

Bibliometric Inferences between Food Security and Nutritional Security

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Abstract. *Food security and nutrition security are two interconnected concepts that address complex global challenges related to food access, availability and quality. Over time, these themes have acquired broader and more general dimensions, reflecting the interdependence between them. This study aims to analyze the intellectual structure of research in the field of food and nutrition security, highlighting the changes that have occurred in the approach to these concepts and the relationships between them. The paper analyzed 69,531 documents for the keyword "food security" and 2,816 documents for the keyword "nutritional security" from the Web of Science database through a bibliometric review. An analysis of the published documents shows an increasing trend in the number of articles in the last 24 years and a natural paradigm shift from food security to food and nutrition security, as interest in ration quality and structure has increased among research, thus completing the quantitative aspect reflected by the term food security. The results of the research are relevant to the research, demonstrating the need to broaden the approach to food security and complement it with nutritional aspects.*

Keywords: food security, nutritional security, food and nutrition security, bibliometric inferences

Introduction

Food security and nutritional security are fundamental concepts for the sustainable development and well-being of the global population. Although often used interchangeably, they relate to different aspects of ensuring access to food. Food security involves the availability and affordability of food, while nutritional security focuses on the quality of food and its ability to meet the body's nutritional requirements (FAO, 2012). Studying the interactions between these concepts through bibliometric methods can provide valuable insights into the dynamics of knowledge and the existing gaps in the field (Hwalla et al., 2016).

In recent years, bibliometric analysis has become an essential method for mapping scientific research in the field of food and nutrition security, facilitating the identification of key trends, influential publications and emerging directions. Studying keyword co-emergence networks, citation patterns, and thematic clusters allows for an in-depth understanding of how these two domains intersect in the scientific literature (Passas, 2024).

The research question addressed in this study is: What are the main bibliometric connections between food security and nutritional security? The study aims to identify the themes and research clusters that define the relationship between food security and nutrition security and to explore the influence of global factors such as climate change, agricultural sustainability and government policies on the two concepts.

Through this approach, the study provides an integrated perspective on the interconnectedness between food security and nutrition security, highlighting key points of intersection and emerging challenges.

The paper is structured as follows: after the introduction, the main results from the literature are presented, followed by the description of the methodology. Next, the results are presented and discussed in the last part of the paper. Finally, conclusions are drawn that underline the importance of food security and nutritional security and address the limitations encountered.

Literature review

According to the literature, food security is defined by the Food and Agriculture Organization of the United Nations (FAO) as the situation in which all people have physical, social and economic access to sufficient, safe and nutritious food that meets their food needs and preferences for an active and healthy life (FAO, 2009).

Nutritional security focuses on ensuring a balanced diet that meets the needs of micronutrients (proteins, fats, carbohydrates) and micronutrients (vitamins and minerals). Also, the nutrients in the food consumed are efficiently assimilated by the body, thus supporting essential physiological processes, such as growth, recovery from diseases, maintaining health during pregnancy and breastfeeding, as well as carrying out physical activities (Kalkhul et al., 2016).

FAO defined nutrition security as the situation achieved when secure access to an appropriately nutritious diet is coupled with a sanitary environment, adequate health services and care, to ensure a healthy and active life for all household members (UN, 2012).

Food and nutritional security are interdependent, with literature showing that food availability does not guarantee adequate nutrition, as the quality of food is as important as its quantity (Weingärtner, 2009). For example, a community may have access to sufficient food in terms of calories, but if that food is low in micronutrients, it will lead to nutritional deficiencies (Ion, 2024). On the other hand, the exclusive promotion of nutritious food without ensuring economic accessibility can perpetuate social inequalities.

The integrated study of food and nutrition security is needed to address the complexity of malnutrition-related issues, which can include both undernutrition and obesity. Integrated approaches allow the identification and implementation of effective solutions to improve the nutritional status of the population (WHO, 2020).

Food and nutrition insecurity have a significant impact on public health, contributing to malnutrition and the development of associated diseases. For example, malnutrition can lead to micronutrient deficiencies, affecting the optimal functioning of the immune system and increasing vulnerability to infections. In addition, hunger and lack of access to adequate food can lead to malnutrition, which negatively affects physical and cognitive development, especially in children (FAO, 2024). An integrated approach to food and nutrition insecurity can reduce the burden of these problems on public health systems, contributing to the prevention and management of malnutrition and associated diseases (De Onis et al., 1997).

The simultaneous study of food and nutrition security allows the development of sustainable policies that promote sustainable agriculture, food waste reduction and nutrition education. These measures contribute to the achievement of the United Nations Sustainable Development Goals, including eradicating hunger, ensuring healthy diets and promoting healthy lifestyles. For example, promoting sustainable agriculture can reduce negative environmental

impacts and ensure sufficient and diversified food production, while nutrition education can help communities adopt healthy eating habits and reduce the risk of malnutrition (Katila et al., 2019).

The development of research on food and nutrition security points to a convergence of the two areas, suggesting that sustainable solutions must include both food production and quality. However, bibliometric analysis highlights gaps in data access and representation of vulnerable regions, indicating the need for greater global collaboration efforts.

Methodology

Bibliometric analysis highlights the overall structure of a field of research by quantitatively examining the distribution of publications and the progress made in this field. The VOSviewer Software was used to represent the thematic structure, analyze the relationships between authors, organizations and countries, as well as to examine the co-appearance of keywords, thus facilitating the analysis of the intellectual structure in the form of thematic maps.

This study identifies relevant articles on food security and food security conducting an analysis of the co-citations to provide a detailed perspective on the historical evolution of the intellectual structure in these fields. Co-citation networks allow the identification of influential articles, which contribute to the theoretical foundation of research in this sector. Keyword co-emergence analysis is used to identify the most commonly used keywords and visualize the connections between them in the literature. This approach facilitates the exploration of the relationships between keywords in collaborative publications and highlights the evolution of research topics. The method can be applied in many research fields, including agri-food (Ion et al., 2024).

The Web of Science database was queried on January 27, 2025, for the keywords "food security" 69,531 results were obtained, and for the keywords "nutrition security" 2,816 results were obtained. The results were sorted by relevance, and subsequently, 1000 results for each keyword were exported to VOSViewer. This decision was adopted because it resulted in a very large number of results for the keyword "food security". The results were subject to some refinement, but due to the fact that the theme addresses two different keywords, the results were not similar for each of the keywords, so it was necessary to end the filtering attempts.

According to the WOS categories, for the keyword "food security", the category that registers the most articles is environmental sciences (12,534 articles), a percentage of 18.46% of 69,531 results, followed by the categories, food science technology (8,028 articles), agronomy (6,916 articles). On the other hand, for the keyword "nutrition security", the category with the most registered articles is nutrition dietetics (572 articles), accounting for 20.31% of the total number of 2,816 results, followed by the food science technology categories (568 articles) and the public environmental occupation health category (296 results). Therefore, it can be seen that the food science technology category is the second in terms of field of interest for both keywords, due to its direct link with processing, safety and the nutritional impact of food on global health.

The interest in food security has gradually increased, if in 2000 according to the results of Web of Science 150 articles were published, in 2010, their number increased to 1,080 articles, the growth being higher and higher, in 2024 the number of articles published was 8,751, which shows a higher level of interest in food security.

As far as nutrition security is concerned, in 2000 only two articles were published on this topic, with interest gradually increasing, with most articles being published in 2022, a number of

Table 1. Core topic recognized in each cluster for food security

Cluster	Keywords and Topic
I	27 items: Aquaculture, Challenges, Countries, Covid-19, Crisis, Economics, Fisheries, Food Policy, Food Production, Food Safety, Food Security, Food Sovereignty, Food Systems, Framework, Global Food Security, Governance, Interventions, Land, Nutrition, Policy, Politics, Sustainability, Sustainable Development, Systems, Trade, Urban Agriculture, WTO Topic: Food security
II	20 items: Adaptation, Agriculture, Biodiversity, Biofuels, Climate-Change, Demand, Diversity, Ecosystem Services, Efficiency, Energy, Environment, Impacts, Land-Use, Management, Model, Patterns, Productivity, Resilience, Risks, Urbanization Topic: Agriculture
III	15 items: Community, Consumption, Diet, Famine, Food, Food Access, Food Availability, Irrigation, Malnutrition, Obesity, Population, Quality, Risk, Vulnerability, Water Topic: Vulnerability
IV	15 items: Conflict, Developing Countries, Development, Economic-Growth, Gender, Household, Inequality, Livelihoods, Migration, Panel-Data, Poverty, Region, Remittances, Urban, Women Topic: Poverty
V	14 items: Children, Coping Strategies, Dietary Diversity, Experience, Food Insecurity, Health, Households, Hunger, Indicators, Insecurity, Measurement, Nutritional-Status, Scale, Validation Topic: Insecurity
VI	14 items: Adoption, Climate Change, Determinants, Drought, Farmers, Growth, Household Food Security, Impact, Income, Shocks, Smallholder Farmers, Strategies, Technology, Welfare Topic: Impact
VII	3 items: Access, Availability, Participation Topic: Participation

Source: Authors' own research contribution.

Cluster I highlights the integration of food security and global policies into food systems studies. The COVID-19 pandemic, disruptions in food production and distribution, as well as increasing economic inequalities have accentuated the vulnerability of food systems and highlighted the need for effective policy interventions to ensure food security. Food sovereignty becomes a necessary concept, emphasizing the right of communities to control their food production and distribution. On the other hand, urban agriculture and sustainable aquaculture are identified as viable solutions for increasing food resilience in the face of global crises. The integration of international trade and the regulations set by organizations such as the WTO (World Trade Organization) significantly influence the sustainability and equity of food systems. In this context, food and nutrition policies, together with global governance, must support sustainable development and respond to challenges related to food security, climate change and economic rights, in particular of developing countries.

Cluster number two shows the interconnectedness between food production, biodiversity protection and the impact of climate change on agricultural systems. In the face of increasing food demand and climate change risks, effective management of land and natural resources is needed to foster sustainable productivity and support ecosystem resilience. Land use models and their management must integrate agricultural practices that foster biological diversity, while improving the resilience of agricultural systems to extreme climatic events. Also, rapid urbanization and pressure on agricultural land require innovative solutions for the integration of urban agriculture and the promotion of biofuels as alternative energy sources.

The third cluster provides insight into the link between resource sustainability and equitable access to quality food. The challenges related to malnutrition, obesity and the vulnerability of the

population to food crises are increasingly present, and the quality of nutrition remains a key concern in the field of public health. Efficient irrigation and water resource management are necessary to maintain sustainable food production that meets the demands of an ever-expanding population.

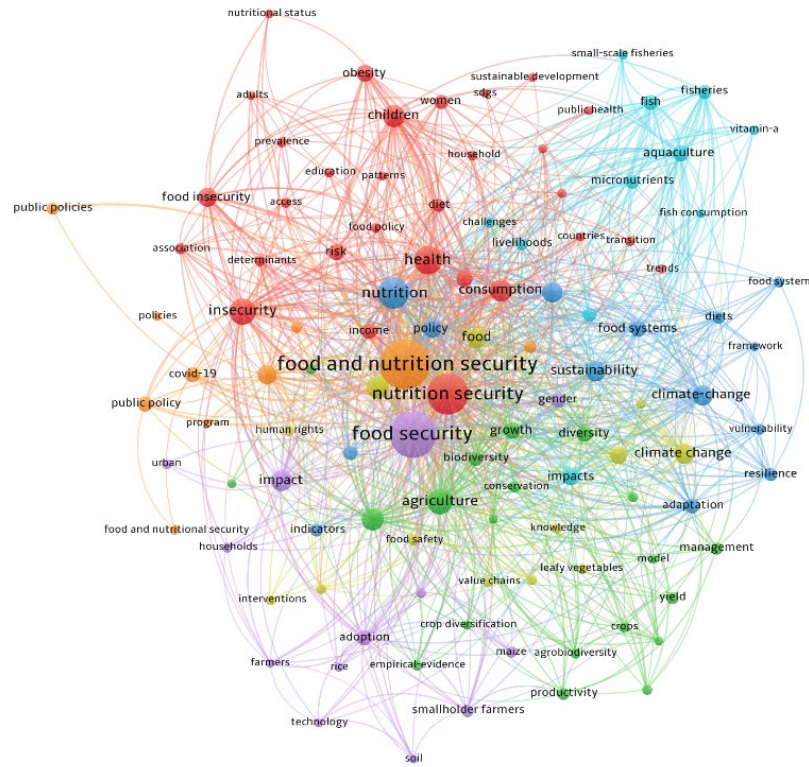
Cluster IV provides an overview of the analysis of the challenges faced by developing regions. Economic disparities and gender inequalities continue to be major drivers of poverty and economic vulnerability, having a direct impact on access to resources, education and job opportunities.

Cluster V concepts such as coping strategies, dietary diversity, experience, food insecurity, health, households, hunger, and nutritional status are fundamental in analyzing how families and communities cope with food insecurity and its impact on children. In the face of food crises, many households are adopting various adaptation strategies to cope with food shortages and improve dietary diversity, which is paramount for children's nutritional status. Experiences of food insecurity affect not only nutritional status, but also children's ability to develop healthily, which can have long-term effects on their health and well-being. Thus, it is important to implement policies and interventions that support both food diversity and equitable access to food to combat hunger and ensure adequate nutritional status for all children.

The sixth cluster reflects the complexity of the challenges faced by smallholder farmers in the face of climate variability. In particular, drought and climate shocks have a significant impact on household food security, affecting both agricultural production and farmers' incomes. To combat these risks, smallholder farmers are adopting various adaptation strategies that include the use of innovative technologies to improve agricultural productivity and cope with climate change. These technologies not only help increase production, but can also help reduce vulnerability to economic and climate shocks. At the same time, farmers' incomes are closely linked to household food security, and adaptation strategies help maintain their economic stability.

The last cluster shows that access to food is a determining factor, influenced by economic and geographical factors, which affects the ability of individuals to obtain sufficient and adequate food. On the other hand, the availability of food is closely linked to local production, distribution infrastructure and food policy, ensuring that food reaches where it is most needed, including in vulnerable regions. There should be an active participation of communities in decision-making processes related to food policies and food resource management strategies for the creation of a sustainable and equitable food system. The involvement of residents in these processes contributes to a better adaptation of solutions to the specific needs of each region, promoting effective collaboration between government authorities, non-governmental organizations and citizens.

Regarding the keyword "nutritional security", according to the co-emergence analysis 119 keywords (Figure 2) were generated, of which the words were eliminated: Africa, Sub-Saharan Africa, Bangladesh, India, Ethiopia, Brazil, China, Kenya, the remaining 111 being grouped into seven clusters (Table 2). The reason for the removal of the words listed above is the same that was mentioned for the key term "food security".



Source: Authors' own research contribution.

Cluster	Keywords and Topic
I	30 items: Access, Adults, Association, Children, Consumption, Countries, Determinants, Diet, Education, Environment, Food Insecurity, Food Policy, Health, Household, Income, Insecurity, Nutrition Security, Nutritional Security, Obesity, Patterns, Prevalence, Public Health, Quality, Risk, SDGS, Sustainable Development, Sustainable Development Goals, Transition, Trends, Women Topic: Nutrition Security
II	20 items: Agricultural Biodiversity, Agriculture, Agrobiodiversity, Biodiversity, Child Nutrition, Conservation, Crop Diversification, Crops, Dietary Diversity, Diversity, Empirical-Evidence, Food Sovereignty, Growth, Intensification, Management, Model, Productivity, Sustainable Intensification, Urban Agriculture, Yield Topic: Agriculture
III	14 items: Adaptation, Climate-Change, Food System, Food Systems, Framework, Hunger, Indicators, Nutrition, Policy, Resilience, Security, Sustainability, Vulnerability Topic: Nutrition
IV	13 items: Child Undernutrition, Climate Change, Food, Food Safety, Future, Human Rights, Interventions, Knowledge, Leafy Vegetables, Malnutrition, Systems, Value Chains, Vegetables Topic: Food
V	13 items: Adoption, Biofortification, Farmers, Food Security, Gender, Households, Impact, Maize, Rice, Smallholder Farmers, Soil, Technology, Urban Topic: Food Security

Cluster	Keywords and Topic
VI	11 items: Aquaculture, Challenges, Fish, Fish Consumption, Fisheries, Impacts, Livelihoods, Micronutrients, Small-Scale Fisheries, Strategies, Vitamin-A Topic: Aquaculture
VII	10 items: Covid-19, Food And Nutrition Security, Food And Nutritional Security, Governance, Policies, Poverty, Program, Public Policies, Public Policy, Undernutrition Topic: Food And Nutrition Security

Source: Authors' own research contribution.

The first cluster highlights the interaction between food security, nutrition security and public health. Ensuring access to safe and nutritious food remains a global challenge, influenced by factors such as household income, food policies and the environment. Also, the link between food insecurity and public health is reflected in phenomena such as obesity, malnutrition and food consumption patterns. Food quality comes with adverse effects on long-term health, with eating habits, consumption trends and risks associated with diet being essential aspects in studies on the sustainability of development and the achievement of the Sustainable Development Goals.

Cluster II explores topics such as agricultural biodiversity, agrobiodiversity, crop diversification, and agriculture, highlighting the role of sustainable agricultural production and food diversity in combating food insecurity and improving nutrition. A central element is dietary diversification and child nutrition, highlighting the importance of access to a variety of foods for healthy growth. Increasing agricultural production through sustainable intensification, crop management and urban agriculture contribute to food sovereignty, reducing dependence on imports and vulnerability to food crises.

The third cluster addresses topics such as adaptation, climate change, food system, policies, resilience and vulnerability, highlighting the challenges and solutions for ensuring food security in a global context marked by climate change and socio-economic inequalities. Resilience reflects the ability of communities and public policies to manage food crises through adaptation and proactive measures.

Cluster number four addresses topics such as child malnutrition, climate change, food, food security, human rights and interventions, highlighting global challenges related to nutrition, access to safe food and the sustainability of food systems. The impact of climate change on food safety and availability has direct effects on child malnutrition. Human rights are central to addressing these issues, highlighting the need for effective interventions for equitable access to nutritious and safe food. Also, nutrition education is very important, especially to know the benefits of eating green leafy vegetables and other vegetables in maintaining a balanced diet. Food systems and value chain analysis helps to understand how food is produced, distributed, and consumed, influencing the future of food security.

The V cluster highlights the role of innovation in agriculture and equitable access to resources for improving food security. A central aspect is the contribution of smallholder farmers to food production and the adoption of new agricultural technologies, such as crop biofortification, to increase the nutritional value of staple foods such as maize and rice. The use of these technologies contributes to increased productivity, soil protection and increased resilience to climate change.

Cluster VI highlights the role of aquatic resources in food and nutrition security. Aquaculture provides food rich in micronutrients essential for health. Fish is an important source

of vitamin A, essential fatty acids and quality proteins, having a significant impact on dietary diversification and the prevention of nutritional deficiencies.

The last cluster deals with topics such as COVID-19, food and nutrition security, governance, policies, poverty, programmes and undernutrition, highlighting the impact of global crises on access to food and nutrition, as well as the role of policy interventions in mitigating these effects. The COVID-19 pandemic has exacerbated food insecurity, affecting supply chains, increasing food prices and lowering the incomes of vulnerable households. The restrictions imposed have limited access to safe and nutritious food, contributing to increased undernutrition and poverty in many regions.

Both food and nutrition security depend on sustainability, climate change adaptation and resilience of agrifood systems, influenced by global factors such as conflict, migration and urbanisation. Effective policies and governance play an important role in ensuring equitable access to food, while economic inequalities affect both food availability and nutrition quality, creating vulnerabilities among disadvantaged populations. Sustainable agriculture, crop diversification and technological innovation are important for food production and maintaining adequate nutrition globally.

Food security focuses on the production, distribution and access to food globally, while nutrition security focuses on the quality of food and its impact on health. The former is more closely related to economic development, trade, and food sovereignty, while the latter focuses on nutrition education, biofortification, and malnutrition prevention. The solutions differ: food security is aimed at sustainable agriculture and trade policies, and nutrition security is based on interventions in public health and improving the nutritional value of food.

Although food security and nutritional security are closely linked, the bibliometric analysis highlights that as health and welfare concerns become more pronounced, further study on nutritional security is needed. Even in countries that have succeeded in ensuring food security through adequate availability of food resources, significant nutritional imbalances persist. These discrepancies highlight the importance of a more comprehensive approach, which is not limited only to the quantity of food, but also includes its quality, to ensure optimal nutrition for all members of the community.

For example, although some countries like Bangladesh achieved food security, as long as their “Average dietary energy supply adequacy” exceeded 100% (112%), the “Prevalence of undernourishment” is 11% and “Prevalence of obesity in the adult population” is 5.3%, in 2022, showing that nutrition security is not achieved and need to be explored (FAO, 2025).

Another relevant example is India, where, although the average food energy supply exceeds 100%, the malnutrition rate remains high and the incidence of obesity is increasing. These discrepancies underline that access to food is not sufficient to guarantee adequate nutrition, and nutritional security requires increased attention to prevent both undernutrition and diseases associated with unbalanced diets (FAO, 2025). In this context, the need to explore nutrition security more deeply becomes a natural reaction to growing concerns about public health and the impact of poor nutrition on the population.

Conclusion

The links between nutrition security and food security are closely linked to economic, political, ecological and technological factors. Approaches that integrate these two dimensions are fundamental to ensuring adequate nutrition and sustainable access to safe and nutritious food for all.

Bibliometric inferences between food security and nutrition security suggest that these two areas are closely linked by common economic, political and ecological factors. Studies in both areas focus on reducing the vulnerability of populations and ensuring equitable access to safe and nutritious food. Also, global crises, technological innovations and sustainable policies are key points of intersection between food security and nutrition research.

Despite the fact that the study provides a solid basis for analysing the differences between nutritional security and food security, there are some important limitations. First, using only the Web of Science (WOS) database is a talking point. Although WOS offers complex and well-verified studies, other relevant sources, such as Scopus or regional databases, have been excluded, which may lead to the omission of significant documents. Also, filtering keywords, especially those relating to emerging countries, may limit the geographical diversity of the study, thus omitting important work from those regions. Another limitation point is that information sources are few, and organizations such as the FAO dominate the field, which can reduce the complexity of the analysis.

Contrary to these limitations, the study is a valuable starting point for future research. One possible direction would be the inclusion of additional databases, which could facilitate the identification of new points of interest or unexplored clusters. Also, case studies, focusing on groups of emerging countries or on a country-by-country basis, could deepen the understanding of nutrition and food security in various contexts.

The paper concludes that while food security can address many significant areas, other new dimensions should also be considered. Additional gaps appear in the literature that provide opportunities for future research directions. Reviewing food security assessment indicators and techniques and identifying high-risk groups should be a priority.

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