

Insurance for climate change and environmental risk: a bibliometric review

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Abstract

Purpose – This study aims to examine the research output on climate change, environmental risks and insurance from 1986 to 2020, thereby revealing the development of the literature through collaborative networks. The relationship between insurance, climate change and environmental threats has gained research attention. This study describes the interaction between insurance, climate change and environmental risk.

Design/methodology/approach – This study is a bibliometric analysis of the literature and assessed the current state of science. A total of 97 academic papers from top-level journals listed in the Scopus database are shortlisted.

Findings – The understanding of climate change, environmental risks and insurance is shaped and enhanced through the collaborative network maps of researchers. Their reach expands across different networks, core themes and streams, as these topics develop.

Research limitations/implications – Data for this study were generated from English-written journal articles listed in the Scopus database only; subsequently, this study was representative of high-quality papers published in the areas of climate change, environmental risks and insurance.

Practical implications – The results of this study can be useful to academic researchers to aid their understanding of climate change, environmental risks and insurance research development, to identify the current context and to develop a future research agenda.

Social implications – The findings of this study can improve the understanding of industry practitioners about climate change and global warming challenges, and how insurance can be used as a tool to address such challenges.



Originality/value – This study is a novel attempt. To the best of the authors' knowledge, this is one of the first studies to better understand climate change, environmental risks and insurance as a research topic by examining its evolution in an academic context through visualization, coupling and bibliometric analysis. This bibliometric study is unique in reviewing climate change literature and providing a future research agenda. Using bibliometric data, this study addressed the technical aspects and the value it adds to actual practice. Bibliometric indicators quantitatively and qualitatively evaluate emerging disciplinary progress in this topic.

Keywords Climate change insurance, Risk, Environmental pollution, Global warming, CO₂ emissions, Carbon risk, Flood insurance, Natural hazard

Paper type Literature review

1. Introduction

Global climate change is intensifying and the overall danger to all forms of nature is highly uncertain. The response of populations and habitats to global climate change is unpredictable (Sala, 2006). The fact that sustainable weather is vital to the future well-being of humankind, economic growth and continued financial protection makes it difficult to cope with the long-term damage caused by climate change (Mills, 2009). Climate change negatively influences the cost and supply of insurance and pressurizes the organizations and citizens. The insurers, regulators and insurance sector are working collaboratively to build a deeper view of physical and business risks. Insurance companies are well prepared to participate in government collaborations to introduce disruptions, extend hazard modelling and discuss responses to the impact of weather alteration (Mills, 2009).

The latest shifts in climate change have challenged countless global economies. It is considered a normal change for some of them and a real problem for others. Although the third-world countries contribute less to annual global carbon emissions, they have the greatest effect. It is expected that a changing climate may increase the frequency and severity of certain climate extremes and disasters. However, this could also be due to geographical location, other vulnerabilities, limited assets and the likelihood of environmental maladaptation (Ullah *et al.*, 2018). With rising global temperatures and more frequent natural disasters, it is worthwhile to develop a roadmap and framework to enhance the ability of individuals and companies to boost community resilience to climate change (Tijana and Lovren, 2018).

The combination of an event and its aftermath explains the risk factors associated with climate change. The analysis of environmental risks complements the research on climate change in this study. It is noteworthy that environmental risks coupled with climate change pose financial and nonfinancial risks to individuals. Climate change has led to a significant increase in health risks in recent years. The climate trajectory remains uncertain posing major economic consequences on global markets. Investors find several ways to hedge themselves against environmental risk and climate change. It is important to note that the non-diversifiable risk associated with climate change makes it difficult for future investors to introduce and implement insurance contracts. Engle *et al.* (2020) highlighted in their study that a mandate requiring all insurance agreements to be fully executed and compensate investors simultaneously becomes realistically difficult during a natural disaster event. This indicates a need for individual investors to be self-insure to protect themselves against environmental and climate risks.

Another essential point is that the media plays a vital role in disseminating relevant information regarding climate change and the actions required at the regional and global levels to address the issue. Bolsen and Shapiro (2018) explained that climate change coverage in the news increased significantly in the USA from 2007 to 2010. Events such as

UN climate change in the 2009 conference, unsuccessful efforts to curb greenhouse gas emissions in the form of trade limits and caps, and the IPCC report released in 2007 were some of the events that gained the attention of the USA. The USA actively participated in understanding the impact of climate change on public health, environment, national security and so on. This study investigates the development of literature, with a bibliometric analysis, on insurance, climate change and environmental risks over the years. This bibliometric study assessed the uncertainties of climate and its impacts on several industries globally. This study highlights that a key to mitigating such risks is to regulate environmental management systems further to identify regulatory risks from time to time and deal with any increased costs of compliance.

2. Literature review

Risk reduction and adaptation to climate change remain poorly understood. There is a niche between legal and social levels in the communication of needs and beliefs regarding climate adaptation strategies (Flyen *et al.*, 2018). However, social protection projects are part of a constructive approach to climate-change management. If gains are achieved by incorporating the effects of global climate change into these projects, they will provide only temporary help until sustainable alternatives are developed (Schwan and Yu, 2018). Risk management is one of the most crucial issues facing natural hazards in contemporary economies. Insurance is considered an increasingly important risk control method (Uwe and Christof, 2011) for managing climate change, which is regarded as a threat to the natural world and human civilization. Therefore, climate change initiatives promote insurance adoption (Yu *et al.*, 2019). Climate change insurance coverage, which depends on legal responsibility, faces serious hurdles. Insurance is emerging as a promising approach to liability and compensation, and represents a modern climate change approach with significant potential to improve climate policies (Horton, 2018).

In recent years, extensive literature has explained individuals' perceptions of climate change and its consequences. Hayes *et al.* (2018) highlighted in their study that climate change and environmental risks threaten human health in several ways. The inequitable effects of climate change remain challenging to address and may lead to the erosion of natural resources in several countries. Market participants are also concerned about the impact and risks associated with climate change, leading towards announcing the commitment towards sustainability initiatives across the globe. Most importantly, the effects of environmental hazards and climate change on various industries are intertwined. These impacts may be uneven across countries, but scarce resources make it difficult for all countries to respond efficiently. Berrang-Ford *et al.* (2021) also reiterated that assessment of global progress is essential to comprehend responses towards global warming and that increased risks associated with environmental change must be a crucial priority of economies worldwide. Berrang-Ford *et al.* (2021) further argue that the expansion of the research literature on this topic does not help measure the level of implantation strategies.

Insurance is a contract that transfers the responsibility for covering the loss faced by the insured to the risk fund controlled by the insurance company, and is perceived to be the most common risk control method developed steadily with the global economy (Jung, 2020). Insurance coverage can help supply low-income households, farmers and organizations with rapid access to disaster liquidity, thus shielding their livelihoods, supporting them in reconstruction, promoting higher-risk investments and stimulating investment in catastrophe prevention measures (Warner *et al.*, 2009). Environmental insurance coverage and the successful resolution of claims under these products rely on several factors such as compliance and technical aspects. The growth of this type of insurance depends on the

development of new insurance policies to address environmental issues (Hollaender and Kaminsky, 2000). There may be a growing international market for products that can help cope with climate change. Many environmental solutions are applicable; therefore, more insurers consider the environment when developing new coverage policies. Solutions to climate change are economically and socially useful, and insurance companies can use their financial capabilities to mitigate emissions in the coming decades (Klein, 2013).

Tong and Ebi (2019) highlighted in their study that global environmental changes pose threats to human health at a higher magnitude. They further explained the need for cross-sectoral collaborations to introduce more effective policies, invest more in advanced technologies to limit greenhouse gas emissions and improve the technological facilities of the health sector. On the other hand, Philipsborn *et al.* (2021) argued that, despite the need of the hour to deal with the climate crisis immediately and mounting evidence revealing health harm to children, doctors do not actively engage with climate change practices in their region. They recommended that climate-informed primary care is essential to serve patients more effectively.

Sawyer (2021) elaborated that this recent era of financialization has also contributed significantly to climate emergencies. He further argued that weak economic policies to deal with climate risks associated with environmental degradation need to be revised, and industrial strategies also need to be changed. Central banks should devise policies that encourage financial institutions to allocate funds favourably towards environmentally friendly business practices coupled with green investments. Rudebusch (2021) discussed another similar perspective in which the sweeping effects of climate change gradually impact the financial sector. This implies that slow economic growth leads to increased unemployment and reduced levels of output and profitability. Economic transformations are highly important for mitigating environmental risk and adapting to climate change to sustain the worth of businesses and assets in the upcoming years.

2.1 Comparison of literature

Following a different analysis timeline, a bibliometric study by Fu and Waltman (2022) found that climate change research has shifted its paradigm from climate systems to technologies impacting the climate and its relevant policies. There is a significant imbalance in the scientific production of knowledge between the developing and developed economies. Moreover, governmental strategies, demand factors and geographical conditions have a considerable role in influencing the emerging research topics of researchers in different regions. In contrast, a regional bibliometric study by Zhong *et al.* (2022) explained that climate change remains a controversial topic for researchers in China. Increased incentives for researchers and the country's role in international politics have further dimmed the importance of climate change and the associated environmental risks, posing a great threat to humanity. A bibliometric study by Benomar *et al.* (2022) highlighted that assisted migration could serve as a useful strategy for mitigating the risks associated with climate change. The authors further explained that expansion in international collaborations could assist migration massively by promoting growth–climate relationships. Milán-García *et al.* (2021) also reinforced their bibliometric study that more international migration may reduce disaster risks. Milán-García *et al.* (2021) further argued that researchers now pay more attention to climate change linked with international migration to seek work and plan and organize businesses in local territories.

3. Methodology

This study investigates insurance as a tool for environmental risk management and an effective solution to climate change risks. We systematically reviewed the literature

gathered through Scopus, keeping all the studies in which the combinations of keywords (environmental emissions, global warming, CO₂ emissions, climate change risk and carbon risk), insurance and risk management, leaving us with 97 papers for this study.

This section discusses the theoretical and methodological frameworks for studying the progress of this topic in recent years.

3.1 Theoretical framework

Studies related to climate change and environmental risks have explained the importance of insurance and how to mitigate such risks to ensure sustainable global growth. Governments are responsible for maintaining regulations to deal with climate change and environmental hazards. In addition, effective policies at the federal and regional levels are essential for dealing with greenhouse gas emissions and improving climate resilience across the globe. Moreover, governments are responsible for authorizing laws to deal with funding challenges that address climate and environmental risks. Market-based and economy-wide approaches to dealing with climate change would require new legislation. [Simpson et al. \(2021\)](#) elaborated that countries globally undermine the complexity of several driving factors, such as greenhouse gas emissions and deforestation, leading to climate change, and how these factors cascade the associated risks. Another recent study by [Orimoloye et al. \(2021\)](#) highlighted that disaster risk insurance, robust materials, geographic information systems coupled with remote sensing and social networking systems can help deal with disaster risk reduction practices.

As can be observed, climate change is one of the most complex issues countries face. This topic can be studied from different perspectives, such as political, economic, scientific, societal, ethical and moral. Climate change is not only a regional problem but also a global issue that will persist for centuries, if not dealt with now. This study investigates the contribution of other research papers in dealing with these environmental risks and climate change-associated problems from different dimensions over the years.

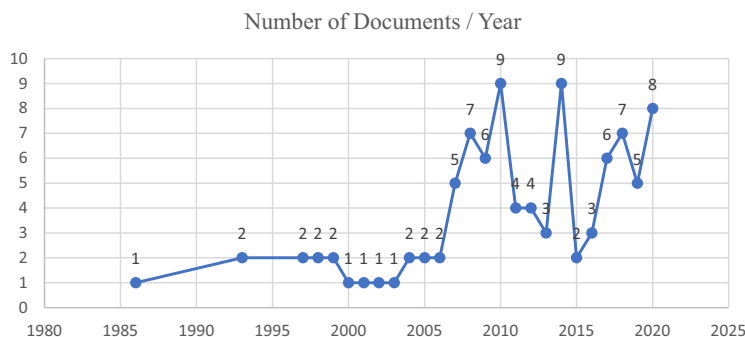
3.2 Methodological framework

To achieve the objective of this research study, a bibliometric review was carried out to understand the global impact of climate change. [Wu et al. \(2018\)](#) observed that environmental governance is essential to control climate change. Current policies have proven inefficient in addressing such complicated issues on a global scale. It is critical to comprehensively review research progress in the scientific community on this topic over the years to identify future research directions.

We used bibliometric citation analysis to capture the abundance of literature on insurance for climate change and environmental risk to analyse 97 articles from 1986 to 2020. This analyses the following topics: main research sources, key literature areas and related future research concerns. This analysis identified seven research streams: risk management, environmental impact, flood insurance, environmental economics, global warming, public-private partnership and natural hazards (see [Table 6](#)). The number of documents published from 1986 through 2020 is summarized in [Figure 1](#); the identified influential articles are listed in [Table 2](#); the influential sources are in [Table 3](#); the influential authors are in [Figure 3](#); the influential organizations are in [Table 5](#); the influential countries are in [Figure 4](#); and the keywords with high occurrences in the existing literature are in [Table 5](#) and [Figure 5](#).

We searched for articles with keywords considered to represent climate change and environmental risks, and related them to insurance. Our search query in the Scopus database included the following keywords: insurance, environment and risk, pollution, environmental emissions, global warming, CO₂ emissions, climate change risk and carbon

Figure 1. Growth in literature



risk. The query results included articles, conference papers, book chapters, reviews and notes in English published in any of the journals (Nobanee *et al.*, 2021). This request was made on October 25, 2020, and 97 references were returned to the database. The resulting documents are linked to the subject of this study: insurance climate change and environmental risk (Nobanee, 2020). The search criteria for Scopus are listed in Table 1 below.

The bibliometric approach helps researchers prepare for and coordinate their reading and critically and systematically approach broad areas of study to develop detailed, rigorous and synthetic knowledge of these fields. Therefore, the VOSviewer was used for visualization, Excel tables and charts (Nobanee, 2021). The themes of bibliometric indicators are complex, and there are several sources of data, including different levels of analysis and different types of metrics. A reliable and robust bibliometric analysis should begin with an appropriately structured database that considers all available information at all levels (De Battisti and Salini, 2013). In this study, the Scopus database was used, this database is reliable, popular and includes many sources and titles (Table 1).

As an integral aspect of mitigating climate change challenges, funding for insurance tools for weather disturbances has become an important issue, with the aim of easing the

	Conditions	No. of documents
Query results	TITLE (("environm* risk" AND "insurance") OR ("environm* pollution" AND "insurance") OR ("global warming" AND "insurance") OR ("CO2 omission*" AND "insurance") OR ("climate change " AND "insurance") OR ("Carbon risk" AND "insurance")) KEY (("environm* risk" AND "insurance") OR ("environm* pollution" AND "insurance") OR ("environm* pollution" AND "insurance") OR ("global warming" AND "insurance") OR ("CO2 omission*" AND "insurance") OR ("climate change " AND "insurance") OR ("Carbon risk" AND "insurance")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "re") OR LIMIT-TO (DOCTYPE , "no")) AND (LIMIT-TO (LANGUAGE , "English"))	97 documents
Access	We included both open access and others	
Years	All years (1986–2020)	
Document type	We limited the search to the article, conference papers, book chapters, review and note	
Language	We kept the English language and excluded others	

Table 1. Scopus database query

development of public/private safety nets for catastrophes using insurance instruments (Linnerooth-Bayer and Mechler, 2006). The insurance sector, which is among the largest industries in the world, has a major function in alleviating the sensibility of people and naturalist ecosystems, and has significant resources and abilities to control climate change-related threats in an affordable manner (Mills, 2007).

4. Bibliometric study results

4.1 Descriptive statistics: number of documents

VOSviewer software was used to determine the number of documents. A total of 97 articles were published between 1986 and 2020 (Figure 1). The years 2010 and 2014 had the highest number of publications. The number of publications has increased in recent years because of the increase in natural calamities, which have caught the attention of researchers worldwide (Figure 1).

4.2 Influential articles

Table 2 presents the influential journal distributions. We rated the top 20 by number of citations. Figure 2 shows the visualization and coupling of influential articles, which shows that Botzen has approximately 262 citations for his articles between 2008 and 2010, which may be a good starting point for a researcher to explore this field (Figure 2 and Table 2).

4.3 Influential sources

In the analysis to determine the importance of article sources based on the number of published documents, the *Geneva Papers on Risk and Insurance: Issues and Practice* had the lead among article sources (Table 3).

Rank	Document	Citations
1	Botzen and Bergh (2008)	146
2	Aerts and Botzen (2011)	72
3	Botzen <i>et al.</i> (2010)	71
4	Mills (2009)	71
5	Falco <i>et al.</i> (2014)	66
6	Collier <i>et al.</i> (2009)	62
7	Glenk and Anke (2010)	49
8	Herweijer <i>et al.</i> (2009)	49
9	Linnerooth-Bayer and Mechler (2006)	49
10	Lamond and Edmund (2014)	48
11	Botzen and Bergh (2010)	45
12	Mills (2007)	42
13	Schwarze <i>et al.</i> (2011)	40
14	Tucker (1997)	38
15	Mills (2003)	36
16	Długolecki (2008)	33
17	Bennett (1999)	29
18	White and Etkin (1997)	29
19	Trærup (2012)	27
20	Michel-Kerjan and Morlaye (2008)	27

Table 2.
Influential articles

Notes: This table represents the 20 most influential articles/topics. Significant articles/topics were sorted based on the five citations. Fifty articles were included. Moreover, the top 20 articles with the highest citation counts were captured

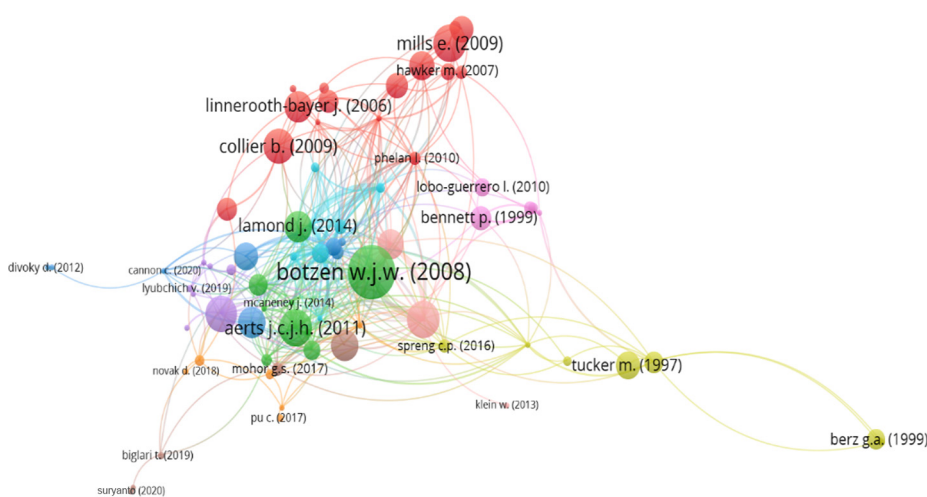


Figure 2. An influential network of papers; VOSviewer tools were used to build the network

Source	No. of documents
<i>Geneva Papers on Risk and Insurance: Issues and Practice</i>	14
<i>Environmental Claims Journal</i>	6
<i>Ecological Economics</i>	5
<i>Climate Policy</i>	3
<i>Natural Hazards</i>	3
<i>IEEE Power Engineering Society General Meeting</i>	2
<i>Advanced Materials Research</i>	2
<i>Building Research and Information</i>	2
<i>Climate Risk Management</i>	2
<i>Energy Policy</i>	2
<i>Global Environmental Change</i>	2
<i>Mitigation and Adaptation Strategies for Global Change</i>	2
<i>Regional Environmental Change</i>	2
<i>Resource and Energy Economics</i>	2

Note: This table represents influential sources

Table 3. Influential source

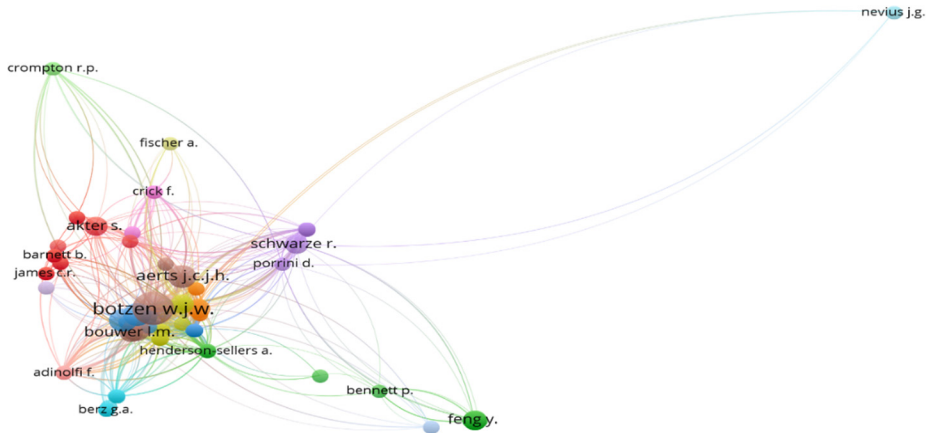
4.4 Influential authors

VOSviewer software was used to identify the most influential authors. We sorted the authors based on a minimum of one author’s document and at least four citations. Following that, 99 authors met this paper requirement from a total number of 205 authors. Researchers can focus on articles published by these authors in future research (Figure 3).

4.5 Influential organizations

VOSviewer software was used to identify influential organizations. By filtering for a minimum of two documents of an organization with a minimum of 10 citations, 64 out of 193 organizations remained in the study set. Table 4 sorted the most important affiliations using a minimum of three documents. Most of the documents belong to the Vrije Universiteit Amsterdam, based on this study criteria (Table 4).

Figure 3.
Influential authors;
the VOSviewer
software was used to
create the influential
authors' network



Rank	Affiliation	No. of documents
1	Vrije Universiteit Amsterdam	8
2	Vrije Universiteit Amsterdam Institute for Environmental Studies	8
3	London School of Economics and Political Science	4
4	Lawrence Berkeley National Laboratory	3
5	Macquarie University	3
6	Universitat Autònoma de Barcelona	3
7	University of Oxford	3
8	UAB Institut de Ciència I Tecnologia Ambientals	3

Table 4.
Influential
organizations

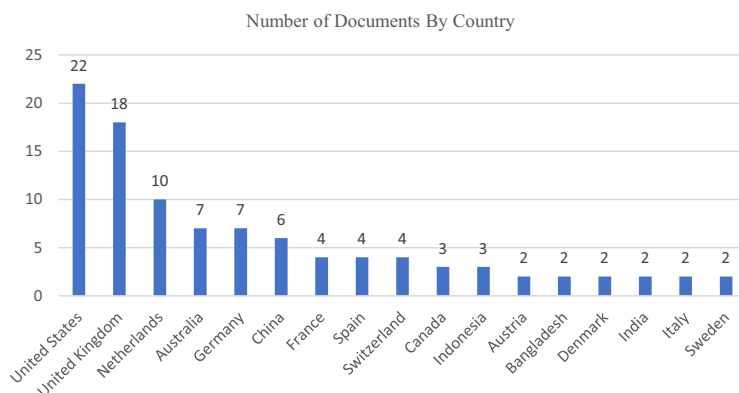
Note: This table lists the number of articles/topics for each organization

4.6 Influential countries

VOSviewer software was used to identify influential countries. The filtering criteria were a minimum of two documents from a country with a minimum of zero citations. Seventeen countries met the inclusion criteria. The USA was the leading country, followed by the UK and The Netherlands. The USA tops this list, implying that the government understands that such climate change will decrease employment opportunities, increase food prices and cause other adverse effects in their country. In addition, the ripple effects of these catastrophes will engulf other countries sooner or later. Therefore, there is an immediate need for researchers and actions to deal with it immediately (Figure 4).

4.7 Keywords

VOSviewer software was used to determine the occurrence of keywords. A minimum number of five occurrences of keywords resulted in 24 keywords that met the study requirements. Climate change and insurance had the highest numbers of occurrences, followed by insurance (Table 5). This implies that the insurance sector is now researching the impact of climate change on industry. Their different segments, such as life insurance, have potentially been affected by global warming, leading to massive deaths. Simultaneously, loss of property is also rising with extreme weather conditions, which puts



Source: The VOSviewer software was used for obtaining the counts

Figure 4.
Influential countries

Rank	Keyword	Occurrences
1	Climate Change	82
2	Insurance	42
3	Insurance Industry	22
4	Insurance System	22
5	Adaptation	18
6	Risk Assessment	16
7	Risk Management	11
8	Environmental Economics	10
9	Disasters	9
10	Global Warming	8

Note: This table lists the occurrences of the keywords

Table 5.
Keywords

more liability losses on shareholders and consumers responsible for such environmental changes (Figure 5 and Table 5).

The analysis based on the number of published articles, the USA was the country with the highest interest in climate change actions, followed by the UK. Climate change has been the most common keyword in literature over the past 20 years. Accordingly, seven streams were determined: risk management, environmental impact, flood insurance, environmental economics, global warming, public-private partnership and natural hazards.

(Botzen and Bergh, 2008) was the most important article based on the number of citations, *Geneva Papers on Risk and Insurance: Issues and Practice* was the most influential source, and Vrije Universiteit Amsterdam was the most influential.

5. Current streams

We constructed a research plan based on the results of the bibliometric study. Firstly, all papers that built a citation map have been identified. Secondly, all papers included in the study were reviewed. Thirdly, the titles of the papers and the keywords in the research sample that matched the streams were checked. Fourthly, the future research agenda translated into research questions.

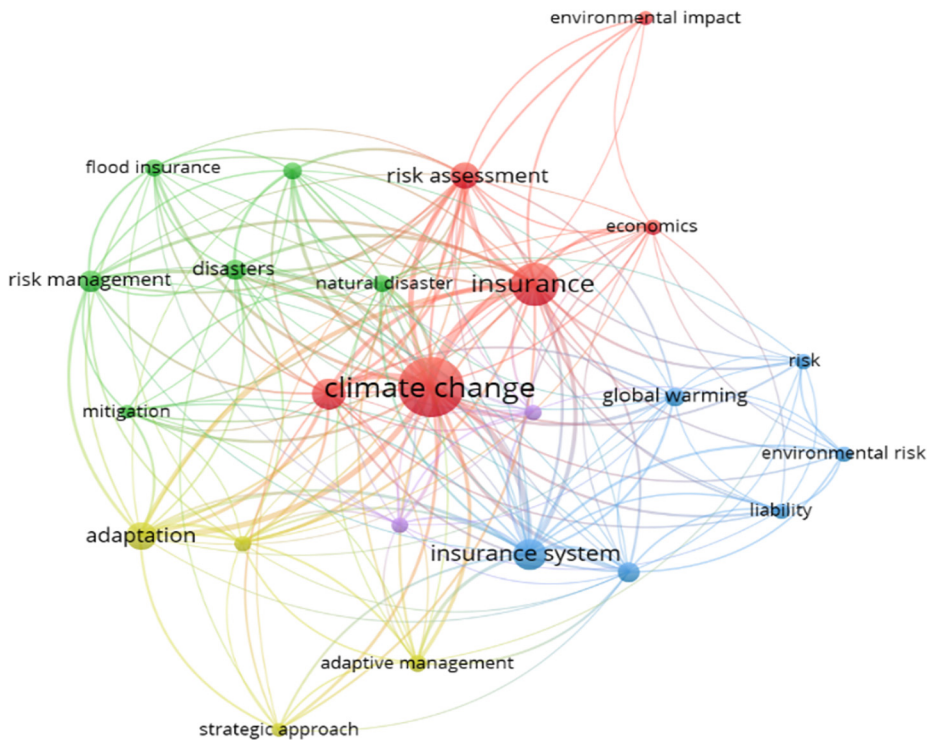


Figure 5.
Keywords map
created using
VOSviewer software

The analysis of the articles identified seven streams and 19 potential study questions. Table 6 identified authors, purpose, findings and relevant future research questions and identified seven streams of research: risk management, environmental impact, flood insurance, environmental economics, global warming, public-private partnership and natural hazard. Subsequently, the articles' purpose, findings and future research questions have been highlighted; this can support interested researchers in their efforts (Table 6).

The increase in environmental impacts and the harm of global warming on this planet has created an urgent need for risk management tools to help society and the next generation survive. This drives us to look for proper risk management instruments to reduce the negative influence on humanity and to define the party's contributions to these efforts, either private or public. There has been continuous effort to find proper tools to mitigate environmental risks. If insurance is the appropriate way to deal with it, it is difficult to define each party's contribution.

Natural hazards and flood insurance have a huge economic impact on the global economy, and sometimes local communities are heavily affected by them. Although they are aware of these risks and consider them unavoidable, they coexist with each other. They do not possess proper ways to protect themselves, and thus suffer from fiscal impact, which is sometimes catastrophic. While studying these streams, many unanswered research questions, reflecting the need to go deeper into this topic. Future research and studies must address the best way to collect data on expected risks and the best way to mitigate them. It

Stream	Authors	Purpose	Findings	Suggestion for future research [in the form of research questions]
Risk management	Jenkins <i>et al.</i> (2017)	The key aim is to develop and evaluate innovative ways of increasing the responsiveness of society to catastrophic impacts of natural disasters by presenting new scenarios and evidence in selected danger cases in close coordination with stakeholders and by creating new multi-sector risk mitigation methods or redistribution alliances	The forces of nature unleashed by climate change should be reversed in a perfect situation. However, it is imperative to enhance risk management and increase resilience against natural disasters as the planet heads toward the point of no return	What is the impact of the publication of empirical loss data? Can all stakeholders contribute to a direct reduction in climate risk?
	Paganob <i>et al.</i> (2018)	The purpose of the article is to present the many climate change adaptation initiatives introduced by insurance providers to build models capable of creating a proper risk prediction	The results addresses the relevance of the interactions between extreme events and protection providers that have been developed	Is it right that the conceptual and realistic research will turn to a more basic philosophy applied to all the firms concerned and supply a basic philosophy mostly directed at studying a single event? Do climate projections supply better insurance loss expectations for the future?
Environmental Impact	Scheel and Himmerichsen (2012)	This paper presents a sample for connecting weather-related insurance damage for buildings for future climate patterns to address future weather-related residential construction coverage losses in Norway	The consequence is an uptick in the anticipated future threat to climate-related insurance in many areas of Belgium	
	Trærup (2012)	This article aims to determine how to begin the enhancement of benchmarks to have an enhanced insurance umbrella for the population	The article raises a philosophical case that approaching households across current informal groups would cut a range of predominant insurance acceptance hurdles. As a result, the strategy has the potential to increase the sensitivity of families to the influence of environmental change	Is it expected that the number of covariate shocks will grow with climate change?

(continued)

Table 6.
Current streams and future research agenda

Stream	Authors	Purpose	Findings	Suggestion for future research [in the form of research questions]
Flood Insurance	Novak (2018)	Define and reform the actual conditions of climate change-related outcomes for insurers and insured in the USA and Germany	The environmental shift, defined as the agreed likelihood of calculating the impact on nature, society and insurance must go hand in hand. Individuals must be informed about the effects of their present actions on environmental risks. Property loss has been seen to cause a rise in death rates for the midlife and old age communities	How much premium contributions are owed to everyone and charged for climate harm to the insured?
	Mijkovic et al. (2018)	Evaluate climate change effects of environmental disasters leading to increasing property loss on the estimated death rate for the US population		What are the best ways to blend the influence of climate change on insurance?
	Tesselaar et al. (2020)	The aim is to demonstrate how the dynamics of the EU flood insurance industry rely on foreign disasters and the potential implications in terms of prices, lack of access and adoption of national flood insurance	The presented way involves public sector flood risk reinsurance, as authorities often can offer lower-cost reinsurance coverage that is less prone to capital price volatility	What are these potential induced effects of increasing the risk and solutions of flooding?
Environmental Economies	Canon et al. (2020)	Discussion on the problems in the steps in the treatment of environmental risks by evaluating flood insurance factors	Awareness of climate risk will be influenced and formed in part by political discussions on the cost of flood insurance and government descriptions of the possibility of floods	How and why do households decide to buy flood insurance?
	Lamond and Edmund (2014)	Analysis of foreign models against three general metrics for the implementation and feasibility of a flooding insurance fund: the perception of the nature of the insurable risk, population and the presence of a sustainable insurance company	No solution to flood insurance reacts to all the problems found in changing climates	What is the right way to assess the insurance policy against financial and social aims?
	Doncaster et al. (2017)	Research analytically illustrates how an expensive climate change adaptation economic system would sustain	They illustrate that mutual mitigation ambitions are possible for both persons and countries and suggest that	Can cooperative mitigation be sustained against the temptation to free-ride on others' contributions?

(continued)

Stream	Authors	Purpose	Findings	Suggestion for future research [in the form of research questions]
Global Warming	Michel-Kerjan and Morlaye (2008)	cooperative mitigation to mitigate greenhouse emissions by designing game-theoretical scenarios; present indicators of global warming, including improved natural hazard resilience coverage The article examines the key factors related to the transformative transition in the insurance and capital market after 2005 and reveals why the sector has not grown even after this transformation	mitigation success is undermined by its present connection with a socioeconomic problem that disappears when confronted with the grim implications of inaction They propose three complementary methods of increasing leverage in these resources, which might successfully cause a turning point for a much greater amount of capital to enter. Market: (1) grow investor trust by trenching; (2) solve the essential risk challenge by index-based derivatives; and (3) create new technologies through the introduction of innovative products Progress in coping with this global challenge needs intervention around the economy To address flood risk, insurance is an essential strategy. However, setting up the best flood insurance policies remains a global obstacle to incentivizing adaptation to flooding risk prevention and climate change It is missing practical ideas that aid an enterprise's ability to help to decrease and, if necessary, across countrywide obstacles, and as part of a broader regime	What is the effect of disasters in heavily insured parts of the globe on producing a range of new creative products?
Public-Private Partnership	Hawker (2007) Crick <i>et al.</i> (2018) Spreng <i>et al.</i> (2016)	Study the influence of environmental change on the insurance sector This article presents the impact of cooperation on flood risk mitigation by considering the UK as a case study and develops the right coverage agreements to reduce risk and adapt to weather change The paper explores the possibility to safely complement and enhance resistance to climate change by jointly using the abilities of the government and industry	How can different parties work jointly to find practical solutions to environmental changes? How is it possible to determine when and how these current coverage systems will help climate resilience? What is the handy strategy that supports current attempts to reduce CO ₂ pollution, improve impairment and prepare for global warming disruption on a global scale?	

(continued)

Table 6.

Stream	Authors	Purpose	Findings	Suggestion for future research [in the form of research questions]
Natural Hazard	Cannon <i>et al.</i> (2020)	To research how corporations can facilitate flood risk management by drawing on the UK government contribution to insurance coverage	The insurance sector alone cannot have a solution to the growing risk problem	How may partners improve the insurance relationship by reducing flood damage and thereby helping to keep competitive insurance rates?
	Schwarze <i>et al.</i> (2011)	Identifies the complexities of applying these policies to global warming and the growing number of natural disasters, providing an overview of the current structures of natural disaster coverage in EU countries including their material features	Natural catastrophes protection must balance the risk transfer and the reward for protection	Are the EU's top-down policies to better align global and subnational structures sufficient?
	Broberg (2020)	This article investigates stochastic risk pooling to provide a useful resource for determining insurance coverage	Parametric risk pooling may provide an effective method of discussing risk and harm, but this should be complemented by a number of other reduction steps to tackle the risks and threats caused by global warming in a general way	What are the main weapons for tackling climate change loss and harm issues systematically?

is also important to study the effect of global warming on all sectors and the cooperative role between the government and private sector in developing a better tool to fight this change and discover a supportive tool for insurance.

Finally, there is no best tool for assessing climate change risk, and there is no clarity on how to merge another instrument with insurance to mitigate the effects of global warming. Pricing techniques should be reviewed to determine the contribution margins for individuals and study their behaviours in obtaining climate change insurance.

5.1 Policy implications

This study suggests that policy responses must be strong enough to recognize the connections between climate change, environmental risks and insurance at the regional and international levels. The impact of climate change on individuals' long-term health is challenging to quantify. Developed countries must take initiatives to spread the costs of climate change and environmental risk concerns. Such partnerships among various economies may help deal with inherent uncertainty more efficiently. This implies that predicting environmental risks and climate change could serve as a mutual warning for countries to prepare well in advance accordingly. The intensification of natural calamities explains the constant variability in climate systems. These random climate patterns do not provide statistical information for scientists to understand the driving factors of climate change carefully. Past research data indicate that governments and several other institutions have spent billions of dollars to comprehend the reasons behind inevitable global warming, posing several environmental risks to the world. [Botzen *et al.* \(2021\)](#) recommended that policies facilitating communications between economies worldwide encourage individuals to pay more attention to risks associated with climate change and the significance of insurance.

The aftermath of such global catastrophes now requires governments, more than ever, to implement policies that take biases and risk perceptions of individuals into consideration. Notably, regulations to control climate change may not be too costly for larger corporations. However, on the other hand, such laws significantly impact small and medium-sized enterprises or projects facing difficulties in raising capital. Incremental costs associated with cap-and-trade have a distortionary effect on small- to medium-sized companies. This further implies that increased regulatory costs place an extra financial burden on less financially strong organizations. Consequently, such companies relocate their emissions to regions with weak regulations. Therefore, laws to control climate change must be consistent across all authorities to minimize the impacts. Moreover, policymakers need to introduce distinguished subsidies to deal with distortions from implementing climate control strategies. Companies must also invest in clean and advanced technologies to shield themselves from emerging regulatory financial expenses.

6. Future research gaps

This study stresses the significance of insurance for climate change and environmental risks. Future researchers should focus on any health diseases associated with climate change in any geographical location. This study has proven the scarcity of a significant number of documents highlighting the impact of insurance, climate change and environmental risks on mental health. Future research can fill such gaps and investigate and determine any possible solutions. The development of such topics by researchers can help reduce the significance of climate change and environmental risks to people. Researchers can also provide solutions to deal with climate change on a global scale by collaborating with developing and underdeveloped economies. This further implies that underdeveloped

and developing countries pay scant attention to such topics. Therefore, collaboration among researchers can help monitor and screen health hazards at an early stage. Moreover, governments must collaborate by providing sufficient funds to promote research topics and investigate new innovative methods to deal with environmental risks and climate change.

7. Limitations

One of the limitations of this bibliometric study is that the literature was shortlisted only from the Scopus database. Other databases were not used in this investigation to gather relevant literature. In addition, research papers published in non-English articles might have significant content that this study did not consider. Another limitation of this study is that the search query mainly focused on insurance for climate change and environmental risk. This topic, in general, has a much more complex and broader scope, thereby implying that the query may not have considered all the literature produced to date on these topics. However, it is also important to note that the search query used in this study ensured that irrelevant documents were not included in the data.

8. Conclusion

This bibliometric study is unique in terms of its chosen topic and literature. This study has facilitated the discovery of research gaps, essential themes and key roles played by several institutions and authors. The current study further highlights the importance of environmental risks and climate change. Therefore, researchers must address international measures and strategies to combat climate change and create further awareness. In addition, the current bibliometric study indicates the insufficient research collaborations required at global levels to contain relevant risks. Such international research collaborations are essential for several countries to understand the impact of climate change and environmental hazards on several aspects, including health. Furthermore, researchers must receive sufficient funds from international organizations to continuously conduct research and assess such impacts on a global scale. Such encouragement of researchers from international health organizations will help create awareness that this is a new global crisis. Climate change and environmental risks are important issues that people and governments globally face today. This article researched insurance's function in weather changes and environmental dangers that adversely impact the global economy and humans engaged in industrial activities. This approach has helped to review research on insurance, weather changes and environmental threats. The drawback of this paper is that only the Scopus database has been used for the bibliometric analysis. We recommend that this study be extended to other data sets. This study identified several topics that require further investigation. There is a need to decide each party's responsibility towards climate change. Thus, there is a need to consider insurance as a tool to reduce the risks associated with environmental changes. Researchers should explore questions to explain the role of insurance, pricing techniques, contribution margins, government functions and other factors. It is further evident from research that the climate crisis has modified common views on environmental risk factors. Global action is required to further evaluate environmental values, assess and mitigate health risks, and identify and monitor emerging ecosystem trends promptly. Such measures could also facilitate and ease difficult tasks allocated to risk managers.

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Further reading

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