et al, 2025). The governance challenges are serious forcing new institutional setups, new capacities and new modes of cooperation to handle the multiple ways that technological innovation and sustainability objectives interact (OECD, 2020). There needs to be a solid governance foundation for successful integration - balancing efficiency with equity, innovation with precaution, and global connectivity with local autonomy. This should encompass strong data governance, clear decision-making and stakeholder involvement in DT and sustainability planning (Rodrigues, M., & Franco, M. , 2021). Moreover, the process generates a potential to deepen democratization. Citizen engagement: Digital can help engage citizens in planning around sustainability, provide feedback in real time on service delivery, and help with collective problem-solving (Palos-Sánchez et al., 2023). These benefits materialize with intentional design that emphasizes accessibility, inclusivity, and meaningful participation (Megawati, S. et al, 2025). New research is emphasising the need to know your local context and make global frameworks fit the local community. Digital technologies and sustainability frameworks can bring their collective benefits globally, but need to be adapted to local conditions, local institution building, local community preferences, and local environmental and social challenges (Wang et al., 2024). This localization demands advanced governance capacities that can negotiate between global norms and locally tailored expressions that are both coherent and effective (OECD, 2020).

1.5 The importance of the research

This study aims to contribute to the global body of research on LG in the context of DT and SD. First, we provide a comprehensive overview of publications in this domain, examining their volume and growth trends over the past five years, from 2021 to the data collection cutoff (June 30, 2025).

A key highlight of this research is the integration of literature from both Scopus and WoS. This combined approach offers a more exhaustive understanding of LG in the context of DT and SD, drawing from two of the world's largest academic databases. Using this dataset, we conducted analyses on publication volume, growth trajectories, geographical distribution, international co-authorship patterns, prominent themes, leading authors and research groups, and top publication outlets. Based on these findings, we also propose future research directions for the study of LG within DT and SD globally.

The emerging nexus between DT and SD in local government represents a complex and intellectually rich subject, demanding interdisciplinary approaches and nuanced conceptualizations. The ensuing bibliometric analysis will uncover trends within this evolving academic domain, identify key contributions, and pinpoint promising areas for future research.

By conducting a systematic review of scholarly literature at these intersecting themes, this article aims to offer practical theoretical and empirical contributions. We seek to illuminate how LG can successfully leverage DT as a means to advance SD objectives within a highly diverse global landscape.

1.6 Research structure and research questions

Building upon these foundations, we structured this study into four main sections and sought to address five research questions.

The four parts of this research are organized as follows:

1. Part 1: Research Context and Questions
2. Part 2: Research Methodology
3. Part 3: Findings and Results
4. Part 4: Discussion and Conclusion

The five research questions:

1. *Research Question 1.* What is the volume and growth trajectory of worldwide publications on LG in the context of DT and SD?
2. *Research Question 2.* How are global studies on LG in the context of DT and SD geographically distributed, and what are the patterns of international co-authorship among countries?
3. *Research Question 3.* Which themes are most prominently highlighted and extensively explored in worldwide research on LG in the context of DT and SD?
4. *Research Question 4.* Who are the leading authors and research groups globally contributing to the field of LG in the context of DT and SD?
5. *Research Question 5.* Which publication sources (journals, proceedings, etc.) are most prolific for global research on LG in the context of DT and SD?

2 RESEARCH METHODOLOGY

To address the five research questions, we collected data from the Scopus and WoS databases by conducting precise searches for publications that simultaneously featured the three keywords: "Local Governance", "Digital Transformation", and "Sustainable Development". Subsequently, we merged the two databases by eliminating duplicate documents using RStudio. Once the combined database was established, we performed descriptive statistics using Microsoft Excel and RStudio, concurrently conducting a bibliometric analysis with the Biblioshiny package. Finally, we present the results of this analysis to address each of the five research questions in turn.

2.1 Data sources for analysis

This study utilizes two leading and highly academic scientific databases, particularly well-suited for its research objectives: Scopus and WoS. Specifically, Scopus, developed by Elsevier, is a powerful multidisciplinary platform providing comprehensive data from peer-reviewed journals, conference proceedings, and academic books, with records archived since 1966 (Burnham, J. F., 2006). WoS, developed by Clarivate, stands as the world's oldest, most widely used, and authoritative data source for scientific and scholarly activity. It provides comprehensive research publication and citation data, rooted in the Science Citation Index, which was established by Eugene Garfield in 1964 (Caroline Birkle, David A. Pendlebury, Joshua Schnell, Jonathan Adams, 2020). Both Scopus and WoS are distinguished by their extensive global and regional coverage, alongside stringent publication selection processes enforced by independent review boards. This rigorous oversight ensures the accuracy, quality, and reliable retrievability of information within their databases (Baas, J. et al., 2020), (Mongeon, P., & Paul-Hus, A. , 2016). Therefore, these two platforms are considered reputable and suitable research resources to address all five research questions posed in our article.

2.2 Research data collection methodology

This study employs the PRISMA model (Moher, D. et al., 2009), with a data collection process comprising four distinct steps (Figure 1). This method boasts high reliability and rigorous validation, making it widely applicable across diverse fields such as finance (Tomas Pečiulis et al., 2024)), (Tomas Pečiulis *et al.*, 2024), economics (Ulker et al., 2023), (Vuk Vukovic et al, 2023), (Diwan, H., Amarayil Sreeraman, B., 2024), (Ulker *et al*., 2023; Vuk Vukovic *et al*., 2023; Diwan, H., Amarayil Sreeraman, B., 2024), healthcare (Vivó P. et al, 2024), (Marcellou, Effimia G. et al., 2025), environment (Arruda Filho et al, 2024), (Behzad, M. et al., 2025), education (Hallinger, P. et al., 2019), (Wandi et al, 2024), (Jaja, 2024), public administration (Chi Jinglin et al, 2024), ... Following this robust process, we systematically gathered data on all worldwide publications concerning LG in the context of DT and SD from both Scopus and WoS, covering all records up to

the data collection cutoff date of June 30, 2025. The entire data filtering process is illustrated in Figure 1. Specifically:

2.2.1 Phase 1: identification

In Phase 1 of the PRISMA guidelines, keywords were determined based on a synthesis of existing research pertinent to LG in the context of DT and SD. These keywords include: "local governance", "digital transformation", and "sustainable development". We conducted searches across both databases on June 30, 2025, utilizing all available fields. For the Scopus database, we employed the query: *(ALL("Local Governance") AND ALL("Digital Transformation") AND ALL("Sustainable Development"))* on the Scopus website (https://www.scopus.com/). This initial query yielded a raw dataset of 210 documents published from 2021 up to the data collection date (June 30, 2025). Similarly, for the WoS database, the search query on the WoS website (https://www.webofscience.com/) utilized the advanced search feature with: *"Local Governance" (All Fields) and "Digital Transformation" (All Fields) and "Sustainable Development" (All Fields).* This initial query generated a raw dataset of 3 documents from 2023 up to the data collection date (June 30, 2025).

2.2.2. Phase 2: screening

In Phase 2 of the PRISMA guidelines, we applied specific criteria to filter documents across all relevant categories, including publication year, author names, subject area, document type, source title, publication stage, keywords, affiliations, funding sponsors, country/territory, source type, and language. We collectively reviewed the exclusion criteria to ensure consistency across both databases. Accordingly, the filtering process within the Scopus database was conducted with the following search query: *(ALL ("Local Governance") AND ALL ("Digital Transformation") AND ALL ("Sustainable Development")) AND (LIMIT-TO (EXACTKEYWORD, "Sustainable Development") OR LIMIT-TO (EXACTKEYWORD, "Digital Transformation") OR LIMIT-TO (EXACTKEYWORD, "Local Governance")) AND (LIMIT-TO (LANGUAGE, "English"))* and the filtering process

within the WoS database was conducted with the following search query: *"Local Governance" (All Fields) and "Digital Transformation" (All Fields) and "Sustainable Development" (All Fields) and English (Language).* The screening results in this phase led to the exclusion of 163 documents from the Scopus database. This comprised 162 documents with keywords that did not precisely match the three core terms identified in Phase 1, and 1 document written in Spanish. Consequently, the Scopus dataset was reduced from 210 to 47 documents and no documents were excluded from the WoS dataset.

Table 1

Criteria used to filter data in the screening process

Criteria	Limited to
Keyword/ Author keyword	"Local Governance" and "Digital Transformation" and "Sustainable Development"
Language	English

(Source: Authors' Compilation)

2.2.3 Phase 3: eligibility

In Phase 3 of the PRISMA guidelines, we rigorously assessed all 50 documents (comprising 47 from Scopus and 3 from WoS). This assessment involved examining various attributes such as author names, publication titles, document types, publication years, abstracts, journal/publisher names, volume and issue numbers, page ranges, citation counts, DOIs, and language. After downloading the full text and thoroughly reading the titles, keywords, and abstracts, each research team member independently evaluated the relevance of these documents to the topic of LG in the context of DT and SD. We then cross-checked and compared our findings to ensure consistency and accuracy. This evaluation confirmed that all collected documents were intimately connected to the study's core theme. No documents were excluded during this phase.

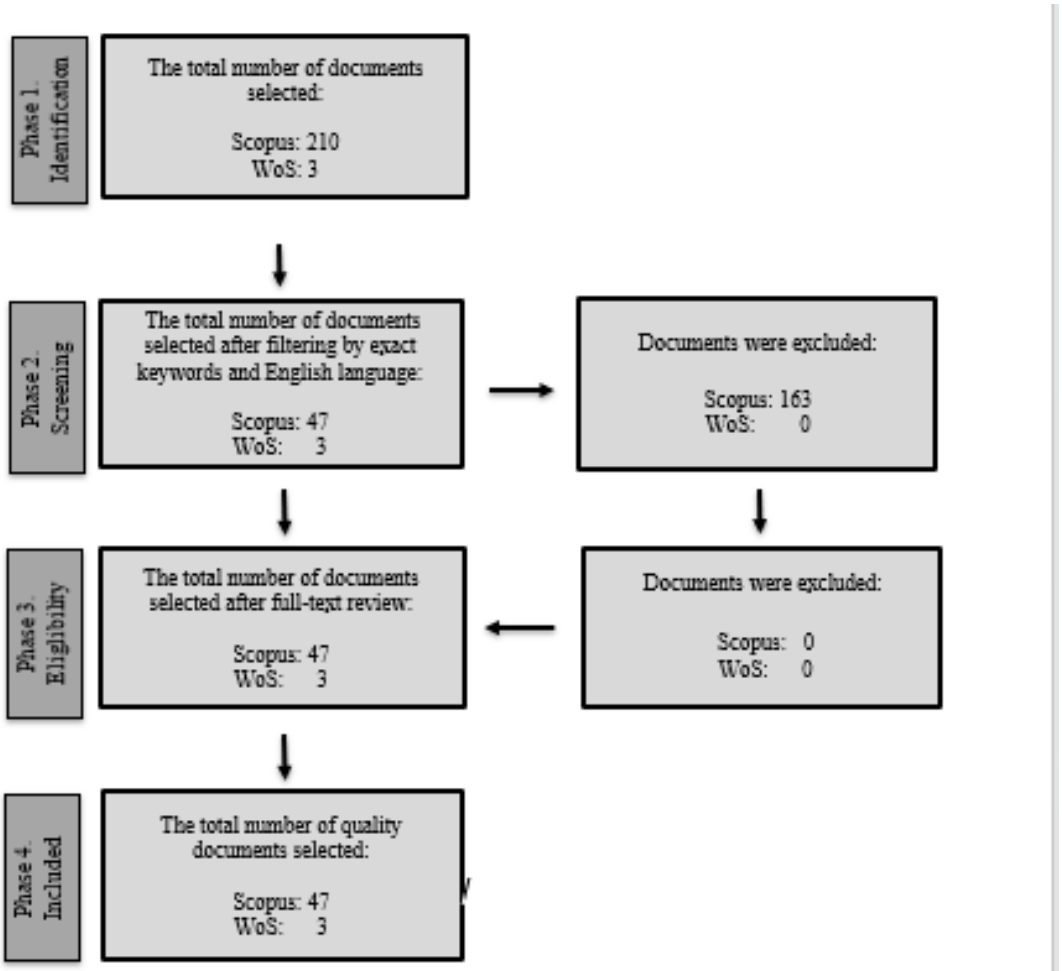
2.2.4 Phase 4: included

In Phase 4 of the PRISMA guidelines, the screening process confirmed that all collected documents met the necessary quality standards for inclusion in the analysis. The

resulting dataset, comprising documents published from 2021 up to the data collection date (June 30, 2025), fully satisfied all filtering criteria.

Figure 1

PRISMA Diagram Illustrating the Document Collection Process for Bibliometric Analysis of LG in the context of DT and SD



(Source: Authors' Compilation)

The datasets, once identified as eligible for each database, were downloaded in BibTeX format, with respective ".bib" file extensions for Scopus (scopus.bib) and WoS (wos.bib). These files were subsequently saved in a dedicated folder named “Merge”, located at C:/Users/user/Downloads/Merge. RStudio was then utilized to eliminate duplicate documents from the two databases, and they were subsequently merged into a unified dataset.

An eight-step process (Table 2) was implemented, following the guidelines (Queiroz, 2022), (W. N. Venables, D. M. Smith, and the R Core Team, 2025) to eliminate two duplicate documents. This resulted in a final merged dataset comprising 48 unique documents on LG in the context of DT and SD, encompassing all relevant worldwide publications to date, which were subsequently included in the bibliometric analysis.

Table 2

Steps for Merging Scopus and WoS Databases Using RStudio

Step	Command Used	Description
Step 1	setwd("C:/Users/user/Downloads/Merge")	Specify the file paths to the two databases (Scopus and WoS) that require merging
Step 2	library(bibliometrix)	To facilitate the reading of the merged database, the bibliometrix package should be installed in Rstudio
Step 3	s=convert2df("scopus.bib",dbsource = "scopus",format = "bibtex")	The data retrieved from the Scopus database file must be converted into a data.frame object within RStudio for subsequent software processing.
Step 4	w=convert2df("savedrecs.bib",dbsource = "isi",format = "bibtex")	The data retrieved from the WoS database file must be converted into a data.frame object within RStudio for subsequent software processing.
Step 5	Database=mergeDbSources(s,w,remove. duplicated = TRUE)	Duplicate documents are to be removed, and the two databases (Scopus and WoS) are to be merged into a new, unified database.
Step 6	dim(Database)	Examine the dimensions of the new merged database.
Step 7	library(openxlsx)	The xlsx package should be installed in RStudio to facilitate the creation of an Excel file after the merging process.
Step 8	write.xlsx(Database,file="data.xlsx")	An Excel file, with a .xlsx extension, should be created from the merged dataset and saved in the Merge folder that initially contained the Scopus and WoS databases.

(Source: Authors' Compilation)

2.3 Research data analysis methodology

To thoroughly analyze the dataset of 48 documents, we meticulously examined information from each document based on specific parameters, including: authors, title, publication year, volume, issue, page range, URL, publisher, citation count, abstract, author-assigned keywords, and indexed keywords. This analysis integrated both descriptive statistical methods and advanced bibliometric analysis techniques. Descriptive statistics were performed using Excel to assess information related to publication productivity by country, author, and publication year. Concurrently, advanced bibliometric analyses-encompassing citation analysis, co-citation mapping, co-authorship networks, keyword co-occurrence, bibliographic coupling, and other in-depth

evaluations—were conducted using RStudio and the Biblioshiny package (Aria, M., & Cuccurullo, C., 2017).

3 RESEARCH RESULTS AND FINDINGS

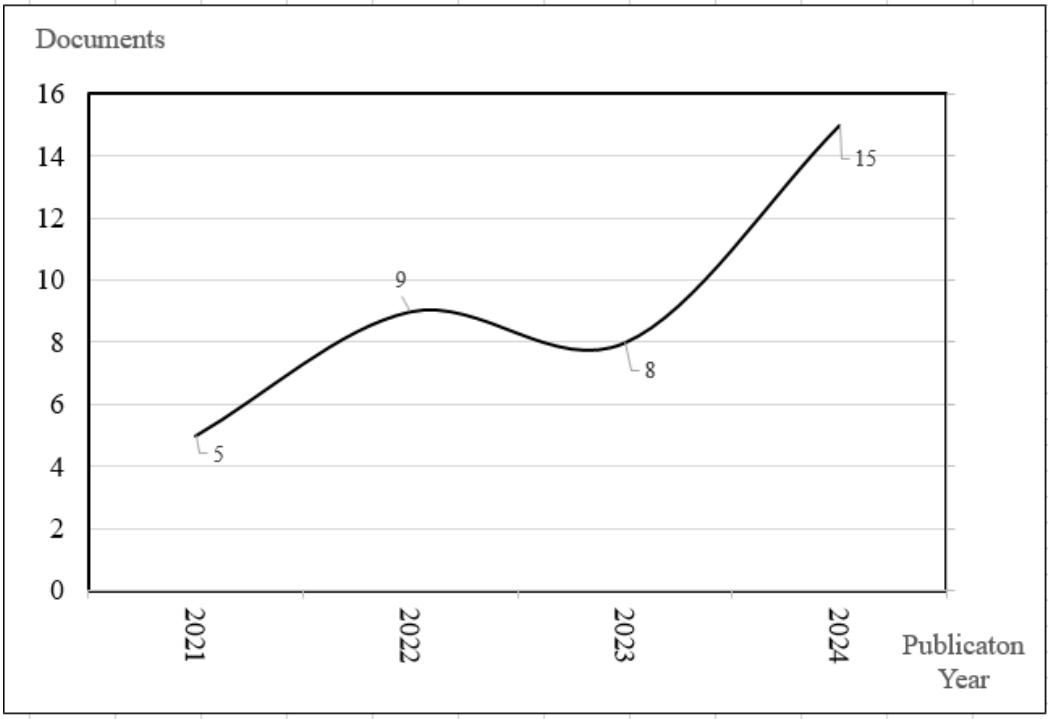
As of the data collection cutoff on June 30, 2025, a total of 48 English-language documents concerning LG in the context of DT and SD have been published by scholars worldwide. These documents are indexed across the two globally recognized databases, Scopus and WoS. This corpus comprises contributions from 153 authors across 40 distinct sources, utilizing 228 author-defined keywords. Nine of these documents are single-authored, with an average of 3.25 co-authors per document. Notably, there is no international co-authorship observed within this dataset. The average citation rate stands at 16.9 citations per document, accumulating a total of 660 citations. The field demonstrates an impressive annual growth rate of 21.79%. The subsequent sections provide a detailed analysis addressing the five pre-defined research questions.

3.1 Volume, growth trend, and locations

Among the 48 English-language documents collected worldwide to date, the distribution by document type is as follows: 32 articles, 3 books, 5 book chapters, 4 conference papers, and 4 reviews. The publication timeline for these works spans from 2021 up to the research cutoff date (June 30, 2025). The annual publication output is visually represented in Figure 3 (note that data for 2025, covering only Q1/2025 and Q2/2025, is not depicted in the figure).

Figure 2

Annual Growth of Publications on LG in the context of DT and SD



(Source: Author's analysis from Excel Application)

It's evident that 2021 marked the emergence of the first five documents focused on LG in the context of DT and SD. This period coincided with the United Nations' enhanced emphasis on the role of local authorities in achieving Sustainable Development Goals (SDGs), alongside the global onset of the COVID-19 pandemic. Under the pandemic's pervasive influence, the critical role of local governments in responding to health, economic, and social crises became increasingly prominent. Local authorities were compelled to rapidly adopt digital technologies for management and public service delivery (e.g., healthcare, education, public administration), and to either initiate or accelerate national DT strategies. Consequently, DT and SD transitioned from being optional considerations to urgent necessities in LG. Simultaneously, DT emerged as a vital tool for SD, not only enhancing LG but also serving as a crucial catalyst for broader SD goals. Figure 2 illustrates that while research on LG in the context of DT and SD has only recently begun within the last five years, the 2021-2024 period collectively yielded 37 documents, averaging approximately 9.3 documents per year, with an Annual Growth

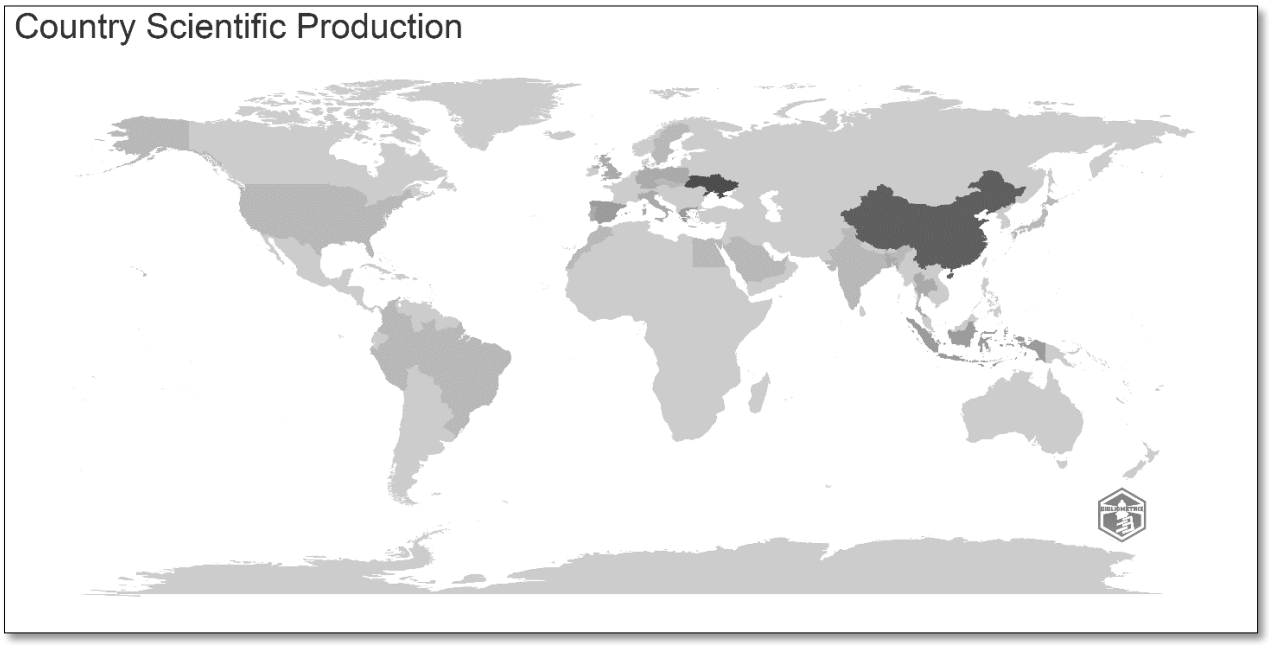
Rate of 21.79%. The volume of research has consistently increased each year, with the number of publications on this topic reaching double digits from 2024 onwards.

3.2 Distribution of publications and co-authoring across countries

Figure 3 illustrates the geographical distribution of contributions to research on LG in the context of DT and SD, from its inception in 2021 up to the data collection date (June 30, 2025). Scholars from 25 countries (Table 3) have participated as authors or co-authors in at least one academic publication on this topic. The geographical distribution of scientific publications related to LG in the context of DT and SD reveals that the most significant contributions originate from Europe, including researchers from 12 countries (notably Ukraine with 8 documents-the highest globally), and Asia, with contributions from 8 countries (notably China with 7 documents). Table 3 further demonstrates that Europe contributes the highest number of publications on LG in the context of DT and SD, with 27 publications (52.9%), followed by Asia with 18 publications (35.3%), the Americas with 4 publications (7.8%), and Africa with 2 publications (3.9%). While publications from Europe and Asia are dominant, contributions from the Americas and Africa remain relatively modest. Notably, Oceania has not yet produced any publications related to LG in the context of DT and SD.

Figure 3

Country Scientific Production between 2021 and 2025



(Source: Authors' analysis from RStudio)

Table 3

Global Publications on LG in the context of DT and SD (2021 - June 30, 2025)

Continent	Number of publications (documents)	Percentage (%)	Detailed Information
Europe	27	52.9	Ukraine (8 documents), Greece, Spain (3 documents), Germany, Italy, Poland, Portugal, UK (2 documents), UK, Czech Republic, Slovakia, Sweden (1 document)
Asia	18	35.3	China (7 documents), Indonesia (3 documents), Bangladesh, Thailand (2 documents), India, Japan, Saudi Arabia, United Arab Emirates (1 document)
Americas	4	7.8	Brazil, Colombia, Peru, USA (1 document)
Africa	2	3.9	Egypt, Morocco (1 document)
Oceania	0	0.0	
Total	**48**	**100**	

(Source: Authors' Compilation)

Table 4 highlights the top five leading countries in global research on LG in the context of DT and SD. Out of the 48 published documents related to this topic, these five nations collectively contributed 24 publications, accounting for 50% of the total. These

include: Ukraine (8 publications), China (7 publications), and Greece, Indonesia, and Spain (3 publications each).

Table 4

Top five countries' scientific production over the period 2021-2024

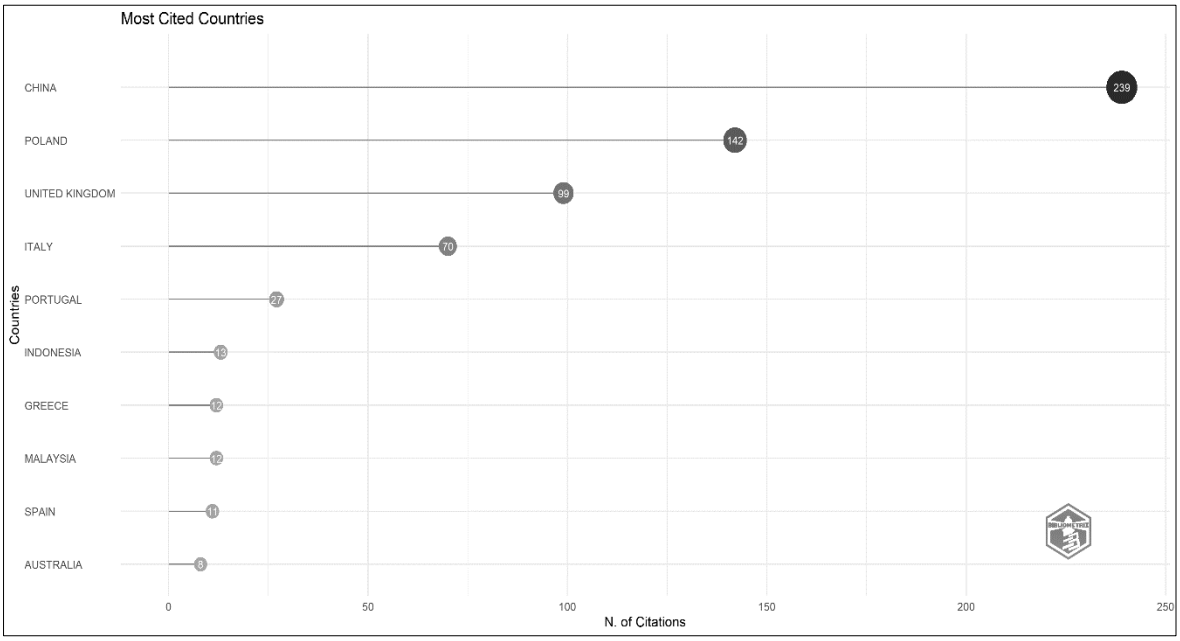
Rank	***Country***	***Frequency***
1	Ukraine	8
2	China	7
3	Greece	3
4	Indonesia	3
5	Spain	3
Total		**24**

(Source: Authors' Compilation)

Among all 48 published studies on this topic, there is no evidence of cross-national collaboration among authors. All co-authors in these publications are from the same country. In other words, there is no international co-authorship model observed in publications concerning LG in the context of DT and SD to date.

Figure 4

Most Cited Countries between 2021 and 2024



(Source: Authors' analysis from RStudio)

Although international collaboration in this research area is limited, scholars in various countries do cite studies from across the globe pertaining to LG in the context of DT and SD (Figure 4). As of June 30, 2025, publications worldwide on this topic have collectively received a total of 660 citations. The top 10 citing countries, by citation count, are: China (239 citations), Poland (142 citations), United Kingdom (99 citations), Italy (70 citations), Portugal (27 citations), Indonesia (13 citations), Greece (12 citations), Malaysia (12 citations), Spain (11 citations), and Australia (8 citations).

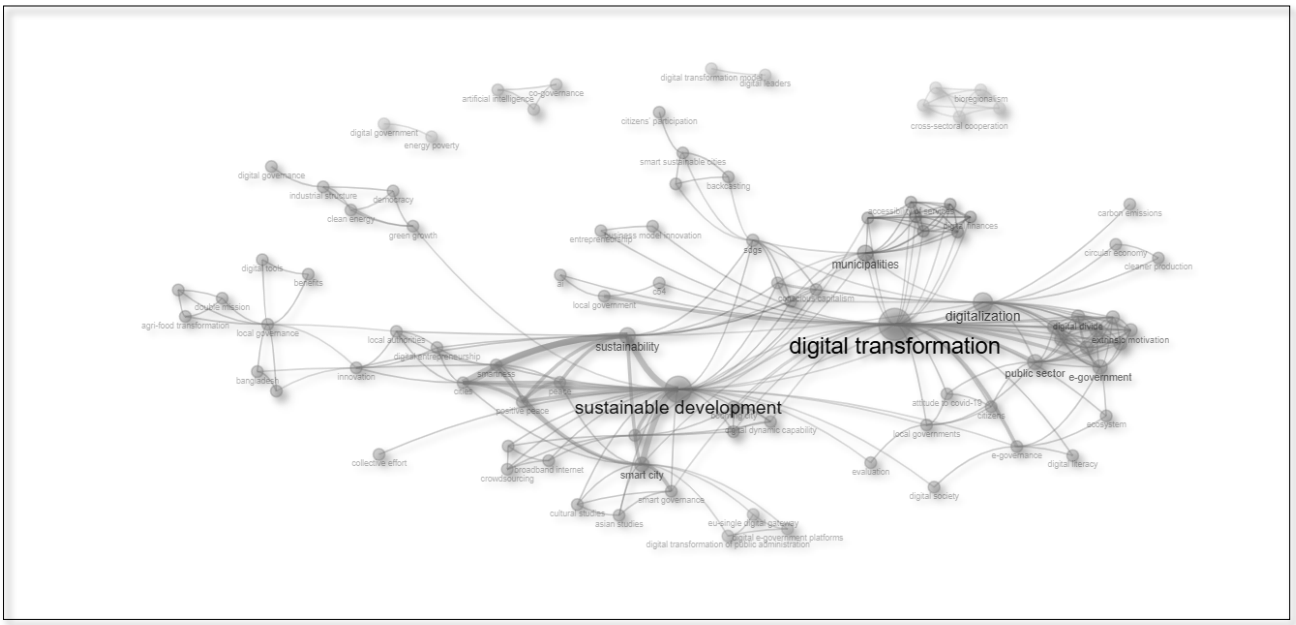
3.3 Most frequent topics

The Scopus and WoS databases indicate that the first five studies on this topic emerged in 2021, encompassing research by (Rodrigues M.; Franco M., 2021), (Timber Haaker et al., 2021), (Cheshmehzangi, 2021), (Hossain, 2021), and (Palumbo et al., 2021). Since then, research on LG in the context of DT and SD has expanded globally, emerging as a significant area of academic inquiry garnering considerable attention from scholars worldwide.

To identify the core research themes and foci, we conducted analyses in RStudio, including a Thematic Map, Most Frequent Words, Word Cloud, and Trend Topics. Figures 5 and 6 illustrate that, among 228 author keywords, 25 appeared with a frequency of two or more. The top 10 most frequently occurring author keywords in research on LG in the context of DT and SD are: sustainable development (14 occurrences), digital transformation (11 occurrences), smart city (6 occurrences), sustainability (5 occurrences), local governance (4 occurrences), cities (3 occurrences), digitalization (3 occurrences), e-governance (3 occurrences), smartness (3 occurrences), and e-government (2 occurrences).

Figure 5

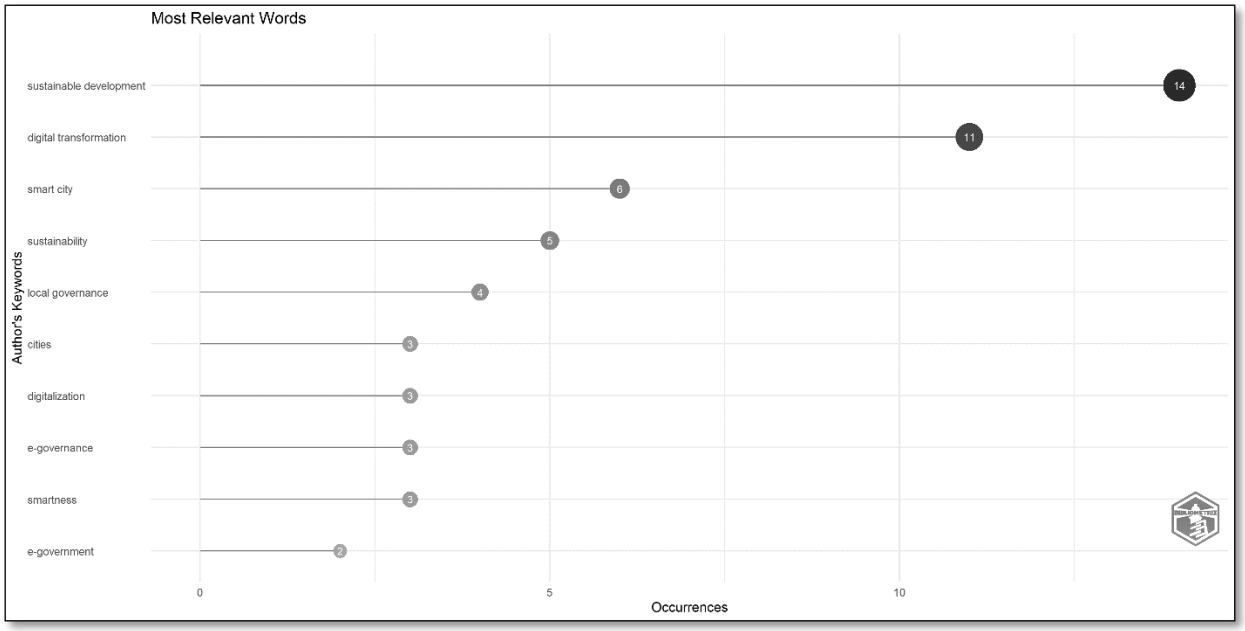
Thematic Map (Network) in research on LG in the context of DT and SD



(Source: Authors' analysis from RStudio)

Figure 6

The most popular topic research on LG in the context of DT and SD

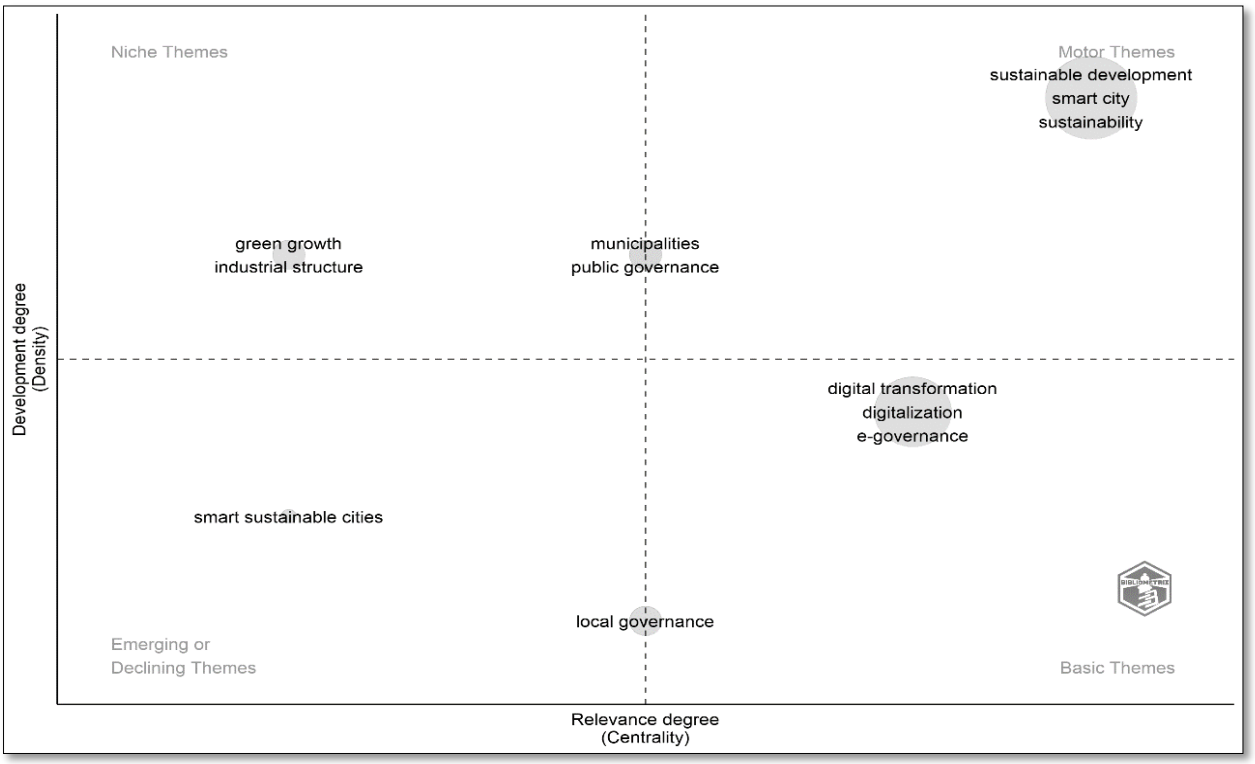


(Source: Authors' analysis from RStudio)

Figure 7 presents a thematic map that illustrates the landscape of various keywords and their positions based on centrality (relevance) and density (development) within research on LG in the context of DT and SD. This map is divided into four quadrants, categorizing ideas into: Motor themes, Niche themes, Basic themes, and Emerging or Declining themes. Accordingly, in the upper-right quadrant, keywords classified as Motor themes, such as "sustainable development" and "smart city" (noting "sustainable development" appears twice, likely indicating its paramount importance), exhibit the highest relevance and development. This signifies their crucial and well-established roles, representing core focal areas in LG research within the DT and SD contexts. In the upper-left quadrant, Niche themes like "green growth" and "industrial structure" demonstrate strong internal cohesion but lower relevance to the overall field. Keywords such as "municipalities" and "public governance" also appear in this section, indicating the specialized yet developed nature of these topics. The lower-right quadrant contains Basic themes including "digital transformation", "digitalization", and "e-governance". These keywords illustrate highly relevant, foundational elements that are widely applied across the research domain. Finally, in the lower-left quadrant, Emerging or Declining Themes like "sustainable smart cities" are positioned, indicating lower internal development and external connectivity. This suggests either a nascent keyword still forming its internal structure and external links, or one that is gradually losing prominence. "Local governance" is also found within this category, pointing to its relatively low current importance and internal maturity within the broader keyword network.

Figure 7

Thematic Map (Map) in research on LG in the context of DT and SD



(Source: Authors' analysis from RStudio)

Figure 8 highlights the prominent themes within research on LG in the context of DT and SD. Accordingly, the keyword "local governance" emerges as a central theme, closely connected with other significant topics such as "sustainability", "digital transformation", "smart city", "cities", "digitalization", "e-governance", "smartness", "e-government", "green growth", "industrial structure", "innovation", "local authorities", and "public administration".

Figure 8

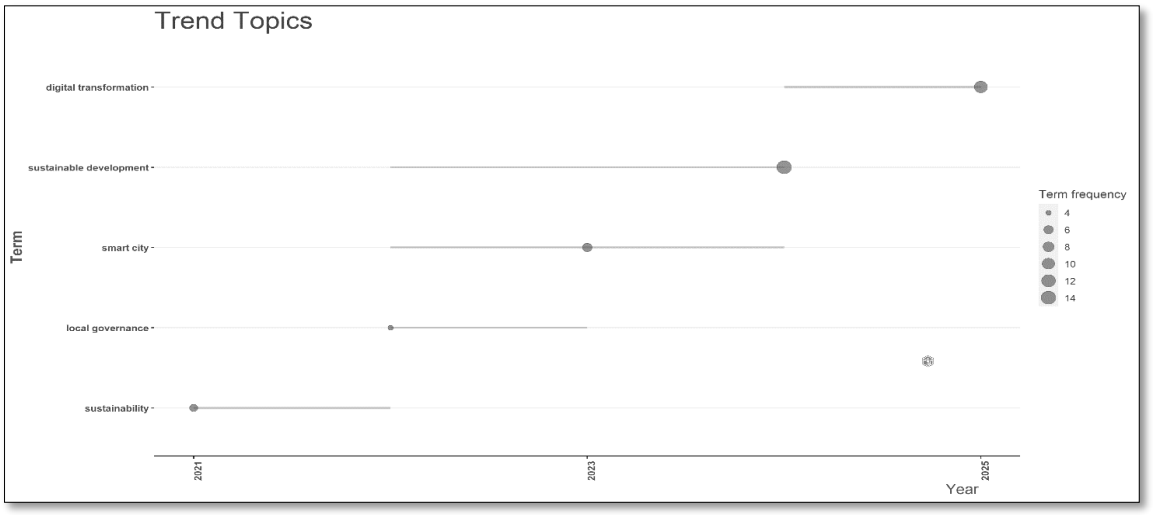
Word Cloud on LG in the context of DT and SD

(Source: Authors' analysis from RStudio)

Recent years have witnessed the emergence of new research trends concerning LG in the context of DT and SD. Academic attention has increasingly converged on five key themes: "digital transformation", "local governance", "sustainability", "smart city", and "sustainable development" (Figure 9).

Figure 9

Trend topics on LG in the context of DT and SD



(Source: Authors' analysis from RStudio)

3.4 Top active authors and research groups

Our database records a total of 153 authors with at least one publication related to LG in the context of DT and SD, as indexed by Scopus and WoS to date. Among these, three leading authors have published two documents each (Figure 10), while the remaining 150 authors have contributed only one publication on this topic. Figure 10 indicates that, given the relatively recent emergence of this research area (starting in 2021), this group of three most prolific authors has collectively published 6 documents (12.5% of the total 48 documents) and received 49 citations (7.4% of the total 660 citations). The top three authors by publication count are Ali Cheshmehzangi from The University of Queensland, Jordan Klimek from the University of Szczecin, Poland, and Xin Li from the College of Business, Shanghai University of Finance and Economics, Shanghai, China, each with two publications. Notably, Ali Cheshmehzangi holds the highest H-index (H-index=44) among these authors and was also among the first five individuals globally to publish on LG in the context of DT and SD. The scholar with the highest number of citations is Lin Xi (43 citations).

Figure 10

Top 3 active authors published on LG in the context of DT and SD

(Source: Authors' analysis from RStudio)

Table 5

Top 3 active authors ranked by number of publications and total citations

0	Author	Full name	Affiliation	H-Index	Number of publications	Total citations	The first paper
1	Cheshmehzangi A	Ali Cheshmehzangi	The University of Queensland	44	2	6	2021
2	Klimek J	Jordan Klimek	University of Szczecin, Poland	3	2	0	2024
3	Li X	Xin Li	College of Business, Shanghai University of Finance and Economics, Shanghai, China	5	2	43	2023

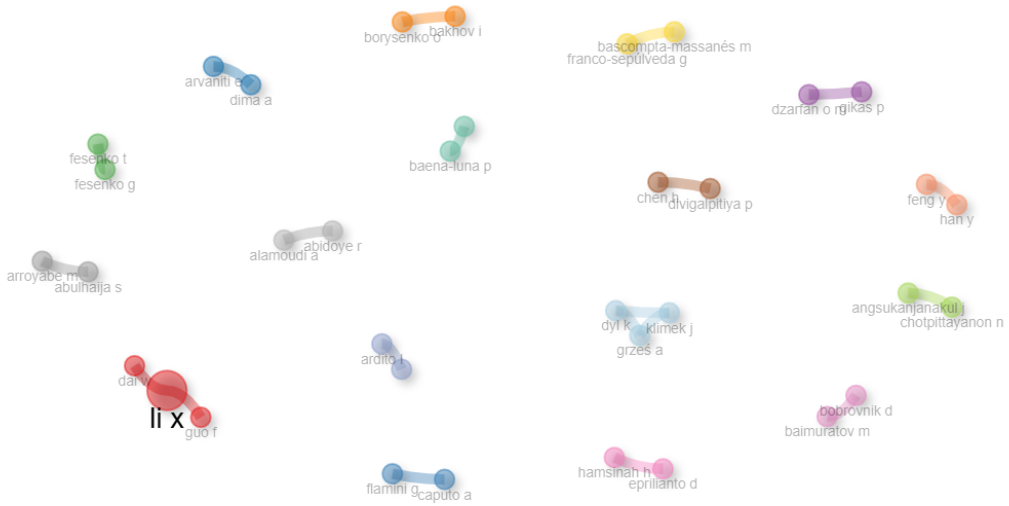
(Source: Authors' Compilation)

An author's influence on a research topic extends beyond the total number of publications, citations, or H-index; it's also reflected in their collaborative output. Globally, a co-authorship map among scholars in this research area hasn't been established. In other words, there are no apparent research clusters from different countries collaborating on publications concerning LG in the context of DT and SD. On a national level, however, scholars have made significant efforts in research collaboration (Figure 11). These collaborations are organized into 17 distinct research clusters, comprising 15 groups with two members and two groups with three members. The two

largest groups (three members each) are the teams of Klimek J., Dyl K., and Grześ A., and Li X., Dai W., and Guo F.

Figure 11

Co-authorship map from 2021 to June, 30th 2025

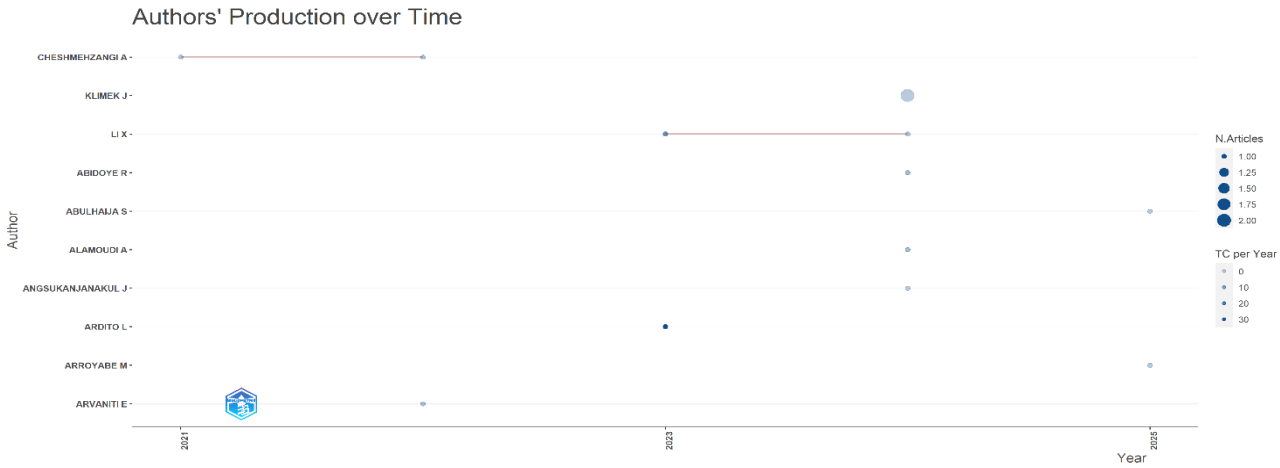


(Source: Authors' analysis from RStudio)

Figure 12 provides a detailed report on the research trajectories of key scholars, including the top ten authors with the highest number of publications. Among these, Li X. is particularly noteworthy, demonstrating the longest research span on this topic, from 2023 to 2024, and being one of the three most prolific authors with two published articles.

Figure 12

Author's Production from 2021 to June 30, 2025



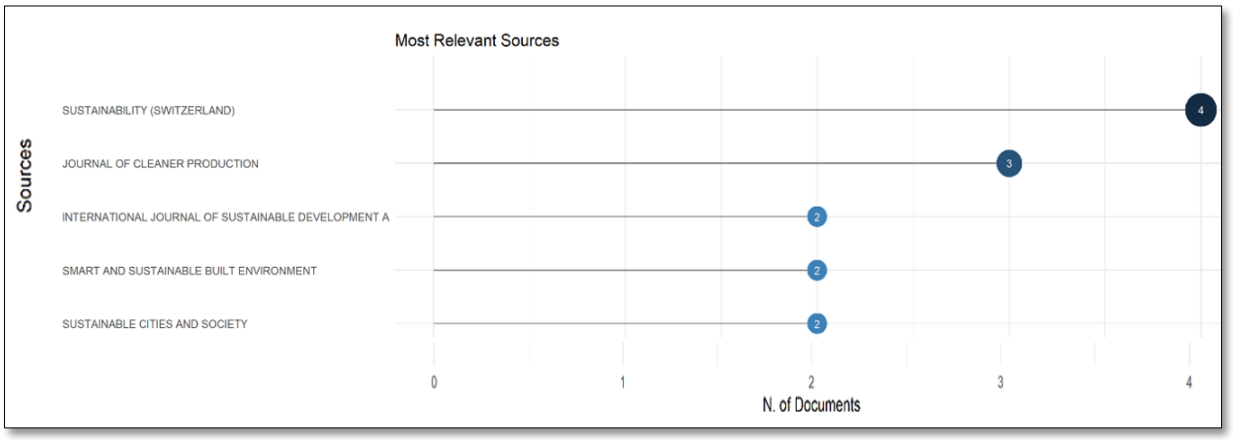
(Source: Authors' analysis from RStudio)

3.5 Top resources

Figure 5 highlights the five most active sources contributing to research on LG in the context of DT and SD, out of the 40 sources analyzed, ranked by publication count. All five are academic journals. Leading the list is Sustainability (Switzerland) with 4 publications. The Journal of Cleaner Production ranks second with 3 publications. The next three journals, International Journal of Sustainable Development and Planning, Smart and Sustainable Built Environment, and Sustainable Cities and Society, each contributed two publications. Collectively, these five sources account for 13 publications, representing 27.1% of the total 48 documents analyzed on LG in the context of DT and SD.

Figure 13

Top Five Most Active Sources by Publication Volume



(Source: Authors' analysis from RStudio)

Table 6 also identifies these five prominent sources as journals, classifying them as core references for research on LG in the context of DT and SD according to Bradford's Law. Figure 14 visually illustrates these sources, arranged from left to right based on their respective contributions.

Table 6

Top Five Most Active Sources Published by Publication Volume

Rank	Sources	Source type	ISSN	Publisher	Aim and scope	Number of publications
1	Sustainability (Switzerland)[1]	Journal	2071-1050 (Electronic)	MDPI	Computer Science, Energy Environmental Science, Social Sciences	4
2	Journal Of Cleaner Production[2]	Journal	0959-6526 (Print), 1879-1786 (Electronic)	Elsevier Ltd.	Cleaner Production, Environmental, and Sustainability research and practice	3
3	International Journal Of Sustainable [3]Development And Planning	Journal	1743-7601 (Print) 1743-761X (Electronic)	International Information and Engineering Technology Association (IIETA)	Environmental design and planning, environmental management, spatial planning, environmental planning, environmental management and sustainable development	2

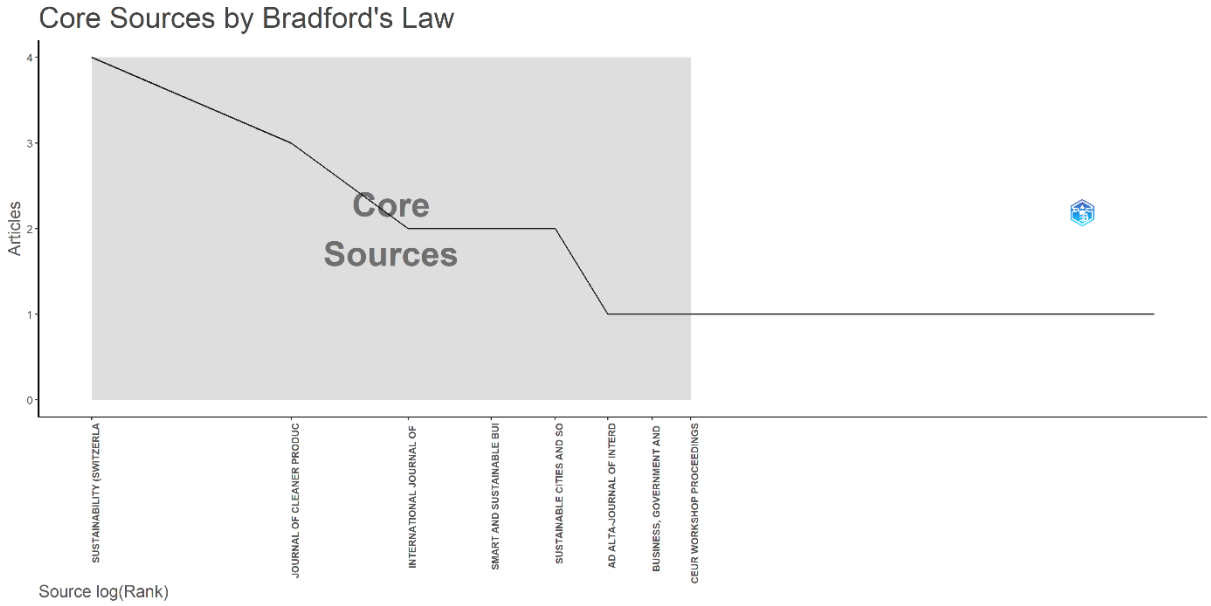
[1] https://www.mdpi.com/journal/sustainability
[2] https://www.sciencedirect.com/journal/journal-of-cleaner-production
[3] https://www.iieta.org/ojs/index.php/IJSDP

					in an integrated way as well as in accordance with the principles of sustainability	
4	Smart And Sustainable Built Environment[4]	Journal	2046-6099 (Print) 2046-6102 (Electronic)	Emerald Publishing Limited	Inform research and industry practice on integrated approaches to developing smart and sustainable built environments	2
5	Sustainable Cities And Society[5]	Journal	2210-6707 (Electronic)	Elsevier Ltd.	Designing, understanding, and promoting environmentally sustainable and socially resilient cities	2

(Source: Authors' Compilation)

Figure 14

Bradford's Law Core Sources



(Source: Authors' analysis from RStudio)

[4] https://www.emerald.com/insight/publication/issn/2046-6099
[5] https://www.sciencedirect.com/journal/sustainable-cities-and-society

4. DISCUSSION AND CONCLUDING REMARKS

4.1 Discussion of findings

This study represents a pioneering effort in employing bibliometric analysis and scientific mapping to provide a comprehensive overview of global research on LG in the context of DT and SD, utilizing Excel and RStudio software. We conducted a rigorous bibliometric examination of 48 publications on this topic, indexed in the two leading global scientific databases: Scopus and WoS. Through this research, we found that the subject of LG in the context of DT and SD has only recently gained scholarly attention worldwide, with the first global research appearing in 2021. This period notably coincided with global efforts to address the devastating consequences of the COVID-19 pandemic. From this inception until June 30, 2025, a total of 48 documents on LG in the DT and SD context have been published, accumulating 660 citations. Our analysis identified 153 contributing authors from 25 countries, with publications spanning 40 distinct sources. Notably, Ali Cheshmehzangi, Jordan Klimek, and Xin Li emerged as the most prolific authors, each contributing two publications. The highest number of citations was attributed to a paper by Kurniawan T. *et al*., with 192 citations (Kurniawan T. et al, 2022). Geographically, Ukraine stands out as the leading country in terms of publication volume, contributing 8 documents. Europe is identified as the most significant contributor to research on LG in the context of DT and SD, accounting for 52.9% of global publications. These findings underscore the global and interdisciplinary nature of research concerning LG in the context of DT and SD.

4.1.1 About the volume, growth trend

This study identifies the earliest recorded publication on LG in the context of DT and SD globally, dating back to 2021. Over nearly five years, this topic has begun to garner significant interest from international scholars, with the number of publications reaching double digits from 2024 onwards, maintaining an average publication rate of 9.3 documents per year. Overall, despite its relatively recent emergence, research into LG in the context of DT and SD has received considerable attention from researchers

worldwide. Given this trajectory, LG in the context of DT and SD is projected to remain a vital and expanding research domain, attracting increasing global scholarly focus in the near future.

4.1.2 About the locational distribution of the author's countries

On a national scale, despite the relatively short timeframe, the research topic of LG in the context of DT and SD has attracted scholars from 25 countries. Among these, five nations have demonstrated particularly notable scientific publication profiles, collectively accounting for 50% of the global publications on this topic: Ukraine, China, Greece, Indonesia, and Spain. In terms of publication volume, Ukraine leads with 8 documents. Regarding citation count, China stands out with the highest number of citations (239 citations) for this subject. At the continental level, Europe spearheads global research output in LG in the context of DT and SD, contributing 52.9% of the total. Asia follows with 18 publications (35.3%), the Americas with 4 publications (7.8%), and Africa with 2 publications (3.9%). Notably, Oceania has yet to produce any publications related to this topic. These findings indicate that LG in the context of DT and SD has evolved into a global research subject, attracting increasing interest from researchers worldwide, particularly those from Europe.

4.1.3 About topics that appealed the attention of scholars

This study identifies the top global keywords most frequently focused on in research concerning LG in the context of DT and SD. These include: "digital transformation", "local governance", "sustainability", "smart city", and "sustainable development". The most frequently used keywords are: "sustainability", "digital transformation", "smart city", "cities", "digitalization", "e-governance", "smartness", "e-government", "green growth", "industrial structure", "innovation", "local authorities", and "public administration". Their prominence indicates their central role in the global research conducted over the past five years. Furthermore, emerging research trends in the field of LG within DT and SD are illustrated by the increasing use of terms such as "digital transformation", "local governance", "sustainability", "smart city", and "sustainable

development". These core topics represent crucial future research trajectories that scholars worldwide should consider when advancing studies related to LG in the context of DT and SD.

4.1.4 About the top authors and research groups

Over the past five years, a total of 153 authors have contributed to research on LG in the context of DT and SD, resulting in 48 publications indexed in both the Scopus and WoS databases. As of the research cutoff date (June 30, 2025), these studies have collectively garnered 660 citations. Although each has contributed a modest number of individual publications on this topic, Ali Cheshmehzangi, Jordan Klimek, and Xin Li have emerged as the most prolific authors. The paper by Kurniawan T. *et al*. stands out with the highest citation count, accumulating 192 citations (Kurniawan T. et al, 2022). However, individual contributions remain relatively modest, with most authors publishing only one to two documents on this topic. Furthermore, no inter-country co-authorship model has emerged. These findings are consistent with the fact that this subject has only been under investigation for the past five years. This underscores the significant potential for further exploration and scholarly contributions within this promising research area.

4.1.5 About the sources in which studies were published

The paper is titled "Unlocking Digital Technologies for Waste Recycling in the Industry 4.0 Era: A Transformation Towards a Digitalization-Based Circular Economy in Indonesia (Kurniawan T. et al, 2022) received the highest number of citations among all studies conducted on LG in the context of DT and SD. Concurrently, Sustainability (Switzerland) has emerged as the journal with the highest number of publications related to this topic, publishing a total of four documents. The limited concentration of publications (ranging from just one to four documents per source) on LG in the context of DT and SD indicates a lack of diversity in publication outlets. This also inadequately reflects the interdisciplinary nature of the field. This suggests that the topic has not yet attracted widespread interest from scholars across various academic disciplines, and

existing publications have not significantly contributed diverse perspectives or analytical methodologies. Consequently, current research on LG in the context of DT and SD does not yet provide a comprehensive, multi-dimensional understanding of the subject.

4.2 Limitations and future research directions

Despite utilizing comprehensive datasets from two of the world's most reputable and well-known databases, encompassing all relevant works on LG in the context of DT and SD without geographical or temporal limitations, this study still possesses certain limitations. Firstly, this methodological approach does not permit an in-depth examination of specific themes, nor does it assess the individual quality, content, or impact of each publication related to LG in the context of DT and SD. Therefore, future research should emphasize content, affirming the importance of LG in the context of DT and SD to further advance research in this promising field. Furthermore, this study does not fully capture the global conceptual scope of LG in the context of DT and SD, as bibliometric methods inherently possess certain limitations (Zupic, I., & Čater, T., 2015). Additionally, the selection of databases for analysis and the interpretation of results are inevitably influenced by the subjective perspectives of the researchers (Zupic, I., & Čater, T., 2015), (Hallinger & Nguyen, 2020). Consequently, achieving an objective understanding of this research topic necessitates extensive background knowledge and the integration of multiple perspectives.

ACKNOWLEDGEMENTS

This research is part of a university-level research project funded by the University of Economics – The University of Danang, under the grant number T2025-04-55

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

How to cite this article (APA)

Thu, H. T. T., Phuong, T. L. N., Van, V. N., Bao, L., & Hai, H. V. (2026). DIGITAL TRANSFORMATION AND SUSTAINABLE DEVELOPMENT: ARE THEY RESHAPING LOCAL GOVERNANCE? A SCOPUS AND WOS BIBLIOMETRIC EXPLORATION. Veredas Do Direito, 23, e235010. https://doi.org/10.18623/rvd.v23.5010