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Mapping the Knowledge Base for the Impact of Artificial Intelligence on Climate Change Adaptation: A Bibliometric Analysis

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Abstract: *This paper focuses on how Artificial Intelligence (AI) can be used to manage climate change by reviewing the literature on the topic in terms of bibliometric analysis of articles published within the 2011-2023 from the Scopus database. The growing intensity of climate change has generated a sense of urgency of new and evidence-based adaptation solutions, and AI has become an effective tool to increase predictive power, make better decisions, and aid in resilience plans. The study employed VOSviewer, MS Excel, SPSS, and PRISMA 2020 statements to analyze the database to determine the patterns of publications, influential authors, leading countries, prominent journals, citation patterns, and the network of co-occurring keywords. The findings indicate the increase in publications, especially since 2017, which is evidence of an increase in interest in using AI to address climate challenges around the world. The United States and China became the top sources of research and citations and have high international collaboration networks, whereas major thematic areas are machine learning application, climate modeling, decision support system, and risk assessment. Additionally, the discussion shows that there is a shift in conceptual research to apply and policy research. Although this has been achieved, there are still significant gaps, especially regarding fusion of the socio-economic aspects and low inputs of developing regions. The article has established that AI is a vital and growing component of climate change adaptation and that inclusive, context-sensitive solutions and collaboration are the key areas of future research to improve global resilience and sustainability.*

Keywords: *Artificial Intelligence; Bibliometric Analysis; Climate Change Adaptation; Machine Learning; VOSviewer*

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1. Introduction

Climate change is a significant issue that continues to affect the ecology, economy and livelihoods of people the world over and with the increasing temperature, extreme weather patterns and the deteriorating environmental conditions, the world is becoming more susceptible. Recent studies point to the fact that the consequences of climate change are becoming more serious and extensive and require new and prompt ways of adapting to them (Intergovernmental Panel on Climate Change, 2022; Li et al., 2024). Artificial Intelligence (AI) has retaliated by coming up with a powerful tool that can be used to aid climate change adaptation with predictive analytics, pattern recognition, and smart decision-making systems (Kasubi, et al., 2025). Application of AI in agriculture, disaster risk management, water resource management, and urban planning has also been increasing with an effort to enhance adaptive capacity and resilience (Leal Filho & Gbaguidi, 2024; Valencia-Arias et al., 2025). According to bibliometric research, which was conducted in recent years, it has been found that the process of climate change adaptation has grown to a large scale, although it is geographically uneven and unevenly distributed among the fields of study, with developing countries being underrepresented (Majahana et al., 2025; Chiquetto and

Nolasco, 2024). Moreover, although the area of sustainability research based on AI is growing at an impressive pace, its implementation in the context of climate adaptation remains decentralized and is not synthesized in terms of its intellectual framework (Valencia-Arias et al., 2025; Barre et al., 2024). These problems indicate the need to use systematic mapping of the knowledge base in order to have a clearer understanding of the trends, gaps, and the new directions of research.

The main goal of this research is to map the knowledge base about the influence of Artificial Intelligence on climate change adaptation through the use of bibliometric analysis. Specifically, the trend of publications, key authors, key publications, and collaborative networks will be discussed in the paper, along with the development of the topic of the field. The existing study will be an extensive survey of research development and research design within the area of AI and climate change adaptation through the analysis of the research articles indexed in the Scopus database in 2011 and 2023.

The integration of the systems theory, sustainability science, and the technological innovation theory informs this study. The technological innovation theory explains how AI technologies are spread in the fields and how adaptive solutions to environmental issues can be used. The systems theory offers a set of conceptual approach to the explanation of the complicated interdependencies of climate systems, technological interventions and socio-economic dynamics. In addition, the sustainability theory emphasizes the significance of the balance between the environmental, the economic, and the social to build the long-term resilience (Ng, 2025). In this respect, AI is postulated as the facilitator of adaptive capacity, which encourages context-specific and evidence-based solutions to climate resilience.

Although the use of AI in climate change adaptation is a developing field of research with an increasing amount of literature, there is still little systematic knowledge of the intellectual landscape of the domain, trends of growth, and the agenda of research. The existing body of literature is inclined to focus on such separate industries as agriculture or water management, without providing a comprehensive picture of the research environment (Sahar et al., 2025; Manyike et al., 2025). Moreover, bibliometric information indicates that there are significant discrepancies between the number of research contributions in developed and developing areas, limiting the generalizability and applicability of findings (Majahana et al., 2025). Without systematic synthesis of AI-driven climate adaptation studies, it is impossible to identify gaps in knowledge and emerging themes and opportunities of interdisciplinary collaboration.

The paper has a number of contributions to the literature. First, it provides a wide bibliometric mapping of the AI and climate change adaptation literature and provides details of the development trends of the publications, the largest contributors, and the most influential research groups. Second, it identifies patterns of collaboration globally and demonstrates the disparity in contribution of the research work in various regions. Thirdly, the study uncovers novel themes and research opportunities thereby informing future research and policy development. Lastly, the results contribute to the comprehension of how AI can be utilized to promote climate resilience and sustainable development, especially in underrepresented and vulnerable areas.

Extended effects of climatic change, coupled with a rise in social and financial frailties, has led adaptation to become an urgent global need. At the same time, the concept of Artificial Intelligence (AI) alters the perception and management of challenging environmental issues since Artificial Intelligence (AI) has the ability to analyze a large amount of information, generate predictive views, and support decision-making processes that are evidence-based (Rolnick et al., 2019; Leal Filho and Gbaguidi, 2024). Although the intersection between Artificial Intelligence (AI) and climate change adaptation has received an increased scholarly attention in later years, the information remained fragmented, cross-disciplinary, and unequally distributed in various regions and areas of use (Valencia-Arias et al., 2025; Barre et al., 2024). It is commonly thought that this incomplete condition inhibits a clear understanding of how research in this area has evolved, who some of the primary authors are, and what topics are receiving the greatest focus.

The existing research primarily focuses on specific applications of Artificial Intelligence (AI) - farming, catastrophe monitoring, or climate simulation - without providing a comprehensive overview of the entire area of exploration (Sahar et al., 2025; Li et al., 2024). This creates a severe gap in the search of initial patterns, boundaries of investigation, and unexplored areas, in particular, in the developing world, which endures more severely due to climate change but receives limited coverage in the scientific output (Majahana et al., 2025; Intergovernmental Panel on Climate Change, 2022). It has been noted that in the absence of a systematic overview, the task of investigators, legislators, and workforces to make informed decisions, allocate funds in the right way, or promote valuable interdisciplinary collaboration becomes difficult.

In this regard, a bibliometric analysis can provide a highly effective and systematic method of mapping the intellectual organization and progress of study of AI and climate change adaptation (Donthu et al., 2021). This research offers an empirical understanding of publication

development, network of collaboration, and development of theme by examining publications indexed in the Scopus database between 2011 and 2023. The justification of the study is thus based on the necessity to summarize current knowledge, find gaps and evidence that could be used in future research, policy-making and practical implementation of AI in the process of improving climate resilience and sustainable development.

The paper used VOSviewer software to perform bibliometric analysis of the Mapping the Knowledge Base for the Impact of Artificial Intelligence on Climate Change Adaptation with a significant emphasis on the research issues as described below:

1. How have the trends of publication and increase of research in the use of Artificial Intelligence in climate change adaptation been over the years 2011-2023?
2. What are the most important contributors and sources (authors, institutions, countries and journals) to the knowledge base in this field of research?
3. Which are the key research themes, clusters and new topics in the intersection of Artificial Intelligence and climate change adaptation?
4. How do collaboration and knowledge networks work and what are the patterns and how they affect the research development and dissemination in this area?

2. Literature Review

The recent research implies that the level of research output in the area of AI and climate change rapidly increases. As an example, David Rolnick et al. (2019) offered one of the first in-depth overviews of the potential of machine learning to respond to climate issues and emphasized its potential in various industries. Based on this, a study by Barre et al. (2024) through a bibliometric analysis revealed that there is a growing trend in the number of publications since 2017 owing to the development of deep learning and big data technologies. Likewise, Valencia-Arias and others (2025) discovered that AI-related sustainability studies have grown exponentially, with climate adaptation being an important area of application. Li et al. (2024) found that the number of climate-related studies, especially in the field of agriculture, continues to increase, which means that AI is gaining more importance as a tool in overcoming climate risks. All these studies will affirm that the literature produced so far in this area is growing fast but is relatively new, making it important to conduct systematic mapping.

The literature indicates that studies on AI and climate adaptation are skewed towards developed nations more so the United States, China and European countries. Leal Filho and Gbaguidi (2024) claim that these areas are the most productive in terms of publications, as well as the most innovative technologies, which is explained by the fact that the research infrastructure is well-developed, and they have access to funding.

Majahana et al. (2025) also shed some light on inequality in international research input, as Africa and other developing countries are still underrepresented in the global research input although they are the most vulnerable to climate change. On the topic of journals, Donthu et al. (2021) highlight the importance of high-impact interdisciplinary journals to form bibliometric spaces, especially in sustainability and environmental sciences. This imbalanced distribution highlights the need to find major contributors and knowledge centers, which is the purpose of this study to map it in a systematic manner.

A number of studies have proposed significant research themes of AI-based climate adaptation. Sahar et al. (2025) observe that the agriculture and food supply chains are already one of the most regularly studied fields, and AI is utilized to optimize crop production and reduce climate risk. On the same note, Li et al. (2024) note the significance of AI in climate-smart agriculture. AI has been utilized in disaster risk management in flood prediction, early warning, and risk assessment (Barre et al., 2024). Moreover, Valencia-Arias et al. (2025) also found that there were new themes like smart cities, energy efficiency, and sustainability, which indicates the wide applicability of AI. The presence of these thematic clusters suggests that the field is mature and has ceased to develop its methodology (AI techniques) and moved to applications in particular sectors.

Teamwork is an important aspect in the development of research. According to Donthu et al. (2021), knowledge diffusion and scientific impact are essential parameters related to the co-authorship and citation networks. Current literature indicates that collaboration networks in AI and climate research are very concentrated and can often be centered on major institutions in developed nations. Leal Filho and Gbaguidi (2024) observe that even though there is a growing international collaboration, partnerships with developing countries are limited. This inhibits knowledge transfer and creation of solutions that are relevant to the place. Moreover, Valencia-Arias et al. (2025) emphasize the need to collaborate interdisciplinary to develop AI applications in the context of sustainability.

Although there is a lot of improvement, the literature finds a number of gaps that are critical. To begin with, a lot of research revolves around particular areas, e.g. agriculture or water management, but it does not give a comprehensive picture of the research landscape (Sahar et al., 2025). Secondly, the socio-economic and policy aspects are

poorly integrated, which are key components of an effective climate adaptation (Majahana et al., 2025). Also, the absence of input on behalf of developing regions sets the question of the inclusivity and generalizability of solutions based on AI (Intergovernmental Panel on Climate Change, 2022). These gaps explain why such a thorough bibliometric analysis was necessary to map the area of study and discover research opportunities in the future.

3. Methodology

The research methodology used in this study is a bibliometric analysis to create a systematic mapping of the body of knowledge in the effect of Artificial Intelligence (AI) on climate change adaptation as per PRISMA (David et al., 2009 and Kasubi et al., 2025). In this study the review includes the research articles published from 2011 to 2023 and indexed in the Scopus database.

3.1 The Sources of Information Used in the Study

The database of the study included the data sources collected through Scopus database because of the following facts: Scopus database offers articles of high standards on various domains than other databases (Saeed et al., 2019).

3.2 Eligibility Criteria of the Study

In this work the search has been restricted to the use of Scopus database and the search was performed on 3 rd October 2023. To run full-text searches on titles, abstracts, and authors' keywords, in the Scopus database, the command "TITLE-ABS-KEY" was used. The following were the inclusion criterion of the study; first, the study was limited to articles and conference papers, publications that are in the final stage. Second inclusion criteria included that the article be in English. Third inclusion criterion, the study considered articles published from 2011 to 2023, in the area of computer science. The study exclusion criteria; conference review, book chapter, review, book, non-English papers and articles in progress were excluded in the study to maintain the quality of the review.

3.3 Study Selection

The selection of documents of the study was demonstrated using the PRISMA method. The research used TITLE-ABS-KEY ("Artificial intelligen*") AND ("Climate change*") AND ("adapt*" OR "predict*" OR "integrat*" OR "mitigation*" OR "adaptabilit*" OR "modification*" OR "evolution*" OR "transformation*") search query in Scopus database. The overall number of articles obtained in this search was 6,741. On the basis of the objectives and scope of study, 803 research articles were chosen to be included in the review after considering each record critically using PRISMA 2020 statement as indicated in figure 1.

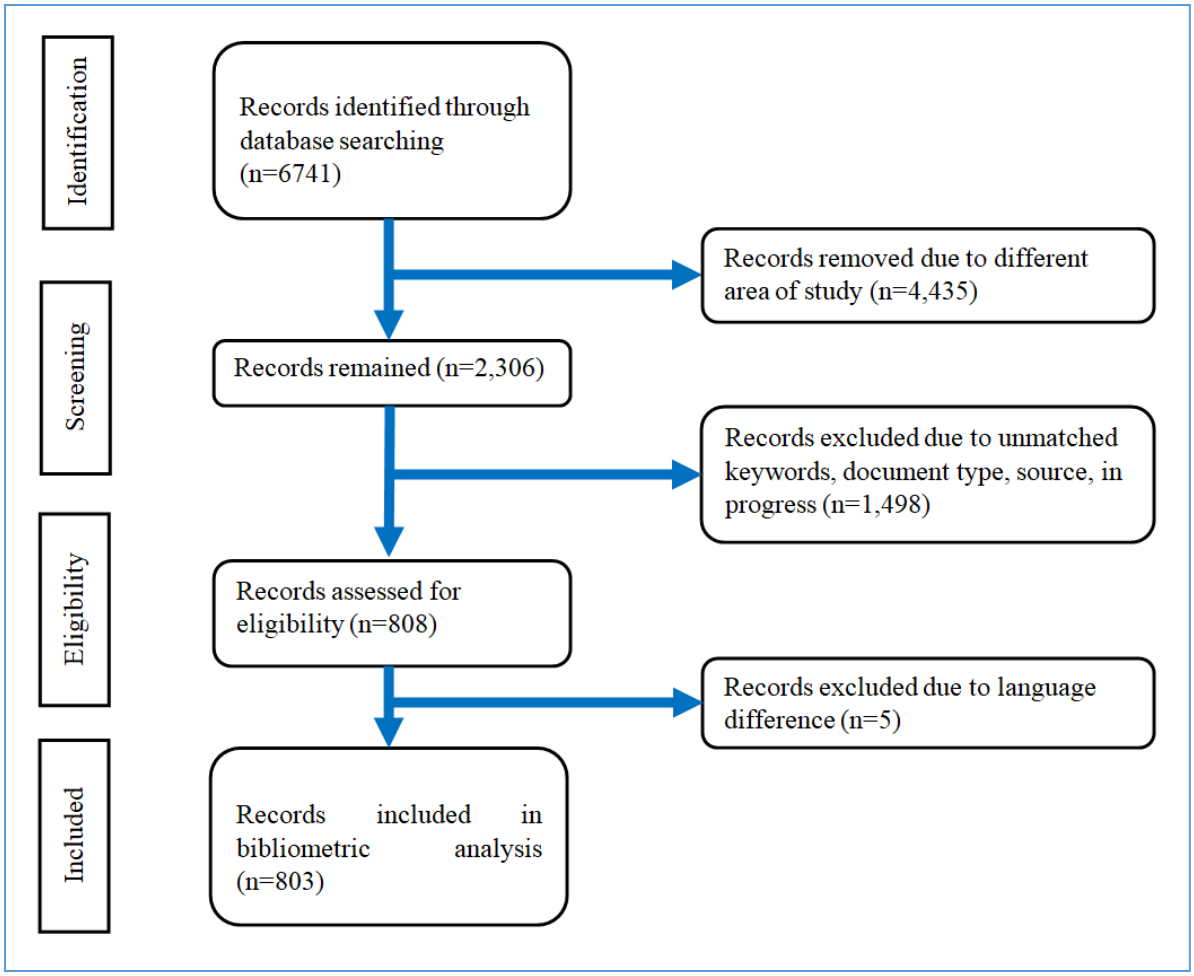

Figure 1. The PRISMA Flowchart Illustrates the Research Selection Procedure

4. Results and Discussion

4.1 Results

The following part describes the findings and discussions of the research using Scopus database collected on 3rd October, 2023. The study employed VOSviewer software (version 1.6.18), MS Excel and SPSS to cater for analysis purposes, because of the benefits they provide over others, such as ease of use, rich graphical representation, and ability to offer superior outcomes (Priyan et al., 2022). The study employed both VOSviewer MS Excel and SPSS software to provide effective ways to analyze the citation, and co-occurrences. The four research questions were investigated through a systematic review using a comprehensive systematic review of the impact of Artificial Intelligence on Climate Change Adaptation. The VOSviewer package was used to analyze 803 research articles published till 3rd October, 2023, which included, authors, titles, keywords, citations, publisher, sponsor, among other details.

4.1.1 The Growth Trend in the Impact of AI in Climate Change Adaptation

This section outlines descriptive of the growth trend research in Impact of Artificial Intelligence on Climate Change Adaptation (figure 2) and between 2011 and 2015, there was limited research output, as the field was young and at its inception. Between 2016 and 2019, there was only a moderate increase in the volume of publications, mostly due to the growing use of Artificial Intelligence technologies. The next and the most active development took place during the period, 2020 to 2023 due to the extensive development of machine learning and due to the increased pressing necessities to implement solutions to solve global climatic change problems.

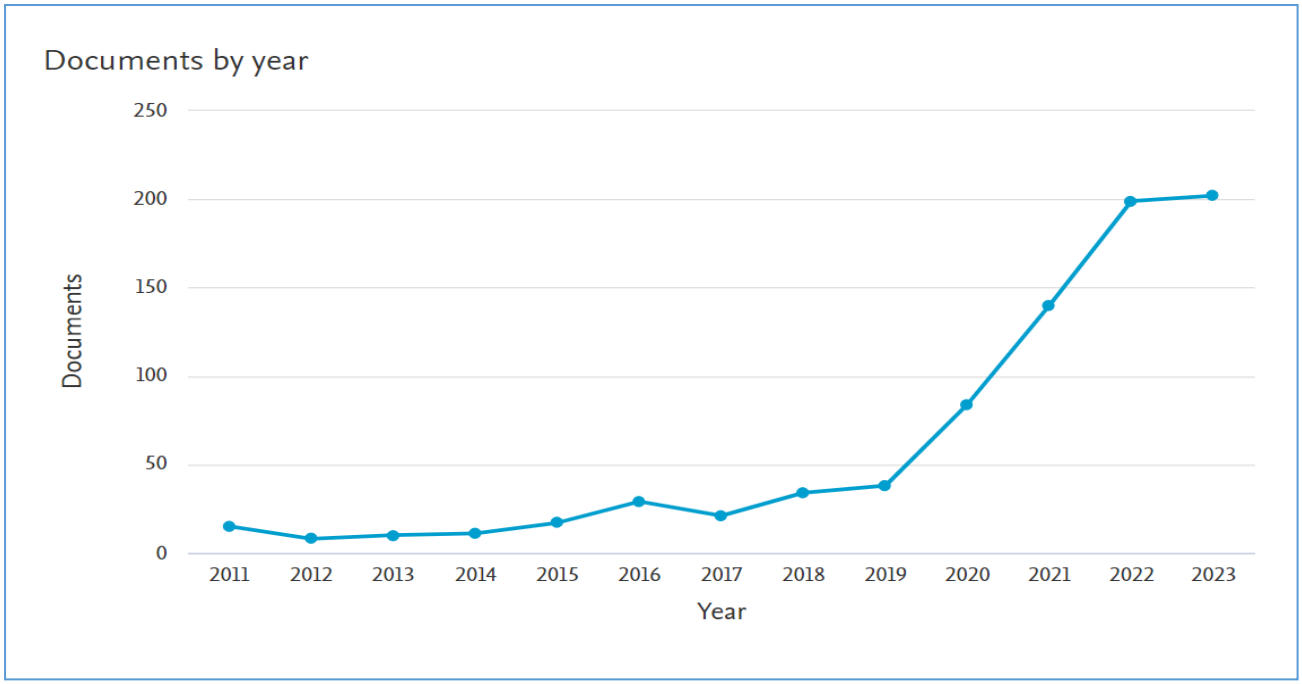

Figure 2. The Growth trend in the Impact of AI in Climate Change Adaptation

4.1.2 Keyword Co-occurrence Analysis to all Keywords

All the keywords provided by the author and indexed in the co-occurrence analysis were first added and then all the keywords got harmonized to obtain the entire scope of terminologies used in the literature. Based on the number of publications about the role of Artificial Intelligence in climate change adaptation, 6,741 keywords were found. A minimum result of 15 appearances per keyword was used to minimize the ambiguity of the results and provide them with an analytical focus. This left 48 keywords that passed this threshold and were represented in the final co-occurrence network analysis.

The conceptual map of the field has been shown in the visualization of these keywords through VOSviewer that depicts clusters that are connected to each other. Some of the most dominant and common keywords include Artificial Intelligence (AI), Machine Learning (ML) and Climate Change, which are dominant nodes in the network. The fact that their frequency is high, and they are at the center speaks to them, being the fundamental basis of studies in this field. These keywords are closely associated with other words like adaptation, sustainability, resilience and prediction, which hints at the fact that the discipline is mainly focused on implementing AI-based methods to solve climate-based issues.

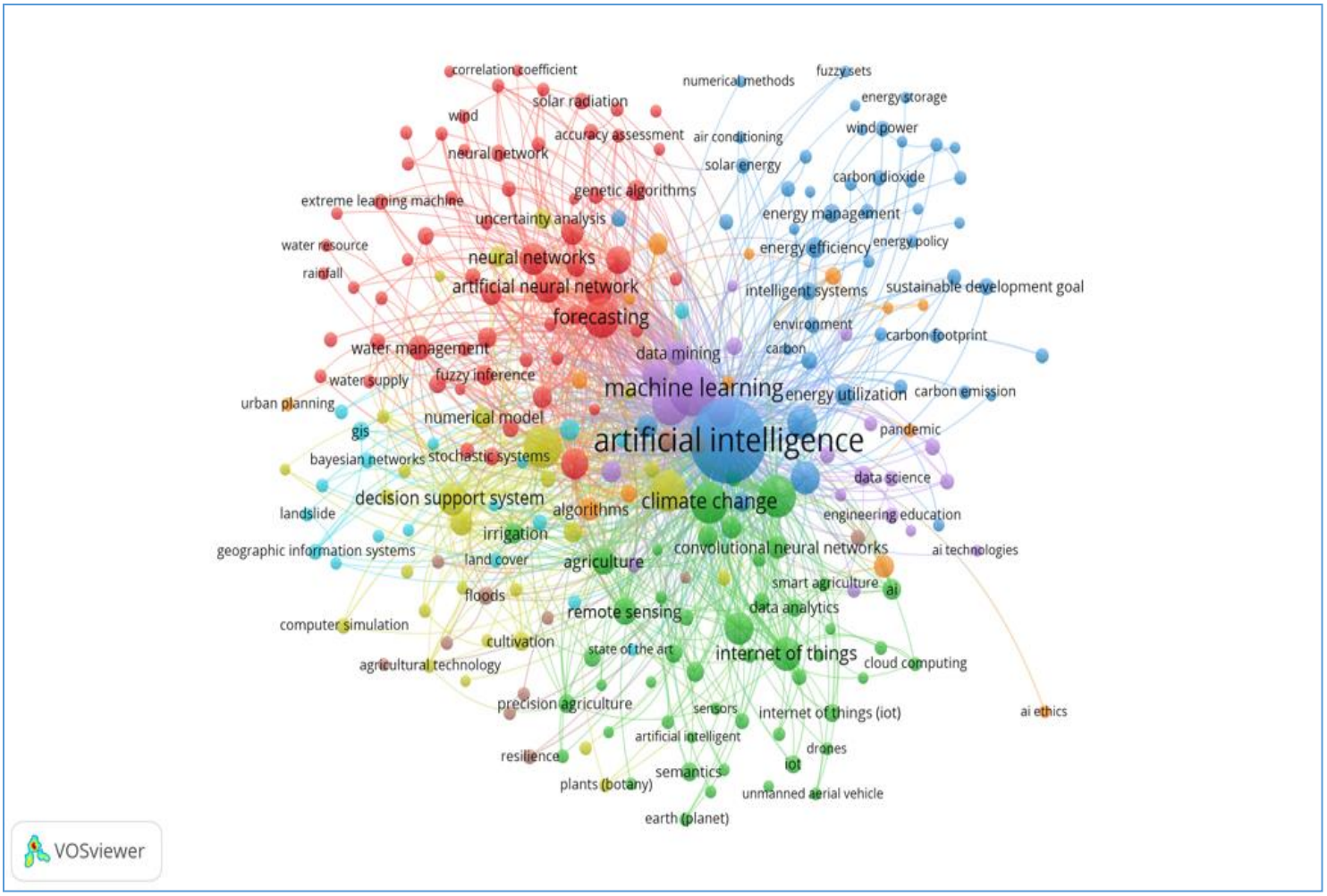

Figure3. Keywords Network Map in the Impact of AI in Climate Change Adaptation

Moreover, thematic clusters are indicated in the co-occurrence map since these reflect the various research directions and application areas. The prevalence of AI- and climate-related terms indicates how interdisciplinary this item is and validates the idea that the majority of studies are aimed at using machine learning approaches to achieve climate change adaptation measures. This trend shows that there is increased convergence between technological innovation and environmental studies as shown in the co-occurrence network below.

4.1.3 The Top Contributing Countries in Terms of Documents

According to the bibliometric findings, the developed, as well as the emerging economies especially the United States, China, and India have the most research output in this field, especially, as in figure 4 below. The research productivity of these countries is high, as seen by a high number of publications, citations and highly ranked authors with well-established institutions. Moreover, they also have elaborated collateral networks, both nationally and globally that complement knowledge sharing and lead to the development of Artificial Intelligence to use in climate change adaptation. They may be attributed to their strong investment on research and development, high level of technology infrastructure as well as favorable policy conditions that facilitates innovation in AI as well as environmentally friendly practices.

Developing countries and in particular Africa have comparatively lower representation in the form of research output and authorship and quite low institutional coverage. This underrepresentation has been the case yet there are countless African countries that are most susceptible to the negative effects of climate change such as extreme weather events, food insecurity and water scarcity. This gap can be attributed to factors like lack of funds to conduct research, ineffective technological support, lack of access to good data and poorness in being integrated in to the world research networks. In turn, this knowledge imbalance brings up questions of the relevance and applicability of current AI-based solutions in their context, which might

not be as applicable to the specific problems of developing areas. This indicates the pressing necessity to enhance study power, worldwide coordination, and make participation inclusive so that AI-grounded climate change adjustment approaches may be just and universally applicable.

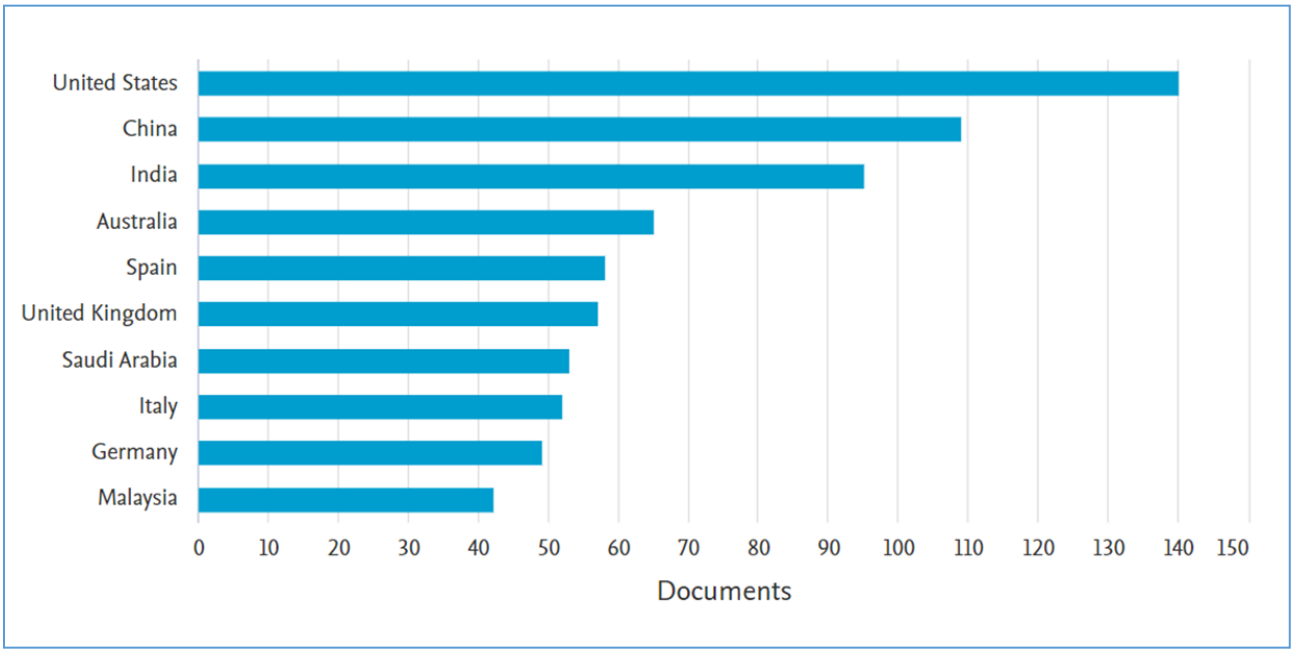

Figure 4. Top Ten Contributing Countries in the Impact of AI in Climate Change Adaptation

4.1.4 Countries with High Citations

The bibliometric findings portray that the literature in this area has been dominated by the developed world and Spain, the United States and France have been the top three among the ten leading developed countries in terms of citation impact as illustrated in Table1 below. This dominance is due to the high-level of research capacity, availability of funds and technically advanced infrastructure in these countries which enables them to have a large share in the high impact publications. The focus of citations in these areas also implies that a significant part of the knowledge power and innovation in the area is based in the developed world and thus in a way might cause hollows in global knowledge generation and hinder the output of knowledge in developing worlds to come into focus.

The citation analysis also leads to a group of very influential publications, which comprise the intellectual background of the field. The most frequently referenced literature is mainly based on the use of the machine learning methods to predict climate, with a particular interest on the accuracy and data-driven implications of predictions. Simultaneously, new research voices are growing around the value of working with Artificial Intelligence to the extent of promoting sustainability and improving climate resilience. The co-citation analysis indicates that the research landscape of AI approaches, environmental science, and policy-focused sustainability research are highly interrelated with each other, which points to a highly integrated and interdisciplinary research space. This meeting ascertains that the discipline is shifting towards more than a technical set of solutions to a more comprehensive structure, which incorporates not only technology and innovation but also issues of the environment and policy in dealing with adaptation to climate change.

Table 1. Top ten contributing countries in the impact of AI in climate change adaptation

Id	Country	Citations	Total link strength
1	Spain	3498	59
2	United states	3445	116
3	France	3092	35
4	Germany	2113	82
5	India	2066	86
6	United Kingdom	1602	85
7	China	1430	93
8	Canada	1373	33
9	Australia	1324	86
10	Malaysia	1316	105

4.1.5 Top Ten Funding organizations in the Impact of AI in Climate Change Adaptation to Documents

A specific threshold was used to conduct the bibliometric analysis of the top ten funding sponsors of studies on the effects of Artificial Intelligence (AI) in climate change adaptation, quantified by the number of documents, to guarantee the robustness of the analysis. Namely, inclusion criteria were a minimum of two documents per funding sponsor and three total contributions, respectively. Among the identified number of funding sponsors in the dataset (n=1,243), only ten funding sponsors fitted these thresholds, and this means that there are only a few agencies that dominate when it comes to funding research in this area. Figure 5 shows the most prominent funding sponsors that have played a significant role in ensuring that compelling studies on the topic of AI and climate change adaptation are published.

The findings show that most of these high funding sponsors are located in the developed world especially in the United States, Europe and China, which illustrates their high level of investment in technological innovation and climate research. Some of the top contributors are the National Natural Science Foundation of China, the European commission, and the National Science Foundation of the United States, which have the highest ranked publications funded. These agencies have been instrumental in promoting research through the funding of research aimed at exploring the use of machine learning, climate modeling, and resilience approaches. Their supremacy reinforces the localization of monetary assets and research talent in more developed areas, which still impacts the orientation and priorities of academic production in this field.

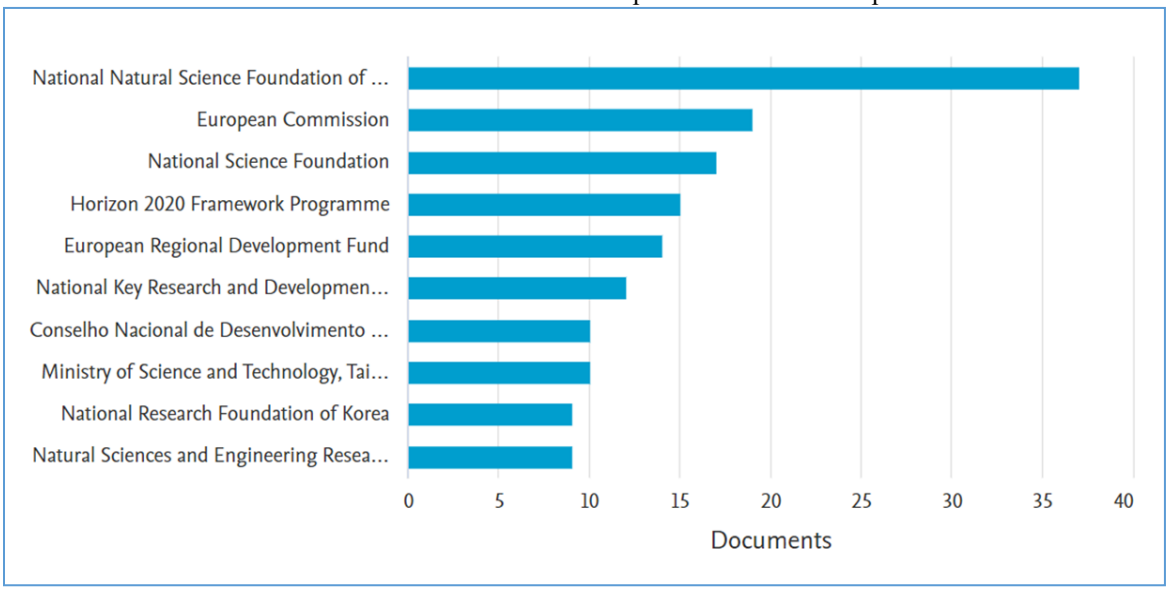

Figure 5. Top Ten Funding Sponsors in the Impact of AI in Climate Change Adaptation

4.1.6 Systematic Analysis on Citations to Cited Authors

Citation analysis by author is done, with a total of 805 authors having contributed towards the publishing on the Impact of Artificial Intelligence on Climate Change Adaptation, a minimum of 2 documents per author are used, a minimum of 2 citations per author are used and 5 among 805 authors fell within the thresholds. Table 3 presents the top five authors who had the highest number of citations in the field of the Impact of Artificial Intelligence on Climate Change Adaptation. The authors Das M. et al, won the maximum number of citations 42 overall, as compared to the other authors, namely Moayedi M et al., and Fox S, who had 37 and 15 citations respectively. These ten researchers published the related documents, which were primarily aimed at the implications of the Impact of Artificial intelligence on Adaptation to climate change.

Table2. Top Five contributing authors in terms of citations

Rank	Author	Scopus Citations
1	Das M.; Ghosh S.K.	43
2	Moayedi M.; Mosavi A.	37
3	Fox S.	15
4	Sokolova M.V; Fernández-Caballero A.	10
5	Bhardwaj R.; Bangia A.	2

4.1.7 Systematic Analysis of the Top Contributing Organizations

The bibliometric analysis to determine the citation impact on the organizational level was carried out using a minimum of three documents per organization and at least ten citations per organization. Among 2,384 organizations that were located in the dataset, only 13 organizations were qualified by these criteria, meaning that a quite limited number of institutions have the highest impact in the field. Figure 1 shows the network of the organizations that have contributed greatly to the publication of high-impact research on the effect of Artificial Intelligence on climate change adaptation. One of them, the Institute of Research and Development, stands out as the most significant contributing body, having the most impacts in citation and it is preceded by the Department of Management Science and the Faculty of Environmental and Laboratory Sciences among others. The fact that these institutions are the most prominent underscores their high research potential, interdisciplinary emphasis and involvement in knowledge development in the AI and climate change adaptation interface. In general, the results indicate that the institutional input to this area is highly localized in a few organizations, which makes it important to evolve research capacity and partnership on a wider scale with a wider number of global organizations.

Figure 4. Citation Analysis Map in Organizations

4.1.8 Systematic Analysis on the Co-Occurrence Analysis in Terms of Author Keywords

After a rigorous harmonization process that was intended to ensure consistency through the combination of synonyms, standardization of language and the elimination of duplicates, co-occurrence of author keywords was examined. Following this process, a total of 45 refined keywords were found from the literature on the effects of Artificial Intelligence on adaptation to climate change. To enhance the strength of the analysis, at least 10 occurrences per keyword was considered; 38 keywords were suitable to meet the inclusion criteria of the co-occurrence network. Additionally, a broader key word analysis identified 3,875 key word references, upon which a minimum threshold of 7 references per key word was applied to yield 17 key words that satisfied the requirement. These selected keywords were subsequently used as the source of the co-occurrence network as indicated in figure 5 below hence providing information on the key areas of research, conceptual framework and links within the topic.

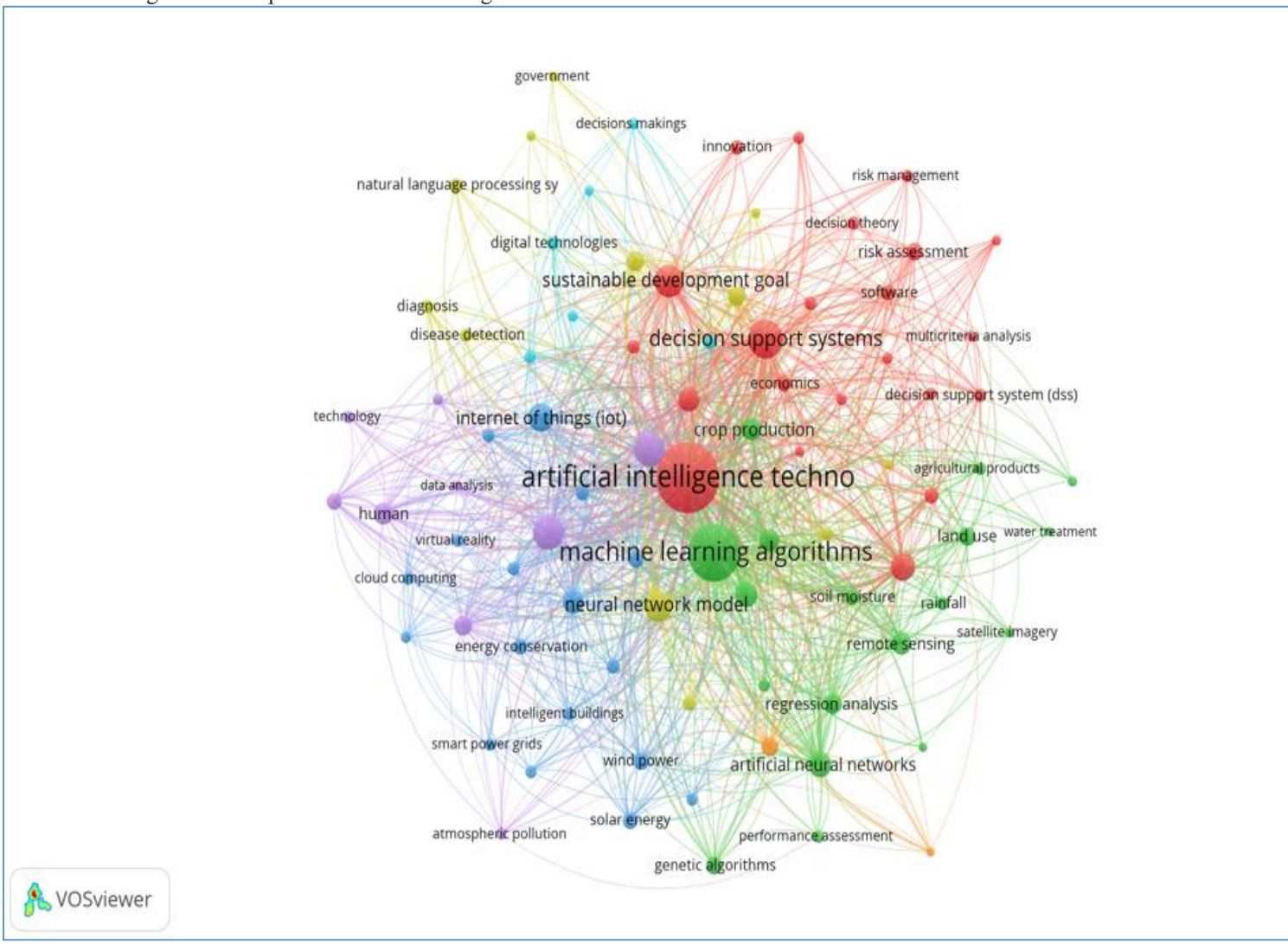

Figure 5. Co-occurrence Analysis to Author Keywords

4.2 Discussions

Reflecting its increasing relevance in handling complicated environmental problems, the results of this research reveal that the branch of artificial intelligence (AI) in climate change adaptation is fast changing and very multidisciplinary. The number of publications is constantly increasing, which indicates that under the conditions of climate change the scientific community is becoming more and more aware of the transformative potential of artificial intelligence to enhance predictive capabilities, decision-making processes and resilience strategies (Valencia-Arias et al., 2025; Leal Filho Andamp; Gbaguidi, 2024). But developed nations' hegemony in citations and research output points to a major geographical knowledge creation disparity. This area of research on such regions as Europe and North America can restrict the extent to which AI-based solutions can be deployed and implemented to vulnerable areas, particularly in impoverished nations that are highly vulnerable to climate change (IPCC, 2022; Majahana et al., 2025).

The thematic clusters, identified by bibliometric research, indicate a clear shift in theoretical and methodological research on AI to practical applications of the AI technology in such significant sectors as agriculture, disaster risk management, and urban systems. This trend aligns with the world sustainability strategies and highlights the increasing importance of artificial intelligence to aid data-based adaptation strategies to enhance resilience and reduce climate-related risks (Sahar et al., 2025; Li et al., 2024). The fact that the focus of the subject matter is based on resilience, modeling of climate as well as machine learning also means that scientists are focusing on developing practical solutions rather than just philosophical concepts. This tendency reveals the interdisciplinary nature of the subject matter as environmental science, policy-based research, and technical innovation are becoming integrated to address factual concerns.

Despite these advances, the study does identify some quite significant aspects that require effort in ensuring that AI can be utilized to its maximum capabilities in managing climate change. To begin with, the fact that emerging countries are not well represented in the world research creates justice concerns and the possibility of the application of recommended solutions (Majahana et al., 2025). Second, many studies' poor integration of socio-economic aspects inhibits the capacity of artificial intelligence technologies to handle the more general aspects of vulnerability and sustainability. Third, the study shows a need for better worldwide networks of cooperation to encourage knowledge sharing, capacity building, and multidisciplinary research. In line with the objectives of the sustainable development agenda (United Nations, 2015), ensuring that artificial intelligence (AI) contributes successfully to fair, inclusive, and sustainable climate adaptation plans all around will depend on closing these gaps.

5. Conclusion, Recommendations

5.1Conclusion

This research presents a comprehensive bibliometric review of the impact of artificial intelligence (AI) on climate change adaptation, based on the number of Scopus database-indexed papers published since 2011. The findings indicate that the amount of research in this field has grown exponentially over the years, particularly since 2017, in line with the rising consciousness of AI as a powerful problem-solving instrument regarding climate change. The research indicates that developed countries, particularly Spain, the United States and France generate the most research and that they have the highest number of citations, this indicates that these regions are scientifically influential. Thematic analysis also reveals that the field is shifting its focus to less theoretical-AI development to more practical use in key fields such as agriculture, disaster response, and urban systems. Broadly, the study confirms the increasing importance of artificial intelligence in assisting resilience planning, data-driven decision-making, and predictive modeling, hence climate change adaptation. Nevertheless, the results also reflect the necessity of more inclusive, interdisciplinary, and globally balanced research to ensure that AI-driven solutions are adequately applied in numerous various contexts and in particular in poor and developing regions.

5.2 Recommendations

This study does not do well in a few aspects, which we need to remember. To begin with, the research only searches papers available in Scopus and this may result in missing out more relevant studies that may be available elsewhere such as Web of Science, Google Scholar, or the local libraries. It can result in the biased coverage of the research scene in the world. We recommend authors to go beyond Scopus database like Web of Sciences, and Google Scholars, among others, to increase the scope for unbiased results.

Second, the study is limited to a specific time period (2011-2023), which brings the study to the specific period in time and may not reflect the latest changes that may have occurred beyond the period of study. We recommend a long period review to increase the scope to reflect the latest changes.

The research also uses search methods based on keywords and might overlook any significant research due to variations in naming or the organization of things. We recommend also the use of longitudinal review for trend evaluation. However, despite the above limitations, the study provides valuable discussion of the knowledge base, architecture, and dynamics of artificial intelligence in climate change adaptation and provides a foundation on future research in this growing field.

5.3 Research Gaps

Despite the rapid increase in the number of works on artificial intelligence and adaptation to climate change, numerous important gaps in the study remain. To begin with, much of the literature is devoted to technical solutions and fails to adequately consider the social equity, governance, and policy implications, thus the literature does not have in-depth studies that incorporate the technical and socioeconomic elements behind AI applications in climate change adaptation. Second, despite their great sensitivity to effects of climate change, bibliometric analysis shows a major underrepresentation of underdeveloped nations, especially in Africa. This mislinkage limits the extrapolatibility and applicability of present AI-based adaptation solutions to various geographical contexts. Third, it is actually very important to develop comprehensive and practical solutions through conducting further research on the collaboration of AI experts, climate scientists, and politicians. Fourth, such emerging areas as ethical AI, data governance, and responsible use of AI in climate change adaptation remain unexamined. Finally, time series and context-specific studies on the real effectiveness of AI solutions to improve climate resilience over time are needed.

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