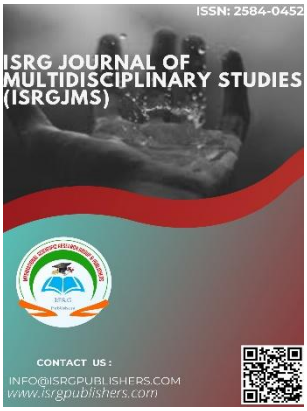
ISRG Journal of Multidisciplinary Studies (ISRGJMS)

ISRG PUBLISHERS
Abbreviated Key Title: isrg j. multidiscip. Stud.
ISSN: 2584-0452 (Online)
Journal homepage: https://isrgpublishers.com/isrgjms/
Volume – III, Issue -IX (September) 2025
Frequency: Monthly



Bibliometric Analysis of Research on Climate Change and the COVID-19 Pandemic

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| **Received:** 27.08.2025 | **Accepted:** 02.09.2025 | **Published:** 24.09.2025

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Abstract

The convergence of climate change and the COVID-19 pandemic has intensified global challenges, leading to a growing body of interdisciplinary research aimed at understanding their interconnected impacts on health, the environment, and society. However, a comprehensive overview of this evolving research landscape has been lacking. This study conducts a bibliometric analysis to map global research trends, key contributors, thematic focus areas, and the intellectual structure of literature on the impact of climate change on COVID-19. The English-language journal articles published between 2020 and 2025 were identified through a systematic Boolean search using the Scopus database. Descriptive statistics were utilized to determine publication output, authorship, institutional affiliation, journal distribution, and country-level contributions. Besides, to explore thematic developments and research linkages over, the time keyword co-occurrence networks, overlay visualizations, and co-citation analyses were generated. The findings indicate a surge in publications peaking in 2022, followed by a gradual decline. The most prominent subject areas included Environmental Science, Social Sciences, and Medicine. Initial research mainly focused on environmental indicators, including air pollution and carbon emissions, while more recent studies have turned to social and health-related issues, such as mental health, education, and vaccination. Besides, the United States, the United Kingdom, and China are the most active publishing nations, which have substantial institutional contributions from respected research organizations. This study provides a comprehensive overview of how the academic community has explored the association of climate change and pandemic-related challenges, offering valuable insights into the evolution of research priorities. The findings emphasize the critical need for interdisciplinary collaboration and integrated policy frameworks to effectively address the multifaceted risks associated with global health and environmental crises.

Keywords: Bibliometric Analysis, Climate Change, COVID-19, Research Trends

DOI: 10.5281/zenodo.17189960

INTRODUCTION

The link between the COVID-19 infectious disease and the impact of climate change is one of the most significant global concerns of the twenty-first century. This issue highlights complex interactions that compromise public health, environmental sustainability, and socioeconomic stability. Climate change increases the risk that infectious diseases will emerge and spread, in addition to creating environmental hazards like heat waves and air pollution. The increasing pattern of infectious disease outbreaks caused by social injustices and environmental stresses motivates an in-depth review of important vulnerabilities and adaptations (Baker et al., 2021). Climate-induced differences are caused by of the outbreak's simultaneous exposure and escalation of public health infrastructure weaknesses which significantly impact underresourced communities (Vuurst and Escobar, 2023).

Researchers are examining the role of environmental stress in shaping the outcomes of pandemics, with growing emphasis on the interconnectedness of planetary health and human well-being. Significant research has been conducted on the link between the spread of infectious diseases and the decline in air quality, as well as the ability of health systems to adapt to climate-related changes (Wijk et al., 2020). The disruptions to ecosystems and biodiversity, along with changes in land use such as urbanization and agricultural expansion, can significantly reduce the risks of human infections (Gibb et al., 2020). These results indicate the importance for multidisciplinary research that bridges the divisions between public health, socioeconomic analysis, and climate science, therefore addressing current gaps.

Even though these interdependencies are becoming more widely acknowledged, the present study is still dispersed, which makes it more difficult to create coherent plans for dealing with these global emergencies. Although recent articles highlight significant public health concerns, they often lack a systematic methodology and fail to adequately capture the interdisciplinary aspects of the issue (Zang et al., 2021). A systematic bibliometric analysis offers an excellent opportunity to examine co-citation networks, discover emerging trends, and underscore significant contributors in this developing research area, employing both quantitative analysis and visualization methods. Additionally, Berrang-Ford et al. underlined the necessity of systematically mapping climate and health literature in order to guide effective policy-making, illustrating the current use of this approach (Berrang-Ford et al., 2021).

This study aims to address existing gaps through a comprehensive bibliometric analysis of publications examining the association between COVID-19 and climate change. The analysis attempts to identify significant topics, impactful publications, and authorship trends, as well as visualising conceptual frameworks through keyword co-occurrence. Miranda et al. (2023) suggest that a solid research foundation is essential for a comprehensive understanding of the connections between public health and climate research, particularly due to the complexity and overlapping vulnerabilities inherent in both disciplines. Besides, Semenza et al. (2022) highlighted the need of recognizing the association between climate and infectious diseases to develop resilient public health policies for future obstacles. Defining the complex connections between pandemic responses and climate change is not only important, but also crucial for promoting resiliency against future threats to global health, advancing interdisciplinary research, and guiding evidence-based policy. Therefore, the purpose of this bibliometric analysis is to compile previous work and establish the framework for further research, opening up the possibility for integrated approaches to mitigate the combined risks of COVID-19 and climate change.

METHODOLOGY

Research Design

This study is carried out according to an approach of analysis of bibliometric data of scientific publications dealing with climate change and COVID-19. The analysis focuses on bibliometric mapping to examine the trends in climate change and COVID-19.

Literature Search

The current study relied on the Scopus database as it is one of the largest abstracts and citation databases of peer-reviewed literature with 22,800 journals from 5000 publishers worldwide. A literature search using the Scopus database was conducted on 10th June 2025 to capture publications that cover climate change and COVID-19.

Search Term

The search action was conducted using the Scopus database, covering an inclusive range of social science journals. The search term was selected to represent a broad spectrum of climate change and COVID-19. As a result, the Boolean search string used for the systematic review process is:

(TITLE-ABS-KEY ((("climate change") AND ("COVID-19"))) AND TITLE-ABS-KEY ("impact" OR "effects" OR "influence")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all"))

Data Analysis

The data analysis in this study was conducted through a bibliometric approach aimed at systematically quantifying and visualizing global research output on the impact of climate change on COVID-19. The process began with a comprehensive literature search using the Scopus database, recognized for its extensive coverage of peer-reviewed academic journals. A structured Boolean query—TITLE-ABS-KEY (("climate change") AND ("COVID-19") AND ("impact" OR "effects" OR "influence"))—was employed to retrieve relevant articles published in English and categorized as research articles, ensuring the inclusion of scholarly and accessible outputs. This search, executed on 10th June 2025, yielded a curated dataset that forms the foundation for subsequent analysis.

Descriptive statistics were first applied to assess publication trends, including annual publication volume, authorship patterns, institutional affiliations, journal distribution, and country-level contributions. These metrics provided a macro-level overview of scholarly engagement and geographic distribution, revealing, for instance, a research peak in 2022 and dominance by authors and institutions from high-income countries.

To uncover intellectual and thematic structures within the literature, advanced bibliometric mapping techniques were employed. Keyword co-occurrence networks, visualized through overlay and cluster maps, were used to identify the most frequent and interconnected research themes over time. This enabled the identification of shifting priorities, such as the transition from environmental factors (e.g., air pollution, carbon emissions) to health and societal concerns (e.g., mental health, vaccination) in later stages of the pandemic. Additionally, co-citation network analysis highlighted influential scholars and citation clusters,

DOI: 10.5281/zenodo.17189960

offering insights into the foundational literature shaping this interdisciplinary field.

Visualization tools such as VOSviewer facilitated the graphical representation of bibliometric relationships, enhancing interpretability through color-coded clusters, node sizes (indicating frequency), and link strengths (showing co-occurrence or citation density). These visualizations not only supported the quantitative findings but also revealed the collaborative and interdisciplinary nature of the field, spanning environmental science, public health, social sciences, and policy.

The integrated use of descriptive statistics and visualization techniques enabled a nuanced interpretation of global research patterns. The analysis reveals both the breadth and depth of scholarly inquiry into the complex interactions between climate change and COVID-19, highlighting emerging hotspots, leading contributors, and thematic evolution. These insights serve as a valuable foundation for directing future interdisciplinary research and informing evidence-based policy development in climate and health domains.

RESULTS AND DISCUSSION

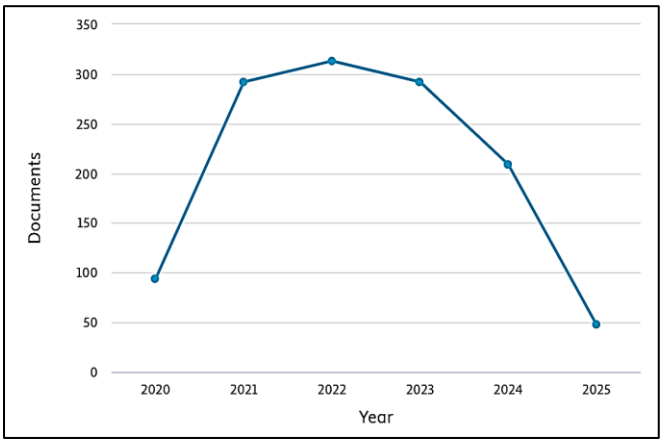

Figure 1. Publication trends over time on the impact of climate change on COVID-19

Figure 1 illustrates the publication trends over time concerning the impact of climate change on COVID-19, spanning the years 2020 to 2025. The data reveal a sharp increase in the number of publications from 2020, peaking in 2022 with over 300 documents. This surge likely reflects heightened academic and scientific interest during the peak of the pandemic and its intersection with environmental factors. However, the trend shows a gradual decline in subsequent years, with a notable drop in 2025, suggesting a waning research focus on this topic as the immediate global urgency of COVID-19 diminishes and attention possibly shifts to other emerging issues.

Figure 2 presents a horizontal bar chart identifying the most prolific authors in the field examining the impact of climate change on COVID-19, based on the number of published documents. Among the listed authors, Sharifi, A. stands out with the highest output, contributing approximately five publications—significantly more than others. The remaining authors, including Brimblecombe, P., Ciais, P., Filho, W.L., and others, each contributed around three publications. This distribution suggests that while a small number of researchers have made notable contributions to this interdisciplinary area, the research output is relatively evenly distributed among several leading scholars, indicating a collaborative and diversified scholarly engagement with the topic.

Figure 3 displays the top contributing institutions in the field of research exploring the impact of climate change on COVID-19, based on publication counts. The Chinese Academy of Sciences leads with the highest number of publications, exceeding 20 documents, followed closely by the CNRS Centre National de la Recherche Scientifique. Other prominent institutions include Harvard University, the University of Oxford, and the University of Cambridge, each contributing around 14 to 15 publications. Notably, a diverse range of institutions from North America, Europe, Asia, and Oceania are represented, indicating broad international engagement in this interdisciplinary area of study. This global distribution highlights the widespread recognition of the interconnectedness between environmental and public health challenges.

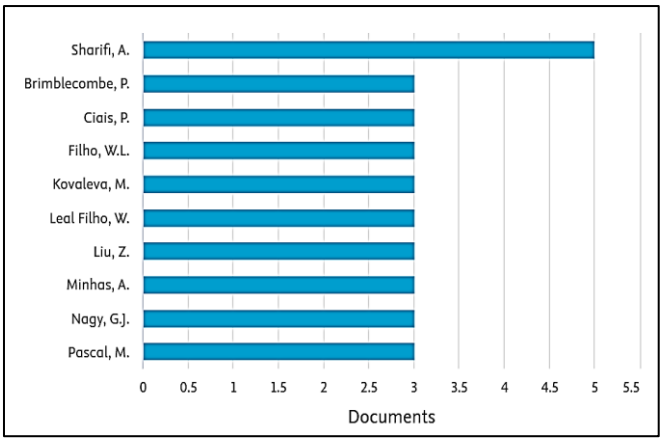

Figure 2. List of prolific authors on the impact of climate change on COVID-19 with publication counts and total publications

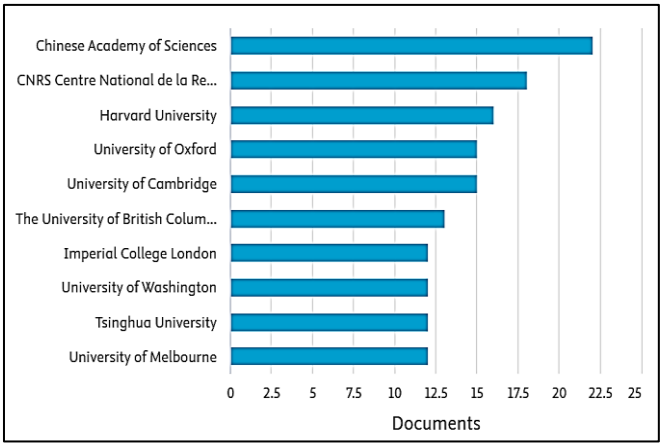

Figure 3. Top contributing institutions on the impact of climate change on COVID-19 with publication counts

Figure 4 illustrates the publication trends from 2020 to 2025 in leading academic journals addressing the impact of climate change on COVID-19. *Sustainability (Switzerland)* consistently published the highest number of documents on the topic, peaking in 2022 with over 20 publications before gradually declining. The *International Journal of Environmental Research and Public Health* maintained steady output in 2021 and 2022, followed by a sharp decrease. *Plos One* experienced a gradual increase, peaking in 2023, then declined thereafter. *Environmental Science and Pollution Research* and *Science of the Total Environment* showed relatively lower and more fluctuating publication rates. Overall, the

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data suggest a temporal concentration of scholarly interest around 2021–2022, with most journals showing declining output in subsequent years, reflecting a broader trend of decreasing academic attention to this interdisciplinary issue.

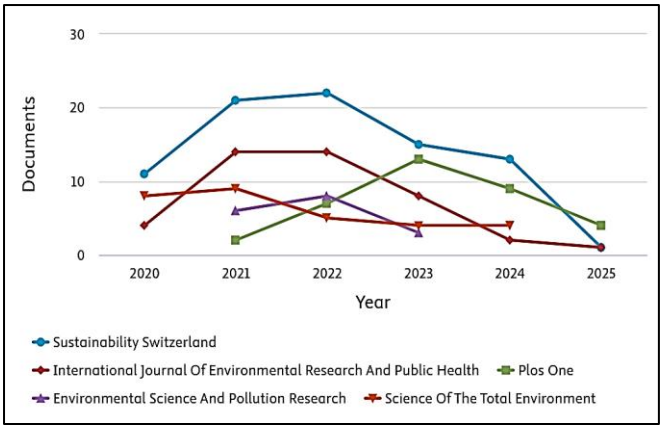

Figure 4. Top journals on the impact of climate change on COVID-19 with publication counts and years

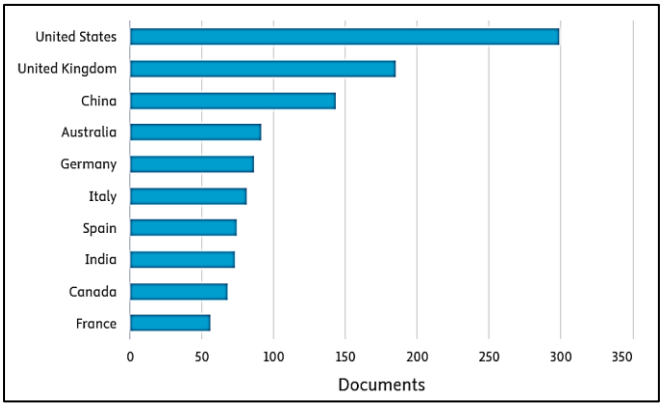

Figure 5. Top contributing country/territory on the impact of climate change on COVID-19 with publication counts

Figure 5 presents the leading countries and territories contributing to research on the impact of climate change on COVID-19, based on publication counts. The United States is the most prolific contributor, with approximately 300 documents, significantly surpassing all other countries. The United Kingdom ranks second with nearly 200 publications, followed by China with around 140. Other notable contributors include Australia, Germany, Italy, and Spain, each producing between 70 and 100 documents. India, Canada, and France also feature in the top ten, reflecting a geographically diverse engagement in this research area. The distribution highlights the prominent role of high-income and research-intensive countries in advancing interdisciplinary studies at the nexus of environmental and public health challenges.

Figure 6 presents a pie chart illustrating the distribution of subject areas in publications related to the impact of climate change on COVID-19. The largest proportion of research falls under *Environmental Science* (21.4%), followed by *Social Sciences* (17.5%) and *Medicine* (10.3%), highlighting the interdisciplinary nature of this research topic. Other notable subject areas include *Energy* (7.3%), *Agricultural and Biological Sciences*, *Computer Science*, *Earth and Planetary Sciences*, and *Engineering*—each accounting for approximately 4.6% to 4.3% of the total. Additionally, fields such as *Economics, Business, Management and Accounting*, and a broad *Other* category contribute smaller shares. The data underscore the multifaceted academic interest in understanding the interconnected effects of climate change and the COVID-19 pandemic across scientific, medical, technological, and socio-economic domains.

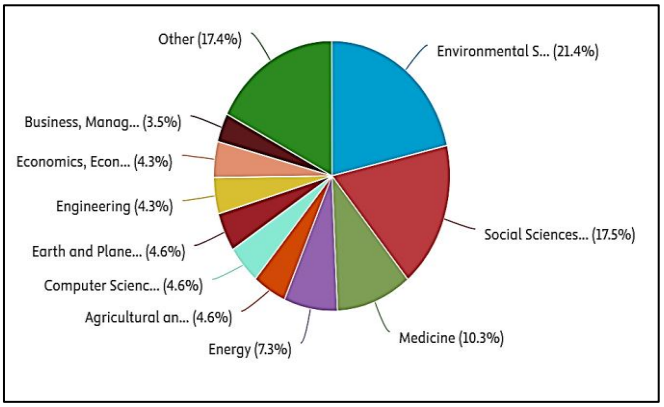

Figure 6. List of subject area on the impact of climate change on COVID-19

Figure 7 displays a network visualization map of keyword co-occurrence in the literature concerning the impact of climate change on COVID-19. The map reveals several prominent thematic clusters, with “climate change” and “human” emerging as the most central and frequently co-occurring terms. Keywords are grouped into color-coded clusters, representing interconnected subthemes. The red cluster focuses on environmental and sustainability-related terms, such as “sustainability,” “environmental policy,” and “resilience.” The blue cluster highlights atmospheric and pollution-related topics, including “air pollution,” “particulate matter,” and “temperature.” The green cluster centers on public health and social issues, with terms like “mental health,” “education,” and “health care system.” Other clusters capture aspects of virology and epidemiology, including “sars-cov-2,” “disease transmission,” and “mortality rate.” The network demonstrates the interdisciplinary nature of the research, with dense interconnections among climate, environmental, health, and societal domains, underscoring the complex interrelations addressed in this body of literature.

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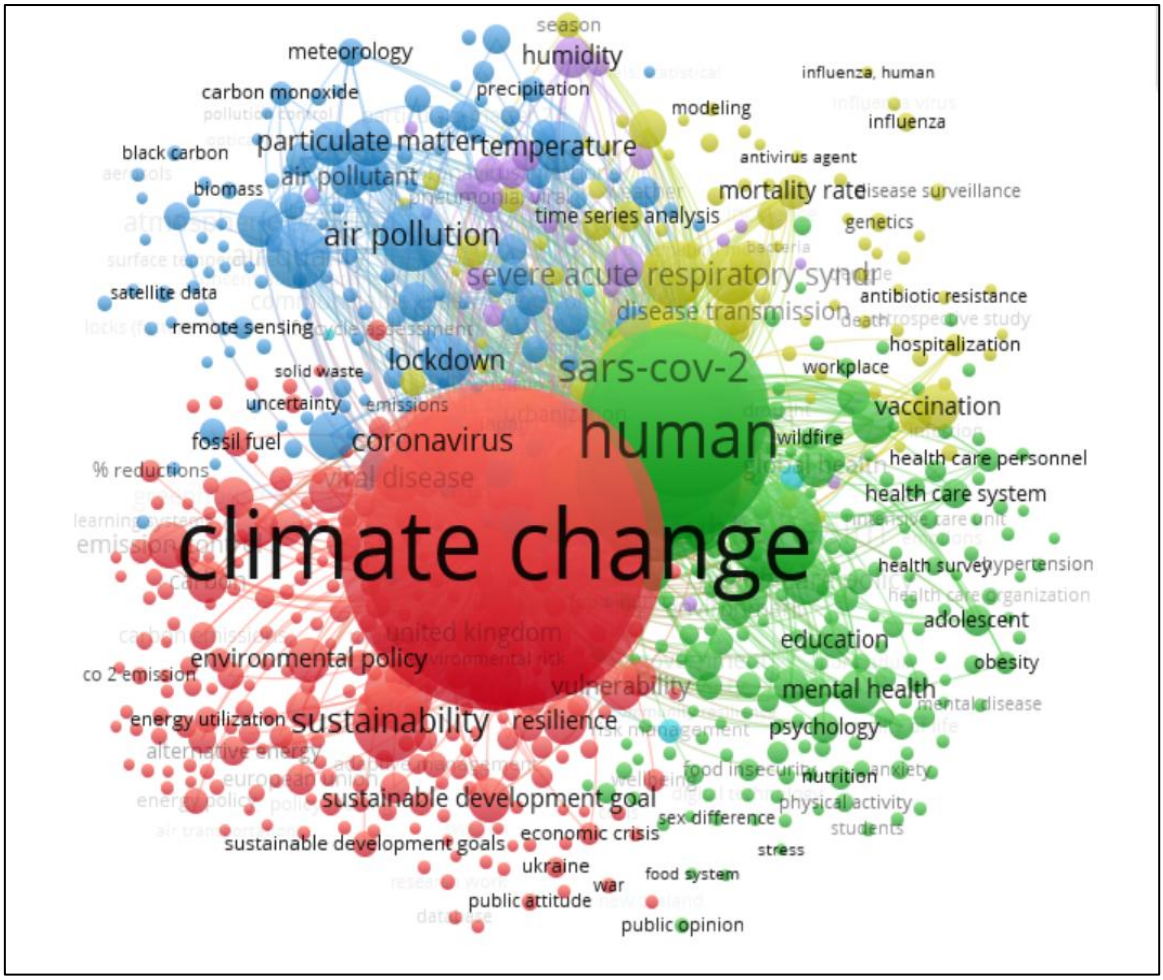

Figure 7. Network visualization map of keywords co-occurrence

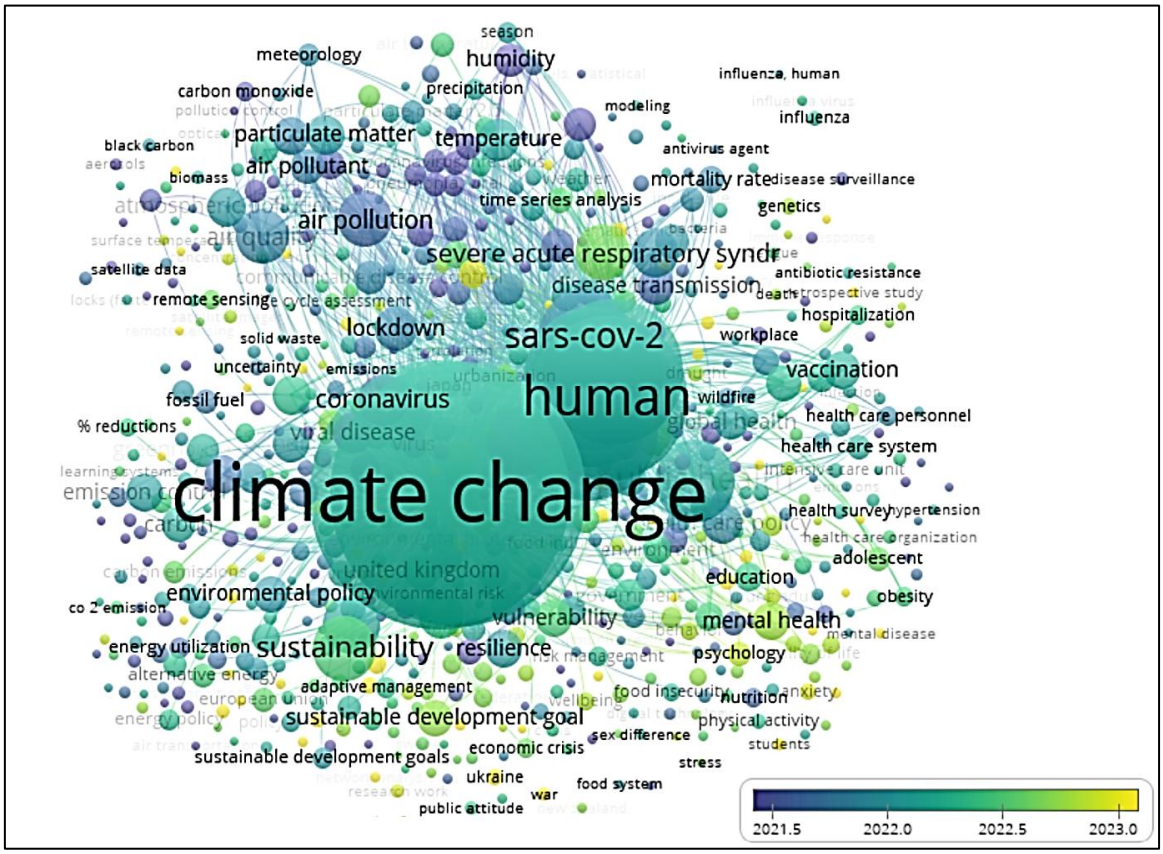

Figure 8. Keywords co-occurrence overlay visualization map according to year

DOI: 10.5281/zenodo.17189960

Figure 8 presents a keyword co-occurrence overlay visualization map, highlighting the temporal distribution of research themes related to climate change and COVID-19 from 2021 to 2023. The size of each keyword indicates its frequency of occurrence, while the color gradient—from purple to yellow—represents the average publication year, with purple denoting earlier research focus and yellow indicating more recent interest. Central keywords such as "climate change," "human," and "sars-cov-2" remain dominant throughout the period. Early studies (purple) predominantly explored themes like "air pollution," "carbon emission," and "remote sensing." In contrast, more recent research (yellow) has shifted toward health and social topics such as "vaccination," "mental health," "education," and "obesity." This temporal mapping illustrates the evolving interdisciplinary nature of the research, transitioning from environmental assessments to human health and societal impacts, thereby reflecting the broadening scope of inquiry into the nexus between climate change and the COVID-19 pandemic.

Figure 9 illustrates the co-citation network of cited authors in research addressing the impact of climate change on COVID-19. Each node represents a cited author, with the node size indicating the frequency of citations, while the colored clusters reflect groups of authors frequently co-cited together, suggesting thematic or disciplinary affinities. Prominent authors such as Wang Y., Liu Y., and Zhang Y. occupy central positions in the network, indicating their significant influence and centrality within the scholarly discourse. The dense interconnections among clusters, especially around major contributors, highlight the collaborative and interdisciplinary nature of the field. Distinct clusters suggest subfields ranging from environmental science and public health to social sciences, reflecting the multifaceted approach required to investigate the intersection of climate change and the COVID-19 pandemic.

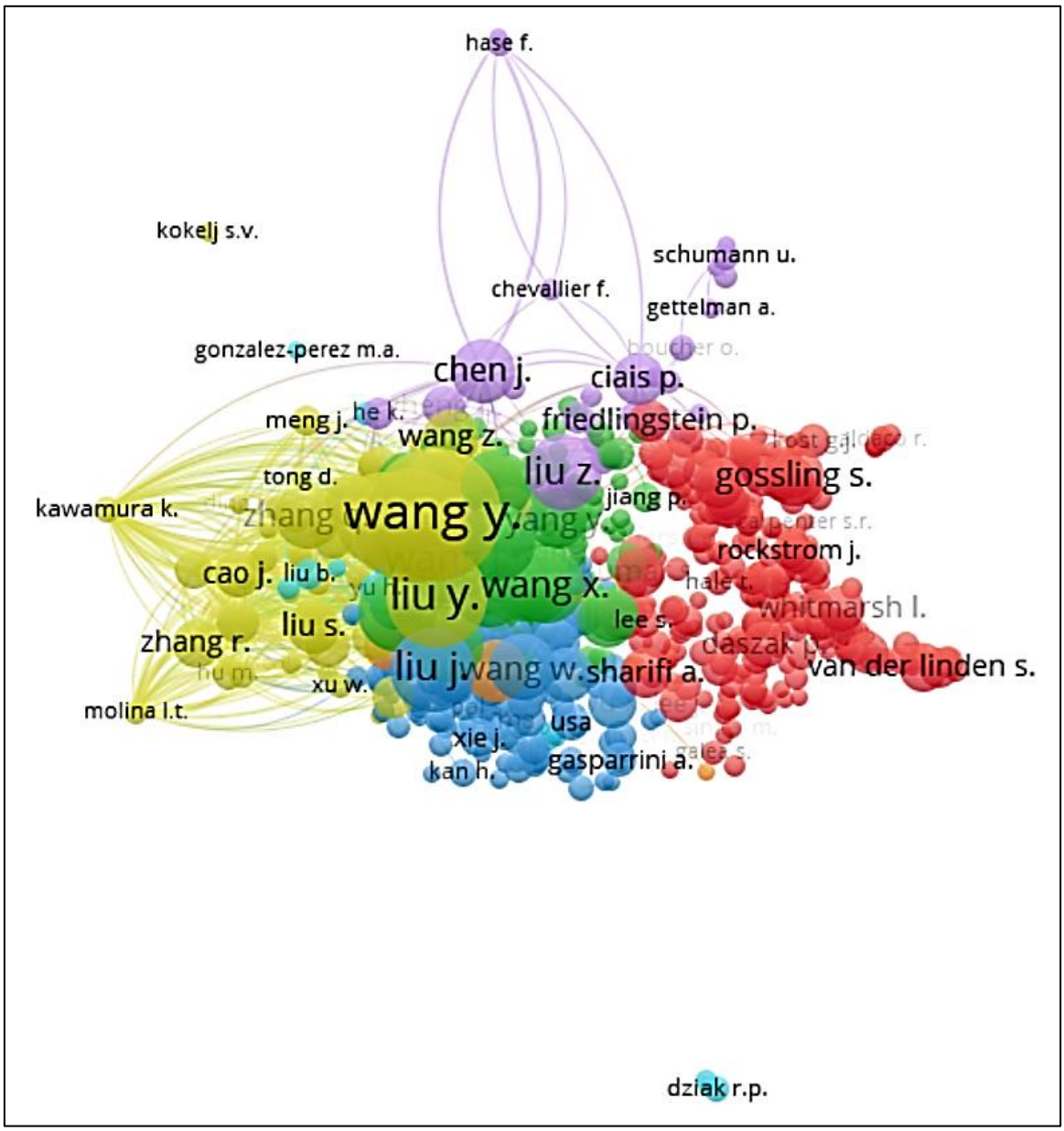

Figure 9. Co-Citation Network of Cited Authors on the impact of climate change on COVID-19

The bibliometric analysis presented herein provides a comprehensive overview of the evolving research landscape at the critical intersection of climate change and the COVID-19 pandemic. The surge in scholarly output during the early years of

DOI: 10.5281/zenodo.17189960

the pandemic—particularly between 2020 and 2021—reflects an urgent global response to the compounded risks posed by simultaneous health and environmental crises. This period coincided with significant public discourse surrounding the pandemic's temporary reduction of greenhouse gas emissions due to stringent lockdown measures, emphasizing the need for integrated approaches to both climate action and pandemic recovery strategies (Filho et al., 2023; Fuentes et al., 2020). It is noteworthy that the subsequent decline in publications from 2022 onwards may indicate a shifting of research priorities or the maturation of specific research themes within this domain, a phenomenon observed across various crisis-driven research topics (Hoffmann et al., 2023; Ongoma et al., 2023).

Examining authorship patterns reveals a concentration of contributions amongst a select group of prolific researchers, notably including Sharifi, A., who has emerged as a prominent author. Interestingly, the distribution among other contributors remains relatively equitable, suggesting a collaborative scholarly environment that embraces a multidisciplinary approach to investigating the interrelations between environmental and epidemiological concerns (Fonkou et al., 2021; Rasul, 2021). Furthermore, analysis of institutional contributions prominently highlights the role of prestigious organizations such as the Chinese Academy of Sciences, CNRS, and Harvard University. This global collaboration is reflected in the geographical diversity of contributions spanning North America, Europe, and Asia, underscoring the widespread acknowledgment of the topic's relevance across diverse sociopolitical and climatic contexts (Ongoma et al., 2023; Botzen et al., 2021).

From a publishing standpoint, the dominance of highly regarded journals such as *Sustainability* and the *International Journal of Environmental Research and Public Health* indicates a strong alignment with both environmental policy and public health domains. The fluctuation in publication volumes across these journals corresponds with the overall trends observed, demonstrating a time-sensitive response to the evolving challenges presented by the pandemic (Shakil et al., 2020). Additionally, the subject area analysis unveils the interdisciplinary nature of this topic, where Environmental Science, Social Sciences, and Medicine constitute the primary domains of investigation. This distribution reinforces the argument for holistic frameworks that intertwine ecological, social, and biomedical perspectives (Filho et al., 2023; Fuentes et al., 2020).

The implementation of keyword co-occurrence and overlay visualizations markedly enhances insights into the intellectual structure and thematic evolution of the field. Over time, prominent research foci such as "climate change," "human," and "SARS-CoV-2" have been complemented by emerging themes that include "mental health," "education," and "vaccination," pointing to a notable shift towards human-centric and policy-relevant research concerns (Stefkovics and Hortay, 2022; Savin et al., 2022). These findings underscore the adaptability of research themes in response to changing societal needs and global events, reinforcing the interconnectedness of health and environmental issues in contemporary discourse (Fu et al., 2024; Lyytimäki et al., 2020).

Finally, the co-citation network analysis sheds light on the foundational intellectual contributions that support this area of research. The central figures, including authors like Wang Y., Liu Y., and Zhang Y., occupy key positions in the citation network, suggesting that their works are pivotal for subsequent studies (Botzen et al., 2021). The identification of distinct citation clusters within the network further supports the existence of multiple robust subfields ranging from environmental monitoring and air pollution to socio-behavioral health and public policy, which collectively highlight the interdisciplinary essence of this research domain (Zang et al., 2021).

LIMITATIONS OF THE STUDY

This study provides significant insights into the academic discourse regarding the effects of climate change on COVID-19, yet it has limitations. The analysis depended solely on the Scopus database, which, while comprehensive and renowned for its peer-reviewed literature, may not entirely encompass the scope of global research. Research indexed in significant databases, including Web of Science, PubMed, or regional repositories such as SciELO and CNKI, was excluded, potentially omitting significant publications, especially from non-English-speaking nations or developing economies.

Second, the inclusion criteria restricted the dataset to English-language articles. This language bias may have inadvertently excluded critical contributions published in other languages, thus limiting the cultural and geographic diversity of the research corpus. Given the global nature of both climate change and the COVID-19 pandemic, the exclusion of non-English sources may underrepresent region-specific insights and localized studies.

Third, the Boolean search strategy, while designed to be comprehensive, was inherently constrained by the specificity of keywords such as “climate change,” “COVID-19,” and related impact terms. As a result, studies that address the same themes under different terminologies or interdisciplinary labels may have been excluded. Moreover, the use of fixed keywords may have overlooked newer or evolving terminologies that emerged during the later stages of the pandemic.

Fourth, the bibliometric indicators used in this study, such as publication counts, co-authorship, co-citation, and keyword co-occurrence reflect quantitative patterns but do not assess the quality, methodological rigor, or policy impact of the studies analyzed. Consequently, while the analysis captures publication trends and research networks, it does not evaluate the substantive contribution of individual works to advancing knowledge or informing real-world interventions.

Lastly, the study's temporal scope, ending in early 2025, means that the dataset may not include recent or forthcoming publications that could significantly alter observed trends. Given the rapidly evolving nature of global health and climate-related research, future developments may shift the landscape in ways not captured by this analysis.

RECOMMENDATIONS FOR FUTURE RESEARCH

The findings from this bibliometric analysis have highlighted several key research trajectories and thematic concentrations, particularly within the domains of environmental science, social sciences, and medicine. However, a deeper critical appraisal of the subject areas reveals both saturation in some themes and underrepresentation in others signaling several opportunities for future inquiry.

Firstly, while environmental science dominates the discourse, much of the research appears to focus on traditional metrics such

DOI: 10.5281/zenodo.17189960

as air pollution, carbon emissions, and temperature changes. Future studies should expand beyond these environmental indicators to incorporate systems-based modeling of climate-health interactions, particularly those involving indirect pathways such as food security, ecosystem disruption, and migration. Integrating climate impact assessment with epidemiological forecasting models can offer more actionable insights for health systems and policy planning.

Secondly, the surge of interest in the social sciences evidenced by studies on education, mental health, and societal resilience calls for more qualitative and community-centered research approaches. Most current studies rely heavily on quantitative methods and bibliometric analytics. Future research should incorporate ethnographic studies, participatory action research, and case studies from climate-vulnerable communities to explore how socio-cultural and behavioral dynamics mediate the dual challenges of climate change and pandemics. Thirdly, while medicine is represented among the dominant subject areas, it is often limited to general pandemic-related outcomes. Future research should examine climate-sensitive infectious diseases and the compounding effects of environmental degradation on comorbidity profiles, immunological vulnerabilities, and vaccine effectiveness. This could also include longitudinal cohort studies across different geographies and climates to identify climate-specific risk factors.

Fourth, interdisciplinary studies remain limited in scope and integration. While environmental, social, and health dimensions are acknowledged, there is still a lack of cross-sectoral frameworks that link governance, economics, digital infrastructure, and sustainable development to pandemic response strategies. Future research should adopt nexus approaches (e.g., climate–health–infrastructure or climate–education–equity) and develop indicators that reflect multi-dimensional vulnerabilities.

Fifth, geographic representation in existing research is skewed toward high-income countries, with limited contributions from the Global South. Future research should prioritize decolonizing climate-health research by supporting localized studies from Africa, Southeast Asia, Latin America, and Pacific Island nations. These studies should not only reflect regional challenges but also promote indigenous knowledge systems and culturally specific adaptation strategies. Additionally, there is scope for more in-depth analysis of policy effectiveness, particularly in how integrated climate and health policies fared during the COVID-19 pandemic. Comparative policy studies and institutional response evaluations can provide critical lessons for future global health emergencies in the context of a changing climate.

Lastly, the evolving nature of both climate science and pandemic dynamics requires adaptive and real-time bibliometric tracking using AI-based tools and dynamic databases. Researchers could develop dashboards and knowledge repositories that continuously monitor shifts in research emphasis, emerging threats, and knowledge gaps across disciplines.

CONCLUSION

This study has provided a comprehensive bibliometric analysis of global research on the impact of climate change on the COVID-19 pandemic, covering publications from 2020 to 2025. Through the systematic extraction and analysis of data from the Scopus database, the study identified key trends in publication output, influential authors, leading institutions, prominent subject areas, and geographic contributions. The findings revealed that research activity peaked in 2022, with a notable shift in thematic focus from environmental indicators in the early years to social and health-related issues in later periods. The dominance of Environmental Science, Social Sciences, and Medicine as the primary subject areas illustrates the interdisciplinary nature of the topic.

The network visualizations of keywords and co-citations further highlighted the conceptual structure and evolution of the field. Central terms such as “climate change,” “COVID-19,” and “human” were consistently dominant, while emerging themes like mental health, vaccination, and education reflected the growing societal relevance of the research. The study also revealed that high-income countries, particularly the United States, United Kingdom, and China, were the most prolific contributors, suggesting a need for greater representation from under-researched regions. Leading institutions and authors played a critical role in advancing discourse, but the relatively even distribution of publications indicates growing global scholarly collaboration.

In conclusion, this bibliometric review offers valuable insights into how the academic community has responded to the complex interplay between environmental and health crises. It identifies both progress and gaps in the current literature and emphasizes the importance of fostering interdisciplinary, inclusive, and policy-relevant research. As climate change and global health challenges continue to intensify, ongoing bibliometric monitoring and cross-sectoral collaboration will be essential to inform evidence-based solutions and support global resilience.

ACKNOWLEDGEMENT

The author would like to express their greatest appreciation to the Ministry of Higher Education and Universiti Teknologi MARA (UiTM) Pahang Branch, Jengka on supporting this research.

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DOI: 10.5281/zenodo.17189960