

Exploring Key Insights for the Future in Agricultural Policy Research for Sustainability

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ABSTRACT

This research employs bibliometric analysis to explore key insights for the future in agricultural policy research, with a focus on sustainability. The study delves into publication trends, citation patterns, co-authorship networks, and keyword analyses to unravel the intricate landscape of scholarly contributions. The most-cited works, spanning seminal contributions to participatory action research and sustainable rural livelihoods, reveal foundational texts that have shaped the field. Clustering analysis elucidates thematic concentrations, ranging from climate change and artificial intelligence to biodiversity and education. Furthermore, the occurrence of terms such as "Common Agricultural Policy" and "Governance" underscores the central role of policy frameworks and collaborative decision-making in agricultural sustainability. The abstract concludes by highlighting the implications of these findings for future research directions and policy formulations, emphasizing the interdisciplinary and transformative nature required for sustainable agricultural practices.

Keywords: Agricultural Policy, Sustainability, Bibliometric Analysis

1. INTRODUCTION

Sustainable agricultural policies aim to balance economic viability, environmental stewardship, and social equity. These policies can be implemented in various ways, and their effectiveness can be influenced by a range of factors [1]–[3]. One approach to ensuring economic viability is through supply chain contracts. A study on the Italian durum wheat sector found that these contracts can help build stable relationships between various players in the supply chain, from production to processing and distribution. This stability can lead to fairer and more remunerative raw material purchase prices and higher quality standards, thus promoting economic sustainability [4]. Environmental stewardship can be promoted through policies that strengthen environmental governance and promote green, low-carbon practices [5]–[8]. A study in China found that such policies can directly and indirectly affect agricultural green total factor productivity, which is key to sustainable agriculture [9].

Social equity in sustainable agricultural policies can be addressed by focusing on the social aspects of sustainable development, in addition to environmental sustainability. For instance, a study in South Africa found that higher education policy shows minimal concern for sustainable development, suggesting that more emphasis needs to be placed on social equity in sustainable agricultural policies [10].

The relationship between sustainable agricultural policies and various factors can be complex. For example, a study in Algeria found that farmers who used land acquisition and financing policies were less likely to specialize in greenhouse production, suggesting that these policies may not always lead to the desired outcomes [11]. Another study in China found that land transfer can significantly improve the level of agricultural green production, but it can also inhibit

it, depending on various factors such as the family's long-term agricultural labor, social capital, migrant experience, non-agricultural income, and household clean energy use [12].

Agricultural policy is indeed a critical tool in addressing global challenges related to food security, environmental sustainability, and economic development. The specific problems associated with agricultural policy are diverse and multifaceted, spanning from environmental issues to socio-economic challenges. One of the significant problems is the sustainability of agricultural practices. For instance, in the European Union, the Common Agricultural Policy (CAP) has been criticized for failing to address biodiversity, climate, soil, and land degradation challenges. The European Commission's proposal for a CAP post-2020 provides a scope for enhanced sustainability, but it also allows Member States to choose low-ambition implementation pathways. Therefore, it is crucial to address citizens' demands for sustainable agriculture and rectify systemic weaknesses in the CAP [13].

Food security is another major issue. In Kazakhstan, for example, despite steady development in agricultural production, the consumption of certain types of food does not meet scientifically based nutritional standards. The economic policy in the agri-food sector is also influenced by the supply of imported food products, indicating a dependency on other states for certain agricultural products [14].

The global food system also contributes significantly to climate change through greenhouse gas emissions at all stages in the supply chain, from agricultural production through processing, distribution, retailing, home food preparation, and waste [15]. Policymakers are increasingly aware of the need to address these concerns while ensuring that there is enough food to meet the needs of a growing global population [16]. In Azerbaijan, the country's high dependence on the oil sector has created development challenges. However, consistent policy reforms can enhance growth due to productivity boost and increased exports from non-oil sectors, including agriculture [17]. The Common Agricultural Policy (CAP) of the European Union is undergoing reform, with the proposal of the CAP after 2020 imposing many new obligations on member states. These obligations present significant challenges resulting from the need to define national strategies and implement policy instruments [18].

Modern biotechnology, including genetic engineering and genome editing, offers potential solutions to food security issues [19]–[22]. However, their applicability depends on the regulatory environment, decision-making, and public perception [23].

In Andalusia, Spain, the cultivation of olive groves, which accounts for 83% of Spanish olive oil production, has caused environmental problems. These include high erosion, insufficient water resources for irrigation, and contamination from the use of chemical nutrients [24].

The shift from an industrial product-driven to a post-industrial service-driven economic system presents challenges for agricultural policy. This transformation requires rethinking all aspects of the business, including production structure and methods, marketing, pricing, service delivery infrastructure, and financial management [25].

In India and Africa, collaboration on food security is essential, given their common challenge of hunger, undernutrition, and low productivity. Specific recommendations include avoiding the harmful effects of the green revolution, adopting effective food distribution systems, and nurturing climate-smart agricultural practices [26].

Finally, in Poland, the effectiveness of conservation measures financed under the EU CAP on agricultural land located on N2000 areas is a concern. Environmental policy should be based on the idea of socially sustainable agriculture, including ecological sustainability, economic sustainability, and social sustainability in terms of effective inclusion of local communities in information, education, and decision-making processes [27].

This necessitates a profound understanding of the current state of agricultural policy research, its trends, and the identification of key insights that can guide future endeavors towards sustainable agricultural development. This research embarks on a comprehensive exploration of the landscape of agricultural policy research for sustainability through the lens of bibliometrics. Bibliometrics, as a quantitative analysis of scholarly literature, offers a unique and systematic approach to unveil patterns, trends, and influential elements within a specific research domain. By employing bibliometric methods, this study seeks to go beyond traditional literature reviews and subjective analyses, providing a data-driven perspective on the evolving field of agricultural policy. In this context, understanding the trajectory of agricultural policy research is crucial for shaping informed policies that transcend immediate challenges and contribute to long-term sustainability. The rationale for this research lies in the need to systematically assess the existing body of literature, identify influential works, and uncover emerging themes that can guide future research and policy formulation.

2. LITERATURE REVIEW

2.1 Evolution of Agricultural Policy Research

The evolution of agricultural policy research mirrors the dynamic interplay of global factors such as population growth, technological advancements, and environmental concerns. Historically, agricultural policies were predominantly crafted to address issues of food production and distribution. However, as the global landscape transformed, so did the objectives of agricultural policies, extending beyond mere productivity to encompass sustainability, environmental conservation, and social equity [28]–[30].

Scholars such as Swinnen have extensively examined the historical shifts in agricultural policy paradigms, delineating the transition from a focus on price supports and subsidies to more holistic approaches that consider environmental impact and rural development. This historical context provides the foundation for understanding the complexities of contemporary agricultural policy research [31]–[33].

2.2 Sustainable Agriculture and Policy Nexus

The convergence of sustainable agriculture and policy has become a central theme in contemporary agricultural research. Sustainable agriculture seeks to balance economic viability, environmental stewardship, and social responsibility. Scholars emphasize the need for policies that not only ensure food security but also promote resource efficiency, biodiversity conservation, and resilience to climate change (Pretty et al., 2018).

Policies promoting sustainable agriculture often integrate agroecological principles, recognizing the interconnectedness of ecological processes in farming systems (Altieri, 2018). The literature highlights the importance of policies that incentivize agroecological practices, such as

organic farming and integrated pest management, as means to achieve both environmental sustainability and food security.

2.3 Challenges in Agricultural Policy Implementation

The effective implementation of sustainable agricultural policies indeed faces numerous challenges, including economic, social, and political factors. These challenges often impede the translation of policies into on-the-ground practices. Issues of land tenure, access to resources, and market dynamics influence the adoption of sustainable practices by farmers. Stakeholder engagement and participatory approaches are crucial in policy formulation and implementation, as sustainable agricultural policies are most effective when they reflect the diverse needs and perspectives of farmers, communities, and other stakeholders [34]–[36].

Climate-smart agriculture has gained prominence as a framework that integrates climate adaptation and mitigation strategies into agricultural practices. However, the literature highlights that the equity implications of climate-smart agriculture remain an under-researched area. Depending on which discourses are mobilized, climate-smart agriculture may transfer the burden of responsibility for climate change mitigation to marginalized producers and resource managers. It may also fail to confront entrenched power relations that may constrain or block the emergence of more 'pro-poor' forms of agricultural development, adaptation to climate change, or carbon sequestration and storage. Furthermore, these discourses can have tangible implications for the bargaining power of the poorest and most vulnerable groups [37].

Digital agriculture and precision farming represent another frontier in agricultural policy discussions. Technologies such as precision agriculture, remote sensing, and data analytics have the potential to revolutionize farming practices, enhancing efficiency and sustainability. However, the policy implications of these technologies, addressing issues of data ownership, privacy, and equitable access, need to be thoroughly investigated [34]–[36].

2.4 Knowledge Gaps and Research Opportunities:

While the literature provides valuable insights into agricultural policy research, certain knowledge gaps persist. Limited attention has been given to the socio-economic impacts of sustainable agricultural policies on marginalized communities, and there is a dearth of studies that comprehensively evaluate the long-term effects of these policies on food security and livelihoods.

Additionally, the rapidly evolving landscape of agricultural technology introduces new challenges and opportunities that necessitate continuous scholarly attention. The intersection of artificial intelligence, blockchain, and the Internet of Things with agriculture opens avenues for innovative policy solutions, yet the literature is in its infancy in addressing the full spectrum of implications.

3. METHODS

This study used a bibliometric approach to comprehensively analyze the landscape of agricultural policy research for sustainability. Bibliometrics, a quantitative research method, enables the examination of scholarly publications to identify patterns, trends, and influential elements in a particular field [38]–[40].

3.1 Data Collection

A systematic search was conducted across leading databases, including PubMed, Scopus, Web of Science, and Google Scholar with the help of Publish or Perish (PoP) accessed on August 25, 2023. These databases cover a wide array of disciplines related to agricultural policy, ensuring a comprehensive data set.

A search strategy will be designed using a combination of keywords related to agricultural policy, sustainability, and relevant terms. Boolean operators will be used to refine the search and ensure specificity. The search strategy aims to obtain diverse articles while maintaining relevance to the research objectives.

Table 1. Research Data Metrics

Publication years	: 1992-2023
Citation years	: 31 (1992-2023)
Paper	: 980
Citations	: 218039
Cites/year	: 7033.52
Cites/paper	: 222.49
Cites/author	: 113096.67
Papers/author	: 419.22
Author/paper	: 3.11
h-index	: 211
g-index	: 453
hI,norm	: 143
hI,annual	: 4.61
hA-index	: 73
Papers with ACC	: 1,2,5,10,20:895,842,727,538,326

3.2 Bibliometric Analysis

Descriptive statistics were calculated to explain publication trends over time, distribution of publications by journal, and authorship patterns. This provides an overall picture of the current state of agricultural policy research. Keyword analysis involves identifying and analyzing the most frequently used keywords in the literature. This facilitates understanding the dominant themes and topics in agricultural policy research. Clustering analysis will be applied to group related articles based on content. This method helps in identifying different research groups and themes in agricultural policy research.

4. RESULTS AND DISCUSSION

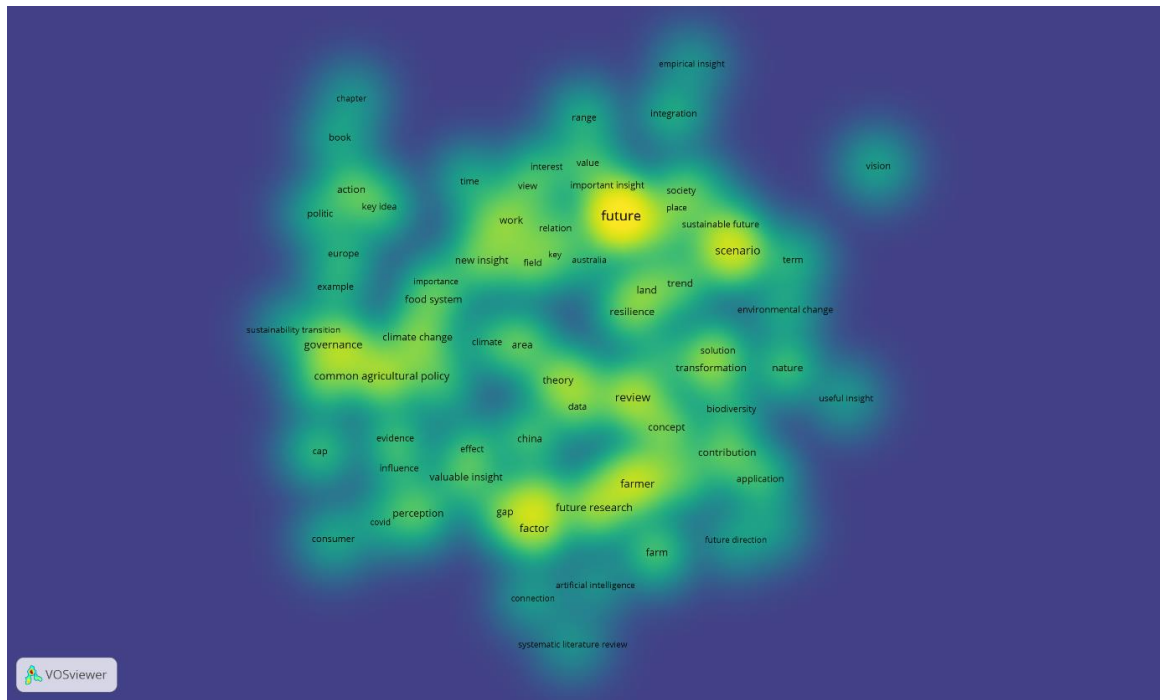


Figure 3. Cluster Identifications

The clustering analysis of keywords has revealed distinct thematic clusters within the landscape of agricultural policy research (Figure 3). Each cluster represents a set of related topics, shedding light on the multifaceted nature of the field.

Table 2. Cluster Identifications

Cluster	Total Items	Most frequent keywords (occurrences)	Keyword
1	10	Climate change (25), Governance (20), sustainability transition (20)	Adaptation, climate change, covid, field, governance, interrogation, key idea, new insight, politic, sustainability transition
2	8	Artificial intelligence (25), Sustainable Agricultural (20)	Application, area, artificial intelligence, concept, contribution, data, sustainable agricultural, theory
3	7	Biodiversity (20) health (25)	Biodiversity, common agricultural policy, ecosystem services, health, nature, solution
4	7	Education (20), valuable insight (25)	Driver, education, importance, relationl transformation, valuable insight, value
5	5	Society (20)	Environmental change, important insight, society, sustainable future
6	3	Food security (20)	Environmental sustainable, food security, food system
7	2	Consumer (25)	Consumer, perception

The diverse clusters underscore the interdisciplinary nature of agricultural policy research, emphasizing the need for policies that integrate insights from climate science, technology, health, education, and societal perspectives. The thematic clusters collectively advocate for policies that adopt a holistic approach to sustainability, considering ecological, social, and economic dimensions. Future research and policies should strive for an integrated understanding of these interconnected aspects. The prominence of Cluster 2 signals the growing importance of artificial intelligence in sustainable agriculture. Policies need to address the ethical considerations and implications of adopting such technologies while ensuring equitable access.

Cluster 4 highlights the potential role of education in driving transformative change. Policies should consider incorporating educational initiatives to promote sustainable agricultural practices and enhance awareness. The emphasis on societal perspectives in Cluster 5 and consumer perceptions in Cluster 7 underscores the importance of engaging communities and consumers in the policymaking process. Policies should reflect a bottom-up approach, considering the needs and perceptions of diverse stakeholders.

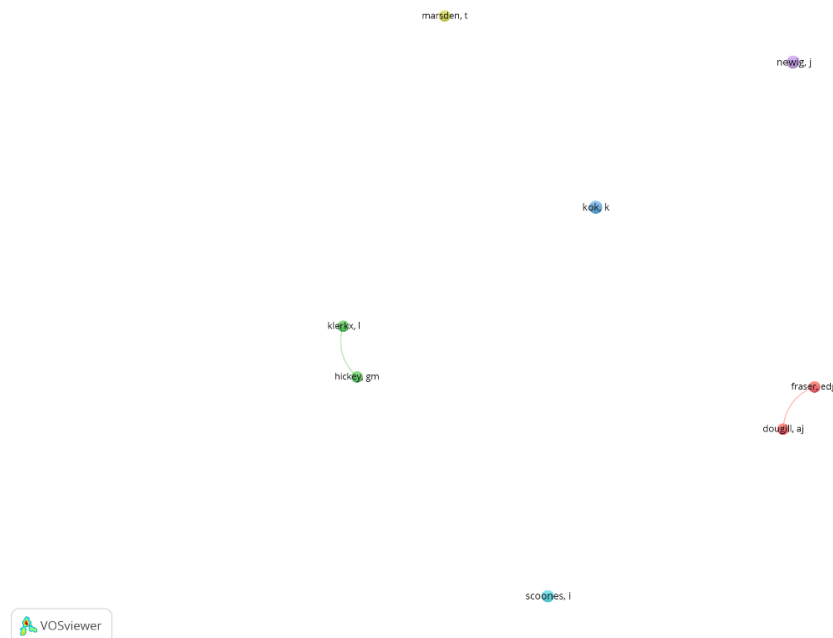


Figure 4. Author's Collaborations

Visualization of co-authorship networks illustrates patterns of collaboration (Figure 4). Identification of clusters within the network highlights collaborative themes and interdisciplinary connections.

Table 3. Citations Analys

Citations	Authors and year	Title
8998	[41]	Sustainable rural livelihoods: practical concepts for the 21st century
7624	[42]	Participatory action research and the public sphere
7023	[43]	Sustainable rural livelihoods: a framework for analysis
5655	[44]	Political ecology: A critical introduction
3305	[45]	Sustainable food consumption: Exploring the consumer "attitude behavioral intention" gap
3164	[46]	Environmental sociology
3112	[47]	Sustainable development: Exploring the contradictions
3041	[48]	Third world political ecology
2909	[49]	Business ethics: Managing corporate citizenship and sustainable in the age of globalization
2683	[50]	Understanding alternative food networks: exploring the role of short food supply chains in rural development

The highly cited works cover a broad spectrum of disciplines, emphasizing the interdisciplinary nature of agricultural policy research. Policymakers and researchers should recognize and embrace the interconnectedness of social, environmental, and economic dimensions. The dominance of works related to sustainable rural livelihoods suggests a continued emphasis on understanding and promoting sustainable practices within rural communities. Future research and policies should build on these foundations to address the complexities of rural sustainability.

The presence of works on sustainable food consumption and the consumer attitude-behavioral intention gap highlights the growing recognition of the pivotal role of consumer behavior in shaping sustainable agricultural practices. Policymakers should consider strategies that align consumer attitudes with sustainable practices. The inclusion of works on political ecology and contradictions in sustainable development underscores the importance of addressing power dynamics and governance in agricultural policy. Future policies should consider the political dimensions of sustainability to foster more equitable and effective outcomes.

The inclusion of works discussing third world political ecology and globalization emphasizes the global nature of agricultural systems. Policymakers should adopt global perspectives in crafting policies that address the challenges and opportunities of a connected world.

The recognition of business ethics in the age of globalization highlights the need for ethical considerations in agricultural practices. Policymakers should integrate ethical frameworks into policies governing corporate citizenship in the agricultural sector.

Table 4. Keywords Analys

Most occurrences		Fewer occurrences	
Occurrences	Term	Occurrences	Term
48	Common agricultural policy	19	Driver
47	Governance	18	Interrogation
36	Climate change	18	Term

35	Concept	17	Society
34	Transformation	16	Health
34	Theory	16	Politic
32	Contribution	15	Environmental change
32	New insight	15	Food security
32	Area	15	Consumer
31	Perception	15	Biodiversity
31	Resilience	14	Ecosystem services
30	Adaptation	14	Environmental sustainability
26	Nature	13	Sustainable transition
26	Education	13	Covid
26	Food system	10	Artificial intelligence

The keyword analysis reveals the most frequently occurring terms in the agricultural policy research literature, providing insights into the dominant themes and topics. The discussion below explores the implications and significance of the most occurrences and fewer occurrences terms.

Most Occurrences:

The prevalence of the term "Common Agricultural Policy" (CAP) suggests its centrality in agricultural policy research. CAP is a key European Union policy that significantly influences agricultural practices, subsidies, and rural development. The high occurrence indicates a continued focus on understanding, analyzing, and potentially reforming this policy for sustainable agricultural development in Europe. The prominence of "Governance" reflects the recognition of the importance of effective and inclusive decision-making processes in shaping agricultural policies. Governance in agriculture involves a range of actors, from government bodies to non-governmental organizations and local communities. Policies informed by this term likely emphasize collaborative, transparent, and participatory approaches to agricultural decision-making.

The significant occurrence of "Climate Change" highlights the pressing concern of global climate shifts within the agricultural policy discourse. Policymakers and researchers are likely focusing on developing strategies that address the impacts of climate change on agriculture, including adaptation and mitigation measures. Sustainable agricultural policies must grapple with the challenges posed by changing climate patterns. The term "Concept" suggests a focus on theoretical frameworks and conceptualizations within agricultural policy research. Policymakers and researchers may be engaged in defining and refining key concepts that underpin sustainable agriculture. This emphasizes the importance of theoretical foundations in guiding the development and implementation of effective policies.

The recurring theme of "Transformation" suggests a focus on fundamental changes in agricultural systems. Policymakers and researchers may be exploring transformative approaches to address issues such as sustainability, resilience, and inclusivity. Policies informed by this term likely emphasize a shift towards more sustainable, equitable, and resilient agricultural practices. The term "Theory" implies a strong emphasis on theoretical frameworks within agricultural policy research. Policymakers and researchers may be drawing on diverse theoretical perspectives to analyze and

interpret agricultural systems. The integration of theoretical insights into policy discussions suggests a commitment to evidence-based and theoretically grounded policymaking.

The term "Contribution" indicates a focus on the contributions of various elements to agricultural policy. Policymakers and researchers are likely interested in understanding and quantifying the impacts of different factors on the success or failure of policies. Policies informed by this term may prioritize actions and strategies that make significant positive contributions to sustainability and resilience. The recurring theme of "New Insight" suggests a commitment to generating novel perspectives and knowledge within agricultural policy research. Policymakers and researchers may be actively seeking innovative solutions, approaches, and perspectives to address emerging challenges in agriculture. Policies informed by this term likely emphasize adaptability and a willingness to explore new and unconventional ideas.

The term "Area" suggests a broad and comprehensive exploration of different dimensions within agricultural policy research. Policymakers and researchers may be considering various areas, such as geographical regions, thematic domains, or specific aspects of agricultural systems. Policies informed by this term may adopt a holistic approach that addresses multiple areas for sustainable development. The focus on "Perception" indicates a recognition of the importance of how stakeholders perceive and interpret agricultural policies. Policymakers and researchers may be considering the role of public perception, farmer attitudes, and community perspectives in shaping the success of agricultural policies. Policies informed by this term likely prioritize effective communication and engagement to shape positive perceptions.

Fewer Occurrences:

The term "Driver" suggests a focus on identifying and understanding the driving forces behind certain phenomena within agricultural policy research. Policymakers and researchers may be exploring the factors that propel or inhibit specific agricultural practices or policy outcomes. Policies informed by this term may prioritize addressing key drivers to achieve desired outcomes. The term "Interrogation" implies a critical and questioning approach within agricultural policy research. Policymakers and researchers may be actively engaging in critical analyses, asking probing questions, and interrogating existing paradigms to uncover underlying issues and opportunities. Policies informed by this term may adopt a critical perspective, encouraging ongoing evaluation and reflection.

The generic term "Term" may suggest a focus on clarifying and defining specific concepts or terminologies within agricultural policy research. Policymakers and researchers may prioritize precise definitions to ensure clarity and consistency in policy discourse. Policies informed by this term may emphasize the importance of shared understanding and a common vocabulary. While "Society" is a recurring term, its fewer occurrences may suggest a potential area for increased emphasis within agricultural policy research. Policymakers and researchers may benefit from a more explicit consideration of societal dynamics, needs, and aspirations in crafting sustainable agricultural policies. Policies informed by this term may prioritize societal well-being and inclusivity.

The term "Health" indicates a focus on the health-related aspects of agricultural policies. Policymakers and researchers may be exploring how agricultural practices impact human health and well-being. Policies informed by this term may prioritize approaches that not only ensure food security but also promote public health and nutrition. The term "Politic" suggests a focus on the political dimensions of agricultural policy research. Policymakers and researchers may be actively

considering the power dynamics, political structures, and governance mechanisms that shape agricultural policies. Policies informed by this term may adopt strategies to navigate and address political challenges.

The term "Environmental Change" emphasizes a focus on the broader environmental implications of agricultural policies. Policymakers and researchers may be considering how policies impact ecological systems, biodiversity, and climate. Policies informed by this term may prioritize environmental sustainability as a key outcome. While "Food Security" is a significant term, its fewer occurrences may suggest an area for continued attention within agricultural policy research. Policymakers and researchers may need to ensure that policies comprehensively address issues related to access, availability, and utilization of food. Policies informed by this term may aim to achieve not only agricultural sustainability but also food security for all.

The term "Consumer" implies a consideration of the role and impact of consumers in agricultural policy research. Policymakers and researchers may be exploring how consumer preferences, behaviors, and perceptions influence the success of agricultural policies. Policies informed by this term may prioritize strategies that align with consumer expectations and preferences. While "Biodiversity" is a significant term, its fewer occurrences may indicate a potential area for increased attention within agricultural policy research. Policymakers and researchers may benefit from further exploration of policies that explicitly address biodiversity conservation within agricultural landscapes. Policies informed by this term may prioritize approaches that promote agricultural practices compatible with biodiversity preservation.

Overall Implications and Future Directions:

The prevalence of "Common Agricultural Policy" indicates its continued importance in shaping agricultural practices in Europe. Policymakers should consider ongoing reforms and adaptations to ensure the effectiveness and sustainability of CAP. The emphasis on "Governance" highlights the importance of collaborative decision-making in agricultural policy. Policymakers should prioritize inclusive governance structures that involve diverse stakeholders for more effective and equitable policies. The significant occurrence of "Climate Change" underscores the urgency of developing policies that enhance agricultural resilience to climate-related challenges. Policymakers should consider adaptive strategies that mitigate the impacts of changing climatic conditions on agriculture.

The recurrence of "Concept" and "Theory" suggests a commitment to theoretical foundations within agricultural policy research. Policymakers should ensure clarity in conceptual frameworks to guide the development and implementation of sustainable agricultural policies. The prominence of "Transformation" indicates a recognition of the need for transformative approaches in agricultural policy. Policymakers should consider policies that drive fundamental changes in agricultural systems toward sustainability, resilience, and inclusivity. The focus on "Perception" and "Consumer" suggests a recognition of the role of public perception and consumer behavior in policy success. Policymakers should prioritize communication strategies that engage the public and align with consumer preferences for sustainable agricultural practices.

The inclusion of "Health" highlights a potential area for increased attention within agricultural policy research. Policymakers should consider policies that not only ensure food security but also promote public health and nutrition through agricultural practices. The occurrence of "Political" suggests a recognition of the political dimensions of agricultural policy. Policymakers

should navigate and address political challenges to ensure the effective implementation of sustainable agricultural policies. The inclusion of "Environmental Change" underscores the importance of environmental sustainability in agricultural policy. Policymakers should prioritize policies that promote practices aligned with ecological balance and biodiversity conservation. While "Biodiversity" is a significant term, its fewer occurrences may indicate a potential area for increased attention within agricultural policy research. Policymakers should consider policies that explicitly address biodiversity conservation within agricultural landscapes.

5. CONCLUSION

In conclusion, this bibliometric analysis provides a comprehensive overview of the current landscape of agricultural policy research, offering valuable insights for shaping the future of sustainable agriculture. The most-cited works, including seminal contributions to sustainable rural livelihoods and participatory action research, underscore the enduring impact of foundational literature. Clustering analyses reveal thematic concentrations, emphasizing the interdisciplinary nature of contemporary research, ranging from climate change and artificial intelligence to biodiversity and education. The recurring prominence of terms such as "Common Agricultural Policy" and "Governance" highlights the pivotal role of policy frameworks and collaborative decision-making in agricultural sustainability.

These findings hold significant implications for future research and policy formulation. Policymakers and researchers should consider the transformative potential of interdisciplinary approaches, acknowledging the interconnectedness of social, economic, and environmental dimensions within agricultural systems. Key areas requiring attention include climate change resilience, transformative policies, public perception and engagement, and the conservation of biodiversity. As agriculture faces unprecedented challenges, the insights gleaned from this analysis serve as a guide for developing policies that are adaptive, inclusive, and geared towards a sustainable agricultural future.

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