




“Government policy on ensuring food security: Bibliometric analysis”

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GOVERNMENT POLICY ON ENSURING FOOD SECURITY: BIBLIOMETRIC ANALYSIS

Abstract

Understanding the role of government policy in advancing sustainable development goals and food sovereignty is key to building food security and food system resilience. This study leverages bibliometric analysis of Scopus data using tools like Biblioshiny to explore global research trends on the interrelationship between government policies in the agrarian sector and food security. The methodology involves structured data collection, cleaning, and analysis of metadata and keywords, revealing growth in publications since the 1980s, with significant increases post-2000 due to heightened global food security concerns. The peak of publication in 2023 is connected to the war in Ukraine, the disruptions it caused to global food security, and the functioning of the grain corridor agreements. From 1922 to 2000, studies focused on broad themes like agricultural policy and food security. Between 2001 and 2010, attention shifted to food markets, sovereignty, grain production, and the Common Agricultural Policy. From 2011 to 2025, research expanded to climate-smart agriculture, dietary diversity, foreign investment, and technological advancements like data analysis and remote sensing, highlighting technology's growing role in food security. The core themes such as "agricultural policy," "food security," "climate change," and "sustainable agriculture" emerged as dominant areas of focus. Advanced topics like "machine learning," "remote sensing," and "climate-smart agriculture" highlight a shift toward data-driven, technologically integrated solutions for food security. China and the USA were identified as leading contributors, producing the most publications and participating in the highest number of international collaborations.

Keywords

agrarian policy, agrarian regulation, agrarian reform, food security, food supply, food sovereignty, Biblioshiny App

JEL Classification

O13, Q01, Q18, Q57

INTRODUCTION

As nations face increasing challenges from climate change, population growth, and geopolitical shifts, ensuring food security has become a critical policy goal. Government policy plays a central role in shaping agricultural practices, trade regulations, and sustainability measures, all of which are essential to maintaining stable food supplies in a competitive global environment.

With rising global resource competition, countries are forced to balance self-sufficiency with international trade. Policies promoting sustainable agricultural practices, food sovereignty, and resilience to climate impacts are essential to addressing food security. Furthermore, the COVID-19 pandemic and recent disruptions in global supply chains have highlighted vulnerabilities in food systems, emphasising the need for resilient, adaptable policies that can withstand shocks. The topic also intersects with technological advancements, such as the use of artificial intelligence in agriculture, remote sensing, and data-driven decision-making, which offer new opportunities to enhance food production and distribution.

The Russian invasion of Ukraine has severely impacted the country's food security, disrupting agricultural production, supply chains, trade routes, and access to food. The war has led to substantial damage to Ukraine's agricultural infrastructure, including destruction of equipment, contamination of farmland with mines, and challenges in harvesting crops. Ukraine's agricultural sector could face indirect losses of up to \$83 billion by the end of 2025 due to reduced sown areas and altered production technologies affecting yields (Andrienko et al., 2024). In response to these challenges, the Ukrainian government, in collaboration with international partners, has implemented initiatives to stabilise the food supply. One notable program is the "Grain from Ukraine" initiative, launched in November 2022, which aims to support humanitarian shipments to countries in need while sustaining Ukrainian grain producers. This program has garnered financial support from over thirty countries and international organisations, accumulating around \$220 million to facilitate grain exports despite the ongoing conflict (Zhuravlyova, 2022). In February 2025, UK Foreign Minister David Lammy visited Kyiv and announced an additional £55 million (\$68.7 million) in financial aid to bolster Ukraine's resilience against Russian aggression. This package includes funds specifically allocated for Ukrainian grain and food shipments to regions like Syria (Reuters, 2025).

Organisations like the UN emphasise sustainable development goals (SDGs) that include zero hunger and climate action, and research on government policy and food security is essential for creating strategies that can withstand future competitive pressures on resources.

1. LITERATURE REVIEW

The relationship between government policy and food security has become a critical area of research, particularly in the face of global competition, climate change, technological advancements, and geopolitical instability. Governmental interventions influence agricultural sustainability, market stability, and resilience to global crises, making food security a multidisciplinary issue spanning economics, policy, technology, and environmental governance.

Early research primarily focused on the broad themes of food security governance, agricultural policies, and supply chain management. Shen et al. (2021) conducted a bibliometric analysis of food safety governance research over two decades, identifying key policy interventions and risk management strategies as dominant themes. Similarly, Xie et al. (2021), Dubanych et al. (2023), and Dobrovolska et al. (2024) highlighted the importance of interdisciplinary and international collaboration in addressing food security challenges, emphasising the need for more research into local governance, equity in food distribution, and the adoption of innovative technologies.

Over time, research has expanded to examine the sub-sectors of agriculture that support food security. Makarenko et al. (2022) and Richardson

(2023) explored how sustainable agricultural practices contribute to environmental health and long-term food stability. Huzenko and Kononenko (2024) emphasised the scientific attention given to sustainable agricultural practices in promoting public health and achieving SDGs. The role of governmental interventions in fostering food system resilience has also been extensively studied. Guliyev et al. (2024) mapped the evolution of research on food security management, underscoring the need for interdisciplinary collaborations to enhance policy effectiveness. Li and Song (2022) provided a long-term bibliometric analysis of food security research, identifying key trends such as the growing role of artificial intelligence (AI) and precision agriculture in improving food supply chain resilience. Zegunis and Balezentis (2024) underscore the need for tailored risk management strategies to enhance agricultural resilience in these regions.

Transparency and regulatory governance are essential for the successful implementation of food security policies. Bozhenko et al. (2023) called for enhanced governance mechanisms to combat corruption in climate finance. Kwasi Bannor et al. (2023), who analysed global food fraud research trends, explored the impact of fiscal policies and regulatory measures on food security. Hedau and Malla (2024) examined the influence of tax

incentives and regulatory adjustments on firms' financial performance, demonstrating how government interventions shape economic resilience in the food sector. Mazurenko et al. (2023) examined the role of good governance in balancing tax competition and managing the shadow economy. Similarly, Dahal et al. (2024) emphasised the importance of political stability in determining profitability among economic entities in developing Asian countries. Bouyacoub (2024) provided a regional perspective on the impact of various policy measures on economic indicators such as growth, inflation, and investment.

Technological advancements have significantly influenced food security governance. Liu et al. (2023) conducted a bibliometric analysis on the application of AI in food safety research, demonstrating its transformative role in contamination detection, supply chain management, and food fraud prevention. Kuzior et al. (2023b) positioned AI as a pivotal technology for fostering transparency and accountability in food governance. Hadouga (2023) analysed how AI tools optimise resource use and enhance decision-making in agriculture. These studies highlight the growing reliance on digital technologies for effective food security strategies.

The integration of blockchain technology has also gained attention in food security governance. Sundarakani and Ghouse (2024) examined blockchain's role in enhancing food supply chain transparency, particularly in the United Arab Emirates, emphasising its potential to mitigate food security risks. Guemidi et al. (2024) explored the design of decision support systems for consumer goods regulation within the agricultural sector, demonstrating how digital governance enhances policy implementation. Pakhnenko and Kuan (2023) examined the integration of digital technologies in public administration and the associated ethical considerations, highlighting the imperative for policymakers to address challenges such as the digital divide and promote equal access to e-government services.

The role of environmental factors in food security is an ongoing area of study. Bilan et al. (2018) identified key determinants such as soil quality, water resources, and biodiversity as essential for sustainable agricultural practices. Arych et al. (2023) and

Juhászová et al. (2023) further emphasised the importance of agricultural insurance in stabilising food systems against environmental shocks. Expanding on agricultural finance, Arych et al. (2023) analysed the cost structure of agricultural holdings within the European Union, focusing on the role of insurance expenses and financial risks.

Various studies highlight the complex effects of fiscal policies, regulatory changes, and technological advancements on economies and public systems. Li et al. (2024) analyse social protection policies' impact on poverty across multiple regions, advocating for frameworks that integrate social and environmental sustainability. Kwasi Bannor et al. (2023) explore global food fraud research trends, while Hedau and Malla (2024) examine how tax incentives and regulations influence firms' financial performance. Mazurenko et al. (2023) discuss good governance's role in managing tax competition and the shadow economy, while Dahal et al. (2024) emphasise political stability's impact on business profitability. Bouyacoub (2024) assesses regional policy effects on growth, inflation, and investment, offering insights into tailored economic strategies and social welfare implications.

Recent research has increasingly focused on the impact of global crises – such as pandemics, climate change, and armed conflicts – on food security. Richardson (2024) analysed the socio-economic impacts of the COVID-19 pandemic, particularly its disruption to food systems and supply chains. Bilan et al. (2023) and Bouhlal and Sedra (2022) conducted a bibliometric analysis of how the pandemic affected food availability, accessibility, and stability. Ray (2023) examined the growth and sustainability of the Supplemental Nutrition Assistance Program in the USA, revealing that its growth exhibits characteristics of a unit root process, indicating significant unpredictability and posing challenges for policymakers.

Armed conflicts pose additional threats to food security, with research emphasising the need for policy interventions to mitigate these effects. Dankevych et al. (2024) examined how war impacts economic security and food stability, while Kuzior et al. (2023a) studied Ukraine's socio-economic resilience following Russia's 2022 full-scale invasion. The importance of social solidarity and

mutual aid in mitigating food security risks during the conflict was a key finding of their research. Yerankin et al. (2023) developed comprehensive indicators for monitoring national food security vulnerabilities, offering a systematic approach to crisis response.

Despite the expanding body of knowledge in this field, certain research gaps continue to persist. This study aims to explore global research trends regarding the interrelationship between government policies in the agrarian sector and food security through a bibliometric analysis, providing insights into the evolving landscape of food governance research.

2. METHODOLOGY

2.1. Data collection

For the data collection, the Scopus database was chosen for its extensive content, user-friendly interface, and reliable, manipulation-resistant impact indicators. The Scopus covers a range of sources, including journals, conference proceedings, and books across scientific fields, with transparent and publicly accessible metrics (Pranckutė, 2021).

To form a sample of the documents from the Scopus database were utilised the following search query: “(TITLE-ABS-KEY (“agrarian reform” AND “food supply”) OR TITLE-ABS-KEY (“agrarian reform” AND “food security”) OR TITLE-ABS-KEY (“agrarian reform” AND “food sovereignty”) OR TITLE-ABS-KEY (“agrarian policy” AND “food supply”) OR TITLE-ABS-KEY (“agrarian policy” AND “food security”) OR TITLE-ABS-KEY (“agrarian policy” AND “food sovereignty”) OR TITLE-ABS-KEY (“agrarian regulation” AND “food supply”) OR TITLE-ABS-KEY (“agrarian regulation” AND “food security”) OR TITLE-ABS-KEY (“agrarian regulation” AND “food sovereignty”) OR TITLE-ABS-KEY (“agricultural reform” AND “food supply”) OR TITLE-ABS-KEY (“agricultural reform” AND “food security”) OR TITLE-ABS-KEY (“agricultural reform” AND “food sovereignty”) OR TITLE-ABS-KEY (“agricultural policy” AND “food

supply”) OR TITLE-ABS-KEY (“agricultural policy” AND “food security”) OR TITLE-ABS-KEY (“agricultural policy” AND “food sovereignty”) OR TITLE-ABS-KEY (“agricultural regulation” AND “food supply”) OR TITLE-ABS-KEY (“agricultural regulation” AND “food security”) OR TITLE-ABS-KEY (“agricultural regulation” AND “food sovereignty”). As a result, 1,694 documents were found.

No limitation to time, languages, or countries was implemented in a search query; only limitation to such type of document as articles was applied, which allows to find 1,262 documents in the sample of documents.

Its single-database format reduces access issues and supports exports in formats like CSV, BibTeX, and Excel for streamlined data handling. Export the metadata of the sample was provided in CVS format.

Table 1 provides an overview of the completeness of bibliographic metadata for 1,262 Scopus documents with a focus on government policy and food security. The dataset is solid for basic bibliographic information but has limitations in more detailed analysis, especially in keyword-based and disciplinary contexts.

2.2. Data cleaning

Some keywords were excluded because they related more to the characteristics of the sample (such as specific countries or regions) or to research methodology and result reporting rather than directly to the study’s research area. Therefore, these were removed to maintain relevance to the study’s objectives. Some terms were identified as synonyms, allowing their metadata to be merged for the analysis.

This study utilises Biblioshiny and Excel to analyse data from Scopus. Data were imported into Biblioshiny and then individually exported to Excel, resulting in 746 publications analysed through bibliometric methods. Table 1 details the metadata quality for documents focusing on government policy in the agrarian sector and food security used in the subsequent bibliometric analysis.

Table 1. Completeness of bibliographic metadata of sampled 1,262 documents

Metadata	Missing Counts	Missing %	Status
Abstract	0	0.00	Excellent
Document Type	0	0.00	Excellent
Language	0	0.00	Excellent
Publication Year	0	0.00	Excellent
Title	0	0.00	Excellent
Total Citation	0	0.00	Excellent
Journal	2	0.16	Good
Author	5	0.40	Good
Affiliation	88	6.97	Good
Cited References	95	7.53	Good
DOI	160	12.68	Acceptable
Authors Keywords	261	20.68	Poor
Corresponding Author	368	29.16	Poor
Keywords Plus	412	32.65	Poor
Science Categories	1262	100.00	Completely missing

Note: AND and OR are Boolean operators used to form the search query.

3. RESULTS

Table 2 summarises the bibliometric analysis of publications focused on government policy in the agrarian sector and food security, covering data from 1922 to 2025 across various publication types. This dataset indicates that government policy in the agrarian sector and food security are well-established research fields with global relevance, marked by impactful contributions, extensive collaboration, and diverse thematic explorations. The high citation rate and the extensive use of references reflect the critical importance of this analysis in guiding policy decisions and informing public discourse on sustainable food security strategies worldwide. The trend of international

collaboration underscores the need for cooperative approaches to address shared global challenges in food security.

The first article in the sample is a publication by Durand (1922) that provides an analysis of agricultural challenges and conditions in Eastern Europe post-World War I. Durand (1922) discusses the region's dense rural population, low agricultural yields, and limited surplus for export, which collectively lead to food shortages and a predominantly vegetable-based diet. The reduction in food production during the war and the continuation of the identified causes of this reduction after the war, the conditions contributing to improving the situation, and the importance of policy changes and agrarian reforms are discussed.

From the early 20th century until around 1980, there were very few publications on this topic, indicating minimal research interest or recognition during these years (Figure 1). Starting around the 1980s, there was a gradual increase in publications, likely reflecting growing awareness of global food security issues and the role of government policy in the agrarian sector. After 2000, there is a sharp increase in publication frequency. The early 2000s saw a rise in global trade and awareness of food security issues tied to international markets. Reports like the Millennium Development Goals (UN, n.d.) brought food security to the forefront of global discussions. Rising commodity prices, economic shocks, and the 2008 global financial crisis may have spurred more research into governmental strategies for stabilising food systems. Increased emphasis on sustainability and climate adaptation, as reflected in the SDGs (launched in 2015), likely encouraged research on agricultural

Table 2. The main information of the sample

Description	Results	Description	Results
MAIN INFORMATION ABOUT DATA		AUTHORS	
Timespan	1922:2025	Authors	3,712
Sources (journals, books, etc)	586	Authors of single-authored docs	310
Documents	1,262	AUTHORS' COLLABORATION	
Annual growth rate %	0.68	Single-authored docs	320
Document average age	9.69	Co-authors per doc	3.34
Average citations per doc	22.96	International co-authorships %	27.97
References	55,838	DOCUMENT TYPES	
DOCUMENT CONTENTS		Article	1,262
Keywords plus (ID)	3,296		
Author's keywords (DE)	3,250		

policies and their impact on food security. This surge could be attributed to a heightened international focus on food security due to factors like population growth, climate change, economic crises, and the need for sustainable agricultural practices. Global events and policy initiatives might have driven researchers to explore these areas more intensively. The graph peaks around 2020, possibly spurred by the COVID-19 pandemic, which brought significant attention to food security issues and caused significant disruptions to global food supply chains, highlighting vulnerabilities in food systems and sparking a surge in research on resilience and policy measures to ensure food availability during crises. However, there is a noticeable drop immediately following the peak, which could either reflect recent data incompleteness (for the current or upcoming years) or a temporary dip in publication output as the initial pandemic-driven urgency wanes (Figure 1).

Figure 2 demonstrates that citations were nearly non-existent in the early period (pre-1980), indicating minimal impact or recognition of these early works, possibly due to limited academic interest or less global focus on food security and policy issues. Citations start to appear in the 1980s–2000s, reflecting growing academic engagement with government policy in the agrarian sector about food security. This period corresponds with an increasing awareness of food security as a global issue, especially in response to various economic

and agricultural challenges. In the 2000s–2010s, citations rose sharply, marking this period as a heightened research impact. This increase likely stems from greater international attention on food security, driven by factors such as climate change, global economic crises, and the push for sustainable development. The citation peaks suggest that studies from this period have become foundational in this research field. The sharp dip in citations toward the current years could be due to several reasons. It may reflect the lag in citations for newer publications, as recent articles often take time to accumulate citations. Alternatively, it could indicate a temporary decline in the influence of recent studies, perhaps due to a shift in research focus or saturation in certain aspects of the field.

The peak in 2023 is connected to the war in Ukraine, the disruptions it caused to global food security, and the functioning of the grain corridor agreements. Ukraine and Russia are among the world's largest exporters of grain, including wheat, corn, and sunflower oil. The war severely disrupted these exports, leading to supply shortages and price spikes in global markets. This heightened the urgency of research into policies to mitigate such disruptions. The Black Sea Grain Initiative, brokered by the UN and Turkey in mid-2022, aimed to enable the safe export of Ukrainian agricultural products. The functioning and negotiation of this grain corridor likely spurred analysis of the role of international policy and collaboration in stabi-

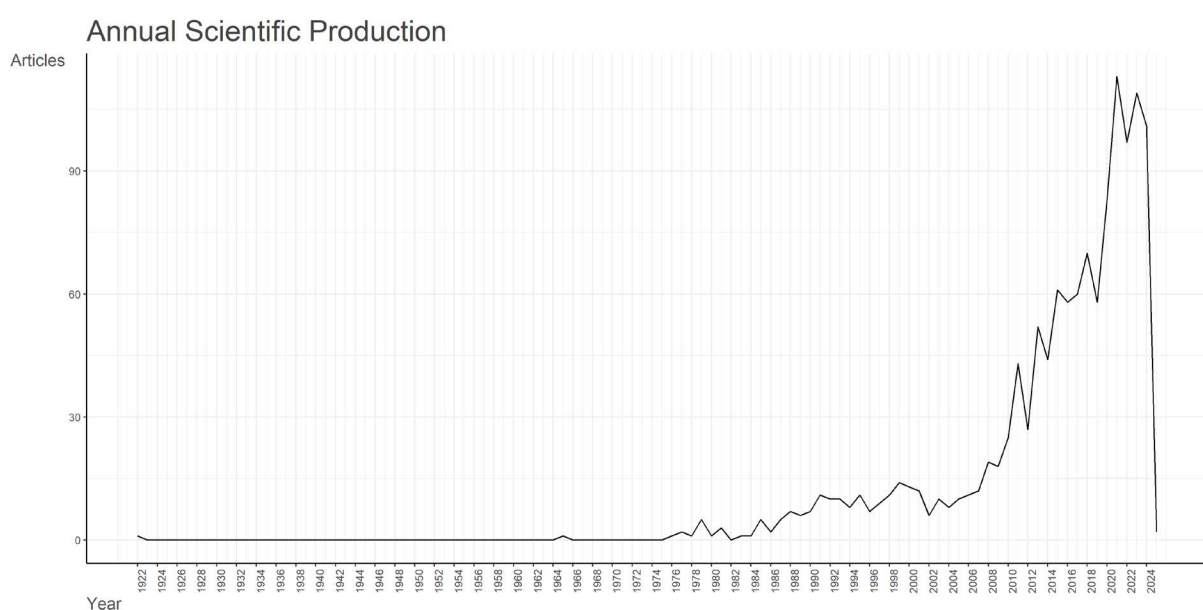


Figure 1. The dynamics of the publication focus on government policy in the agrarian sector to ensure food security

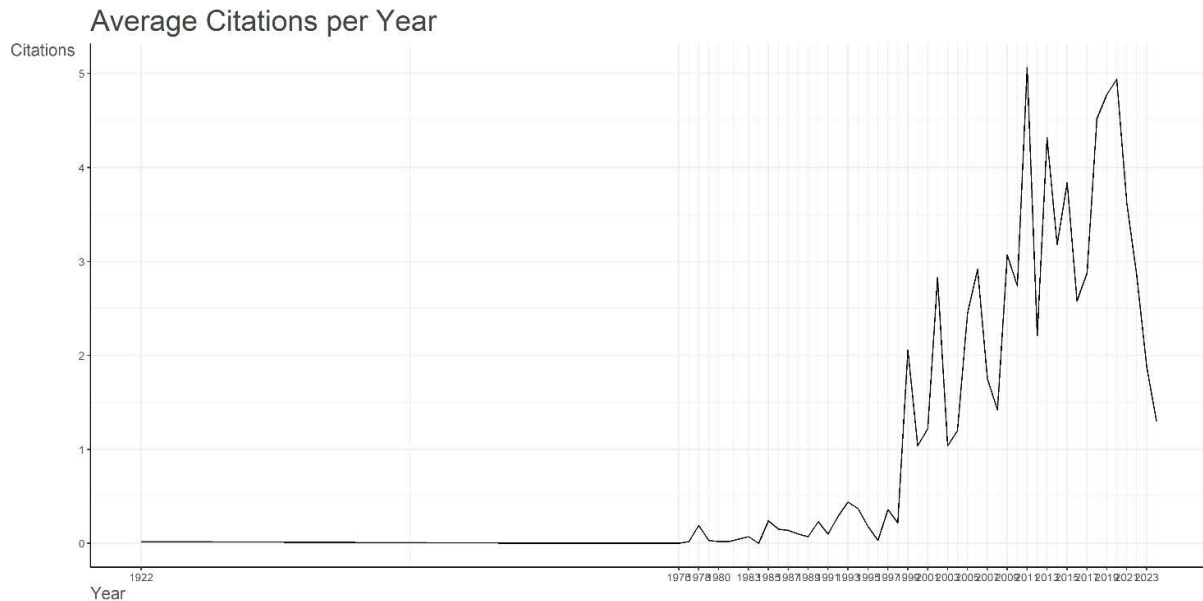


Figure 2. Average citation per year of the sampled documents

lising food systems during conflicts. Countries in Africa and the Middle East, which rely heavily on grain imports from Ukraine and Russia, faced severe food security challenges. This likely prompted research into government interventions and international aid strategies to support these regions. Economic sanctions on Russia and their impact on fertiliser exports (of which Russia is a major producer) further strained agricultural productivity globally. These developments likely spurred research on the cascading effects of geopolitical tensions on food security. Governments worldwide introduced emergency measures to address rising food prices and ensure food supply stability. Researchers likely analysed these policies, contributing to the surge in publications.

The combination of authors' local impact metrics offers a comprehensive view of each author's impact and trajectory in research on government policy in the agrarian sector and food security. Authors with high h-index and g-index values, like Liu Y. and Zhang Y., are well-established, while newer contributors with high m-index values, such as Li Z., are quickly making their mark. Table A1 (Appendix A) reflects a blend of experienced pioneers and promising new researchers, collectively advancing the understanding of how government policy in the agrarian sector affects food security.

Table A2 (Appendix A) provides insight into the local and international impact of research publica-

tions on government policy in the agrarian sector and food security by country. China (128) and the USA (126) lead in the number of publications, indicating a strong research focus from these nations. Higher SCP numbers, like in China (91) and the USA (77), suggest a significant volume of research conducted domestically without international collaboration. Countries with high MCP values, like the USA (49) and China (37), indicate active international collaboration, which can increase the research's diversity and perspective. China and the USA again have the highest values (0.101 and 0.1), showing their prominence in this research field. A higher MCP ratio, such as Kenya (0.667) and Australia (0.542), shows that a substantial portion of research is produced through international partnerships, suggesting that these countries rely more on global collaborations. China and the USA lead in both total publications and international collaborations, making them central players in the research landscape of government policy in the agrarian sector and food security. Countries like Kenya, Australia, and the Netherlands have high MCP_Ratios, indicating a preference or need for collaborative research, possibly due to resource sharing or leveraging diverse expertise. India has a low MCP_Ratio (0.087), indicating that most of its research is conducted domestically, with limited international collaboration. Table A2 reveals the importance of both domestic research output and international collaboration in advancing knowledge on government policy in the agrarian

sector and food security. Leading contributors like China and the USA play dual roles as local research hubs and international collaborators, while countries like Kenya and Australia rely more heavily on international partnerships, reflecting diverse research dynamics across regions.

Global citations reflect a document's overall impact within the entire bibliographic database, often attracting citations from diverse research areas. In contrast, local citations measure how often a paper is cited within a specific subset of studies being examined (Biblioshiny Tutorial, n.d.). Tables A3 and A4 (Appendix A) present the top 10 most globally and locally cited documents in the dataset, along with their citation details. The most globally cited document (705 citations) is the article by Altieri and Toledo (2011), which discusses the agroecological revolution in Latin America, emphasising its role in promoting environmental sustainability, food sovereignty, and the empowerment of rural communities. The authors argue that traditional agricultural practices, which often rely on industrial methods, can lead to ecological degradation and social inequalities. The document with the highest indicators of total citation per year (61.83) and normalised total citation (12.95) is an analysis by Renard and Tilman (2019) that examines the role of crop diversity in stabilising national food production. The article argues that increased diversity in crop systems can enhance resilience against environmental variability, pests, and diseases, ultimately leading to a more stable food supply.

The most locally cited document (eight citations) is the article by McKay et al. (2014) that explores the concept of food sovereignty in Latin America, focusing on the political projects and alternative pathways in Venezuela, Ecuador, and Bolivia. While these countries have made significant strides in advancing food sovereignty, they also face challenges related to implementation, governance, and external pressures. The highest indicator of normalised local citations (21.54) has the investigation by Wang et al. (2018), which addressed the spatial changes in China's grain production and the potential implications for the country's food security. The study likely discusses how shifts in land use or agricultural practices affect the distribution of grain production, contributing to the

broader discourse on sustainable agriculture and food policy. The highest LC/GC Ratio (20.00%) is the article by Nugent (2004) that discusses how food and agricultural policies intersect with the prevention of noncommunicable diseases (NCDs). It likely examines policy strategies that can impact NCD rates by addressing factors like nutrition, food accessibility, and agricultural practices, adding to the policy discourse on public health and nutrition.

The tree map of authors' keywords (Figure 3) provides a visual representation of the most used terms in articles related to government policy in the agrarian sector and food security. Dominant Keywords ("agricultural policy" (11%) and "food security" (10%)) are the most prominent keywords, highlighting these as central themes in the research. This aligns with the topic's focus on policy impacts and food security as a major global concern. Other significant keywords include "food supply" (6%), "agriculture" (4%), and "climate change" (2%), indicating the importance of these areas in discussions on government policy in the agrarian sector and food security. The presence of "policy approach" and "stakeholder" as keywords reflects the inclusion of governance strategies and multi-actor collaboration in the research. Terms like "poverty," "income," and "livelihood" suggest that many articles focus on the socio-economic aspects of food security, exploring how government policies affect income stability and poverty reduction. The tree-map highlights that research on government policy in the agrarian sector and food security is broad, covering everything from core policies and food supply issues to environmental sustainability, technological innovations, and social impacts. Larger keywords show the primary focus areas, while smaller keywords indicate niche or emerging research areas that provide depth and diversity within the field. This layout provides a snapshot of the multidisciplinary nature of food security research, which spans environmental science, economics, health, and agriculture.

Figure 4 shows the evolution of popular research keywords related to government policy in the agrarian sector and food security over time. In the early 2000s, topics like "economic reforms," "grain production," and "production" were among the earliest, reflecting a focus on foundational



Figure 3. The tree map of authors' keywords

economic and agricultural issues in food security. Starting around 2010, “sustainable agriculture,” “climate change,” and “food security” gained prominence, indicating a shift toward sustainability and climate impact on food policy. More recent terms like “machine learning,” “smallholder farmers,” and “COVID-19” reflect current concerns, such as technology’s role in agriculture and the effects of the pandemic on food security.

The size of the circles represents the frequency of each term. Larger circles, like those for “food security,” “climate change,” and “sustainability,” highlight that these are major themes, showing consistent and widespread interest over time. Smaller circles for terms like “irrigation,” “land grabbing,” and “drought” indicate niche or emerging areas within the broader food security research. Topics with longer timelines, such as “agriculture,” “food policy,” and “agrarian reforms,” have been explored consistently, suggesting they are established research areas within food security. Newer terms like “agroecology,” “smallholder farmers,” and “machine learning” reflect emerging areas that may become more central to future research, especially as technology and specific farming practices gain importance. The appearance of “COVID-19” as a keyword in recent years highlights how global events shape research focus, especially regarding food security disruptions caused by pandemics. Terms like “climate-smart agriculture” and “sustainability” have gained attention alongside the growing urgency of climate action, showing how environmental challenges have influenced the research landscape.

Figure 4 reflects the dynamic nature of food security research, with an evolving focus from traditional agricultural and economic reforms to more complex issues like sustainability, climate change, and technology adoption in recent years. The increasing frequency of terms related to sustainable practices, climate response, and technological applications suggests that these areas are becoming critical in understanding and shaping future government policies on food security. This trend indicates a broader and more interdisciplinary approach, incorporating environmental, technological, and socio-economic aspects in the context of global challenges.

The co-occurrence network of authors' keywords (Figure 5) provides insight into the relationships and themes within research on government policy in the agrarian sector and food security. Central keywords (“food security” and “agricultural policy”) are the most prominent nodes, shown by their larger size and central position. This indicates that they are the primary focus of the research network, with many connections to other keywords, demonstrating their broad relevance in studies on government policy in the agrarian sector and food security. “Agriculture” also appears close to the centre, indicating its foundational role in discussions on food security and government policy in the agrarian sector.

The network is divided into clusters (colour-coded), each representing related concepts that frequently appear together. Green cluster (linked to “food

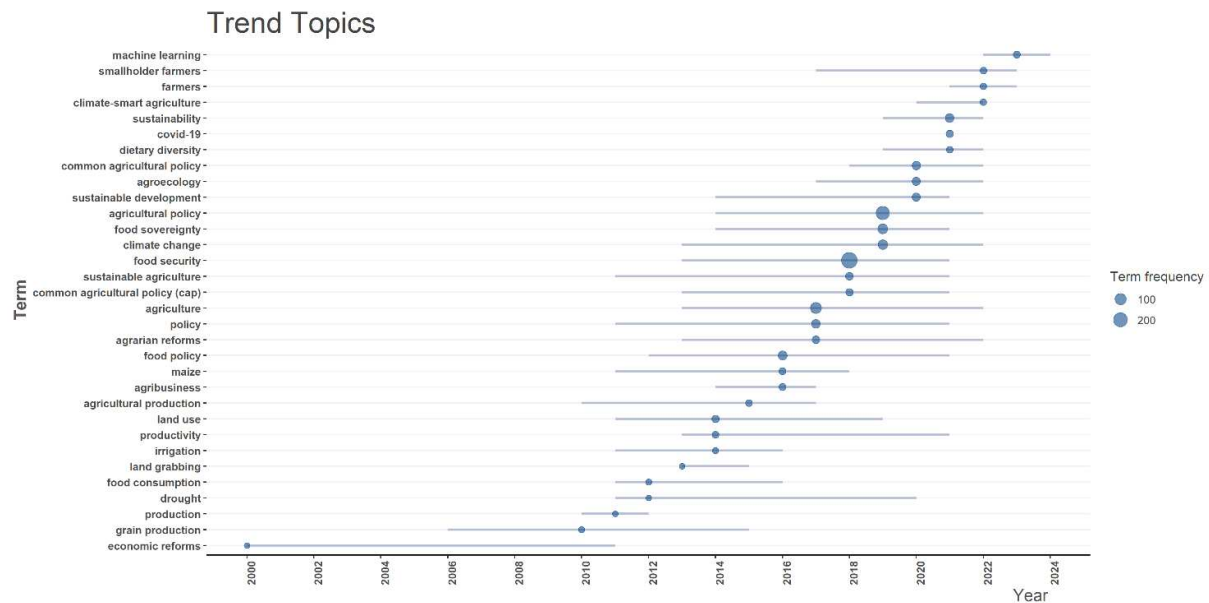


Figure 4. The trend topics of authors' keywords

security” and “agriculture”) includes terms like “sustainable development,” “climate-smart agriculture,” “adaptation,” and “smallholders,” suggesting a focus on sustainable agricultural practices and resilience to climate change. The blue cluster (linked to “agricultural policy” and “food policy”) contains keywords like “common agricultural policy,” “public policy,” and “food production,” indicating a focus on governmental and public policies around food production and distribution. Red cluster (linked to “resilience” and “agroecology”) contains terms like “farmers,” “COVID-19,” and “sustainable agriculture,” highlighting concerns about resilience in the face of global challenges like pandemics and the sustainability of farming practices. Brown cluster with “machine learning” and “remote sensing” points to the role of technology in food security research. Purple cluster, which has “biodiversity” and “land use,” indicates an ecological focus, examining the environmental impact of agricultural practices.

Strongly linked keywords suggest well-established research themes. For example, “food security” has strong connections to “agriculture,” “sustainable development,” and “policy,” indicating that sustainable agricultural policies are central to food security studies. Emerging terms, such as “machine learning” and “remote sensing,” have fewer connections but indicate growing interest in using technology for agricultural data analysis and resource management.

Keywords like “COVID-19,” “climate change,” and “sustainable intensification” reflect recent global challenges and evolving research areas, showing how external events and environmental issues shape government policy in the agrarian sector and food security research. Terms related to specific policies, like “common agricultural policy (CAP)” and “European Green Deal,” suggest regional or policy-specific studies focusing on Europe. Terms such as “food sovereignty,” “right to food,” and “agrarian reforms” indicate that some research addresses social justice, economic reform, and rights-based approaches to food security, linking governmental policy with social equity.

The longitudinal thematic map (Figure 6) shows that research on government policy in the agrarian sector and food security has evolved from broad themes toward specialised, interconnected, and data-driven approaches. Core themes like “food security” and “agricultural policy” remain foundational, while recent years have introduced nuanced topics addressing climate adaptation, data analytics, and global policy implications. This evolution reflects an increasing complexity in the field, with modern research focusing on the interplay between policy, sustainability, technology, and global competition in securing food systems.

The earliest research (1922–2000) focused primarily on broad themes such as “agricultural policy”

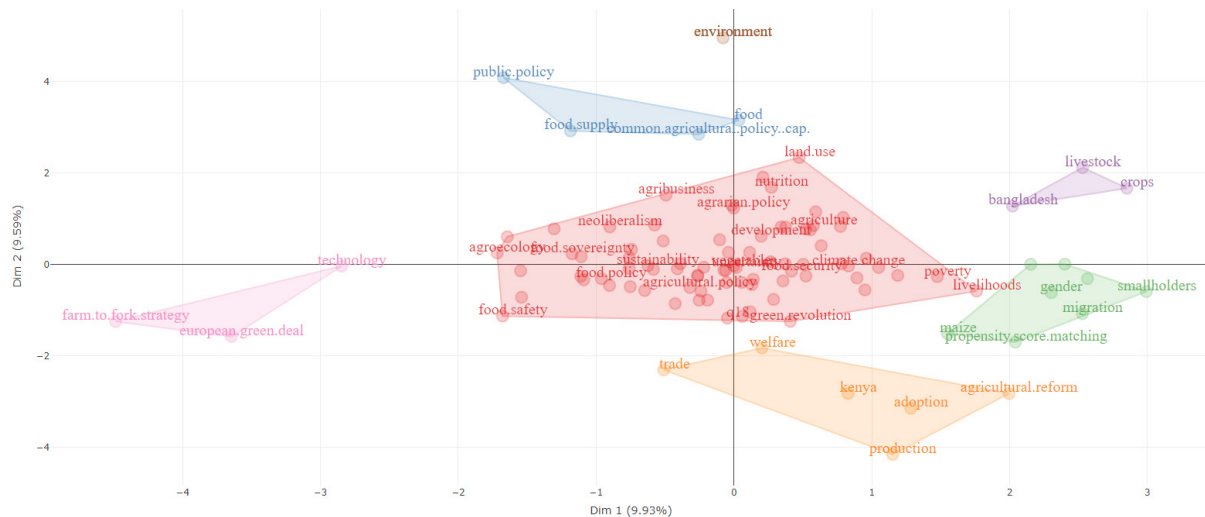


Figure 7. Factorial analysis of the author's keywords

Thus, the results of the analysis confirm a growing research interest in this field, especially since the 1980s, with a notable increase after 2000. This surge aligns with global concerns about food security, driven by population growth, climate challenges, and recent disruptions, including the COVID-19 pandemic. The upward trend in publications and citations suggests that researchers are increasingly recognising the critical role of government policy in the agrarian sector in ensuring food security under competitive global pressures. This aligns with global efforts to address food security challenges exacerbated by population growth, climate change, and geopolitical instabilities. The bibliometric trends demonstrate that government policy in the agrarian sector has become a focal point for addressing food security, reflecting its critical importance in achieving sustainable development goals.

The key findings highlight the dominance of research themes such as “agricultural policy,” “food security,” “climate change,” and “sustainable agriculture.” The factorial and co-occurrence analyses indicate that the intersection of policy with environmental sustainability and technological advancements is central to the discourse. Thematic maps and co-occurrence networks illustrated how research has evolved from foundational topics like “agrarian reforms” to interdisciplinary studies combining policy with technology and environmental sustainability.

There has been a noticeable shift toward exploring specific factors that influence the effectiveness of

government policy in the agrarian sector on food security. The factorial and longitudinal analyses revealed an increasing integration of technology, sustainability, and socio-economic factors into policy-related research, reflecting a comprehensive approach to tackling food security. Recent research focuses more on integrating advanced technologies like machine learning, remote sensing, and climate-smart agriculture. These trends reflect a movement from foundational studies toward more sophisticated, data-driven analyses of policy impact on resilience and sustainability in food systems. This evolution underscores an interdisciplinary approach that combines policy with environmental, economic, and technological factors to address contemporary and future food security challenges.

This study's findings align with and extend previous bibliometric and methodological research focused on the interrelationship between government policy and food security. The observed increase in publications since the 1980s is consistent with the growth trends highlighted by Shen et al. (2021), who documented a surge in food safety governance studies due to global crises and evolving policy responses. Unlike Shen et al. (2021), who emphasised risk management and policy interventions, this study demonstrates a broader thematic scope, incorporating advanced technological applications such as climate-smart agriculture and machine learning. The dominant research themes identified in this study – “agricultural policy,” “food security,” and “climate change” – mirror the

core focus areas observed by Richardson (2023), who highlighted their role in enhancing food system resilience.

However, this study adds a methodological dimension by demonstrating how these themes intersect with technological advancements like AI and remote sensing, offering new tools for addressing food security challenges. While Richardson (2023) explored the environmental and public health implications of sustainable agriculture, this study emphasises the role of digital governance and data-driven decision-making in food security governance. Geographically, this study's findings align with Xie et al. (2021), who identified China and the USA as leading contributors to food security research. Both studies highlight the extensive research output and international collaborations of these countries. However, unlike Xie et al. (2021), this study underscores the limited participation of developing regions such as Sub-Saharan Africa, emphasising the need for more inclusive research efforts to address the global nature of food security challenges.

The observed shift toward examining specific policy implementations and their effectiveness is consistent with the findings of Liu et al. (2023), who highlighted AI's transformative role in food safety practices. While Liu et al. (2023) focused on contamination detection and supply chain management, this study broadened the scope by illustrating how AI and remote sensing contribute to climate-smart agriculture and agricultural resilience. Additionally, this study critiques the digital divide that limits access to advanced technologies, an issue not addressed in Liu et al. (2023).

This study's bibliometric analysis of keyword co-occurrence networks aligns with the approach used by Sundarakani and Ghouse (2024), who mapped the application of blockchain technology in food security. Both studies highlight the growing reliance on digital governance to enhance transparency and accountability in food

supply chains. However, this study goes further by integrating longitudinal thematic analysis, revealing the evolution of research from foundational topics like "agrarian reforms" to advanced concepts such as "machine learning" and "remote sensing." The factorial analysis conducted in this study identifies the multidimensional nature of food security research, encompassing policy, environmental sustainability, socio-economic dynamics, and technological integration. This aligns with the findings of Guliyev et al. (2024), who emphasised the need for interdisciplinary collaborations to enhance policy effectiveness. However, this study adds a bibliometric perspective by quantifying the evolution of research themes and illustrating their interconnections through co-occurrence networks and thematic maps. Methodologically, this study shares similarities with the bibliometric reviews of Pranckutė (2021), who emphasised the advantages of Scopus for bibliometric analyses due to its extensive coverage and reliable impact indicators. Like Pranckutė (2021), this study leveraged Scopus to capture a comprehensive dataset of publications, ensuring robust insights into global research trends.

However, this study advances the methodological approach by employing Biblioshiny for network visualisation and longitudinal analysis, providing a more detailed understanding of the evolving research landscape. In summary, this study enhances the existing body of bibliometric research by offering a comprehensive analysis of global trends in food security governance, with a particular focus on the interplay between government policy, technological advancements, and environmental factors. By comparing its findings with previous bibliometric and methodological studies, this study demonstrates the evolving nature of food security research, highlighting both the progress made and the gaps that remain, particularly regarding regional disparities and the accessibility of advanced technologies.

CONCLUSION

This study aimed to explore global research trends on the role of government policy in the agrarian sector in ensuring food security through a bibliometric analysis of Scopus-indexed publications.

The findings highlight a significant increase in research activity since the 1980s, with a peak in 2023 driven by geopolitical disruptions, particularly the Russia-Ukraine war. The bibliometric trends confirm that government policy in the agrarian sector plays a pivotal role in mitigating food security challenges, emphasising the importance of sustainable agricultural practices, technological advancements, and international cooperation.

Key research themes include “agricultural policy,” “food security,” “climate change,” and “sustainable agriculture,” reflecting the evolving discourse on food security governance. The factorial and co-occurrence analyses indicate a shift from traditional agrarian policy research to interdisciplinary approaches integrating environmental sustainability and technological solutions such as machine learning, remote sensing, and climate-smart agriculture. This evolution underscores the increasing reliance on data-driven policy frameworks to enhance food system resilience.

The study also identified disparities in research contributions, with China and the USA leading in publications and international collaborations while developing regions with pressing food security challenges remain underrepresented. This highlights the need for more inclusive research efforts to address global food security in a holistic manner.

Moreover, the study confirms that recent research has shifted toward examining specific factors that influence the effectiveness of government policy in supporting food security, particularly in crisis-prone regions. The growing emphasis on digital technologies, policy transparency, and economic resilience indicates a transformation in how food security challenges are approached at national and international levels.

Future studies should prioritize regional diversity, explore the practical implementation of policies, and address ethical and accessibility concerns associated with technological advancements. This approach will ensure that research not only advances academic knowledge but also translates into impactful policies that promote equitable and sustainable food security worldwide.

AUTHOR CONTRIBUTIONS

Conceptualization: Bayali Atashov, Anar Abbasov, Azer Gurbanzade.

Data curation: Anar Abbasov.

Formal analysis: Azer Gurbanzade.

Funding acquisition: Bayali Atashov.

Investigation: Anar Abbasov.

Methodology: Bayali Atashov.

Project administration: Azer Gurbanzade.

Resources: Bayali Atashov.

Software: Anar Abbasov, Azer Gurbanzade.

Supervision: Bayali Atashov.

Validation: Azer Gurbanzade.

Visualization: Bayali Atashov, Azer Gurbanzade.

Writing – original draft: Bayali Atashov, Anar Abbasov, Azer Gurbanzade.

Writing – review & editing: Bayali Atashov, Anar Abbasov, Azer Gurbanzade.

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APPENDIX A

Table A1. Top 22 most influential authors (H-Index = 4 and higher)

Source: Scopus database using the Biblioshiny App.

Author	h_index	g_index	m_index	TC	NP	PY_start
Liu Y.	6	10	0.5	356	10	2013
Ma L.	5	5	0.5	452	5	2015
Yang X.	5	5	0.714	181	5	2018
Zhang Y.	5	9	0.25	542	9	2005
Chen J.	4	8	0.5	68	8	2017
Ekardt F.	4	4	0.8	214	4	2020
Garske B.	4	4	0.8	214	4	2020
Hickey G.M.	4	4	0.4	90	4	2015
Jayne T.S.	4	4	0.125	196	4	1993
Davis J.R.	4	4	0.364	327	4	2014
Li Z.	4	7	1	81	7	2021
Liu M.	4	4	0.8	37	4	2020
Liu X.	4	4	0.4	70	4	2015
Liu Z.	4	6	0.4	113	6	2015
Rahut D.B.	4	4	0.571	199	4	2018
Rosegrant M.W.	4	4	0.143	106	4	1997
Smale M.	4	4	0.19	102	4	2004
Sumberg J.	4	4	0.143	107	4	1997
Wang J.	4	10	0.5	274	10	2017
Wu L.	4	5	0.364	208	5	2014
Xie H.	4	4	0.364	118	4	2014
Zhu Y.	4	4	0.5	64	4	2017

Note: h_index – metric indicates an author’s productivity and citation impact; g_index – the g-index gives more weight to highly cited publications; m_index – adjusts the h-index based on career length, showing the rate at which an author’s influence grows; TC (Total Citations) is the cumulative number of citations an author’s works have received; NP (Number of Publications) reflects productivity; PY_start (Publishing Year Start) denotes the year each author began publishing on the topic.

Table A2. Top 17 countries affiliated with the authors who focused on government policy and food security

Source: Scopus database using the Biblioshiny App.

Country	Articles	SCP	MCP	Freq	MCP_Ratio
China	128	91	37	0.101	0.289
The USA	126	77	49	0.1	0.389
The United Kingdom	82	57	25	0.065	0.305
Italy	39	29	10	0.031	0.256
Germany	37	23	14	0.029	0.378
Canada	35	24	11	0.028	0.314
The Netherlands	29	14	15	0.023	0.517
Australia	24	11	13	0.019	0.542
India	23	21	2	0.018	0.087
South Africa	23	16	7	0.018	0.304
Brazil	17	12	5	0.013	0.294
Spain	17	12	5	0.013	0.294
France	16	12	4	0.013	0.25
Japan	16	11	5	0.013	0.313
Kenya	12	4	8	0.01	0.667
Ghana	10	5	5	0.008	0.5
Poland	10	8	2	0.008	0.2

Note: SCP (Single Country Publications) – articles written by authors from a single country; MCP (Multiple Country Publications) – articles co-authored by researchers from multiple countries; Freq (Frequency) represents each country’s share in the dataset as a fraction. MCP_Ratio (MCP/SCP Ratio) reflects the extent of international collaboration in each country.

Table A3. Most global cited documents

Source: Scopus database using the Biblioshiny App.

Source	Total citation	Total citation per year	Normalized total citation
Altieri et al. (2021)	705	50.36	9.94
Teixeira et al. (2013)	629	52.42	12.13
Holt Giménez and Shattuck (2011)	575	41.07	8.11
Cassidy et al. (2013)	487	40.58	9.39
White et al. (2011)	485	34.64	6.84
Welch and Graham (1998)	454	17.46	8.47
Pretty et al. (2010)	400	26.67	9.73
Renard and Tilman (2019)	371	61.83	12.95
Ollerton et al. (2014)	327	29.73	9.36
Smaijl et al. (2015)	313	31.30	8.15

Table A4. Most local cited documents

Source: Scopus database using the Biblioshiny App.

Source	Local citations	Global citations	Local/Global citation ratio (%)	Normalized local citations	Normalized global citations
McKay et al. (2014)	8	102	7.84	10.06	2.92
Wittman (2009)	7	227	3.08	9.69	4.63
Altieri and Toledo (2011)	7	705	0.99	13.68	9.94
Giunta (2014)	6	78	7.69	7.54	2.23
Jayne et al. (2006)	4	94	4.26	5.50	1.69
Edelman et al. (2014)	4	187	2.14	5.03	5.35
Verburg et al. (2000)	4	112	3.57	7.43	4.31
Candel et al. (2014)	4	94	4.26	5.03	2.69
Wang et al. (2018)	4	168	2.38	21.54	5.30
Nugent (2004)	4	20	20.00	6.40	0.80