# Agri-Startup Trend Analysis Based on Thematic Map Clustering

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#### 3 Abstract

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This study employs thematic map clustering and social network analysis (SNA) to analyze 4 global Agri-startup trends, utilizing bibliometric data from the Scopus database. The research 5 identifies key contributors, collaboration networks, and key thematic clusters that drive 6 innovation in the agricultural sector. Findings reveal a significant upward trend in Agri-startup 7 8 research, with sustainability, entrepreneurship, and technology integration emerging as central themes. The study highlights the critical roles of prominent regions, institutions, and journals 9 10 in shaping the field, underscoring the importance of precision agriculture and digital technologies in advancing agriculture. These insights offer actionable recommendations for 11 stakeholders to foster innovation, promote sustainable development, and address global 12 agricultural challenges and enhance food security, bridging academic research with practical 13 applications in innovation ecosystems. 14 Keywords: Entrepreneurial Ecosystems; Sustainable Development; Rural Development; Smart 15 Farming; Agri-entrepreneurship. 16

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#### 1. Introduction

In multiple industries, including the agricultural industry, the emergence of startups has become more prominent (Suresh et al., 2024). The growth of agricultural startups is a reflection of the rising need for innovative methods that boost productivity and sustainability, among other factors in agriculture (Runck et al., 2022). These startups, often termed 'Agripreneurs' or 'Agristartups', use information technology to solve industry-specific social, environmental, and economic issues, emphasizing the growing significance of entrepreneurship in agriculture for sustainable development (Arumugam & Manida, 2023).

Agri-startups are being recognized worldwide as innovators and agents of change, that advocate

- 27 for the challenges affecting farmers and the agriculture industry (Anjali, 2023). They facilitate
- a transition from subsistence farming to agribusiness, which leads to improved income levels
- among the farmers (Reddy, 2023). Agri-startups contributed to building a sustainable future for

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agriculture, a stable food supply, and the development of culture within the industry (Nemadeet al., 2023).

Despite the growing interest in Agri-startups, there are notable gaps in the existing literature. 32 Judijanto et al. (2023) used bibliometric tools to explore trends in Agricultural Technologies 33 and agribusiness, identifying key authors and emerging themes within the academic discourse. 34 While this study effectively maps academic influence, it lacks a direct connection to the 35 practical challenges and thematic clusters relevant to the startup environment, particularly in 36 understanding how these themes translate into real-world startup success. Bethi and Deshmukh 37 (2023) offer a broad overview of the challenges and opportunities for Agri-startups in 38 developing economies, focusing on general trends and issues. However, their study lacks 39 specificity in identifying the key thematic drivers and network structures that are crucial for 40 understanding startup success in these diverse contexts. This limitation is echoed in recent 41 works such as Guerrero-Ocampo and Díaz-Puente (2023), and Dias et al. (2019), which 42 highlight innovation, responsibility, and sustainability but lack integration across themes. These 43 gaps underscore the currently fragmented research on this expanding industry (Barrett et al., 44 2020; Klerkx & Rose, 2020). Therefore, scholars and professionals are left to negotiate a 45 46 complex network of studies without clear guidance (Rose & Chilvers, 2018). Prior research studies have been performed on too many aspects of Agri-startups, and this article provides an 47 academic landscape of Agri-startups (Bhagat et al., 2022; Chalgynbayeva et al., 2023; de Souza 48 et al., 2022; Mendes et al., 2022; Yousaf et al., 2023). 49

Despite growing attention to Agri-startups, few studies provide a systematic thematic and 50 network-based view of the field. The necessity of this research lies in addressing the fragmented 51 understanding of Agri-startups and their role in addressing global agricultural challenges. While 52 Agri-startups are increasingly recognized as key drivers of innovation and sustainability, there 53 is a lack of systematic analysis that connects academic research with practical applications. This 54 55 study aims to bridge this gap by identifying the key thematic drivers, collaboration networks, and emerging trends that shape the Agri-startup ecosystem. By doing so, it provides a 56 foundation for stakeholders to make informed decisions and foster innovation in agriculture. 57

To address these gaps, this study utilizes Thematic map clustering and Social Network Analysis
(SNA) to offer insights across several domains, significantly impacting academic and scientific
stakeholders. Key contributions include:

61 (1) This study provides an in-depth examination of the growth trajectory of Agri-startup62 research over time.

- 63 (2) The analysis identifies leading contributors, including prolific authors, key academic64 institutions, countries, and journals that have made significant impacts in the field.
- (3) Highlighting the most cited works in the field, the study sheds light on influential studiesthat have shaped the current landscape of Agri-startup research.
- (4) The study examines the emergence and popularity of specific research topics, tracking the
  evolution of interests and technological advancements in the field. It uses tools like word
  clouds, thematic maps, and cluster analysis to reveal the dynamic nature of research themes and
  analyze trends over time.
- (5) Drawing on previous findings, the study proposes future research avenues that address
  identified gaps and capitalize on emerging trends. This forward-looking perspective aims to
  inspire Agri-startups to address agricultural challenges, suggesting innovative approaches and
  methodologies.
- 75 The following sections begin with an explanation of the methodology, Next, the findings 76 section presents the outcomes of data analysis, including the examination of key contributors 77 and their relations, and the clustering of papers based on a thematic map analysis. Finally, in 78 the Conclusion and Discussion, a comprehensive analysis of clusters focusing on various 79 periods is carried out using trend analysis.
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#### 2. Methodology

#### 82 **2.1. Data collection**

This study analyzes the trends of Agri-startups using a combined methodology of social network analysis and thematic mapping, guided by the logic of coupling clustering. To understand and track the evolution of trends over time, the data collection was structured around four distinct time periods. Each period was selected to represent a significant phase in the development of Agri-startups, thereby providing a comprehensive view of the dynamic landscape (Figure 1).



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Figure 1. Methodological Framework.

92 The inclusion and exclusion criteria for the data selection were determined based on relevance to the Agri-startup research landscape and the methodological rigor of the sources. Only peer-93 reviewed journal articles and conference papers from the Scopus database were included to 94 ensure the quality and credibility of the data. Studies that focused on broader agricultural trends 95 96 without a clear connection to startups or entrepreneurial activities were excluded. Additionally, papers lacking sufficient bibliometric information or not written in English were omitted to 97 maintain consistency in the analysis. Error! Not a valid bookmark self-reference. illustrates 98 the PRISMA process, which was followed to achieve these objectives. 99



#### 101 102

Figure 2. PRISMA.

103 2.2. Social Network Analysis

To elucidate the collaborative dynamics within the research field of Agri-startups, an SNA was 104 conducted using Gephi. The primary objective of this analysis was to identify key contributors, 105 central figures, and the overall structure of the research community (Guerrero-Ocampo & Díaz-106 107 Puente, 2023). A co-authorship network was constructed where nodes represented authors, and edges denoted co-authorship links, with the strength of each link determined by the number of 108 109 co-authored publications between any two authors (Kumar, 2024). To pinpoint the most influential authors within the network, centrality measures such as Degree Centrality, 110 Betweenness Centrality, and Closeness Centrality were calculated. (Sagr et al., 2022; Si, 2022). 111 This network analysis provided crucial insights into the key contributors and the collaborative 112 structure of research in the Agri-startup field. 113

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#### 115 **2.3. Thematic Map**

To provide a comprehensive understanding of the research themes within the Agri-startup field,Thematic mapping is utilized.

The foundation of thematic mapping is based on coupling and clustering techniques. Specifically, bibliographic coupling is used to group related documents based on shared references, which helps in forming clusters of documents that share common research themes. These clusters are then analyzed and positioned on the thematic map according to their centrality and density, two key metrics in thematic mapping (Rojas-Lamorena et al., 2022).

- 123 Centrality measures how connected a theme is to other themes, indicating its importance within
- the research field, while density reflects the internal cohesion of the theme, showing how well-
- developed the theme is (Karakose et al., 2024). Using these metrics, a thematic map isconstructed with four quadrants (Zhu et al., 2024):
- 127 **Motor Themes** (high centrality and high density): These represent well-developed and 128 influential topics that drive the research field.
- Basic Themes (high centrality but low density): These are essential themes that are widelyconnected but still underdeveloped.
- Niche Themes (low centrality but high density): These are specialized, well-developed areasthat are not widely connected to other themes.
- Emerging or Declining Themes (low centrality and low density): These indicate topics thatare either gaining traction or losing relevance.
- By positioning the research clusters within these quadrants, the thematic map provides a clear
- visualization of the research landscape, highlighting the core areas of focus, as well as emerging
- 137 and declining trends within the Agri-startup field.
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# 139 **3. Results**

## 140 **3.1. Analysis of annual publications**

The analysis of annual publications reveals key growth trends in Agri-startups research, as shown in Figure 3. Among the 942 documents published, we have identified three dominant trends that have shaped the field: sustainability, technology integration, and entrepreneurship. These trends were selected for further analysis due to their consistent prominence across all phases of research and their critical role in addressing global agricultural challenges. The evolution of research activity can be divided into three main phases, each marked by a growing emphasis on these key themes:

Initial Phase (2000-2010): This period was foundational, with the field being relatively
underexplored and an average of 10 publications per year.

Growth Phase (2011-2016): A marked increase in publications began around 2011, with an
average of 30-40 publications annually, driven by growing awareness of sustainable agriculture
and technological advancements.

Peak and Stabilization (2017-2023): The most significant surge occurred between 2017 and
2020, with annual publications exceeding 100. This peak reflects heightened interest, supported

- by policy and investment. Post-2021, the publication rate stabilized, indicating the field's 155
- maturation. 156
- This upward trend underscores the critical role of Agri-startups in addressing global agricultural 157
- challenges, particularly through sustainability in AgTech and the promotion of resilient farming 158
- systems. 159



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Figure 3. Annual publications of research on Agri-startups.

#### 3.2. Key contributors of Agri-startups 163

164 As depicted in Table 1, Lans and Modaffari lead the Agri-startup research field, each with five publications, indicating their central roles and leadership within their research groups. They are 165 closely followed by Blok, Lindsay, and Verstegen, each contributing four articles, reflecting 166 their sustained expertise and focus in the field. The collective contributions of these authors are 167 crucial for advancing theoretical frameworks, methodological approaches, and practical 168 applications in Agri-startups. Their work also plays a significant role in mentoring future 169 researchers and shaping the research agenda. 170

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Author	Count
Lans, Thomas	5
Modaffari, Giuseppe	5
Blok, Vincent	4
Lindsay, Bruse R	4
Verestegen, Jos	4
Bertucci Ramos	3
Paulo, Henrique	3
Bickley, James M	3
Cornelissen, Gerard	3
Fafchams, Marcel	3

Table 1. Top 10 productive authors.

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Frare, Anderson Betti

Figure 4, illustrating the authors' collaboration network, offers valuable insights into the 174 collaborative dynamics within the academic scene of Agri-startups. The connections among 175 these authors have been analyzed in the co-authorship network, where each line represents a 176 co-authorship relationship, and the size of each box indicates the author's influence in the 177 network, measured by the degree centrality (Alnajem et al., 2021). Figure 4 is vital for 178 identifying key players and collaborative hubs within the agri-startup research field. It reveals 179 the structure of existing collaborations and potential opportunities for new ones. Understanding 180 these dynamics is crucial for fostering a cohesive, interdisciplinary research environment in this 181 rapidly evolving field. By highlighting central figures and collaboration networks, Figure 4 182 serves as a roadmap for nurturing future collaborations to enhance innovation and tackle 183 challenges in the agricultural startup ecosystem. 184



# Figure 4. Authors' collaboration network.

To identify key universities and research institutions in the field of Agri-startups, as Table 2 shows, we analyzed the number of publications produced by each institution. The UoC emerged as the leader with 19 articles, followed by Wageningen University with 17 publications. ICA -Indian Institute ranks third, contributing 13 articles. This analysis highlights the major players driving research and innovation in Agri-startups.

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Affiliations	Count
University of California	19
Wageningen University	17
ICAR-Indian Institute of	13
Farming Systems Research	
Italian National Institute for	13
Health	
Université Evangélique en	13
Afrique	
Ghent University	11
Sapienza University of Rome	11
Swedish University of	11
Agricultural Sciences	
Aristotle University of	10
Thessaloniki	
Max Planck Institute for	10
Evolutionary Anthropology	

Table 2. Top 10 productive affiliations.

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The institution collaboration network in Agri-startups research, as illustrated in Figure 5, 199 reveals a dynamic and interconnected web of academic and research institutions worldwide, 200 composed of several distinct communities that vary in influence and collaboration intensity 201 202 among their members. Each line represents a co-authorship link, and the size of the box indicates the strength of that affiliation's position in the network, based on the degree centrality 203 204 metric (Albuquerque et al., 2022). Within this network, Wageningen University emerges as a leading institution, playing a central role in multiple communities due to its extensive 205 contributions to agricultural research and innovation. The relationships between these 206 affiliations or organizations were examined using a co-authorship network. The rest can be 207 observed in Figure 5. These partnerships enhance knowledge exchange but also facilitate the 208 development of innovative solutions to global agricultural challenges, showcasing the essential 209 role of collaborative efforts in driving progress within this evolving field. 210



211 Figure 5. Institution collaboration network. 212 213 The bibliometric data concerning the contributions of various countries to the field of Agri-214 startups, as depicted in Figure 6, provides a detailed overview of global research efforts and 215 collaboration patterns, differentiating between single-country publications (SCP) and multi-216 country publications (MCP) to offer insights into both the volume of research output and the 217 nature of authorship (Musa et al., 2021). The United States leads with 99 articles, comprising 218 85 SCPs and 14 MCPs, reflecting strong internal collaboration and a robust research 219 infrastructure. The significant number of MCPs highlights the USA's role in international 220 collaborations. China follows with 43 articles, including 29 SCPs and 14 MCPs, indicating a 221 balanced approach between internal and international collaboration, underscoring China's 222 growing influence in the global research community. Overall, the high volume of SCPs shows 223 strong national research capabilities, while MCPs emphasize the importance of global 224 collaboration for advancing the field through diverse perspectives and shared resources. 225



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**Figure 6.** Top 10 productive countries.

Figure 7 illustrates the collaboration network among countries in the academic scene, highlighting the central roles of the USA and the UK. The USA, in particular, plays a pivotal role with strong connections to various countries, especially with the UK. New Zealand is part of a distinct cluster along with Canada and South Africa, emphasizing its involvement in regional collaborations. The rest of the network dynamics are also evident in the visualization of Figure 7.





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#### 3.3. Analysis of top journals 240

- Table 3 shows the distribution of articles published across several journals in the field of Agri-241
- startups research. The most prominent journal is "Sustainability (Switzerland)" with 25 articles, 242
- indicating its central role in this research area. "Bioresource Technology" follows with 16 243
- articles, and "Journal of Rural Studies" has 13 articles. These journals are highlighted in Table 244
- 3, reflecting their importance in the dissemination of Agri-startups research. 245
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Table 3. Top 10	productive journals.
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Journal	Count
Sustainability	25
Bioresource Technology	16
Journal of Rural Studies	13
Emerald Emerging Market Case	10
Studies	
Water Science and Technology	10
Chemosphere	9
Ecological Engineering	8
Agricultural and Human Values	7
Journal of Small Business and	7
Enterprise Development	
Agricultural Systems	6

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#### 3.4. Analysis of top-cited articles 249

- Table 4 summarizes ten highly cited articles in Agri-startups, detailing their focus, citation 250
- count, and authors. 251

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<b>1 able 4.</b> Highly cited article	Table 4	4. Hi	ghlv	cited	article
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Reference	Title	Citations
(Angenent et al., 2002)	Methanogenic population dynamics during startup of a full- scale anaeropic sequencing batch reactor treating swine waste	228
(Barbieri & Mshenga, 2008)	The Role of the Firm and Owner Characteristics on the Performance of Agritourism Farms	189
(Vik & McElwee, 2011)	Diversification and the Entrepreneurial Motivations of Farmers in Norway	155
(Lovell et al., 2010)	Integrating agroecology and landscape multifunctionality in Vermont	151
(Fafchamps & Minten, 1999)	Relationships and traders in Madagascar	136
(Debata et al., 2020))	COVID-19 pandemic! It's impact on people, economy, and environment	135
(Hansson et al., 2013)	Farmers' motives for diversifying their farm business – The influence of family	127
(Birner et al., 2021)	Who drives the digital revolution in agriculture?	124
(Pant & Reddy, 2003)	Potential internal loading of phosphorus in a wetland constructed in agricultural land	123
(Cornelissen et al., 2016)	Emissions and Char Quality of Flame-Curtain "Kon Tiki" Kilns for Farmer-Scale Charcoal/Biochar Production	121

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- 256 **3.5. Thematic map analysis**
- The word cloud shown in Figure 8 highlights key themes in Agri-startup research, showing a strong focus on agriculture (49), entrepreneurship in agriculture (46), and sustainability (33). These themes were selected for in-depth analysis due to their centrality in the literature and their potential to drive future innovation in the sector. While other topics like renewable energy and rural development are also important, this study will focus on the three dominant themes, as they represent the most critical areas for addressing global agricultural challenges and fostering sustainable development.
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Figure 8. Word cloud based on keywords.

Figure 9 presents a thematic map of keywords in the Agri-startups academic scene, dividing 267 them into four quadrants: Motor Themes, Niche Themes, Basic Themes, and Emerging or 268 Declining Themes. Motor Themes, including keywords like nitrogen and bioreactor, are central 269 and well-developed, highlighting their importance in sustainability and environmental impact 270 in agriculture. Niche Themes, such as land use and regional focuses like India and the UK, are 271 highly developed but more region-specific. Basic Themes, including agriculture and the US, 272 273 are essential but less explored, representing foundational aspects of the field. Emerging or Declining Themes, like agricultural technology and economic development, are either in early 274 stages of research or losing relevance, indicating potential areas for growth or rethinking. 275

Overall, the map illustrates a dynamic academic landscape with established areas of research and opportunities for further exploration, especially in technology integration and regional challenges in agriculture. This thematic structure reflects a growing cross-disciplinary convergence in Agri-tech, echoing findings by Chalgynbayeva et al. (2023) in the context of agrivoltaic system research.

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#### Figure 9. Thematic map of keywords.

The thematic evolution of keywords in agricultural research, as shown in Figure 10, highlights shift in focus over four periods. The selected time periods were determined based on significant shifts in research output and thematic evolution within the field of Agri-startups. Each period reflects a distinct phase in the volume, focus, and development of research, allowing for a structured longitudinal analysis. These divisions enable the identification of emerging trends, key technological advancements, and shifts in scholarly attention over time, providing a clearer understanding of how the field has progressed:

1. 1943-2011: Research was diverse and foundational, covering topics like drainage, water
 treatment, and economic development, with an emphasis on agricultural workers, forestry,
 and the rural economy. This period laid the groundwork with a broad focus on agricultural
 practices and regional studies.

2012-2018: The focus shifted to more specialized themes such as anaerobic digestion, agroindustry, smallholder farming, and sustainable development, while still addressing general themes like agriculture and the rural economy. This period marks a deeper engagement with the behavioral and production aspects of agriculture.

3. 2019-2021: Sustainability became a central theme, with continued emphasis on agroindustry, livelihood, and agricultural production. The emergence of crop research indicates a more detailed exploration of specific agricultural outputs, reflecting growing concerns about environmental stewardship and socio-economic well-being.

303 4. 2022-2024: The research focus evolved to include entrepreneurial activities and business
304 aspects, with new themes like China, agricultural technology, and climate change.
305 Traditional themes like agriculture and sustainability remained important, while newer
306 advancements like agricultural robots and supply chain management emerged, signaling a
307 forward-looking approach in agricultural research.

308 This thematic evolution shows a shift from foundational agricultural practices to a focus on 309 sustainability, technology, and the economic dimensions of agriculture.





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#### Figure 10. Thematic evolution of keywords.

#### 313 4. Discussion

This research aimed to analyze the research trends in the Agri-startup scene. We extracted relevant articles from the Scopus database and utilized a combination of SNA and thematic analysis techniques. Our objective was to identify key contributors within the field and analyze their networking patterns. Moreover, through thematic analysis and creating various time-slice views, we sought to examine the progression of research themes and the clusters associated with each period. This resulted in various key findings, the most important ones were:

320 The predominant keywords identified were "agriculture," "entrepreneurship," and 321 "sustainability," with "Sustainability (Switzerland)" being the most cited journal in the field.

Analysis revealed significant contributions from the USA and the UK within the academic 322 network of agri-startups. We categorized major thematic clusters as Motor Themes 323 (characterized by high centrality and density), Basic Themes (noted for high centrality but low 324 density), Niche Themes (marked by low centrality but high density), and Emerging or Declining 325 Themes (distinguished by low centrality and density). Insights from Figure 10 allowed for 326 327 detailed identification of clusters within each thematic map, enhancing our understanding of niche areas that propel the domain, such as ecosystems and sustainability. Mendes et al. (2022) 328 similarly noted that AgTech research is driven by the intersection of digital innovation and 329 sustainability concerns, which aligns with the dominant clusters in this study. Based on the time 330 periods illustrated in Figure 11 and so on, we distinguished each thematic map cluster separately 331 to discover if they are in Motor, Basic, Niche, or Emerging or Declining themes. 332 As illustrated by Figure 11, in the period until 2011, key themes indicated an early emphasis 333 on environmental sustainability and resource management, with a focus on technological 334

advancements like bioreactors and constructed wetlands. Additionally, economic development
was underscored by themes related to small and medium-sized enterprises, reflecting the
importance of supporting smaller agricultural enterprises. The prominence of themes around
water quality and biomass highlights an early recognition of the need for sustainable resource
management in agriculture.



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#### Figure 11. Thematic map of keywords.

During 2012 to 2018, as shown in Figure 11, research themes expanded to emphasize 344 sustainable energy solutions and the role of agricultural labor, signaling a more applied focus 345 in the field. The emergence of themes such as anaerobic digestion and agricultural workers 346 347 points to a deeper exploration of how to integrate sustainable practices into agricultural operations. Themes related to capacity building and smallholder economic growth reflect 348 349 ongoing efforts to empower small agricultural enterprises and improve workforce development, indicating a shift towards enhancing human capital and economic resilience within the 350 agricultural sector. In the 2019–2021 period, scholarly focus shifted notably toward the 351 integration of technology and sustainability, particularly in relation to production efficiency and 352 resource optimization. Figure 11 shows the focus on themes like sustainable development and 353 agricultural robots highlighting an increasing reliance on technological innovation to drive 354 355 agricultural efficiency and productivity. The continued importance of themes related to agricultural technology and livelihood improvement suggests an ongoing effort to enhance 356 living standards and advance technological applications in agriculture. This period marks a 357 significant turning point where the intersection of technology, sustainability, and economic 358

359	development became more pronounced. In the most recent period from 2022 to the present
360	(Figure 11), advanced technological integration and human-centric approaches have become
361	prominent. The emphasis on detection methods, sustainability, and the broader impacts of
362	agriculture on global environmental issues reflects a sophisticated approach to modern
363	agricultural challenges. These trends also reflect the focus identified by Nemade et al.
364	(2023), who emphasize advanced agronomic practices as a foundation for sustainable crop
365	production. The importance of themes related to food security, supply chain management, and
366	innovation underscores the evolving challenges and innovative solutions in the field. Yousaf et
367	al. (2023) also emphasized the growing relevance of AI-based decision support systems in
368	agriculture, reinforcing this study's identification of technology-driven emerging themes. This
369	period highlights a comprehensive approach to addressing both technological and human
370	aspects of agriculture, including smart farming systems and innovations.
371	This research findings suggest numerous potential avenues for future research:
372	1. Impact on Sustainability and Food Security
373	Investigate how Agri-startups influence sustainability in AgTech, sustainable practices, and
374	global food security, including economic and societal impacts.
375	2. Climate-Smart Agriculture
376	Explore adaptive strategies for climate change mitigation, focusing on technologies that
377	enhance resilience and reduce emissions.
378	3. Ethical Technology Integration
379	Examine ethical considerations in agricultural technology, ensuring equitable access and fair
380	distribution of benefits.
381	4. Precision Agriculture Efficiency
382	Study the efficacy of precision agriculture technologies in diverse environments, focusing on
383	productivity and resource use.
384	5. Advanced Frameworks
385	Develop interdisciplinary frameworks to assess the societal impact of Agri-startups, promoting
386	inclusive growth.
387	6. Longitudinal Studies
388	Conduct long-term studies to track Agri-startup evolution and adaptation to market and
389	environmental changes.
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While this study provides valuable insights into Agri-startup trends, it is important to 391 acknowledge certain limitations. The reliance on the Scopus database, while comprehensive, 392 may introduce biases due to its selective indexing of journals, potentially overlooking relevant 393 studies from non-indexed or regional publications. Additionally, bibliometric analysis, though 394 useful for identifying patterns and trends, is inherently limited by its reliance on metadata such 395 as citations and keywords, which may not fully capture the depth and context of individual 396 397 studies, thereby affecting the interpretative richness of the findings.

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#### 399 5. Conclusion

To achieve an inclusive, fair, and adaptable agricultural landscape, it is necessary for 400 401 stakeholders to work together in order to address the difficulties and take advantage of the potential given by Agri-startups. These observations together emphasize the field's ever-402 403 changing development and its substantial contributions to improving agricultural practices and results. Furthermore, they emphasize the importance of a deliberate strategy in incorporating 404 cutting-edge technologies in agriculture, guaranteeing that progress is based on ethical 405 principles and has widespread advantages. As Klerkx and Rose (2020) suggest, managing 406 407 diversity and responsibility in the adoption of Agriculture 4.0 technologies is crucial to ensure inclusive innovation pathways. For policymakers, the findings suggest creating targeted 408 409 funding mechanisms, such as grants or low-interest loans, to support Agri-startups focusing on sustainability, climate resilience, and food security. Regulatory frameworks should facilitate 410 the integration of technologies like precision agriculture, smart farming, and IoT while ensuring 411 data privacy. Establishing innovation hubs or incubators can foster collaboration between 412 startups, researchers, and farmers, enabling co-creation of context-specific solutions. For 413 practitioners, adopting a multi-stakeholder approach is crucial. Agri-startups should collaborate 414 with farmers and local communities to develop affordable, scalable technologies through 415 inclusive models of Agri-entrepreneurship. Capacity-building initiatives, such as training 416 programs, can ensure innovations are accessible to all, including marginalized groups. 417 Leveraging data analytics and social network analysis can help identify emerging trends and 418 419 potential collaborators, enhancing innovation and scalability.

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523	
524	تحلیل روند استارتاپهای کشاورزی بر اساس خوشهبندی نقشه موضوعی
525	نوید محمدی، آصف کریمی، مهدی سوقی، و محمد ثابت
526	چکیدہ
527	این مطالعه از خوشهبندی نقشههای موضوعی و تحلیل شبکههای اجتماعی برای تحلیل روندهای جهانی استارت آپهای
528	کشاورزی استفاده میکند و از داده های کتاب سنجی پایگاه داده اسکوپوس بهر ه میبرد. این پژو هش مشارکتکنندگان کلیدی،
529	شبکههای همکاری و خوشههای موضوعی که محرک نوآوری در بخش کشاورزی هستند را شناسایی میکند. یافتهها
530	نشاندهنده روند صعودی قابل توجه در تحقیقات مربوط به استارتآپهای کشاورزی است که در آن موضوعاتی مانند
531	پايداري، كار أفريني و ادغام فناوري به عنوان موضوعات محوري مطرح شدهاند. اين مطالعه نقش مناطق، مؤسسات و
532	مجلات برجسته در شکلدهی به این حوزه را برجسته میکند و اهمیت فناوری های دیجیتال در پیشر فت کشاورزی را تأکید
533	مینماید. این بینشها توصیههای عملی برای ذینفعان ارائه میدهد تا نوآوری را تقویت کنند، توسعه پایدار را ترویج دهند
534	و چالشهای جهانی کشاورزی را برطرف نمایند و در نتیجه پلی میان تحقیقات دانشگاهی و کاربردهای عملی ایجاد کنند.
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