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Review

A bibliometric analysis of research trends in air pollution and environmental impacts

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Abstract: This study presents an extended bibliometric analysis to identify the research landscape, trends, and influential aspects in the field of air pollution and environmental impacts. This study aims to explore the existing gaps and emerging trends in the research landscape on air pollution and its environmental impacts by analyzing publication records, author analysis, country analysis, keywords analysis and thematic maps. The findings expose the increasing interest in air pollution and its environmental impacts worldwide, growing research output, key contributors, and influential knowledge hubs that are in the process of shaping this field of study. Bibliometric techniques, like keyword co-occurrence and thematic mapping, unravel the intellectual structure and evolving focal areas within this research domain. The main findings reveal a number of highly frequent keywords that describe the interdisciplinary nature of air pollution and environmental impact studies. Thematic mapping highlights the following major themes: "air", "climate" and "pollution", while emerging themes in research involve "emission", "biomass" and "factors", etc. The study gives useful insights for future studies and informed decision-making in the industry with a better understanding of the status quo in air pollution and its environmental impacts research. Future research efforts are recommended to be directed toward more interdisciplinary approaches, strengthened regional studies in developing countries, and the promotion of international collaborations in order to meet air pollution and its environmental consequence challenges effectively on a global scale.

Keywords: air pollution; environmental impacts; bibliometric analysis; climate change; sustainability

1. Introduction

Air pollution is one of the most crucial environmental problems associated with public health, ecosystem and global climate change [1–3]. Close to 99% of the world's population is exposed to air that cannot be considered safe according to WHO guideline limits [1]. Some 7 million deaths each year from stroke, heart disease, lung cancer and chronic obstructive pulmonary diseases are linked to this polluted air [4]. In addition to its health effects, air pollution contributes to soil degradation, water contamination, and the loss of biodiversity, underscoring its far-reaching impact [5]. Over the past few decades, extensive research has focused on understanding the sources, mechanisms, and effects of air pollution, as well as exploring ways to mitigate it [6–8]. The environmental consequences are significant, encompassing climate change, acid rain, diminished biodiversity, and the degradation of soil and water resources. These three challenges are interconnected, making it evident that to protect lives and the environment, researchers must urgently address the issue of air pollution.

Over the years, research in air pollution and its environmental impacts has continuously grown, reflecting its technicalities and interdisciplinary nature [9,10]. Air pollution remains a critical environmental and public health challenge around the world. The rapid pace of urbanization and industrialization, along with generally weak regulatory frameworks, are key factors behind its disproportionate effects on developing countries [11]. Low- and middle-income countries have more people exposed to high levels of air pollution, causing severe health consequences, economic loss, and environmental degradation [12]. For instance, research has shown that air pollution is responsible for millions of premature deaths annually, with the majority occurring in Asia and Africa, where air quality management policies are often inadequate [13]. In the rapid economic development in countries like Iran, China, and India, environmental pollution has intensified, which calls for an immediate scientific assessment of environmental efficiency by using the network data envelopment analysis model to identify various inefficiencies and propose strategic solutions for improvement in air quality and sustainability [14]. Most of the researchers have been reviewed on all aspects from the dynamics of pollutants, their emission sources, to their short-term and long-term effects on ecosystems and human health [15]. This ever-growing base of knowledge provides a wealth of information but is starting to pose some challenges in tracking emerging trends, identifying influential contributions, and investigating knowledge gaps.

Bibliometric studies allow for a systematic realization of publication patterns, the usage of keywords, citation trends, and identification of key studies [16]. The emerging themes and research gaps identified also provide useful guidelines for future studies [17]. This ensures that new research has a strong foundation in previous knowledge and takes the field forward in meaningful ways [18]. Performing a bibliometric analysis in the field of air pollution and its impacts on the environment plays a crucial role in shaping future directions for research and assisting in the development of evidence-based policies. The present study analyzes the publication trend, co-authorship network, and country analysis to put forward a comprehensive look into the changing research landscape. These findings will go a long way in shaping the future research and policy frameworks by pointing out critical gaps and emerging areas in air pollution-related studies. Although a number of bibliometric studies have been conducted on air pollution research, most are limited in scope to one aspect of the area, such as health impacts [19,20], policy responses, or technological advancement [21], rather than offering a panoramic view of the whole research area. Most studies are based on very limited or specific locations [22] without comprehensive cluster analysis or lack investigation into interdisciplinary linkages that are important for understanding wider environmental implications. Air pollution has grown into a global challenge with serious environmental, economic, and health effects. Some studies systematically review research on the use of bibliometric analysis and keyword co-occurrence network analysis, showing evolving trends, key methodologies, policy evaluations, and emerging research gaps that are expected to contribute to future studies and policymaking [23]. Furthermore, temporal trends and the evolution of research themes are underexplored in existing analyses. This study fills these gaps by carrying out the improved bibliometric analysis based on advanced mapping techniques that show the underlying research patterns. Based on the key

themes, influential collaboration, and emerging trends, the present study proposes systematic understanding related to the intellectual structure of air pollution research. This study aims to explore the existing gaps and emerging trends in the research landscape on air pollution and its environmental impacts. Section 3.1 analyzes publication trends on air pollution and environmental impacts. Sections 3.2 and 3.3 present, respectively, an analysis based on authors and countries. Section 3.4 compares the keywords of high frequency in a diachronic view of author keywords. Section 3.5 presents thematic evolution analysis. Finally, Section 3.6 provides a qualitative overview of highly cited articles related to air pollution and environmental impacts at a global level by identifying the main contributions of research and detecting potential structural gaps.

2. Materials and methods

Bibliometric analysis is used in this research as a way of offering an overview of the current state of scientific research by evaluating the quality of previous studies carried out and acquiring a comprehensive understanding of this field of study. Most bibliometric analyses typically comprise five important steps: Study design, data collection, data analysis, visualization of results, and interpretation [24]. This study focuses on the following two main stages, covering all five stages.

2.1. Data sources and primary keywords

Data for this analysis were retrieved from the Scopus (Scopus® database, at the website https://www.scopus.com) database. The research was performed on 26 November 2024. Scopus is an outstanding source of abstracts and references in peer-reviewed literature. The following keyword string was used to collect literature about air pollution and its environmental impacts. ((“Air Pollution” OR “Air Quality” OR “Pollutant Emissions” OR “Atmospheric Pollution”) AND (“Environmental Effects” OR “Ecological Impact” OR “Environmental Impact” OR “Ecosystem Effects”) AND (“Climate Change” OR “Global Warming” OR “Greenhouse Gas Emissions” OR “Carbon Emissions”)). A total of 570 articles were suitable for analysis after the application of inclusion and exclusion criteria. In this study, the target research was on “air pollution and its environmental impacts”, including only studies that were published in English from the year 2015 to 2024.

2.2. Main research methods

The bibliometric methods used to analyze different topics vary in nature, including co-occurrence analysis, co-citation analysis, bibliographic coupling, performance analysis, and network analysis: all these try to establish, among others, the relationships among keywords or themes; the manner of citing publications, the publication trends, author productivity, and institutional contribution; and visualize and interpret connections between authors, institutions, or research themes, respectively. Further, cluster analysis and factor analysis will be done to find out the thematic structures and emerging research directions in this area. This study utilizes Bibliometric and Biblioshiny (www.bibliometrix.org Version 4.3.2) software packages for the analysis and visualization of research trends in “air pollution and its

environmental impacts", along with the current state of knowledge. It then examines the basic pattern of "air pollution and its environmental impacts" by means of indicators such as annual publication trends, major contributors regarding countries, authors, journals, research hotspots, and thematic focuses [25]. Therefore, the research provides a useful framework of insight and recommendations to guide further studies in the field of "air pollution and its environmental impacts" through its historical publication analysis across subjects and its evolution. Biblioshiny is an integrated tool for science mapping and bibliometric analysis, which offers a series of options regarding analytics and visualization. The data would then be presented in various tables and figures, trend graphs, and thematic maps. From these visualizations and statistical data, meaningful conclusions could be drawn. Different bibliometric methods and the use of software tools increase the reliability of the findings and contribute much to the knowledge base on air pollution and its environmental impacts research. The research flow of this study is illustrated in **Figure 1**.

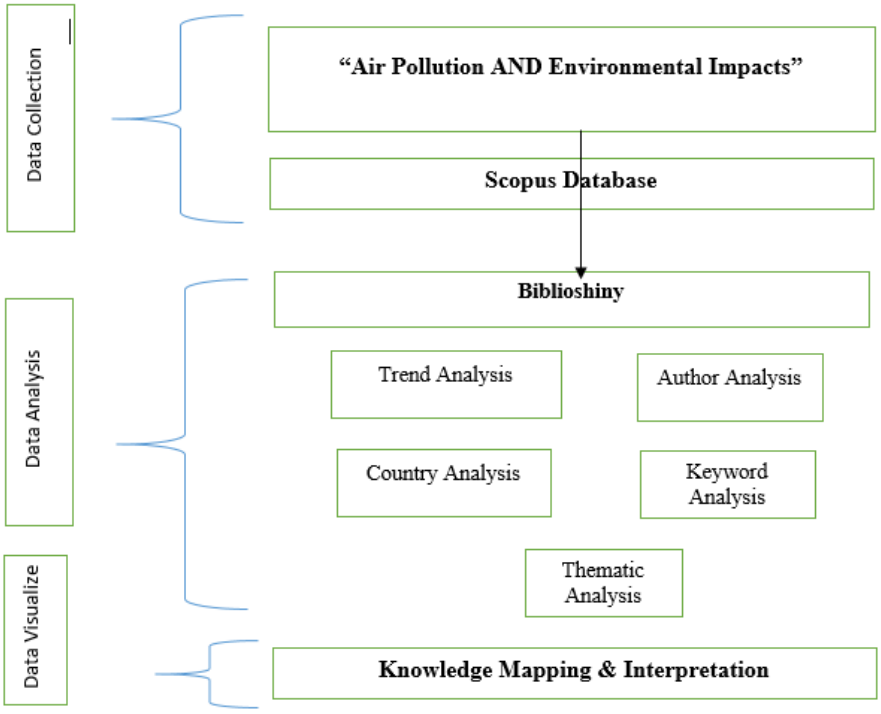

Figure 1. Schematic illustration of research flow.

3. Results

The findings of this bibliometric analysis provide valuable explorations into the research landscape of air pollution and its environmental impacts. This section outlines the results of the following aspects: publication trends, influential contributors, keywords, thematic clusters, underexplored areas and knowledge gaps.

3.1. Trend analysis

Figure 2 shows an annual trend analysis of the number of publications from 2015 to 2024. The publication trend, from 2015 to 2024, illustrates the dynamics in the quantity of publications published, pointing to an increased interest in this research field. With a gradual increase from 2015 to 2019, from about 20 to 60, this reflects an

expanding focus on the field during this time. A significant increase starts from the year 2020, with a peak in publications in 2022, with approximately 110 in number. This dramatic improvement may be linked to the growing global awareness, available funds for research, and related joint projects to address the major challenges faced in the air quality and environmental impacts field. However, there was a slight decline in 2023 and 2024, where the numbers decreased but remained well above the pre-2020 levels.

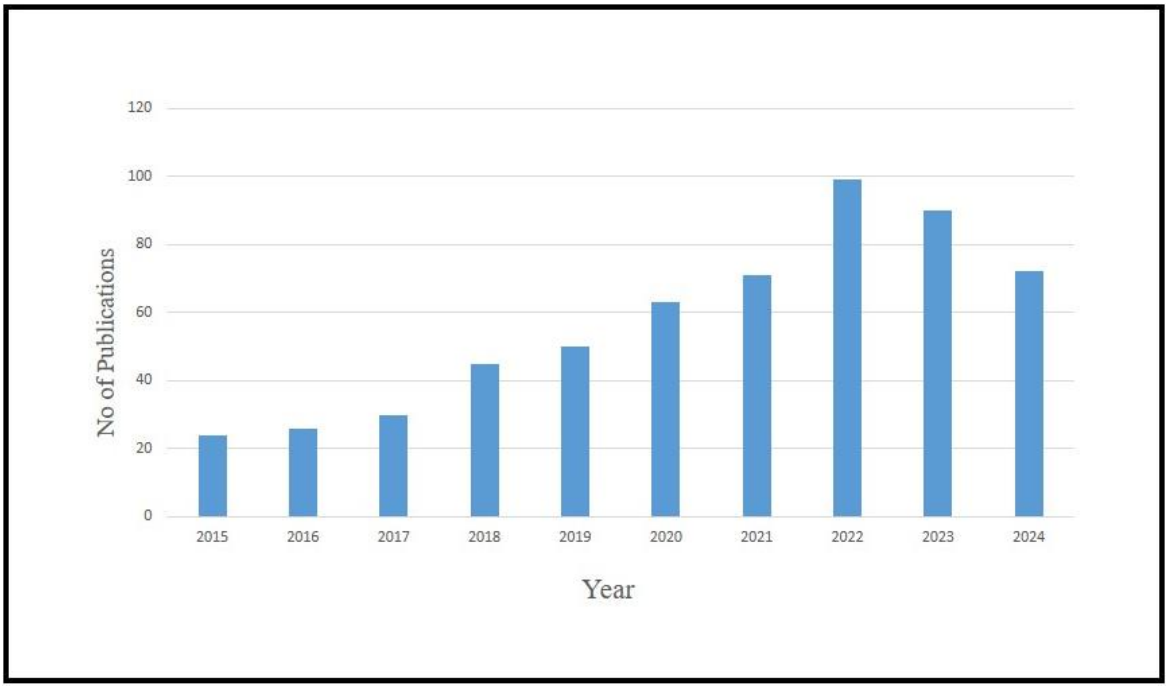

Figure 2. Trend of publications in the field of air pollution and environmental impacts for the Scopus database 2015–2024.

3.2. Analysis of main authors

There are 2818 authors who contributed to the field of air pollution and environmental impacts publications between 2015 and 2024. **Figure 3** represents the publication trends of major authors in air pollution and environmental impacts research. Authors such as 'Zhang Y' and 'Wang Y' present consistent contributions throughout the years, with notable peaks in output and citations around 2021. This period most probably correlates with the heightened research activity in response to pressing global environmental challenges that include the deterioration of air pollution and its implications for public health and ecosystems. The size of the circles corresponds to the number of articles, and the darker shading represents higher citation counts, suggesting that research during this period increased not only in quantity but also in scholarly impact. Authors such as 'Liu Y' and 'Zhang X', while publishing fewer articles, received a significantly higher number of citations, reflecting the quality and influence of their work in this field.

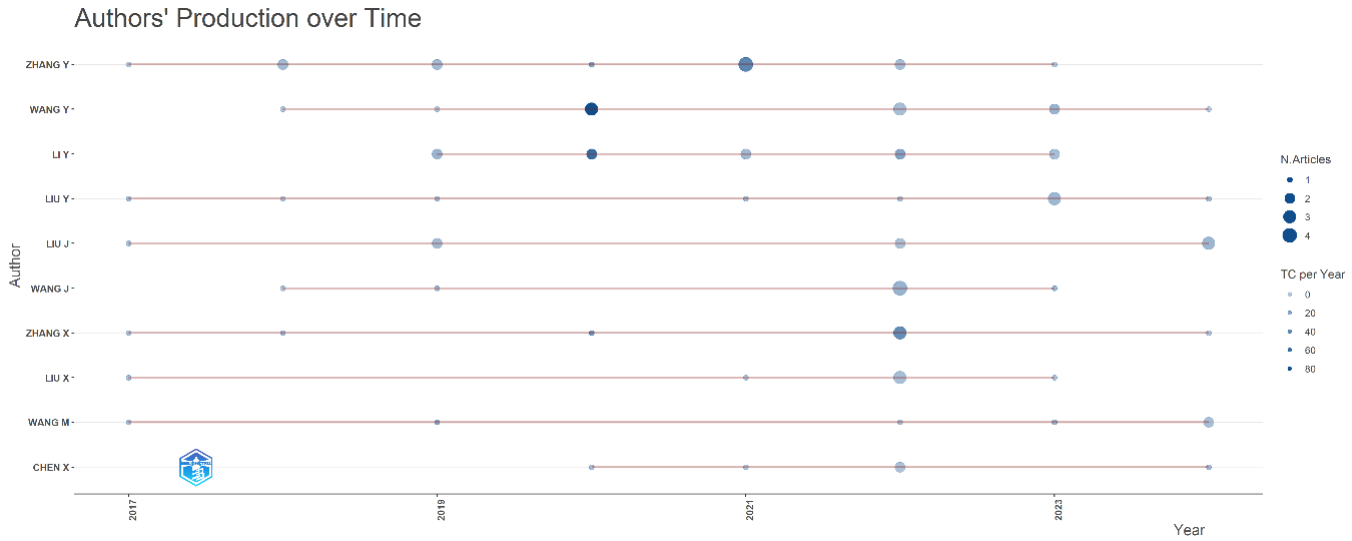

Figure 3. Authors' production over time in the field of air pollution and environmental impacts.

3.3. Country analysis

The publication of papers in different countries can reflect the importance of the contribution to the field of air pollution and environmental impacts. A total of 69 countries or regions published papers from 2015 to 2024. **Figure 4** represents the geographical distribution of scientific production, whereby countries around the world take part in this research concerning air pollution and its effects on the environment. Most importantly, the leading countries come out to be China, the United States, and several European nations like the United Kingdom, Germany, and France, reflecting advanced research capabilities and a generally increased awareness of air quality challenges. These countries are also on the front line when it comes to research on air pollution, whose impact on public health, ecosystems, and climate has been great. Further, the emergence of Asian countries like India, Japan, and Thailand in the leading list indicates an emerging concern over air pollution in countries experiencing fast industrialization and urbanization processes that deteriorate air quality.

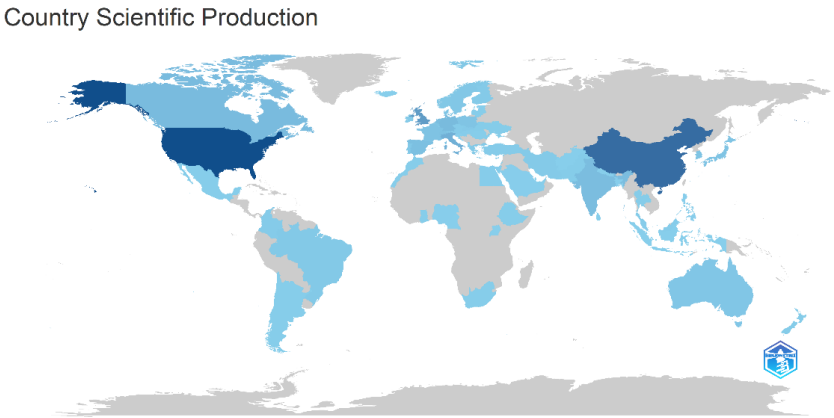

Figure 4. Scientific production distribution in the field of air pollution and environmental impacts.

3.4. Keyword analysis

Figure 5 illustrates the keyword analysis using a word cloud. Keyword analysis highlights the key themes and backgrounds of research on air pollution and

environmental impact. The most prominent keywords in the word cloud include "environmental impact", "climate change", and "air pollution". Additionally, "air quality" stands out due to the high number of articles in which it is used as a keyword. Other notable keywords include "carbon dioxide", "environmental monitoring", "particulate matter", and "atmospheric pollution".

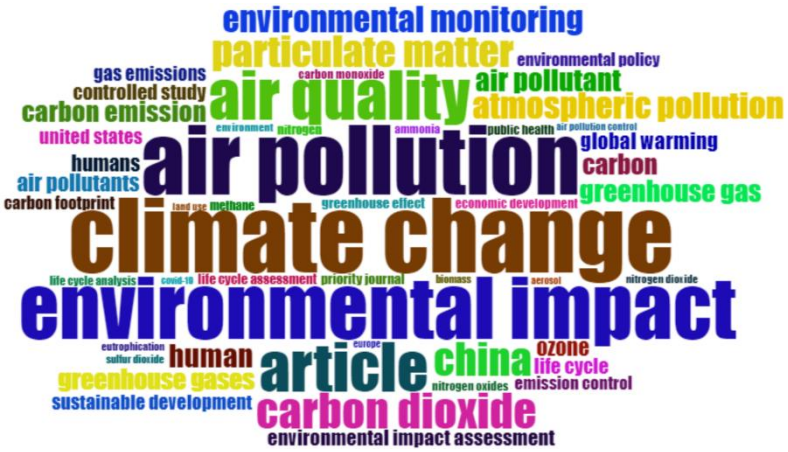

Figure 5. Word Cloud.

Figure 5 further demonstrates that terms such as "greenhouse gases" and "carbon footprint" are directly associated with global warming and emphasize the urgency of addressing anthropogenic emissions. Additionally, terms like "sustainable development" and "life cycle analysis" reflect a focus on long-term systematic solutions that evaluate environmental impacts across the life cycles of products within the broader economy. Geographical mentions, including "China" and "United States", likely pertain to case studies or significant contributors to global emissions.

3.5. Thematic analysis

Figure 6 presents a thematic map for research in the field of air pollution and environmental impacts, which visually communicates the main and novel themes that can be considered within this research context. The map is divided into four main sections, each highlighting different types of themes.

In the bottom-right section, the map highlights basic themes. These are well-established and widely researched topics within the research domain. These foundational themes form the backbone of every research and have been pivotal to its development [26]. As the basic themes in this research context highlight the "environmental emissions" and "impacts".

The top-right area of the map is reserved for the themes that have recently come to the fore [26]. Among such topics, "air", "climate" and "pollution" are the most important. These emergent themes reflect the interest growth and are giving birth to new lines of research in the air pollution and environmental impact domain.

In the top left part of the map, the niche themes are depicted. These themes, including "organic", "volatile" and "burning" indicate this area requires further study in future research as well. Finally, based on **Figure 5** the transition theme or emerging themes such identifiable keywords are "emission", "biomass" and "factors", etc. **Figure 5**'s thematic map serves as a visual illustration to guide researchers in

identifying the trending and underexplored themes within the air pollution and environmental impact research domain.

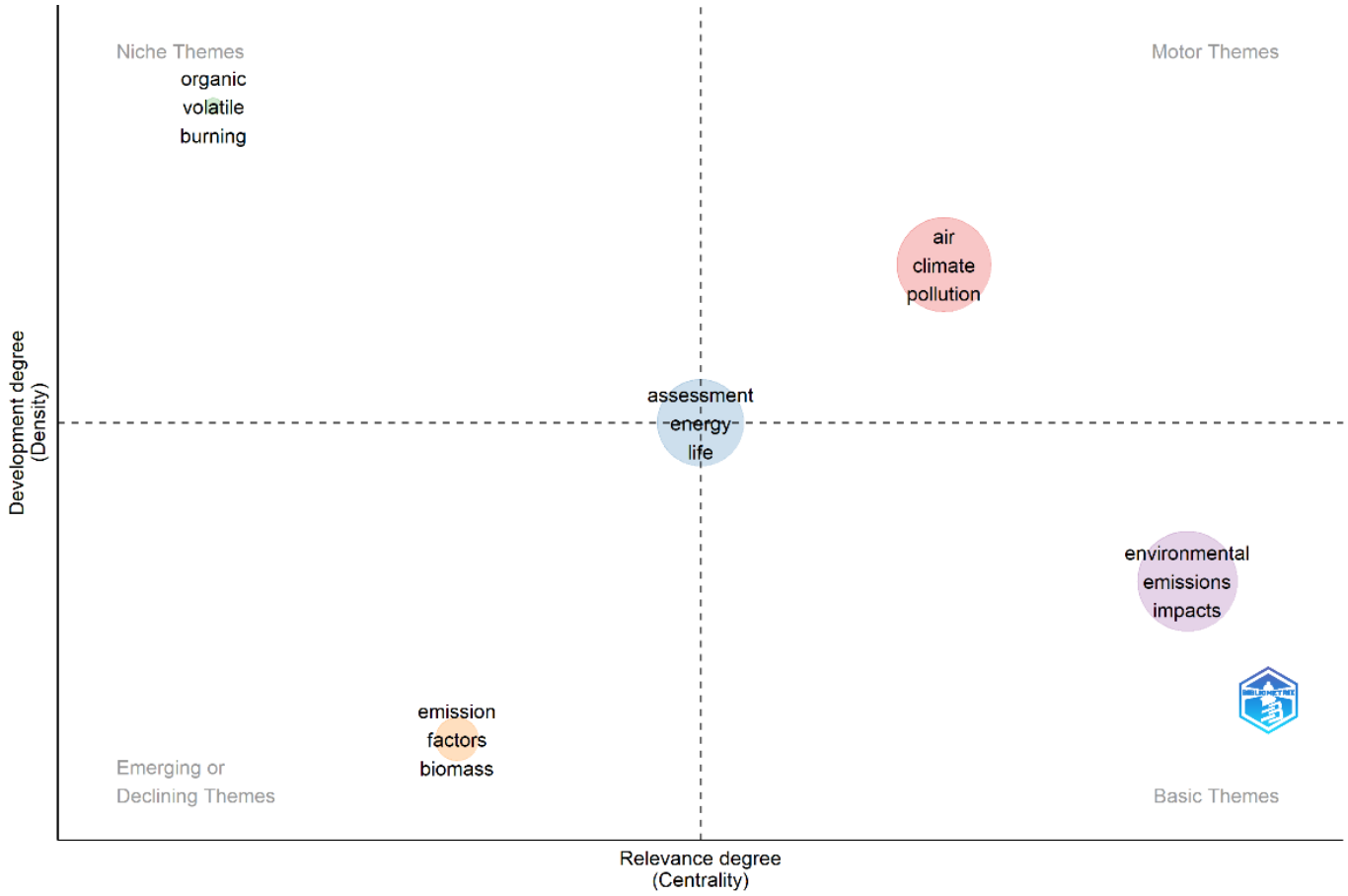

Figure 6. Scientific production distribution in the field of air pollution and environmental impact.

3.6. Qualitative analysis

This section outlines the review of the literature, focusing on the most highly cited articles in the "air pollution and environmental impact" domain.

Springmann et al. [27] conducted a study "Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: A global modelling analysis with country-level detail" and provided a comprehensive global modeling analysis on the health and environmental impacts of sustainable diets. They found that plant-based diets could significantly reduce greenhouse gas emissions and improve nutrient adequacy, especially in high-income countries. However, water use increased in some scenarios. The study emphasizes the context-specificity of sustainable diets and highlights the potential for public health strategies to align with environmental sustainability. Based on their analysis, it demonstrates the way public health strategies may be matched with environmental sustainability. It gives a new perspective on the place of food systems in the effort to limit air pollution and broader ecological degradation. However, the rise in water usage under some diet scenarios accentuates the problem of meeting sustainable goals and indicates that policies will need to address resource use in its entirety.

Moreover, Martins et al. [28] published "an analysis of fossil fuel energy

consumption and environmental impacts in European countries that analyzed the trends in consumption and challenges of fossil fuel, together with their environmental implications in Europe". From the study, the region relies heavily on the use of fossil fuel energy, while renewable energy systems are considered a necessity in the shortest time possible. In fact, critical depletion is projected by 2050, which calls for immediacy to be taken for the sake of energy sustainability [28]. This study further showed that the majority of European countries were still dependent on fossil fuels, and their reserves were small, which could be quickly exhausted if used [28]. The works highlight the need to increase transitions towards renewable energy systems and reduce environmental impacts of air pollution, global warming, and resource depletion by reinforcing broader goals to lessen carbon footprints and improve health outcomes associated with negative pollution.

Another important paper, entitled "Heterogeneous impacts of renewable energy and environmental patents on CO_2 emission—Evidence from the BRIICS" [29], examines the impact of renewable energy and environmental patents on CO_2 emissions in BRIICS countries. Their estimations indicate that renewable energy lowers emissions, while environmental patent impacts are mixed. The study concludes by emphasizing how the maximum benefits of emerging economies could be reaped with appropriate policy interventions in renewable energy adoption. Further, their findings reinforce the need for tailored policies that can foster economic development and reduce environmental degradation. It also brings forth the dual importance of technological innovation, such as environmental patents and energy transitions, in order to reduce air pollution and its associated health risks.

Additionally, a paper titled "Crop residue burning in India: policy challenges and potential solutions" presents a detailed overview. Further, this research discussed the environmental and health concerns arising from crop residue burning in India. They highlighted the sustainable management practices of biochar production and composting, but their implementation is restricted by socioeconomic barriers. The study recommends integrated policy frameworks and farmer education to mitigate the problem [30]. The study calls for integrated policy frameworks and farmer education that address the socioeconomic barriers to the adoption of environmentally friendly practices. This work is important in understanding how land use and agricultural practices contribute to air quality degradation and public health.

Lastly, the paper "Environmental impacts of the U.S. health care system and effects on public health" [31] studied the environmental impacts of the U.S. healthcare sector and estimated its contribution to greenhouse gas emissions and pollution. According to them, the improvement in environmental performance would not only enhance the outcomes in public health but also meet the broader sustainability objectives. Their study calls for improvements in the environmental performance of this sector, both for ecological reasons and for the betterment of public health. This perspective directly connects healthcare practices with environmental sustainability and is thus a very strong reason why greener healthcare policies should be developed to help combat air pollution and its health effects.

Together, these papers offer profound insights into the transformative potential, challenges, and regulatory issues concerning air pollution and environmental impacts, thus offering valuable insights for the researchers, policymakers, and industry

professionals in navigating the emergent domain. The reviewed articles examine key environmental sustainability challenges and solutions, focusing on climate change mitigation, renewable energy, sustainable agriculture, and public health. A common theme is the link between energy consumption, emissions, and environmental degradation [28,29]. Several studies highlight the environmental consequences of agricultural practices, including livestock production and crop residue burning, emphasizing their impact on land use, biodiversity, and pollution [30]. Others explore the intersection of sustainability and public health, particularly through dietary choices [27] and healthcare sector emissions [31]. Methodologically, the studies employ empirical data analysis, econometric modeling, and comparative policy analysis to assess environmental impacts. However, a key limitation is the lack of interdisciplinary approaches integrating environmental science with socio-economic and policy dimensions [29,30].

Despite valuable insights, several research gaps remain. There is limited analysis of the long-term effectiveness of environmental policies, with many studies focusing on short-term benefits. Additionally, more interdisciplinary research is needed to develop holistic sustainability solutions. Comparative studies across geographic regions are sparse, limiting the understanding of scalable policy interventions. While renewable energy adoption is widely promoted, challenges in large-scale implementation, particularly in developing countries, remain underexplored [27,30]. Addressing these gaps through interdisciplinary and comparative approaches could enhance the effectiveness of sustainability strategies and policies.

4. Discussion

The growing volume of research on air pollution and environmental impacts, as reflected by the trends from 2015 to 2022, underlines an increased awareness globally for the urgent need to address environmental degradation and health consequences of pollution. This increasing trend in research, especially in the period from 2020 to 2022, reflects a high focus on the aspect of air quality with environmental sustainability [32] and human health [33]. Ongoing global challenges, such as increased frequency of extreme weather events, the global health crisis brought about by the COVID-19 pandemic [34], and the drive toward technological innovation in monitoring [35–37] and mitigating pollution, have shaped the landscape of the research field. The slight decline in publications after 2022 may suggest that research intensity has stabilized, perhaps due to funding shifts, etc. However, the interest in these areas post-2020 underlines the durability of these issues.

This is reflected in the increased participation of researchers from what may be called the Global South, such as from countries like Brazil, South Africa, and Argentina, contributing toward increasing inclusivity in the study of localized environmental challenges. Such research on air pollution very often interconnects with concerns regarding biodiversity loss [38,39], deforestation [40,41], and urban degradation [42,43] to highlight that environmental issues hardly stand in isolation from general ecological crises. This trend is a certain suggestion of the need for global cooperation, given that pollutants more often than not transcend political and geographical boundaries. In that respect, international collaboration in research is a

key component in devising effective air quality management strategies, especially for those regions that are experiencing fast urban population growth.

Moreover, the growing contributions from productive authors—especially in 2021—indicate a growing awareness of the need for an interdisciplinary approach to the problem of air pollution. These authors likely address such emerging global concerns as those linked to air pollution, climate change [44,45], public health [46,47], and socio-economic inequalities [48]. New technologies, such as big data analytics, have also been increasingly applied, with research integrating climate-related terms such as “environmental monitoring” and “policy”, reflecting the expanded roles that governance frameworks and data-driven strategies are assuming. This shift towards interdisciplinary research reflects the complexity surrounding environmental problems, where the solution must integrate a broad set of fields, from policy and technology to public health and social sciences.

Mapping research themes has pointed out that the focus on environmental research is centered more on climate change and air pollution [49,50]. The themes will be fundamental, considering their direct link to the core environmental problems such as greenhouse gas emissions, degraded air quality, and impacts related to human health. Basic themes such as environmental impacts further reinforce the idea that research must consider both the direct and indirect consequences of pollution, particularly in terms of biodiversity loss, ecosystem damage, and public health [51,52]. One important insight from the thematic distribution is the emerging importance of niche areas, such as the study of organic pollutants [53]. These pollutants, often linked to industrial activities, represent an area of growing concern due to their potential for long-term environmental damage. This therefore calls for research that goes beyond the broad themes and explores specific pollutants and their unique impacts on air quality and ecosystem health.

The focus on air pollution and climate change is understandable, yet the emergence and decline of research themes indicate that variability in some areas may signal the need for further development. The collective contributions from these studies to the increasing knowledge base on air pollution and environmental impacts accentuate the need for an integrated, interdisciplinary approach in addressing such complex challenges. They underscore the need for a multispectral approach in tackling air pollution through energy [54], agriculture [55–57], health [58], and other sectors while pressing for more inclusive and holistic policy interventions. By focusing on both global and localized issues, these studies provide useful insights for researchers, policymakers, and practitioners who seek to mitigate the environmental impacts of air pollution and build a more sustainable future. The findings of this Bibliometric analysis provide insightful inputs for shaping policy and strategic initiatives in the field of air pollution research. It is thus recommended that trends and gaps identified be used in the prioritization of research funding toward emerging areas, such as air pollution mitigation strategies in developing countries, inter-disciplinary research combining environmental health and technology, and regional pollution sources that are under-explored.

5. Conclusion

This study presents a comprehensive bibliometric analysis of research on air pollution and its environmental impacts, highlighting the field's expanding significance, global research trends, and key thematic developments. The increasing volume and global distribution of publications emphasize the widespread and interdisciplinary interest in the domain.

The thematic analysis of the most recent studies reveals increasing inclusivity and interdisciplinarity in research on air pollution. Contributions by researchers from the Global South underline that environmental issues are interrelated: air pollution is directly related to biodiversity loss, deforestation, and urban degradation. Further, the combination of governance frameworks, big data analytics, and policy-oriented approaches indicates a move toward holistic solutions across fields such as technology, public health, and social sciences. The interdisciplinary focus reflects the complexity of air pollution issues and requires cooperative strategies across regions and sectors to effectively address the challenges posed by air pollution.

The limitation of the research is that it relies only on data taken from the Scopus database. However, for the impact of this limitation, the findings and discussion of the research will not be affected, since the Scopus database is recognized for its comprehensiveness and reliability in most current research studies. It is expected that future studies will discuss the emergent interdisciplinary themes and the role of policy measures in lessening the environmental impact of air pollution. The study underscores the need for focused research on organic pollutants and scaling up integrated multi-sectorial approaches that integrate renewable energy, sustainable agriculture, and healthcare systems. By fostering international collaboration and inclusive policy frameworks, such strategies offer promising pathways to mitigate air pollution and advance global sustainability.

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References

1. World Health Organization. Ambient (outdoor) air pollution. Available online: https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health (accessed on 24 November 2024).
2. Sofia D, Gioiella F, Lotrecchiano N, et al. Mitigation strategies for reducing air pollution. Environmental Science and Pollution Research. 2020; 27(16): 19226–19235. doi: 10.1007/s11356-020-08647-x
3. Nandasena S, Wickremasinghe A, Sathiakumar N. Air pollution and public health in developing countries: Is Sri Lanka different? Journal of the College of Community Physicians of Sri Lanka. 2012; 17(1): 15. doi: 10.4038/jccpsl.v17i1.4932
4. World Health Organization. Air pollution. Available online: https://www.who.int/india/health-topics/air-pollution (accessed on 24 November 2024).

5. United States Environmental Protection Agency. Ecosystems and air quality. Available online: https://www.epa.gov/eco-research/ecosystems-and-air-quality (accessed on 24 November 2024).
6. Bruce N, Perez-Padilla R, Albalak R. Indoor air pollution in developing countries: A major environmental and public health challenge. Bulletin of the World Health Organization. 2000; 78: 1078–1092.
7. Fahmy YM, Fornasiero P, Zinoviev S, et al. Air pollution control technologies compendium. International Center for Science and High Technology, United Nations Industrial Development Organization; 2007.
8. Smith P, Martino D, Cai Z, et al. Greenhouse gas mitigation in agriculture. Philosophical Transactions of the Royal Society B: Biological Sciences. 2007; 363(1492): 789-813. doi: 10.1098/rstb.2007.2184
9. Chen F, Zhang W, Mfarrej MFB, et al. Breathing in danger: Understanding the multifaceted impact of air pollution on health impacts. Ecotoxicology and Environmental Safety. 2024; 280: 116532. doi: 10.1016/j.ecoenv.2024.116532
10. Manisalidis I, Stavropoulou E, Stavropoulos A, et al. Environmental and Health Impacts of Air Pollution: A Review. Frontiers in Public Health. 2020; 8. doi: 10.3389/fpubh.2020.00014
11. World Health Organization. World Health Statistics. World Health Organization; 2021.
12. Landrigan P, Fuller R, Acosta N, et al. The Lancet Commission on pollution and health. The Lancet. 2017; 391. doi: 10.1016/S0140-6736(17)32345-0
13. Lelieveld J, Pozzer A, Pöschl U, et al. Loss of life expectancy from air pollution compared to other risk factors: a worldwide perspective. Cardiovascular Research. 2020; 116(11): 1910-1917. doi: 10.1093/cvr/cvaa025
14. Fehresti-Sani M, GholamAzad M, GholamAzad MA. Assessing the effect of industrial products on air pollution in Iran: a novel NDEA approach considering undesirable outputs. Environment, Development and Sustainability. 2024. doi: 10.1007/s10668-024-04868-z
15. Ghorani-Azam A, Riahi-Zanjani B, Balali-Mood M. Effects of air pollution on human health and practical measures for prevention in Iran. Journal of Research in Medical Sciences. 2016; 21. doi: 10.4103/1735-1995.189646
16. Passas I. Bibliometric Analysis: The Main Steps. Encyclopedia. 2024; 4(2): 1014–1025. doi: 10.3390/encyclopedia4020065
17. Öztürk O, Kocaman R, Kanbach DK. How to design bibliometric research: an overview and a framework proposal. Review of Managerial Science. 2024; 18(11): 3333–3361. doi: 10.1007/s11846-024-00738-0
18. Donthu N, Kumar S, Mukherjee D, et al. How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research. 2021; 133: 285–296. doi: 10.1016/j.jbusres.2021.04.070
19. Wen S, Tan Q, Baheti R, et al. Bibliometric analysis of global research on air pollution and cardiovascular diseases: 2012–2022. Heliyon. 2024; 10(12): e32840. doi: 10.1016/j.heliyon.2024.e32840
20. Sun J, Zhou Z, Huang J, et al. A Bibliometric Analysis of the Impacts of Air Pollution on Children. International Journal of Environmental Research and Public Health. 2020; 17(4): 1277. doi: 10.3390/ijerph17041277
21. Ansari A, Quaff AR. Bibliometric Analysis on Global Research Trends in Air Pollution Prediction Research Using Machine Learning from 1991–2023 Using Scopus Database. Aerosol Science and Engineering. 2024; 8(3): 288–306. doi: 10.1007/s41810-024-00221-z
22. Villacura L, Sánchez LF, Catalán F, et al. An overview of air pollution research in Chile: Bibliometric analysis and scoping review, challenger and future directions. Heliyon. 2024; 10(3): e25431. doi: 10.1016/j.heliyon.2024.e25431
23. Feng T, Sun Y, Shi Y, et al. Air pollution control policies and impacts: A review. Renewable and Sustainable Energy Reviews. 2024; 191: 114071. doi: 10.1016/j.rser.2023.114071
24. Zupic I, Čater T. Bibliometric Methods in Management and Organization. Organizational Research Methods. 2014; 18(3): 429–472. doi: 10.1177/1094428114562629
25. Xie H, Zhang Y, Wu Z, et al. A Bibliometric Analysis on Land Degradation: Current Status, Development, and Future Directions. Land. 2020; 9(1): 28. doi: 10.3390/land9010028
26. Dissanayake H, Popescu C, Iddagoda A. A Bibliometric Analysis of Financial Technology: Unveiling the Research Landscape. FinTech. 2023; 2(3): 527–542. doi: 10.3390/fintech2030030
27. Springmann M, Wiebe K, Mason-D'Croz D, et al. Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: A global modelling analysis with country-level detail. Lancet Planetary Health. 2018; 2(9): e451–e461. https://doi.org/10.1016/S2542-5196(18)30206-7
28. Martins F, Felgueiras C, Smitkova M, et al. Analysis of Fossil Fuel Energy Consumption and Environmental Impacts in European Countries. Energies. 2019; 12(6): 964. doi: 10.3390/en12060964

29. Cheng C, Ren X, Wang Z, et al. Heterogeneous impacts of renewable energy and environmental patents on CO2 emission: Evidence from the BRIICS. Science of The Total Environment. 2019; 668: 1328–1338. doi: 10.1016/j.scitotenv.2019.02.063
30. Bhuvaneshwari S, Hettiarachchi H, Meegoda JN. Crop Residue Burning in India: Policy Challenges and Potential Solutions. International Journal of Environmental Research and Public Health. 2019; 16(5): 832. doi: 10.3390/ijerph16050832
31. Eckelman MJ, Sherman J. Environmental Impacts of the U.S. Health Care System and Effects on Public Health. Ahmad S, ed. PLOS ONE. 2016; 11(6): e0157014. doi: 10.1371/journal.pone.0157014
32. Bacoş IB, Gabor MR. Air Quality Indices—Case Study: Environmental Sustainability Pillar and Romania's Positioning in the European and Global Context. Acta Marisiensis Seria Technologica. 2021; 18(1): 22–27. doi: 10.2478/amset-2021-0004
33. Al Nadhairi R, Al Kalbani M, Al Khazami S, et al. Air quality and health risk assessment during Middle Eastern dust storms: a study of particulate matter. Air Quality, Atmosphere & Health. 2024. doi: 10.1007/s11869-024-01662-8
34. Ben B, Yang X, Shao P, et al. Assessment of COVID-19 lockdown measures on air quality over the Sichuan Basin, China: insights from multiple observations. Air Quality, Atmosphere & Health. 2024. doi: 10.1007/s11869-024-01671-7
35. Hadj Sassi MS, Chaari Fourati L. Comprehensive survey on air quality monitoring systems based on emerging computing and communication technologies. Computer Networks. 2022; 209: 108904. doi: 10.1016/j.comnet.2022.108904
36. Elbestar M, Aly SG, Ghannam R. Advances in Air Quality Monitoring: A Comprehensive Review of Algorithms for Imaging and Sensing Technologies. Advanced Sensor Research. 2024; 3(11). doi: 10.1002/adsr.202300207
37. Rani Hemamalini R, Vinodhini R, Shanthini B, et al. Air quality monitoring and forecasting using smart drones and recurrent neural network for sustainable development in Chennai city. Sustainable Cities and Society. 2022; 85: 104077. doi: 10.1016/j.scs.2022.104077
38. Lovett GM, Tear TH, Evers DC, et al. Effects of Air Pollution on Ecosystems and Biological Diversity in the Eastern United States. Annals of the New York Academy of Sciences. 2009; 1162(1): 99–135. doi: 10.1111/j.1749-6632.2009.04153.x
39. Kumar JIN. Impact of pollution on aquatic biodiversity. Ecology, Environment and Conservation. 1997; 3: 209–217.
40. Viedra GGZ, Sukojo BM. Analysis of The Effect of Deforestation Rates on Air Pollution Concentration and Land Surface Temperature Using Landsat-8 Imagery with Google Earth Engine (Case Study: East Kalimantan Province, 2019-2020). IOP Conference Series: Earth and Environmental Science. 2023; 1127(1): 012032. doi: 10.1088/1755-1315/1127/1/012032
41. Rahman RA, White B, Ma C. The effect of growth, deforestation, forest fires, and volcanoes on Indonesian regional air quality. Journal of Cleaner Production. 2024; 457: 142311. doi: 10.1016/j.jclepro.2024.142311
42. Liang L, Gong P. Urban and air pollution: a multi-city study of long-term effects of urban landscape patterns on air quality trends. Scientific Reports. 2020; 10(1). doi: 10.1038/s41598-020-74524-9
43. Sicard P, Agathokleous E, Anenberg SC, et al. Trends in urban air pollution over the last two decades: A global perspective. Science of The Total Environment. 2023; 858: 160064. doi: 10.1016/j.scitotenv.2022.160064
44. Kumar A, Omidvarborna H, Shandilya KK. Air Pollution and Climate Change. Research Anthology on Environmental and Societal Impacts of Climate Change. 2022: 1066–1102. doi: 10.4018/978-1-6684-3686-8.ch053
45. Stanisci I, Sarno G, Curzio O, et al. Air Pollution and Climate Change: A Pilot Study to Investigate Citizens' Perception. Environments. 2024; 11(9): 190. doi: 10.3390/environments11090190
46. Hilly JJ, Singh KR, Jagals P, et al. Review of scientific research on air quality and environmental health risk and impact for PICTS. Science of The Total Environment. 2024; 942: 173628. doi: 10.1016/j.scitotenv.2024.173628
47. Craig L, Brook JR, Chiotti Q, et al. Air Pollution and Public Health: A Guidance Document for Risk Managers. Journal of Toxicology and Environmental Health, Part A. 2008; 71(9–10): 588–698. doi: 10.1080/15287390801997732
48. Van den Brekel L, Lenters V, Mackenbach JD, et al. (2024). Ethnic and socioeconomic inequalities in air pollution exposure: A cross-sectional analysis of nationwide individual-level data from the Netherlands. Lancet Planetary Health. 2024; 8: e18–e29. doi: 10.1016/S2542-5196(23)00258-9
49. Pinho-Gomes AC, Roaf E, Fuller G, et al. Air pollution and climate change. Lancet Planetary Health. 2023; 7: e727–e728. doi: 10.1016/S2542-5196(23)00189-4
50. Rabie S. Air Pollution and Climate Change. The Lancet Planetary Health. 2022; 7(9): e727-e728.
51. Tran HM, Tsai FJ, Lee YL, et al. The impact of air pollution on respiratory diseases in an era of climate change: A review of the current evidence. Science of The Total Environment. 2023; 898: 166340. doi: 10.1016/j.scitotenv.2023.166340
52. Boogaard H, Patton AP, Atkinson RW, et al. Long-term exposure to traffic-related air pollution and selected health outcomes: A systematic review and meta-analysis. Environment International. 2022; 164: 107262. doi: 10.1016/j.envint.2022.107262

53. Déciga-Alcaraz A, Tlazolteotl Gómez de León C, Morales Montor J, et al. Effects of solvent extracted organic matter from outdoor air pollution on human type II pneumocytes: Molecular and proteomic analysis. Environmental Pollution. 2023; 337: 122551. doi: 10.1016/j.envpol.2023.122551
54. Ai H, Tan X. A Literature Review of the Effects of Energy on Pollution and Health. Energy RESEARCH LETTERS. 2021; 2(4). doi: 10.46557/001c.28135
55. Harizanova-Bartos H, Stoyanova Z. Impact of agriculture on air pollution. In: Proceedings of the CBU International Conference Proceedings; 2018. pp. 1071–1076.
56. Dong D, Wang J. Air pollution as a substantial threat to the improvement of agricultural total factor productivity: Global evidence. Environment International. 2023; 173: 107842. doi: 10.1016/j.envint.2023.107842
57. Pandya S, Gadekallu TR, Maddikunta PKR, et al. A Study of the Impacts of Air Pollution on the Agricultural Community and Yield Crops (Indian Context). Sustainability. 2022; 14(20): 13098. doi: 10.3390/su142013098
58. Dominski FH, Lorenzetti Branco JH, Buonanno G, et al. Effects of air pollution on health: A mapping review of systematic reviews and meta-analyses. Environmental Research. 2021; 201: 111487. doi: 10.1016/j.envres.2021.111487