Nexus Between Foreign Direct Investment and Agriculture Sector: A Bibliometric Analysis of Scopus Database

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Abstract: *Foreign direct investment (FDI) has enormous potential to incentivise the enhancement of the agriculture sector. The introduction of FDI in the agriculture sector plays a crucial role in advancing agriculture productivity, technology, and resources. The present study aims to provide deep insight into the synchronization between FDI and the agriculture sector by using bibliometric analysis following the PRISMA protocol technique to evaluate the 162 pertinent documents retrieved from the Scopus database. Biblioshiny and Vos Viewer applications were used to identify the most prominent authors, nations, sources, publications, themes, citations, keywords, collaboration networks, and bibliographic coupling. The findings depicted that Dhahri S, Jorgenson A K, and Omri A. are the most productive and the top cited authors according to h_index in this domain. Sustainability is the most productive and top-cited source. 'South China Agricultural University' has published the highest number of documents, and China is the most productive nation. The outcome of the co-word analysis reveals the trending themes in this field, which are foreign direct investment, agriculture, FDI, agriculture production, food security, economic growth, sustainable development, foreign investment, etc. Furthermore, this study identified research hotspots in existing studies using keyword analysis and network analysis and provided future research directions related to them. The findings are intended to offer academicians detailed insight into existing research in the emerging field of FDI and the agriculture sector and recommend a potential roadmap for future research.*

Keywords: *Foreign Direct Investment; Agriculture Sector; Bibliometric Analysis; Science Mapping*

Introduction

The agriculture sector is essential for the development of the economy around the globe, particularly in developing economies. Agricultural development is substantial for enhancing food security, precisely due to its significance and effectiveness in increasing food supply, accessibility, and the stability of food systems (Jiang & Chen, 2020). Sustainable agriculture is the main focus of the 2030 UN agenda, and it is also the first vital step towards reaching zero hunger. Sustainable agriculture is the best approach to challenge primary issues related to food security. According to estimations from the Food and Agriculture Organization (FAO), $209 billion of annual investments will be required on average to meet the anticipated demand for agricultural productivity in 93 developing nations by the year 2050 (Chen et al., 2017). Most of the less developed nations depend on foreign agricultural investment to fulfil their development requirements due to their limited capacity to invest in the agriculture sector (Jiang et al., 2018).

The recent outbreak of coronavirus also affected the agriculture sector. It is vital to strengthen agricultural resilience in the current circumstances, encourage green production, and investigate the key factors affecting agricultural productivity as several other changes in global development emerge (Chen et al., 2022). The economic fallout from the pandemic affected farmer's financial stability. Thus, the majority of agriculture producers continue to engage in traditional farming practices and hand labour regardless of the significance of the agriculture sector for the economic prosperity of emerging nations. Such practices increase production costs while simultaneously lowering agricultural yield. Inadequate investment in the agriculture sector also results in low production and stagnant agricultural productivity. By overcoming the investment and technology gaps in the agriculture sector that occur primarily due to inadequate income and credit sources, Foreign Direct Investment (FDI) significantly contributes to enhanced growth in this sector (Awunyo-Vitor & Sackey, 2018).

The introduction of FDI is able to bring in technology, experience, capital, and best practices that can have a favourable influence on the agriculture sector when it is properly directed and accompanied by appropriate regulations and policies. In order to boost their agricultural production and meet the demands of agricultural development, many emerging nations have started encouraging foreign direct agricultural investment (Kaarhus, 2018). Agriculture development could be accomplished by enhancing the level of agricultural exports, utilizing advanced production techniques, and effectively incorporating foreign resources (Sikandar et al., 2021). Foreign investment has been cited as a significant factor in determining agriculture productivity because of the technological and management skill transfers that can benefit farmers (Santangelo, 2018). The ability to export agricultural products and earn foreign exchange can also be facilitated by FDI, which can help to link local agricultural producers to overseas markets.

Some researchers believe that FDI is a significant driver of economic development (Korsah et al., 2022; Nguyen et al., 2020) and agricultural production (Ahmed et al., 2017; Dhahri & Omri, 2020b). FDI appears to be a practical way to stabilize and boost economic growth, especially in the agriculture sector. With the establishment of agricultural projects that create employment and agricultural value-added, FDI may incentivise agricultural productivity and aid in achieving sustained agricultural growth. In several nations, the agricultural sector is an important indicator of employment generation. The primary source of income in rural regions is the agriculture sector, which supplies the majority of food necessities for the rural people and makes up a sizeable component of GDP.

The study aims to specify an overview of the synchronization among FDI and the agriculture

sector. So, this research attempted to discuss the following research questions:

RQ 1: What is the annual growth of publications, and which authors, affiliations, outlets, and nations produce the most documents in this domain?

RQ 2: Who is the most cited contributor, and what is the pattern of collaboration among authors and nations in this area?

RQ 3: Which themes have emerged recently in this field?

RQ 4: What could be the focus of future research on the relationship between FDI and the agriculture sector?

Scanty of empirical, exploratory, and conceptual studies have been conducted on FDI and the agriculture sector in economics, business management, and finance. However, the novelty of this research is that it explores the literature review and comprehensive science mapping of the synchronization among FDI and the agriculture sector. This research is anticipated to assist researchers in identifying past trends, emerging themes, and future research directions pertaining to aligning the synchronization among FDI and the agriculture sector.

Research Methodology

This research is based on the bibliometric Scopus database. The bibliometric analysis is a quantitative analysis technique to gain insights into a collection of documents (De Bakker et al., 2005; Muhuri et al., 2019). For systematic analysis, several parameters are used in this study, such as annual growth of publication, citation analysis (authors, source, and documents), bibliographic coupling, collaboration network of authors and nations, and keywords co-occurrence analysis.

Database: Scopus and Web of Science (WOS) are the most widely recognized and multidisciplinary databases worldwide (Saleem et al., 2021). The Scopus database is used for this study because it is one of the largest databases of scientific literature (Nobanee et al., 2024) and encompasses publications from more than 11,000 different publishers, comprising scientific journals, conference proceedings, and books (Yadav et al., 2023). It includes a wider range of global research outputs that serve the fields of humanities, social science, science, medicine, and other disciplines. Additionally, it makes the analytic process more convenient by ensuring that the author's profiles and institutional addresses are available for each document (Mongeon & Paul-Hus, 2016).

To find the pertinent research documents, the authors applied the following search query (Title, Keywords, and Abstract): ("Foreign Direct Investment" AND "Agriculture*") OR ("FDI" AND "Agriculture*") OR ("Foreign Direct Investment" AND "Agribusiness*") OR ("FDI" AND "Agribusiness*") on 07 November 2024 retrieved 585 documents (Figure 1). Further limit to 'Subject Area' in four subjects: (1) Economics, econometrics, & Finance (2) Business, management, & Accounting (3) Arts & Humanities (4) Social Sciences, it results in 424 documents. In document type, only published articles and the language of documents is limited to English only, which retrieved 318 documents from the Scopus database (Figure 1). Furthermore, the present study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyzes (PRISMA) protocol for the inclusion and

exclusion of documents. Lastly, after reading the documents, the authors consider 162 relevant documents that explore the relationship between foreign direct investment and the agriculture sector (Figure 1).

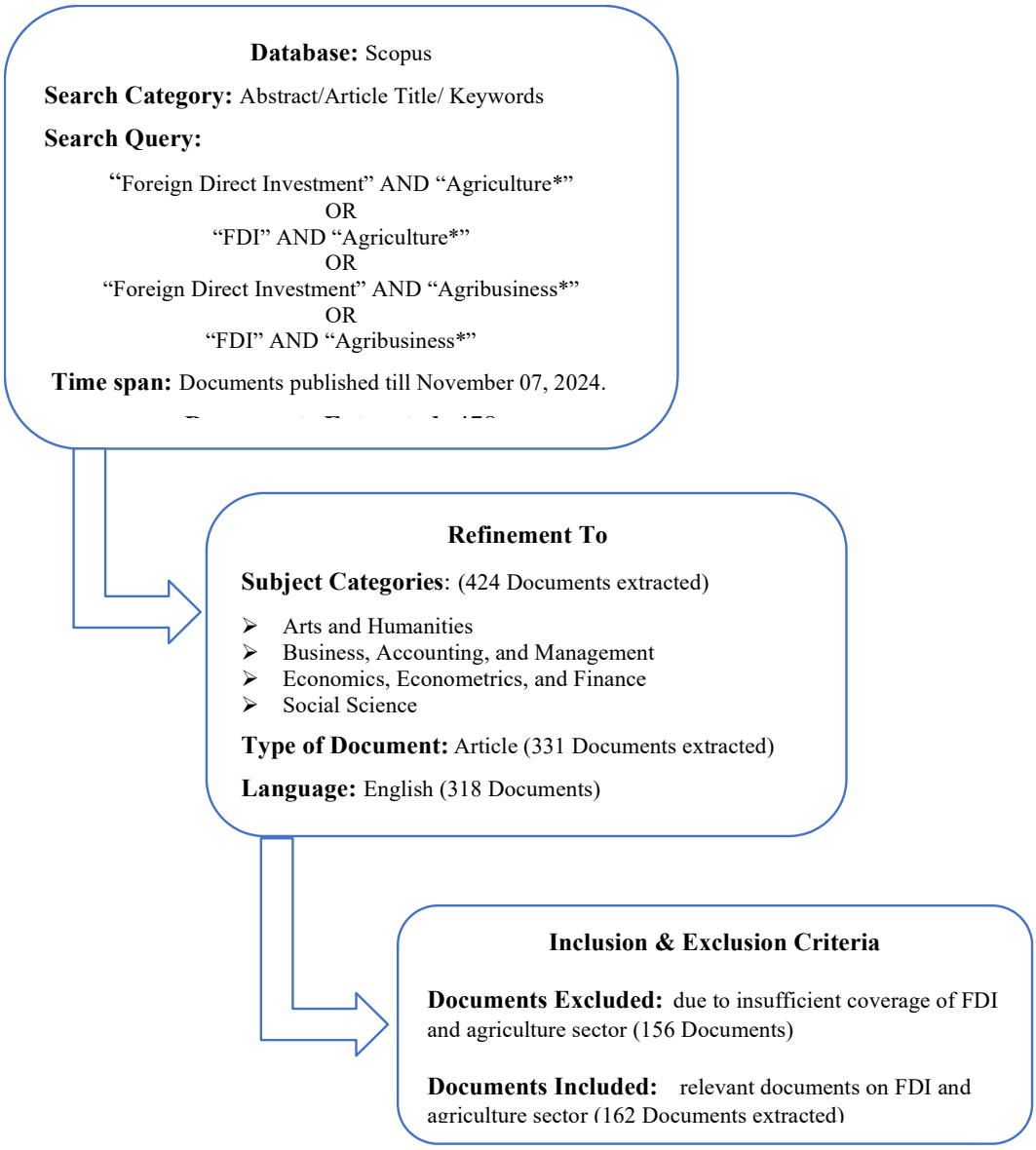

Figure 1: Data inclusion process

Data Analysis

Bibliometric networks have been analyzed and visualized using the Biblioshiny, Microsoft Excel, and Vos Viewer interfaces. Biblioshiny is a user-friendly interface for science mapping analysis that facilitates users to conduct pivotal bibliometric and visual research through an interactive online interface (Davidescu et al., 2022). Vos Viewer interface can generate several graphs using the bibliometric dataset, such as keyword co-occurrence map, bibliographic coupling map, co-authorship map, citation, and co-citation map (Van Eck & Waltman, 2010).

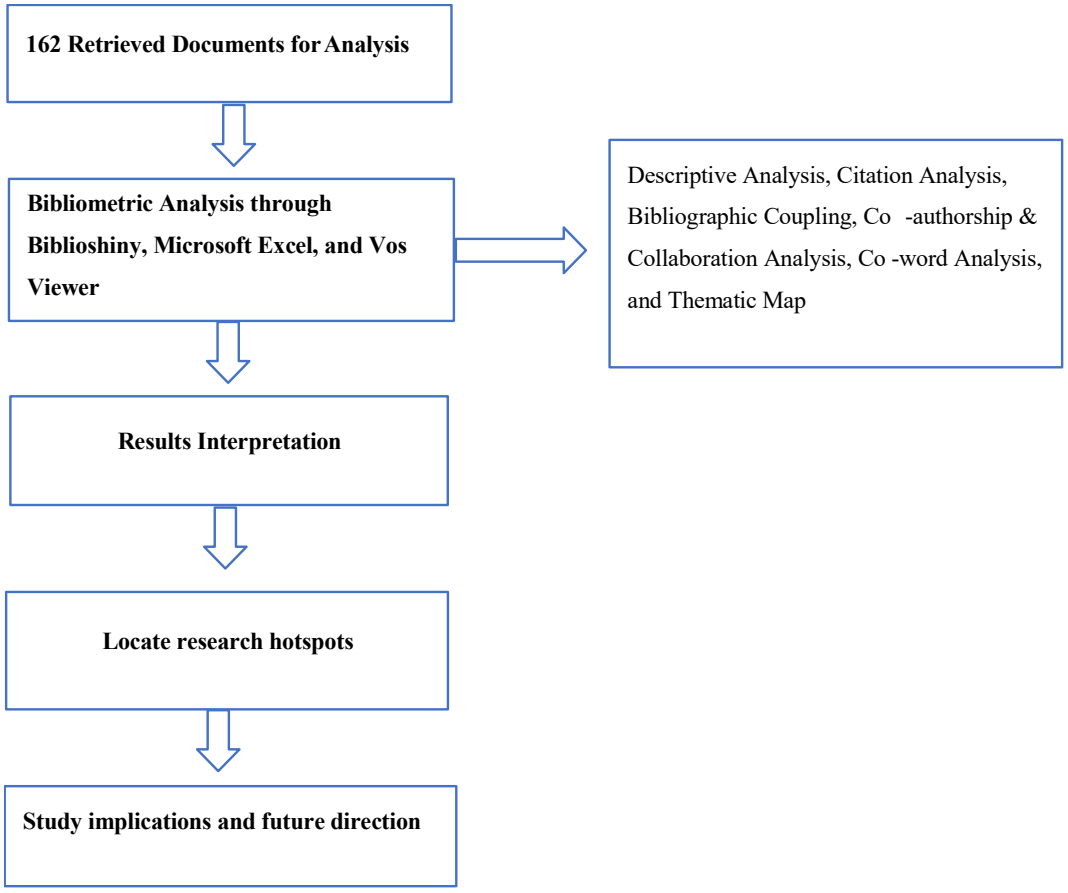

Figure 2: Data analysis workflow chart

Analysis and Results

Descriptive Analysis:

Data Sets: An overview of bibliometric data retrieved from the Scopus database between 1989 to 2023 (Table 1). The biblioshiny application (Aria & Cuccurullo, 2017) is used for various analytical dimensions of bibliometric data, and the result comprises 162 documents from 124 sources contributed by 372 authors, with an average co-authorship of 2.5 per document. The dataset includes 465 author's keywords and 377 keywords plus, with an average citation of 11.61 per document.

Table 1: Data set summary

Description	Results
Documents	162
Sources (Journals, Books, etc.)	124
Keywords plus (ID)	377
Author's Keywords	465
Timespan	1989-2024
Average citations per document	11.61
Annual Growth Rate%	7.09
Authors	
Authors	372
Authors of single-authored documents	46
Authors of multi-authored documents	326
Author's Collaboration	
Single-authored documents	50
Documents per author	0.43
Authors per documents	2.30
Co-authors per documents	2.5

Annual Growths of Publication: The evolution of publications and the first article related to this area was published in 1989 (Reese et al., 1989) (Figure 3). The scanty of studies were published between 1989 to 2014. Since the year 2015, publications in this field picked up the pace. In 2015, the adoption of the agenda for sustainable development, which includes 17 SDGs, by United Nations Member States may be the reason for the research community's growing interest in this field (United Nations, 2015). Therefore, from 2015, the volume of studies also increased regularly and consistently. The most studies were published in 2020 and 2022, with 19 publications, followed by 2023, with 16 publications. 74.07% of 162 studies have been published between 2015-2024 (till 07 November) in the previous 10 years, which depicts the evolving scenario of research in this area.

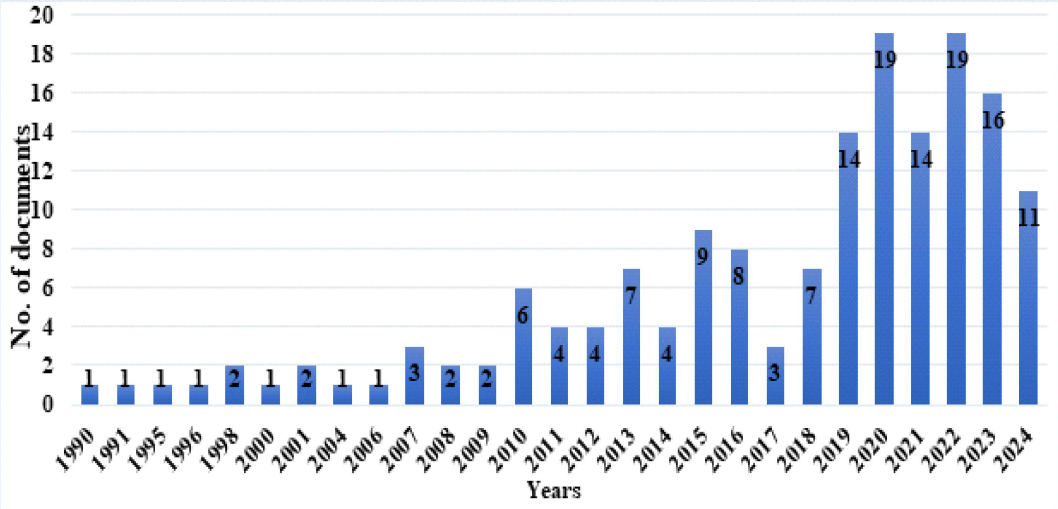

Figure 3: Annual scientific production. Source: Scopus data analyzed through Biblioshiny.

Most Productive: A bird's-eye view of the top productive authors, affiliations, sources, and nations in this field (Tables 2 & 3). Djokoto, J. G. was the most productive researcher with 4 publications, followed by Dhari, S., Jorgenson. A. K., Kastratović, R., Omri, A., Udemba, E. N., and Alagidede, I. P. with 3 publications each (Table 2).

Sustainability was the most productive source with the most publications, 12 scientific literature, followed by Journal of Peasant Studies and Agribusiness with 5 documents each related to FDI and the agriculture sector (Table 3). South China Agricultural University published a maximum of 7 documents in this domain. China and the USA published the maximum number of 54 and 46 documents, followed by Ghana and India, with 28 and 24 documents, being the most productive nations in this area. Further, it inferred that except the USA and UK, all other countries are developing economies in most document production. This concludes that developing nations have a significant interest in this area.

Table 2: Most productive authors.

Rank	Author	Affiliation	Documents Count
1	Djokoto, J. G.	Central University, Accra, Ghana	4
2	Dhahri, S.	University of Sfax, Tunisia	3
3	Jorgenson, A. K.	University of Utah & Washington State University, USA	3
4	Omri, A.	Qassim University, Saudi Arabi & Carthage University, Tunisia	3
5	Kastratović, R.	University of Belgrade, Serbia	3
6	Udemba, E. N.	Istanbul Gelisim University, Turkey	3
7	Alagidede, I. P.	University of the Witwatersrand, South Africa	3
8	Andrianarimanana, M. H.	Chongqing University, China	2
9	Asamoah, M. E.	Central University, Accra, Ghana,	2
10	Chaudhuri, S.	University of Calcutta, India	2

Source: Scopus data analysis through Biblioshiny

Table 3: Most Productive Journal, Affiliations, and Country.

Rank	Sources	Documents Count	Affiliations	Documents Count	Country	Documents Count
1	Sustainability	12	South China Agricultural University	7	China	54
2	Journal of Peasant Studies	5	Istanbul Gelism University	6	USA	46
3	Agribusiness	5	King Saud University	6	Ghana	28
4	International Journal of Recent Technology and Engineering	4	Universiti Putra Malaysia	6	India	24
5	Cogent Economics and Finance	4	SLIIT Business School	6	Nigeria	19
6	African Development Review	2	Institute of Agricultural Economics and Development	5	Pakistan	18

7	China Agricultural Economic Review	2	Nanjing Agricultural University	5	UK	14
8	Economic Reseach-Ekonomska Istrazivanja	2	Northeast Forestry University	5	Turkey	12
9	International Journal of Scientific and Technology Research	2	International Water Management Institute	4	South Africa	12
10	Journal of Agricultural Economics	2	Chongqing Normal University	4	Brazil	10

Source: Scopus data analysis through Biblioshiny

Citation Analysis

In this research, citation analysis was measured in three subsets: document citation, author citation and source citation.

Documents Citation: A published document's citation count is acknowledged as one of the significant indicators in determining its caliber, scientific significance, and importance in the field of study (Aria & Cuccurullo, 2017). With 128 global citations[1], it is identified that the document "Foreign Direct Investment, inequality, and growth" (Basu et al., 2007) is the most globally cited publication, followed by the publication "New investment, old challenges. Land deals and the water constraint in African agriculture" (Woodhouse, 2012) with 102 citations (Table 4).

(Footnotes)

[1] Global citation is the aggregate number of citations a publication received from the entire Scopus database.

Table 4: Most globally cited documents.

Rank	Title	Source	Global Citations
1	Foreign Direct Investment, inequality, and growth. (Basu et al., 2007)	Journal of Macroeconomics	128
2	New investment, old challenges. Land deals and the water constraint in African agriculture. (Woodhouse, 2012)	Journal of Peasant Studies	102
3	Institutions and FDI: evidence from developed and developing countries. (Sabir et al., 2019)	Financial Innovation	101
4	Agrarian structure, foreign investment in land, and land prices in Brazil. (Sauer & Pereira Leite, 2012)	Journal of Peasant Studies	81
5	The impact of FDI in land in agriculture in developing countries on host country food security. (Santangelo, 2018)	Journal of World Business	70

Document "Institutions and FDI: evidence from developed and developing countries" (Sabir et al., 2019) published in the Financial Innovation is the highest trending article with the maximum number of citations every year (Table 5). It is also the third most cited article in most globally cited documents. Regardless of the year of publication, the number of citations every year aids in comparing the impact of the publications.

Table 5: Top trending documents

Rank	Title	Source	Total Citations	TC Per Year
1	Institutions and FDI: evidence from developed and developing countries. (Sabir et al., 2019)	Financial Innovation	101	16.83
2	The impact of FDI in land in agriculture in developing countries on host country food security. (Santangelo, 2018)	Journal of World Business	70	10
3	Green economy, Scandinavian investments and agricultural modernization in Tanzania. (Bergius et al., 2017)	Journal of Peasant Studies	67	9.57
4	New investment, old challenges. Land deals and the water constraint in African agriculture. (Woodhouse, 2012)	Journal of Peasant Studies	102	7.85
5	Foreign Direct Investment, inequality, and growth. (Basu et al., 2007)	Journal of Macroeconomics	128	7.11

Santangelo (2018) is the most locally cited document, and surprisingly, it is observed that (Basu et al., 2007; Sabir et al., 2019; Woodhouse, 2012) were the top 3 globally cited documents, but they could not be in the list of top locally cited documents (Table 6). It implies that there is a difference between the global and local citations[1].

([1] Global citation is the aggregate number of citations a publication received from the entire Scopus database.

[2] Local citation is the sum of citations a publication receives from the other publications in the selected dataset (Cipollina et al., 2021)

Table 6: Top 5 local cited publications

Rank	Documents	Source	Local Citations
1	The impact of FDI in land in agriculture in developing countries on host country food security. (Santangelo, 2018)	Journal of World Business	7
2	The role of sectoral FDI in promoting agricultural production and improving food security. (Ben Slimane et al., 2016)	International Economics	6
3	Effects of foreign direct investment in African agriculture. (Gunasekera et al., 2015)	China Agricultural Economic Review	5
4	FDI in agricultural land, welfare and unemployment in a developing economy. (Chaudhuri & Banerjee, 2010)	Research in Economics	5
5	Agricultural sector foreign direct investment and economic growth in Ghana. (Awunyo-Vitor & Sackey, 2018)	Journal of Innovation and Entrepreneurship	4

Authors Citation: Woodhouse P. is the most cited author from "The University of Manchester" who obtained the highest 144 total citations, followed by Basu P. and Guariglia A. from "Durham University" and "University of Nottingham" with 128 citations each (Table 7).

Table 7: Top 10 cited authors

Rank	Author	Organization	Total Citations
1	Woodhouse P.	The University of Manchester, United Kingdom	144
2	Basu P.	Durham University, United Kingdom	128
3	Guariglia A.	University of Nottingham, University Park, United Kingdom	128
4	Jorgenson A. K.	University of Utah & Washington State University, USA	119
5	Abbas K.	Department of Statistics, University of Azad Jammu & Kashmir, Pakistan	101
6	Rafique A.	Kashmir Institute of Economics, University of Azad Jammu & Kashmir, Pakistan	101
7	Sabir S.	Kashmir Institute of Economics, University of Azad Jammu & Kashmir, Pakistan	101
8	Pereira Leite S.	Federal Rural University, Rio de Janeiro, Brazil	81
9	Sauer S.	University of Brasilia, Brazil	81
10	Santangelo G. D.	University of Catania, Italy	70

According to the number of citations per document, only authors with at least 1 publication have been considered (Table 8). Woodhouse P., Jorgenson A.K., and Chaudhuri S. are the top authors who received the maximum number of citations for each document.

Table 8: Top 10 authors in terms of citation per document

Rank	Author	Organization	Citations per document
1	Woodhouse P.	The University of Manchester, United Kingdom	72
2	Jorgenson A.K.	University of Utah & Washington State University, USA	39.67
3	Chaudhuri S.	University of Calcutta, India	32
4	Wang J.	Fuzhou University, China	16
5	Dhahri S.	University of Sfax, Tunisia	14.67
6	Omri A.	Qassim University, Saudi Arabia & University of Carthage, Tunisia	14.67
7	Jiang X.	Institute of Agricultural Economics and Development, Chinese Academy of Agricultural Sciences, China	12
8	Kastratović R.	University of Belgrade, Serbia	6.67
9	Djokoto J.G.	Central University, Accra, Ghana	6
10	Udemba E.N.	Istanbul Gelisim University, Turkey	2.33

The h_index is based on the researcher's most cited article and the times their work has been cited in other documents (Hirsch, 2005). After extracting results from the Biblioshiny application of the selected dataset, the Top 10 author's h_index depicts that the Dhahri S., Jorgenson A.K., Omri A., and Djokoto JG tops the enlist of h_index of selected dataset and most influential authors (Figure 4).

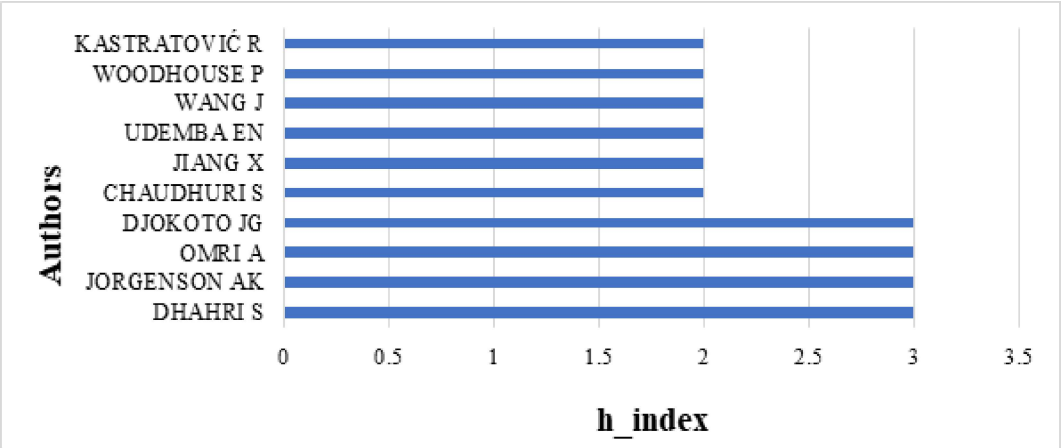

Figure 4: Top 10 authors h_index. Source: Scopus database analysis through biblioshiny

Source Citation Analysis: It refers to the number of times an article from a journal is cited by other researchers in their studies, and the higher the citation, the higher the journal quality (Ingale & Paluri, 2022). The Journal of Peasant Studies is the top-cited and most impactful journal, as it has received the maximum number of 280 citations in this field. Sustainability, Journal of Macroeconomics, and Financial Innovation are other top 3 sources with 149, 128, and 101 citation counts, respectively (Table 9).

Table 9: Top-cited sources

Rank	Source	Number of Citations
1	Journal of Peasant Studies	280
2	Sustainability	149
3	Journal of Macroeconomics	128
4	Financial Innovation	101
5	Society and Natural Resources	78
6	Journal of World Business	70
7	Journal of Rural Studies	69
8	Journal of Innovation and Entrepreneurship	63
9	International Economics	47
10	Water Alternatives	42

As per the citations per document, the Journal of Macroeconomics is the most impactful journal, with 128 citations, followed by Financial Innovation and Journal of World Business, with 101 and 70 citations, respectively (Table 10). Journal of Peasant Studies tops the list of the top-cited outlets (Table 9) but slips to the 5th in the list of cites per document with 56 citation counts (Table 10).

Table 10: Top 10 sources in terms of cites per document

Rank	Source	Cites per document
1	Journal of Macroeconomics	128
2	Financial Innovation	101
3	Journal of World Business	70
4	Journal of Rural Studies	69
5	Journal of Peasant Studies	56
6	International Economics	47
7	Water Alternatives	42
8	International Journal of Comparative Sociology	41
9	Society and Natural Resources	39
10	International Studies Quarterly	39

Bibliographic Coupling

Bibliographic coupling, the practice of two works citing the same third work in their bibliographies, is a similarity metric that generates the association among publications, outlets, authors, countries, and affiliations by analyzing their citations. Some researchers used bibliographic coupling in their documents, such as documents coupling (Bhatnagar & Sharma, 2022), authors coupling (Davidescu et al., 2022), journal coupling (Small & Koenig, 1977), country coupling (Merigó et al., 2016), organization coupling. The volume of citations that the two articles share determines the degree of their bibliographic coupling. A higher total link strength (TLS) indicates a stronger connection among the entities (Van Eck & Waltman, 2014). For bibliographic coupling analysis, this study used Vos Viewer software, which provides flexibility to set the threshold limit for users. To obtain as much information as possible, the boundary condition was reduced to the barest lowest to meet the threshold.

The bibliographic coupling of top contributors according to TLS among authors, articles, outlets, affiliations, and countries (Table 11). With a TLS of 889, Chen Y. is the most influential author. Sustainability and Review of World Economics are the two most impactful sources, with TLS of 179 and 125, respectively. The bibliographic coupling of documents displays the article cited in the bibliographies of two distinct publications. With a link strength of 77, 'Are international capital flows really matter for achieving SDGs 1 and 2: ending poverty and hunger?' authored by (Dhahri & Omri, 2020a) is the most influential publication in this domain. The University of Sfax, Tunisia, has a very impactful affiliation with a TLS of 810 in the research on FDI and its relatedness to the agriculture sector. The United States is the most influential in countries, followed by China and Tunisia, with a link strength of 1280, 1147, and 759, respectively.

Table 11: Based on total link strength (TLS), top contributors from bibliographic coupling

Rank	Author	TLS	Document	TLS	Outlet	TLS	Affiliation	TLS	Nation	TLS
1	Chen, Y.	889	Are international capital flows really matter for achieving SDGs 1 and 2: ending poverty and hunger? (Dhahri & Omri, 2020a)	77	Sustainability	179	University of Sfax, Tunisia.	810	United States	1280
2	Dhahri, S.	804	Foreign capital towards SDGs 1 & 2—Ending Poverty and hunger: The role of agricultural production. (Dhahri & Omri, 2020c)	69	Review of World Economics	125	University of Central Punjab, Pakistan.	525	China	1147
3	Omri, A.	804	Investing in agriculture: A preference for democracy or dictatorship? (Bastiaens, 2016)	64	Journal of Peasant Studies	80	College of Economics and Management, Northeast Forestry University, China.	525	Tunisia	759
4	De alban, J.D.T.	707	Modernization vs. Dependency Revisited: Effects of Foreign Direct Investment on Food Security in Less Developed Countries. (Mihalache-O'keef & Li, 2011)	62	Structural Change and Economic Dynamics	69	Stavropol State Agrarian University, Russian Federation.	525	Canada	742
5	Jamaludin, J.	707	Does foreign capital really matter for the host country agricultural production? Evidence from developing countries. (Dhahri & Omri, 2020b)	58	British Journal of Politics and International Relations	64	Harbin Engineering University, China.	525	Pakistan	673

Collaboration and Co-authorship Analysis

A network where the nodes are authors and the links are co-authorships is a scientific collaboration network between two or more authors in a field or area of interest (Jalal, S. K. 2019). The thicker the link, the greater the level of cooperation. The biblioshiny application creates collaboration and co-authorship visualization maps of the selected dataset (Figure 5-6). This research shows the collaboration network of authors and nations. The study identified that very little interaction is visible at the author's level of collaboration (Figure 5). Dhahri and Omri collaborated, and both are also the top authors in the production of articles. Chen collaborated with Jiang and Wang; both the former are from China and the latter from the United Kingdom. The identification of a collaborative network involving researchers Alagidede, Asamoah, and Adu, all hailing from the African continent, highlights a meaningful collaboration among African researchers in this domain

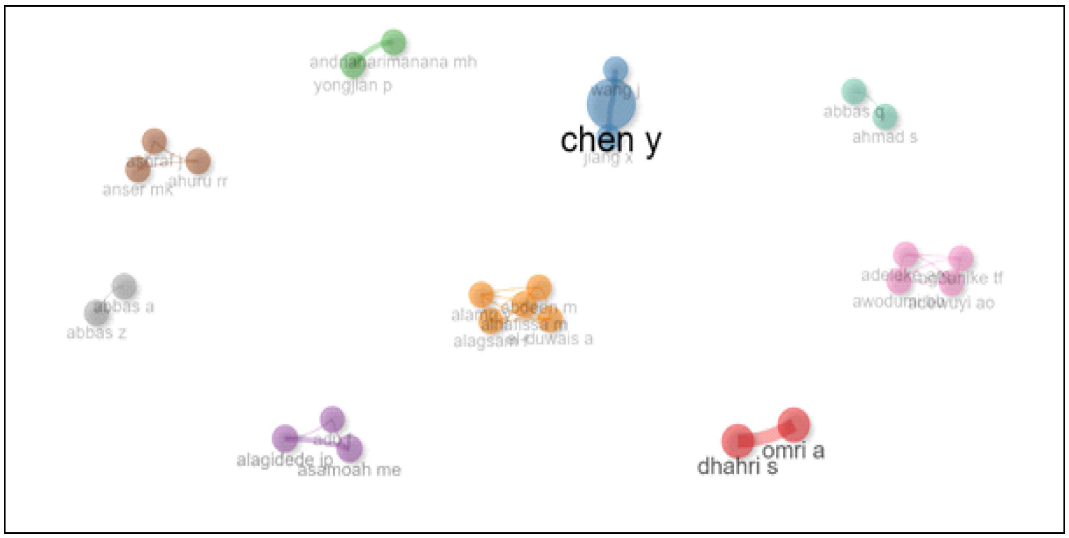

Figure 5: Authors collaboration networks

Cooperation among nations is in the early stages; however, it must be encouraged to broaden research in this area. It could indicate the degree of communication among nations, incorporating those who have significant influence in this domain. As per nations' collaboration networks, the USA collaborated with most nations, such as Germany, the United Kingdom, Morocco, Armenia, Myanmar, Singapore, and Liberia (Figure 6). China is the most productive nation in terms of publication. However, in collaboration network analysis, China collaborated with a few nations, such as the USA, Pakistan, Nigeria, and Korea. India collaborated with Hungary and Ghana in this domain. This shows that Indian researchers have no interest in collaborating with researchers from other nations in this field. The overall finding shows no evidence of a well-established collaborative network among nations. This denotes a lack of collaboration among researchers from different nations on FDI and its relatedness to agriculture. To increase research in this field, more and more collaboration is needed.

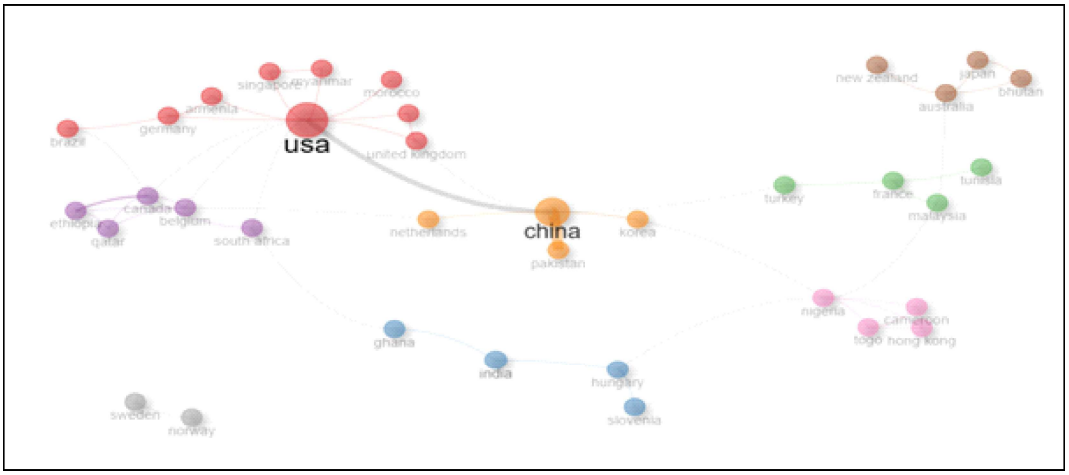

Figure 6: Countries collaboration network

Emerging Trends and Thematic Analysis

Co-word Analysis: It is a content analysis method used to map the level of relationship between textual data's informative elements of identifying, describing, and visually representing the connection among keywords in a scientific subject (Callon et al., 1983). It monitors the number of documents in which how frequently two keywords occur together to analyze their co-occurrence frequency (Rojas-Lamorena et al., 2022). A scientific discipline can utilize co-word analysis to quantify the connections between its research themes, discover domains and trending topics, and forecast future trends. This research used both the index and the author's keywords for analysis. As per the author's opinion, the author's keywords are a collection of words that best capture the work and demonstrate the underlying themes of the research. The publisher uses index keywords to index the documents.

Keyword Statistics: It identifies the vital keywords in the documents related to FDI and the agriculture sector. The outcome of keyword analysis reveals 465 authors and 377 index keywords of the Scopus bibliometric dataset, resulting in 741 keywords in this domain. Table 12 enlists the top 15 authors and indexes keywords based on the frequency of their occurrence in this domain.

Table 12: Shows the most occurring authors and index keywords.

Rank	Authors Keywords	Occurrences	Index Keywords	Occurrences
1	Agriculture	44	Foreign Direct Investment	59
2	Foreign Direct Investment	42	Agricultural Production	19
3	FDI	22	Agriculture	15
4	Food Security	10	Developing World	13
5	Economic Growth	9	Agricultural Development	12
6	Africa	8	Agroindustry	12
7	Agribusiness	7	Food Security	10
8	Developing Countries	7	Economic Growth	9
9	India	6	Sustainable Development	9
10	Land Grabbing	6	Governance Approach	7
11	Brazil	5	Investment	7
12	Foreign Investment	5	Capital Inflow	7
13	Globalization	5	Agricultural Land	7
14	China	5	China	7
15	Sustainable Development	5	Brazil	6

The authors have frequently used agriculture, foreign direct investment, FDI, food security, and economic growth, whereas publishers have used foreign direct investment, agriculture production, agriculture, agroindustry, and agricultural development. The researchers in this area focused on measuring the synchronization among FDI and the agriculture sector along with food security, economic growth, and agribusiness in Africa, Brazil, China, India, and developing nations. The frequency of occurrence of the author's keywords, such as agriculture, foreign direct investment, FDI, and agribusiness, also confirmed the search term used for selecting the dataset. However, based on their occurrence, the publisher focused on measuring the synchronization among FDI and the agriculture sector (agriculture production, agroindustry, and agricultural development). This research's subsequent analysis relies on author keywords

that indicate works linked to the paper's goal. In addition, author keywords are included in the study to preserve consistency among the outcomes produced by various keyword analysis software.

Visualization of Co-occurrence of All Keywords: A network can be mapped using keyword co-occurrence analysis. The network's nodes stand in for individual keywords, and their connections signify the co-occurrence of those terms (Azevedo et al., 2019). By analyzing the co-occurrence of keywords, researchers can gain insight into new discoveries and trends in a discipline.

The co-occurrences of all 741 keywords were examined with the intent of showing the research hotspots in the area of synchronization among FDI and the agriculture sector. Using the entire counting approach, Vos Viewer software was used for co-occurrence analysis with the minimum requirement of 3 times the occurrence of keywords. It results in 6 clusters of 81 keywords with 796 links and 1305 TLS. The word link denotes the existence of an association between two keywords. The total number of articles in the sample documents where two keywords co-occurred is indicated by the TLS. Cluster 1 comprises 22 elements, subsequently followed by clusters 2, 3, 4, 5, and 6, having 15, 13, 13, 11, and 7 elements, respectively (Figure 7). Based on TLS top 5 keywords are foreign direct investment, agriculture, agricultural production, agroindustry and FDI with value of 342, 195, 117, 64, and 64, respectively.

To demonstrate recent trends in publication, the overlay visualization network analysis was performed to gaze at the frequency of keywords based on time series (Figure 7). It is clear that the keywords that are indicated in yellow and light green-yellow are those that have been employed in the documents recently. The findings reveal that agriculture sector, foreign direct investments, agricultural policy, investment, agribusiness, poverty alleviation, agricultural trade, sustainable development, economic growth, energy consumption, etc., had an average publication of keywords in 2020 and after 2020.

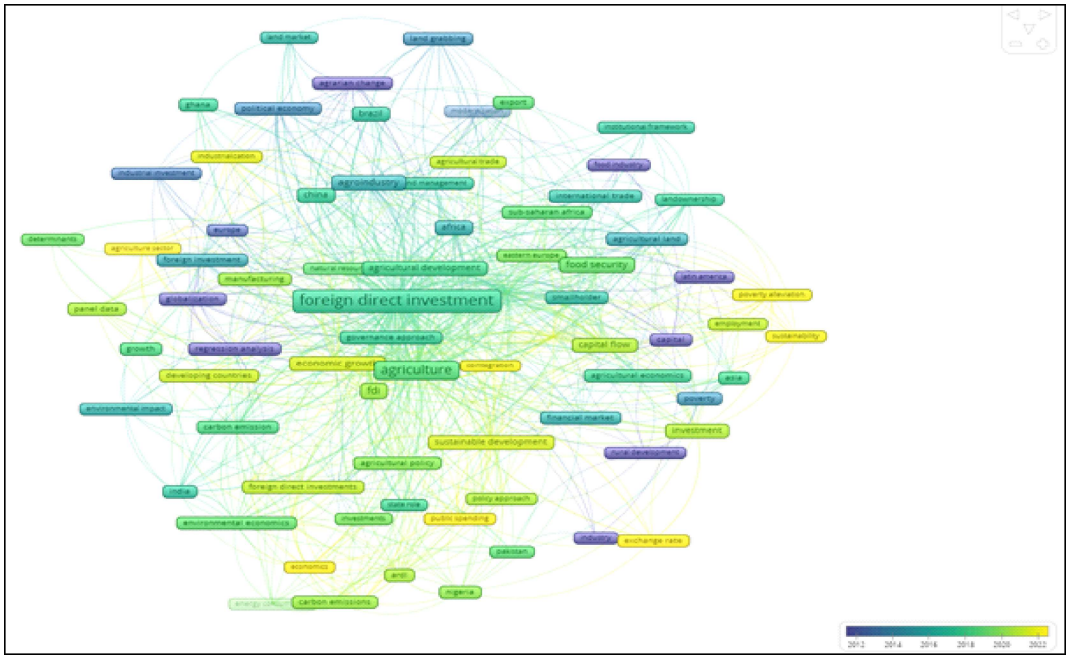

Figure 7: Overlay visualization of occurrence of keywords. Source: The selected dataset was analyzed through Vos Viewer.

Thematic Map: A thematic map is used to plot the typological themes on a two-dimensional graph. Key themes based on authors' keywords are identified by thematic analysis of authors' keywords in this domain. With the help of the author's keywords, keywords plus, titles, and abstracts, the biblioshiny application allows users to create broad themes. On the two-dimensional graph, where the two dimensions are centrality and density, these themes can be split into four quadrants according to their centrality and density. Every theme is portrayed by a bubble on the map. In the current study, a thematic map was created using the author's keywords (Figure 8). In a thematic map, the upper right quadrant displays the leading or vital themes.

Foreign direct investment, agriculture, agricultural growth, FDI, agribusiness, sustainable development, etc., are this domain's most discussed and developed themes. The lower right quadrant of the thematic map shows that the underlying themes, such as food security, agricultural production, poverty reduction, etc., are vital but not fully developed. The niche themes are shown in the upper left quadrant, while the emerging themes in this field are agribusiness, land grabbing, and industrialisation, displayed in the lower left quadrant.

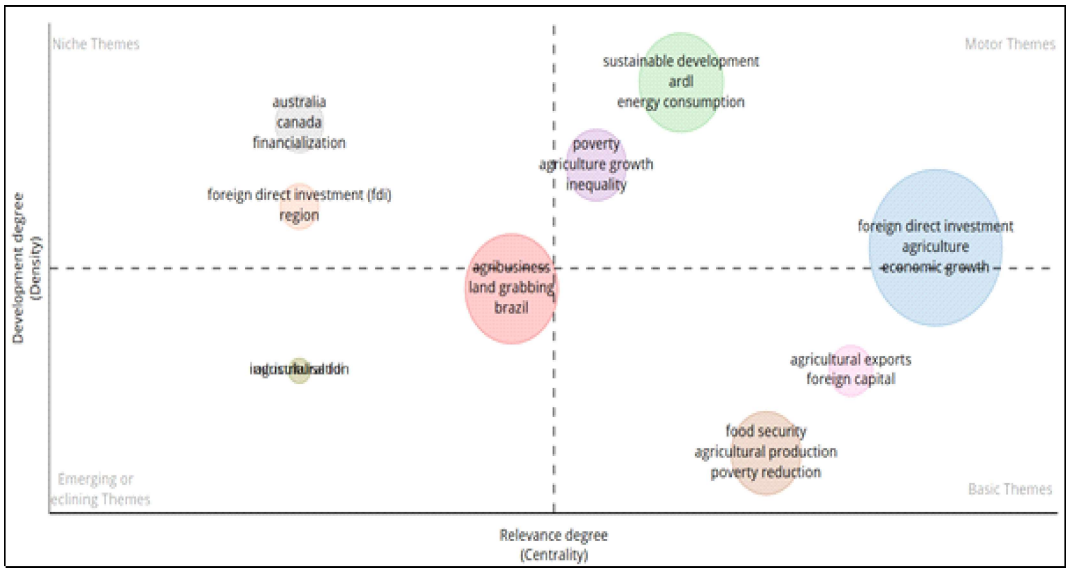

Figure 8: Thematic map of author's keywords

Research Hotspots Future Directions

Impact of FDI on Agricultural Productivity (AP): The growth of AP and the economy of emerging nations both rely significantly on FDI. Several empirical studies have revealed that FDI significantly improves the AP of nations (Badu-Prah et al., 2023; Sandumini et al., 2024; Soni & RL, 2024). Future studies could consider the additional research to distinguish among the short and long-run impacts of foreign funds inflows on the advancement of the agriculture sector and reduction of poverty, as well as to test these impacts on a broader range of least developed and emerging nations in Africa, Latin America, and Asia (Sikandar et al., 2021). Wang et al. (2019) recommended that to direct agricultural FDI into China's agricultural production services and offer technological assistance and administration services for Chinese agricultural enterprises, the foreign capital deployment and collaboration model must be reinvented. Further studies could

consider the nature, origin, and aim of foreign aid in assessing its impact rather than just the total amount of foreign aid that can affect agricultural productivity (Dhahri & Omri, 2020b). Policymakers should frame policies related to assisting agricultural producers in enhancing productivity through the advancement of farming technologies and the supply of satisfactory quality resources such as seeds, fertilizer, and pesticides from FDI.

Effect on Agricultural Export: The rise in agricultural exports is necessary to achieve faster economic growth. Future research will focus on encouraging FDI inflow in developing nations that will help them to overcome the shortage of financial resources in financing the agricultural sector in developing nations, which is a significant barrier to agricultural exports. The macro-level justification for the agriculture industry's export competitiveness from developing markets was explored in an earlier study; future research on the micro-level justifications is possible (Huo et al., 2020).

Poverty Reduction and Food Security: The UN agenda of Sustainable Development includes key concerns on food security and eliminating poverty. There has been an enormous decline in global food security in recent years, specifically in developing nations. Further, researchers could investigate the effect of FDI inflow on the other goals of sustainable development (along with eliminating poverty and hunger) closely related to the agriculture sector (Dhahri & Omri, 2020c). Jiang & Chen (2020) recommend that the host nations should formulate an extensive plan of action that integrates foreign agricultural investment into their domestic agricultural development goals. Further, it suggested to facilitate foreign agricultural investment to flow to vital regions that support food security and fight against poverty in the host nation.

Influence on Macroeconomic Variables: Growth is considered as a burning issue in economics. Macroeconomic studies could be expanded to include other emerging economies from the other country categories, such as ASEAN, developed nations, the European Union, etc. Additionally, the relationship between sectoral FDI and economic growth can be examined in light of other conditional variables such as institutional quality, financial development, governance indicators, human capital, etc.

Impact on Agricultural Emissions: Research could be carried out on measuring the connections between sectoral FDI inflow and various other components of GHG emissions (except CO2 emission), which can undoubtedly improve decision-makers understanding of FDI inflow and environmental interaction in its broadest sense (Pazienza & De Lucia, 2020). The studies could also focus on framing policies related to the attraction of FDI in an efficient manner to reduce environmental emissions from the agriculture sector.

Implication of the Study

This study has divided the prior literature into 5 crucial research hotspots in accordance with their themes, making it easier for the future researcher to pick the areas to study within the synchronization among FDI and the agriculture sector. The findings also depict that research hotspots are related to each other, as the inflow of FDI helps increase the agricultural productivity of the host nation, which leads to improvement in agricultural exports, helps in providing food security to poor people, a further benefit to raise GDP, and to generate employment. Further, it will benefit readers by developing their understanding of the trend and depth of studies in the area. Moreover, the future research direction suggested in this study indicates the areas that need to be explored by academicians and policymakers for the advancement of the agriculture sector through FDI.

The suggestions will be inculcated for framing policies, such as attracting an optimum level of FDI for developing the agriculture sector in host nations. The development of the agriculture sector could be accomplished by enhancing the

quality of agricultural exports, using the latest techniques of production, and efficient utilization of FDI. Thus, the policymakers and governments of host nations should frame policies for the enhancement of productivity of the agricultural sector through the advancement of methods of farming and the supply of efficient resources for production, such as seeds, pesticides, fertilizers, modern farming machines, etc., from FDI. The researchers could also measure the influence of the purpose, origin, and nature of FDI on the agriculture sector.

Conclusion

This study explored the existing synchronization among FDI and the agriculture sector and identified potential future research areas. Studies on the impact of FDI with a specific focus on the agriculture sector demonstrate an upward trend from 2015 onwards, probably due to United Nations member states' adoption of 17 SDGs. This depicts the emerging scenario of research in this field. Djokoto, J. G., Dhari, S., Jorgenson. A. K., and Omri, A. are the most productive and influential authors in this area, according to h_index. South China Agriculture University in China is the most significant affiliation with 7 documents. China is the most productive nation, with 53 documents, and the United States is the most influential nation, with a TLS of 1280. The findings also witnessed that developing nations have greater involvement in academic studies in this domain than developed nations. Sustainability and the Journal of Peasant Studies are the most productive and influential outlets according to the production of documents and citation analysis. The outcomes of the Co-word analysis depict the trending themes such as foreign direct investment, agriculture, FDI, agricultural production, food security, economic growth, foreign investment, sustainable development, agribusiness, etc. Further, this research identified 5 research hotspots and recommended future directions, such as the influence of FDI on agricultural productivity, its effect on agricultural exports, macroeconomic variables, agricultural emissions, food security, and poverty reduction. The findings are intended to offer academicians detailed insight into existing literature in the emerging domain of FDI and the agriculture sector. This research will assist the researchers in locating prolific authors, important documents, significant journals, influential keywords, and research hotspots for further research. In the study, the data is collected only from the Scopus database. However, the comprehensive coverage of other databases, such as Web of Science, Google Scholar, and EBSCO, may add some value to further studies. The findings of this research are limited to the PRISMA inclusion and exclusion criteria in the English language for document selection. Future research could be carried out on detailed content analysis by adding other relevant keywords in the database search string in this domain.

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