Preliminar

Effects of climate change. Equity and social justice actions in environmental sustainability

Efectos del cambio climático. Acciones de equidad y justicia social en la sostenibilidad ambiental

Efeitos das mudanças climáticas. Ações para a equidade e a justiça social na sustentabilidade ambiental

María del Pilar Longar Blanco[1]
Talía Santana Quinter[2]
Rubén Oliver Espinoza[3]
Lydia Velázquez García[4]
Antonio Cedillo Hernández[5]

Received: October 10th, 2024
Accepted: December 15th, 2024
Available: September 5th, 2025

How to cite this article:
M. del P. Longar Blanco, T. Santana Quinter, R. Oliver Espinoza, L. Velázquez García, and A. Cedillo Hernández, "Effects of climate change. Equity and social justice actions in environmental sustainability / Efectos del cambio climático. Acciones de equidad y justicia social en la sostenibilidad ambiental," *Revista Ingeniería Solidaria*, vol. 21, no. 2, 2025. https://doi.org/10.16925/2357-6014.2025.02.06

Review article. https://doi.org/10.16925/2357-6014.2025.02.06
[1] Instituto Politécnico Nacional, Centro de Investigaciones Económicas, Administrativas y Sociales CIECAS.
E-mail: mlongar@ipn.mx.
ORCID: https://orcid.org/0000-0003-2416-8919
[2] Universidad Nacional Autónoma de México, Instituto de Investigaciones Sociales IIS.
E-mail: steclis@sociales.unam.mx. Orcid: https://orcid.org/0009-0002-4909-7141
[3] Instituto Politécnico Nacional, Centro de Investigaciones Económicas, Administrativas y Sociales CIECAS.
E-mail: roliver@ipn.mx.
ORCID: https://orcid.org/0000-0002-7712-8980
[4] Instituto Politécnico Nacional, Centro de Investigaciones Económicas, Administrativas y Sociales CIECAS.
E-mail: velazquezg@ipn.mx.
ORCID: https://orcid.org/0000-0003-2441-2117
[5] Tecnológico de Monterrey, Escuela de Ingeniería y Ciencias.
E-mail: acedillo@tec.mx.
ORCID: https://orcid.org/0000-0003-3420-6851

Abstract

Objective: The purpose of the research was to analyze how key concepts in the scientific literature on sustainability, climate change, and resilience are interrelated, in order to gain both quantitative and qualitative perspectives on emerging trends in these areas of study.
Methodology: A qualitative approach was employed through bibliographic network analysis, using VOSviewer to examine the frequency and co-occurrence of terms.
Results: Seven clusters were identified, revealing specific subthemes within the fields of adaptation, climate change, governance, resilience, and capabilities.
Conclusion: The analysis of bibliographic networks and the identification of emerging terms provide a solid foundation for future studies addressing sustainability in urban and rural contexts affected by climate change.
Originality: This study offers innovative insight by using VOSviewer to analyze the interconnections between key concepts, enabling a clearer understanding of emerging trends in the scientific literature related to climate change and sustainability.
Limitations: Although the qualitative approach was useful in identifying patterns in the bibliographic networks, a more in-depth quantitative analysis of the impact of these concepts on practice was not included, limiting the ability to generalize the results globally.

Keywords: Climate Change, Equity, Social Justice, Bibliographic Networks, Adaptation, Resilience.

Resumen

El artículo es producto de una investigación sobre los efectos del cambio climático y las acciones de equidad y justicia social en la sostenibilidad ambiental, desarrollada en el Instituto Politécnico Nacional en el año 2025. El propósito de la investigación fue analizar cómo se interrelacionan los conceptos clave en la literatura científica sobre sostenibilidad, cambio climático y resiliencia, con el fin de obtener una perspectiva tanto cuantitativa como cualitativa de las tendencias emergentes en estas áreas de estudio.
Se empleó un enfoque cualitativo mediante el análisis de redes bibliográficas, utilizando el software VOSviewer para examinar la frecuencia y coocurrencia de palabras. Los resultados identificaron siete clústers que revelan subtemas específicos dentro de los campos de adaptación, cambio climático, gobernanza, resiliencia y capacidades.
El análisis de las redes bibliográficas y la identificación de términos emergentes proporciona una base sólida para futuros estudios que aborden la sostenibilidad en contextos urbanos y rurales afectados por el cambio climático. Este estudio ofrece un aporte original al emplear VOSviewer para explorar las interconexiones entre conceptos clave, lo que permite una comprensión más clara de las tendencias emergentes en la literatura científica relacionada con el cambio

climático y la sostenibilidad.
No obstante, se reconoce como limitación que, aunque el enfoque cualitativo fue útil para identificar patrones en las redes bibliográficas, no se incluyó un análisis cuantitativo más profundo del impacto de estos conceptos en la práctica, lo cual restringe la capacidad de generalizar los resultados a nivel global.

Palabras clave: cambio climático, equidad, justicia social, redes bibliográficas, adaptación, resiliencia.

Resumo

Este artigo é fruto de uma pesquisa sobre os efeitos das mudanças climáticas e das ações de equidade e justiça social na sustentabilidade ambiental, realizada no Instituto Politécnico Nacional em 2025. O objetivo da pesquisa foi analisar como os principais conceitos da literatura científica sobre sustentabilidade, mudanças climáticas e resiliência se inter-relacionam, a fim de obter uma perspectiva quantitativa e qualitativa sobre as tendências emergentes nessas áreas de estudo. Uma abordagem qualitativa foi empregada utilizando análise de redes bibliográficas, com o auxílio do software VOSviewer para examinar a frequência e a coocorrência de palavras. Os resultados identificaram sete agrupamentos que revelam subtemas específicos nos campos de adaptação, mudanças climáticas, governança, resiliência e capacitação.
A análise de redes bibliográficas e a identificação de termos emergentes fornecem uma base sólida para futuros estudos que abordem a sustentabilidade em contextos urbanos e rurais afetados pelas mudanças climáticas. Este estudo oferece uma contribuição original ao utilizar o VOSviewer para explorar as interconexões entre os principais conceitos, permitindo uma compreensão mais clara das tendências emergentes na literatura científica relacionada às mudanças climáticas e à sustentabilidade.
Contudo, reconhece-se uma limitação: embora a abordagem qualitativa tenha sido útil para identificar padrões nas redes bibliográficas, não foi incluída uma análise quantitativa mais aprofundada do impacto desses conceitos na prática, o que restringe a capacidade de generalizar os resultados globalmente.
Palavras-chave: mudanças climáticas, equidade, justiça social, redes bibliográficas, adaptação, resiliência.

1. INTRODUCTION

Recent research highlights the importance of equity and justice in climate action planning. Justice has played a key role in facilitating conflict resolution through the use of laws and regulations that govern society [1]. Cities are increasingly incorporating social equity goals into their climate plans, although this remains a

challenge for many [2]. Effective and equitable climate action requires authentic frontline community engagement, trust-building, and the addressing of historical harms [3]. Climate finance and adaptation strategies can exacerbate existing inequalities if not carefully designed [4]. Evaluating the effectiveness of climate plans in promoting social justice goals is crucial, yet remains underdeveloped [5]. To achieve a just transition, climate policies must proactively empower and prioritize disadvantaged groups [6]. This includes developing participatory approaches that center on vulnerable residents and support communication across social divides [7].

In addition, equitable climate education is essential to building a diverse climate workforce and engaging people from all backgrounds in creating climate solutions [8].

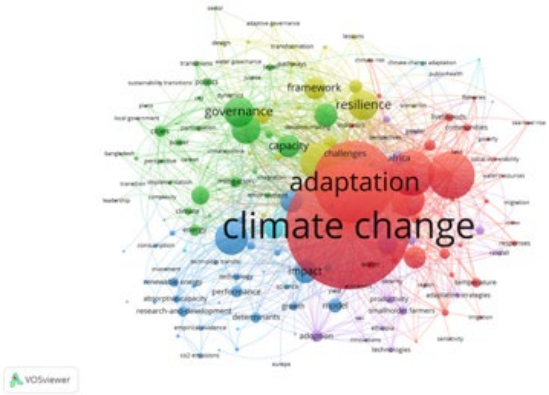
On the other hand, the indiscriminate use of natural resources without sustainability considerations puts the planet's carrying capacity at risk. The growing demand for sustainable products and services offers opportunities for companies that adopt responsible business practices [9]. Studies such as that of Girling [10] reveal that approximately 90% of the raw materials used in manufacturing become waste before the final product leaves the plant, and that around 80% of manufactured goods are discarded within the first six months of their useful life. This situation is further aggravated by projections that global demand for resources will double by 2050 [11].

1.1 Word frequency and co-occurrence

Bibliographic co-occurrence analysis proves to be a powerful tool for exploring and understanding the structure of knowledge in any scientific area. By identifying how terms and concepts are related and how they evolve, researchers gain deep

insight into the dynamics of the field, making it easier to identify emerging trends and areas of opportunity. In the analysis of the reviewed literature (Figure 2), emerging terms such as adaptation, climate change, governance, resilience, and capacities have been highlighted. These terms are not only thematically related but also reveal how they are interconnected within the field of study. This visibility underscores the relevance of these concepts in current research and highlights a promising and rapidly growing area. In addition, the analysis reveals increasing interdisciplinary collaboration, demonstrating the integration of diverse approaches and perspectives in the study of these issues.

Fig. 2. Frequency and Co-occurrence of words



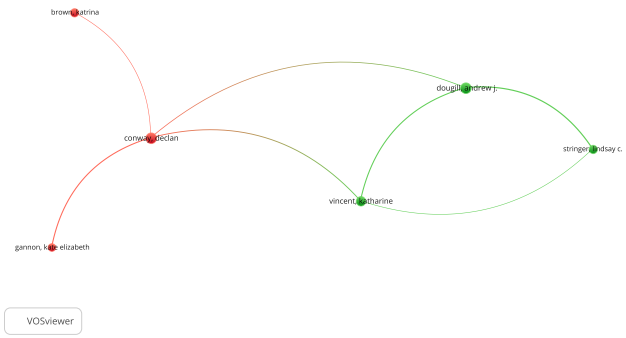
Source: Authors' elaboration with VOSviewer, 2024.

1.2. Co-audit

Co-authorship analysis in literature reviews is critical to understanding the dynamics of scientific collaboration, providing valuable insights into how researchers work together and the structure of collaborative networks. This approach facilitates the identification of leaders and trends in the field of study and encourages more effective and strategic collaboration. In the analysis, researchers Stringer, Dougill, Vincent, Conway, Brown, and Gannon (Figure 3) were identified as prominent figures within collaborative networks in the research area. These findings are particularly relevant in the context of emerging terms such as adaptation, climate change, governance, resilience, and capabilities. The presence

of these researchers in key topics indicates strong collaboration in critical areas, which not only reflects the growing importance of these subjects in research but also underscores the value of interdisciplinary networks in addressing complex problems and driving meaningful advances in scientific knowledge.

Figure 3. Co-authorship

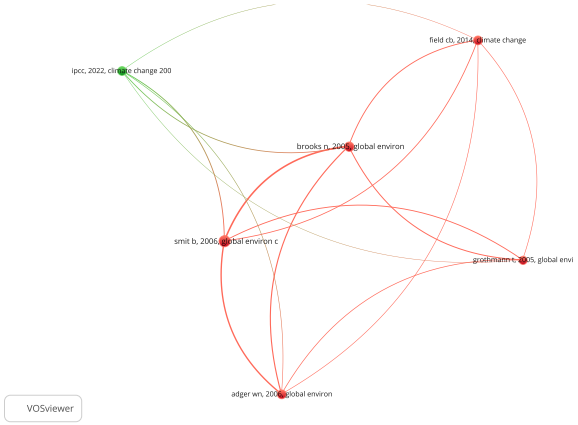


Source: Own elaboration with data from VOSViewer, 2024.

1.3 Co-citation

Co-authorship analysis in the literature review reveals important dynamics of scientific collaboration, providing valuable insights into how researchers work together and the structure of collaborative networks. In this analysis, prominent researchers such as Stringer, Dougill, Vincent, Conway, Brown, Gannon, Grothmann, Field, Brooks, Smit, and IPCC (Figure 4) were identified, who play a crucial role in the areas of adaptation, climate change, governance, resilience, and capabilities. The presence of these authors on the key themes highlights collaboration in critical areas, underscoring the importance of interdisciplinary networks to address complex problems. These findings not only reflect the rise of emerging topics in research, but also illustrate the collaboration and impact of these researchers in advancing scientific knowledge.

Figure 4. Co-citation

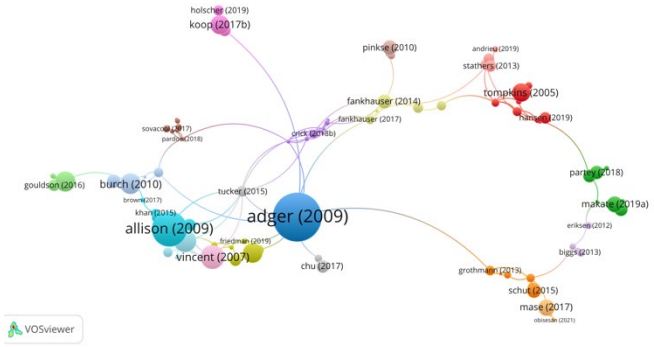


Source: Authors' elaboration with execution at VOSViewer, 2024.

1.4 Summons

The co-authorship and citation analysis reveals a network of scientific collaboration focused on key issues such as adaptation, climate change, governance, resilience, and capacities. Prominent researchers (Figure 5) such as Stringer, Dougill, Vincent [12], and Grothmann [13], along with Adger [14], Field, Brooks [15], Smit, Koop [16], Burch [17], Anguelovski & Roberts [18], Mase [19], and Makate [20], emerge as central figures in the literature. Citation maps illustrate how these authors and their work are interconnected, identifying emerging trends and areas of impact. The high frequency of citations of documents by Adger, Lorenzoni, and Vincent suggests their crucial role in the fields of resilience and climate change, while the influence of Koop and Burch is notable in governance and adaptation. These findings underscore the significance of these collaborations and provide a deeper understanding of the evolution of knowledge, optimizing research and literature review strategies by revealing thematic structures and cross-disciplinary influence.

Figure 5. Subpoena



Source: Own elaboration with execution in the VOSViewer, 2024.

1.5 Bibliographic

Linkage bibliographic coupling is an essential technique in bibliometric analysis that enables us to understand the relationships between documents and authors based on shared references. In the context of the findings from the review (Figure 6), the work of Woolf [21], Adger [22], and Barnett [23] is critical to exploring the structure of knowledge surrounding adaptation, climate change, governance, resilience, and capacities. These authors stand out in the literature due to the high frequency of shared citations, which indicates a close thematic relationship between their research.

The bibliographic coupling analysis reveals how these documents are grouped around common themes. For instance, the coupling between Adger and Barnett's work may suggest a shared focus on resilience and adaptation to climate change, while Woolf may be contributing perspectives on environmental governance. This type of analysis enables the construction of knowledge maps that visualize how documents and concepts are interrelated, facilitating the identification of both established and emerging thematic areas within the field.

Furthermore, bibliographic coupling supports the tracking of research evolution by showing how new publications connect with previous works, thereby revealing trends in the development of the field.

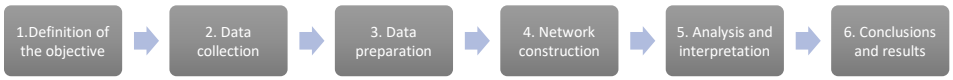
2. MATERIALS AND METHODS

The VOSviewer tool was used for the construction and analysis of bibliographic networks with the aim of identifying and visualizing the relationships between key terms in research on sustainability in cities and localities, hunger, climate change, capacities, innovation, and development. This tool enables the creation of keyword co-occurrence maps and citation networks that reveal patterns and connections in the scientific literature.

The analysis focused on discovering how these concepts are interrelated within the academic body, providing both a quantitative and qualitative perspective on emerging trends and areas of further development. Visualizing these networks not only facilitates the understanding of thematic dynamics but also allows for the identification of research gaps and potential areas for future exploration.

This methodology was developed based on the following conceptual framework (Figure 6):

Fig. 6. Methodological process of the bibliography



Source: own elaboration

1) Definition of the Objective: The objective of this methodology is to analyze the interrelationships and trends in the scientific literature related to sustainability in cities and localities, hunger, climate change, capacities, innovation, and development. Through the construction and analysis of bibliographic networks using VOSviewer, the aim is to identify patterns, connections, and gaps in existing

research, in order to provide a comprehensive view that can guide future research and strategies in these key areas.

2) Data Collection: For the bibliometric analysis in this research, an exhaustive search was conducted in the Web of Science and Scopus databases, yielding approximately 200 relevant records. Using VOSviewer, the exported data in .csv and .txt formats were utilized, containing detailed information about articles, authors, keywords, and references. The selection of this data was guided by the goal of identifying and mapping the interrelationships between the key concepts of sustainability, hunger, climate change, capacities, innovation, and development.

3) Data Preparation: To ensure accurate analysis in VOSviewer, the data must be in the proper format, which includes cleaning the data, removing duplicates, and correcting errors in author names or keywords. Once prepared, the data were imported into VOSviewer through its interface, carefully selecting the type of network to be built—such as author co-citation or keyword co-occurrence networks—to effectively explore interrelationships in the scientific literature.

4) Construction of the Network: Units of analysis, such as authors, papers, or keywords, are selected according to the focus of the study. The network is then configured by defining how these units are related; for example, in a keyword co-occurrence network, the nodes represent keywords, and the connections (edges) indicate how frequently two words appear together in documents. A minimum threshold can be applied for the inclusion of nodes in the network, based on frequency of occurrence or number of citations, ensuring that only the most relevant elements are considered. Nodes are automatically grouped into clusters based on the density of their connections, allowing thematic groups or research communities to be identified. For better visual interpretation, it is possible to adjust the size of the nodes and the strength of the connections according to the needs of the analysis.

5) Analysis and Interpretation: The analysis and interpretation of the generated network allow for the identification of key patterns, such as influential authors, emerging themes, and significant collaborations. The identified clusters help delineate subfields within the research area or closely related topics, providing a clear view of the thematic structure. If the analysis includes temporal data, it becomes possible to observe trends over time, highlighting how topics and collaborations evolve within the field. In the conclusion, the main findings—such as identified clusters, key authors, and emerging research areas—are summarized, using the generated visualizations to effectively present these results in reports or presentations.

6) Conclusions and Results: Depending on the results obtained, it may be necessary to refine the analysis by adjusting the network parameters or exploring other types of networks to deepen the understanding of the studied field.

3. RESULTS

In bibliometric analysis, the identification and visualization of bibliographic clusters are crucial for understanding the internal structure and dynamics of a field of study. These clusters represent groups of documents, authors, or terms that are highly interconnected within networks of co-citation, co-occurrence, or co-authorship. For example, in the current research, the seven clusters identified reveal specific sub-themes within the fields of adaptation, climate change, governance, resilience, and capacities. Each cluster corresponds to a well-defined subject area, providing a clear view of how the field is divided into more specific topics and how these relate to one another in both conceptual and methodological terms.

The analysis of these clusters not only helps to uncover the structure of knowledge—highlighting central and peripheral themes—but also offers insight into collaborative networks and emerging research trends. Clusters demonstrate how researchers work closely on specific topics, how intellectual communities form around shared interests, and how these evolve over time. They also enable the detection of new research directions and the identification of influential topics that are gaining momentum across different disciplines.

Moreover, identifying interrelations between clusters can highlight interdisciplinary bridges between domains that are often addressed separately. This provides valuable insights for scholars interested in developing integrative approaches or exploring under-researched intersections. Additionally, these thematic groups guide researchers in focusing their work by helping to identify gaps in the literature and areas with high academic or societal impact. This insight is particularly

relevant for early-career researchers aiming to contribute meaningfully to their disciplines or position themselves in competitive academic environments.

For academic institutions, research centers, and funding agencies, clusters offer strategic information on where to allocate resources, support emerging areas, and encourage interdisciplinary collaboration. Understanding how topics cluster also helps align research funding with scientific trends, public policy priorities, and long-term societal needs.

Assessing thematic connectivity between clusters provides a broad and integrated perspective on how various topics are interrelated within the field, facilitating a comprehensive understanding of its intellectual landscape. Ultimately, cluster analysis becomes a key methodological tool for mapping scientific production, evaluating knowledge structures, and forecasting future directions of academic inquiry.

REFERENCES

[1] G. M. Prats, “Capítulo I Justicia Tributaria. Métodos de resolución de conflictos y derechos humanos," *Tópicos Jurídicos de Derechos Humanos*, vol. 13, 2024.

[2] I. Anguelovski and D. Roberts, “Spatial justice and climate change: multiscale impacts and local development in Durban, South Africa," 2011.

[3] S. Burch, “In pursuit of resilient, low carbon communities: An examination of barriers to action in three Canadian cities," *Energy Policy*, vol. 38, no. 12, pp. 7575–7585, 2010.

[4] M. Bouyé, D. O'Connor, A. Tankou, D. Grinspan, D. Waskow, S. Chattopadhyay, and A. Scott, “Achieving social equity in climate action: Untapped opportunities and building blocks for leaving no one behind," *World Resources Institute Working Paper*, 2021.

[5] H. Cao, C. Tan, Z. Gao, Y. Xu, G. Chen, P. A. Heng, and S. Z. Li, “A survey on generative diffusion models,” *IEEE Transactions on Knowledge and Data Engineering*, 2024.

[6] P. Ekins, N. Hughes, S. Brigenzu, C. Arden Clark, M. Fischer-Kowalski, T. Graedel, and H. Westhowk, “Resource efficiency: Potential and economic implications,” 2016.

[7] T. Brooks, “Introduction to Climate Change Ethics for an Endangered World,” New York & London: Routledge, 2020. [Online]. Available: https://ssrn.com/abstract=3617336

[8] H. Fitzgerald, A. Stride, and S. Drury, “COVID-19, lockdown and (disability) sport,” *Managing Sport and Leisure*, vol. 27, no. 1–2, pp. 32–39, 2022.

[9] R. Girling, *Sea Change: Britain's Coastal Catastrophe*. Random House, 2011. Citado en: L. Lebel, T. Grothmann, and B. Siebenhüner, “The role of social learning in adaptiveness: insights from water management,” *International Environmental Agreements: Politics, Law and Economics*, vol. 10, pp. 333–353, 2010.

[10] A. S. Mase, B. M. Gramig, and L. S. Prokopy, “Climate change beliefs, risk perceptions, and adaptation behavior among Midwestern US crop farmers,” *Climate Risk Management*, vol. 15, pp. 8–17, 2017.

[11] M. Makate, N. Mango, and S. Siziba, “Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations: Lessons from Southern Africa,” *Journal of Environmental Management*, vol. 231, pp. 858–868, 2019.

[12] G. Schrock, E. M. Bassett, and J. Green, “Pursuing Equity and Justice in a Changing Climate: Assessing Equity in Local Climate and Sustainability Plans in U.S. Cities,” *Journal of Planning Education and Research*, vol. 35, no. 3, pp. 282–295, 2015. [Online]. Available: https://doi.org/10.1177/0739456X15580022

[13] A. Koop, L. Koetsier, A. Doornhof, et al., “Assessing the Governance Capacity of Cities to Address Challenges of Water, Waste, and Climate Change,” *Water Resources Management*, vol. 31, no. 11, pp. 3427–3443, 2017. [Online]. Available: https://doi.org/10.1007/s11269-017-1677-7

[14] L. C. Stringer, K. Vincent, D. Conway, A. Brown, C. Siderius, S. R. Kolusu, M. C. Todd, A. Bhave, A. J. Dougill, C. J. Reason, and D. Conway, “Climate variability affects water-energy-food infrastructure performance in East Africa,” *One Earth*, vol. 4, no. 3, pp. 397–410, 2021.

[15] T. Grothmann and M. Pütz, “Reflexive regional governance – a framework for enhancing adaptiveness of environmental governance," *Working Paper*, 2009.

[16] L. C. Stringer, A. J. Dougill, J. C. Dyer, K. Vincent, F. Fritzsche, J. Leventon, and G. Kalaba, “Advancing climate compatible development: lessons from southern Africa," *Regional Environmental Change*, vol. 14, pp. 713–725, 2014.

[17] J. C. Swanson, “Animal welfare and economic sustainability of farms," *Frontiers in Animal Science*, vol. 5, p. 1377908, 2024.

[18] A. Waheed and Q. Zhang, “Effect of CSR and Ethical Practices on Sustainable Competitive Performance: A Case of Emerging Markets from Stakeholder Theory Perspective," *Journal of Business Ethics*, vol. 175, no. 4, pp. 837–855, 2022.

[19] T. Ibn-Mohammed, K. B. Mustapha, J. Godsell, Z. Adamu, K. A. Babatunde, D. D. Akintade, and S. C. L. Koh, “A critical analysis of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies," *Resources, Conservation and Recycling*, vol. 164, p. 105169, 2021.

[20] D. Woolf, J. E. Amonette, F. A. Street-Perrott, J. Lehmann, and S. Joseph, “Sustainable biochar to mitigate global climate change," *Nature Communications*, vol. 1, no. 1, p. 56, 2010. [Online]. Available: https://doi.org/10.1038/ncomms1053

[21] W. N. Adger, I. Lorenzoni, and K. L. O'Brien, Eds., *Adapting to Climate Change: Thresholds, Values, Governance*. Cambridge University Press, 2009.

[22] M. L. Barnett, “Stakeholder influence capacity and the variability of financial returns to corporate social responsibility," *Academy of Management Review*, vol. 32, no. 3, pp. 794–816, 2007.