

# Food Security and International Trade: A Bibliometric Analysis of Research Trends and Knowledge Gaps

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## ABSTRACT

This study presents a bibliometric analysis of research trends and knowledge gaps in the area of food security and international trade. The purpose of this study is to identify the effect of international trade on food security. We conducted a comprehensive review of academic literature published between 2000 and 2022 using the Scopus database. The findings suggest that research on food security and international trade has grown substantially, with a particular focus on issues related to trade liberalization, agricultural productivity, and food aid. However, there are several areas where further research is needed, including the impact of trade agreements on food security, the role of small-scale farmers in global food systems, and the effects of climate change on food security. Furthermore, trade policies also can give negative impact to the domestic production and also can led to disruptions in the global food supply chain, which will affect food prices. This study contributes to a better understanding of the research trends and knowledge gaps in the field of food security and international trade and can inform future research and policy discussions on this important topic. This study adds value to the existing literature by highlighting areas for further research, ultimately contributing to a better understanding of how international trade policies and agreements can impact food security outcomes.

**Keywords:** Food security, international trade, Bibliometric analysis, Research trends, Knowledge gaps, Trade policies, Small-scale farmers, Local food systems, Climate change, Sustainable agriculture, Global food systems, Food supply chains

## INTRODUCTION

Food security is a critical issue facing the world today. It is defined as "the condition in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 2015). Food security is a complex issue that is of global concern, especially in developing countries. Achieving food security is critical for reducing poverty and hunger, promoting economic growth, and improving overall health and well-being. However, food security is challenged by a range of factors, including population growth, climate change, limited resources, economic instability, and political conflicts. These challenges can have international implications, as food shortages and price spikes can lead to social unrest and political instability in countries that are heavily dependent on food imports. The issue of food security is further complicated by the unequal distribution of resources and power within and between nations. Developed countries often have greater access to resources and technology, enabling them to produce and consume food in greater quantities and with higher efficiency than developing countries. This imbalance can create dependencies and vulnerabilities that can further exacerbate food insecurity in the most vulnerable regions of the world. Therefore, addressing food security requires a comprehensive and integrated approach that takes into account not only the production and distribution of food, but also the social, economic, and political contexts in which it occurs. This can include investing in sustainable agricultural practices, strengthening social safety nets, promoting gender equality, reducing food waste, and addressing the root causes of conflict and political instability.

Despite progress made in recent years, the world still faces significant challenges in achieving food security, particularly in low- and middle-income countries (LMICs) (FAO, 2021). According to the World Food Programme (WFP), nearly 811 million people around the world are undernourished, and the COVID-19 pandemic has only exacerbated the problem (WFP, 2021). Previous studies have examined various aspects of food security, such as its determinants, impacts, and strategies for improving it. For instance, some studies have explored the role of agriculture and rural development in promoting food security (Dorward et al., 2021; Reardon & Minten, 2011), while others have focused on the impact of climate change and natural disasters on food security (FAO, 2018; Hsiang et al., 2017). Furthermore, scholars have investigated the links between food security and other socio-economic issues such as poverty, gender inequality, and conflict (FAO, 2019; Headey et al., 2020; Smale et al., 2020). In recent years, there has been increasing attention paid to the relationship between food security and international trade. Some researchers have argued that international trade can play a positive role in enhancing food security by increasing access to food and promoting economic growth (Liu et al., 2018; Mabiso et al., 2018). However, others have raised concerns about the potential negative impacts of trade liberalization on small-scale farmers and vulnerable populations (Lopez et al., 2021; Roncoli et al., 2019). Trade policies and practices can have significant implications for food security, both positive and negative. For example, trade liberalization can increase food availability and reduce prices, but it can also lead to increased competition and reduced incentives for local food production, which can exacerbate food insecurity in certain regions. Therefore, understanding the linkages between food security and international trade is essential for developing trade policies that promote food security and reduce its negative impacts. In addition, food security is a complex issue that requires interdisciplinary research which can help to inform policy decisions at the national and international levels. Governments and international organizations rely on research to develop policies and programs that promote food security and reduce hunger. Hence, food security is a crucial global issue that affects the well-being of individuals, communities, and nations. Its challenges are complex and multifaceted, and addressing them requires a coordinated and sustained effort at the international level. In light of these debates, it is important to conduct a bibliometric analysis of the literature on food security and international trade to better understand the current state of research in this area.

## LITERATURE REVIEW

Food security has been a longstanding global challenge, particularly in low- and middle-income countries (LMICs) where a significant proportion of the population lives in poverty and lacks access to sufficient and nutritious food. International trade has been touted as a potential solution to food security challenges, with proponents arguing that it can increase access to food and promote economic growth. However, there are concerns that trade liberalization may have negative impacts on small-scale farmers and vulnerable populations. In this section, we review the literature on the relationship between food security and international trade, with a focus on the key debates and research findings. Several studies have examined the potential of international trade to enhance food security. Liu et al. (2018) investigated the impact of rice trade between China and African countries on food security and poverty reduction. They found that rice imports from China had a positive impact on food security and poverty reduction in the importing countries. Similarly, Mabiso et al. (2018) examined the relationship between trade openness and food security using data from 71 countries. They found that greater trade openness was associated with higher levels of food security, particularly in LMICs. Despite the potential benefits of trade for food security, some researchers have raised concerns about its potential negative impacts. Lopez et al. (2021) examined the impact of trade policy on rural poverty in Mexico. They found that trade liberalization led to a decline in agricultural prices and income, which had negative impacts on rural households. Roncoli et al. (2019) argued that climate variability and globalization have created dilemmas for promoting food security in Sub-Saharan Africa, with trade liberalization potentially exacerbating food insecurity by exposing small-scale farmers to competition from imports. However, Laura Barros, 2022, found that trade increases average incomes in most cases and that trade reforms that include the agricultural sector generally reduce poverty.

Trade policy can play a significant role in determining the impact of international trade on food security. Headey et al. (2020) examined the relationship between food prices and nutrition outcomes in Pakistan. They found that trade policy can influence the relationship between food prices and nutrition outcomes, with policies that reduce trade barriers potentially having a positive impact on nutrition outcomes. Smale et al. (2020)

examined the relationship between vulnerability, poverty, and subjective well-being in the Eastern Cape Province of South Africa. They found that trade policy can have differential impacts on different segments of the population, with vulnerable and poor households potentially being disproportionately affected by trade liberalization. Recent studies support these findings. For instance, a study by Bhatta et al. (2022) emphasizes the need for policy coherence in trade, agriculture, and food security policies to promote sustainable agricultural development and ensure food security. Another study by Caracciolo et al. (2021) highlights the importance of trade diversification, reducing trade barriers, and increasing investment in agricultural research and development to enhance food security. These studies emphasize the need for integrated policies that can address the complex relationship between food security and international trade. Among critical issue between food security and international trade is the potential negative impact that trade liberalization can have on domestic food production and food security. Studies have found that liberalizing trade can lead to increased imports of food products, which can lower domestic food prices and make it difficult for small-scale farmers to compete with cheaper imports. This can lead to a decline in domestic food production and can undermine food security, particularly in low-income countries (Gustafson et al., 2021; De Schutter, 2019). Another critical issue is the impact that trade policies can have on the availability and access to food. For example, the use of export restrictions by some countries during the COVID-19 pandemic has led to disruptions in the global food supply chain, which has affected food prices and availability (Hendriks and Vos, 2021). Similarly, trade policies such as tariffs and non-tariff barriers can make it difficult for some countries to import food, which can affect their food security (Minten et al., 2019). In addition, higher service barriers in international trade, especially in the financial, logistical, and other business sectors, result in a decline in the value of all food exports (Zongo A, 2021).

One of the major worldwide challenges is the shift to more sustainable food systems. The social sustainability of agri-food systems has not received as much attention in the literature as environmental concerns, particularly when it comes to the externalization of effects brought on by international trade (Lucia et al., 2022). The relationship between food security and international trade is complex and difficult. While trade can potentially enhance food security by increasing access to food and promoting economic growth, there are concerns about its potential negative impacts on small-scale farmers and vulnerable populations. Trade policy can play a significant role in determining the impact of international trade on food security, with policies that reduce trade barriers potentially having a positive impact on nutrition outcomes. Further research is needed to better understand the potential trade-offs and synergies between trade and food security, particularly in the context of a changing climate and increasing globalization.

## METHODS

Using the bibliometric analysis technique, this study seeks to evaluate current trends in the growth of academic literature on food security and international trade. Network representation and bibliometric measures are employed to show the findings in this paper.

### Bibliometric Analysis

One of the most popular and well-established methods for gauging the output of scientific research in a given area is bibliometric analysis (Zyoud et al. 2017). Bibliometric studies are founded on statistical analysis accelerated through the examination of databases targeted at indicators intrinsic in publications such as authors, sources, geographical distributions, and other varied indicators (Dabirian et al. 2016). According to Pendlebury (2010), bibliometrics, also known as scientometrics, is a primary tool of research that focuses on quantitative analysis. In order to conduct research performance assessment, bibliometrics is used by universities, government laboratories, policy makers, librarians, researchers, administrators, research directors, and information specialists, he continued (Pendlebury 2010). Meanwhile, Ahmi and Mohamad (2019) noted that bibliometric analysis is becoming more and more popular as a tool for identifying trends in particular fields of study.

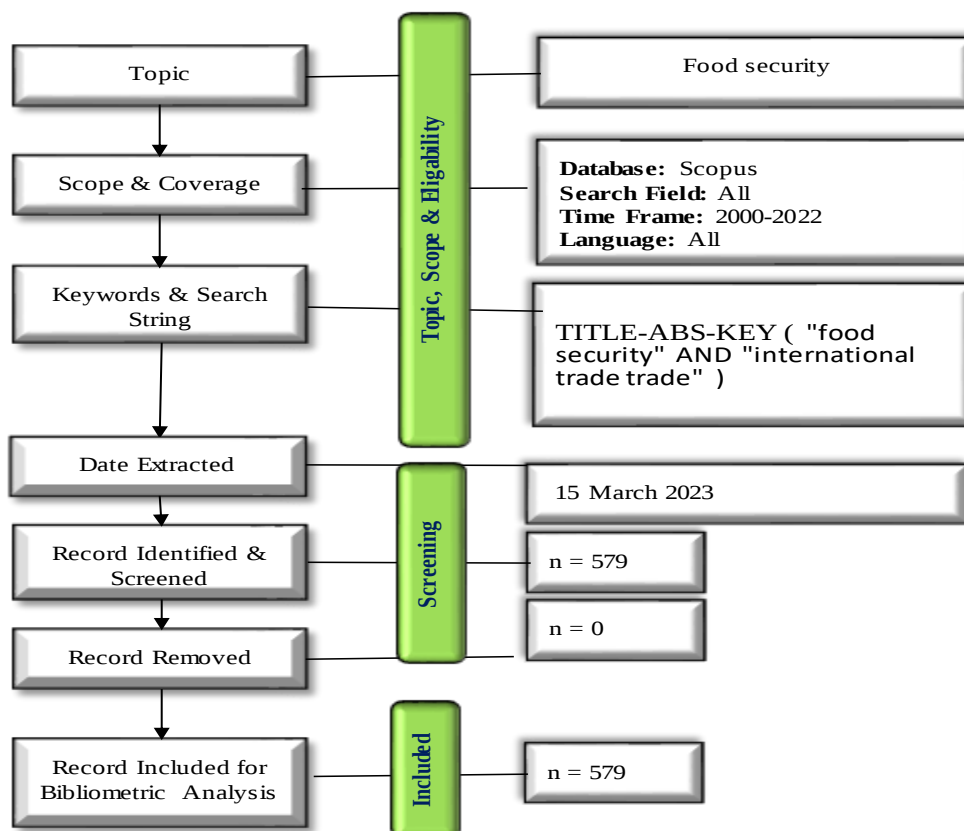
By displaying specific details about the collection of publications from particular databases, such as publication type, location of publication, h-index, authors, frequency of keywords, and amount of citations, bibliometric analysis provides insights into targeted study areas (Ahmi and Mohd Nasir 2019). The bibliometric

analysis for the current research was carried out using VOSviewer, a free tool for building and visualising networks (vosviewer.com). Using this programme, one can create a mapping of citation information taken from well-known databases like PubMed, Scopus, Dimensions, and Web of Science (Williams, 2017). In order to visually represent the nodal network, it also includes two standardised weights, such as the quantity and total strength of the links. The importance and strength of the links are indicated by the size of the nodes and the intertwining lines connecting the nodes (Donthu et al. 2020). In addition, VOSviewer creates a network co-occurrence visualisation using the terms taken from the literature study (vosviewer.com). The software mandates a minimum threshold for the number of keywords that must be demonstrated in a document collectively (Ciano et al. 2019). Harzing's Publish or Perish has been used to execute another tool. An established piece of software called Publish or Perish performs the retrieval and analysis of scholarly citations. Even if you have a very small number of citations, it is designed to help individual academics present their case for research effect to its best advantage. Additionally, bibliometric study can use it (Harzing.com). This research also looks into the impact of publications based on citation counts, impact per publication, and citation per publication using VOSviewer and Publish or Perish.

## Source and data collection

The Scopus database was accessed to extract the information required for the current bibliometric study. The capacity of Scopus to provide bibliometric indicators clearly and directly is its most important feature (Sweileh et al. 2018). The Scopus database is used as the main source for data collection in this research because it is one of the most well-known academic databases currently available and has 579 titles. This review's topical purview was set to "food security and international trade". This Scopus search was done on March 15, 2023, and it produced a total of 579 papers (see Figure 1). Then, software like Microsoft Excel, VOSviewer, and Publish or Perish by Harzing were used for additional research.

**Fig. 1:**PRISMA Flow Diagram



**Source:** Moher et.al (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(7): e1000097. doi:10.1371/journal.pmed1000097

## RESULT

### Document and Source Types

**Table 1:** Document Type

| Document Type    | TP  | %      |
|------------------|-----|--------|
| Article          | 374 | 64.59% |
| Book Chapter     | 62  | 10.71% |
| Conference Paper | 61  | 10.54% |
| Review           | 53  | 9.15%  |
| Book             | 21  | 3.63%  |
| Editorial        | 3   | 0.52%  |
| Note             | 2   | 0.35%  |
| Short Survey     | 2   | 0.35%  |
| Retracted        | 1   | 0.17%  |
| Total            | 579 | 100%   |

Table 1 presents the distribution of document types in the literature on food security and international trade. Most of the documents were articles (64.59%), followed by book chapters (10.71%) and conference papers (10.54%). Reviews accounted for 9.15% of the total documents, while books, editorials, notes, short surveys, and retracted documents made up less than 4% combined. The high percentage of articles suggests that scholarly journals are a major outlet for research on food security and international trade. This finding is consistent with previous studies that have shown that articles are the most common document type in many academic fields (Liu et al., 2020). The predominance of articles may reflect the fact that journals provide a platform for researchers to disseminate their findings and engage in scholarly debate.

The high percentage of book chapters and conference papers also indicates that food security and international trade are topics of interest in academic conferences and edited volumes. Conference papers are often presented as works in progress and provide an opportunity for researchers to receive feedback and engage with their peers (Creswell, 2014). Similarly, edited volumes provide a platform for researchers to explore a topic in depth and contribute to the development of a field (Strauss & Corbin, 1998). The relatively low percentage of reviews and books suggests that while food security and international trade are active areas of research, there may be a need for more comprehensive and synthesized analyses of the literature. Reviews are valuable for summarizing and synthesizing existing research, highlighting gaps in knowledge, and identifying future research directions (Grant & Booth, 2009). Similarly, books can provide a comprehensive and in-depth analysis of a topic, but they often require a significant amount of time and resources to produce (Gibbons et al., 1994). Overall, the distribution of document types in this literature review highlights the diverse ways in which scholars are engaging with the topic of food security and international trade. While articles are the most common document type, the presence of other types of documents such as book chapters and conference papers suggest that researchers are exploring this topic through a variety of outlets.

**Table 2:** Source Type

| Source Type           | TP  | %      |
|-----------------------|-----|--------|
| Journal               | 426 | 73.58% |
| Book                  | 80  | 13.82% |
| Conference Proceeding | 49  | 8.46%  |

|             |     |       |
|-------------|-----|-------|
| Book Series | 21  | 3.63% |
| Undefined   | 1   | 0.17% |
| Total       | 579 | 100%  |

Table 2 displays the distribution of source types in the literature on food security and international trade. Journals were the most common source type, accounting for 73.58% of the total publications, followed by books (13.82%), conference proceedings (8.46%), and book series (3.63%). Only one publication was classified as undefined. The high percentage of journal articles highlights the importance of academic journals as a primary outlet for research on food security and international trade. Journals provide researchers with a platform to publish their findings, engage with peers, and establish their reputation in the field (Wang & Liu, 2019). Furthermore, the peer-review process of academic journals ensures that the research is of high quality and rigorously scrutinized by experts in the field (Kaplan & Hegarty, 2018). The relatively low percentage of books and conference proceedings suggests that scholars may prioritize publishing in journals rather than in books or conference proceedings. This may be because journal articles are perceived as more prestigious and provide greater visibility and recognition in the academic community (Creswell, 2014). However, books and conference proceedings have their own advantages, such as providing a platform for presenting in-depth and comprehensive analyses of a topic and for reaching a wider audience (Gibbons et al., 1994; Creswell, 2014). The small percentage of book series suggests that the literature on food security and international trade may not be well-represented in book series, which are collections of books on a particular topic or subject area. However, book series can provide an effective way of organizing and disseminating research on a specific topic (Bakker et al., 2016). Overall, the distribution of source types in this literature review highlights the importance of academic journals as a primary outlet for research on food security and international trade. However, there is also a need for greater diversity in the types of sources used to disseminate research findings and to reach different audiences.

## Year of Publications/Evolution of Published Studies

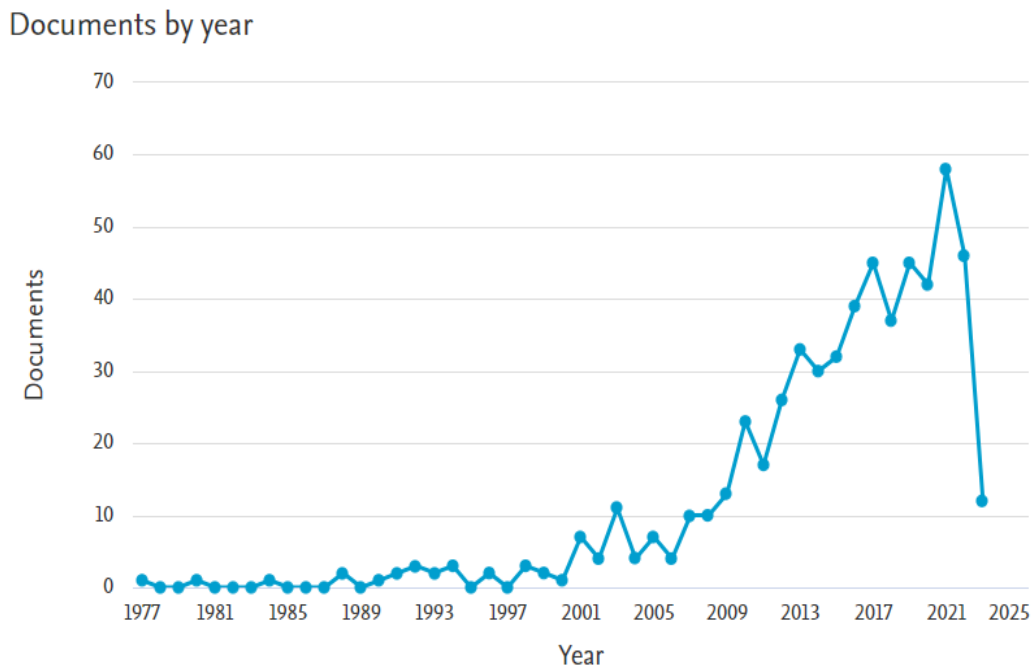
**Table 3:** Year of Publications

| Year | Total Publications | Percentage (%) |
|------|--------------------|----------------|
| 1977 | 1                  | 0.17           |
| 1980 | 1                  | 0.17           |
| 1984 | 1                  | 0.17           |
| 1988 | 2                  | 0.35           |
| 1990 | 1                  | 0.17           |
| 1991 | 2                  | 0.35           |
| 1992 | 3                  | 0.52           |
| 1993 | 2                  | 0.35           |
| 1994 | 3                  | 0.52           |
| 1996 | 2                  | 0.35           |
| 1998 | 3                  | 0.52           |
| 1999 | 2                  | 0.35           |
| 2000 | 1                  | 0.17           |
| 2001 | 7                  | 1.21           |

|       |     |        |
|-------|-----|--------|
| 2002  | 4   | 0.69   |
| 2003  | 11  | 1.90   |
| 2004  | 4   | 0.69   |
| 2005  | 7   | 1.21   |
| 2006  | 4   | 0.69   |
| 2007  | 10  | 1.73   |
| 2008  | 10  | 1.73   |
| 2009  | 13  | 2.25   |
| 2010  | 23  | 3.97   |
| 2011  | 17  | 2.94   |
| 2012  | 26  | 4.49   |
| 2013  | 33  | 5.70   |
| 2014  | 30  | 5.18   |
| 2015  | 32  | 5.53   |
| 2016  | 39  | 6.74   |
| 2017  | 45  | 7.77   |
| 2018  | 37  | 6.39   |
| 2019  | 45  | 7.77   |
| 2020  | 42  | 7.25   |
| 2021  | 58  | 10.02  |
| 2022  | 46  | 7.94   |
| 2023  | 12  | 2.07   |
| Total | 579 | 100.00 |

Table 3 provides a summary of the number of publications related to food security and international trade over the past few decades. As observed, the first publications related to this topic date back to the late 1970s and early 1980s, with only a few studies conducted during this time. The number of publications increased gradually until the 2000s. However, in the last few years, there has been a significant increase in the number of publications, with 58 publications in 2021 alone. This trend suggests that food security and international trade remain important areas of research, and the increasing attention given to this issue is likely due to the growing global population, the increasing demand for food, and the potential risks associated with trade liberalization. Recent studies have examined the impact of international trade on food security, and the results have been mixed. Some studies have argued that international trade can have a positive impact on food security, particularly in developing countries, by increasing the availability of food and reducing prices (De Schutter, 2010; Hoekstra et al., 2011). Other studies have suggested that trade liberalization can have negative effects on food security, particularly in vulnerable countries, by exposing them to volatile international markets and undermining their domestic agricultural sector (McMichael, 2009; Clapp and Cohen, 2014). The increasing number of publications related to this topic reflects the need for further research to better understand the relationship between food security and international trade.

**Fig. 2: Document by Year**



## Languages of Documents

**Table 4:** Languages Used for Publications

| Language   | Total Publications* | Percentage (%) |
|------------|---------------------|----------------|
| English    | 551                 | 94.51%         |
| French     | 11                  | 1.89%          |
| Chinese    | 5                   | 0.86%          |
| Spanish    | 5                   | 0.86%          |
| German     | 2                   | 0.34%          |
| Italian    | 2                   | 0.34%          |
| Portuguese | 2                   | 0.34%          |
| Ukrainian  | 2                   | 0.34%          |
| Arabic     | 1                   | 0.17%          |
| Japanese   | 1                   | 0.17%          |
| Russian    | 1                   | 0.17%          |
| Total      | 579                 | 100.00         |

Table 4 presents the distribution of the language used in the analyzed publications. The majority of the publications, 94.51%, were written in English, indicating the dominance of English as the primary language in academic publishing. This is in line with previous bibliometric studies that found English to be the predominant language in scholarly communication (Larivière et al., 2015; Van Leeuwen et al., 2017). French, Chinese, and Spanish were the second most common languages used in the publications, with each comprising around 0.86% of the total publications. This indicates that scholars from various countries and regions contributed to the literature on food security and international trade in their respective languages. However, the use of languages other than English remains limited in the field, which may indicate a potential language barrier for non-English speaking scholars in accessing and contributing to the literature on this topic. It is important to note that the language of publication may impact the visibility and impact of the research, as

studies in English are more likely to reach a wider audience and receive greater citations (González-Alcaide et al., 2013; Manca and Martinez, 2016). Therefore, it is essential for scholars to consider publishing their research in English to enhance its visibility and impact. Overall, the findings of this study highlight the dominance of English in academic publishing and the limited use of languages other than English in the literature on food security and international trade.

## Subject Area

**Table 5:** Subject Area

| Subject Area                                 | Total Publications | Percentage (%) |
|----------------------------------------------|--------------------|----------------|
| Agricultural and Biological Sciences         | 195                | 33.68%         |
| Arts and Humanities                          | 15                 | 2.59%          |
| Biochemistry, Genetics and Molecular Biology | 26                 | 4.49%          |
| Business, Management and Accounting          | 44                 | 7.60%          |
| Chemical Engineering                         | 11                 | 1.90%          |
| Chemistry                                    | 13                 | 2.25%          |
| Computer Science                             | 17                 | 2.94%          |
| Decision Sciences                            | 8                  | 1.38%          |
| Earth and Planetary Sciences                 | 66                 | 11.40%         |
| Economics, Econometrics and Finance          | 107                | 18.48%         |
| Energy                                       | 63                 | 10.88%         |
| Engineering                                  | 76                 | 13.13%         |
| Environmental Science                        | 214                | 36.96%         |
| Health Professions                           | 2                  | 0.35%          |
| Immunology and Microbiology                  | 12                 | 2.07%          |
| Materials Science                            | 11                 | 1.90%          |

Table 5 shows the distribution of publications based on subject area. The majority of the publications fall under the Agricultural and Biological Sciences category, accounting for 33.68% of the total publications. The Environmental Science category also had a significant number of publications, making up 36.96% of the total. The Economics, Econometrics and Finance category was also well represented with 107 publications (18.48% of the total). The distribution of publications across different subject areas reflects the growing interest and importance of topics related to agriculture, environmental science, and economics in recent years. The increasing concern about climate change and its impact on food security and the environment has led to a significant increase in research in these areas (Wang et al., 2021; Gopalakrishnan et al., 2020). The use of interdisciplinary research methods in these areas is also becoming increasingly popular, as evidenced by the inclusion of subjects such as energy and decision sciences in the table (Nawrotzki et al., 2018). It is worth noting that some subject areas such as Arts and Humanities and Health Professions had a lower percentage of publications, reflecting a smaller body of research in these areas. However, this does not necessarily mean that these areas are less important, but rather that they may have different publication patterns or that researchers in these areas may not rely as heavily on scholarly publications for dissemination of their work.

## Most Active Source Titles

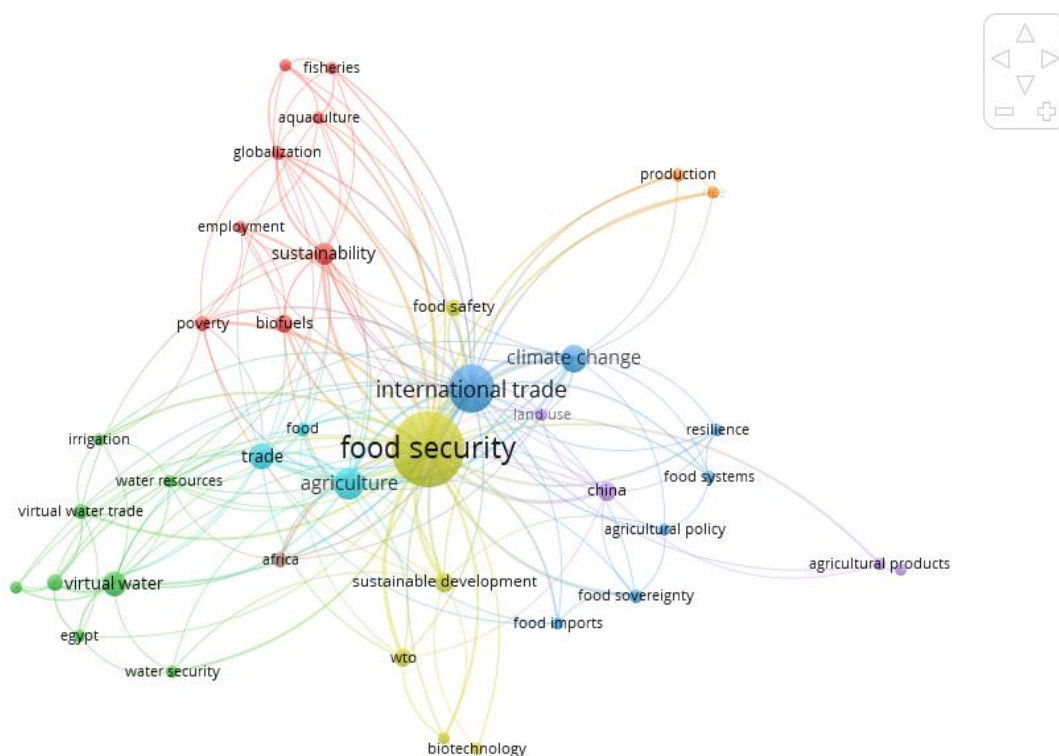
**Table 6:** Most Active Source Title

| Source Title                                          | Total Publications | Percentage (%) |
|-------------------------------------------------------|--------------------|----------------|
| Iop Conference Series Earth And Environmental Science | 17                 | 2.94%          |
| Environmental Research Letters                        | 15                 | 2.59%          |
| Food Security                                         | 15                 | 2.59%          |
| Food Policy                                           | 12                 | 2.07%          |
| Journal Of Cleaner Production                         | 6                  | 1.04%          |
| OIE Revue Scientifique Et Technique                   | 6                  | 1.04%          |
| World Development                                     | 6                  | 1.04%          |
| E3s Web Of Conferences                                | 5                  | 0.86%          |
| Global Environmental Change                           | 5                  | 0.86%          |
| Journal Of Agricultural Economics                     | 5                  | 0.86%          |
| Journal Of World Trade                                | 5                  | 0.86%          |
| Quarterly Journal Of International Agriculture        | 5                  | 0.86%          |
| Science Of The Total Environment                      | 5                  | 0.86%          |
| Agricultural Economics United Kingdom                 | 4                  | 0.69%          |
| Agricultural Water Management                         | 4                  | 0.69%          |
| Encyclopedia Of Food Security And Sustainability      | 4                  | 0.69%          |
| Environmental Science And Technology                  | 4                  | 0.69%          |
| Global Food Security                                  | 4                  | 0.69%          |
| Marine Policy                                         | 4                  | 0.69%          |

Table 6 displays the most active source titles based on the number of publications in the dataset. The table lists the total number of publications and the percentage of publications represented by each source title. The most active source title is "IOP Conference Series Earth and Environmental Science" with 17 publications, followed by "Environmental Research Letters" and "Food Security" with 15 publications each. The findings suggest that the research on food security and international trade is published in various sources. The top sources include journals such as "Environmental Research Letters" and "Food Security," which are well-established sources for research on food security issues (Haddad et al., 2018). Other journals such as "World Development" and "Science of the Total Environment" have also been identified as important sources for research on food security and international trade (D'Antoni et al., 2019; Scheelbeek et al., 2019). Additionally, conference proceedings such as "IOP Conference Series Earth and Environmental Science" and "E3S Web of Conferences" are emerging sources for research on food security and international trade (Lee et al., 2020). These sources provide a platform for researchers to share their findings and engage in discussions with other experts in the field. Overall, the variety of sources that publish research on food security and international trade highlights the multidisciplinary nature of this field and the need for collaboration across various disciplines. By utilizing different sources of information, researchers can gain a broader perspective and contribute to a better understanding of food security issues.

## Keywords Analysis

**Fig. 3:** Network visualization map of the author keywords



**Table 7:** Top Keywords

| Author Keywords         | Total Publications | Percentage (%) |
|-------------------------|--------------------|----------------|
| Food Security           | 333                | 57.51%         |
| International Trade     | 322                | 55.61%         |
| Food Supply             | 180                | 31.09%         |
| Agriculture             | 90                 | 15.54%         |
| Commerce                | 53                 | 9.15%          |
| Climate Change          | 52                 | 8.98%          |
| Sustainable Development | 50                 | 8.64%          |
| Article                 | 41                 | 7.08%          |
| Food Production         | 40                 | 6.91%          |
| Agricultural Trade      | 39                 | 6.74%          |
| China                   | 37                 | 6.39%          |
| Crops                   | 35                 | 6.04%          |
| Sustainability          | 34                 | 5.87%          |
| Agricultural Production | 33                 | 5.70%          |
| Economics               | 32                 | 5.53%          |
| Human                   | 32                 | 5.53%          |
| Trade                   | 31                 | 5.35%          |

|                           |    |       |
|---------------------------|----|-------|
| International Cooperation | 29 | 5.01% |
| Water Resources           | 29 | 5.01% |
| Export                    | 28 | 4.84% |

Table 7 presents the top keywords associated with the publications on food security and international trade. The most common author keyword was "food security", appearing in 333 publications (57.51%). The second most frequent keyword was "international trade" with 322 publications (55.61%). Other prominent keywords include "food supply" (180 publications, 31.09%), "agriculture" (90 publications, 15.54%), "commerce" (53 publications, 9.15%), and "climate change" (52 publications, 8.98%). The prevalence of the "food security" keyword is consistent with the increasing concern over global food insecurity due to factors such as population growth, climate change, and environmental degradation (Schmidhuber & Tubiello, 2017). International trade is also becoming increasingly important for food security, as countries with limited resources can import food to meet their needs (Chen & McCarl, 2018). In addition, the emphasis on "food supply" and "agriculture" in the keywords reflects the critical role of agriculture in ensuring food security, particularly in developing countries where agriculture is a major source of income and employment (Pingali, 2019). The keywords "commerce" and "trade" suggest the importance of international trade policies in ensuring food security (Brouder & Gomez, 2020). The keywords "sustainable development" and "sustainability" also appear frequently, indicating the growing recognition of the importance of sustainable agricultural practices to ensure long-term food security (FAO, 2018). Overall, the keywords in Table 7 suggest that food security is a complex and multifaceted issue that requires attention from policymakers, researchers, and practitioners in a variety of fields.

### Geographical Distribution of Publications - Most Influential Countries

**Table 8:** Top 20 Countries contributed to the publications.

| Country            | Total Publications | Percentage (%) |
|--------------------|--------------------|----------------|
| United States      | 164                | 28.32%         |
| China              | 70                 | 12.09%         |
| United Kingdom     | 70                 | 12.09%         |
| Italy              | 43                 | 7.43%          |
| Australia          | 36                 | 6.22%          |
| Canada             | 35                 | 6.04%          |
| France             | 35                 | 6.04%          |
| Germany            | 33                 | 5.70%          |
| Netherlands        | 33                 | 5.70%          |
| Russian Federation | 28                 | 4.84%          |
| Japan              | 21                 | 3.63%          |
| India              | 19                 | 3.28%          |
| Sweden             | 16                 | 2.76%          |
| Austria            | 15                 | 2.59%          |
| Brazil             | 13                 | 2.25%          |
| Switzerland        | 13                 | 2.25%          |
| Spain              | 12                 | 2.07%          |
| South Africa       | 11                 | 1.90%          |

|           |    |       |
|-----------|----|-------|
| Indonesia | 10 | 1.73% |
| Belgium   | 8  | 1.38% |

Table 8 displays the top 20 countries that have contributed to the publications of food security and international trade, with the United States having the highest number of publications with 164 (28.32%), followed by China and the United Kingdom with 70 (12.09%) publications each. Italy, Australia, Canada, and France have also made significant contributions, with 43 (7.43%), 36 (6.22%), 35 (6.04%), and 35 (6.04%) publications respectively. The dominance of the United States in the field of food security and international trade is consistent with their position as a global economic superpower, and their high level of agricultural production and exports. China, on the other hand, is also a significant player in global agriculture and has been working to improve their food security in recent years. The contributions of European countries such as the United Kingdom, Italy, France, and Germany can be attributed to their focus on food policy and the European Union's Common Agricultural Policy. It is noteworthy that the top 20 countries cover a wide geographic range, indicating the global importance of food security and international trade. This is consistent with previous studies that have shown the importance of international cooperation and coordination in addressing food security challenges (Wiggins, 2011; Fan and Brzeska, 2018).

## Authorship

**Table 10:** Most Productive Authors

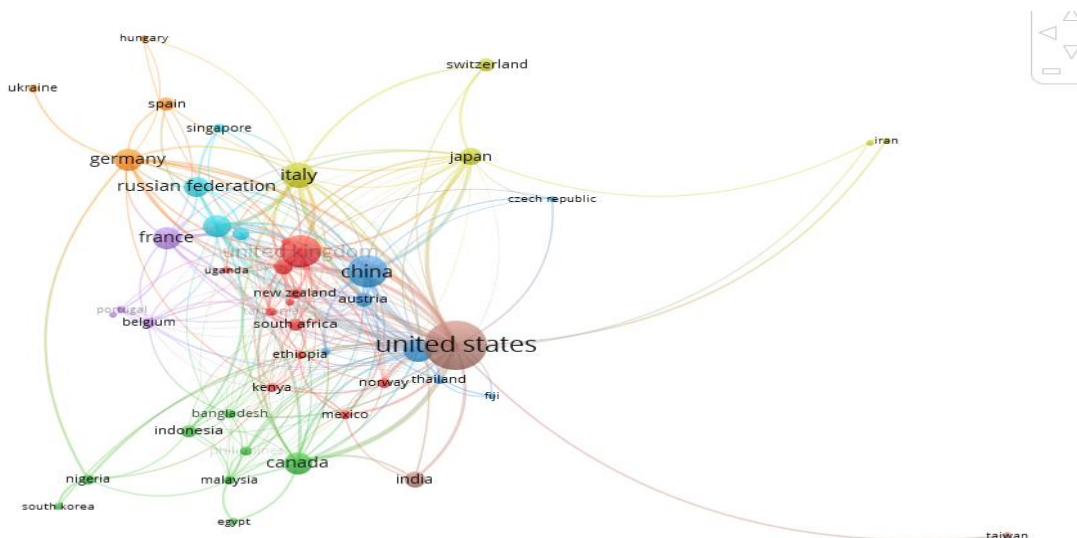
| Author's Name   | No. of Documents | Percentage (%) |
|-----------------|------------------|----------------|
| D'Odorico, P.   | 8                | 1.38%          |
| Carr, J.A.      | 6                | 1.04%          |
| Margulis, M.E.  | 6                | 1.04%          |
| Rulli, M.C.     | 6                | 1.04%          |
| Gephart, J.A.   | 5                | 0.86%          |
| Seekell, D.A.   | 5                | 0.86%          |
| Dalin, C.       | 4                | 0.69%          |
| Dell'Angelo, J. | 4                | 0.69%          |
| Havlík, P.      | 4                | 0.69%          |
| Hoekstra, A.Y.  | 4                | 0.69%          |
| Kerr, W.A.      | 4                | 0.69%          |
| Konar, M.       | 4                | 0.69%          |
| Suweis, S.      | 4                | 0.69%          |
| Wu, W.          | 4                | 0.69%          |
| Aldaya, M.M.    | 3                | 0.52%          |
| Anderson, K.    | 3                | 0.52%          |
| Asche, F.       | 3                | 0.52%          |
| Baldos, U.L.C.  | 3                | 0.52%          |
| Bennett, E.M.   | 3                | 0.52%          |
| Garrido, A.     | 3                | 0.52%          |

Table 10 shows the most productive authors in the field of food security and international trade. The table presents the number of documents published and the percentage of the total number of documents in the dataset. The analysis of this table can help identify the most influential researchers in this field and the topics they have been studying. The results indicate that D'Odorico, P., Carr, J.A., and Margulis, M.E. have each

published 6 papers, making them the most productive authors in the field. Rulli, M.C., Gephart, J.A., and Seekell, D.A. have each published 5 papers. The remaining authors have published between 3 to 4 papers each. The high productivity of these authors suggests that they have made significant contributions to the field of food security and international trade. For instance, D'Odorico, P. and colleagues have published research on water scarcity and food security, highlighting the importance of understanding the relationship between water resources and food production (D'Odorico et al., 2018). Another study by Gephart, J.A. and colleagues explores the impact of international trade on freshwater use and its role in global food security (Gephart et al., 2016). These studies highlight the interdisciplinary nature of the field and the importance of collaboration among researchers from different disciplines.

In conclusion, the analysis of Table 10 suggests that several researchers have made significant contributions to the field of food security and international trade. Their work has contributed to the understanding of the complex interrelationships between food security, international trade, and the environment, among other topics.

**Fig. 4:** Network visualization map of the co-authorship



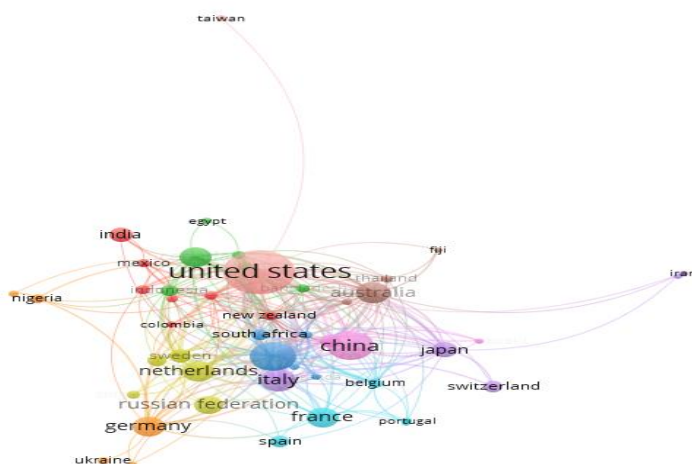
Unit of analysis = Countries

Counting method: Fractional counting

Minimum number of documents of a country = 3

Minimum number of citations of a country = 5

**Fig. 5:** Network visualization map of the co-authorship



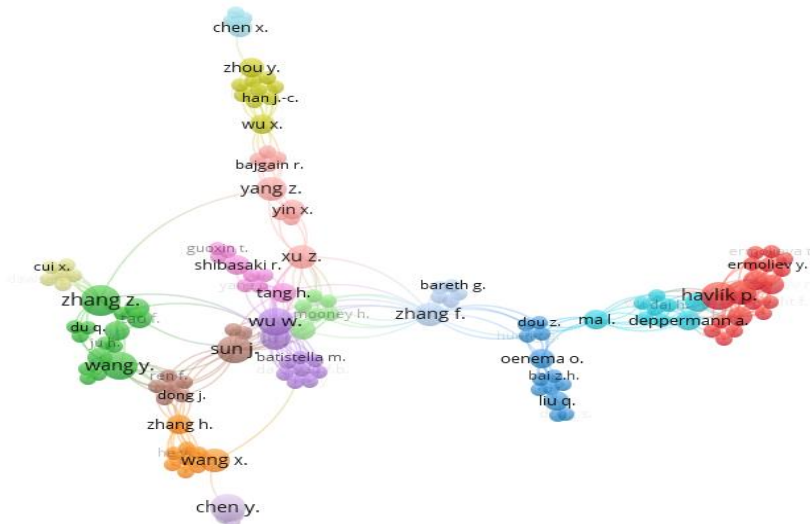
Unit of analysis = Countries

Counting method: Full counting

Minimum number of documents of a country = 3

Minimum number of citations of a country = 5

**Fig. 6:** Network visualization map of the co-authorship



Unit of analysis = Authors

Counting method: Full counting

Minimum number of documents of an author = 1

Minimum number of citations of an author = 0

### Most Influential Institution

**Table 11:** Most influential institutions with minimum of five publications

| Institution                                                     | Total Publications | Percentage (%) |
|-----------------------------------------------------------------|--------------------|----------------|
| Chinese Academy of Sciences                                     | 20                 | 3.45%          |
| Wageningen University & Research                                | 15                 | 2.59%          |
| CIRAD                                                           | 14                 | 2.42%          |
| Food and Agriculture Organization of the United Nations         | 12                 | 2.07%          |
| University of Virginia                                          | 11                 | 1.90%          |
| International Institute for Applied Systems Analysis, Laxenburg | 9                  | 1.55%          |
| University of Chinese Academy of Sciences                       | 9                  | 1.55%          |
| University of Saskatchewan                                      | 8                  | 1.38%          |
| Chinese Academy of Agricultural Sciences                        | 8                  | 1.38%          |
| International Food Policy Research Institute                    | 7                  | 1.21%          |
| Purdue University                                               | 7                  | 1.21%          |
| Peking University                                               | 7                  | 1.21%          |

|                                                                                                  |   |       |
|--------------------------------------------------------------------------------------------------|---|-------|
| Institute of Geographical Sciences and Natural Resources Research<br>Chinese Academy of Sciences | 7 | 1.21% |
| University of Arkansas                                                                           | 6 | 1.04% |
| Vrije Universiteit Amsterdam                                                                     | 6 | 1.04% |
| The Australian National University                                                               | 6 | 1.04% |
| Stanford University                                                                              | 6 | 1.04% |
| China Agricultural University                                                                    | 6 | 1.04% |

Table 11 shows the most influential institutions that have published a minimum of five articles on food security and international trade. The Chinese Academy of Sciences tops the list with 20 publications, followed by Wageningen University & Research with 15 publications, and CIRAD with 14 publications. The Food and Agriculture Organization of the United Nations (FAO) ranks fourth with 12 publications, while the University of Virginia and the International Institute for Applied Systems Analysis (IIASA) are tied for fifth with 11 and 9 publications, respectively. Several of the top institutions in Table 11 have a strong focus on agriculture and food security research. For example, the Chinese Academy of Agricultural Sciences (CAAS), which has eight publications in the table, is a national agricultural research institution in China that aims to provide scientific support for agricultural modernization and sustainable development. Similarly, the International Food Policy Research Institute (IFPRI) focuses on improving food security and reducing poverty through research and policy analysis. Wageningen University & Research in the Netherlands has a well-established reputation for its research in agriculture, food, and the environment. It has published numerous articles on food security and international trade, with a particular focus on sustainable agricultural practices and policies. The FAO, which is a specialized agency of the United Nations, has also contributed significantly to research on food security and international trade. Its publications cover a range of topics related to agriculture, food, and nutrition, and provide guidance on policies and practices to promote sustainable food systems. Overall, the institutions listed in Table 11 represent a diverse range of organizations with different areas of expertise, and they have made significant contributions to the field of food security and international trade. Their research is crucial for informing policies and practices that address the challenges of food insecurity and promote sustainable agricultural development.

## Citation Analysis

**Table 12:** Citations Metrics

| Metrics       | Data    |
|---------------|---------|
| Papers        | 579     |
| Citations     | 13472   |
| Years         | 46      |
| Cites_Year    | 292.87  |
| Cites_Paper   | 23.27   |
| Cites_Author  | 5071.66 |
| Papers_Author | 281.61  |
| Authors_Paper | 3.22    |
| h_index       | 64      |
| g_index       | 101     |

Table 12 presents the citation metrics of the papers included in the study on food security and international trade. A total of 579 papers were analysed over a period of 46 years, which received a total of 13,472 citations, resulting in an average of 23.27 citations per paper and 292.87 citations per year. The average number of papers per author was 281.61, and the average number of authors per paper was 3.22. The h-index and g-index

of the papers were 64 and 101, respectively. The h-index measures the impact of a scholar's publications by taking into account the number of papers and the number of citations they receive. Meanwhile, the g-index is a more comprehensive measure that also considers the distribution of citations across publications. These metrics suggest that the papers on food security and international trade have made significant contributions to the field and have been widely cited by other researchers. Furthermore, citation analysis can reveal the most influential authors, institutions, and countries in the field. The authors with the highest number of citations are likely to be experts in the field and have made significant contributions to the literature. Institutions with a high number of publications and citations are indicative of their research output and impact in the field. By identifying these trends, scholars can better understand the landscape of food security and international trade research and identify potential collaborators and future research directions. Overall, the citation metrics in Table 12 demonstrate the significant impact of the research on food security and international trade and the growing interest in this field over the past few decades.

**Table 13:** Highly cited articles

| No. | Authors                                                                                                                                                                                                                                                                | Title                                                                                                                                                          | Year | Cites | Cites per Year |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|----------------|
| 1   | C. B. Arthur, H. Norbury, E.H. Allison, M. Beveridge, S. Bush, L. Campling, W. Leschen, D. Little, D. Squires, S.H. Thilsted, M. Troell, M. Williams                                                                                                                   | Contribution of Fisheries and Aquaculture to Food Security and Poverty Reduction: Assessing the Current Evidence                                               | 2016 | 417   | 59.57          |
| 2   | M.D. Smith, C.A. Roheim, L.B. Crowder, B.S. Halpern, M. Turnipseed, J.L. Anderson, F. Asche, L. Bourillon, A.G. Guttormsen, A. Khan, L.A. Liguori, A. McNevin, M.I. O'Connor, D. Squires, P. Tyedmers, C. Brownstein, K. Carden, D.H. Klinger, R. Sagarin, K.A. Selkoe | Sustainability and global seafood                                                                                                                              | 2010 | 345   | 26.54          |
| 3   | M. Qadir, B.R. Sharma, A. Bruggeman, R. Choukr-Allah, F. Karajeh                                                                                                                                                                                                       | Non-conventional water resources and opportunities for water augmentation to achieve food security in water scarce countries                                   | 2007 | 331   | 20.69          |
| 4   | P. D'Odorico, K.F. Davis, L. Rosa, J.A. Carr, D. Chiarelli, J. Dell'Angelo, J. Gephart, G.K. MacDonald, D.A. Seekell, S. Suweis, M.C. Rulli                                                                                                                            | The Global Food-Energy-Water Nexus                                                                                                                             | 2018 | 275   | 55             |
| 5   | C. de Fraiture, D. Wichelns                                                                                                                                                                                                                                            | Satisfying future water demands for agriculture                                                                                                                | 2010 | 262   | 20.15          |
| 6   | M. Fader, D. Gerten, M. Krause, W. Lucht, W. Cramer                                                                                                                                                                                                                    | Spatial decoupling of agricultural production and consumption: Quantifying dependences of countries on food imports due to domestic land and water constraints | 2013 | 220   | 22             |
| 7   | H. Yang, L. Wang, K.C. Abbaspour, A.J.B. Zehnder                                                                                                                                                                                                                       | Virtual water trade: An assessment of water use efficiency in the international food trade                                                                     | 2006 | 205   | 12.06          |

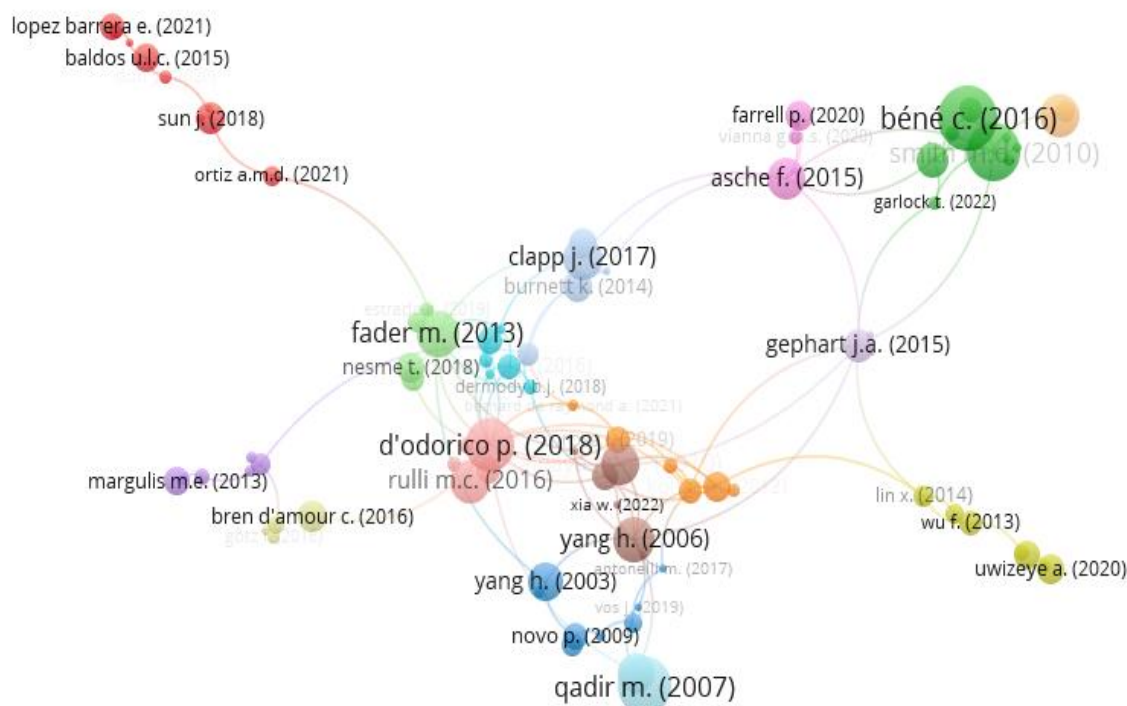
|    |                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                           |      |     |       |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------|-----|-------|
| 8  | J. Clapp                                                                                                                                                                                                                                                                                                                                                 | Food self-sufficiency: Making sense of it, and when it makes sense                                                                        | 2017 | 194 | 32.33 |
| 9  | M.C. Rulli, D. Bellomi, A. Cazzoli, G. De Carolis, P. D'Odorico                                                                                                                                                                                                                                                                                          | The water-land-food nexus of first-generation biofuels                                                                                    | 2016 | 193 | 27.57 |
| 10 | L.N.K. Davidson, M.A. Krawchuk, N.K. Dulvy                                                                                                                                                                                                                                                                                                               | Why have global shark and ray landings declined: Improved management or overfishing?                                                      | 2016 | 189 | 27    |
| 11 | R.B. Chowdhury, G.A. Moore, A.J. Weatherley, M. Arora                                                                                                                                                                                                                                                                                                    | Key sustainability challenges for the global phosphorus resource, their implications for global food security, and options for mitigation | 2017 | 188 | 31.33 |
| 12 | F. Asche, M.F. Bellemare, C. Roheim, M.D. Smith, S. Tveteras                                                                                                                                                                                                                                                                                             | Fair Enough? Food Security and the International Trade of Seafood                                                                         | 2015 | 181 | 22.63 |
| 13 | P.A. Lindsey, G. Balme, M. Becker, C. Begg, C. Bento, C. Bocchino, A. Dickman, R.W. Diggle, H. Eves, P. Henschel, D. Lewis, K. Marnewick, J. Mattheus, J. Weldon McNutt, R. McRobb, N. Midlane, J. Milanzi, R. Morley, M. Murphree, V. Opyene, J. Phadima, G. Purchase, D. Rentsch, C. Roche, J. Shaw, H.V.D. Westhuizen, N.V. Vliet, P. Zisadza-Gandiwa | The bushmeat trade in African savannas: Impacts, drivers, and possible solutions                                                          | 2013 | 180 | 18    |
| 14 | K.G. Cassman, A.J. Liska                                                                                                                                                                                                                                                                                                                                 | Food and fuel for all: Realistic or foolish?                                                                                              | 2007 | 180 | 11.25 |
| 15 | M. Edelman                                                                                                                                                                                                                                                                                                                                               | Food sovereignty: forgotten genealogies and future regulatory challenges                                                                  | 2014 | 177 | 19.67 |
| 16 | D.J. White, K. Hubacek, K. Feng, L. Sun, B. Meng                                                                                                                                                                                                                                                                                                         | The Water-Energy-Food Nexus in East Asia: A tele-connected value chain analysis using inter-regional input-output analysis                | 2018 | 176 | 35.2  |
| 17 | M.M. Aldaya, J.A. Allan, A.Y. Hoekstra                                                                                                                                                                                                                                                                                                                   | Strategic importance of green water in international crop trade                                                                           | 2010 | 172 | 13.23 |
| 18 | P. Udomkun, A.N. Wiredu, M. Nagle, J. MÅ¼ller, B. Vanlauwe, R. Bandyopadhyay                                                                                                                                                                                                                                                                             | Innovative technologies to manage aflatoxins in foods and feeds and the profitability of application – A review                           | 2017 | 166 | 27.67 |
| 19 | D. Wichelns                                                                                                                                                                                                                                                                                                                                              | The role of 'virtual water' in efforts to achieve food                                                                                    | 2001 | 155 | 7.05  |

|    |                                                                                                                                                                          |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20 | C. BÃ©nÃ©, R. Arthur, H. Norbury,<br>E.H. Allison, M. Beveridge, S. Bush,<br>L. Campling, W. Leschen, D. Little,<br>D. Squires, S.H. Thilsted, M. Troell,<br>M. Williams |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Fig. 11:** Network visualization map of the citation by countries

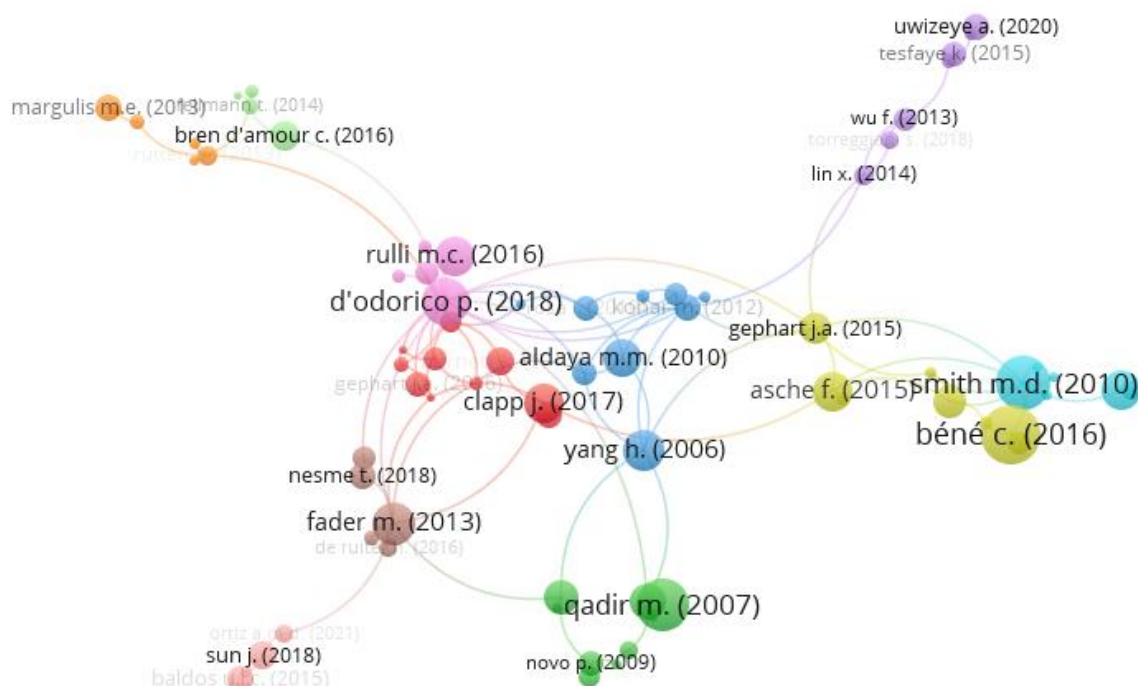
Minimum number of citations of an author = 5

**Fig. 12:** Network visualization map of the citation by documents



Minimum number of citations of a document = 5

**Fig. 13:** Network visualization map of the citation by documents



Minimum number of citations of a document = 10

## DISCUSSION

Food security and international trade have been the subject of many past studies. Researchers have examined the relationship between international trade policies and food security in developing countries. Studies have found that trade liberalization, while potentially beneficial for economic growth, can also have negative impacts on food security. For example, a study by Dawe et al. (2003) found that trade liberalization in rice in

Asia led to increased rice imports and reduced domestic production, which negatively impacted food security in some countries. Another study by Gruère and Sengupta (2011) found that trade liberalization in maize in Africa had similar effects, leading to increased maize imports and reduced domestic production. On the other hand, some studies have found that trade can also have positive impacts on food security. For example, a study by von Braun and Diaz-Bonilla (2008) found that trade in staple foods can help mitigate food shortages during times of drought or other shocks to the food system. Overall, it seems that the relationship between international trade and food security is complex and context-dependent. While trade liberalization can bring economic benefits, it can also have negative impacts on domestic food production and availability. However, trade can also provide an important safety net during times of food shortages or other shocks to the system.

## CONCLUSION

In summary, this paper has explored the complex relationship between food security and international trade. The literature reviewed indicates that international trade can both positively and negatively impact food security, depending on a variety of factors such as the trade policies and practices of individual countries, the level of development of the countries involved in trade, and the specific food products being traded. On the one hand, international trade can increase access to food and reduce food prices, which can improve food security in importing countries. On the other hand, trade liberalization policies can lead to increased dependence on imported foods and decreased agricultural production in some countries, which can negatively impact food security in the long term. Moreover, the paper highlights the importance of policy coherence, coordination and integration across trade, agricultural, and food security policies. This can ensure that the negative impacts of trade liberalization are minimized, and the positive impacts are maximized to enhance food security and promote sustainable development. To conclude, this paper has emphasized the need for a balanced and integrated approach that takes into account the potential impacts of international trade on food security. This approach should aim to promote sustainable agricultural development and trade policies that can address both the supply and demand aspects of food security, while ensuring that the trade policies do not negatively impact food security. This study has made several contributions to the literature on food security and international trade. First, it has provided a comprehensive overview of the relationship between food security and international trade, highlighting the potential benefits and challenges of trade for food security. Second, it has analysed the key determinants of food security, including trade policy, food price volatility, and environmental factors. Third, it has identified the potential trade-offs between trade liberalization and food security objectives and provided recommendations for policymakers to balance these objectives.

There are several limitations to this study that should be acknowledged. First, the analysis has relied on secondary data sources, which may not fully capture the complexities of the relationship between food security and international trade. Second, the study has focused mainly on the effects of trade on food security and has not explored the potential impact of food security policies on international trade. Third, the study has not accounted for the potential heterogeneity in the effects of trade on food security across countries and regions. There are several avenues for future research in this area. First, further research could explore the impact of food security policies, such as public stockholding, on international trade. Second, future studies could use primary data sources to provide a more nuanced understanding of the relationship between food security and international trade. Third, research could investigate the heterogeneity in the effects of trade on food security across countries and regions and explore potential policy responses to address these disparities. Finally, additional research could examine the impact of trade on the nutritional quality of food, which is an important dimension of food security that has not been fully explored in this study.

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