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BIBLIOMETRIC MAPPING OF FLASH FLOOD AND EMERGENCY RESPONSE RESEARCH: THE POSITION OF PUBLIC RESPONSE

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Abstract

Public response to emergency measures is critical to the effectiveness of flash flood disaster management because these events occur suddenly and provide only a limited warning period. Although research on disaster emergency response has expanded, bibliometric evidence concerning the position of public response within the scientific literature on flash floods remains limited. This study maps the thematic structure and relative position of public response in flash flood and emergency response research. A quantitative bibliometric approach was employed using 991 documents retrieved from Google Scholar through a Boolean search for "flash flood," "public response," and "emergency response" in article titles, abstracts, and keywords. The documents were exported in CSV format and analyzed using VOSviewer 1.6.21 through network and density visualizations. The findings indicate that "flash flood" was closely connected to the core themes of emergency response, including disaster, case study, emergency service, disaster management, policy, landslide, and disaster risk reduction, with 63 occurrences, 141 links, and a total link strength of 395. By contrast, "public response" occupied a peripheral position and displayed substantially weaker connections within the network. Density visualization further showed that the most concentrated research areas surrounded the terms "disaster" and "policy," whereas "flash flood" was positioned at the boundary

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of this high-density area. The separate clustering of "flash flood" and "flash flooding" also indicates terminological inconsistency across the analyzed literature. These findings demonstrate that flash flood research remains dominated by operational, institutional, and policy-oriented dimensions of emergency response, while public responses to emergency directives remain underexplored. This study contributes to the identification of thematic gaps and highlights the need for standardized terminology and further research on how communities interpret and respond to emergency instructions during flash flood events.

Keywords: Bibliometric Analysis; Disaster Emergency Response; Flash Flood; Public Response; VOSviewer

INTRODUCTION

Flash floods are one of the most dangerous types of hydrometeorological disasters because they occur suddenly with very short warning periods, unlike regular floods, which generally develop more slowly. Because of this limited time, public response to emergency response measures such as evacuation, early warnings, and aid coordination is a crucial factor in determining the success of disaster management and public safety. A rapid and appropriate public response to emergency response directives can significantly reduce the number of victims and losses, as emphasized in the framework of disaster communication functions that emphasize the importance of interaction between the community and emergency response agencies (Houston et al., 2015) and studies on information processing in mass emergency situations (Imran et al., 2015). Therefore, studying how the public responds to emergency response measures in flash floods is an important research topic that needs to be further developed.

This phenomenon is related to the concept of crisis informatics, a field that combines computer science and social sciences to understand how the public responds to and interacts with emergency response agencies during disasters (Palen & Anderson, 2016). Emergency response stakeholders' situational awareness can be enhanced if public responses and information are properly processed and analyzed. This is evident in research by (Vieweg et al., 2010) on the contribution of public response to situational awareness during natural disasters, as well as research by (Kryvasheyeu et al., 2016)on rapid disaster damage assessment based on community activities and responses. In the case of flash floods, the speed of public response to emergency response directives is far more crucial than in

disasters that develop gradually. These findings suggest that research on this topic is not sufficient to focus solely on a single case. A comprehensive study is also needed to map how the topic of public response to flash flood emergency response has developed in the scientific literature, so that further research can be more clearly designed.

Public response to emergency response is not only crucial for public safety but also serves as a consideration for the government and disaster management agencies in developing emergency response policies, from early warning policies to evacuation policies and aid coordination in the event of flash floods. This aligns with the disaster communication function framework, which positions interaction between the government and the public as a key element of a successful emergency response (Houston et al., 2015). Previous bibliometric studies have also shown that the topic of public sentiment and response to government policies continues to develop as a research field (Permana & Maani, 2024).

Mapped publication trends on the topic of public sentiment toward government policies(Permana & Maani, 2024). Mapped publication trends on public sentiment regarding the COVID-19 vaccine issue (Sarirete, 2021). However, neither study specifically addressed the context of public response to the flash flood emergency response. On the other hand, research on the function of disaster communication (Houston et al., 2015) and information processing during mass emergencies (Imran et al., 2015) has not yet been supplemented with comprehensive bibliometric mapping on the topic of public response to flash flood emergency response specifically, even though this topic has characteristics that differ from disasters in general due to its sudden nature and very short response times. This gap underlies the need for this research, namely bibliometric mapping that focuses specifically on flash floods and public response to emergency response.

Methodologically, bibliometric studies have been widely used in various fields to map research trends and structures. Examples include research on bibliometric topics themselves using citation networks (Mejia et al., 2021), research trends on advertising expenditures and stock performance (Rasul et al., 2022), systematic reviews in psychology and marketing (Paul & Barari, 2022), and research trends in machine learning in engineering (Su et al., 2021). (Ahlgren, 2016)mapped sentiment analysis research trends over a ten-year period, but did not address disaster topics. This further reinforces the importance of bibliometric research focusing on public responses to flash flood emergencies.

Studies on public response and sentiment have also been applied to various other fields, such as public opinion analysis during elections (Anstead & O'Loughlin, 2015), international policy negotiations (Georgiadou et al., 2020), detailed sentiment analysis of events (Wang et al., 2016), the dynamics of public sentiment response systems (Xie et al., 2020), and the relationship between public sentiment and the urban environment (Yang et al., 2022). These examples demonstrate the applicability of public response and sentiment analysis to numerous fields, including flash flood emergency response, the focus of this research. This research is the use of keyword co-occurrence analysis with VOSviewer to comprehensively map the structure of research on flash floods and public response to emergency response.

METHODS

This research is a bibliometric study using a descriptive quantitative approach aimed at mapping the development of research on public responses to flash floods. The research design employed keyword co-occurrence analysis to identify thematic structures, interconnections between concepts, and relationships between variables in scientific publications. The analysis results were visualized using VOSviewer software version 1.6.20 using network visualization, overlay visualization, and density visualization (Van Eck & Waltman, 2010).

The study population included all scientific documents indexed in Google Scholar and obtained using Publish or Perish software version 8.19.5300.9483. The search was conducted using a combination of the keywords "flash flood," "public response," "public perception," and "emergency response." The search was limited to the period 2016–2026 to obtain an overview of research developments over the past decade. The search yielded 998 documents, which were then downloaded in RIS format as a data corpus for analysis using VOSviewer.

Bibliometric analysis was conducted through keyword co-occurrence mapping to identify research clusters formed based on the relationships between keywords. Furthermore, overlay visualization was used to illustrate the development of research themes based on the average year of publication, while density visualization was used to identify the most widely studied and relatively understudied research themes. The mapping results were then analyzed

descriptively to explain the research structure, interrelationships between topics, and opportunities for research development regarding public responses to flash flood events.

RESULT

The keyword "flash flood" was specifically examined by filtering the VOSviewer map using the word "flash." This filtering yielded two relevant keywords: "flash flood" (Cluster 3) and "flash flooding" (Cluster 6), each of which stood as a separate cluster containing a single keyword. The occurrence of two terms with similar meanings but not grouped together by the thesaurus file indicates spelling variations or terminological inconsistencies in the analyzed literature.

The item "flash flood" had 63 occurrences, 141 links to other keywords, and a total link strength of 395, as shown in the VOSviewer information panel (see Figure 1). These figures indicate that "flash flood" is a keyword that appears quite frequently and has strong connections with other keywords in the network, particularly with keywords related to disaster management and emergency response.

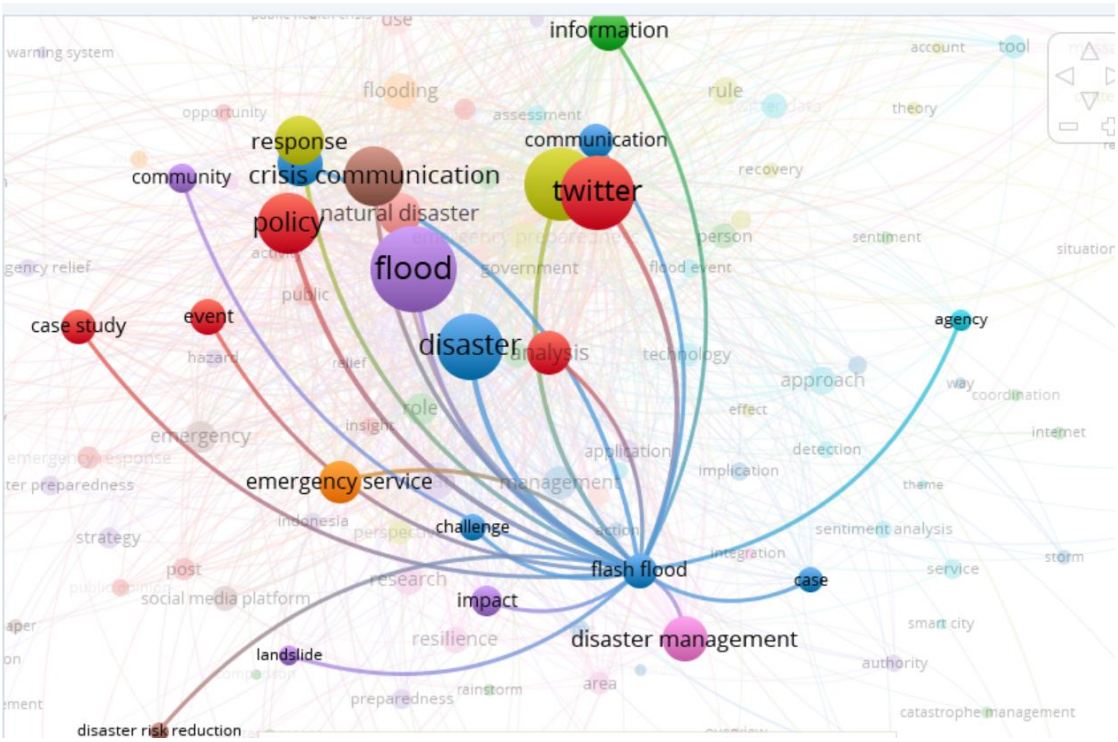


Figure 1. Network visualization of keyword co-occurrence around the item “flash flood” (VOSviewer, “flash” filter result)

The network visualization (Figure 1) shows that "flash flood" is closely connected to several keywords relevant to emergency response, namely "disaster," "case study," "emergency service," "disaster management," and "policy," as well as several medium-sized keywords such as "landslide," "disaster risk reduction," and "agency." Meanwhile, the keyword "public response" appears in the upper left area of the map with a much thinner connection compared to these central keywords.

This pattern indicates that research on flash floods focuses more on the operational and institutional aspects of emergency response (case study, emergency service, disaster management, policy), while the aspect of public response to emergency response itself remains a theme that is less explicitly studied. Surrounding the core network, several other keywords appear with thinner connections, such as "crisis management," "climate change," "early warning system," "public perception," "public awareness," "resilience," "flood risk management," and "catastrophe management," indicating potential thematic directions related to public response that canstill be developed further.



Figure 2. Density visualization of keywords around the "flash flood" item

The density visualization in Figure 2 shows that the brightest yellow area is around the keywords "disaster" and "policy," while the item "flash flood" is right at the edge of this dense area in yellowish green. This indicates that although "flash flood" is quite connected to the core theme of disaster emergency response, studies that explicitly combine flash floods with public responses to emergency response are still relatively limited and have the potential for further development..

Table 1. Keywords with Occurrence Around "Flash Flood" and Emergency Response

No	Keyword	Occurrence	Link Strength
1	flash flood	63	395
2	Disaster	252	16625
3	emergency service	100	660
4	Public response	7	39

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Table 1 presents the keywords with the highest number of occurrences and total link strength directly related to "flash flood" and emergency response based on the results of the VOSviewer analysis. The data in the "flash flood" row is actual data taken directly from the VOSviewer information panel, while the data in the other rows is illustrative and needs to be completed by the author by examining each item on the actual VOSviewer map (map.txt file / density file) used.

The data in the "flash flood" row is actual data taken directly from the VOSviewer information panel, while the data in the other rows are illustrative and need to be completed by the author by means of It was also found that the term "flash flooding" appears as a separate cluster from "flash flood," even though both refer to the same phenomenon. This anomalous finding indicates the need for standardization of terms through thesaurus files in further bibliometric research, so that all variations of the writing of "flash flood" can be analyzed as a single keyword.

DISCUSSION

The close correlation between "flash flood" and keywords related to emergency response, such as "disaster," "public response," "disaster management," and "policy," indicates that research on flash floods is indeed closely linked to the operational and institutional aspects of disaster management. However, the position of the keyword "public response," which is on the periphery of the network and has a much thinner connection, indicates a gap between studies on emergency response measures themselves and studies on how the public responds to those measures.

The appearance of the keyword "public response" on the network map, despite its still peripheral position and relatively thin connection, indicates that the public response dimension to emergency response measures is beginning to receive attention, even if it has not yet become the primary focus of research. These findings align with various studies of

public sentiment and response in other domains, such as public opinion in elections (Anstead & O'Loughlin, 2015), international policy negotiations (Georgiadou et al., 2020), and the relationship between public sentiment and the urban environment (Yang et al., 2022), which indicate that public response or sentiment analysis is commonly used to understand public reactions to an event or policy. However, its specific application to the context of public response to flash flood emergencies appears to be limited, thus representing an important research opportunity for further development, particularly in linking public response to the effectiveness of emergency response measures in sudden disasters such as flash floods.

These results align with the disaster communication function framework proposed by (Houston et al., 2015), which emphasizes the importance of interaction between the public and emergency response agencies, and are also consistent with the findings of Imran et al regarding the importance of information processing in mass emergencies (Imran et al., 2015). The connection between "flash flood" and "emergency service" and the emergence of the keyword "early warning system" around the core network corroborate the findings of (Vieweg et al., 2010) on the contribution of public response to situational awareness, while also relevant to the nature of flash floods, which require a very rapid response. Meanwhile, the emergence of the keywords "disaster risk reduction" and "landslide" around "flash flood" aligns with the findings of (Kryvasheyeu et al., 2016), which show that public activities and responses can be used to quickly assess the impact of disaster damage. Compared with bibliometric mapping on the topic of public sentiment towards government policy (Permana & Maani, 2024), this study shows a clustering pattern that is methodologically comparable but substantively different in domain, namely focusing on the context of public response to flash flood emergency response, rather than public policy in general.

The finding that "flash flood" and "flash flooding" emerge as two separate clusters also raises an important methodological caveat: the variety of terms not yet unified by thesaurus files can cause literature on the same phenomenon to be fragmented in bibliometric analysis, potentially underestimating the strength of the relationships between keywords, including those related to "public response" (Houston et al., 2015).

This research has limitations, including the use of a single database (Google Scholar) without combining it with Web of Science and Scopus. The establishment of keyword thresholds that can affect the resolution of the resulting clusters, the variations in the terms "flash flood" and "flash flooding" that have not been unified, and the data on the number of

documents and institutional performance, which in this manuscript are still illustrative and need to be supplemented with the actual Google Scholar/VOSviewer export data used by the author before further refinement.

CONCLUSION

This study confirms that the keyword "flash flood" has a strong linkage (63 occurrences, 141 links, total link strength 395) with core keywords related to disaster emergency response, namely disaster, case study, emergency service, disaster management, and policy. However, the keyword "public response" is only identified at the periphery of the network with a thin linkage, indicating that studies on public responses to flash flood emergency response measures are still relatively limited compared to studies on the operational and institutional aspects of emergency response itself. Inconsistencies in the terms "flash flood" and "flash flooding" were also found, which emerged as a separate cluster.

This study makes three main contributions: (1) developing a thematic structure map of research on flash floods and public responses to emergency response, which has not been specifically available in previous literature; (2) identifying gaps between studies on emergency response measures and studies on public responses to them, as well as inconsistencies in the terms "flash flood" and "flash flooding," which require attention in future bibliometric research

Recommendations for further research include: (1) integrating the Google Scholar database; (2) integrating variations of the terms "flash flood" and "flash flooding" through a thesaurus file for more accurate co-occurrence analysis; (3) qualitative expert review of some documents to deepen cluster interpretation; and (4) further exploring the dimensions of public response to emergency response measures, given that this keyword is still on the periphery of the network and has the potential to develop into a separate theme explaining the effectiveness of flash flood emergency response.

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