# Global Research Trends in Food Security: Insights from a Bibliometric Analysis

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## ABSTRACT

In light of escalating global challenges, including climate change, population growth, and economic disparities, food security has emerged as a critical area of research. This study presents a comprehensive bibliometric analysis of food security literature sourced from the Scopus and Web of Science (WoS) databases, encompassing 506 valid publications. The findings reveal a notable upward trend in scholarly interest over the past decade, with a particular focus on themes such as climate change, sustainability, agricultural innovations, and the socio-economic dimensions of food systems. Significant contributions highlight the effectiveness of interdisciplinary approaches and regional research, especially in Southeast Asia, where Malaysian institutions have demonstrated notable leadership. Some important insights are the use of advanced modelling methods like hydrodynamic and socio-ecological frameworks, the integration of behavioural reasoning and generational cohort theories, and the wide use of farming methods that are resilient to climate change. The study also identifies highly cited works that address sustainable practices and policy implications, reflecting the multifaceted nature of the field. However, gaps remain in areas such as the impacts of microplastics, urban food deserts, and the role of blockchain technology in food systems. This research underscores the necessity for international collaboration and the adoption of multidisciplinary perspectives to advance sustainable solutions for food security. This bibliometric mapping serves as a strategic guide for researchers, policymakers, and stakeholders to address critical knowledge gaps and foster innovation in achieving global food security objectives.

**Keywords:** Food Security, Bibliometric Analysis, Sustainability, Countries

## INTRODUCTION

In an era when the global population is projected to reach nearly 10 billion by 2050, the challenge of food security has never been more pressing. Food security, defined as the condition in which all individuals have physical, social, and economic access to sufficient, safe, and nutritious food, is a fundamental human right (Ridzuan et al., 2024). It is intricately linked to health, well-being, and sustainable development. As climate change, economic disparities, and geopolitical tensions continue to threaten food systems worldwide, exploring research trends in

food security becomes essential. Understanding these trends not only highlights the complexities of food production and distribution but also reveals innovative solutions to ensure that everyone has access to sufficient, high-quality food (McCarthy et al., 2018). The importance of examining research trends in food security cannot be overstated. A thorough analysis of current studies and practices enables policymakers, researchers, and practitioners to identify gaps in knowledge and areas that require urgent attention. For instance, advancements in agricultural technology, such as precision farming and genetically modified organisms (GMOs), have the potential to enhance yields and resilience in the face of climate variability. However, these novelties must be accompanied by rigorous research to assess their long-term impacts on ecosystems, human health, and socio-economic structures. By closely monitoring research trends, stakeholders can adapt their strategies to ensure that food systems are both productive and sustainable (Transforming Food Systems Under a Changing Climate, 2023).

Moreover, exploring these trends lights the multifaceted nature of food security. It encompasses not only the availability of food but also its accessibility, utilization, and stability over time. Research indicates that nearly 690 million people globally are undernourished—a figure exacerbated by the COVID-19 pandemic and ongoing conflicts (The State of Food Security and Nutrition in the World 2020, 2020). This alarming statistic underscores the need for collaborative research efforts that prioritize marginalized communities disproportionately affected by food insecurity. By focusing on the social determinants of health and food access, researchers can better inform interventions that target vulnerable populations, ensuring that no one is left behind (Paschal et al., 2020). The role of interdisciplinary research in food security is also critical. Addressing this complex issue requires insights from various fields, including agriculture, economics, sociology, and environmental science (Fears et al., 2019; Ridzuan et al., 2025). Regions such as South East Asia are especially important for studying food security due to their diverse agricultural practices, rapidly growing populations, and significant reliance on imported food in certain areas. These factors provide valuable insights into the challenges of balancing food production, resource management, and equitable access. Furthermore, Asia's vulnerability to climate change impacts, such as rising sea levels and erratic weather patterns, underscores the necessity of regional studies to inform global food security strategies. For example, studies on the intersection of climate change and food production reveal that rising temperatures and erratic weather patterns pose significant threats to crop yields. Research that integrates climate modelling with agricultural practices can lead to more resilient farming systems that adapt to these changes. Additionally, understanding the socio-economic factors that influence food distribution enables researchers to propose policies that promote equitable access to nutritious food, particularly in urban areas where food deserts are prevalent (Fan et al., 2017).

The role of interdisciplinary research in food security is also critical. Addressing this complex issue requires insights from various fields, including agriculture, economics, sociology, and environmental science (Fears et al., 2019; Khairul Hafezad, 2023) For example, studies on the intersection of climate change and food production reveal that rising temperatures and erratic weather patterns pose significant threats to crop yields. Research that integrates climate modelling with agricultural practices can lead to more resilient farming systems that adapt to these changes. Additionally, understanding the socio-economic factors that influence food distribution enables researchers to propose policies that promote equitable access to nutritious food, particularly in urban areas where food deserts are prevalent (Fan et al., 2017). In addition to addressing immediate needs, exploring research trends in food security fosters long-term sustainability. Sustainable agricultural practices, such as agroecology and permaculture, are emerging as viable alternatives to conventional farming methods. These practices not only improve soil health and biodiversity but also empower local communities by promoting food sovereignty. By investigating the effectiveness of these approaches through rigorous research, policymakers can develop frameworks that support sustainable food systems, ultimately leading to improved food security for future generations (Woodhill et al., 2022). The global nature of food security issues necessitates international collaboration in research and policy making. Initiatives such as the United Nations' Sustainable Development Goals (SDGs) emphasize the importance of partnerships in eliminating hunger and promoting sustainable agriculture (Pérez-Escamilla, 2017). By examining research trends across different regions, stakeholders can share best practices and lessons learned, fostering a collective approach to tackling food insecurity. This global perspective is crucial for understanding how local challenges are interconnected and how solutions can be adapted to diverse contexts. The research questions presented below are considered crucial for enhancing the current study's understanding of previous research on food security:

What trends and patterns have been identified about the quantity and categories of publications pertaining to food security research?

1. What are the most prolific source titles are published and common themes emerging in food security research?
2. What are the most underpinning theories and models used in food security research?
3. Which institutions are made substantial contributions to food security research?
4. Who are the most cited articles in food security research?

# METHODOLOGY

This study employs bibliometric analysis to assess scholarly publications on food security research. Bibliometric analysis is a quantitative method that employs statistical techniques to analyse academic literature. It provides valuable insights into research trends in food security by systematically examining publication data. This method allows researchers to assess the growth of publications over time, identify influential authors and their contributions, and explore collaborative networks within the field. By utilizing bibliometric analysis, the researcher can gain a clearer understanding of how research in food security has evolved, the impact of various studies, and the areas that require further exploration (Xie et al., 2021). The value of bibliometric analysis lies in its ability to present an objective overview of the research landscape. It can identify shifts in focus, methodological approaches, and the emergence of new themes. Additionally, this method supports evidence-based decision-making for policymakers and researchers by highlighting critical areas of interest and potential gaps in knowledge. Thus, bibliometric analysis serves as a robust tool for mapping the intellectual terrain of food security research. Bibliometric methods also can effectively uncover various dimensions of research trends in food security. By analysing citation patterns, the researcher can identify key authors whose work has significantly influenced the field. These authors often lead the way in shaping research agendas and methodologies, making their contributions vital for furthering knowledge in food security (Sweileh, 2020). Moreover, bibliometric analysis can highlight pivotal publications that have garnered high citation counts, indicating their importance and relevance. These seminal works often set the foundation for subsequent research and can serve as critical references for scholars entering the field. The evolution of themes within the research landscape can also be discerned through bibliometric techniques. By examining keyword co-occurrences and publication trends over time, researcher can identify emerging areas of focus, shifts in research priorities, and the interconnections between various topics within food security. This thematic exploration allows researchers to understand how different concepts relate to one another and how they have developed in response to global challenges (Soehartono & Khor, 2020; Li & Song, 2022).

**Database and Software**

In this study, the Scopus and WoS databases were selected as the appropriate academic databases for analysing publications related to food security. The Scopus and WoS databases have been widely used by scholars as the primary databases for finding relevant scientific publications for their research. Both databases can be considered multidisciplinary and contain documents that offer a broad scope and coverage. Additionally, they provide search analysis tools that can be used to generate representative statistics in bibliometric analysis. ScientoPy is one of the software applications used in this study to generate science mapping and visualization networks. ScientoPy is a software tool implemented in Python, specifically designed to analyse publication data obtained from the Scopus and WoS databases (Khairul Hafezad, 2023). Currently, the programming language of this system is exclusively compatible with the aforementioned databases. ScientoPy is crucial for evaluating various publication parameters, including subject matter, authorship, country of origin, document type and keywords. It is also tool for constructing and displaying bibliometric networks such as co-citations, bibliographic pairings, or co-authorship associations.

**Pre-processing of Retrieved Datasets**

The dataset acquired was subjected to a preliminary pre-processing phase, which included the elimination of duplicate entries and the integration of associated data. The data processing was conducted using the ScientoPy software. Table 1 outlines the initial results derived from the gathered data, achieved through the processes of

data integration and the removal of duplicates during the pre-processing phase. The data reveals a total of 644 research papers on food security, which were sourced from the Web of Science (WoS) and Scopus databases. Nonetheless, 74 documents, representing 11.50%, were excluded due to their classification. Out of the total, 84 papers, representing 14.70%, were sourced from WoS, whereas 486 papers, accounting for 85.30%, were derived from Scopus. Upon applying filters to select particular document types, including research articles, conference papers, book chapters, reviews, and proceedings, the resulting count of valid publications was determined to be 570, representing 88.50% of the total. In this analysis, 0 papers (0.00%) from WoS and 64 papers (13.20%) from Scopus were recognized as duplicates. Consequently, following the elimination of duplicates, the aggregate count of valid publications reached 506, comprising 84 papers (16.60%) sourced from WoS and 422 papers (83.40%) from Scopus. The acquisition of data surpassing 100 entries enables the execution of bibliometric analysis.

Table 1: Data Integration and Duplicate Elimination

| Data Pre-processing Output | Information | Number | Percentage (%) |
|---|---|---|---|
| Initial data set processing | Total Papers from WoS and Scopus | 644 | - |
| | Documents omitted by type | 74 | 11.50 |
| | WoS data Sets | 84 | 14.70 |
| | Scopus data Sets | 486 | 85.30 |
| | Total publications after selecting document types (Research articles, conference papers, book chapters, review papers, and proceedings) | 570 | 88.50 |
| Duplicates removing | Duplicated publications from WoS | 0 | 0.00 |
| | Duplicated papers from Scopus | 64 | 13.20 |
| Reliable and valid data set | Publication WoS | 84 | 16.60 |
| | Publication Scopus | 422 | 83.40 |
| | Total of Valid data set | 506 | |

Source: Author, using ScientoPy 2.1.3

# RESULT

The results of the present study are available to answer each research question outlined in the methodology section. The graphical visualization of ScientoPy is deployed to show the findings.

**Publication Patterns and Trends**

Figure 1 illustrates the number of publications on food security research over time, as indexed in the Scopus and Web of Science (WoS) databases. Several key trends and patterns can be identified. First, there has been an overall growth in publications, with a steady increase in the number of publications captured by both Scopus and WoS, indicating a growing research interest and focus on food security. This trend has accelerated in recent years, particularly the last 10–15 years, with a sharp increase in the number of publications in the 2010s and 2020s, suggesting that food security has become an increasingly important and actively researched topic. Additionally, the Scopus database consistently shows a higher number of publications compared to WoS, implying that Scopus may be indexing a broader range of food security-related literature, and the gap between the two databases has widened over time, particularly in the last 5–10 years. This growth in publications could be attributed to various factors, such as growing global concerns about food availability, accessibility, and sustainability, as well as the increasing importance of addressing challenges related to climate change, population growth, and resource constraints. The graph also reveals a clear upward trend in the quantity of publications on food security research, with a notable acceleration in recent years, indicating an increasing scientific focus and attention on this critical issue.

Figure 2 provides a bar-trend graph categorizing the types of documents published. The analysis reveals that articles make up the largest proportion of publications, indicating that primary research is prevalent in this field. A high number of articles suggests rigorous research efforts and the sharing of original findings within the academic community. The second most common type of document is conference papers. This indicates that discussions on food security are actively taking place in academic conferences, reflecting the importance of networking and collaboration among researchers in this area. The figures also show that other document types, such as reviews and book chapters, have lower counts compared to articles and conference papers. This suggests that while there is a solid base of foundational research, there is still room for extensive review works that can synthesize existing literature and provide comprehensive overviews of food security issues.
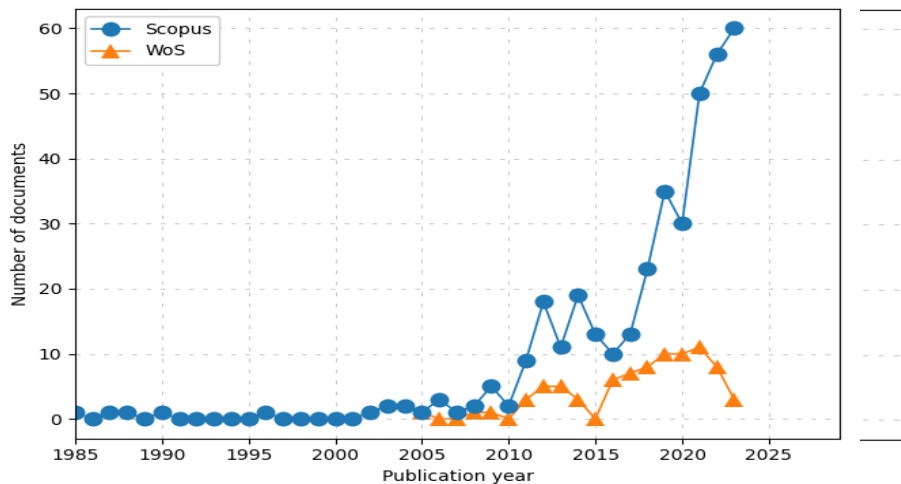


Figure 1: The Evolution of Publication Growth
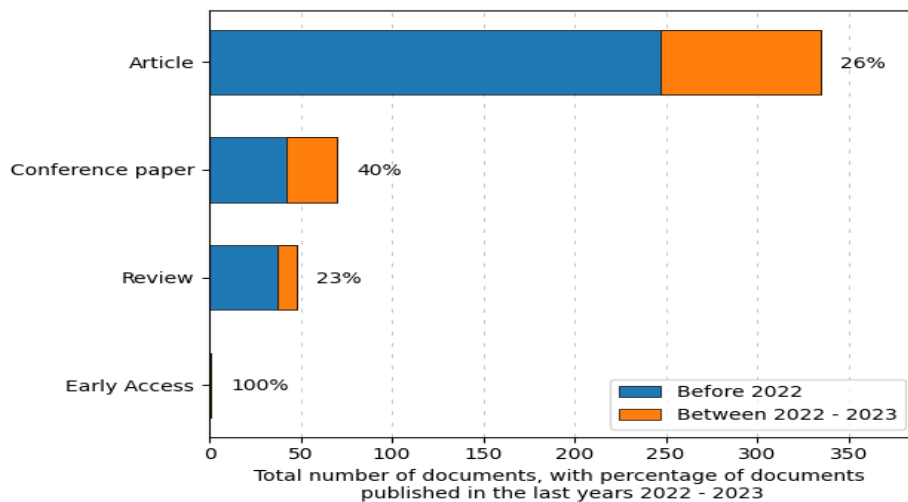
Source: Author, using ScientoPy 2.1.3



Figure 2: Bar-trend graph of document type

Source: Author, using ScientoPy 2.1.3

**Prolific Source Titles**

This study includes the selection of source titles that have been identified as highly prolific in terms of publishing research on the topic of food security. The study has identified the top ten source titles, as depicted in Figure 3. Based on figure 3, it was found that the most prolific source titles for published research on food security appear to be the AIP Conference Proceedings, The Journal Sustainability, and the Journal of Sustainability Science and Management. The AIP Conference Proceedings shows the highest percentage of documents published (57%) in

the period between 2022 and 2023, indicating it is a very active outlet for research on food security and related topics. The Journal Sustainability also has a high percentage of documents published (46%) in the recent period, suggesting it is a prominent platform for scholarly work on sustainability, which is closely connected to food security issues. Similarly, the Journal of Sustainability Science and Management has 40% of its documents published in the 2022-2023 period, positioning it as another significant outlet for research in the sustainability and food security domain. The data reveals that the most prolific source titles for published work on food security are conference proceedings and academic journals that focus on sustainability, environmental research, and applied sciences. This aligns with the interdisciplinary nature of the topic, which intersects with environmental science, agricultural studies, policy, and socioeconomic factors. The high publication percentages in these source titles indicate that they are actively contributing to and shaping the current discourse on food security, providing outlets for researchers to disseminate their findings and engage with the broader academic community working on these critical global challenges.
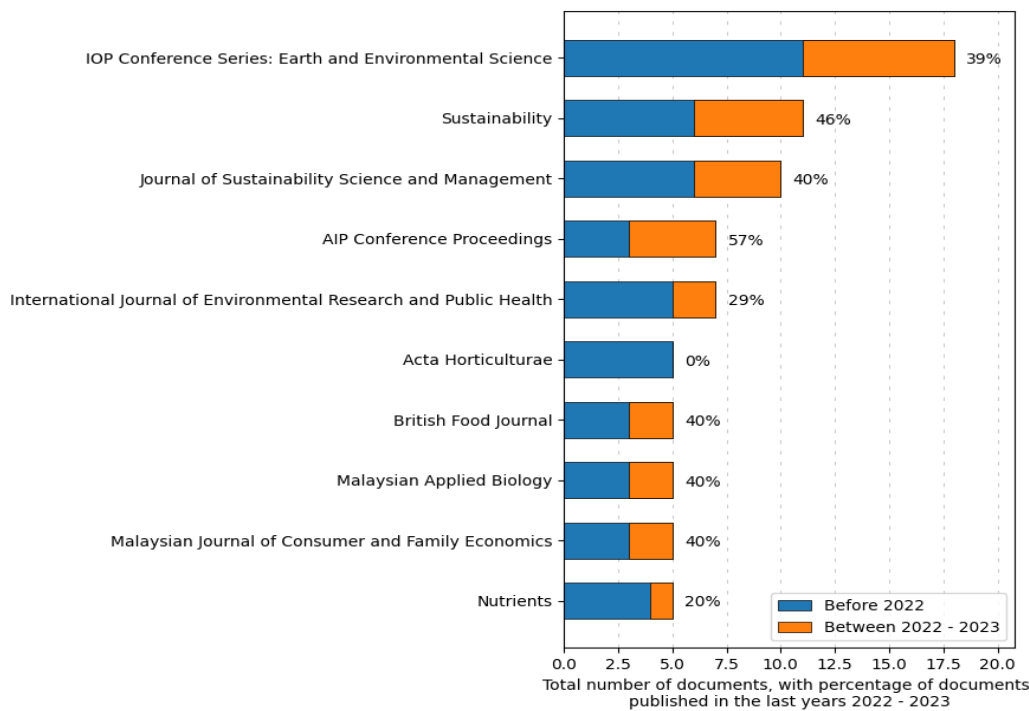


Figure 3: The Prolific Source Titles

Source: Author, using ScientoPy 2.1.3

**Research Themes or Topics Emerging**

This study employs ScientoPy to analyse the authors' keywords and examine the prevailing research trends and intriguing topics in food security. Based on figure 4, the most common research topics in this field revolve around food security, sustainability, and regional dynamics, particularly in Malaysia and Southeast Asia, which collectively reflect critical global and regional challenges. Food security is the most dominant theme, with 27% of related publications emerging between 2022 and 2023, emphasizing its ongoing importance. In specific research, Malaysia accounts for 18% of recent studies, highlighting a sustained focus on localized food and agricultural issues. Climate change, another major area, aligns with 27% of recent publications, signifying its impact on agriculture and food systems. Closely related to food security, food insecurity highlights access and affordability challenges, with 19% of studies being recent. Sustainability has also gained traction, with 38% of its research published recently, underscoring efforts to balance environmental and economic priorities. COVID-19 remains a standout topic, with 56% of recent studies exploring its disruption of food systems, supply chains, and agriculture. Agriculture, a foundational field, accounts for 33% of recent publications, while rice, a staple crop, holds 27%, reflecting its critical role in food security. Research on Southeast Asia (40% recent publications) emphasizes regional strategies to tackle these issues, while paddy, though less studied, shows emerging interest (11% recent publications) in addressing cultivation challenges. Overall, the field reflects a mix of urgent, global-

scale topics like climate change and COVID-19, alongside region-specific and crop-focused studies that are essential for countries heavily reliant on rice-based economies.
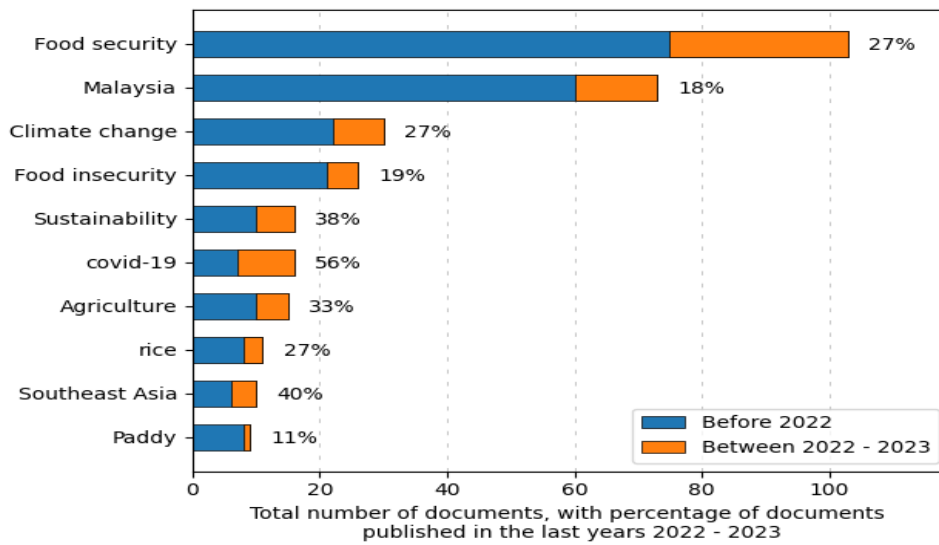


Figure 4: The bar-trend graph of research themes and topics

Source: Author, using ScientoPy 2.1.3

**Theories and Models**

Based on Figure 5, the study shows that Behavioural Reasoning Theory is the most prominent, accounting for 100% of documents published in 2022-2023. This theory explains that people's intentions and actions are shaped by their reasons for behaving a certain way. Similarly, Generational Cohort Theory also appears in 100% of recent publications. This theory suggests that people from the same generation share similar values, beliefs, and experiences that influence their behaviour and decisions. In contrast, Diffusion of Innovation Theory and Institutional Theory have received little attention in food security research, with a 0% presence in recent publications. Diffusion of Innovation Theory looks at how new ideas and technologies spread in society, while Institutional Theory examines how institutions and policies affect behaviour. Institutional Theory is particularly important for food security because it analyses how organizations and rules impact food production, distribution, and access. For example, good governance can help improve food supply chains, while failures in institutions can lead to food insecurity due to poor resource allocation or corruption. Research using Institutional Theory has shown its value in tackling food security issues. Studies have explored how changes in agricultural policies can improve food availability and how local governance can help communities become more resilient to climate-related food shortages. These findings highlight the importance of understanding how institutions affect food systems. While Behavioural Reasoning Theory focuses on individual choices, Institutional Theory adds depth by considering the broader structural factors that influence those choices. For instance, decisions about food consumption are affected not only by personal preferences but also by factors like food prices and government health campaigns. By combining these theories, researchers can gain a better understanding of how individual actions and systemic issues work together in achieving food security. In this case Incorporating Institutional Theory with Behavioural Reasoning Theory and Generational Cohort Theory would create a more comprehensive approach to addressing food security challenges. Future studies should investigate how Institutional Theory can illuminate the role of governance and policies in building resilient food systems. Meanwhile, Lee's Migration Theory and the Theory of Planned Behaviour have not been emphasized in recent research, each showing a 0% presence. Overall, the figure indicates that Behavioural Reasoning Theory and Generational Cohort Theory are the leading frameworks in current food security research, while other theories have been less highlighted.

Meanwhile, Figure 6 reveals that the binary model constitutes a significant portion of the research, with a high percentage of documents published in the last years (2022-2023). Hydrodynamics modelling also has a

substantial presence in recent food security research. Marine biogeochemical models and marine ecosystem models, related to the marine environment, are important components of the research. PLS-Structural Equation Modelling, a statistical modelling technique, is utilized in a notable percentage of the recent publications. The research also incorporates the Partial Equilibrium Model and Path Modelling, albeit to a lesser extent than the previously mentioned approaches. The food security research incorporates the Population Model and Regional Climate Modelling, which concentrate on population dynamics and regional climate patterns. Specific models and indexes related to rice production and technological advancement are a significant part of the research. The Socio-Ecological Model, which considers the interplay between social and ecological factors, is also utilized in the food security studies. A stochastic model, a type of probabilistic modelling, was employed in a portion of the recent publications. The Technology Acceptance Model (TAM), which examines the adoption of technologies, is also present in the food security research landscape. The figure also indicates a diverse array of modelling approaches employed in food security research, with a strong emphasis on binary, hydrodynamic, and marine-related models, as well as statistical and population-focused techniques. The research also highlights the importance of rice production, technological advancements, and socio-ecological considerations in the field of food security.
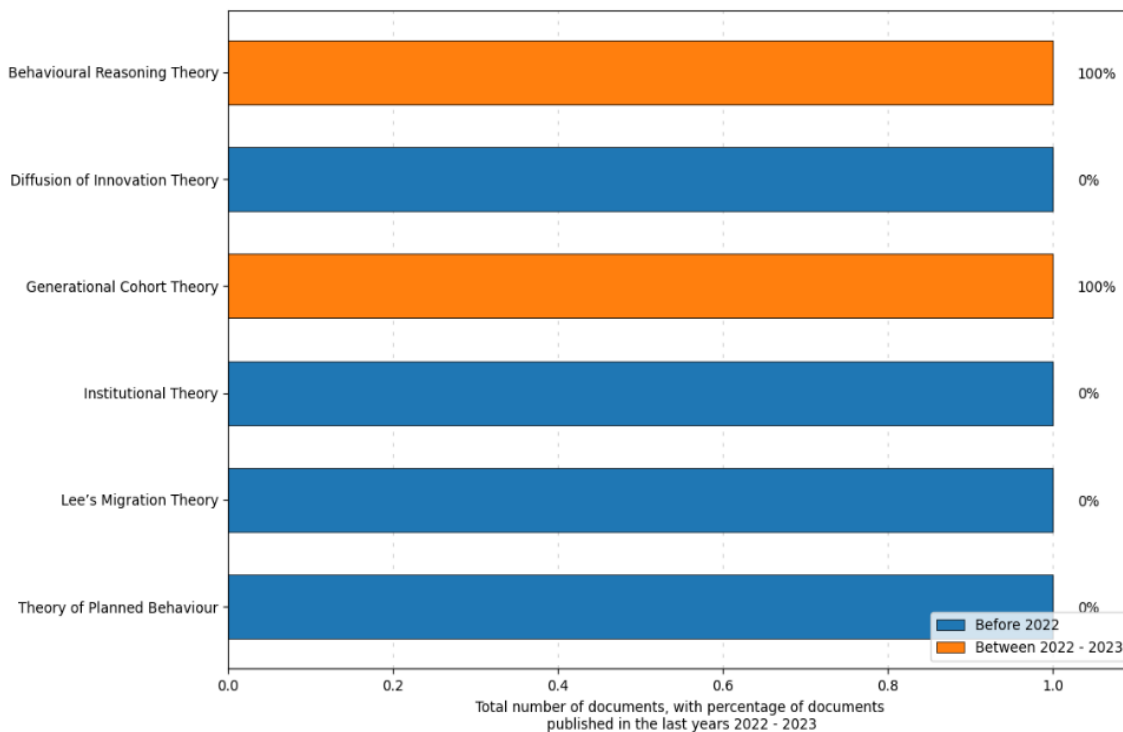


Figure 5: Theories are Used in Food Security Research

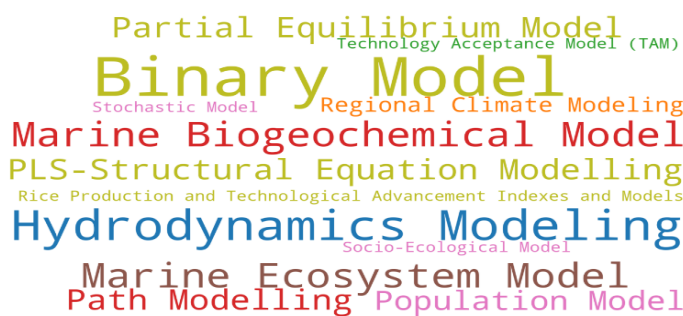Source: Author, using ScientoPy 2.1.3



Figure 6: Models are Used in Food Security Research

Source: Author, using ScientoPy 2.1.3

## Productive Institutions

The analysis of the data presented in Figure 7 indicates that Malaysian universities, particularly University Putra Malaysia, University Kebangsaan Malaysia, University Malaya, University Teknologi Malaysia, and University Sains Malaysia, have been at the forefront of food security research, demonstrating the strong emphasis and scholarly output from these institutions in this field. Based on data in Figure 8, University Putra Malaysia (UPM) in Malaysia stands out as the leading institution, with the highest total number of publications at around 23 documents. This indicates UPM's significant contributions to research in the field of food security. University Kebangsaan Malaysia (UKM), another Malaysian university, also has a substantial number of publications, around 13, demonstrating its strong commitment and research output related to food security. University Malaya (UM), an additional prominent Malaysian institution, has 6 publications on food security research, further highlighting the research focus on this topic within Malaysia. University Teknologi Malaysia (UTM) has around 5 publications in the domain of food security, reinforcing the strong emphasis on this area of research within the Malaysian university landscape. University Sains Malaysia (USM) also contributes significantly, with about 4 publications related to food security, solidifying its position as one of the key contributors from Malaysia. While the figure shows contributions from other institutions, such as the University of Adelaide in Australia, the University of British Columbia in Canada, the University of Nottingham Malaysia, the University of the Philippines, and the University of Technology Sydney in Australia, their publication counts are lower compared to the leading Malaysian universities.
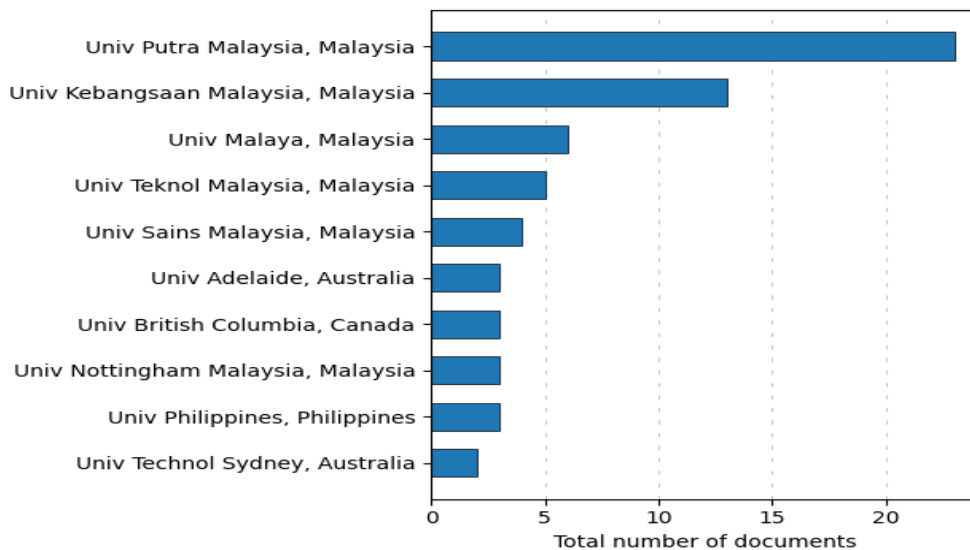


Figure 7: The Top Ten Most Productive Academic Institution

Source: Author, using ScientoPy 2.1.3

## The Most Cited Articles

According to the Table 2, the article with the highest citation count in food security research is Creation of a high spatio-temporal resolution global database of continuous mangrove forest cover for the 21st century (CGMFC-21) by Hamilton S.E and Casey, D. (2016), which has received 751 citations. Other notable articles include Swidden Transformations and Rural Livelihoods in Southeast Asia by Cramb R.A. et al.(2009) with 237 citations, The Development of Biofuels in Asia by Zhou A. and Thomson E (2009) with 236 citations, Palm Oil-Based Biofuels and Sustainability in Southeast Asia: A Review of Indonesia, Malaysia, and Thailand by Mukherjee I. and Sovacool B.K ( 2014) with 231 citations, and Nipah Virus: Impact, Origins, and Causes of Emergence by Epstein J.H. et al. (2006) with 161 citations. These highly cited articles encompass a wide array of topics related to food security, including land use changes in mangrove forests, biofuel development, the sustainability of palm oil, and the implications of emerging infectious diseases on food systems. This diversity highlights the multifaceted nature of food security research, which integrates insights from environmental

science, agriculture, and public health. The significant citation counts reflect the impact these studies have had on the field, likely shaping the focus and direction of future research endeavours in food security.

Table 2: Top Ten Most Cited Sources

| Authors | Title | Citation | Document Type | Sources |
|---|---|---|---|---|
| Hamilton S.E & Casey D. (2016) | Creation of a high spatio-temporal resolution global database of continuous mangrove forest cover for the 21st century (CGMFC-21) | 751 | Article | Scopus |
| Cramb, R.A. et.al. (2009) | Swidden Transformations and Rural Livelihoods in Southeast Asia | 237 | Review | WoS |
| Zhou A. & Thomson E. (2009) | The development of biofuels in Asia | 236 | Article | Scopus |
| Mukherjee I. & Sovacool B.K. (2014) | Palm oil-based biofuels and sustainability in southeast Asia: A review of Indonesia, Malaysia, and Thailand | 231 | Review | Scopus |
| Epstein J.H. et.al. (2006) | Nipah virus: Impact, origins, and causes of emergence | 161 | Review | Scopus |
| Oliphant A.J. et.al. (2019) | Mapping cropland extent of Southeast and Northeast Asia using multi-year time-series Landsat 30-m data using a random forest classifier on the Google Earth Engine Cloud | 157 | Article | Scopus |
| Ong K.L. et.al (2018) | Trends in food waste valorization for the production of chemicals, materials and fuels: Case study South and Southeast Asia | 150 | Review | Scopus |
| Poon W.C & Low K.L.T. (2005) | Are travellers satisfied with Malaysian hotels? | 137 | Review | Scopus |
| Johari A. et.al. (2015) | The challenges and prospects of palm oil-based biodiesel in Malaysia | 123 | Article | Scopus |
| Shariff, Z.M & Khor, G.L. (2005) | Obesity and household food insecurity: evidence from a sample of rural households in Malaysia | 113 | Article | WoS |

Source: Author, using ScientoPy 2.1.3

## DISCUSSION

Given the lack of previous studies examining food security articles from a bibliometric perspective, this study will be conducted to comprehensively analyse the existing research using the ScientoPy analysis tool, which can overall provide valuable contributions to various future research. This study examines the current state of research on food security on a global scale. At the same time, this study offers valuable insights into academic collaboration by using visualization techniques to help depict the interconnections between studies and researchers in the same research field through analysis of the most frequently cited papers. The use of the ScientoPy analysis tool in bibliometric studies is crucial in understanding the field and topics of food security comprehensively. Researchers can investigate various patterns in scientific research on specific topics or fields involving food security research. This includes analysing the increase in published studies, identifying popular subjects, examining the sources from which these studies originate, and being able to categorize the types of documents produced. Furthermore, through this study, the researchers can identify the countries and institutions

that contribute the most to research and writing related to food security. Therefore, the bibliometric method in food security research provides various benefits, including the ability to identify current trends and popular topics that have not yet been studied, as well as explore new and innovative avenues for further research (Khairul Hafezad, 2023).

The findings of this research on the convergence of food security provide substantial insights into the publication patterns and trends observed in this particular domain. As illustrated in Figure 1 and Figure 2, the data provided suggests that research on food security-related topics, particularly in the context of Malaysia, has been steadily growing over the past decade. The number of publications on this subject has continuously increased from under 400 in 2010 to an average of 50–60 per year by 2019, indicating a heightened interest and focus in this area. Notable shifts in research methodologies can be observed, with a greater emphasis on the use of remote sensing and GIS techniques to assess land use changes in tropical mangrove forests, which are crucial for food security. This shift in approach has likely been driven by the recognition of the importance of these ecosystems in supporting food production and the need for more sophisticated tools to monitor and analyse land use dynamics. Additionally, the research has expanded beyond just land use change, exploring issues related to policy, food security, and forest resources, highlighting the multifaceted nature of the food security challenge. The growing body of research in this field can be attributed to several factors, including the increasing global awareness of the importance of sustainable food production, the recognition of the threats posed by climate change and land use changes, and the need to develop more efficient and resilient agricultural systems, particularly in the tropics. The research has also been influenced by the availability of new technologies, such as remote sensing and GIS, which have enabled more comprehensive and data-driven approaches to understanding and addressing food security issues.

Examining the prominent source titles depicted in Figure 3 demonstrates a collection of scholarly journals and conference papers that focus on various aspects related to food security in Malaysia. The majority of the papers are published in the IOP Conference Series: Earth and Environmental Science, which is a journal published by IOP Publishing. This journal likely has a relatively high impact factor and is considered a reputable outlet for research in the fields of earth and environmental sciences. The distribution of research across journals indicates a focus on understanding the challenges and opportunities related to agricultural production, climate change, and the utilization of underutilized crops in Malaysia. Several papers explore topics such as the suitability of land for growing alternative crops like bambara groundnut, the impact of climate change on palm oil and rice production, the adoption of innovations in beef cattle farming, and the integration of geospatial data for surface water mapping. These studies suggest a multidisciplinary approach to addressing food security issues in the country, spanning areas like crop science, climate science, and geospatial technology. The diverse range of topics covered in these conference papers indicates that food security is a pressing concern in Malaysia, and researchers are actively exploring various strategies and solutions to ensure the country's long-term food supply and sustainability. The concentration of research in the IOP Conference Series: Earth and Environmental Science suggests that this journal may be a particularly prominent outlet for studies related to food security and agricultural development in the Malaysian context.

Figure 4 provides a bibliometric analysis of research on food security, highlighting several key themes and topics. Most of the time, people want to know how climate change affects food production, especially for important staple crops like rice in Southeast Asia; how small-scale and artisanal fisheries help ensure food security, especially in coastal communities; how new technologies like blockchain could make food supply chains more traceable and clear, which would improve food safety and security; and how larger social, economic, and political issues affect primate conservation, which is closely linked to sustainable land use and food production. Studies examine how rising temperatures, changing rainfall patterns, and extreme weather events could affect crop yields and food supply, underscoring the significant implications for ensuring food security in the region given the reliance on domestic rice production. Research also indicates that small-scale fisheries often provide more food for human consumption than industrial fleets, suggesting the importance of supporting these sectors to maintain food supplies. Additionally, studies explore how blockchain-based systems could be implemented in the halal food industry in Malaysia to improve traceability and transparency, while trends like rapid population growth, inequality, corruption, and weak environmental regulations in primate range countries pose threats to both primates and human food security. While these topics have received significant attention, there may be value in

further exploring issues like the impacts of microplastics and other pollutants on aquatic food resources, as well as innovative approaches to enhancing agricultural resilience and productivity in the face of climate change. Continued multidisciplinary research in these areas can provide critical insights to safeguard food security in Southeast Asia and beyond.

The findings depicted in Figures 5 and 6 show that the most prominent theories and models used in food security research appear to be a combination of social, institutional, and technical approaches. The strong focus on Behavioural Reasoning Theory and Generational Cohort Theory suggests that researchers are deeply interested in understanding the social and psychological factors that influence food security, such as individual and generational attitudes, beliefs, and behaviours. Researchers are also looking at how institutions, technology, and decisions affect food security. This is shown by the popularity of the Diffusion of Innovation Theory, the Institutional Theory, and the Theory of Planned Behaviour. Additionally, the fact that models like the Binary Model, Hydrodynamics Modelling, Marine Biogeochemical Model, and Marine Ecosystem Model are included shows that researchers are using both quantitative and computational methods to look at the ecological and biophysical aspects of food production and distribution systems. Overall, the diversity of theoretical and modelling perspectives reflects a multidisciplinary approach to addressing the complex and multifaceted challenge of food security, drawing insights from various social, technical, and natural science disciplines.

Figure 7 also indicates that University Putra Malaysia (UPM) has produced the most research output in the field of food security, with a total of 23 publications. This is followed by University Kebangsaan Malaysia (UKM) with 13 publications and University Malaya (UM) with 6 publications. UPM's prominence in this field can be attributed to its strong expertise in agriculture, agronomy, and food science, as well as its significant collaborations with government agencies and international research bodies focused on agricultural development. UPM's access to substantial funding for agricultural research also enhances its capacity to conduct impactful studies in this domain. The collaborative networks between UPM and UKM are particularly noteworthy, as both institutions have a shared emphasis on agricultural and environmental research in Malaysia. This partnership likely facilitates the sharing of resources, joint projects, and the pooling of expertise, further reinforcing their positions as leading institutions in addressing food security challenges in the region.

Food security remains a critical global issue, deeply intertwined with agricultural practices, environmental sustainability, and socio-economic factors. Within the vast body of research addressing food security, certain articles stand out due to their high citation counts, which signify their influence on academic discourse and practical applications. According to Table 2, several demonstrate significant citation counts, indicating their wide recognition and relevance in the field of food security. For instance, the article titled "Swidden Transformations and Rural Livelihoods in Southeast Asia" (Cramb et al., 2009) explores the interplay between swidden farming practices and rural livelihoods, receiving substantial attention for its comprehensive examination of agrarian change and food security. Another notable article, "Palm oil-based biofuels and sustainability in Southeast Asia: A review of Indonesia, Malaysia, and Thailand" (Mukherjee & Sovacool, 2014), discusses the sustainability implications of palm oil biodiesel, highlighting its effects on food security in the region. These articles, among others, have become foundational texts in understanding food security dynamics and the socio-environmental challenges in Asian contexts.

The influence of these highly cited articles extends beyond mere academic acknowledgment. They have shaped subsequent research agendas by identifying critical areas requiring further exploration, such as the socio-economic impacts of agricultural practices and the sustainability of biofuels. For example, Cramb et al.'s (2009) research has encouraged additional studies on indigenous farming practices and their resilience in the face of market pressures, thereby fostering a nuanced understanding of rural livelihoods and food security. Furthermore, Mukherjee and Sovacool's analysis has spurred discussions regarding the trade-offs between biofuel production and food supply, prompting policymakers to consider sustainable practices that mitigate food insecurity while promoting renewable energy resources. In practice, these articles have influenced policy development and agricultural strategies. By shedding light on the complexities of food production systems and their socio-economic implications, they have provided stakeholders ranging from local farmers to international organizations with insights necessary for formulating effective interventions. For instance, the emphasis on

integrating local knowledge systems in agricultural practices has informed development programs aimed at enhancing food security in vulnerable communities.

The themes prevalent in these highly cited articles reflect the multifaceted nature of food security. A common thread is the examination of agricultural practices and their sustainability. Articles like those by Cramb et al. and Mukherjee & Sovacool address the balance between agricultural productivity and environmental health, demonstrating that food security cannot be viewed in isolation from ecological impacts. Another significant theme is the socio-economic factors influencing food security, particularly in Southeast Asia. The articles explore how rural livelihoods are affected by changes in agricultural policies, market access, and the integration of cash crops. They point out the dual-edged nature of agricultural intensification, where benefits can lead to increased vulnerability among local populations if not managed carefully. Furthermore, the intersection of food security with energy production is a critical topic, especially in the context of biofuels. The discourse surrounding biofuels, as highlighted in Mukherjee and Sovacool's work, raises important questions about land use, food supply, and the sustainability of energy resources. This theme emphasizes the need for holistic approaches in addressing food security—recognizing that agricultural and energy policies are intricately linked.

### Policy recommendations for food security challenges

To address food security challenges, several actionable strategies can be implemented. Firstly, promoting sustainable agricultural practices, such as climate-resilient farming, agroecology, and permaculture, should be prioritized. In addition, this can be supported by incentives and subsidies for adopting technologies like precision agriculture and renewable energy for irrigation. Secondly, strengthening food supply chains can be achieved through the use of blockchain and digital technologies to ensure transparency. Moreover, urban food deserts can be tackled by establishing local food hubs or incentivizing supermarkets to serve underserved areas. Thirdly, effective policy integration and governance are essential. For example, creating policies that link food security to climate change, economic growth, and healthcare, alongside establishing regional food security councils, can foster collaboration in Southeast Asia. Furthermore, social safety nets must be improved by expanding food assistance programs and setting up community-based food banks to redistribute surplus produce. Another key point is encouraging research and development. Specifically, funding should address emerging challenges such as microplastics and alternative protein sources, while fostering public-private partnerships to scale up innovations. Finally, raising awareness through nationwide campaigns on sustainable consumption and incorporating food literacy and eco-literacy into school curriculums can educate and empower communities to support long-term food security.

## CONCLUSION

The bibliometric analysis reveals a significant increase in food security research, particularly over the last decade. Prominent journals, such as Sustainability and the Journal of Sustainability Science and Management, dominate the field. Key research topics include the impact of climate change, sustainability practices, and agricultural techniques, with a strong focus on regions like Southeast Asia. Malaysian institutions, especially University Putra Malaysia, are leaders in this area. Influential authors and highly cited articles address diverse issues, including mangrove conservation and the sustainability of palm oil. The thematic analysis highlights barriers such as socio-economic disparities and proposes solutions like sustainable farming and innovative technologies. While the current research addresses critical aspects of food security, gaps remain in areas such as the impacts of microplastics on food systems and the role of alternative protein sources. Emerging fields, such as the use of blockchain in food supply chains and the analysis of urban food deserts, require deeper exploration. Future studies should prioritize the integration of social, environmental, and technological perspectives. Addressing food security challenges necessitates collaboration across disciplines—agriculture, sociology, environmental science, and economics. Partnerships among countries, institutions, and various fields can foster innovative solutions, as demonstrated by the integration of climate modelling with sustainable agricultural practices.

The bibliometric approach provides a comprehensive overview, identifying publication trends, key contributors, and thematic shifts in food security research. It offers a robust framework for mapping the intellectual landscape

and guiding strategic research priorities. Recognizing leading researchers, journals, and themes ensures a targeted approach to advancing the field. This analysis emphasizes the pivotal role of multidisciplinary and regional efforts, particularly in Southeast Asia, in shaping the discourse on food security. The study's reliance on the Scopus and Web of Science databases may introduce biases, such as regional or language limitations. These databases might overlook some influential works. Additionally, bibliometric methods focus primarily on quantitative aspects, potentially missing qualitative insights. Understanding cultural influences on food security is crucial. Comparative studies across diverse contexts can uncover unique challenges and adaptive strategies, fostering more inclusive policy and practice development. Future analyses should blend bibliometric insights with qualitative methods, such as in-depth interviews with researchers or content analysis of seminal works. This integration can provide richer context, capturing the motivations and impacts behind research trends.

## CONFLICT OF INTEREST

The authors declare no conflict of interest

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