

Review Article**MAPPING AGRICULTURAL IMPACT INVESTING FOR CLIMATE CHANGE MITIGATION: A BIBLIOMETRIC ANALYSIS UNDER THE SDGS FRAMEWORK**K. I. Khan^{1*} and K. A. Malik²

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<https://orcid.org/0000-0003-0316-1670>**ABSTRACT**

Impact investing has emerged as a critical financing approach that aligns financial gains with social and environmental objectives, particularly in addressing climate change through sustainable agricultural practices. The purpose of this study is to examine the role of impact investing in climate change mitigation under the Sustainable Development Goals (SDGs) framework. Data were collected from the Scopus database from 2016 to 2025 using bibliometric analysis, from which 164 documents were obtained. Performance analysis uncovered the trends in publishing, important authors, institutions and influential journals; conceptual analysis uncovered major research themes through co-occurrence mapping and conceptual networks. The results highlighted four main interconnected clusters, shaping the intellectual structure of agricultural impact investing research: (1) sustainable finance & low-carbon transition, (2) climate-resilient development & green growth, (3) financial mechanisms & sustainability metrics, and (4) stakeholder engagement & SDGs alignment. These clusters have shown how interdisciplinary research on agricultural sustainability, climate change mitigation and impact investing is connected with each other. Basic themes, such as “climate change” and “SDGs,” served as anchors for the field. At the same time, emerging topics, including “agroecology”, “food production”, and “greenhouse gases”, highlighted future research paths in the thematic map. The study concludes that agricultural impact investing is increasingly positioned as a mechanism for mitigating climate change, but its development is uneven across regions and thematic areas. This research provides a comprehensive overview of the intellectual structure and evolution of the field, offering insights for scholars, policymakers, and practitioners seeking to expand impact-oriented agricultural investments aligned with global sustainability goals.

Keywords: Sustainable Agriculture, Green Growth, Food Production, Impact Investing, Sustainable Development Goals, Climate Change Mitigation

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INTRODUCTION

Agriculture plays a vital role in achieving global sustainability targets, as it is directly linked to food security, rural livelihoods, and climate change mitigation (Sheeraz and Khan, 2026). However, the agricultural sector continues to face financial, environmental and socio-economic challenges, particularly for small farmers in developing economies (Shehzad et al., 2025). Government policies, governance issues, and financial regulations are key concerns, along with political instability, border barriers and reliance on traditional methods that adversely affect agricultural development. Further, the consequences of environmental degradation are not limited to ecological health and public health, but are also associated with issues of food security and climate resilience in agriculture (Prip, 2018).

Declining soil fertility, resource depletion, and environmental pollution can reduce agricultural productivity, threaten food security, and increase the vulnerability of farming systems to climate-related risks (Di Vaio et al., 2024). Addressing these interconnected challenges requires not only technological and regulatory interventions but also adequate financial resources to support sustainable agricultural transitions. Blended-finance approaches can be helpful in resource mobilization through a public-private partnership (Abdellatif et al., 2026). Additionally, innovative financing mechanisms, including impact investing, are used to foster environmental sustainability while supporting long-term agricultural development (Gebrekidan et al., 2025).

Impact investing is a financial approach that produces tangible environmental and social benefits alongside financial returns (Shehzad and Khan, 2025). It was first used in the 18th century, which involves investing in organizations to generate quantifiable monetary gains while ensuring positive social outcomes. Quakers were among the earliest adopters of impact investing in the 1890s (Mill, 2006). The conceptualization of impact investing is also based on ethical and socially responsible investing. In ethical investing, investors consider ethical values, which encompass social, moral, and religious principles alongside financial returns (Khan *et al.*, 2024). In contrast, in socially responsible investing, environmental protection is prioritized (Lindgreen and Swaen, 2010), and measurement of non-financial investment outcomes was emphasized (Abdel-Maksoud *et al.*, 2005).

The concept of impact investing was coined in 2005, which encompasses all efforts to achieve positive social and environmental outcomes along with financial gains (Sparkes and Cowton, 2004). It is a growing concept whose theoretical basis is rooted in multidisciplinary subject areas of finance, economics, environmental, and social sciences. Prior researchers have employed various theories to explain it. For example, capital structure theory offers techniques for financing business operations through the combination of debt and equity (Enjolras and Sentis, 2011). Similarly, by implementing resource mobilization, organizations can easily raise funds from resource providers by sharing their predetermined positive social and environmental goals (Karami *et al.*, 2024; Junker *et al.*, 2025).

Sustainable development and ESG (Environmental, Social, and Governance) theories are directly applied to impact investing due to their positive social and environmental outcomes that directly contribute to sustainable development, and specifically, in sustainable agriculture (Emran *et al.*, 2021; Shi *et al.*, 2019). CSR theory (Tolmie *et al.*, 2020), Stakeholders' Theory (Herold *et al.*, 2019), and Supply and Demand Theory (Adegbite and Machethe, 2020; Santamarta *et al.*, 2021) also support agricultural impact investing in promoting sustainable financing practices, ethical and moral obligations, managing risk and opportunities, renewable energy use, water efficiency, and climate-smart technologies within agriculture, which contribute to the Sustainable Development Goals (SDGs), particularly SDG 2 (Zero hunger) and SDG 13 (Climate Action) (Li *et al.*, 2023).

Despite its growing significance, the literature on agricultural impact investing remains confused with a variety of sustainable investment approaches, including green finance, climate finance, green bonds, and ESG-oriented investment strategies that play a significant role in its conceptual evolution (Shehzad and Khan, 2024). While these approaches contribute to sustainability objectives, impact investing occupies a distinct position within the sustainable-finance landscape by explicitly seeking to generate positive social and environmental outcomes alongside financial returns (Berk and van Binsbergen, 2025). In the agricultural sector, this dual objective is particularly important because investment decisions are often linked to broader goals such as food security, climate resiliency, rural development, and sustainable use of resources (Khan and Shehzad, 2025a).

Consequently, understanding the evolution and contribution of impact investing is still vital to promoting sustainable agricultural development and achieving the SDGs (Cernev and Fenner, 2020). The existing literature is unable to adequately convey the significance of impact investing from the perspectives of sustainable agriculture and climate change (Khan and Shehzad, 2025). Few studies systematically analyze the intellectual structure of this field or track its development through bibliometric methods (Agrawal and Hockerts, 2021; Jeffers *et al.*, 2024; Verma *et al.*, 2025; Watts and Scales, 2020). A comprehensive bibliometric analysis of impact investing is still missing. Therefore, the present study aims to investigate how impact investing contributes to climate change mitigation through sustainable agricultural initiatives within the SDGs framework, and to identify areas where future research opportunities exist.

The originality of this study lies in its attempt to fill these gaps by performing a comprehensive bibliometric analysis of impact investing in agriculture within the SDGs framework for climate risk mitigation. It aims to address the following potential research questions. RQ1: How has the concept of impact investing evolved? RQ2: Which SDGs are most prominently addressed and prioritized in agricultural impact-investing research? RQ3: What are the most-cited journals, researchers, countries, institutions, and documents contributing to the literature? RQ4: What are the prevailing themes and knowledge clusters that link agricultural impact investing, climate change mitigation and SDGs? In short, the study integrates performance and conceptual analysis, mapping key contributors and thematic clusters and identifying under-explored areas and new frontiers, providing a new and innovative contribution to academic scholarship and, as a consequence, the policy discussion.

MATERIALS AND METHODS

The study employed a bibliometric analysis to examine the role of impact investing in sustainable agricultural initiatives aimed at mitigating climate change within the SDGs framework. Data were collected from the Scopus database for the period 2016-2025 on 20th September 2025. Therefore, the extracted data represented the publications indexed on the retrieval date, but did not cover the complete publication year, which is one of the possible limitations of the present study. The study used a comprehensive query by adopting the method of Farooq *et al.* (2023) for query

development, as explained in Table 1. Agricultural impact investing is an interdisciplinary concept that interacts with broader domains like sustainable investment, ESG investment, green finance, climate finance, etc. (Khan and Shehzad, 2025b).

Initially, the concepts, terminologies, and keywords related to impact investing were used to compile a list of all associated synonyms. The subject experts were requested for assistance, and 15,490 documents were finalized at the initial stage. The terms supporting agricultural adaptation to climate risks were introduced at the second stage and linked to the SDGs at the third stage. Similarly, related subject areas, document type, and publication stage were defined later to identify the relevant literature that falls within the definition of impact investing. Finally, linguistic limitations were applied, and 164 English-language documents were shortlisted.

Table 1: Query Development Process

Phases	Query	Keywords Used	Documents
1	Key Terms for Impact Investing	"impact invest*" OR "social invest*" OR "sustainable invest*" OR "ESG invest*" OR "responsible invest*" OR "ethical invest*" OR "green finance" OR "climate finance"	15490
2	Introducing Agricultural Adaptation to Climate Risks	"agricultur*" OR "farming" OR "sustainable agriculture" OR "agricultural development" OR "rural development") OR ("climate risk*" OR "climate change" OR "climate adaptation" OR "climate resilience" OR "climate-smart agriculture"	2685
3	Linking with SDGs	"Sustainable Development Goals" OR "SDG*" OR "global goals" OR "2030 Agenda"	319
4	Subject Area	Environmental Science, Business, Management and Accounting, Economics, Econometrics and Finance, Social Sciences, Agricultural and Biological Sciences	287
5	Document Type	Article & Review	189
6	Publication Stage	Final	170
7	Language	English	164

R software, Bibliometrix, Biblioshiny, VOSviewer, Edraw Max, and OriginPro were used to analyze the extracted data. The data included 164 documents (articles: 147; Reviews: 17) from 115 sources that significantly presented the history, need, latest future trends, and patterns of agricultural impact investing for mitigating climate risk. The research growth was presented in four phases in relation to SDGs in Figure 1, which is presented through a three-dimensional graph where years were presented on the y-axis, number of articles on the x-axis and number of citations on the z-axis. Phases are divided as follows: (1) Emergence Phase (2016-17) represents scattered early studies, mainly of an exploratory nature, for example, early SDG discourse. (2) Expansion Phase (2018-19) shows steady output with structured reviews on the topic, with a serious emphasis on Paris Agreement momentum. (3) Acceleration Phase (2020-22) is evident in a sharp increase in publication growth by adding diversified topics with impact funding, with a focus on the post-COVID-19 scenario, climate resilience, etc. (4) Consolidation Phase (2023-25) signifies it as a mature field with strong SDG–climate links by emphasizing Cross-SDG integration and adaptation finance topics. It is also important to mention that the year 2025 covers only Jan-Sep, partial-year data.

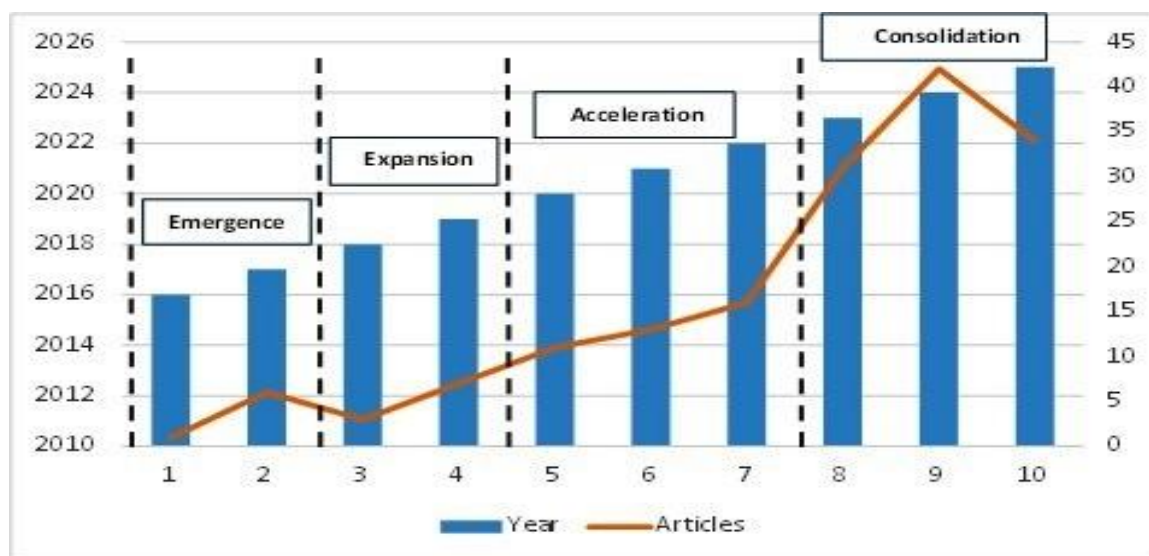


Figure 1. Growth Phases in Impact Investing Publications in Relation to SDGs

RESULTS

The findings report on influential researchers, regions, publications, journals, and organizations related to impact investing and suggest a future research agenda for further exploration.

Performance Analysis: Performance analysis is a quantitative assessment of research productivity and impact, highlighting the most productive sources, authors, countries, institutions, highly cited publications, and collaborative networks. The emerging concept of impact investing and the drive to achieve the SDGs by 2030 have encouraged many journals to broaden their scope and address trending topics. Consequently, the most relevant sources and their impacts are listed in Table 2. Sustainability has the highest NP of 24, with a TC of 442, an h-index of 9, a g-index of 21, and an m-index of 1. This journal has an impact factor of 3.3 and a CiteScore of 7.7.

Table 2: Top Ten Relevant Sources of Publication

Source	h-index	g-index	m index	TC	NP	IF	CiteScore
Sustainability (Switzerland)	9	21	1.00	442	24	3.3	7.7
Climate Policy	4	4	0.57	85	4	5.2	13.1
Climate and Development	3	3	0.43	84	3	3.4	8.5
Journal of Cleaner Production	3	3	0.60	234	3	10	20.7
Resources Policy	3	4	1.00	111	4	9.5	17
Sustainable Development	3	3	1.50	209	3	8.2	14.5
Environmental Science and Pollution Research	2	2	0.67	18	2	4.3	6.6
Global Environmental Change	2	2	0.50	105	2	9.1	18.1
Green Finance	2	3	0.50	96	3	5.0	10.3
International Review of Economics and Finance	2	2	0.67	43	2	5.6	7.3

Note: TC = Total Citations; NP = Number of Papers; IF = Impact Factor; h-index (measuring productivity and citation impact of publications); g-index (including highly cited papers in the dataset); and m-index (reflecting the ratio of h-index to the number of years the researchers have been actively publishing their research work).

The Journal of Cleaner Production has the highest TC of 234, with an h-index of 3, a g-index of 3, and an m-index of 0.6, along with the highest impact factor of 10 and a CiteScore of 20.7. This journal primarily publishes work on sustainability, environmental issues, and cleaner production. Meanwhile, the International Review of Economic and

Finance has the fewest citations (TC = 43) among the most relevant sources. This scholarly journal primarily focuses on theoretical and empirical studies in financial, macro, and international economics.

The details of the most impactful authors contributing to the development and recognition of the emerging concept of impact investing are shown in Table 3. The prominent authors working on climate finance, the SDGs Framework, environmental changes and sustainable agricultural development reflect the multidisciplinary nature of agricultural impact investing. The emerging concept of impact investing is being discussed from the perspective of various theories of finance, economics, social sciences and environmental sciences by prior researchers across different subject areas that help to reshape the theoretical and financial frameworks.

Table 3: Top Ten Authors and Their Focused SDGs

Authors	h-index	g-index	m-index	TC	NP	Focused SDGs
Chirambo, D	4	4	0.40	64	4	SDG 7
Esquivias, M A	3	3	1.00	53	3	SDGs
Behera, B	2	2	1.00	203	2	SDG 13
Chadha, G	2	2	1.00	41	2	SDGs
Edenhofer, O	2	2	0.22	125	2	SDG 13
Makarenko, I O	2	2	0.40	31	2	SDGs 2, 3
Negra, C	2	2	0.33	98	2	SDGs 2, 3
Plastun, A	2	2	0.40	31	2	SDGs 2, 12
Sethi, N	2	2	1.00	203	2	SDGs 7, 13
Singhanian, M	2	2	1.00	41	2	SDGs 7, 12, 13

Note: TC= Total Citation; NP= Number of Papers

SDG: Sustainable Development Goal

The top author is Chirambo, who has published four articles to expand the literature on impact investing. His publications have received 64 citations (h-index=4, g-index=4, and m-index=0.4), with a primary focus on SDG 7 (Chirambo, 2016; 2018). Furthermore, Esquivias is the second most contributing author, who published three research articles with 53 citations, focusing on the SDGs. Miguel's recent work focuses on current sustainability topics, including ecological footprints, natural resources, urbanization, and globalization (Hossain *et al.*, 2025).

Although both Behera and Sethi have published only two articles, they both share the highest total citation count of 203 (h-index = 2, g-index = 2, and m-index = 1), with a primary focus on SDG 13. According to Sethi *et al.* (2024), global warming is one of the most critical issues of the 21st century. They explored the dynamics of climate change through their research publications (Singh *et al.*, 2025). Furthermore, Plastun is the least contributing author among the top ten, with only 31 citations (h-index = 2, g-index = 2, and m-index = 0.4).

Table 4 shows the most productive countries based on the research contributions of their active researchers. The long list of countries reflects global interest in the emerging concept of impact investing and the presence of active scholars working to achieve the SDGs using various data analysis methods. China is the top country, with 70 active researchers focused on different SDGs, as shown by a 2025 SDGs index score of 74.39 and an SDGs index rank of 49. India is the second-most productive, with 38 publications, and ranks 99th on the SDG index, which is considered quite good. Nigeria ranks 147th in the SDG index, which shows a relatively poor ranking position.

Table 4: Most Productive Countries in Publications and SDGs Attainments

Countries	Freq	SDGs Index Score	SDGs Index Rank	Countries	Freq	SDGs Index Score	SDGs Index Rank
China	70	74.39	49	Italy	10	80.26	22
India	38	66.95	99	Japan	10	79.87	19
Germany	30	83.67	4	Denmark	9	85.00	3
Pakistan	29	56.97	140	Nigeria	9	54.58	147
USA	26	75.19	44	South Korea	9	78.15	34
Indonesia	19	70.22	77	Turkey	9	70.61	73
Spain	17	81.04	14	Bangladesh	8	63.88	114
UK	17	81.85	11	Canada	8	79.17	25
Ukraine	12	75.74	42	Netherlands	8	79.21	23
Australia	11	77.88	36	Saudi Arabia	8	65.19	105

Multiple global organizations and institutions have established research centres and teams of potential researchers to address current societal and environmental needs (see Table 5). The Polytechnic University of Madrid, in Spain, has several active research centres that contribute to agricultural and food development projects and to the protection of natural resources and ecosystems. The research groups have published 10 articles on impact investing. Indonesian authors who have collaborated with Airlangga University have published seven scientific works, featuring keywords such as food security, agriculture, sustainable agriculture, and hunger.

India has two active institutions: the National Institute of Technology Rourkela and the University of Delhi. Researchers from both organizations have published six articles. In response to the growing population, research units in India are focusing on water management, policymaking, and skilled labour, among other areas. The agricultural sector is the primary driver of Ethiopia's economic growth. Consequently, scholars in this agrarian country mainly focus on sustainable agriculture, with Adigrat University being the most prominent institution working toward SDG 2 by 2030.

Table 5: Top Ten Worldwide Institutional Affiliations and their Agricultural Relevance

Affiliation	Location	Articles	Active Research Centres/Units	Agricultural Relevance
Polytechnic University of Madrid	Spain	10	Research Centre for Biotechnology and Plant Genomics, Biomedical Technology Centre, Research Centre for the Management of Agricultural and Environmental Risks	Agricultural and food activity development, natural resources, and the ecosystem
Airlangga University	Indonesia	7	Centre for Public Policy, Governance and Development, Centre for Competition and Business Studies, Centre for Political Economy and Business Research	Agricultural growth, food security, and agricultural byproducts
University of Chinese Academy of Sciences	China	7	Centre for Agricultural Resources Research, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences, Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences	Achieving challenges impacting agricultural progress
National Institute of Technology Rourkela	India	6	Poverty Alleviation Research Centre, Renewable Energy Systems, Space Technology Incubation Centre, Steel Research Centre	Water resources, bio-medical, energy, and material science
University of Delhi	India	6	Agricultural Economics Research Centre, Centre for Independence and Partition Studies	Policy making, skilled workforce, food and nutrition
Ural Federal University	Russia	6	Artificial Intelligence Research Centre, Research Centre for Energy Saving and Automation Problems, Artificial Intelligence Research Centre	Development of agriculture in Russia
HSE University	Russia	5	Laboratory for Economics of Innovation, HSE, Institute for Statistical Studies and Economics of Knowledge, HSE, Laboratory for Science and Technology Studies, HSE	Agricultural economics, policy development, and agricultural enterprise
Korea University	South Korea	5	Institute of Korean Studies, Institute of Engineering Research, Education Research Institute	Agricultural practices and business, farming research
Technical University of Denmark	Denmark	5	Pioneer Centre for Artificial Intelligence, Danish Data Science Academy	Sustainable food, sugar beet crops, and agricultural strategies
Adigrat University	Ethiopia	4	Multiple research and community services	Sustainable agriculture, agricultural improvements

Table 6 presents the most cited scientific publications. The publication by Khan *et al.* (2022) has the leading position in the list, with 245 citations and an average of 61.25 citations per year. This study efficiently examined the role

of green finance in mitigating climate risks and ecological footprints. The JEL classification of the majority of the publications by Khan *et al.* (2022) was O13, O44, and Q01. Furthermore, the second most cited document was cited by Ikram *et al.* (2021). This publication emphasized sustainable hydrogen production and sustainability, gaining 191 total citations since its publication. This publication was among the leading sources to analyze the significance of green technology indicators in achieving sustainability goals.

Table 6: Top Ten Cited Documents with Contributions

Publications	TC	TC per Year	Normalized TC	Major Contribution
Khan <i>et al.</i> , (2022)	245	61.25	4.10	Green Finance, Climate Mitigation Finance, Ecological Footprints
Ikram <i>et al.</i> (2021)	191	38.20	5.39	Sustainability, Sustainable Hydrogen Production, Complexity
Tolliver <i>et al.</i> (2019)	170	24.29	3.20	Green Bonds, Climate Change, Sustainable Development
Bai <i>et al.</i> (2022)	163	40.75	2.73	Carbon Emissions, Environmental Sustainability, Natural Resource Consumption
De Lucia <i>et al.</i> (2020)	147	24.50	4.00	ESG Performance, Ethical Finance
Ozili, (2022)	131	32.75	2.19	Green Finance, Sustainable Finance, SDGs
Sethi <i>et al.</i> (2024)	110	55.00	9.73	Green Technology, Carbon Emissions, Renewable Energy
Iacobuta <i>et al.</i> (2022)	98	24.50	1.64	Climate Finance, SDGs, Climate Change
Steckel <i>et al.</i> (2017)	97	10.78	2.72	Sustainable Development, Finance, Climate Finance
Behera <i>et al.</i> (2024)	93	46.50	8.22	Green Finance, Energy Consumption, SDG13

The scientific contributions of the most acknowledged documents were not limited to this. Researchers had made significant contributions to the development of sustainable and innovative financing tools and techniques, including green finance, climate change mitigation, climate finance, green bonds, and green stocks. The third enlisted document highlighted the need for green bonds to expand the implementation of the SDGs (Tolliver *et al.*, 2019). This publication had 170 citations, averaging 24.29 per year.

Bai *et al.* (2022) and Sethi *et al.* (2024) focused on carbon emissions, environmental sustainability, natural resource consumption, green technology, and renewable energy concepts that are relevant to environmental protection and received TC=163 and TC=110, respectively. De Lucia *et al.* (2020) discussed the relation between ethical finance and ESG performance. They explained how the availability of impact finance can improve ESG performance. Ozili (2022), Iacobuta *et al.* (2022), Steckel *et al.* (2017), and Behera *et al.* (2024) discussed the effect of green or climate finance on climate change mitigation under the SDGs framework by emphasizing green energy resources adoption.

Conceptual Analysis: Conceptual analysis represents the knowledge structure by reporting key research themes, topics, and streams in the literature through collaborative network, trend, thematic, and co-occurrence analysis. Figure 2 shows the country-wise bibliographic coupling, which presents a similar relationship among documents. It effectively explores the similarities and scientific relations among the different countries, highlighting the common research foundations. Each cluster of bibliographic coupling presents an identical theme. The coupling relations are determined based on factors such as the number of documents, the number of citations, and the average number of publications per year, among others. The USA and China are the most prominent countries, with 646 and 924 citations, 20 and 30 publications, respectively.

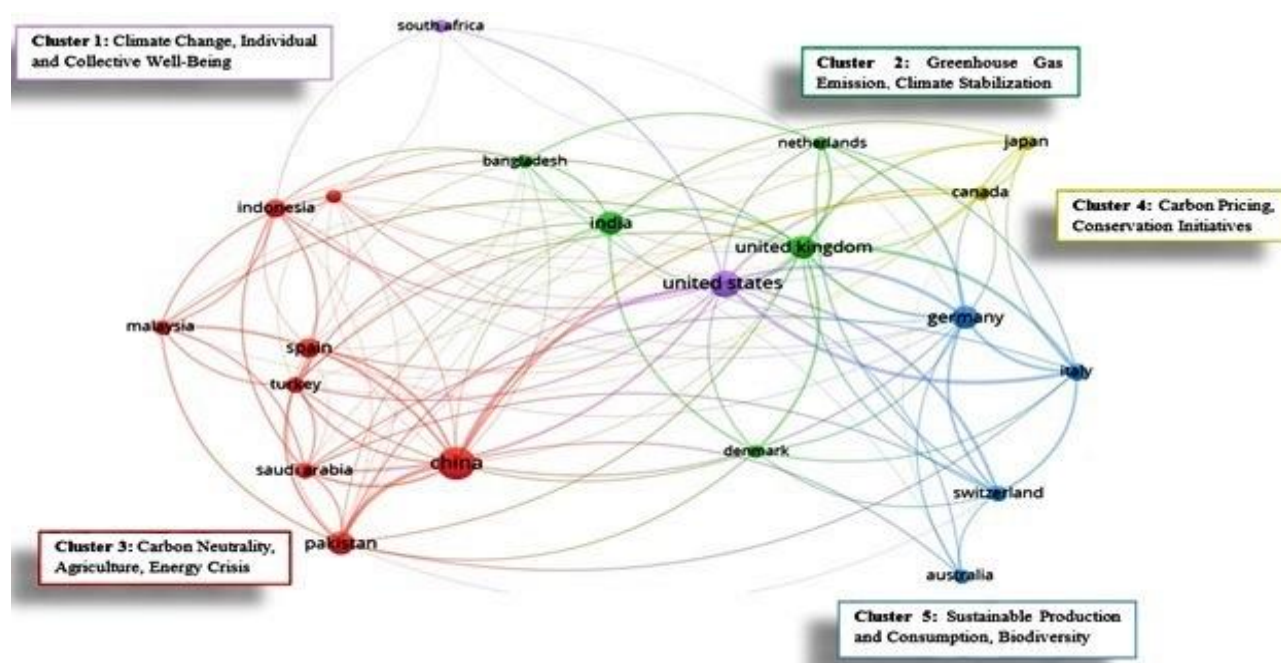


Figure 2: Cluster-wise Bibliographic Countries Coupling

Co-Occurrence Analysis: The co-occurrence analysis grouped keywords into four clusters based on their frequency. This study identified four clusters that capture the main themes in the agricultural impact investing literature. Table 7 shows the most frequently occurring keywords that highlight cross-disciplinary connections among different subject areas. Cluster 1 (Red) focuses on *Sustainable Finance & Low-carbon Transition*, which includes SDGs, finance, alternative energy, carbon emissions, renewable energy, and a green economy. This cluster bridges the connection between finance and sustainability within the context of the low-carbon transition, where agricultural impact investing initiatives operate. It explains how financial flows (green finance, sustainable investments) support the adoption of this practice. Within the agricultural context, low-carbon transition encompasses efforts to reduce greenhouse gas emissions, promote climate-smart agricultural practices, improve resource-use efficiency, and strengthen sustainable agri-food supply chains. The prominence of this cluster highlights the increasing role of financial mechanisms in supporting agricultural systems that contribute to both productivity enhancement and environmental sustainability.

Table 7: Co-occurring Keywords Analysis and Research Themes

Keywords: Links (Occurrences)	Clusters	Research Themes
Sustainable Development Goal 53(41); Finance 48(18); Alternative Energy 44(15); Carbon Emission 36(15); Renewable Energy 34(13); Green Economy 34(12); Innovation 35(12); Economic Growth 32(10); Developing World 34(9); Environmental Protection 31(9); Climate Change Mitigation 23(6); Greenhouse Gases 32(5)	1	<i>Sustainable finance & low-carbon Transition</i>
Climate Change 61(70); Sustainable Development 61(51); Green Finance 47(40); Sustainability 45(27); Investment 38(26); Sustainable Finance 28(15); Green Bonds 33(12); ESG 15(10); Environmental Sustainability 22(9); Risk Assessment 25(8); Climate Risk 13(6); Impact Investment 16(5)	2	<i>Climate-Resilient Development & Green Growth</i>
Paris Agreement 31(36); Climate Finance 44(24); Environmental Economics 44(16); Environmental Policy 47(15); Mitigation 31(7); Adaptation 22(6); Adaptive Management 24(6); Climate Policy 17(6); Food Security 17(6); Greenhouse Gas 26(6); Financial Inclusion 20(5); Global Warming 25(5)	3	<i>Financial Mechanisms & Sustainability Metrics</i>
SDGs 35(12); Stakeholder 19(6)	4	<i>Stakeholder Engagement & SDGs Alignment</i>

Cluster 2 (Green) highlights the *Climate-Resilient Development & Green Growth* theme, focused on climate change, sustainable development, green finance, sustainability, investment, and green bonds. This cluster emphasizes policy-driven green growth by integrating climate change with SDGs and financial tools. It highlights the essential role of international and national institutions, alongside financial instruments like impact investing, green bonds, and sustainable finance, in guiding agriculture and economies toward climate-resilient practices. China stands out as the most prominent country in this cluster.

Cluster 3 (Blue) represents the theme of *Financial Mechanisms & Sustainability Metrics*, encompassing ideas such as climate finance, financial inclusion, the Paris Agreement, climate policy, environmental economics, adaptive management, and food security. This cluster discusses frameworks and tools for evaluating the ESG results of agricultural impact investing. It highlights the practical, real-world challenges facing agrarian systems, especially in Africa and developing regions. It emphasizes the resilience of smallholder farmers and the critical role of food security amid climate change.

Stakeholder Engagement & SDG Alignment is demonstrated with Cluster 4 (Yellow) to show how stakeholders engage to achieve the SDGs. However, it is a small cluster; that highlights how the SDGs can serve as a broad framework linking agricultural finance, energy and climate policies to achieve global development goals. Based on co-occurrence analysis, agricultural impact investing research primarily revolves around four themes, but finance and climate issues frequently intersect in all clusters. It should also be noted that a significant gap exists in localized agricultural adaptation research, particularly in connecting smallholder realities with global investment strategies.

The study also conducted a thematic analysis, which divided the quadrants into four themes, with their conceptual explanations shown in Table 8. The motor theme focuses on carbon emissions and economic development as primary drivers, emphasizing their link to global climate finance. Basic themes include climate change and the SDGs as foundational elements, reflecting a practical focus within the agricultural sector. Niche themes highlight investment in developing economies, signalling a need for further research in this area. Lastly, emerging themes point to agroecology and mitigation as promising areas for agricultural impact investing. Technologies such as precision agriculture, digital monitoring systems, and biotechnology-based solutions can enhance resource-use efficiency, climate resilience, and sustainable productivity, offering valuable opportunities for future impact-investment initiatives.

An important implication of the findings is the relatively limited focus on agriculture-specific financing challenges within the broader sustainable finance literature. Although smallholder farmers are primary beneficiaries of impact-investment initiatives, issues like their vulnerability, agri-export financing, and localized sustainability assessment frameworks are underrepresented in mainstream research. This suggests that climate finance and sustainability investment discussions largely concentrate on macro-level policy and financial system changes, highlighting opportunities for future research to develop more context-specific approaches addressing the practical realities of agricultural production, rural livelihoods, and regional sustainability outcomes.

Table 8: Conceptual Explanation of Thematic Map Themes

Themes	Concepts	Centrality	Density	Explanation
Motor	Carbon Emission, Economic Development, Carbon	High	High	- These are well-developed and highly relevant themes. They serve as “engines” driving research forward. - In agricultural impact investing, the linkages between carbon and economic development are central, reflecting sustainability finance, carbon credits, and green growth.
Niche	Investments, Developing World, Environmental Protection	Low	High	- These are specialized yet well-developed themes. They are internally strong but not yet central to the field as a whole. - Research in this area is advanced but somewhat isolated. Example: focused studies on investments in the developing world’s agriculture.
Basic	Climate Change, Sustainable Development Goal, Sustainable Development	High	Low	- These are foundational themes that are less developed internally but are still very important. - These themes constitute the core of the field, but research often remains conceptual or general.

Emerging or Declining	Agroecology, Food Production, Greenhouse Gases, Gas Emissions, Climate Change Mitigation	Low	Low	- These are either emerging frontiers (new, underdeveloped) or declining topics (losing relevance). - In the current study, agroecology and food production are emerging areas in impact investing, although they are not yet mainstream in bibliometric terms.
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Further, the study also conducted a detailed keyword analysis to explore the significance of the emerging concept of impact investing. This analysis, visually presented in Figure 3, highlights the most frequently used and related terms from prior literature. Impact investing aims to generate positive social and environmental returns by focusing on renewable, transformative, and eco-friendly projects within a sustainability framework. Using the extracted data, the study developed connections between impact investing potential, SDGs, and climate relevance.

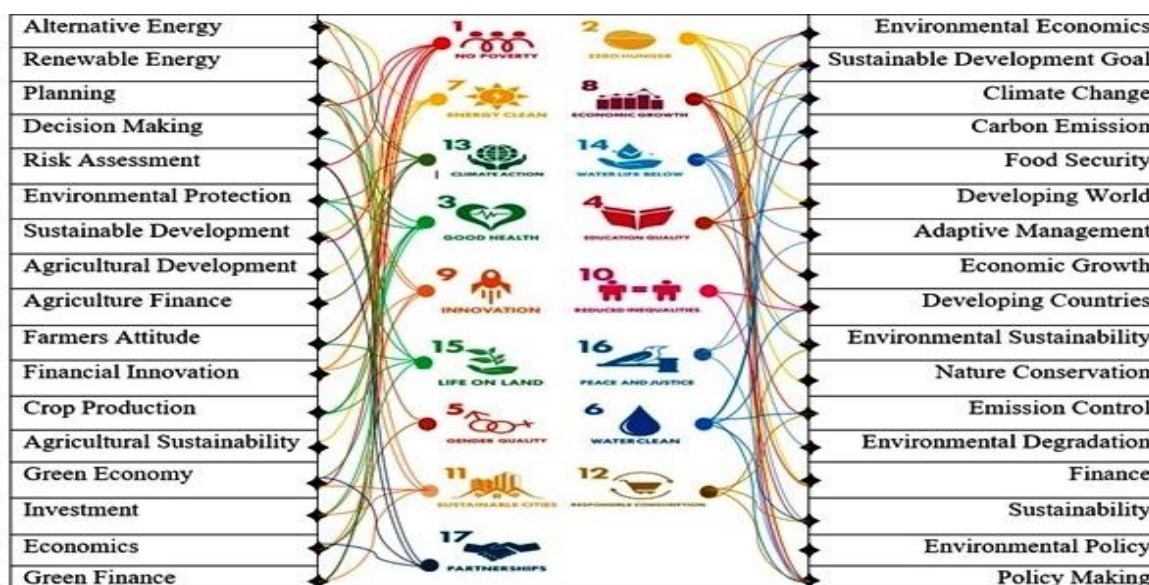


Figure 3: Impact Investing in Agricultural Sector for SDGs Attainment

A comprehensive list of keywords was examined to identify the 34 most frequent terms linked to relevant SDGs. Among these, SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action) emerged as the most closely associated, underscoring the importance of impact investing and innovative financial tools to protect the natural environment and its resources. Moreover, the linkage of SDG 3 (good health), SDG 2 (zero hunger), SDG 14 (life below water), and SDG 15 (life on land) advances the application of impact investing in the agriculture sector. Sustainable agricultural practices provide a safer, healthier life and a better future for all (Tandukar *et al.*, 2025). It has ensured the protection of the ecosystem, maintained soil fertility, and promoted the sustainable use of resources in the agricultural sector to attain the SDGs (Ziolo *et al.*, 2021).

DISCUSSION

Impact investing plays a significant role in addressing global challenges, including poverty and climate change, as well as in enhancing agricultural productivity (Rust *et al.*, 2022). Therefore, this novel concept has direct or indirect implications across sectors, including infrastructure, healthcare, energy, and sustainable agriculture (Sheeraz and Khan, 2026). The agricultural sector is the most closely linked sector, where impact investing has significant implications. The current climatic conditions, driven by globalization and rapid industrialization, are adversely affecting the natural rate of soil formation (Khan *et al.*, 2025). The declining productivity of land is impacting the global food supply, particularly in emerging economies, where agriculture is a significant contributor to the economy (Feliciano, 2022).

In this situation, innovative financial instruments like impact investing are required to generate positive, significant social, environmental, and financial returns, particularly in the agricultural sector (Gebrekidan *et al.*, 2025). Impact investing directly scales agrarian innovations. Although sustainable investments are still not common in the agriculture sector, recent investment instruments have been developed by international agricultural research

organizations (Feliciano, 2022). The term has been used for a long time, but under different terminology related to sustainable investment opportunities, like climate finance, green bonds, and ESG-oriented investment strategies, which play a significant role in the conceptual development of impact investing. The researchers emphasized the adoption of agricultural impact investing through public-private partnerships (Leitão *et al.*, 2017)

Overall, the findings suggest that impact investing is increasingly positioned as a mechanism to align agricultural development with climate change mitigation and the SDGs. However, the literature still lacks a robust integration of smallholder perspectives, localized impact measurement, and innovative financial tools, such as blockchain and blended finance. Future research should focus on bridging these gaps by connecting high-level investment strategies with ground-level agricultural realities, ensuring that impact investing contributes meaningfully to equitable and climate-resilient food systems.

An important finding is the relatively limited research visibility of regions such as Sub-Saharan Africa and South Asia, despite their prominence as priority destinations for impact-investment initiatives in agriculture. This disparity may be attributed to differences in research capacity, funding availability, data accessibility, and publication representation within internationally indexed databases. As a result, regions facing some of the most pressing agricultural sustainability and climate-resilience challenges remain underrepresented in the global knowledge base. Strengthening research collaboration and supporting locally driven scholarship may therefore be essential for developing context-specific impact-investment strategies and sustainable agricultural solutions.

Conclusion: Despite growing interest, the literature on impact investing in agriculture remains fragmented, with limited focus on how these investments concretely contribute to climate change mitigation within the SDGs framework. This bibliometric study provides a comprehensive overview of how impact investing intersects with sustainable agriculture and climate change mitigation within the SDGs framework. The performance analysis reveals a steady growth in research output since the mid-2010s, with contributions concentrated in advanced economies. Meanwhile, although highly relevant in practice, developing regions remain underrepresented. It reported the most influential source (Sustainability), the researcher (Chirambo), the country (China), the affiliated institution (Polytechnic University of Madrid, Spain), and the collaborating countries (USA and China). The top-ten publications mainly focused on SDGs 2, 7, and 13, contributing to climate mitigation finance, agricultural productivity, ESG, environmental sustainability, and natural resource consumption. The conceptual analysis highlights four dominant thematic clusters: (1) sustainable finance & low-carbon transition, (2) climate-resilient development & green growth, (3) financial mechanisms & sustainability metrics, and (4) stakeholder engagement & SDGs alignment. Carbon emissions and economic development emerge as motor themes, while agroecology, food production, greenhouse gases, and gas emissions are identified as emerging but underexplored areas in agricultural impact investing.

Implications of the Study: The current study emphasizes the conceptual and practical implications of the trending topic of impact investing. First, it examines the concept of impact investing from the perspectives of the SDGs and agricultural sustainability, which will guide future scholars in developing a detailed theoretical foundation for this emerging concept by connecting theories from fields such as finance, economics, the social sciences, management, and sustainability. Second, it helps mitigate climate risks by adopting sustainable investment options, such as impact investing. The managers of production units can consider the highlighted need to protect ecosystems and biodiversity. Third, introducing green and sustainable investment opportunities that generate positive social and environmental returns, as well as financial gains, can benefit financial organizations and investors. Fourth, governing and administrative authorities can develop strict rules and regulations governing stakeholders' environmental and social interactions. Policymakers can align their policies with sustainability goals and develop targeted policies to address the challenges and opportunities in achieving the SDGs by 2030.

Limitations and Future Directions: The study outlines challenges that future researchers can address to expand the field. First, it highlights the need for impact investing for sustainable agricultural practices, which emphasizes future investment opportunities to help investors identify green investment options. Second, it discusses the concept of impact investing in the agricultural sector without distinguishing between developed and developing economies. In future, scholars should focus on regional case studies in developing economies, where impact investing plays a crucial yet underexplored role in climate resilience and food security. Third, the dynamic nature of this field means that new studies, especially on digital finance, climate finance, agricultural finance, carbon markets, and climate-smart technologies, can be explored by potential researchers to assist investors and financial institutions and can also quickly reshape existing trends.

Fourth, the study conducted a bibliometric analysis; however, in the future, a mixed-method approach can be employed to help develop an impact measurement framework, inclusive finance models, and cross-sectoral partnerships related to this concept, which can strengthen understanding of how impact investing can effectively contribute to SDGs,

particularly SDG 2 (Zero Hunger) and SDG 13 (Climate Action). Fifth, the research clearly indicated that the findings are based on the articles published within selected Scopus databases, with limited inclusion of relevant grey literature as well as policy reports. They also excluded articles that were not in English but would have made a significant contribution to the understanding of the topics covered in those articles. Including additional databases such as Web of Science, etc., would provide a broader set of articles for this analysis and ultimately improve the quality of the findings since there will be a greater variety and number of high-impact articles included in this analysis. Finally, although the data retrieved for this review included the publications that were indexed at the time the review was performed, the total number of citations for the articles could not be obtained, leading to a potentially incomplete understanding of these publications' citation patterns over time. Future authors/researchers should revisit their analyses and provide a more thorough analysis to assess temporal patterns/trends.

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