

Trends and Analyzes regarding Vulnerabilities in the Agricultural Sector. A Bibliometric Study

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Abstract:

This study presents a literature review of the vulnerabilities faced by the agricultural sector (economic vulnerabilities, climate vulnerabilities, and social vulnerabilities) and a bibliometric analysis of the studies published on this topic. The agricultural sector is highly sensitive to current economic, climate, and social changes. The results show that research on this topic has grown rapidly in recent times, demonstrating the increased interest from academia. It was also noted that the topic is being addressed by researchers in 69 countries. The US has participated most in the formation of the literature on the topic of vulnerabilities in the agricultural sector, followed by Brazil and China. The most common research topics studied include issues related to education, health, and food security, but also social issues (politics, population, inequality, etc.).

Keywords: Vulnerabilities, agricultural sector, bibliometric analysis

JEL Classification: Q10, Q54

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1. Introduction

Vulnerabilities in the agricultural sector are weaknesses or critical points that put agriculture at risk, affecting stability, resilience, and food security.

Today, the agricultural sector is a key foundation of the global economy, which is influenced by a number of internal and external factors that directly affect its sustainability (Dumitru et al., 2023). Although the agricultural sector is essential for securing food needs, vulnerabilities have become increasingly evident and persistent in the context of economic, climatic, and social changes (Taboada et al., 2021; Dumitru et al., 2023).

Research interests on the vulnerabilities of the agricultural sector focus on climate change, accessibility of natural resources, price volatility and economic and social challenges. (Ibarrarán et al., 2010; Motofeanu et al., 2022).

Climate change is one of the most worrying vulnerabilities that the agricultural sector presents, directly affecting productivity and food security (Foden et al., 2019).

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Extreme events directly impact the fertile soil layer and reduce the capacity of the land in terms of long-term productivity and quality, as well as to support different crops. The impact of climate change directly affects soil, and water and will have long-lasting effects such as desertification, pests, and animals (Micu et al., 2022).

From an economic perspective, vulnerabilities in the agricultural sector influence production costs by increasing input costs and thus profitability. Price volatility significantly influences farmers' incomes, with price fluctuations being attributed to various factors such as speculation occurring in the market, climatic conditions, and changes in product demand, which create uncertainty for traders (Melkonyan, 2014).

Vulnerabilities in the agricultural sector inevitably produce imbalances in the supply and demand of agricultural products, which are also influenced by changes in consumer behavior, leading to overproduction or underproduction, directly affecting farmers' incomes (Barker, 2012; Dumitru et al., 2023).

The research objectives are to identify the vulnerabilities of the agricultural sector, and the dynamics of publications over the years, and to map the geographical distribution of research. The paper aims to identify recent trends in vulnerabilities using rigorous methods such as bibliometric analysis to identify research directions, contributions, and scientific developments in the field.

2. Literature Review

The agricultural sector is one of the sensitive areas, being influenced by various issues such as projected global warming, associated climate change, economic factors, political factors, etc., which are discussed in many academic studies.

In academia, topics related to social vulnerabilities have been debated. A representative publication (603 citations) is entitled "A Social Vulnerability Index for Disaster Management", where the authors stated that social vulnerability is expressed through socio-economic, but also demographic

variables influencing the resilience of communities. Also in this study, it is stated that socially vulnerable people are more likely to be adversely affected in the event of a disaster. Effectively addressing social vulnerability reduces both human suffering and economic losses related to the provision of social services and public assistance after a disaster. This paper describes the development of a Social Vulnerability Index (SVI) from 15 census tract-level variables for use in emergency management (Flanagan et al., 2011).

Another study with a strong impact on the field is the publication based on vulnerability to floods: Review of case studies and implications for measurement". In this study, the authors presented the main factors of social vulnerability through a meta-analysis of 67 case studies of flood disasters. They argue that a key challenge in measuring social vulnerability to hazards is for the outcome measures to better reflect the context in which vulnerability occurs. The results identify demographic characteristics, socioeconomic status, and health as the main empirical drivers of social vulnerability to damaging flood events. However, risk perception and adaptive capacity were also prominent in the case studies, yet these factors tend to be poorly reflected in many indicators of social vulnerability. The influence of social vulnerability factors varied considerably depending on the stage of the disaster and the national context, highlighting the importance of context in understanding the precursors, processes, and outcomes of social vulnerability. To help adapt quantitative indicators of social vulnerability to flood contexts, the article concludes with recommendations on temporal context, measurability, and interrelationships between indicators (Rufat et al., 2015).

Social vulnerability indices have also been reviewed in the paper "Social vulnerability indices: a comparative assessment using uncertainty and sensitivity analysis", where the authors argue that they have emerged in the last decade as quantitative measures of the social dimensions of vulnerability to natural hazards (Tate, 2012).

Another crucial study titled "Reviewing Concepts and Evidence of Social Vulnerability to Climate Change" presents an extensive analysis of existing scientific literature concerning social vulnerability to climate change. The primary objective is to identify which social and demographic groups, spanning various geographical regions, face heightened vulnerability to climate change impacts across four key dimensions of well-being: health, safety, food security, and displacement. The researchers investigated the temporal dynamics of vulnerability and emphasized the identification of critical thresholds where vulnerability undergoes significant shifts. Consequently, the study highlights that climate change is likely to exacerbate existing vulnerabilities and inequalities. The findings underscore concerns regarding climate justice, particularly in terms of its intergenerational aspects. For instance, deficiencies experienced in early childhood may restrict future educational and income-generating opportunities. Although evidence of definitive thresholds is limited, it primarily pertains to the vulnerability of specific age groups, household income levels, and the effects of varying degrees of global warming (Otto et al., 2017).

Academia has also studied climate vulnerabilities. For example, a representative study is "Climate change and rural communities in Ghana: Social vulnerability, impacts, adaptations, and policy implications", in which the authors assessed the

level of social vulnerability, impacts, and adaptation strategies to climate change in rural communities in four ecological zones in Ghana. Primary data were collected through questionnaires and interviews from 196 households in 14 rural communities. Using six demographic, social, and economic indicators in assessing social vulnerability to climate change, the Sudan and Guinea Savanna zones were ranked as the most vulnerable to climate change, with SVIs of 0.552 and 0.550 respectively. Common effects of climate change in the four ecological zones were erratic rainfall, reduced crop yields, prolonged drought, and change in harvest season. The most implicated adaptation strategies included crop diversification, engagement in secondary non-farm employment, rural-urban migration, and increasing farm size (Dumenu & Obeng, 2016).

3. Research Questions/Aims of the research

This research starts from the assumption that the agricultural sector is very sensitive to current changes, be they climatic, economic, or social. This is supported by Fellmann (2012), who argues that the agricultural sector will be affected by climate, economic, and social vulnerabilities in many ways, among others, the changes that will occur within the agricultural sector include increased variability in temperature, rainfall, as well as increased frequency and intensity of extreme weather events, changes in rainfall patterns and water availability, and through disruptions to ecosystems.

The research was also based on the question: Is the agricultural sector analyzed in terms of climate, economic, and social vulnerabilities?

The objectives of the research are to identify publications that reflect the current situation of climate, economic, and social vulnerabilities. In order to achieve these objectives, qualitative research is carried out on the publications found in the Web of Science database, published on the mentioned topics.

4. Research Methods

Bibliometrics is the statistical analysis of written scholarly literature with the ultimate goal of obtaining quantitative analyses of academic literature.

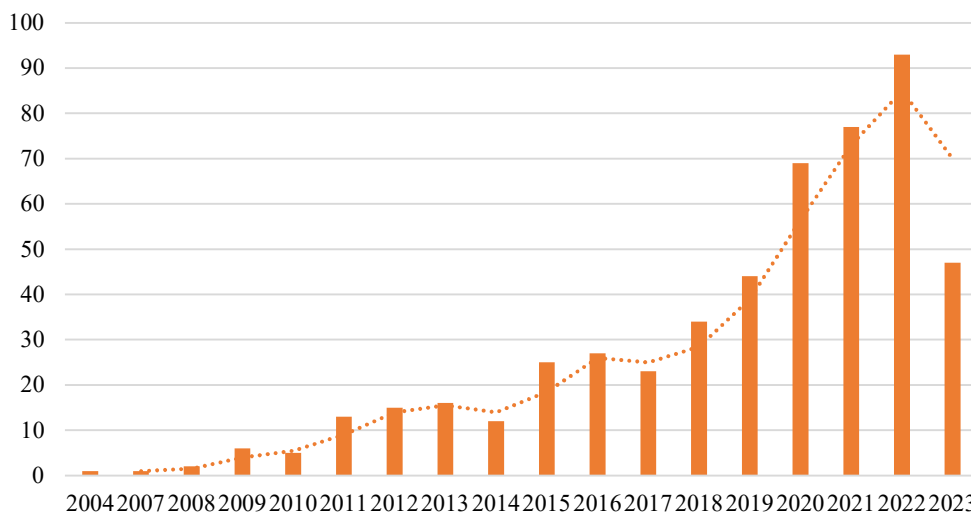
In order to outline and understand the vulnerabilities faced by the agricultural sector, a bibliometric analysis was carried out by studying the literature in the field. For this, the Web of Science database was queried (Iancu et al., 2022). The actual search was carried out by title, abstract, and keywords: "climatic vulnerabilities" or "social vulnerabilities" or "economic vulnerabilities" and "agricultural sector". The result was 512 articles, published between 2004 and 2023. Subsequently, in order to highlight the specific vulnerabilities, three types of vulnerability (climate, economic and social) were selected and the database was queried using the keywords "climate

vulnerability", "economic vulnerability" and "social vulnerability", resulting in 28,709 publications, 17,634 publications, and 33,755 publications respectively. The processing of the data obtained was carried out using the VOS Viewer software, which generated a series of network maps based on links (links between keywords used in the publications, links in co-author countries, etc.).

5. Findings

The analysis of scientific publications was first carried out from the perspective of the year of publication and an upward trend was observed (Figure 1). A search of the database yielded 510 articles on climate vulnerabilities, social vulnerabilities, and economic vulnerabilities, with an average of 19.96 citations per paper. As Figure 1 shows, the steady increase in the number of publications per year highlights the vibrant activity in this area, with an annual publication growth rate of 25.42%. The number of papers fluctuated slightly until 2015, with a total of 71 publications, with the main focus of the research based on social and environmental vulnerabilities (Figure 1).

Figure 1. Evolution of documents on the chosen theme according to the year of appearance identified in the WoS database



Source: Own representation based on data extracted from the Web of Science database

The high number of publications in 2015-2016 could be correlated with the four goals set out in the United Nations International Strategy for Disaster Reduction UNISDR in the 2012-2015 work program. These objectives aimed to improve coherence with the climate change adaptation community and sought to jointly strengthen decision-making and investment in this area (UNISDR, 2011; Giupponi

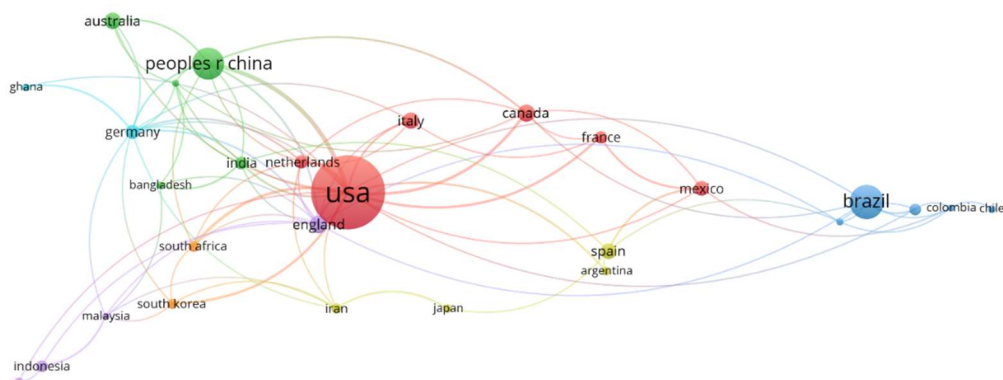
and Biscardo, 2015). This time lag in the number of publications is explained by the inclusion of the topic of vulnerabilities in the four strategic objectives included in the UNISDR work report. As evidence, the political impetus explains the growing interest in vulnerabilities.

In addition, in the same period, the IPCC report was published, which outlined ways to effectively manage extreme events, including effective disaster management for adaptation to present climate change (UNISDR, 2011; IPCC, 2012). For this report, work was done to develop a coordinated approach to climate change adaptation and disaster risk, and a clear definition of vulnerability was proposed and subsequently adopted in the AR5 synthesis report.

The increased focus on climate, social, and environmental vulnerabilities could also be attributed to the 2015 Global Sustainable Development Report. This intergovernmental mandated report on the science-policy interface for sustainable development was presented to UN Member States at the High-Level Political Forum. Through this report, the aim was to see how well the scientific community is prepared to inform the kind of integrated and multidimensional problem-solving and policy-making that will be needed to implement the new sustainable development agenda (GSD report, 2015; Sharifi et al., 2021).

In the following period (2020-present), the number of articles increased considerably, reaching a total of 286 publications, representing 56.1% of the total number of articles published on this topic. It can therefore be deduced that the field of social vulnerabilities, and economic and climate vulnerabilities has attracted substantial attention from the academic community, reaching a stage of marked development.

Figure 2. Distribution of documents by country on climate, social and economic vulnerabilities



Source: own processing based on WoS results using VOSviewer

In order to highlight and correctly assess the vulnerabilities of the agricultural sector, the bibliometric analysis was divided into three steps by analyzing three types of vulnerability (climate vulnerability, economic vulnerability, and social vulnerability) separately. Thus, for the first analysis, the keywords "climate vulnerabilities" were used, identifying 28,709 publications. Using the VosViewr database and software, a map was generated containing the keywords used at least 5 times in research and grouped into 7 clusters.

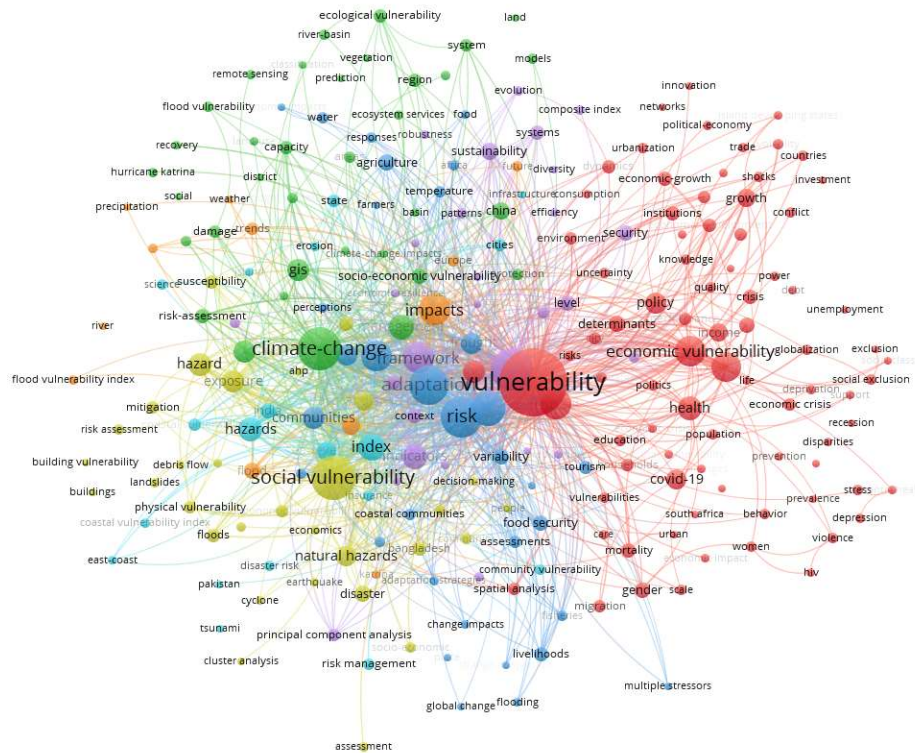
Cluster 1 (red) named „impact” contains the following keywords: sensitivity, management, temperature, vulnerability assessment, future, fisheries, evolution, adaptation strategies, land use, area, patterns, exposure, global change, performance, risk assessment, productivity, predictions, extinction, exchange, speed, ecosystem, ocean acidification, climate change impact, species vulnerability, methodology, quality, conservation planning.

Cluster 2 (green) called „vulnerability” includes resilience, poverty, capacity, gender, challenges, sustainability, policy, disasters, disaster risk, sustainable development, climate vulnerability, climate resilience, climate impact, policy, cities, developing countries, mapping vulnerability, environment, institutions, conflict, geography, climate policy, adaptation finance, heat, justice.

Cluster 3 (blue) called „social vulnerabilities” consists of sea level rise, health, index, disasters, food, rainfall, population, public health, climate risks, and floods.

Cluster 4 (yellow) called „impacts of change” consists of the following keywords: uncertainty, system, indicators, information, water resources, scenarios, land use change, and climate change adaptation. Cluster 5 (purple) named, ”adaptation” includes food security, strategies, variability, farmers, livelihoods, and farmers. Perception, poverty, household, security, knowledge, risk perception, perspectives, urban planning. Cluster 6 (turquoise) called „communities” consists of community, weather, tourism, setting, adaptation to change, and human dimensions. Cluster 7 (orange) comprises ocean, benefits, and degradation (Figure 3).

Figure 4. Linking economic vulnerabilities to other related terms



Source: own processing based on WoS results using VOSviewer

Following the "economic vulnerabilities" query, a total of 17,634 completed works were identified. Following the generation of the keyword map, these were grouped into six clusters. The first cluster (red) called „vulnerability” includes: economic vulnerabilities, education, covid-19, gender, migration, spatial analysis, risk, health, policy, determination, population, mortality, urban, women, behaviour, violence, social exclusion, non-employed, conflict, political economy, innovation, countries, investment, globalisation, violence, depression. The second (green) cluster called "climate change" includes: risk assessment, capacity, recovery, socio-economic vulnerabilities, Hurricane Katrina, district, damage, region, predictions, vegetation, river basin, models, terrain, remote sensing. The third cluster (blue) labelled „risk” includes: adaptation, variability, food security, tourism, assessment, livelihoods, climate change, risk perception, drought, temperatures, agriculture, water, response, food, communities, adaptive capacity. The fourth cluster (yellow) called „social vulnerabilities” includes: susceptibility, migration, disasters, natural disasters, building vulnerabilities, floods, physical vulnerabilities, debris flows, landslides,

validation, frailty, dementia, quality of life, impact, older adult, primary care, frail elderly, financial vulnerability.

The second (green) cluster called „resilience” includes: environmental justice, communities, sustainability, index, environment, assessment, spatial analysis, social indicators, conversation, evaluation, socio-ecological systems, land, level, science, hazards, coastal communities, coastal vulnerability, tsunami, sustainable development, political ecology, conservation, fisheries, flood management, governance. The third cluster (blue) called „social vulnerability” includes: context, disaster, hazard, land, exposure, system, flood hazard, natural hazard, flood, region, flood risk, principal component analysis, risk assessment.

The fourth cluster (yellow) called „risk” comprises: management, community, flood, disaster risk, hurricane Katrina, environmental hazards, natural disaster, migration, mitigation, risk perception, preparedness, emergency management, health care, race, experience, crisis, social risk, simulation, information, recovery, ethnicity, geography, fire, seismic risk. The fifth cluster (purple) called „climate change” includes: sea level rise, flooding, mapping, biophysical vulnerability, socio-economic vulnerability, sensitivity, temperature, and challenge (Figure 5).

6. Conclusions

The paper investigated the vulnerabilities of the agricultural sector by means of a bibliometric study, which also presented the evolution of the literature in the field. The trend of scientific production over the years is positive, which illustrates the increased interest and expansion of research in the field. Also, the global interest in vulnerability is evidenced by the high number of publications from the United States of America, which is a major actor with significant involvement in the field due to natural disasters and rural poverty.

Over the years, topics related to climate vulnerabilities such as temperature sensitivity, climate impact, precipitation, climate hazards, landslides, temperatures, earthquakes, tsunamis, floods, and seismic risk have been researched. Furthermore, researchers have also shown interest in socio-economic vulnerabilities such as: developing countries, food security, conflict, migration, violence, education, pandemics, and financial vulnerabilities.

Thus, the bibliometric study revealed an increase in scientific output and the main concerns that are increasingly researched worldwide.

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