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CONFERENCE PAPER

DOES CLIMATE CHANGE ADAPTATION PROMOTE SUSTAINABILITY: A BIBLIOMETRIC ANALYSIS

Somanath Kumar Mishra and Monalisa Kar

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Abstract

Climate change poses an unprecedented threat to the environment, the economy, and social well-being by escalating disaster risks. It affects ecosystems, livelihoods, and long-term sustainability. Addressing these challenges requires a comprehensive understanding of how adaptation strategies integrate with sustainable development. Although there is growing recognition of climate change adaptation strategies, there remains a lack of bibliometric studies examining research trends and patterns on these two emerging themes. Therefore, to address this limitation, this study provides a comprehensive bibliometric analysis of climate change adaptation and sustainability. Moreover, this study uses a set of 1,473 documents extracted from the Scopus database spanning from 2002 to 2025. This study finds that a gradual increase in publications in this field has been observed since 2015, due to rising global awareness of climate risks and the adoption of adaptation policies. However, we identify that the United States and China are the key contributors and leading countries, whereas India has an emerging contribution in the research landscape. Thematic analysis reveals a shift toward interdisciplinary, solution-based themes focusing on adaptation, vulnerability, and sustainable development. Our findings underscore the need to promote international collaboration, enhance the accessibility of funds for adaptation research, and integrate scientific evidence into a sustainability-oriented policy framework.

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Introduction:-

In recent decades, worldwide climate change has emerged as a major issue, escalating risks of natural disasters (Carter et al., 2015; Glasser, 2020). The Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report reveals that rising global air and sea temperatures, temporal changes in precipitation patterns, and extreme rainfall lead to climate change. These phenomena are caused by several human-led activities, for instance, the emission of GHGs, deforestation, and the overexploitation of natural resources (Carter et al., 2015; Waseem et al., 2024). As a result, it will act as a driver of increased frequency of several natural disasters, such as floods, cyclones, droughts, and landslides (Van Aalst, 2006; Mall et al., 2011). It leads to a complex and diverse dilemma with huge implications for the socio-economic and environmental worldwide.

Corresponding Author:- Somanath Kumar Mishra

Hence, to address these growing risks of adverse impact of disasters and attain sustainability, it is required to incorporate adaptation strategies at various levels of governance (Raftopoulos et al., 2024).

Climate change adaptation is a process in which human beings should adapt to anticipated climatic events and their negative impacts, resulting in reducing the adverse effects of climate change and taking advantage of beneficial opportunities. However, the United Nations Development Programme (UNDP) defines climate change adaptation as including strategies and actions that lessen vulnerability to current or anticipated impacts of disaster risks, like natural disasters and biodiversity loss (UNDP, 2023). Additionally, it refers to addressing the adverse impacts of climate change through changes to economic, social, and ecological systems. CCA is mainly considered as a long-term planning to protect the environment, livelihood, and safeguard vulnerable communities by incorporating adaptive strategies into several policies and actions (Nyong et al., 2007; Alessa et al., 2016). Furthermore, IPCC (2022) highlights that CCA plays a major role to strengthen resilient and attaining sustainability. The Brundtland Commission defines sustainable development as the development that “meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 1987; Guest, 2010). While climate change poses serious threats in the form of disaster risks. Consequently, it is essential to significantly reduce the environmental impacts of climate change for sustainable development (Ahmed et al., 2019). Moreover, the United States has recognized the need for climate change adaptation for sustainable development by incorporating it into the Sustainable Development Goals (SDGs). For instance, sustainable cities and communities (SDG 11), climate action (SDG 13). Additionally, the United Nations Framework Convention on Climate Change has also highlighted the need for a comprehensive framework for mitigating and adapting to disaster risks by combining these objectives with the SDGs (UNFCCC, 2015).

Despite growing recognition of climate change adaptation strategies, there remains a lack of bibliometric studies examining research trends and patterns on these two emerging themes. To address this limitation, this study provides a comprehensive bibliometric analysis of climate change adaptation and sustainability to explore the growth trajectory and research gap in this context. Therefore, this study performs a bibliometric analysis to evaluate earlier research, examine publication trends and patterns, identify major contributors, and suggest a roadmap for future studies to integrate climate change adaptation with sustainability. Generally, this study has the following objectives:

1. To examine the academic contribution to climate change adaptation and sustainability.
2. To identify the most prominent author or contributor in this field.
3. To explore the emerging themes by using a keyword analysis.
4. To identify the most influential study in this domain through traditional citation analysis.
5. To evaluate the most scientifically productive country that influences the knowledge patterns worldwide.

This study is categorised into certain distinct phases. Section 2 explains the data and methodological approach that have been employed in this study. Results and discussion have been discussed in Section 3. Section 4 describes concluding remarks, and limitation, and future of the study.

Acronyms and Abbreviations	
ABS	Abstract
CCA	Climate change adaptation
IPCC	Intergovernmental Panel on Climate Change
KEY	Keyword
SDG	Sustainable development goals
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

Data and methodology:-

This study has used the Scopus database to examine evolving research trends in adaptation strategies and sustainability. The rationale for selecting the Scopus database is that, to ensure reliable and reproducible results, bibliometric analysis requires a comprehensive and standardized database. Hence, the Scopus database provides extensive coverage of high-quality, citation-based, peer-reviewed journals across several disciplines (Elsevier, 2018). It offers broader coverage of datasets and is easy to download (Harzing and Alakangas, 2016; Ruban et al., 2018; Herrera-Franco et al., 2020; Caputo and Kargina, 2022, add another citation). Furthermore, the Scopus database provides information on journals, document types, authors and affiliations, publication h-index metrics, and citation counts (Minasny et al., 2013; Agarwal et al., 2016; Schotten et al., 2017; Sweileh, 2018, add another one).

Given the multidisciplinary nature of climate change adaptation and sustainability, the Scopus database is appropriate for ensuring a comprehensive understanding of global research trends.

After selecting an appropriate database to retrieve relevant literature, this study has used predefined keywords with the Boolean operators “AND” and “OR.” These operators are used to meaningfully combine different words (Lashkari et al., 2009). The search criteria are described in Table 1. To extract the dataset for analysis, the TITLE-ABS-KEY field was used in Scopus, yielding 2,069 documents. Thereafter, this study has applied inclusion and exclusion criteria to extract the most relevant literature for a comprehensive bibliometric study. This study has mainly focused on articles and review papers and has considered only English-language papers for the analysis. Following the refined criteria, this study has extracted a final dataset of 1,473 documents from 2002 to 2025. However, data before 2002 were not available in the Scopus database.

Table 1: Search criteria

Database	Scopus
Search Criteria	TITLE-ABS-KEY (("climate change adaptation") AND ("sustainable development goals" OR "sustainable production" OR "sustainable consumption" OR "sustainability"))
Boolean Operators	AND, OR
Document type	Article, review
Language	English
Time Frame	2002 to 2025
Date Searched	09 th April, 2026
Results	1,473

Note: ABS stands for abstract, and KEY is used for Keyword.

The final dataset has been exported into two file formats, CSV and BibTex, for further analysis in various software, especially RStudio and VOSviewer. The retrieved dataset includes title, author(s), publication year, source, abstract, author’s keywords, language, affiliations, and citation number (if available) in the full record. This final dataset was extracted on 9th April, 2026.

Data analysis technique:

The bibliometric analysis technique plays a major role in research by examining evolving research trends, patterns, prominent authors, and major contributors in a scientific field (Alsharif et al., 2020, add more citations). This approach has been used to evaluate large volumes of scientific data and emerging subfields within an area in a systematic and reproducible manner. Consequently, it minimizes the subjective bias largely associated with the traditional literature review method (Aria and Cuccurullo, 2017; Donthu et al., 2021; Shu et al., 2024; Verma et al., 2025). Therefore, this study has adopted a descriptive analysis approach to examine research trends and patterns on the nexus of climate change adaptation and sustainability. In the descriptive statistics, we have examined publication trends, author analysis, keyword analysis, citation analysis, and country analysis. Furthermore, the Biblioshiny package of RStudio and VOSviewer software has been used for the analysis.

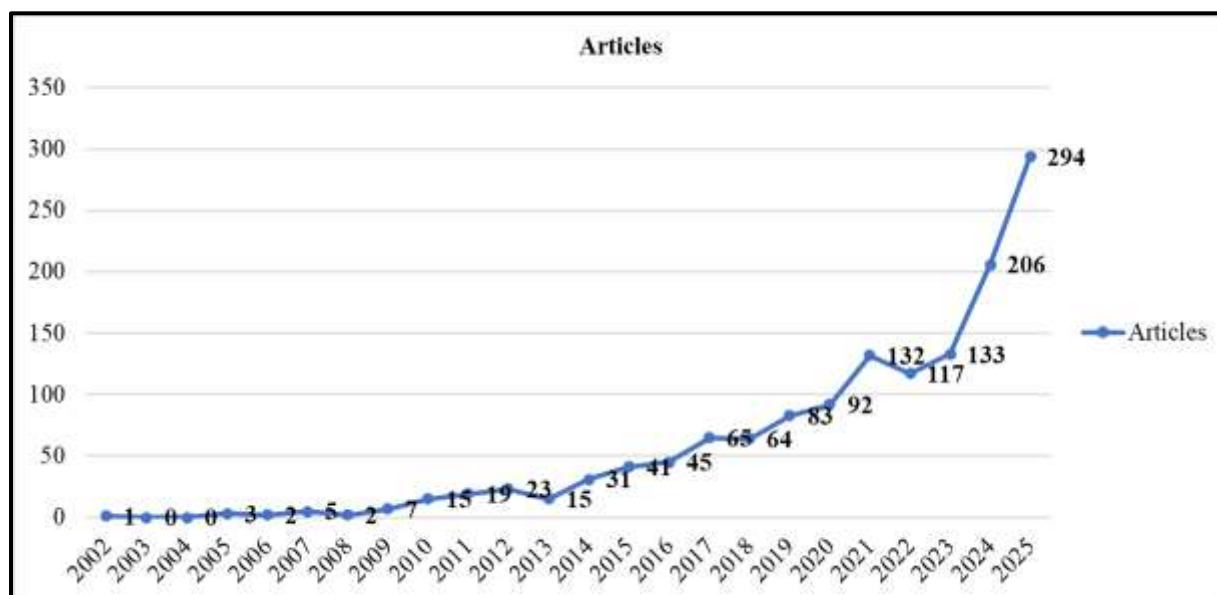
Results and analysis:-

Publication trend analysis:

The publication trend analysis reveals a temporal distribution of publications and an accelerating growth trajectory in a particular field (Zhang, 2015; Zupic and Cater, 2015; Fan et al., 2023). Figure 1 shows a longitudinal analysis of publications on climate change adaptation and sustainability from 2002 to 2025. It demonstrates that the research on the integration of adaptation strategies with the broader climatic events from 2002 to 2015 is in the early stages. However, a gradual increase in publications in this field has been observed since 2015, due to rising global awareness of climate risks and the adoption of adaptation policies. Subsequently, the institutionalization of sustainability agendas and the introduction of Sustainable Development Goals (SDGs) enhance the integration of

adaptation strategies to promote sustainability. This growing research intensifies research collaborations, policy-driven research initiatives, and strengthens the academic contribution to attain sustainability.

Figure 1: Publication trends



Source: Authors' own compilation

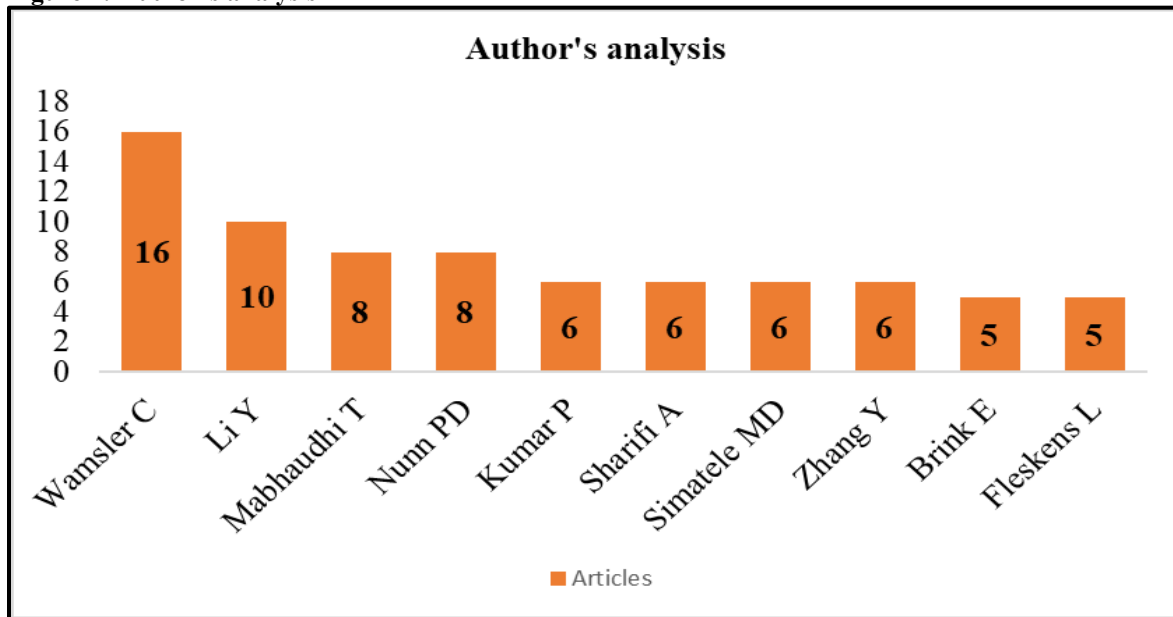
Author's analysis:

The author's analysis plays a very important role in bibliometric analysis to identify the most prominent author in a specific field. Table 2 and Figure 2 highlight that Wamsler has emerged as the most prolific author with 16 publications, which is followed by Li and Mabhaudhi with 10 and 6 publications, respectively. This author-wise distribution highlights the growing academic involvement of researchers, emphasizing interdisciplinary collaborations and contributions in this field.

Table 2: Top-ten authors analysis

Authors	Articles
Wamsler C	16
Li Y	10
MabhaudhiT	8
Nunn PD	8
Kumar P	6
Sharifi A	6
Simatele MD	6
Zhang Y	6
Brink E	5
Fleskens L	5

Source: Authors' own compilation using R

Figure 2: Author's analysis

Source: Authors' own compilation

Keyword analysis:

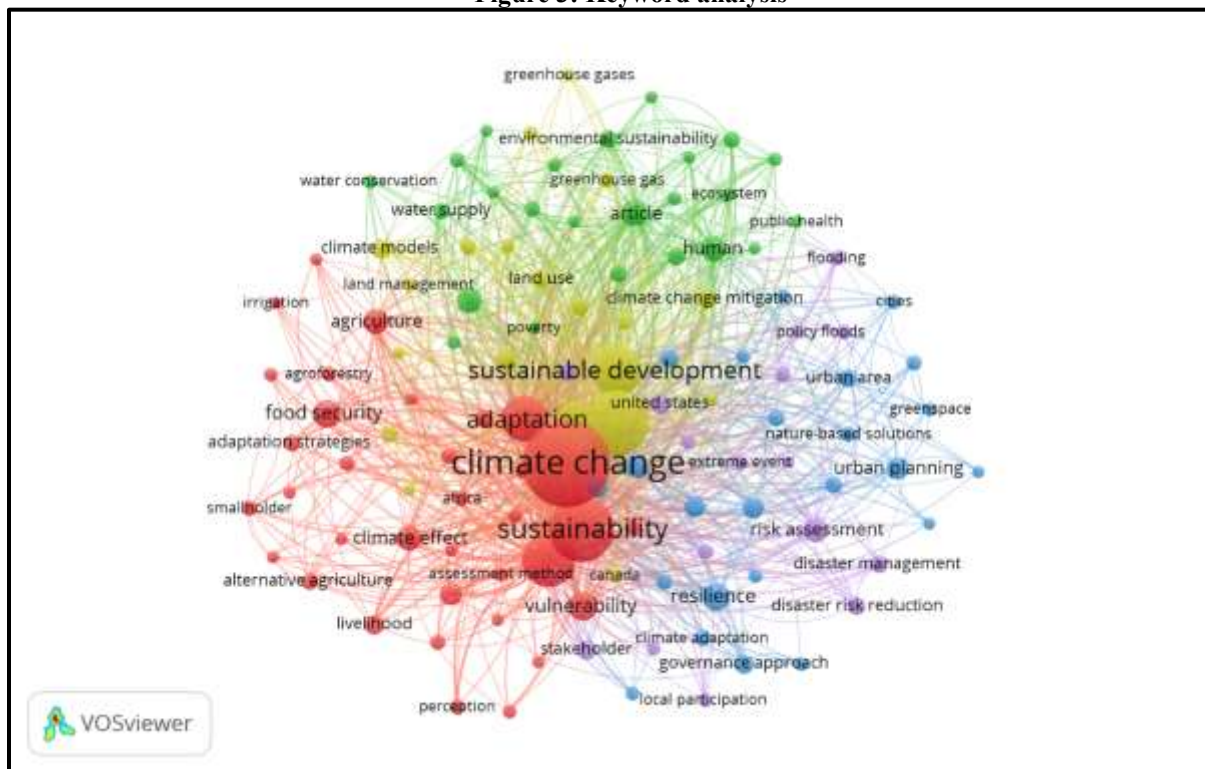
In the bibliometric study, keyword analysis has emerged as the key factor that reveals the occurrences of key terms in a specific field (Alsharif et al., 2020). Table 3 and Figure 3 present the keyword analysis, which reflects the dominance of the keywords “climate change” and “sustainability,” indicating that most of the authors are engaged in broad environmental and development studies. Further, the frequent use of terms “adaptive management” and “sustainable development” suggests recent studies have a strong concentration towards policy-relevant and integrative approaches. Additionally, the terms, including “climate change adaptation”, adaptation, and “vulnerability” reveal a continuous focus on resilience and risk reduction.

Table 3: Top-ten keywords analysis

Terms	Frequency
Climate change	1236
Sustainability	443
Adaptive management	384
Sustainable development	328
Climate change adaptation	242
Decision making	155
Adaptation	148
Water management	109
Risk assessment	106
Vulnerability	93

Source: Author's own compilation

Figure 3: Keyword analysis



Source: Author's own compilation using VOSviewer

Figure 4 presents a word cloud, which also reveals that terms like climate change, sustainability, adaptive management, and sustainable development are more often used keywords in this domain. In general, the author keyword highlights that recent studies have shifted toward interdisciplinary, problem-solving, and policy-driven research frameworks in this area.

Figure 4: Word cloud



Source: Author's own compilation using R

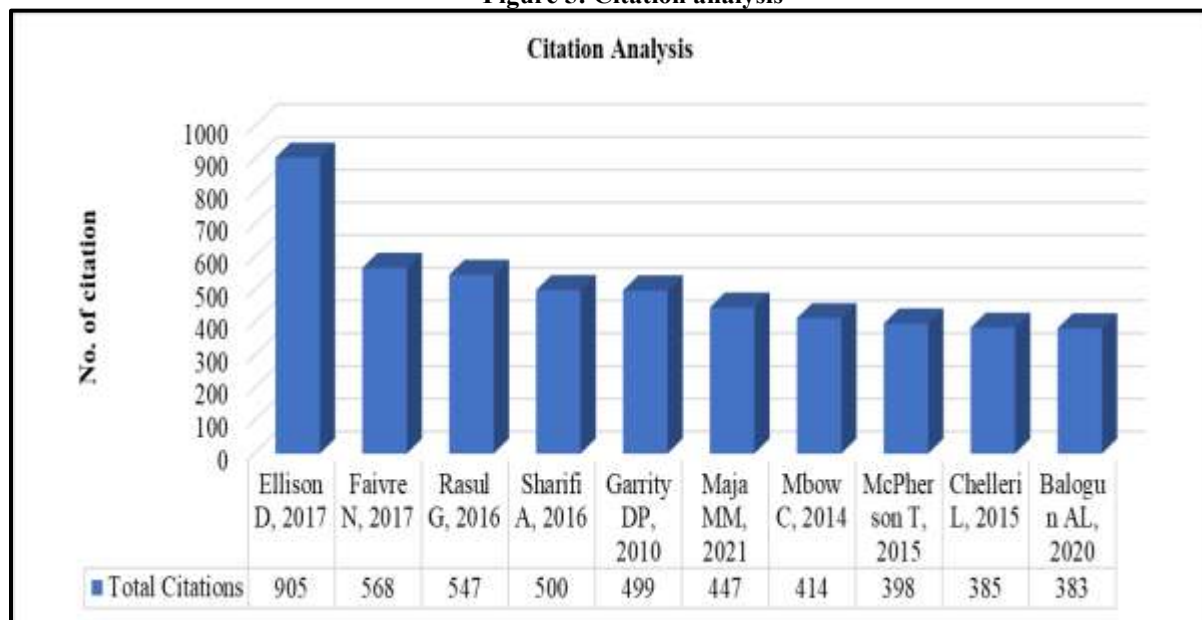
Citation analysis:

It is a primary tool in bibliometric analysis to identify the impactful literature in a research field (Donthu et al., 2021). This study has used a final dataset of 1,473 documents to analyse the most cited documents published in the context of adaptation and sustainability. Table 4 and Figure 5 present the citation analysis, which identifies that the study by Ellison (2017) is the most influential in the field of climate change adaptation and sustainability, with 905 citations. This is followed by the study of Faivre (2017) and Rasul (2016), with citations of 568 and 547, respectively. Overall, these findings reveal that these studies are shaping the integration of adaptation strategies with sustainability.

Table 4: Top-ten citation analysis

Paper	DOI	Total Citations
Ellison D, 2017	10.1016/j.gloenvcha.2017.01.002	905
Faivre N, 2017	10.1016/j.envres.2017.08.032	568
Rasul G, 2016	10.1080/14693062.2015.1029865	547
Sharifi A, 2016	10.1016/j.rser.2016.03.028	500
Garrity DP, 2010	10.1007/s12571-010-0070-7	499
Maja MM, 2021	10.1007/s41748-021-00209-6	447
Mbow C, 2014	10.1016/j.cosust.2013.10.014	414
McPherson T, 2015	10.1016/j.ecoser.2014.07.012	398
Chelleri L, 2015	10.1177/0956247814550780	385
Balogun AL, 2020	10.1016/j.scs.2019.101888	383

Source: Author's own compilation using R

Figure 5: Citation analysis

Source: Author's own compilation

Country analysis:

Country analysis shows the degree of involvement of research conducted in a geographical region (Rana et al., 2022). Furthermore, it exhibits the country-wise distribution of publications that highlights the geographical contribution to research outcomes in the context of climate change adaptation and sustainability. Table 5 and Figure 6 show the country-wise publications in this field. It reveals that the advanced and developed countries are significantly involved in research, which leads to promoting sustainability by adopting several adaptation strategies.

The countries like the United States, China, and the United Kingdom have published the highest number of documents with 544, 335, and 277, respectively. This finding suggests that these countries are highly involved in concentrating on climate resilience and attaining sustainability by adopting several policies. Moreover, it also highlights that government-driven incentives and policy have strongly enhanced scientific publications in this domain.

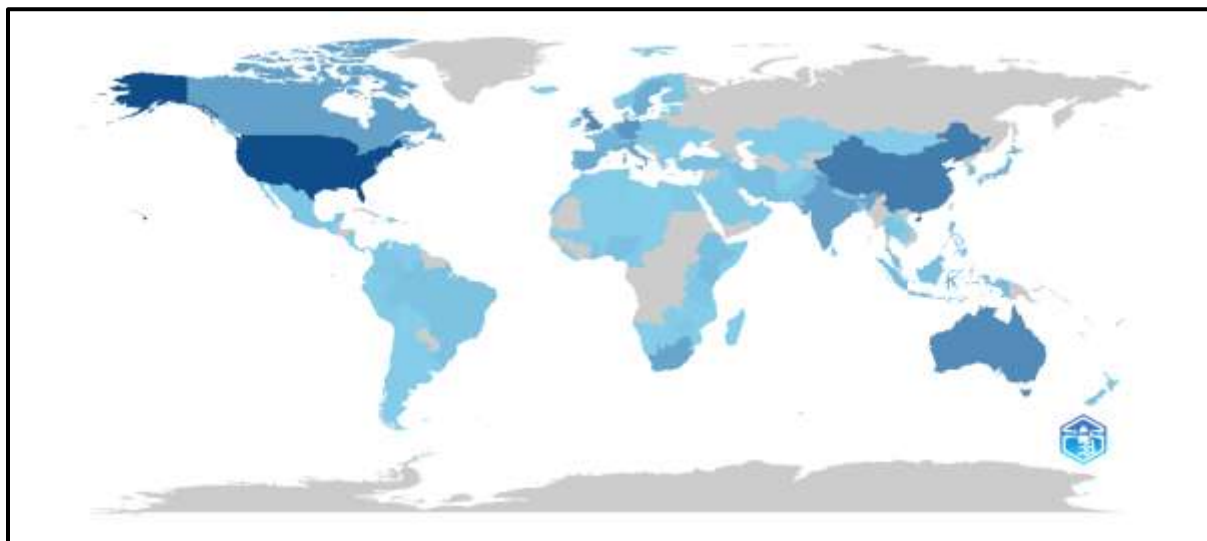
Although India is highly vulnerable to climate change and natural disasters, the publication still shows a moderate rate of growth in research contribution. It may be lower research findings, infrastructural constraints, and limited access to high-impact publication platforms compared to developed countries. Despite these challenges, the findings suggest a growing concentration on adaptation and sustainability, especially in policy and region-specific studies. Overall, the results reveal that developed countries have a dominant research output due to better access to resources and institutional capacity as compared to developing countries.

Table 5: Top-ten country analysis

Country	Freq
USA	544
China	335
UK	277
Australia	272
Germany	217
India	180
Canada	179
South Africa	160
Italy	148
Spain	137

Source: Author's own compilation using R

Figure 6: Country-wise scientific publication



Source: Author's own compilation using R

Conclusion:-

Climate change has emerged as one of the greatest threats worldwide and poses escalating environmental and socioeconomic risks. It underscores the need for adaptation strategies to enhance resilience, reduce vulnerability, and promote sustainability. Despite growing recognition of climate change adaptation strategies, there remains a lack of bibliometric studies examining research trends and patterns on these two emerging themes. Therefore, this study provides a comprehensive bibliometric analysis of climate change adaptation and sustainability, drawing on 1,1473 documents from the Scopus database spanning 2002 to 2025. The findings reveal a gradual increase in publications since 2015, driven by rising global awareness of climate risks and the adoption of adaptation policies. Keyword analysis further highlights interdisciplinary, solution-oriented research, with a focus on adaptation, vulnerability, and sustainable development. The results also indicate that developed countries, including the United States, China, and the United Kingdom, play a dominant role in this field, publishing the highest number of documents. This underscores the role of strong research ecosystems and funding support. However, despite lower output, India has an emerging contribution, with growing research engagement on adaptation and sustainability. From a policy perspective, this study suggests strengthening international research collaboration, enhancing funding to focus on adaptation strategies, particularly in developing countries, and promoting the integration of climate-resilient planning with sustainable development goals.

Limitations and future scope of the study:

This study provides several insights into the evolving research and policy implications, but it has certain constraints. First, despite the Scopus database providing high-quality documents, relying solely on one database may omit relevant studies indexed in other databases, such as Web of Science. Second, restricting the analysis to English-language literature may exclude significant research published in other languages. Further, the study is limited to research articles and review papers, which restricts the inclusion of other pertinent research papers. Future studies may expand the scope by adding multiple databases to enhance the comprehensiveness of the dataset for an in-depth understanding of the research trends and patterns. Further studies may also examine the association between adaptation strategies and sustainability using an empirical methodological approach to strengthen policy relevance.

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