Climate Change and Food Security: Bibliometric Study

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Abstract

In recent decades, climate change has emerged as one of humanity's most important challenges, having far-reaching effects for many facets of our existence. Among its numerous effects, arguably none is more significant than its influence on food security. Climate change and food security are inextricably linked, posing complicated issues to the world's population. According to the Food and Agriculture Organization (FAO), food security occurs “when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. However, the continuous march of climate change upsets this delicate balance, aggravating existing vulnerabilities and posing new challenges to ensuring food security for all. The purpose of this study is to offer the most recent status of published articles on climate change and food security from the Scopus database. Findings reveals that research on food security and climate change has grown, with 3,519 publications in the Scopus database by February 2024. Environmental science leads this field, with contributions from diverse disciplines. A cluster analysis identified six research groups, covering areas like groundwater management,

agricultural adaptation, and policy frameworks. Key studies emphasize the role of groundwater in climate resilience , the decline in crop yields due to rising temperatures , and the need for climate-smart agriculture . Regional studies highlight adaptation challenges in Africa and the Mediterranean, stressing the need for equitable solutions.

Keywords: Review, Climate Change and Food Security, Bibliometric, Scopus database

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Introduction

The interplay between climate change and food security has emerged as a critical area of research, drawing attention from scholars across various disciplines. As climate change continues to disrupt ecosystems and agricultural systems globally, its impact on food security— defined as the availability, accessibility, and utilization of food for all people—has become an urgent concern. Understanding this complex relationship is essential for developing sustainable strategies that address the growing threat of food insecurity, particularly in vulnerable regions. To provide a comprehensive overview of the academic landscape on this topic, this study undertakes a bibliometric analysis of the research concerning climate change and food security.

Bibliometric studies offer valuable insights into research trends, key themes, and collaborative networks, helping to map the intellectual development of a field. Despite significant research efforts, there is a notable gap in the literature when it comes to synthesizing the wide range of studies on climate change and food security into a unified framework. While individual studies have explored various dimensions—such as the effects of climate variability on agricultural productivity (Challinor et al., 2014), the role of groundwater in supporting ecosystems and food security (Taylor et al., 2013), and the global disparities in agricultural yields under climate change scenarios (Parry et al., 2004)—there has been limited effort to analyze these contributions as part of a cohesive body of work.

This bibliometric study aims to bridge this gap by systematically analyzing research trends, publication patterns, and knowledge gaps in the intersection of climate change and food security. Previous analyses, such as those by Lipper et al. (2014) on Climate-Smart Agriculture (CSA) and Hahn et al. (2009) on vulnerability assessments, offer foundational insights into adaptive strategies, yet lack a broader understanding of how these themes interact within the larger research ecosystem. Similarly, Bryan et al. (2009) and Cramer et al. (2018) emphasize the need for regional and sectoral adaptation, but their findings remain fragmented in the overall scholarly discussion.

By conducting a bibliometric analysis, this study seeks to present a systematic overview of the academic contributions to the field, identifying key authors, influential papers, and emerging research themes. In doing so, it maps the global research output, highlights collaborative networks, and uncovers the geographic

distribution of research activity. This approach will provide a clearer picture of the intellectual structure of climate change and food security research, offering stakeholders insights into where future research efforts should be directed.

The bibliometric analysis not only consolidates the vast body of literature but also provides a framework for understanding how academic discourse in this area has evolved. By identifying the most influential studies and tracking the development of key themes, this study aims to inform future research and policymaking at the intersection of climate change and food security. This will ultimately contribute to more effective strategies for mitigating the impacts of climate change on global food systems, with particular emphasis on vulnerable populations

2. Literature Review

The growing threat of climate change has amplified concerns about its impact on essential resources, particularly global food security. Food security, as defined by the 1996 World Food Summit, refers to the availability and access to sufficient, safe, and nutritious food for all people at all times. This crucial issue is increasingly interlinked with climate variability, which threatens agricultural systems and food distribution worldwide. The scholarly focus on the intersection of climate change and food security has expanded in recent years, with research emphasizing the intricate relationships between climate dynamics, resource management, and agricultural productivity (Taylor et al., 2013; Challinor et al., 2014).

The examined literature provides a thorough analysis of the complex issues raised by climate change, with a focus on how it affects essential resources and global food security. Taylor et al. (2013) and Challinor et al. (2014) explore the complex interplay between climate dynamics and vital resources including agricultural productivity and groundwater. According to Taylor et al. (2013), groundwater is essential to maintaining ecosystems and human resilience in the face of climatic instability. It also plays a crucial role in guaranteeing water and food security on a global scale. On the other hand, Challinor et al. (2014) draw attention to the need for sophisticated analysis in order to predict the intricate effects of climate change on world food supply. They emphasize uncertainties and the need for adaptation measures, especially in the face of projected declines in crop yields, particularly staple cereals, under different warming scenarios.

Parry et al. (2004) multiply on this discussion by estimating how agricultural yields would be affected globally by climate change. Through the use of agricultural simulations and climate models, they present a troubling forecast of lower food yields, particularly in warmer temperatures, with notable differences between wealthy and developing countries. Their results highlight how urgent it is to put in place comprehensive strategies to address regional differences in food security in the context of climate change.

Climate-smart agriculture (CSA) is a solution that Lipper et al. (2014) propose in response to the requirement for adaptable techniques to fight with climate change and food security. They stress the significance of

strengthening farmers' ability to adapt and incorporating climate issues into frameworks for agricultural finance. Through contextually nuanced tactics that are adapted to local conditions, their study shows CSA as a viable strategy to addressing the intricacies of climate change impacts on agricultural systems.

Hahn et al. (2009) present the Livelihood susceptibility Index (LVI) as a tool to measure susceptibility in Mozambique's districts in relation to climate change. Their research identifies differences in vulnerabilities between districts, providing information that is essential for monitoring vulnerabilities and directing policy actions, especially in situations when data is scarce. This emphasizes how crucial it is to use reliable approaches in order to identify and mitigate vulnerabilities in the face of changing climatic circumstances. Furthermore, Hanjra et al. (2010) emphasize the criticality of tackling poverty and hunger within the changing global food policy environment. Their research highlights the connections between food security, poverty, and climate change, highlighting the necessity of taking a comprehensive strategy to solving these issues. Similarly, Bryan et al. (2009) argue for programs that support small-scale farmers and equal access to resources, emphasizing the value of comprehending and assisting farmer's adaptation techniques in reducing the risks that climate change poses to African agriculture.

The study by Cramer et al. (2018) on Mediterranean basic on climate change support measures for sustainable development in areas that are vulnerable, like the Mediterranean Basin. They emphasize the significance of incorporating adaptation strategies and reducing rising risks from climate change by proactive policy actions, despite obstacles brought on by little data. Together, these studies offer a sophisticated knowledge of the intricate relationships that exist between climate change, essential resources, and global food security. This highlights the pressing need for proactive and comprehensive policy interventions to reduce the negative consequences of climate change.

Taylor et al. (2013) stress the importance of groundwater in maintaining ecosystems and human resilience, demonstrating its role in ensuring water and food security in the face of climate instability. Similarly, Challinor et al. (2014) explore the need for more advanced analytical models to predict the impact of climate change on global food supplies. Their findings highlight a troubling future where crop yields, particularly staple cereals, may decline significantly due to rising temperatures. Parry et al. (2004) reinforce this concern by presenting a global outlook on agricultural yields, predicting uneven impacts, with developing nations being the most vulnerable to these changes.

The call for adaptive strategies is echoed by Lipper et al. (2014), who advocate for Climate- Smart Agriculture (CSA) as a key solution. CSA emphasizes enhancing farmers' resilience to climate change by integrating climate considerations into agricultural financing and decision- making. Additionally, Hahn et al. (2009) present the Livelihood Vulnerability Index (LVI) as a tool for assessing climate susceptibility, particularly in data-scarce regions like Mozambique, where such metrics can inform targeted policy interventions. The broader implications of climate change on poverty and hunger are explored by Hanjra et al. (2010), who argue for comprehensive strategies to address food insecurity in the face of shifting global food policies. Bryan et al.

(2009) further emphasize the importance of empowering small-scale farmers and ensuring equitable access to resources, particularly in Africa, where adaptation challenges are most pronounced.

Cramer et al. (2018) extend this dialogue by focusing on climate risks in the Mediterranean Basin, advocating for proactive policies that incorporate adaptation strategies into sustainable development frameworks. Collectively, these studies underline the urgent need for comprehensive policy responses to mitigate the far-reaching impacts of climate change on food security.

While these individual studies provide valuable insights, there is a notable gap in the literature regarding a comprehensive understanding of the evolving research landscape on climate change and food security. Previous work has largely focused on isolated aspects, lacking an overarching analysis of how these domains interact and influence one another over time. This bibliometric study seeks to fill this gap by synthesizing existing research, identifying major trends, and highlighting knowledge gaps. By mapping the intellectual landscape, this analysis aims to provide a systematic overview of the research output, collaborative networks, and thematic shifts in the field. Ultimately, this study will offer new insights into the direction of future research, contributing to a more holistic understanding of the relationship between climate change and global food security

The study on climate change and food security literature analysis highlights the pressing need for aggressive policy interventions to tackle the intricate issues surrounding climate change's impact on global food security. These studies offer important new information about vulnerability assessment techniques, resilience and sustainability methods for agricultural systems, and the effects of climate change on food production.

Despite the increasing interest in this area, there is a noticeable gap in the literature regarding a comprehensive analysis of the evolving research landscape. Previous studies have primarily focused on isolated aspects of climate change and food security, leaving an inadequate understanding of how these domains intersect and influence each other over time. Furthermore, the lack of a consolidated framework to assess the academic output, collaborations, and thematic trends presents an opportunity to advance the discourse.

The motivation for this bibliometric study stems from the urgent need to explore the multifaceted relationship between climate change and food security. This relationship poses significant challenges for global health, sustainability, and economic stability. While there has been a growing body of research on this topic, existing studies often lack a systematic overview that encapsulates the breadth of academic discourse. By conducting a bibliometric analysis, we aim to synthesize existing knowledge, identify major themes, and provide insights into the direction of future research.

2.1 Theoretical Framework

The exploration of the intersection between climate change and food security requires a robust theoretical foundation to inform our understanding of the complex relationships at play. Several theories provide insights into how environmental changes impact food systems and the broader implications for food security.

2.1.1 Systems Theory: Systems theory posits that food systems are complex, interconnected entities influenced by various environmental, economic, and social factors. According to systems theory, changes in one component of the system, such as climate, can have cascading effects on agricultural productivity, food distribution, and ultimately food security (Meadows, 2008). This perspective emphasizes the need for holistic approaches to research and policy- making, considering the interplay between different system components.

2.1.2 Vulnerability Theory: Vulnerability theory focuses on the susceptibility of populations to climate change and environmental stresses. It posits that food security is not solely a function of food availability but is also influenced by social, economic, and political factors that determine individuals' and communities' capacities to cope with change (Adger, 2006). This framework is essential for understanding how marginalized groups may be disproportionately affected by climate-induced disruptions in food systems.

2.1.3 Resilience Theory: Resilience theory emphasizes the capacity of food systems and communities to adapt to changing conditions while maintaining essential functions. This perspective is crucial in understanding how climate change impacts food security, as it highlights the importance of adaptive strategies, resource management, and community involvement in enhancing resilience against environmental shocks (Folke, 2006).

2.1.4. Sustainable Livelihoods Framework: The sustainable livelihoods framework explores how people utilize various assets (natural, social, financial, physical, and human capital) to secure their livelihoods, including food security. It emphasizes the need to consider the diverse strategies employed by individuals and communities to adapt to changing climatic conditions, recognizing that food security is intricately linked to broader socio-economic contexts (Scoones, 1998).

These theoretical lenses not only inform our understanding of the challenges posed by climate change to food security but also guide the formulation of our research question and objectives. By integrating insights from these theories, this bibliometric analysis aims to shed light on how different scholarly approaches have framed the discussion around climate change and food security, thus offering a comprehensive overview of the literature.

3. Methodology

It has been said that the most recent state-of-the-art research on the climate change and good security may be found in the Scopus database. With over 5000 publishers, 16 million authors, and 40000 volumes among its

75 million entries, the Scopus database is the most extensive collection of published papers.

When the inquiry first began, the Scopus search with the keywords "climate change and food security" produced an many articles, too many to go at in the context of the current study.

Consequently, only items having the term in the title were returned in the search. Nonetheless, the title included these terms either as part of the title or as an exact phrase. This is one of the drawbacks of the Scopus search by subject. It was later found, among other things, that some of the articles had to do with energy, engineering, medicine, etc.

The "title, abstract, and keywords search option" was used to assess the term "climate change and food security" for this research. Only materials published through the end of February 2024 were included in the search. 3,519 documents were found as a result of this process. VOS Viewer is a citation analysis tool used to analyze network analysis.

3.1. Year-wise Analysis of climate change and food security

Figure 1 shows how food security and climate change have changed throughout time. Scholars continue to be interested in the issue of climate change and food security since it has received a lot of attention in the past few years. Climate change and food security topic first publication was published in the year 1988. After 2015, it became more and more popular, publishing an average of 440 publications per a year between 2021 and 2023. It's noteworthy to see that scholar's interest in this area has increased after 2015. The annual total of publications is as follows: 2020:323, 2021:443, 2022:405, 2023:474, and 2024 (Feb):86 have been recorded.

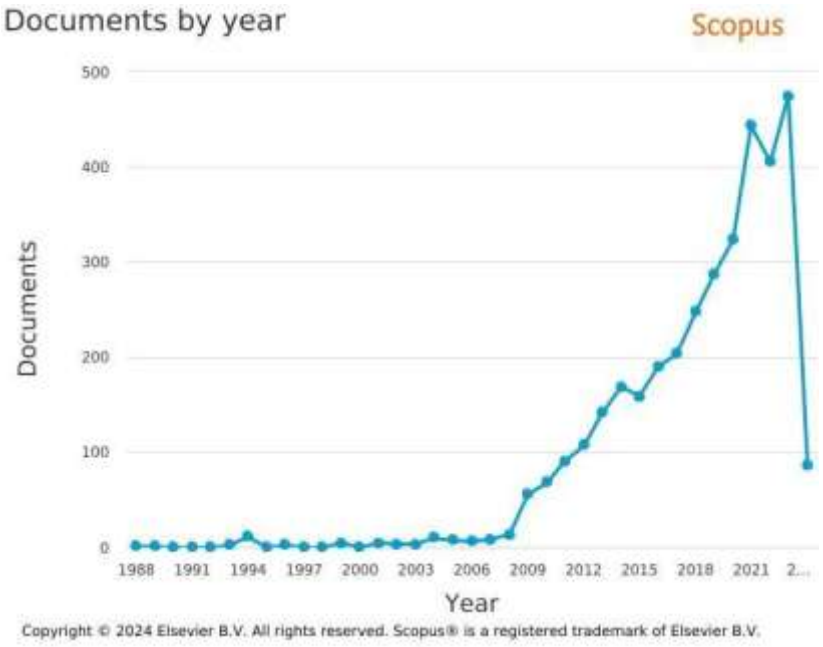

Figure no. 1: Year-Wise Trend (Year 1988 to Feb'2024) in Published Documents on climate change and food security

3.2. Country-wise Analysis of climate change and food security

Researchers from all across the world are interested in the worldwide phenomenon of climate change and food security. The top ten nations with the most articles are displayed in Figure 2. The United States (766 publications), the United Kingdom (452 publications), and Australia (294 publications) are the next most prolific countries. India comes in fourth place with 277 articles in addition to the. It should be emphasized that developed, emerging markets have a need for climate change and food security.

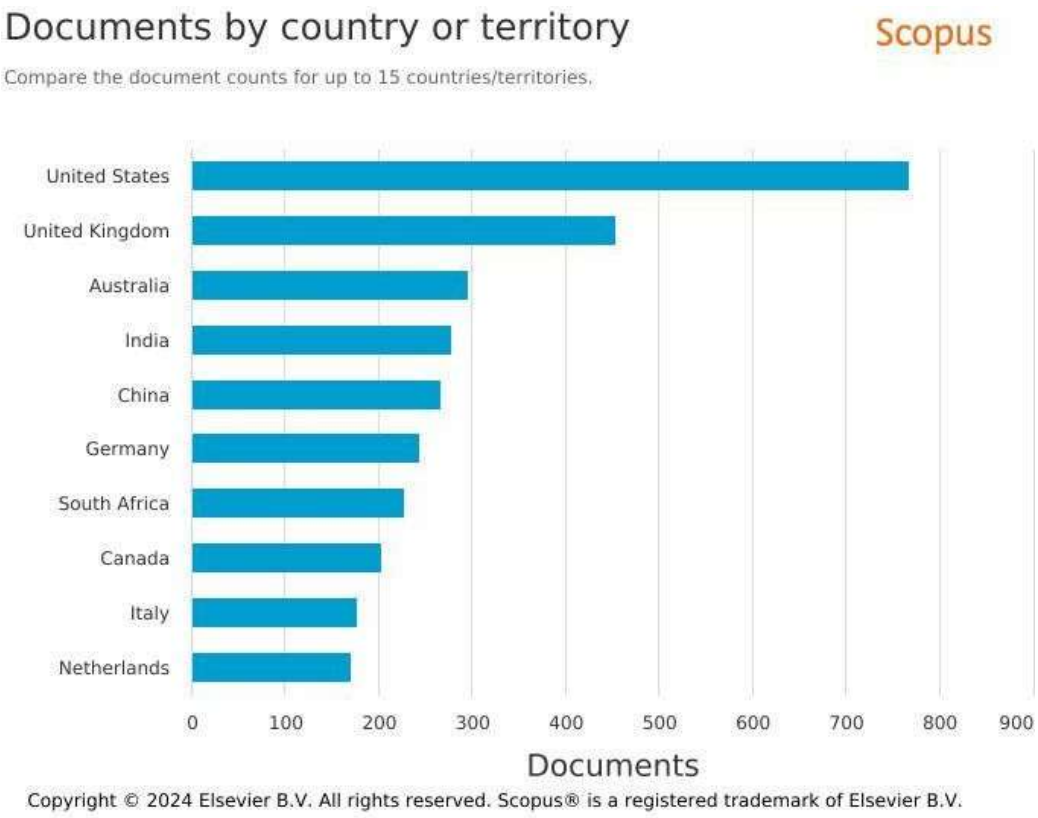

Figure no. 2: Country-Wise Trend in Published Documents On Climate Change and food serciruty

3.3. Author-wise Analysis of climate change and food Security

Table 1 lists the top ten authors on food security and climate change (sorted by total number of articles). Notably, with 14, 12, and 12 publications apiece, Thornton, P.K. and Herrero, M., Mabhaudhi, T. have the largest number of paper publications.

Table no. 1: Top ten Authors (Publication-Wise) on Climate Change and Food Security

Sr. No.	Name	No. of Publications
1	Thornton, P.K.	14
2	Herrero, M.	12
3	Mabhaudhi, T.	12
4	Campbell, B.M.	11

5	Hertel, T.W.	11
6	Lal, R.	11
7	Islam, M.S.	10
8	Thornton, P.	10
9	Kieu, E.	9
10	Lipper, L.	9

3.4. Top cited papers on Climate Change and Food Security

This section offers a description of the studies that make up the top referenced papers on the subject of food security and climate change. A table of these publications can be found below.

Table no. 2: Top Ten Authors, title, year source title and citation count details on Climate Change and Food Security

Sr. No	Author full names	Title	Year	Source title	Cited by
1	Taylor, Richard G. et.al	Groundwater and climate change	2013	Nature Climate Change	1434
2	Challinor, A.J. et. al	A meta-analysis of crop yield under climate change and adaptation	2014	Nature Climate Change	1338
3	Parry, M.L. et. al	Effects of climate change on global food production under SRES emissions and socio-economic scenarios	2004	Global Environmental Change	1281
4	Lipper, Leslie et. al	Climate-smart agriculture for food security	2014	Nature Climate Change	1008

5	Hahn, Micah B. et.al	The Livelihood Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change-A case study in Mozambique	2009	Global Environmental Change	902
6	Hanjra, Munir A. et.al	Global water crisis and future food security in an era of climate change	2010	Food Policy	884
7	Bryan, Elizabeth et. al	Adaptation to climate change in Ethiopia and South Africa: options and constraints	2009	Environmental Science and Policy	770
8	Cramer, Wolfgang et. al	Climate change and interconnected risks to sustainable development in the Mediterranean	2018	Nature Climate Change	766
9	Shiferaw et. al	Crops that feed the world 6. Past successes and future challenges to the role played by maize in global food security	2011	Food Security	736
10	Rojas-Downing et. al	Climate change and livestock: Impacts, adaptation, and mitigation	2017	Climate Risk Management	723

3.5. Subject-area Analysis of Climate Change and Food Security

Publications on Climate Change and Food Security are available in a number of industries. Food security and climate change are relevant to several functional areas. Figure 3 illustrates the substantial space occupied by social science (34.5% of total publications, or 3,195 publications), environmental science (20% of total publications, or 1856 publications), and agricultural and biological sciences (8.5% of total publications, or 778 publications) in this domain.

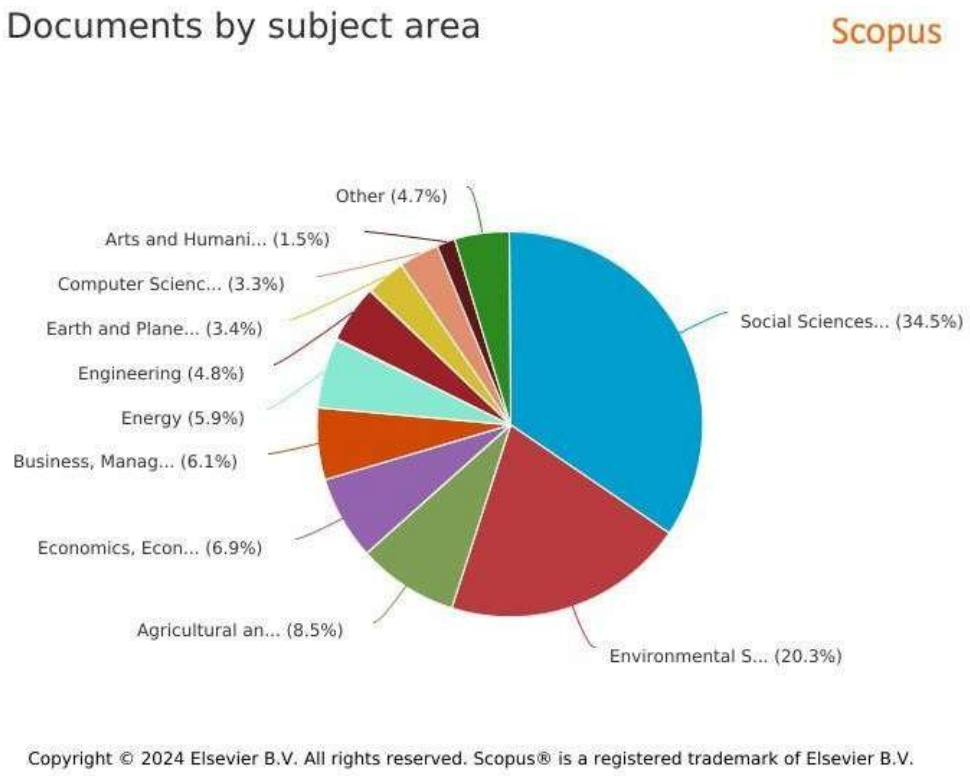

Figure no. 3: Subject-Area Wise Trend in Published Documents On Climate Change and Food Security

3.6. Keyword-wise Analysis of Climate Change and Food Security

A thorough keyword-by-keyword analysis is shown in Figure 4, which offers insightful information about the subjects and themes that are frequently found in research that are

published in peer-reviewed journals. This study reveals that researchers have employed a wide range of keywords to express their conclusions and define the parameters of their studies. Notably, ‘food,’ ‘climate’, ‘change’, and ‘security’ stand up as being very common among these terms. Their frequent use emphasizes how important they are as focal points in the academic conversation on the topic. ‘Food’ is probably a reflection of the significant attention that is paid to problems pertaining to dietary habits, agricultural methods, and food security. The terms ‘climate’ and ‘change’ also allude to the widespread concern over environmental dynamics, which includes methods for mitigating and adapting to climate change. Furthermore The term ‘security’ alludes to an increasing focus on the interplay between dietary, environmental, and sociopolitical

concerns, underscoring the complex character of current research initiatives in this field. The presence of these terms highlights the topics that are prevalent in the literature as well as the connections between food, climate, and security-related concerns in scholarly discourse.

Figure no. 4: Wordcloud Diagram: Cliamte Change and Food Security Keyword

3.7. Source-wise Analysis of Climate Change and Food Security

There are books, book chapters, conference proceedings, journals, and trade publications that include information about food security and climate change. Below is a detailed description of these works (Figure 5).

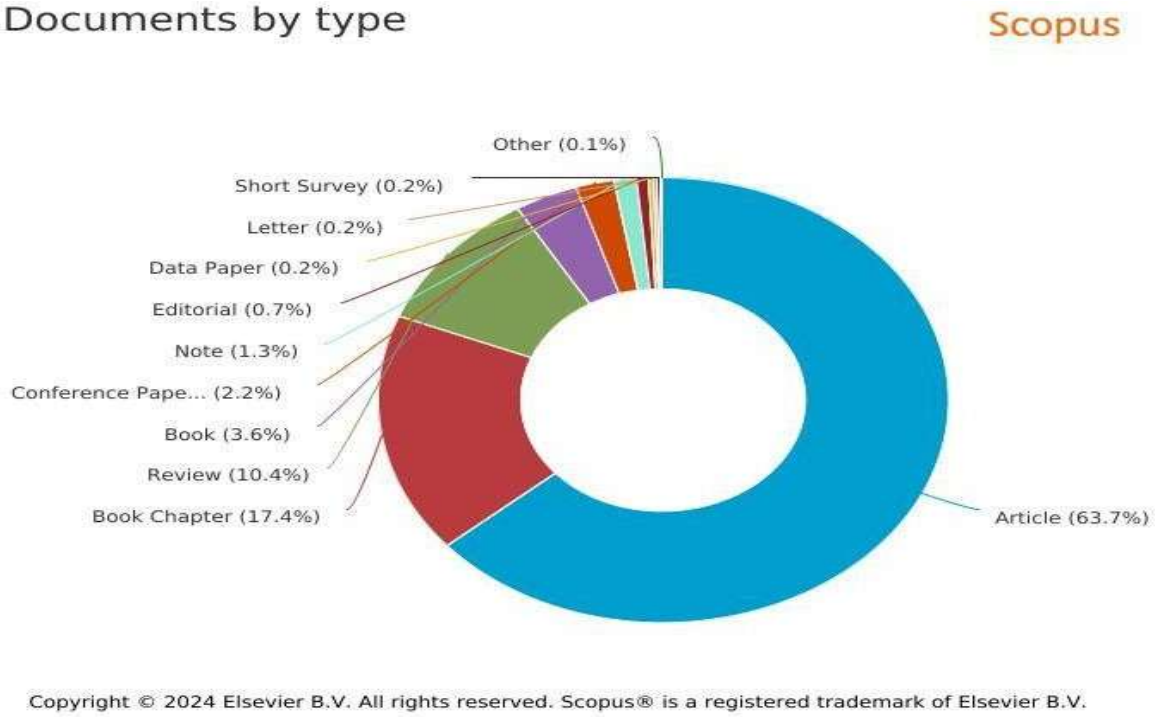

Figure no. 5: Source Wise Publications on Climate Change and Food Security

3.8. Journal-wise Analysis of Climate Change and Food Security

The most productive journals are those that focus on environmental development and sustainability, water

Switzerland, food security, sustainability Switzerland, and journal of cleaner production, as seen in Figure 6.

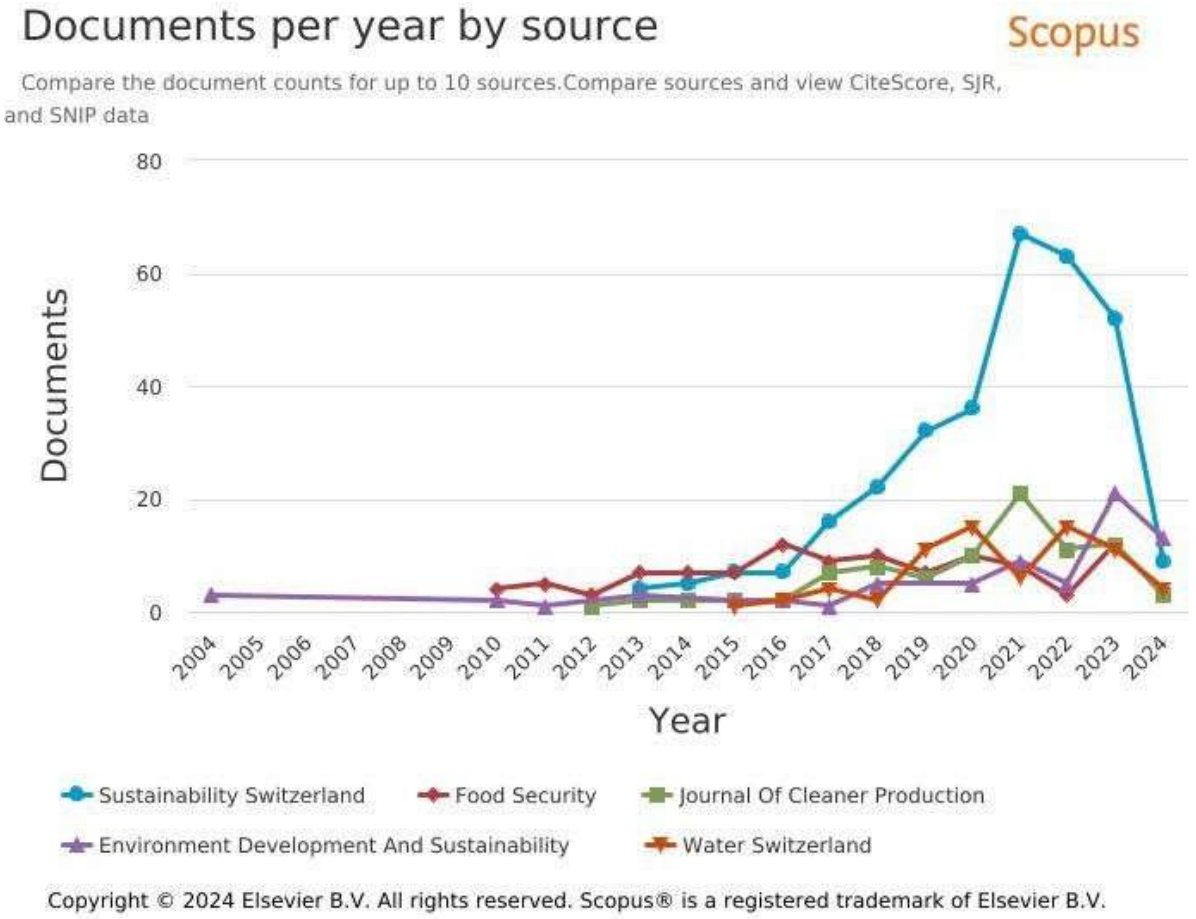

Figure no. 6: Top Journals (in Terms of several Publications) On Climate Change and Food Security

3.9 Map analysis using VOSviewer

VOSviewer was the preferred tool for carrying out the map analysis, which made it easier to create a bibliographic data map from Scopus data. The examination of citations in the dataset served as the main focus of this procedure. The methodical trip consisted of the following phases in order:

Step 1: Create map ->Choose data type (tab) -> create map based on bibliometric data Step 2: choose data source ->read data from bibliometric database file

Stop 3: select file -> Scopus

Step 4: Choose type of analysis and counting method -> type of analysis citation Step 5: select max numbers of authors per documents as 25

Step 6: choose minimum number of documents of an author: 5, minimum number of citation of an author: 0

Step 7: shows selection 54 met the threshold

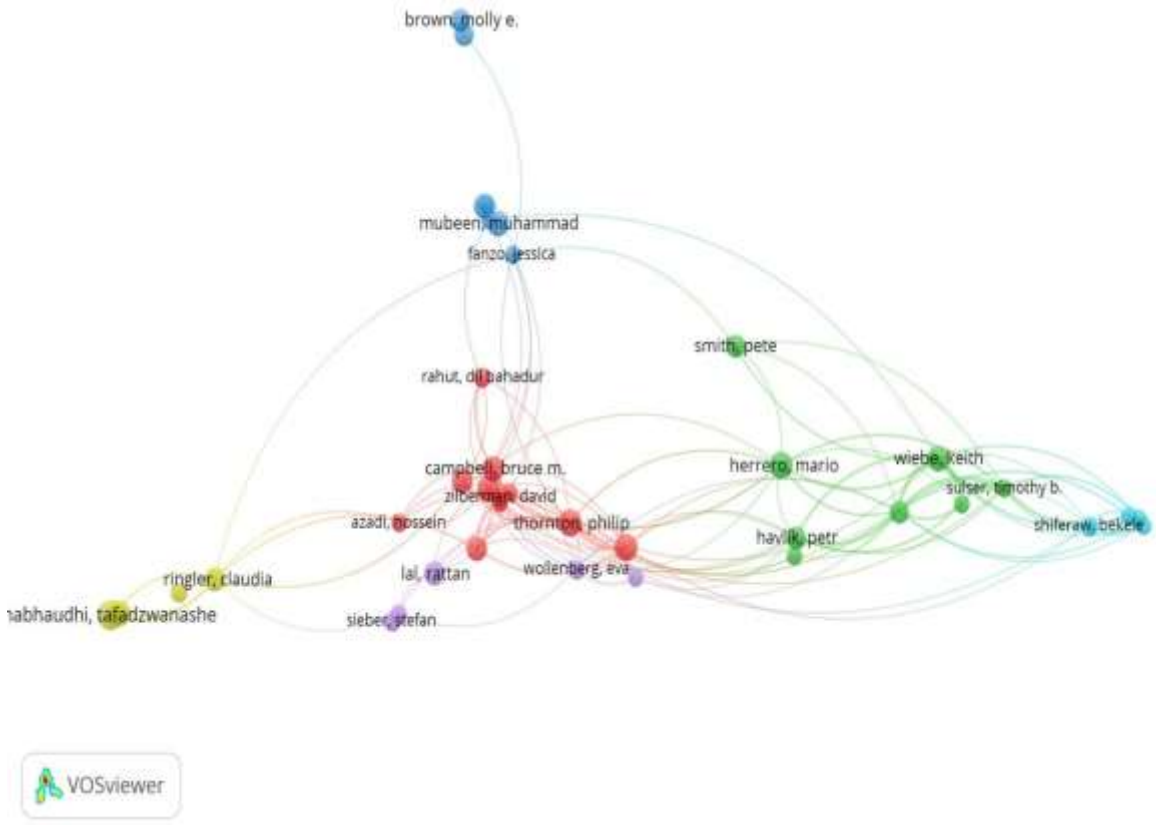

Figure 7: Network Visualization Diagram of Citation and Document Analysis For climate change and food security

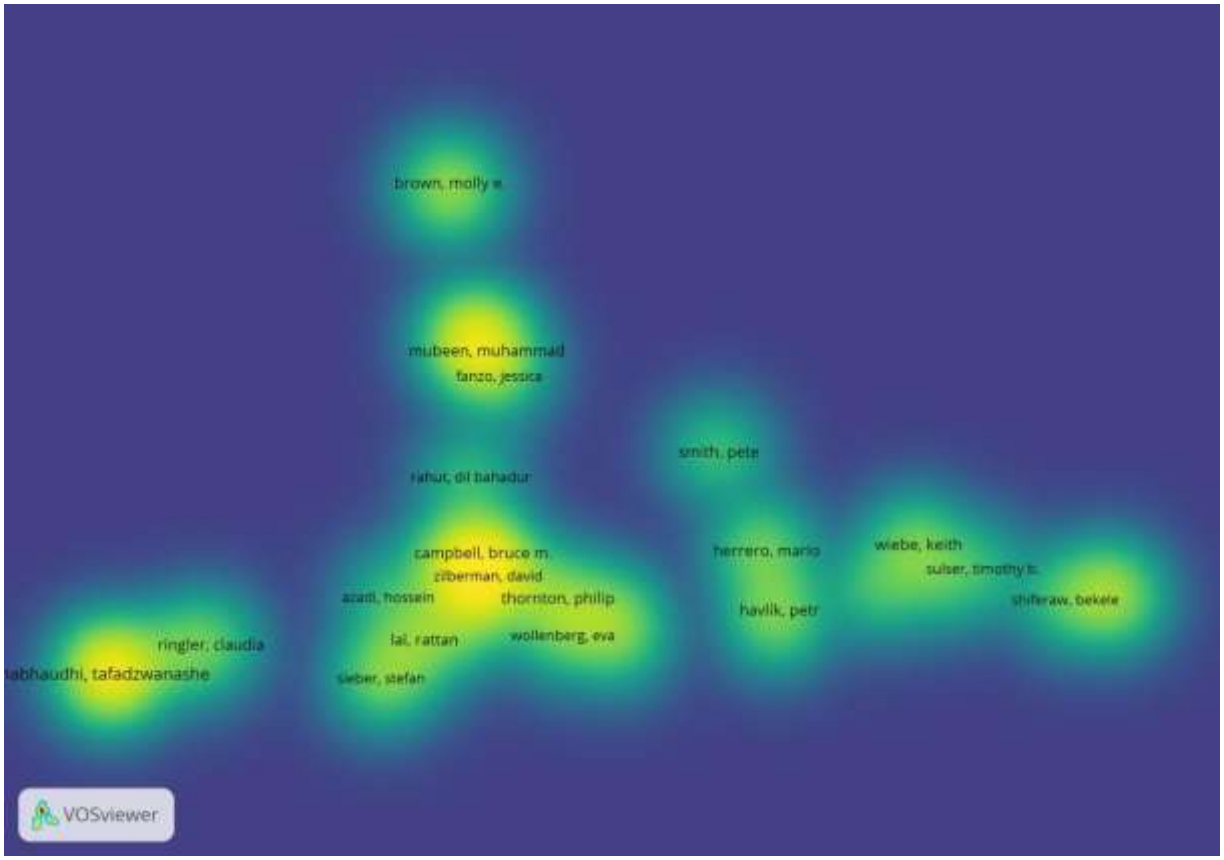

Figure 7: Density Visualization Diagram for Climate Change And Food Security

4. Discussion and Conclusion

This research aims to provide the most current, cutting-edge status of published papers on food security and climate change on the Scopus database. The "Title, Abstract, and Keywords" search option in the Scopus database was used to do a bibliometric study on the term "climate change and food security".

The results show that the relationship between food security and climate change is a worthwhile subject for study. The objectives and standards for food security and climate change vary among industrialized, developing, and poor nations. As of February 2024, 3,519 papers are accessible through the Scopus database. The Scopus database has the first article on climate change and food security components from 1988. The study shows that although food security and climate change are relatively new and unknown topics, researchers from many countries, regions, and streams are still interested in learning more about them. Food security and climate change are national and international issues that have drawn the interest of scholars from all around the nation. The investigation reveals that there are a variety of publications accessible on food security and climate change. This field of study is dominated, as could be assumed, by publications in the subject of environmental science.

The bibliometric analysis carried out in this work reveals a complex picture of academic contributions in the field of food security and climate change research. After careful inspection, six different group's surface, each containing a different quantity of documents. Three papers make up the first cluster, four documents make up the second, and ten documents make up the third, which is the largest. In addition, there are four papers in each of the fourth and sixth clusters, and eight documents in the fifth cluster. Like the first cluster, the last one has three papers in it. These groups of articles offer coherent collections of work that illuminate various aspects of food security and climate change.

The study on top citation articles reveals that, groundwater is essential to maintaining ecosystems and human resilience in the face of climatic unpredictability. Their analysis looks at the intricate connection between groundwater and climate change, taking into account both natural and man-made processes. The paper highlights the lack of data preventing a complete knowledge of this relationship and assesses the potential and problems in managing groundwater resources for climate change (Taylor et al., 2013)

The impact of climate change on global food production is discussed by Challinor et al. (2014), who emphasize the necessity for sophisticated studies that take uncertainty and adaptation strategies into account. According to their research, agricultural yields will decrease in a 2°C warming scenario, especially for basic grains. They stress the significance of fair policies in resolving international inequities and support crop-specific adaptation solutions.

Parry et al. (2004) look at how agricultural yields and food security are affected by climate change on a worldwide scale. They predict lower agricultural yields, particularly in warmer temperatures, with notable differences between rich and developing countries, using crop simulations and climate models. The study emphasizes the need for multimodal approaches to alleviate regional differences in food security in the context of climate change.

According to Lipper et al. (2014), climate-smart agriculture (CSA) is a critical strategy for adjusting agricultural practices to changing climatic circumstances. They push for a contextually sensitive approach, highlighting the significance of strengthening farmers' adaptive ability and incorporating climate issues into agricultural financing systems.

In order to evaluate the degree of susceptibility to climate change in Mozambique's districts, Hahn et al. (2009) offer the Livelihood susceptibility Index (LVI). Their research highlights the significance of LVI in directing vulnerability monitoring and policy assessment, especially in contexts with limited data, by revealing disparate vulnerabilities throughout districts.

In their 2010 study, Hanjra et al. examine how climate change may affect international food policy and stress how critical it is to combat severe poverty and hunger in this setting. Bryan et al. (2009) emphasize how climate change poses a danger to Africa's agricultural output and how crucial it is for policymakers to comprehend farmers' adaptation plans. Their study highlights the need for programs that assist small-scale farmers and identifies obstacles to effective adaptation, such as restricted access to resources. The accelerated rate of climate change in the Mediterranean Basin and its consequences for environmental sustainability are covered by Cramer et al. (2018). They support strategies for sustainable development that combine adaptation measures and reduce risks, even in the face of data scarcity in sensitive areas. This study acts as a guide for upcoming research in the subject as well as a reflection of current research trends. As such, it is well-positioned to direct future research and offer a strong basis for more study and progress in our comprehension of the processes underlying consumer pleasure.

5. Implications

This bibliometric analysis provides significant theoretical and practical implications for scholars, policymakers, and practitioners concerned with climate change and food security. Firstly, the study contributes to the theoretical framework by identifying and mapping key research themes and emerging trends in the literature. This mapping enhances our understanding of how different academic fields intersect, providing a comprehensive overview of the existing knowledge landscape. Such insights are crucial for developing interdisciplinary approaches to tackle the multifaceted challenges posed by climate change on food security.

From a practical standpoint, the findings highlight the urgent need for collaborative research efforts across various disciplines. Policymakers can leverage these insights to allocate resources more effectively and foster partnerships that bridge gaps in research. For instance, the identified knowledge gaps suggest areas where further empirical research is required, allowing policymakers to direct funding and initiatives towards these critical domains.

Moreover, the study underscores the importance of integrating local perspectives and practices into climate change and food security strategies. By emphasizing the geographic distribution of research output, the

analysis encourages stakeholders to consider region-specific challenges and solutions, promoting localized interventions that are more likely to succeed.

5. Limitations and Future Scope

Other databases are not included in this study; the analysis is finished on the Scopus database through the cutoff year of February 2024. A similar research can be finished in the future.

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