

Global Evolution of Ecological Communication Studies in Disasters: A Bibliometric Analysis

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Abstract

The urgency of ecological communication is critical, given the increasingly complex and urgent challenges caused by disasters. The purpose of this research is to evaluate the development of studies on disaster-related ecological communication. This study uses bibliometric analysis, in which the data source comes from the Scopus database. The analysis tool used is Vosviewer. The findings of this study indicate that the number of publications discussing ecological communication in disasters has increased significantly in recent years. The focus of the research findings includes disaster prevention, risk assessment, climate change, and natural disasters. This research provides important insights into the role of communication in responding to disasters and environmental challenges and building community resilience. Ecological communication research trends in disasters open prospects to expand understanding and develop effective communication strategies to face environmental challenges and disasters in the future. The results of this research can be used as a basis for developing more effective communication strategies in facing environmental challenges in the future

Keywords: Ecological communication, disasters, disaster prevention, community resilience, disaster communication

1. Introduction

Ecological communication is a concept used to understand and analyze the interactions and dynamics of communication within a more extensive system or environment (Norton, 1998). Ecological communication views communication as a complex system with various interacting elements (Dryzek, 1995). These elements include individuals, groups, organizations, media, technology, and the physical environment in ecological communication. In ecological communication, attention is paid to the patterns and communication networks within a system. This includes the way individuals and groups communicate with each other, how messages and information are disseminated and received, and the impact of communication on individuals and the surrounding environment (Miller, 2022).

Niklas Luhmann is a German sociologist known for his contributions to social systems theory and communication theory. One of the main concepts he developed was "social systems theory," which influenced his understanding of ecological communication (Valentinov, 2019). In Luhmann's view, the social system consists of communication as an essential element. Communication is exchanging meaning between individuals or units in a social system. Luhmann argues that communication is the primary means a social system generates and maintains itself. The concept of ecological communication in Luhmann's thinking highlights the relationships and interactions between various communication systems in a more comprehensive social system. Just as natural ecosystems are composed of various interacting and interdependent organisms, Luhmann's ecological communication reflects the interaction between different communication systems in society (Valentinov, 2014).

Using an ecological communication approach, researchers and practitioners can understand how communication affects and affects the surrounding social, cultural, technological, and environmental contexts. It helps in understanding the complexities of human communication and shapes the way we interact and communicate with each other in various contexts. Ecological communication can also be applied in a disaster context (Fadhiah et al., 2022). When natural disasters or crises occur, effective communication is essential to disseminate accurate information (Seppänen &

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Virrantaus, 2015), coordinate rescue efforts (Chaudhuri & Bose, 2020), and reduce losses incurred (Khaled & Mcheick, 2019).

In a disaster situation, a strong and well-connected communication network is essential. This involves collaboration between various stakeholders, such as governments, aid agencies, community organizations, media, and individuals (Prell, Hubacek, & Reed, 2009). This network must be able to communicate quickly and effectively to convey information about disaster situations, early warnings, evacuation instructions, and available assistance. According to Luhmann, communication is an adaptive system with dynamics and logic (Luhmann, 2008). In disaster situations, communication is essential in disseminating information, mobilizing aid, and coordinating response (Kusumasari & Prabowo, 2020). Luhmann's ecological communications help us understand how communication systems adapt quickly and respond to environmental changes in disaster situations (Arifudin, Wahyuni, & Trisakti Haryadi, 2020).

Effective communication in disaster situations involves conveying accurate, clear, and timely information. The messages must be easily understood by various groups, including those with language or accessibility limitations. Governments, aid agencies, and the media are essential in disseminating information to the public. In ecological communication in disasters, public participation is essential. Individuals and communities should be encouraged to participate in the communication process, including providing input, sharing important information, and reporting emergency needs. Ecological communication in disaster contexts helps to understand the complexities of communication in difficult situations. This helps ensure that the information needed is adequately conveyed, public participation is increased, and a more effective response can be made.

Thus, understanding the concept of ecological communication is critical in understanding the complexity of interactions and communication dynamics in various contexts, including disaster situations. This concept is inspired by Niklas Luhmann's views on social systems theory, where communication is essential in maintaining and developing a more extensive social system. Previous research in this area has tended to be dominated by qualitative and quantitative approaches that rely on case studies.

However, there is an excellent opportunity to develop further research using a bibliometric analysis approach, which could provide a more comprehensive understanding of trends, developments, and comparisons in the literature on ecological communication in disasters. Thus, future research can expand our understanding of how ecological communication influences and is influenced by social, cultural, technological, and environmental contexts, as well as how these concepts can be applied effectively in disaster situations to improve coordination and better response.

Much research has been done on ecological communication. However, there are still very few studies that specifically analyze this topic by relating it to a bibliometric analysis approach, especially linking it to the topic of simultaneous disasters. However, there is some relevant previous literature. *First*, the urgency of ecological communication lies in understanding the importance of effective communication in understanding, responding to, and overcoming the complex challenges faced by society today (Spialek & Houston, 2019). *Second*, in a disaster context, timely and accurate communication can save lives and reduce losses (Khan, Gupta, & Gupta, 2020). *Third*, bibliometrics is an analytical approach used to measure and analyze scientific publications' quantity, quality, and pattern. This involves using bibliographical data, such as information from journal articles, conferences, books, and other scientific sources (Linnenluecke, Marrone, & Singh, 2020).

The purpose of this study is to fill the gaps in previous research by analyzing the evolution of the study of ecological communication in disasters. This research question is formulated as follows. (a) How is the evolution of the study of global ecological communication? (b) What are the relationships between the different research topics, and what are the gaps for future research? The answers to these two questions make it possible to know trends in developing studies related to ecological communication in future disasters.

The results of this research will help identify development trends and gaps in the literature, thereby enabling researchers and practitioners to design more targeted and relevant future research. This research is needed because, with a better understanding of the evolution of ecological communication studies in disasters, we can develop more effective communication strategies to face environmental challenges and disasters in the future, as well as contribute to the formation of better community resilience.

2. Research Method

This research uses bibliometric analysis. The data source comes from the Scopus database. The bibliometric analysis method using the Scopus database was chosen because of Scopus' superiority in covering cross-disciplinary literature

and its ability to provide high-quality data, allowing researchers to identify trends and patterns in the literature more effectively (Widayat et al., 2022). This supports a comprehensive analysis of this research. Data collection was carried out using filtering techniques based on keywords. The keywords used are (ecological communication) and (disaster). This data filtering is not limited to document type, year of publication, author affiliation, country, or others, so the filtering only focuses on keywords. The screening results found 183 documents. These figures were then analyzed in this research. This research analysis maximizes the analysis of search results from the Scopus website. It helps to visualize the collected data.

This study also maximizes and relies on analysis tools such as Vosviewer. Vosviewer is used to accommodate 183 document results. The use of Vosviewer is maximized by using the Co-occurrence analysis type with the All keywords analysis unit. This Co-occurrence analysis focuses on pairs of words that appear together in documents. The Co-occurrence analysis type in Vosviewer finds and builds a network model with nodes representing words and edges (lines). Meanwhile, the All Keywords analysis unit treats all words in the document as essential elements of analysis. This type and unit of analysis function to build a network with nodes representing words and edges connecting nodes representing pairs of words that appear in the same document. After that, the data successfully collected was visualized to answer research questions.

3. Results and Discussion

3.1. Evolutionary development of the study of ecological communication in disasters

The study of ecological communication in disasters has evolved significantly over time. Initially, the main focus may be more on communication's technical and practical aspects in disaster situations. However, as an understanding of the complexity of the relationship between system and their environment has developed, more holistic and ecological approaches to disaster communication have evolved.

This section explicitly describes research development trends based on the number of documents, the year of publication, and the number of author citations. The trend of published documents based on the year of publication is observed as follows:

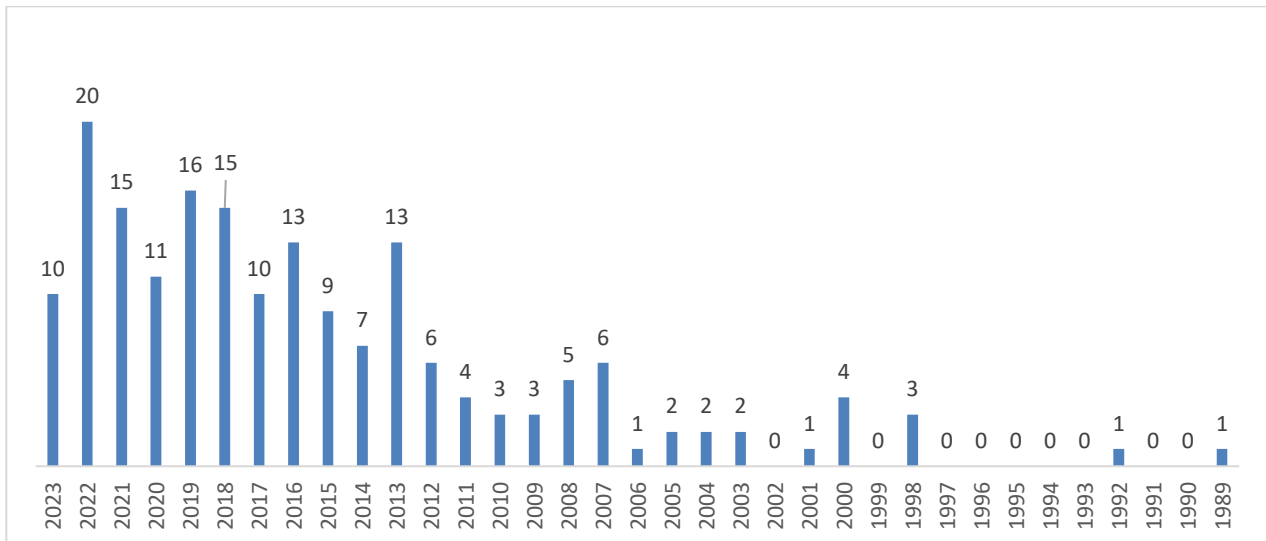


Figure 1. Trends based on the number of published documents

Figure 1 shows that publications on ecological communication in disasters have experienced a significant trend in the number of published documents. From these data, it is also known that discussing these topics has been published since 1989, but discussing the details of the two topics seems insignificant. In 2007, it began to show an increase in the number of published documents, as many as 7 documents. A few years later, the number of documents decreased, and starting in 2013, published documents began to increase significantly by 13 documents. 2022 is the peak of the high number of published documents on both topics. During that period, 20 publication documents were found.

The development of the study of ecological communication in disasters has increased in recent years. This is related to the growing awareness of the importance of effective communication in responding to disasters and environmental challenges. The challenges of increasingly complex disasters, such as climate change, frequent natural disasters, and social conflicts, have awakened the need for more effective and coordinated communication (Huppert & Sparks, 2006). This has prompted more in-depth research into how to improve communication in complex situations. In addition, social media and digital technology development have changed communication during disasters (Al-Saggaf & Simmons, 2015). Social media provides a new platform for sharing information, disseminating early warnings, organizing relief, and mobilizing communities. The study of ecological communication in disasters has responded by investigating the role of social media and technology in disaster communication (Wahyuni, Rum, Octastefani, & Fitrah, 2022).

The study of ecological communication in disasters increasingly highlights the importance of sustainability and adaptability in communication (Mathur, 2009). This means developing a communications strategy that adapts quickly to changing environments, technology, and societal needs. Research on sustainable and adaptive communication is essential in the context of increasingly frequent disasters. The development of studies on ecological communication in disasters has provided valuable insights into improving disaster response, building community resilience, and reducing the negative impacts caused by disasters and environmental challenges (Wahyuni, Fitrah, Handayani, & Robie, 2018). This study continues to evolve with the increasing complexity of our challenges.

The development of this study implies that research in ecological communication in disasters is increasingly relevant and essential in facing increasingly complex disasters and environmental challenges. Focusing on sustainability and adaptability in communications enables the development of more effective communication strategies in frequently occurring disaster situations. In addition, understanding the role of social media and digital technology in disaster communication provides new insights into disaster mitigation and response efforts. The results of this research can be used to improve responses to disasters, build community resilience, and reduce the negative impacts caused by disasters and environmental challenges. With the increasing complexity of the challenges faced, the study of ecological communication in disasters continues to develop to provide a better understanding and more effective future strategies for dealing with disasters.

Table 1. Top 10 frequently cited publication documents

Document title (Year)	Authors	Cited
Freshwater biodiversity conservation: Recent progress and future challenges (2010)	Strayer, D.L., Dudgeon, D.	1140
Cross-boundary and cross-level dynamics increase vulnerability to severe winter disasters (dzud) in Mongolia (2012)	Fernández-Giménez, M.E., Batkhishig, B., Batbuyan, B.	148
Systemic resilience: principles and processes for a science of change in contexts of adversity (2018)	Ungar, M.	137
Defining Extreme Events: A Cross-Disciplinary Review (2018)	McPhillips, L.E., Chang, H., Chester, M.V., (...), Rosi, E.J., Shafiei Shiva, J.	122
Climate change and coastal environmental risk perceptions in Florida (2013)	Carlton, S.J., Jacobson, S.K.	114
Satellite remote sensing of harmful algal blooms (HABs) and a potential synthesized framework (2012)	Shen, L., Xu, H., Guo, X.	82
A decision support system for managing forest fire casualties (2018)	Bonazountas, M., Kallidromitou, D., Kassomenos, P., Passas, N.	65
Sustainable urban infrastructure: A review (2017)	Ferrer, A.L.C., Thomé, A.M.T., Scavarda, A.J.	52
Participatory modelling for sustainable development: Key issues derived from five cases of natural resource and disaster risk management (2019)	Hedelin, B., Evers, M., Alkan-Olsson, J., Jonsson, A.	48
Resilience to surprises through communicative planning (2009)	Goldstein, B.E.	47

In addition to increasing the number of published documents based on the year of publication, there is another trend, namely frequently cited published documents.

Table 1 shows that several published documents are most frequently cited in studies on ecological communication in disasters. Other documents must cite publication documents on ecological communication in disasters. Documents with in-depth research and analysis results are essential for citation because they provide a solid basis for understanding and discussing relevant topics. Documents that are reliable and accurate references are essential to cite because they support and validate arguments or claims expressed in other documents.

In general, document citations have an essential role in helping strengthen arguments, providing academic support, and influencing research and policy developments (Malik, Prianto, Roni, Yama, & Baharuddin, 2023). The high citation of published documents related to ecological communication issues in disasters has an essential contribution to the development and influence of this field. The citations show how such research is becoming part of an evolving scientific narrative, filling knowledge gaps, and making new contributions to understanding issues on both topics.

The more frequently other documents cite a published document, the higher the visibility and recognition it will get for the author and related institutions (Tahamtan, Safipour Afshar, & Ahamdzadeh, 2016). This can enhance the authors' and institutions' academic and professional reputations. Widely cited published documents can help strengthen the support and influence of policies proposed by governments. Citation by relevant published documents can provide a solid basis for formulating and implementing an effective policy on ecological communication in disasters.

In addition, the high level of rewriting by other documents reflects recognition and appreciation of the quality and relevance of the research, both for the authors and the relevant institutions. In other words, this research has become integral to the evolving scientific narrative, filling knowledge gaps and providing valuable contributions to understanding both studied topics. The implication is that researchers and related institutions must produce quality and valuable documents in research on ecological communication in disasters. These documents will not only increase the visibility and academic reputation of authors and institutions. However, they can also support more effective policy influence and decision-making in ecological and disaster contexts. Therefore, investment in in-depth and accurate research on this topic can provide significant benefits in understanding and responding to future environmental challenges and disasters.

Figure 2 shows that among interrelated research topics, some topics are still relatively new. Related research topics continue to experience development trends. Some topics have often been studied in other cases. However, when it comes to ecological communication in disasters, it is considered that global researchers have yet to explore them widely. It became a gap for future research. Some new research topics have been identified, including disaster prevention, risk assessment, climate change, and natural disasters.

Communication in disaster prevention focuses on the role of communication in building awareness, education, and public participation in disaster prevention (Oh & Lee, 2020). This includes studies on the effectiveness of disaster prevention communication campaigns, communication strategies that promote behavior change, and the use of social media to disseminate disaster prevention information (Rajput, Li, Zhang, & Mostafavi, 2020). Evaluation of disaster risk and communication of risk information helps study how communication of disaster risk information can help individuals and communities understand and respond to the risks they face (Shah et al., 2020). This includes research on the effectiveness of various risk communication methods, community risk perceptions, and communication strategies that can enhance disaster risk understanding and preparedness.

In the context of climate change, communication can affect understanding and attitudes towards climate change (Azadi, Yazdanpanah, & Mahmoudi, 2019). It involves the study of compelling communication narratives in tackling climate change, the use of media and technology in disseminating climate change information, and communication in encouraging mitigation and adaptation actions. In addition, communication can be improved during natural disasters to facilitate emergency response coordination (Lovari & Bowen, 2020), delivery of critical information, and psychosocial assistance (Jacobs et al., 2019). This involves research on emergency communication systems, using traditional media and social media in disaster situations, and evaluating communication effectiveness during natural disasters.

Communication and post-disaster recovery examines the role of communication in post-disaster recovery, including how communication can support the process of physical, psychological, and social recovery (Monteil, Simmons, & Hicks, 2020). It involves the study of communication between stakeholders, management of recovery information, and the role of the media in shaping post-disaster recovery narratives. These topics provide insight into how communication can be critical in responding to disasters, reducing risk, and managing environmental change.

Topics such as disaster prevention, risk assessment, climate change, and natural disasters are still relatively new in the study of ecological communication. However, current research trends in this field can make a valuable contribution to understanding the role of communication in disaster contexts. This research trend opens up opportunities to expand understanding of ecological communication in disasters and provide a basis for developing more effective communication strategies in dealing with environmental challenges and disasters.

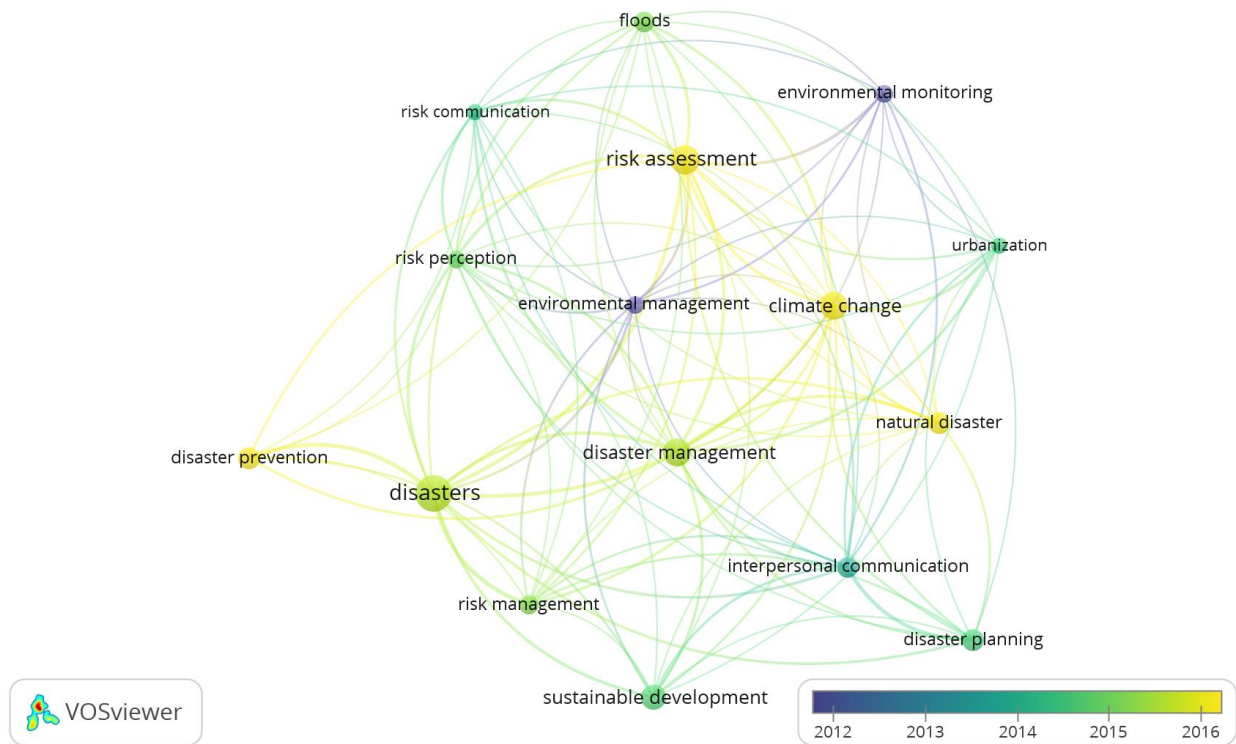


Figure 2. Trends in research topics related to ecological communication in disasters

Data trends obtained by previous analyses show that several topics have received sufficient attention. However, many relatively new areas still have yet to be widely explored by global researchers. This encourages the attention of global researchers in the future to fill space for further research to explore these issues more deeply. The theoretical implication of this research trend is that understanding communication's role in disaster contexts continues to develop. This study can provide a more robust basis for designing more effective communication strategies in facing environmental challenges and disasters in the future. In addition, this research also illustrates the importance of using social media and technology in disaster communication, which can influence changes in people's behaviour and perceptions of environmental and disaster issues.

Future research could expand this understanding by delving deeper into each topic, comparing various communication approaches in disaster contexts, and considering contextual aspects specific to different geographic locations and cultures. Thus, future research in this area has the potential to make a valuable contribution to developing our understanding of how communication can be used effectively to manage disaster risk, reduce environmental impacts, and build community resilience.

4. Conclusions

Research on ecological communication in disasters has increased significantly, especially in disaster prevention, risk assessment, climate change and natural disasters. This research provides valuable insights into the role of communication in responding to disasters and environmental challenges and building community resilience. More and more attention is being paid to participatory communication, risk communication, adaptive communication, and social

media and technology in the context of disasters and climate change. The results of this bibliometric analysis reflect increased awareness of the importance of effective communication in dealing with the complexity of disasters and environmental change. With this understanding, communications research and practice will continue to evolve to face increasingly complex environmental and disaster challenges in the future.

The implications of this study's findings can significantly impact various fields, including ecological communication, policy making, and disaster management. First, a deeper understanding of the role of communication in responding to disasters can help practitioners develop more effective strategies in crises. Second, with a better understanding of the communication factors that play a role in managing risk and responding to disasters, policies can be designed to be more targeted and based on scientific evidence. Third, in disaster management, these findings can help improve the efficiency of coordination and delivery of critical information during disaster situations. This can provide direct benefits in minimizing losses and protecting affected communities.

The main limitation of this research is that the analysis is based only on published documents in the Scopus database. This approach may have limitations in covering all relevant contexts, practitioners' experiences, or dynamics in ecological communication in disasters that may only sometimes be reflected in written documents. Therefore, further research involving a case study approach could be an excellent step to deepen understanding of the implementation of communication practices in natural disaster situations and involving various stakeholders. In this way, research can more deeply explore the actual dynamics on the ground and evaluate the impact of communication practices in complex disaster contexts.

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