

Performance Analysis and Science Mapping of Agricultural Research Within the Sustainable Livelihoods Framework: A Bibliometric Analysis Using the Scopus Database

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Abstract

The Sustainable Development Goals (SDGs) were established to eradicate poverty, achieve food security, promote sustainable agriculture, and develop resilient communities, making sustainable livelihoods a global priority. As a key livelihood sector, agriculture plays a central role in advancing these goals, particularly for vulnerable populations in the Global South. While agricultural sustainability has been widely studied through various lenses, there is growing interest in using the Sustainable Livelihoods Framework (SLF) to explore the complex interplay among social, economic, and environmental factors shaping rural livelihoods. This study contributes to the literature through a comprehensive bibliometric analysis that maps the evolution of agricultural research within the SLF. Drawing on 1,977 documents indexed in the Scopus database (1960–2023), it employs performance analysis to identify influential authors, institutions, countries, and journals. It further applies scientific mapping to trace thematic shifts and collaboration networks. The thematic analysis reveals that clusters such as *livelihood–resilience–sustainability* occupy a central position, indicating their role as the primary drivers of contemporary sustainable livelihood scholarship. In contrast, themes such as *climate change*, *adaptation*, *vulnerability*, *sustainable livelihoods*, and *livelihood assets*, particularly in lower-income contexts like Ghana, appear as basic yet underdeveloped, signaling critical research gaps. By identifying these uneven thematic trajectories, the study offers new theoretical insights into how the SLF has been operationalized in agricultural research and provides evidence-based guidance for policymakers and researchers seeking to strengthen livelihood resilience and sustainability in vulnerable agrarian contexts.

Keywords

Agriculture; bibliometric analysis; performance analysis; science mapping; social capital; sustainable livelihoods framework

Introduction

Agriculture plays a central role in ensuring global food security and supporting rural livelihoods (Usman et al., 2025). However, the sector is increasingly being challenged by the intersecting impacts of climate change, land and soil degradation, rural depopulation, and water pollution (Ayanlade et al., 2017; Nguyen-Thi-Kim et al., 2024). As the global population continues to rise, pressure on agricultural systems intensifies, leading to unsustainable practices that further exacerbate resource depletion and environmental degradation (Gentle & Maraseni, 2012). Among these challenges, climate change poses a particularly significant threat to agricultural sustainability. Its adverse impacts are disproportionately felt in tropical and subtropical regions, where developing countries face heightened risks to food production and rural livelihoods (Das et al., 2024). Estimates suggest that global agricultural output has declined by 1–5% per decade due to climate change, compared to a scenario without its influence (Das et al., 2024). These changes not only affect food systems but also deepen the vulnerabilities of rural communities dependent on agriculture for both sustenance and income (Das et al., 2024; Gentle & Maraseni, 2012).

A growing body of research has sought to understand localized adaptation and mitigation strategies (Das et al., 2024). Studies consistently highlight the importance of differential access to resources and institutional support, both of which significantly shape farmers' adaptive capacities and decision-making in response to climatic risks (Alam et al., 2016; Ayanlade et al., 2017; Delaporte & Maurel, 2018). Against this backdrop, the Sustainable Livelihoods Framework (SLF) developed by the Department for International Development (DFID) in 2000 has become a key analytical tool. Widely adopted in research on rural livelihoods and climate vulnerability, the SLF conceptualizes livelihoods as comprising five core asset types: natural, physical, human, social, and financial (Below et al., 2012; Tang et al., 2013). These assets interact within broader institutional and environmental contexts, providing a holistic framework for examining how smallholders mobilize resources, navigate structural constraints, design adaptation or resilience strategies (Below et al., 2012; Opiyo et al., 2023).

By conceptualizing rural livelihoods through the interaction of these five capitals, the SLF also provides a lens for examining how demographic pressures and social inequalities are manifested across regions and over time. Mapping the evolution of SLF-based agricultural research, therefore, contributes to population and social studies by highlighting how population-related processes and social relations are conceptualized within this research.

Although other frameworks, such as Sustainability Assessment of Food and Agriculture Systems (SAFA) and Tool for Agroecological Performance Evaluation (TAPE), emphasize the sustainability performance of production systems (Gharbi et al., 2025; Zarbà et al., 2025), the SLF offers a complementary household-centered perspective. Its institutionally embedded and multi-capital lens enables a finer understanding of how resource access, social relations, and livelihood strategies intersect. These dimensions are not easily captured by supply chain- or farm-performance-oriented assessment tools such as SAFA and TAPE. This distinction is especially salient in agricultural contexts, where adaptation, vulnerability, and resilience emerge from everyday livelihood practices rather than solely from production metrics.

Despite a growing body of literature linking sustainable agriculture and the SLF, relatively few studies have systematically mapped the intellectual landscape that connects these domains. Synthesizing existing scholarship is therefore essential for understanding how

research on agricultural livelihoods has evolved and for identifying persistent knowledge gaps and future research directions. To address this gap, the present study conducts a bibliometric analysis of research indexed in Scopus. Scopus is selected because it indexes a substantially larger number of social science journals and offers broader disciplinary and regional coverage than comparable databases, making it well-suited for capturing the multidisciplinary nature of sustainable livelihoods research (Mongeon & Paul-Hus, 2016; Singh et al., 2021).

Objectives

The primary objectives of this study are to:

- Identify the most prominent countries, institutions, documents, and authors contributing to agricultural research within the SLF framework.
- Examine key trends and patterns shaping the discourse on sustainable agricultural livelihoods.
- Highlight major keywords and thematic clusters at the intersection of the SLF and agricultural sustainability.

The structure of this paper is organized as follows. First, the following section reviews existing literature to contextualize the study within broader academic discussions. This is followed by sections on Research Methodology and Bibliometric Analysis Techniques, which detail the data sources and analytical procedures. The Results and Discussion section reports and interprets the key findings. The paper concludes with a summary of insights, implications, and recommendations for future research.

Literature review

The concept of sustainable livelihoods (SL) has gained considerable academic attention since its emergence in the early 1990s. Over time, it has evolved into a key framework for analyzing the complex interconnections among poverty reduction, environmental conservation, and rural development. This growing body of literature has also prompted the development of bibliometric studies that map research trends, thematic clusters, and evolving priorities in the field.

Zhang et al. (2019) examined global trends in SL, underscoring the increasing prominence of this research area within international economic development and environmental governance. Their analysis identified several research hotspots, including theoretical explorations of the SLF, studies on ecosystem conservation, poverty alleviation, climate change impacts, and policy and institutional reforms related to SL. Building on this, Cai et al. (2022) conducted a bibliometric analysis using the Web of Science database to identify similar research concentrations. However, they expanded the scope by highlighting rural livelihoods as a distinct and increasingly significant area within SL research. Their work reflected a growing alignment between global policy objectives, particularly the Sustainable Development Goals (SDGs), and scholarly interest in rural communities.

Khan et al. (2023) similarly noted the rising trajectory of rural livelihood research, attributing this surge to increased policy emphasis on sustainable rural development within the SDG framework. Further expanding the field, Li et al. (2022) conducted a scientometrics study that identified 10 major frontiers in SL research: solar home systems, artisanal and small-scale mining, forest quality, marine protected areas, agricultural sustainability, sustainable rangeland management, Indigenous knowledge systems, livelihood alternatives, vulnerability, and livelihood security. In a separate study, Li et al. (2023) focused on SL in grassland ecosystems and identified 14 prominent thematic clusters. Key topics included Net Primary Productivity (NPP) dynamics, global environmental change, ecological restoration, and risk indicators. Although not specifically centered on SL, Zhai et al. (2024) conducted a bibliometric analysis of livelihood strategies among agricultural populations. Their findings identified the intersection of climate change and agrarian livelihood strategies, the sustainability of these strategies, and their defining characteristics as central themes of the research.

Similarly, Der Tambile et al. (2024) analyzed rural livelihoods and found that climate change, drought, poverty, and food security were dominant themes in scholarly discourse. Putra et al. (2025) focused on pasture ecosystems, stressing the urgency of addressing climate change impacts. Their study highlighted research themes including pasture ecosystem dynamics, adaptation strategies, and the interrelationships between climate change and land-use practices. Recently, Kumari et al. (2025) foregrounded gender dynamics within sustainable agriculture. Their review found that gender equity in landownership and access to agricultural inputs is an increasingly important research concern. They called for future research to explore policy interventions and digital innovations that empower women in agricultural livelihoods, thereby promoting more gender-equal outcomes.

Methodology

Source of data

This study used the Scopus database to retrieve relevant literature.

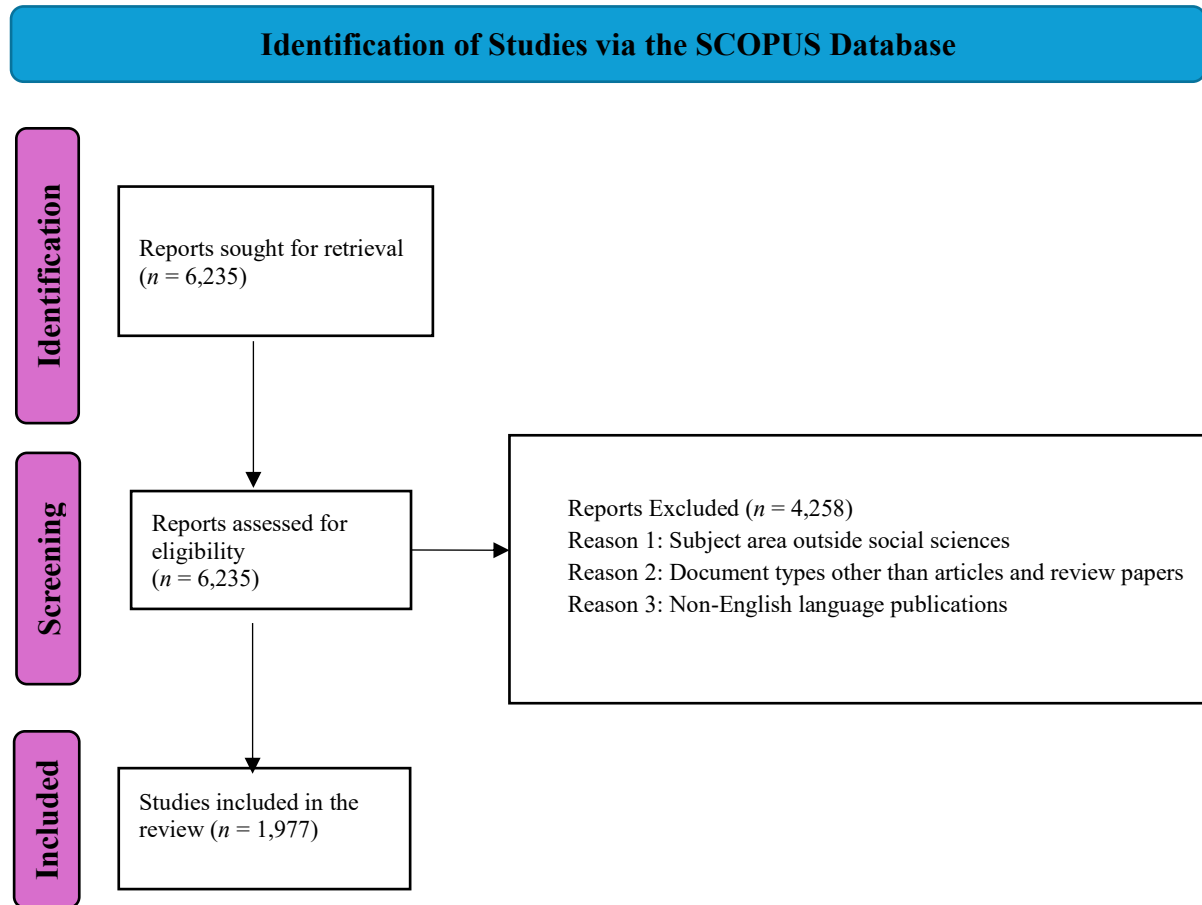
Identification and document selection

A bibliometric approach was employed to explore the academic landscape of research on sustainable agricultural livelihoods within the social sciences. A comprehensive search was conducted in the Scopus database to retrieve relevant publications using a structured query applied to the title, abstract, and keywords fields. The search string included terms such as “livelihood resilience,” “sustainable livelihoods,” “sustainable livelihoods framework,” “livelihood capital,” “social capital,” “human capital,” “natural capital,” “livelihood assets,” combined with agricultural terms such as “agriculture,” “farm*,” “forestry,” “agroforestry,” and “agroecology.” The use of truncation (e.g., “farm*”) was used to capture all relevant keyword variants to ensure broad coverage of the literature.

Documents were retrieved using the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) framework, which provides a systematic and rigorous method for identifying, screening, and including relevant studies (Selcuk, 2019). Each document was screened for relevance, and only studies published in English and classified as journal articles

or review papers within the social sciences were included. The final dataset comprised publications spanning from 1960 to 2023, with data extraction completed in 2024. Figure 1 shows the PRISMA flow illustrating the document selection process.

Figure 1: Document Selection Process based on the PRISMA Framework



The selected dataset was exported to RStudio for analysis using the Biblioshiny interface of the Bibliometrix package (Aria & Cuccurullo, 2017). To support this analysis, VOSviewer, which is open-source software widely used for bibliometric visualization, was employed to generate network maps. These included visualizations of international and institutional collaboration patterns, co-word networks, and keyword density maps. Together, these tools provided insights into the intellectual structure, thematic development, and leading contributors in SL and agriculture.

Bibliometric methodology

The term “bibliometrics” was first introduced by Belgian documentalist Paul Otlet in the 1930s (Rousseau, 2014) and gained wider recognition when Alan Pritchard, a British librarian, highlighted it in the *Journal of Documentation* in December 1961 (Öztürk et al., 2024). Bibliometrics is the quantitative study of research activity, aimed at analyzing, mapping, measuring, and assessing scientific outputs and their impacts at various levels, ranging from countries to disciplines, research groups, and individual scholars (Martin, 2011). This methodology has proven instrumental in managing large volumes of scientific data and plays a significant role in evaluating research impact (Passas, 2024).

Researchers employ bibliometric analysis for multiple purposes, including identifying emerging trends in article and journal performance, analyzing collaboration patterns and research constituents, and uncovering the intellectual framework of a specific domain within the existing literature (Verma & Gustafsson, 2020). By systematically analyzing unstructured bibliographic data, bibliometrics enables the mapping of aggregated scientific knowledge and reveals the evolving contours of established disciplines. Consequently, a well-executed bibliometric study provides a robust foundation for advancing knowledge across academic fields (Passas, 2024). Two approaches are commonly utilized in bibliometric analysis.

Performance analysis

This approach evaluates the contributions of various research constituents within a specific field. It is descriptive in nature and focuses on measuring the productivity and influence of authors, institutions, countries, and journals (Baker et al., 2020; Gutiérrez-Salcedo et al., 2018; Priovashini & Mallick, 2022). Performance analysis is widely used in bibliometric reviews to identify the most active and impactful entities in a research domain.

Science mapping

Science mapping investigates the relationships and intellectual interactions among research entities. It examines the structural connections between publications and authors using techniques such as citation analysis, co-citation, bibliographic coupling, co-word analysis, and co-authorship analysis (Donthu et al., 2021; Ghatode & Nimbarte, 2025). Central to these techniques is network analysis, which represents research entities as *nodes* and their relationships as *links*. Network analysis enables the examination of structural properties through network metrics such as node frequency, link strength, centrality, and clustering, as well as through visualization tools that map these relationships graphically (Donthu et al., 2021).

This study employs both performance analysis and science-mapping techniques using the Bibliometrix package in R and the VOSviewer visualization tool. Together, these tools enable a comprehensive examination of the bibliographic dataset, facilitating the identification of key entities, conceptual trends, and the intellectual evolution of research on sustainable agricultural livelihoods.

Results and discussion

Summary information on agriculture research within the sustainable livelihoods framework

Table 1 presents the bibliometric data extracted from the Scopus database on publications related to SL in agriculture.

Table 1: Information About the Data

	Description	Result
Timespan		1960:2023
Sources (journals, books)		553

Description	Result
Documents	1,977
Annual growth rate %	8.77
Document average age	8.6
Average citations per doc	24.05
References	96,519
Keywords plus (id)	3,527
Author's keywords (de)	4,829
Authors	5,328
Authors of single-authored docs	359
Single-authored docs	380
Co-authors per doc	3.21
International co-authorships %	29.14
Article	1,918
Review	59

Note: All tables were created using Biblioshiny in R (Version 4.4.1)

The study identified 1,977 documents published across 553 sources. The dataset only included peer-reviewed journal articles and review papers; all other document types were excluded. Of the selected documents, 1,918 were journal articles, and 59 were reviews. The average number of citations per document was 24.05, with an annual growth rate in publications of 8.77%. Together, the selected documents featured 3,527 keywords and 4,829 author keywords. In terms of authorship, 359 documents were single-authored, while 5,328 authors contributed to co-authored publications.

Performance analysis

Performance analysis can be conducted using various methods; the most common include tracking the annual number of publications and citations attributed to specific research entities. The number of publications serves as a proxy for productivity, while citation counts indicate scholarly impact and influence (Mukherjee et al., 2022). In this study, the h-index, g-index, and m-index were used to evaluate author and journal performance. The h-index measures scholarly influence and is defined as the largest h such that h publications have received at least h citations each. The g-index captures cumulative citation impact and corresponds to the highest number g for which the top g publications have collectively received at least g^2 citations. The m-index reflects contemporary productivity by dividing an author's h-index by the number of years since their first indexed publication.

Although all three indices are measures of scholarly performance, they differ in emphasis: the h-index balances productivity and influence and is therefore widely used as an indicator of sustained scholarly contribution; the g-index gives greater weight to highly cited publications and highlights entities with landmark works; and the m-index adjusts for academic age, allowing equitable comparison among scholars at different career stages (Donthu et al., 2021).

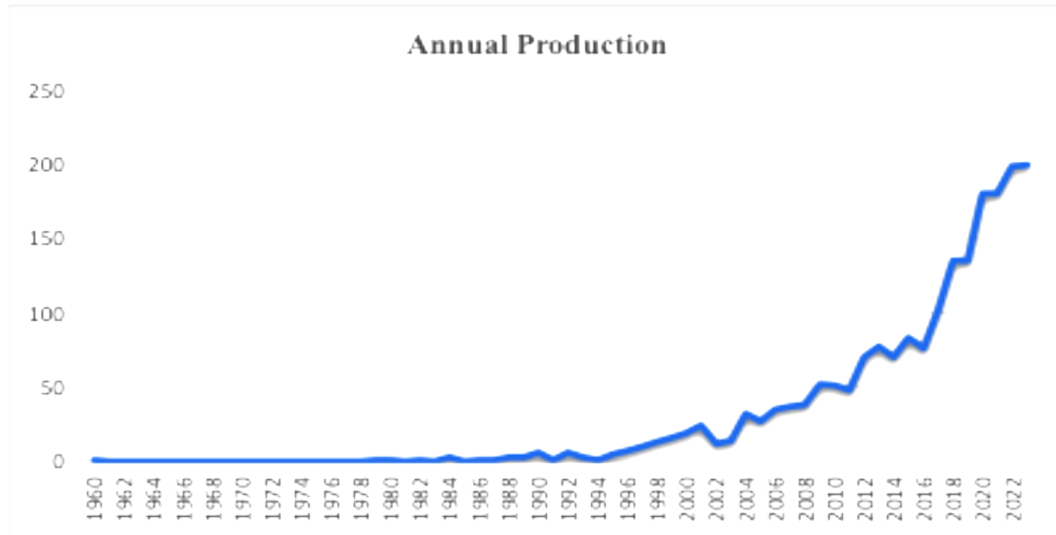
Trends of published documents by year

Annual scientific production

Figure 2 indicates that Annual Scientific Production was relatively limited prior to 2002, after which the field experienced sustained growth. Publications focusing on agriculture within the SLF have continued to rise, reaching approximately 200 articles by 2023. This post-2002

inflection likely corresponds to increasing policy attention to livelihood issues in the lead-up to and emergence of the SDG agenda, as well as improvements in interdisciplinary indexing practices in databases such as Scopus.

Figure 2: Annual Evolution of Published Papers



Most productive journals in the field of sustainable livelihoods and agriculture

Table 2 lists the 20 most productive journals in SL and agriculture. *Land Use Policy*, the *Journal of Rural Studies*, and *World Development* emerged as the top-ranking journals based on their h-index values: 36, 30, and 30, respectively. In terms of the g-index, *Land Use Policy* and *World Development* demonstrated the highest values, indicating a strong cumulative citation impact. In terms of the m-index, *Sustainability* ranked the highest, reflecting its rapid growth and influence in recent years.

Table 2: List of the 20 Most Productive Journals

Source	h_index	g_index	m_index	Total Citations	Number of Publications	Publication Year (Start)
Land Use Policy	36	57	0.973	3,511	89	1988
Journal of Rural Studies	30	51	0.882	2,788	69	1991
World Development	30	57	1	4,833	57	1995
Sustainability	29	41	2.417	2,786	203	2013
Forest Policy and Economics	21	38	1	1,524	43	2004
Food Policy	17	24	0.515	1,083	24	1992
Global Environmental Change	16	17	0.842	3,874	17	2006
Environment, Development, and Sustainability	14	23	0.538	599	41	1999
Climate and Development	13	20	1.3	506	20	2015
Environmental Science and Policy	13	15	0.684	1,114	15	2006
Rural Sociology	13	13	0.371	495	13	1990

Source	h_index	g_index	m_index	Total Citations	Number of Publications	Publication Year (Start)
International Journal of Disaster Risk Reduction	11	17	1.375	358	17	2017
International Journal of Sustainable Development and World Ecology	11	16	0.458	293	19	2001
Land Degradation and Development	11	17	0.44	340	17	2000
Agrekon	10	16	0.345	275	21	1996
Human Ecology	10	14	0.37	504	14	1998
Journal of Development Studies	10	14	0.357	275	14	1997
Journal of International Development	10	14	0.286	455	14	1990
Climate Risk Management	9	10	1.125	321	10	2017
Food Security	9	14	0.692	365	14	2012

While Table 2 presents the top-ranking journals based on the h-index and g-index, Table 3 highlights the 20 most productive journals regarding publication count, along with their impact factors, publishers, and quartile classifications. *Sustainability* leads with the most publications ($n = 203$), followed by *Land Use Policy* ($n = 89$), the *Journal of Rural Studies* ($n = 69$), and *World Development* ($n = 57$).

Table 3: List of the 20 Most Relevant Journals for Publication

Journal	Total Publications	Publisher	Language	Subject Categories	Quartile	Impact Factor
Sustainability	203	Multidisciplinary Digital Publishing Institute (MDPI)	English	Social Sciences, Computer Sciences, Environmental Sciences	Q1	3.3
Land Use Policy	89	Elsevier	English	Geography	Q1	7.1
Journal of Rural Studies	69	Elsevier	English	Geography, Planning and Development, Sociology and Political Science, Nature and Landscape Conservation, Forestry, Development	Q1	5.1
World Development	57	Elsevier	English	Geography, Planning and Development, Sociology and Political Science, Economics and Econometrics, Development	Q1	6.9
Forest Policy and Economics	43	Elsevier	English	Policy and Economics	Q1	4.0
Environment, Development	41	Springer	English	Environmental Sustainability	Q1.	4.7

Journal	Total Publications	Publisher	Language	Subject Categories	Quartile	Impact Factor
and Sustainability Food Policy	24	Elsevier	English	Economic and Social Aspects of Food Policy	Q1	6..8
GeoJournal	24	Springer	English	Geography, Planning, and Development	Q1	2.5
Agrekon	21	Taylor and Francis	English	Agriculture and Biological Sciences, Economics, Econometrics and Finance, Social Sciences	Q2	1.5
Climate and Development International	20	Taylor and Francis	English	Climate and Development	Q1	4.6
Journal of Sustainable Development and World Ecology	19	Taylor and Francis	English	Ecology; Green & Sustainable Science & Tech;	Q1	7.7
Global Environmental Change	17			Geography/Planning Sciences; Geography; Ecology		
International Journal of Disaster Risk Reduction	17	Elsevier	English	Disaster risk reduction; Geosciences; Water resources	Q1	9.1
Land Degradation and Development	17	Elsevier	English		Q1	4.5
	15	Wiley	English	Soil Science; Environmental Sciences; Agronomy Development	Q1	3.7
Development Southern Africa	15	Taylor and Francis	English	studies; Geography; Social Sciences	Q2	1.3
Environmental Science and Policy	15	Elsevier	English	Environmental policy; Geography; Planning & Development	Q1	5.6
International Forestry Review	15	Commonwealth Forestry Association	English	Forestry; Ecology; Natural resource management	Q2	0.9
Sustainability Science	14	Springer	English	Sustainability; Ecology; Global Change; Policy	Q1	5.3
Food Security Human Ecology	14	Springer	English	Food science; Agronomy; Development	Q1	6.2
		Springer	English	Anthropology; Sociology; Environmental Studies	Q1	1.7

The prominence of these top-ranking journals has also been affirmed in prior bibliometric studies. Sarkar et al. (2022), in their research on sustainable agriculture, identified *Land Use Policy* as a leading journal, attributing its high ranking to its broad acceptance of diverse thematic contributions. Similarly, Malanski et al. (2021) highlighted both the *Journal of Rural Studies* and *World Development* for their substantial contributions to research productivity in the agricultural domain. *Sustainability* has likewise been consistently ranked among the top journals in agriculture and sustainable development, a recognition often linked to its broad thematic scope and open-access publication model (Sarkar et al., 2022).

Most prolific authors

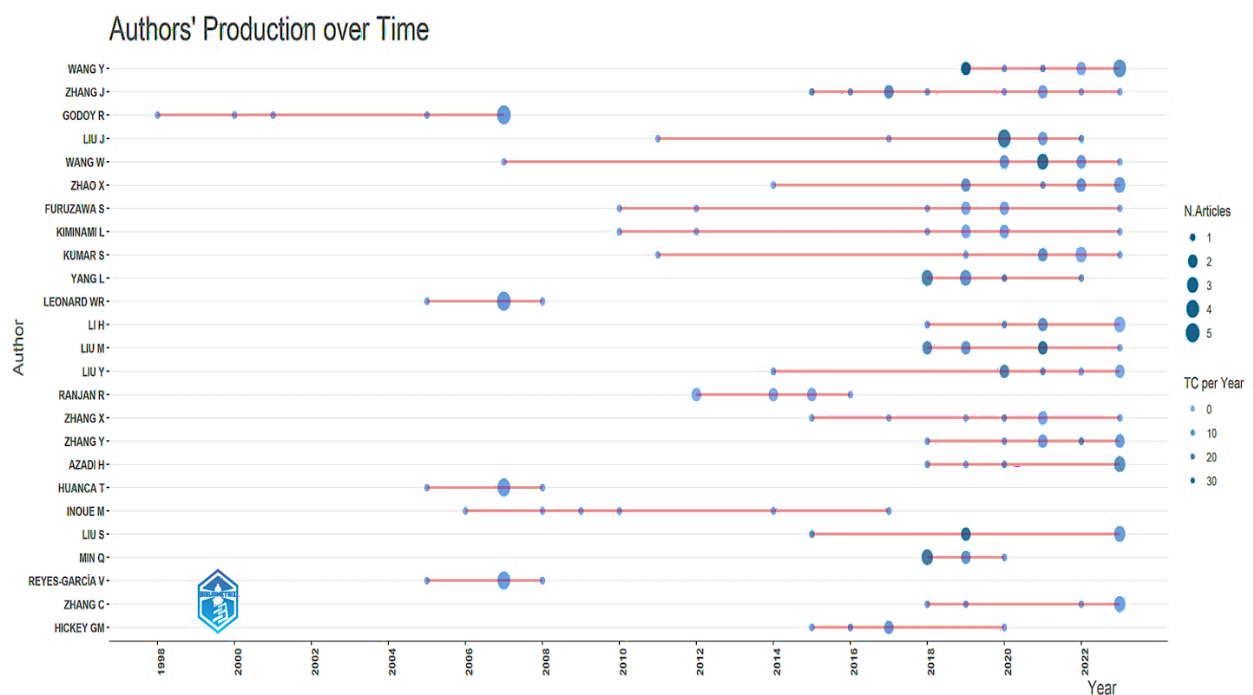
A total of 5,328 authors have published on sustainability and agriculture. Of these, 329 were single-author contributors, while the remainder published collaboratively. Table 4 lists the most prominent authors based on h-index, with Godoy R, Leonard WR, and Liu J ranking the highest. The g-index is highest for Wang, Y., and Zhang, J., whereas the m-index is highest for Savari, M

Table 4: List of the 20 Most Relevant Authors

Author	h_index	g_index	m_index	Total Citations	Number of Publications	Publication Year (Start)
Godoy, R.	9	9	0.333	251	9	1998
Leonard, W. R.	7	7	0.35	192	7	2005
Liu, J.	7	9	0.5	181	9	2011
Yang, L.	7	8	1	254	8	2018
Huanca, T.	6	6	0.3	174	6	2005
Min, Q.	6	6	0.857	228	6	2018
Reyes-García, V.	6	6	0.3	164	6	2005
Wang, Y.	6	10	1	301	10	2019
Zhang, J.	6	10	0.6	306	10	2015
Azadi, H.	5	6	0.714	115	6	2018
Hickey, G. M.	5	5	0.5	141	5	2015
Inoue, M.	5	6	0.263	104	6	2006
Li, Y.	5	5	0.417	130	5	2013
Liu, M.	5	7	0.714	261	7	2018
Otsuka, K.	5	5	0.192	130	5	1999
Ranjan, R.	5	6	0.385	40	7	2012
Savari, M.	5	5	1.25	111	5	2021
Speelman, S.	5	5	0.455	161	5	2014
Vadez, V.	5	5	0.25	146	5	2005
Wang, W.	5	9	0.278	175	9	2007

Figure 3 illustrates author productivity, showing that Wang, Y., has produced the most papers, followed by Zhang, J., and Godoy, R. These authors also rank as the most relevant, in the same order.

Figure 3: Author Production Over Time



Most productive countries

Table 5 presents the total citation (TC) counts for each country, illustrating the overall influence of their contributions to the field.

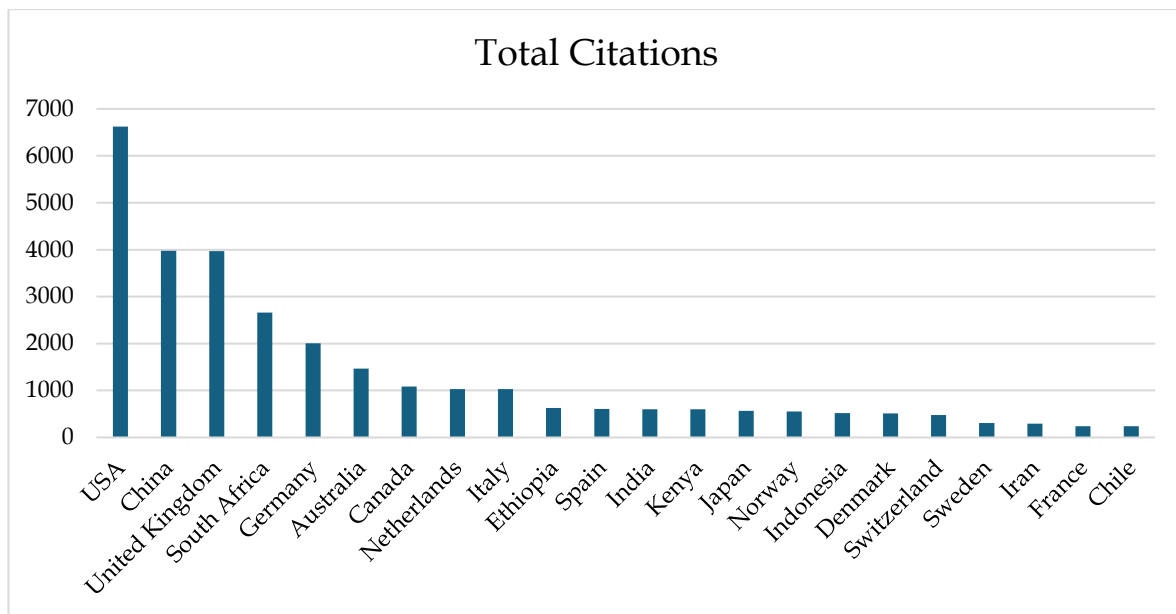
Table 5: Citations by Country

Country	Total Citations	Average Article Citations
United States	6,624	37.00
China	3,979	19.80
United Kingdom	3,971	39.70
South Africa	2,661	34.60
Germany	2,004	29.50
Australia	1,469	22.30
Canada	1,083	25.80
Netherlands	1,032	26.50
Italy	1,028	33.20
Ethiopia	631	14.00
Spain	607	22.50
India	604	7.60
Kenya	604	37.80
Japan	568	12.90
Norway	556	46.30
Indonesia	519	12.70
Denmark	512	73.10
Switzerland	481	21.90

Country	Total Citations	Average Article Citations
Sweden	310	19.40
Iran	294	12.20
France	242	12.70
Chile	237	39.50

Figure 4 complements this by displaying the top 20 countries ranked by TC. Both sources indicate that the United States (TC = 6,624), China (TC = 3,979), and the United Kingdom (TC = 3,971) are the most highly cited contributors, reflecting their strong research activity and visibility.

Figure 4: Country-Wise Citations



Earlier bibliometric evaluations in the domains of sustainability and agriculture have likewise identified the United States, the United Kingdom, and China as prominent contributors, underscoring the continued dominance of these countries in shaping the field's research trajectory (Li et al., 2024; Rana & Pragati, 2024; Sarkar et al., 2022). However, the dominance of these countries should be interpreted in the context of broader structural factors, including higher research funding capacities, well-developed academic and publication infrastructures, and greater institutional support for large-scale research output.

Additionally, major bibliometric databases such as Scopus are disproportionately dominated by English-language journals and publications from the Global North, leading to indexing and language biases that enhance the visibility and citation impact of research originating in these countries (Mongeon & Paul-Hus, 2016; Paasi, 2015).

These leading countries are followed by South Africa, Germany, Australia, Canada, the Netherlands, Italy, and Ethiopia, which together constitute the next tier of influential contributors. Geographically, the distribution of high-impact countries spans North America, Europe, Asia, Africa, and Oceania, suggesting that research at the intersection of the SLF and agricultural sustainability has gained traction across diverse socio-environmental contexts.

Most productive institutions

Table 6 shows the most productive universities in this field. China emerges as the most dominant contributor with seven institutions represented, and Beijing Normal University (China) ranks first with 39 publications. This strong presence reflects China's growing investment in agricultural, environmental, and sustainability research over the past two decades, as well as the prominence of Chinese universities in global publication networks. The clustering of institutions in Beijing and other major academic hubs underscores China's strategic emphasis on research on climate change, food security, and rural development.

The United States follows with three institutions, maintaining its traditional role as a global leader in academic research. Although the number is lower than China's, the presence of universities such as Brandeis, Cornell, and Michigan State signals the continued influence of US-based research in shaping global discourse on sustainability and agriculture. Institutions from the Global North dominate the list, though the presence of universities from Ethiopia, South Africa, Ghana, and Indonesia suggests growing contributions from the Global South, particularly in context-specific research on food systems, climate adaptation, and sustainability challenges.

Table 6: List of 20 Most Productive Affiliations

Affiliation	Articles
Beijing Normal University	39
Wageningen University	34
Brandeis University	29
Addis Ababa University	28
Huazhong Agricultural University	28
Ghent University	27
Institute Of Geographic Sciences and Natural Resources Research	27
Wageningen University and Research	27
Beijing	25
University of Bern	25
University of Leeds	24
Beijing Forestry University	23
University of KwaZulu-Natal	23
Cornell University	22
McGill University	22
Sichuan Agricultural University	22
Michigan State University	21
Kwame Nkrumah University of Science and Technology	19
University of Bonn	19
Brawijaya University	18

Globally cited documents

Table 7 presents the papers with the highest citation counts in the field. Two publications stand out, each with more than 1,000 citations. The most cited paper, with 1,135 citations, was published by Deressa et al. (2009) in *Global Environmental Change*. Previous bibliometric work also identified Deressa et al. as a landmark paper (Chogou et al., 2023); our analysis corroborates this interpretation and places it within a broader network of highly cited climate adaptation research. The authors are affiliated with the Centre for Environmental Economics and Policy in Africa and the Department of Agricultural Economics and Rural Development

at the University of Pretoria, South Africa. The study investigates the factors influencing farmers' adaptation choices to climate change and the barriers they face (Deressa et al., 2009).

The second-most-cited paper, with 1,077 citations, was published in *World Development* by Pretty and Ward (2001), a team of scientists from the University of Essex, United Kingdom. Their paper examines the role of social and human capital in shaping environmental outcomes (Pretty & Ward, 2001). The third-most-cited paper, by Below et al. (2012), received 498 citations and was also published in *Global Environmental Change*. Affiliated with the Department of Agricultural Economics at Humboldt University in Germany, the authors' paper explores the relationship between socio-economic variables and farmers' adaptation behaviors.

Table 7: List of the 20 Most Globally Cited Documents

Paper Title	Authors	Year	Total Citations	Total Citations Per Year	Normalized Total Citations
Determinants of Farmers' Choice of Adaptation Methods to Climate Change in The Nile Basin of Ethiopia	Deressa, T. T.	2009	1,135	70.94	18.50
Social Capital and the Environment	Pretty, J.		1,077	44.88	13.65
Can Farmers' Adaptation to Climate Change Be Explained by Socio-Economic Household-Level Variables?	Below, T. B.	2012	498	38.31	11.71
Trends, Drivers, and Impacts of Changes in Swidden Cultivation in Tropical Forest-Agriculture Frontiers: A Global Assessment	Van Vliet, N.	2012	447	34.38	10.51
An Indicator Framework for Assessing Ecosystem Services in Support of The EU Biodiversity Strategy To 2020	Maes, J.	2016	410	45.56	14.87
Global Assessment of Agricultural System Redesign for Sustainable Intensification	Pretty, J.	2018	408	58.29	16.15
Local Enforcement and Better Forests	Gibson, C. C.	2005	398	19.90	7.17
Between Development and Social Policies: The Impact of European Structural Funds in Objective 1 Regions	Rodríguez-Pose, A.	2004	394	18.76	7.53
Managing Vulnerability to Drought and Enhancing Livelihood Resilience in Sub-Saharan Africa: Technological, Institutional and Policy Options	Shiferaw, B.	2014	352	32.00	10.16

Paper Title	Authors	Year	Total Citations	Total Citations Per Year	Normalized Total Citations
Livelihoods, Vulnerability and Adaptation to Climate Change in Morogoro, Tanzania	Paavola, J.	2008	352	20.71	7.17
The Importance of Dry Woodlands and Forests in Rural Livelihoods and Poverty Alleviation in South Africa	Shackleton, C. M.	2007	343	19.06	12.62
Understanding The Adoption of a Portfolio of Sustainable Intensification Practices in Eastern and Southern Africa	Kassie, M.	2015	335	33.50	9.08
Revitalising Traditional Villages Through Rural Tourism: A Case Study of Yuanjia Village, Shaanxi Province, China	Gao, J.	2017	327	40.88	10.64
Paying For Environmental Services: An Analysis of Participation in Costa Rica's PSA Program	Zbinden, S.	2005	306	15.30	5.51
Rural Household Demographics, Livelihoods, And the Environment	De Sherbinin, A.	2008	295	17.35	6.01
Evolving Themes in Rural Development 1950s-2000s	Ellis, F.	2001	282	11.75	3.57
Geographic Poverty Traps? A Micro Model of Consumption Growth in Rural China	Jalan, J.	2002	274	11.91	5.23
Trust, Networks, and Norms: The Creation of Social Capital in Agricultural Economies in Ghana	Lyon, F.	2000	271	10.84	5.28
Promising Approaches to Address the Needs of Poor Female Farmers: Resources, Constraints, And Interventions	Quisumbing, A. R.	2010	260	17.33	8.66
Demonstrated Benefits from Social Capital: The Productivity of Farmer Organisations in Gal Oya, Sri Lanka	Uphoff, N.	2000	257	10.28	5.01

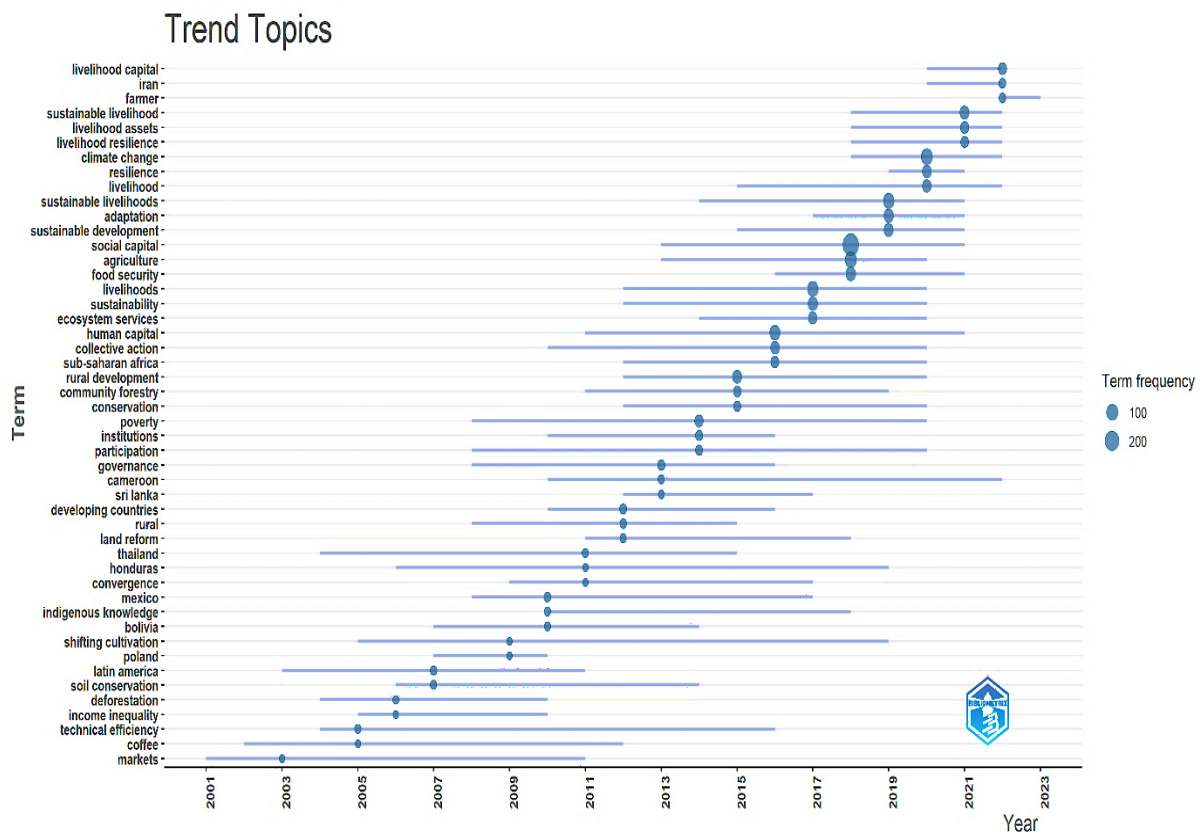
Scientific mapping

This section presents the scientific mapping of research in the field, encompassing trend topic analysis, keyword co-occurrence, international collaboration networks, and the thematic evolution of key concepts. To examine the structural and conceptual organization of the literature, the study applies network analysis to both author keyword networks and country collaboration networks, using VOSviewer to construct and visualize the networks. By integrating network metrics and visualization, science mapping enables a systematic assessment of the field's bibliometric structure (e.g., collaborative linkages) and conceptual structure (e.g., thematic organization and evolution), thereby offering a comprehensive understanding of the intellectual landscape surrounding the SLF and agricultural sustainability.

Relationship between keywords, authors, and sources in the field

Figure 5 illustrates trending topics based on author keywords in agricultural research within the SLF from 1992 to 2023.

Figure 5: Trend Topics Based on Author Keywords



In keyword networks, node size denotes the frequency of a keyword's occurrence, while link thickness reflects the strength of co-occurrence between terms; distinct colors identify thematic clusters that signify groups of conceptually related keywords and their interconnections. In recent years, keywords such as *livelihood capital*, *Iran*, *farmers*, *sustainable livelihood*, *livelihood assets*, *livelihood resilience*, and *climate change* have emerged as prominent

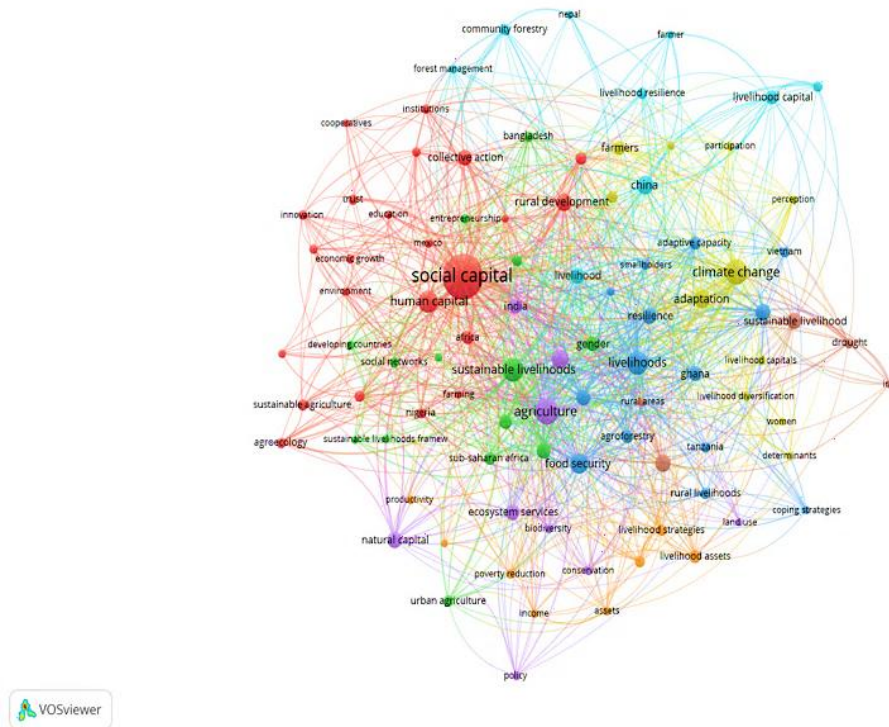
trends, although their frequencies remain low. The prominence of “Iran” as a recent trending topic can be attributed to a noticeable increase in empirical studies examining climate-related livelihood challenges faced by rural and farming households in the country. Recent publications address core SLF concerns by examining issues such as the role of social capital in mitigating drought impacts, household resilience under drought conditions, gendered dimensions of climate adaptation, and the effects of water scarcity in arid and semi-arid regions (Goli et al., 2023; Savari et al., 2023a, 2023b)

In contrast, foundational topics such as adaptation, sustainable development, and social capital occur significantly more frequently, reflecting their established relevance within the field. This visualization underscores the potential for further investigation into newer and underrepresented themes. While these emerging topics are gaining traction, their relatively low frequencies suggest opportunities for future research to address evolving challenges and fill existing knowledge gaps in the field.

Co-word analysis through author keywords

In line with Objective 3, which seeks to highlight the major keywords and thematic clusters at the intersection of the SLF and agricultural sustainability, co-word analysis was employed to identify the field’s conceptual structure. Within science-mapping techniques, co-word analysis typically uses author keywords as the unit of analysis. The rationale for using co-word analysis is that keywords serve as concise representations of a document’s core content, making them an effective proxy for capturing the literature’s thematic focus (Comerio & Strozzi, 2019). The frequency with which a word appears indicates its prominence within the research field, while the co-occurrence of words reveals thematic lineages and major conceptual clusters (Baker et al., 2020). However, because individual terms may be used in varied contexts, close reading of the underlying documents remains essential to ensure accurate interpretation of the thematic relationships identified (Donthu et al., 2021; Mukherjee et al., 2022).

Figure 6 illustrates the co-word analysis of author keywords generated with VOSviewer. In this visualization, node size represents the frequency of a keyword’s occurrence, while the connections (links) between nodes indicate co-occurrences. The thickness of these links reflects the frequency of co-occurrence, with thicker lines signifying more frequent associations between keywords.

Figure 6: Most Frequent Keyword Co-Occurrences

Larger nodes indicate more frequently used keywords, and distinct colors represent thematic clusters. Each cluster encapsulates a thematic grouping, offering insights into its scope and interconnections within the broader research landscape. The analysis identified six prominent clusters, with “social capital” emerging as the most frequently occurring keyword, as evidenced by its large node size. Other significant thematic clusters included “climate change and adaptation,” “agriculture,” “sustainable livelihoods,” “gender,” “food security,” and “rural development”. These clusters reflect the field’s key themes and the interrelated nature of its concepts.

Social capital and rural development

Within the SLF, social capital constitutes one of the five core livelihood capitals that play a crucial role in enabling access to resources. The prominence of social capital as the largest node underscores its centrality within the research domain. This thematic dominance is further supported by empirical literature that consistently links social capital to farmers’ adaptive capacities. For instance, Liu et al. (2020) demonstrated that social capital significantly shapes farmers’ access to credit, with interpersonal, political, and organizational relationship capital influencing both formal and informal credit channels. Similarly, Alare et al. (2022) highlighted how the erosion of collective action driven by processes such as urbanization, shifting household structures, and declining trust diminishes communities’ ability to cope with climate-related risks and maintain systems of mutual support. The literature also emphasizes that social capital operates as both an enabling and a constraining force: while certain groups can broaden their support networks, others encounter structural limitations linked to gender norms, marital status, and educational attainment (Kaiser et al., 2020).

Climate change adaptation and livelihood capitals

Studies indicate that adaptation to climate change is shaped by the interplay of household assets, institutional support, and wider socio-environmental conditions (Chitongo, 2019; Zerihun, 2021). Research employing the SLF demonstrates that adaptive capacity is fundamentally linked to the availability, quality, and interaction of key livelihood capitals, particularly human, social, and natural assets (Savari & Zhoolideh, 2021).

Food security, agriculture, sustainable livelihoods

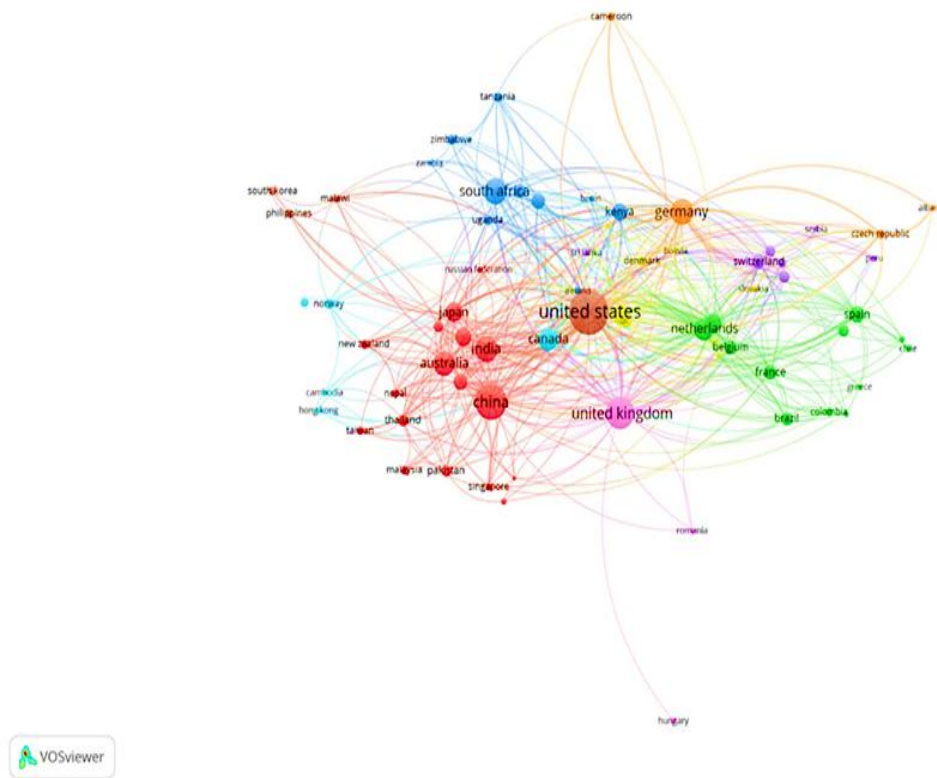
Multiple studies examine the dynamics of food security through the lens of social, environmental, and livelihood factors. Kaiser et al. (2020) highlighted how social capital shapes household food security outcomes, reinforcing the importance of community-based support structures. Evidence from Savari and Zhoolideh (2021) demonstrated that household food security is closely tied to climate impacts and the presence (or absence) of adaptive capacities, as conceptualized within the SLF. Additional research indicates that agroforestry is a viable livelihood diversification strategy that enhances household resilience and improves access to food (Zerihun, 2021). Moreover, recurrent drought intensifies household vulnerability, prompting reliance on various on-farm adaptive strategies to address food insecurity (Chitongo, 2019).

Gender and sustainable livelihoods

Gender-differentiated access to livelihood capital and adaptive strategies emerge as recurrent themes. Findings show that male farmers typically possess greater livelihood capital than women, and that distinct determinants shape capital accumulation for each group. Education and participation in agricultural cooperatives primarily influence men's livelihood capital, while women rely more heavily on policy support and subjective well-being (Kuang et al., 2022). Other studies reveal that women initially engage in short-term coping mechanisms but gradually transition to more sustainable adaptive practices that draw on indigenous knowledge and enhance social and human capital (Liru & Heinecken, 2021). Social norms, particularly within patriarchal contexts, shape married women's access to social networks, while female-headed households often exercise greater flexibility in building informal support systems (Alare et al., 2022).

Collaboration networks of countries

The country-level collaboration network, based on co-authorship data, was analyzed using VOS viewer. Countries with no collaborative links were excluded from the analysis. Figure 7 illustrates the collaboration network across countries and territories. The size of each node represents the volume of article production, while the thickness of the links represents the strength of collaboration between countries. Different colors indicate distinct clusters of collaborative activity. The analysis identifies seven major clusters centered around key countries: the United States, China, the United Kingdom, South Africa, Germany, the Netherlands, and Switzerland.

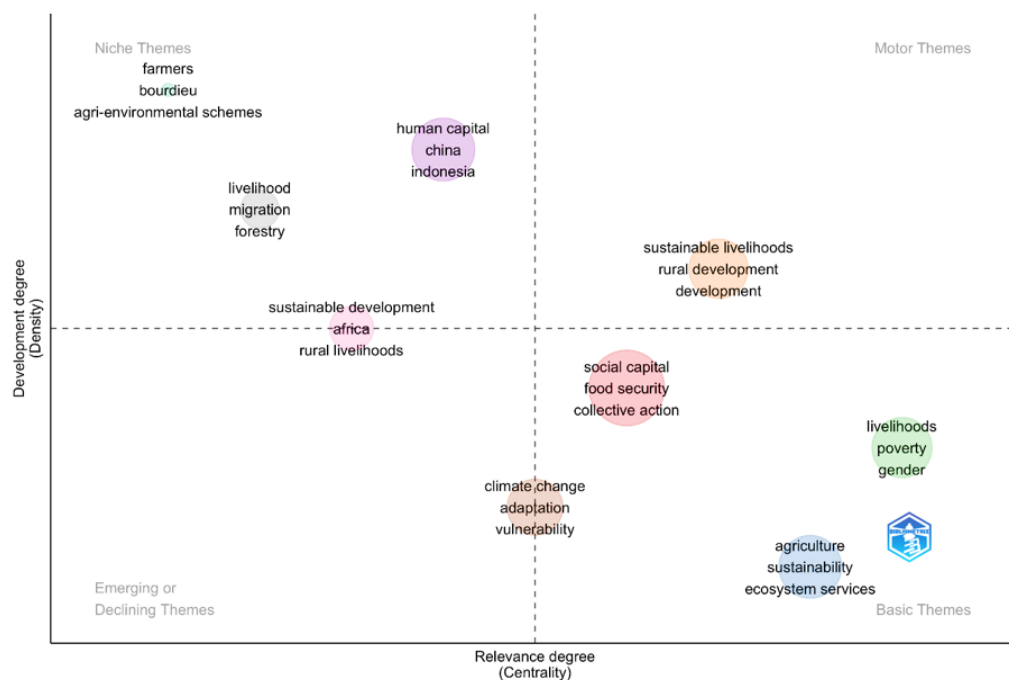
Figure 7: Countries' Collaboration Networks

Thematic analysis

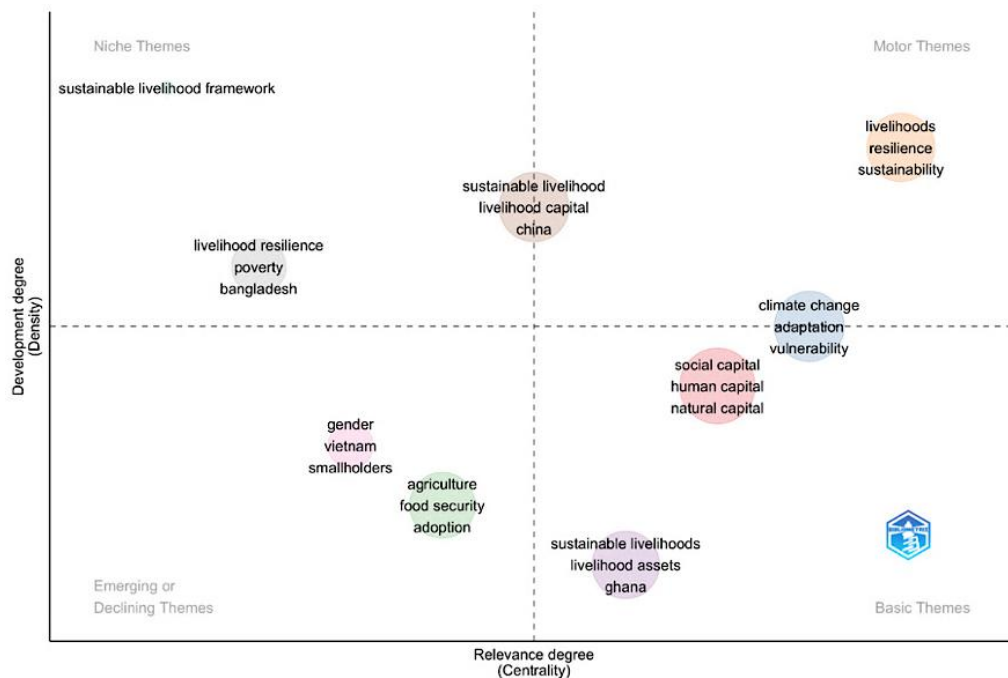
Thematic analysis was conducted across two periods, using the default cut-off year of 2018 provided by Biblioshiny. This approach utilized two parameters: centrality, indicating a theme's significance in the research field, and density, reflecting the level of the theme's development (Cobo et al., 2011). In the visual representations, centrality is plotted on the X-axis and density on the Y-axis. Themes are categorized into four quadrants: niche themes (high density, low centrality); motor themes (high density, high centrality); emerging or declining themes (low density, low centrality); and basic themes (high centrality, low density).

Figure 8(a), which covers the period from 1960 to 2018, reveals a thematic evolution from niche themes such as *Bourdieu* as Bourdieu's theoretical construct of social capital was used by authors while analyzing livelihood assets (Häuberer, 2011), *agri-environmental schemes*, *human capital*, *livelihood*, *migration*, and *forestry* to more general themes like *sustainable livelihoods* and *rural development*. Several themes, including *social capital*, *food security*, *collective action*, *poverty*, *gender*, *agriculture*, *sustainability*, and *ecosystem services*, displayed high centrality but lower density, indicating their importance alongside relative underdevelopment and potential for future research. During this period, themes such as *climate change*, *adaptation*, and *vulnerability* began transitioning from emerging to basic themes, reflecting their growing prominence.

Figure 8(a): Thematic Evolution (1960–2018)



The thematic evolution observed in the post-2018 period can be understood in the context of the growing global emphasis following the adoption of the SDGs in 2015. This emphasis has significantly shaped research agendas across development, agriculture, and livelihoods scholarship. Figure 8(b) illustrates the post-2018 landscape, where many earlier themes persist but have increased centrality and density. Notably, *livelihood resilience* and *sustainability* have emerged as dominant themes. *Climate change*, *adaptation*, and *vulnerability* also showed substantial gains in density and centrality, though they still offer substantial scope for further investigation. A notable emerging trend is the growing focus on specific geographical contexts, such as *Ghana*, in discussions of SL. The thematic map indicates that “food security” has shifted toward the lower-left quadrant in recent years, suggesting it is currently less developed (lower density) and less centrally connected to other themes, indicating a relative decline rather than emergence.

Figure 8(b): Thematic Evolution (2018–2023)

Strength and limitations

The strength of this study lies in its use of performance analysis and scientific mapping techniques to examine research trends in the critically important fields of sustainability and agriculture. Drawing on data from the Scopus database, the analysis provides a systematic, transparent, and reproducible macro-level and longitudinal overview of the evolution of themes in the literature. The findings offer a robust empirical foundation for future qualitative and theory-driven investigations.

The study acknowledges several limitations, primarily related to the data-retrieval methodology. Only English-language documents were considered, potentially excluding relevant research published in other languages. Furthermore, the analysis was confined to the social sciences, thereby omitting contributions from the natural sciences that could offer complementary insights. Additionally, data were sourced solely from the Scopus database, which, while comprehensive, may not encompass all pertinent studies available in other repositories such as Web of Science or Google Scholar.

Moreover, the study focused exclusively on journal articles and review papers, excluding other scholarly outputs, such as book chapters, which are common in the social sciences. While bibliometric analysis enables a broad quantitative overview of existing literature, it may not capture the depth and contextual nuances of individual studies. Future research could incorporate qualitative approaches to gain deeper insights and conduct more context-specific explorations of themes within this field.

Conclusion and future research directions

This study examined research trends in agriculture through the SLF, employing bibliometric performance analysis and scientific mapping. Drawing on data from the Scopus database from 1960 to 2023, the analysis identified key contributors, including leading authors, countries, institutions, and journals, and traced the evolution of themes and collaboration patterns. The United States, China, and the United Kingdom emerged as the most influential countries in terms of citation impact, while authors such as Godoy, R., Leonard, W.R., Liu, J., and Yang, L. were among the most cited. Leading journals included *Land Use Policy*, the *Journal of Rural Studies*, and *World Development*.

The findings reveal steady growth in agricultural research within the SLF, with 4,829 author keywords identified. Dominant themes include *social capital*, *agriculture*, and *climate change*. Thematic analysis shows a temporal shift: before 2018, research centered on topics such as social capital, food security, collective action, rural development, poverty, and gender. Post-2018, the focus has shifted to a deeper exploration of social, human, and natural capital, with greater attention to climate change, adaptation, and vulnerability. By tracing these thematic trajectories, the study clarifies how social relations, institutional contexts, and livelihood strategies are conceptualized within sustainability-oriented agricultural scholarship, thereby contributing to broader debates in population and social studies concerned with rural livelihoods, vulnerability, and social organization.

Overall, this study maps the intellectual landscape of SL in agriculture and highlights thematic concentrations and persistent gaps. It underscores the need for further research, particularly in underexplored areas characterized by high centrality but low density. These insights provide a foundation for future scholarly work that can deepen understanding of sustainable agricultural livelihoods and inform policy-relevant research agendas.

Ethical consideration

Ethical approval was not required for this bibliometric study, as it is based solely on analysis of published literature indexed in the Scopus database and does not involve human subjects or identifiable personal data.

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