ISSN 2621- 458X

Mapping Research Trends in the Disaster Resilient Village Program: A Bibliometric Approach and Scientific Visualization Analysis

Hj. Aidah.S
ITBA Al Gazali Barru
aidah@algazali.ac.id
Marsuk
ITBA Al Gazali Barru
marsuki@algazali.ac.id

ABSTRACT

This study examines the development patterns of disaster research through a visualization analysis of keyword density generated from a bibliometric study. The visualization identifies two main clusters that demonstrate distinct but complementary research focuses. The first cluster highlights substantive aspects of disaster, including themes such as disaster, society, disaster, and community, which have received significant attention in the literature. The second cluster focuses on methodological approaches, dominated by keywords such as bibliometric analysis, articles, citations, and publications, reflecting the trend of using quantitative methods to map research developments. The connecting zone containing the keywords "method" and "keyword" demonstrates a significant integration between thematic and methodological aspects, confirming that modern disaster research focuses not only on substantive studies but also adopts systematic and measurable analytical techniques. These results provide a comprehensive overview of the dynamics of disaster research and emphasize the importance of synergy between theoretical and methodological studies. These findings are expected to serve as a reference for researchers and academics to develop more focused and impactful research, utilizing bibliometric approaches as a tool for evaluation and knowledge mapping. This study also recommends increasing cross-disciplinary collaboration to enrich disaster research perspectives relevant to practical and policy needs. Thus, this research contributes to strengthening understanding of research trends and the direction of disaster science development that is adaptive to future challenges.

Keywords: Disaster, Bibliometric Analysis, Density Visualization, Research Trends

A. INTRODUCTION

The number of disasters occurring in Indonesia has continued to increase over the past year, a matter of concern for the government and communities in disaster-prone areas (Ramadhan et al., 2025). Village resilience to disasters has now become a key focus of risk mitigation policies in Indonesia. The Disaster Resilient Village/Village Program is designed to increase community capacity in facing various disaster threats (BNPB, 2012). This concept emphasizes preparedness, mitigation, response, and recovery based on strengthening local communities (BNPB, n.d.). The program's implementation is also supported by national standards that provide operational direction through resilience indicators (BSN, 2017). Several empirical studies have measured the effectiveness and challenges of implementing this program in various regions (Putri, 2019). However, studies that comprehensively map research trends related to this program are still limited. A bibliometric approach is relevant for understanding scientific developments, topic distribution, and publication patterns. Therefore, this study seeks to fill this gap through a bibliometric analysis of related literature.

Bibliometric analysis provides the ability to identify publication patterns, author collaborations, and dominant research themes within a field (Donthu et al., 2021). This method utilizes indexed metadata from databases such as Scopus and Web of Science to obtain a comprehensive overview of research developments. Tools such as VOSviewer and bibliometrix in R are widely used to visualize networks, keywords, and topic clusters (van Eck & Waltman, 2010; Aria & Cuccurullo, 2017). Through citation, co-author, and co-occurrence maps, researchers can assess the evolution of scholarship on a particular topic. In the context of the Disaster Resilient Village Program, bibliometrics can reveal geographic concentrations, key research themes, and methodological trends in the literature. These findings are highly beneficial for researchers, practitioners, and policymakers. The analytical methods used must be structured transparently so they can be replicated by other researchers.

The national policy framework for Disaster Resilient Villages/Sub-Districts has undergone several strengthenings through official guidelines and facilitator curricula (BNPB, 2012; BNPB, 2021). These national standards and technical guidelines provide direction for program implementation at the local level and serve as a basis for related research. Several case studies

indicate that implementation outcomes vary, influenced by institutional capacity, resources, and community participation (Putri, 2023). These studies address issues such as effectiveness, sustainability, financing, and inter-agency coordination. Frequently identified barriers include budget constraints, lack of training, and inconsistencies between policies (Akbar, 2024). By mapping the literature bibliometrically, it is possible to determine whether research focuses primarily on technical, social, or institutional aspects. The results of this mapping serve as a basis for assessing the direction and quality of research conducted.

The literature on disaster resilience programs demonstrates a close relationship between policy implementation theory and disaster risk management. Implementation theories are needed to understand the gap between policy design at the central level and implementation at the sub-district level (Putri, 2019). Field research generally uses a qualitative approach to capture local dynamics, while quantitative research emphasizes measuring program impact. Bibliometric analysis can identify trends in research methods used in these studies (Donthu et al., 2021). Understanding these trends is crucial for identifying unexplored methodological opportunities and gaps. Furthermore, this approach helps map the extent to which research is multidisciplinary. Interdisciplinarity is crucial because community resilience issues involve technical, social, economic, and public policy factors.

Visualization tools such as network visualization, overlay, and density maps are helpful in comprehensively understanding bibliometric results (van Eck & Waltman, 2010). Network visualizations can illustrate citation relationships and collaboration patterns between authors or institutions. Overlay visualizations provide temporal information on the emergence and development of research topics. Meanwhile, density maps show the most dominant keywords or articles within a field of study. In the context of Disaster Resilient Villages, this visualization allows researchers to identify topic clusters such as community preparedness, BPBD capacity, community participation, and policy innovation. This analysis provides an empirical basis for developing recommendations for further research agendas. To ensure accurate research results, the parameters Data analysis and cleaning must be carried out consistently. Technical guidelines in the literature serve as the primary reference in this process.

The quality of bibliometric data is highly dependent on the data cleaning and integration process performed (Aria & Cuccurullo, 2017). Data cleaning includes normalizing author name variants, unifying keyword terms, and removing duplicate articles. Databases used, such as Scopus or Web of Science, are selected based on completeness of metadata and accessibility. Search keyword selection is crucial to ensure the research corpus encompasses all relevant literature (Donthu et al., 2021). Local terms such as "Disaster Resilient Village" can have varying spellings, so search strategies must be designed inclusively. Documentation of each step in data collection, inclusion, and exclusion of literature is necessary to ensure research transparency. This ensures that the analysis results will be more representative of the actual research landscape. This process also opens up opportunities for cross-country analysis if relevant international literature is available.

Research mapping is not simply a literature inventory, but a strategic approach to generating insights that impact decision-making. Bibliometric results can reveal research gaps between BNPB policy recommendations and field practice (BNPB, 2012). If a lack of evaluative research or specific studies is identified, this can serve as a reference for future research priorities. Furthermore, identifying the most productive authors or institutions facilitates the formation of research collaborations. For BPBDs in various regions, including Barru Regency, this mapping result can demonstrate the progress of local research. This information can also be used by academics in determining relevant undergraduate or graduate thesis topics. Thus, bibliometrics can bridge research and policy needs at the local level. This approach indirectly strengthens evidence-based disaster governance.

This study focuses on mapping the literature over a specific time period based on the availability of data in indexed publication databases. The analysis includes annual publication trends, author collaboration patterns, dominant keywords, and citation networks (van Eck & Waltman, 2010; Aria & Cuccurullo, 2017). Furthermore, local Indonesian literature containing case studies on the implementation of the Disaster Resilient Village Program was also used as a primary reference (Putri, 2019; Putri, 2023; Akbar, 2024). The bibliometric approach used combines quantitative metadata analysis with qualitative interpretation to gain contextual understanding. Qualitative interpretation is necessary so that the analysis results are not only descriptive but also able to explain policy phenomena and field practices. Therefore, the results of

this study are expected to produce topic maps, research recommendations, and implications for disaster policy implementation. Specifically, this study highlights research needs relevant to the context of Barru Regency. This mapping also contributes to strengthening community-based disaster studies.

Overall, this bibliometric mapping of research on the Disaster Resilient Village Program will provide a comprehensive overview of the development and direction of research in this field. This analysis has the potential to strengthen the link between academic research and mitigation policy implementation at the local level. The resulting findings can be an important source of information for researchers, policymakers, and practitioners at the regional Regional Disaster Management Agency (BPBD). Furthermore, the identified research gaps can be directed as research agendas that need to be encouraged to improve the program's effectiveness. The results of this study also provide a systematic and replicable methodology for other community resilience issues. With the support of modern bibliometric tools and standardized data, scientific mapping can produce more accurate and informative results. Therefore, this research has strong academic and practical relevance for strengthening disaster risk management. The following section will explain the methods and analytical steps used in this study.

B. RESEARCH METHODS

This research method uses a bibliometric approach to map the development of research related to the Disaster Resilient Village Program. This bibliometric approach was chosen because it provides a comprehensive overview of the structure of scientific publications through the analysis of metadata such as authors, keywords, institutions, publication sources, and citation patterns. Research data was collected from the Scopus database because it has a broad coverage of international journals and provides comprehensive metadata, including citation information and keywords. The data collection process was carried out using relevant search keywords such as "disaster-resilient village," "community resilience," "disaster preparedness," and other terms related to disaster resilience programs at the village level.

The next stage was data cleaning and normalization to ensure the integrity of the analysis. Data cleaning was carried out by removing duplicate articles, unifying variations in author names, and normalizing keywords with different spellings or terms. After the data was cleaned, analysis was conducted using VOSviewer software and the bibliometrix package in R. The analysis included co-authorship, keyword co-occurrence, citation analysis, and network visualization using network visualization, overlay visualization, and density mapping. These visualizations helped identify research clusters, temporal trends, and key themes that dominate the literature.

In this study, the analysis process was conducted systematically according to bibliometric research guidelines widely used in international scientific studies. According to Donthu et al. (2021), bibliometrics can provide a comprehensive understanding of the evolution and structure of a research field through a quantitative approach to publication metadata. Therefore, this method is considered appropriate for describing research patterns in the Disaster Resilient Village Program and identifying gaps and future research opportunities. The analysis results were then interpreted qualitatively to provide contextual meaning for policy development and future research.

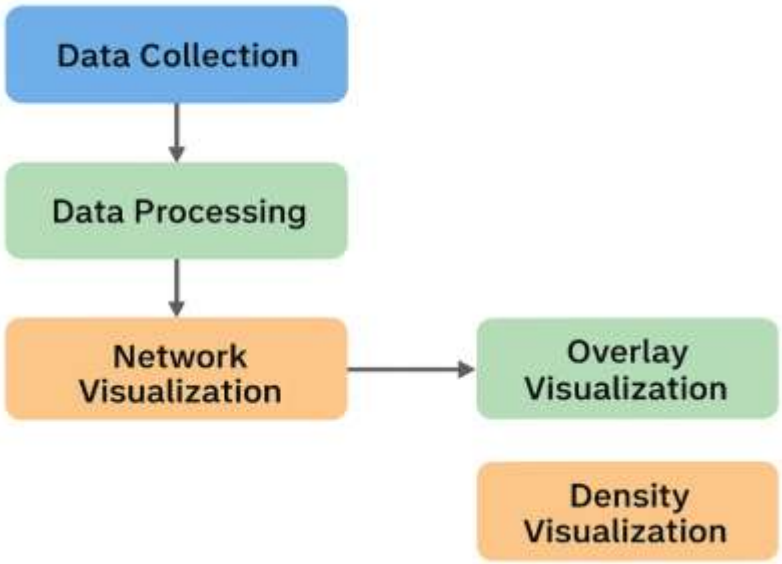

Figure 1 Framework Diagram

C. RESEARCH RESULTS AND DISCUSSION

- Research Results

The results of this research were compiled using a bibliometric analysis approach, beginning with data collection through the Crossref database. Determining the keywords and research title "Disaster Resilient Village Program" served as the initial step in exploring various relevant scientific publications, including journal articles, proceedings, and other scientific works. This search process aimed to map the development of research related to disaster resilience at the village level, including publication trends, dominant topics, author collaborations, and the research's intellectual landscape. This initial stage was fundamental because the quality of the data collected significantly determined the accuracy of the bibliometric analysis conducted in subsequent stages.

After bibliographic data was successfully collected from Crossref, all publication metadata was extracted and processed using Publish or Perish (PoP) software. This application was used to convert the data into Research Information Systems (RIS) format and select relevant articles based on eligibility criteria such as title suitability, publication year, and completeness of bibliographic information. The output, a RIS file, was then prepared for further analysis through network mapping. This stage is crucial for filtering duplication, grouping research by topic, and ensuring that the processed data is truly valid and reflects the state of scientific research development.

In the final stage, all RIS files are entered into VOSviewer software to produce three main outputs: Network Visualization, Overlay Visualization, and Density Visualization. Network Visualization displays the relationships between authors, keywords, and publication sources. Overlay Visualization provides an overview of the temporal development of a topic based on the year of publication. Meanwhile, Density Visualization shows the density of research focus, allowing researchers to identify the most widely studied and less frequently addressed themes. This entire process allows researchers to obtain a comprehensive map of the direction, development, and research opportunities regarding the Disaster Resilient Village Program in both national and global contexts.

Table 1 Citation Metrics Generated from the *Publish or Perish* Application

Citation Metrics	Value
Publication Years	2020 - 2025
Papers	1000
Citations	389
Cites Year	77.80
Cites Paper	0.39
Cites author	227.25
h-index	9
g-indeks	14

Source: Publish or Perish (PoP), 2025

Table 1 shows that publications related to this research were spread across the years 2020 to 2025, with a total of 1,000 articles published. This figure reflects relatively high research productivity over the past five years. Despite the large number of publications, the total number of citations received reached 389, which is relatively low compared to the number of papers. This suggests that despite the large amount of work produced, much of it is only just beginning to receive recognition or citations from other researchers, indicating that this literature is still in its infancy and will require time to become more widely known.

The ratio of citations per year (Cites Year = 77.8) and per paper (Cites Paper = 0.39) indicates that each publication receives, on average, less than half the citations per article per year, which is relatively low. However, the citations per author (Cites Author = 227.25) indicate that individual authors' contributions are significant and have an impact on the literature as a whole. This could mean that some authors produce works that are more frequently cited, although the overall impact of citations per paper remains limited.

The h-index (h-index = 9) and g-index (g-index = 14) indicate that there are a number of highly cited and influential articles, although the distribution of citations is uneven. An h-index of 9 means that there are 9 publications each cited at least 9 times, while a g-index of 14 indicates that the top articles have a more concentrated citation distribution. This combination of metrics indicates that research in this area is thriving, with several influential papers laying the foundation for further research, while most publications await wider academic recognition.

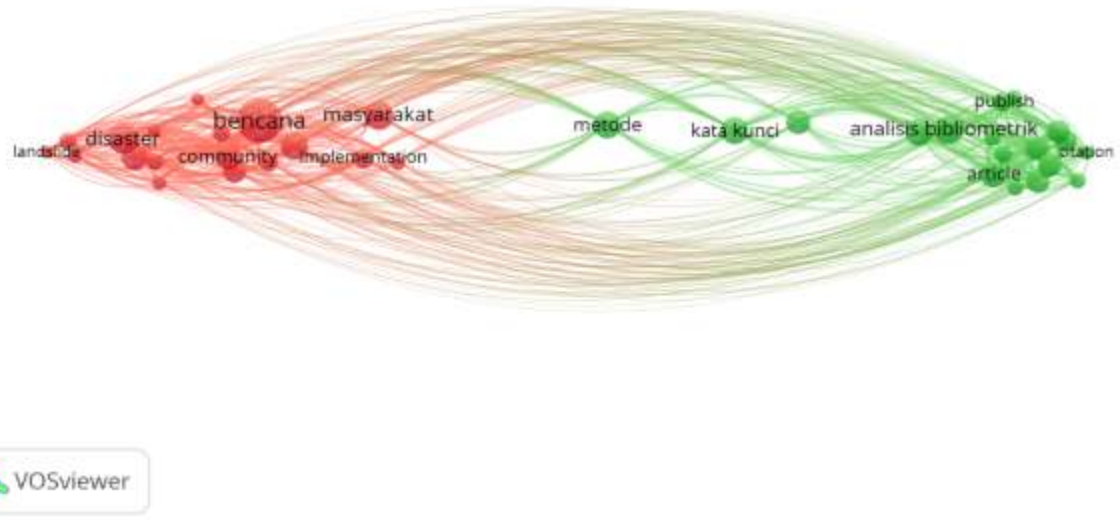

Figure 2. Visualization of the keyword network using VOSviewer showing two main research clusters. The red cluster represents disaster-related topics, such as disasters, society, and implementation, while the green cluster depicts methodological topics, specifically bibliometric analysis. The relationships between clusters are indicated by the numerous connecting lines, depicting the conceptual link between substantive disaster studies and bibliometric analytical approaches in mapping research trends.

This network visualization shows two main clusters, distinguishable by color: a red cluster on the left and a green cluster on the right. The red cluster contains keywords related to disaster issues, such as "disaster," "disaster," "society," "community," and "implementation," as well as specific terms like "landslide." This indicates that this research group focuses on substantive and applicable aspects of disaster management, including the role of the community, policy implementation, and specific types of disasters. Larger node sizes for terms like "disaster" and "society" reflect a higher frequency of occurrence or higher connection weight in the literature.

Meanwhile, the green cluster shows keywords related to bibliometric analysis, such as "bibliometric analysis," "article," "citation," "publish," and "keywords and methods." This cluster represents the methodological approach used in the literature to map research developments. The position of bibliometric analysis as a central node with numerous connections indicates that this

approach is widely used to analyze the dynamics of scientific publications. Through these strong relationships, the green cluster illustrates how trends, author productivity, citation patterns, and research directions can be systematically analyzed in the context of disaster studies.

The strong relationship between the two clusters, as seen by the numerous red-green connecting lines, indicates that disaster research is increasingly being analyzed using a bibliometric approach. This indicates an integration between substantive disaster studies and quantitative methodological studies of scientific publication patterns. The central position of the words "methods" and "keywords" indicates that they serve as a conceptual bridge connecting the two domains. Thus, this visualization demonstrates that understanding disaster research trends increasingly relies on bibliometric analysis as a tool for understanding the direction, intensity, and structure of scientific development.

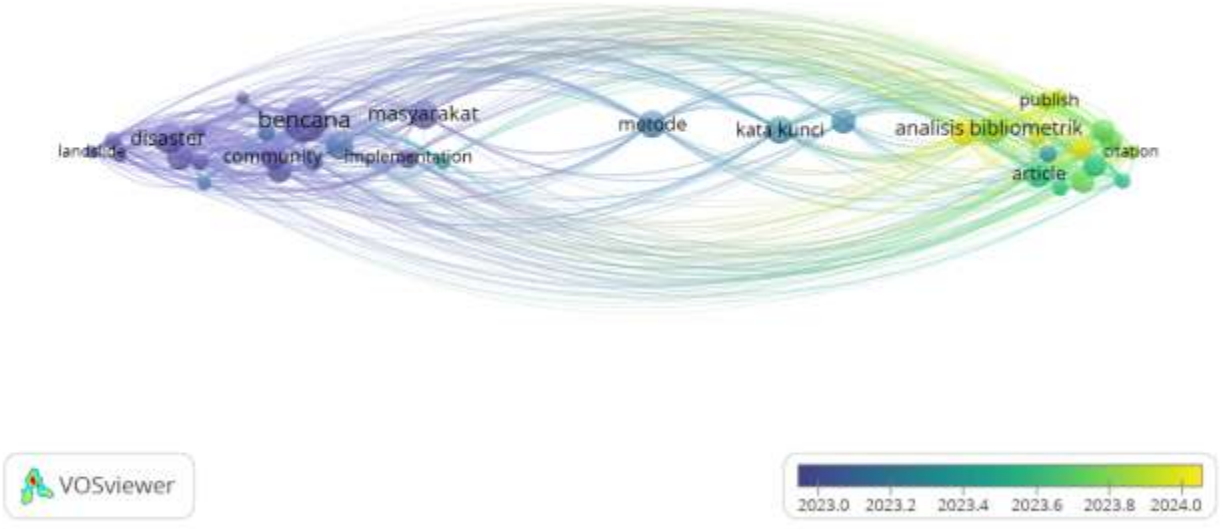

Figure 3 Visualization of keyword networks based on year overlay shows a shift in research from disaster topics (purple–blue) to bibliometric approaches (green–yellow). Lighter colors indicate newer topics emerging in late 2023 to 2024. This map illustrates the transition in research focus from substantive issues to analysis of publication and citation patterns.

This network visualization shows the dynamics of research development over time, represented by a color gradient from purple (earlier, 2023) to yellow (later, 2024). The cluster on the left side is dominated by dark purple to blue, indicating that topics such as disaster, society, community, and landslide were earlier areas of study and were widely discussed before the current phase. Larger nodes for the terms "disaster" and "society" indicate a high frequency or weight of connection to these themes, reflecting a strong focus in the foundational disaster literature. The numerous lines connecting the nodes illustrate the intense relationships between topics, indicating that substantive disaster issues have been the foundation of research since the beginning of the analysis period.

In the center of the network, the terms "methods" and "keywords" appear in a blue-green transition. This indicates that discussions on methodology and keyword identification began to intensify after the development of substantive disaster studies. The central position of the two nodes indicates their role as a bridge between substantive research and more advanced analytical approaches. The thick connecting lines in this area indicate that method selection and keyword formulation are increasingly being used for knowledge mapping. Thus, this phase marks a transition to a more systematic and structured scientific approach to understanding disaster publication trends.

The right side of the graph displays green to yellow clusters, indicating the latest topics emerging from late 2023 to 2024, such as bibliometric analysis, articles, citations, and publications. Brighter colors indicate that bibliometrics is becoming an increasingly relevant research trend and has been widely published in the most recent period. The large size and rich connections of bibliometric analysis nodes underscore the shift in research focus toward analyzing publication patterns, citation networks, and scientific productivity in the field of disasters. The presence of lines from the old clusters to the new ones demonstrates that the bibliometric approach is not only a methodological trend but also an integrative tool that comprehensively connects substantive research and scientific evaluation.

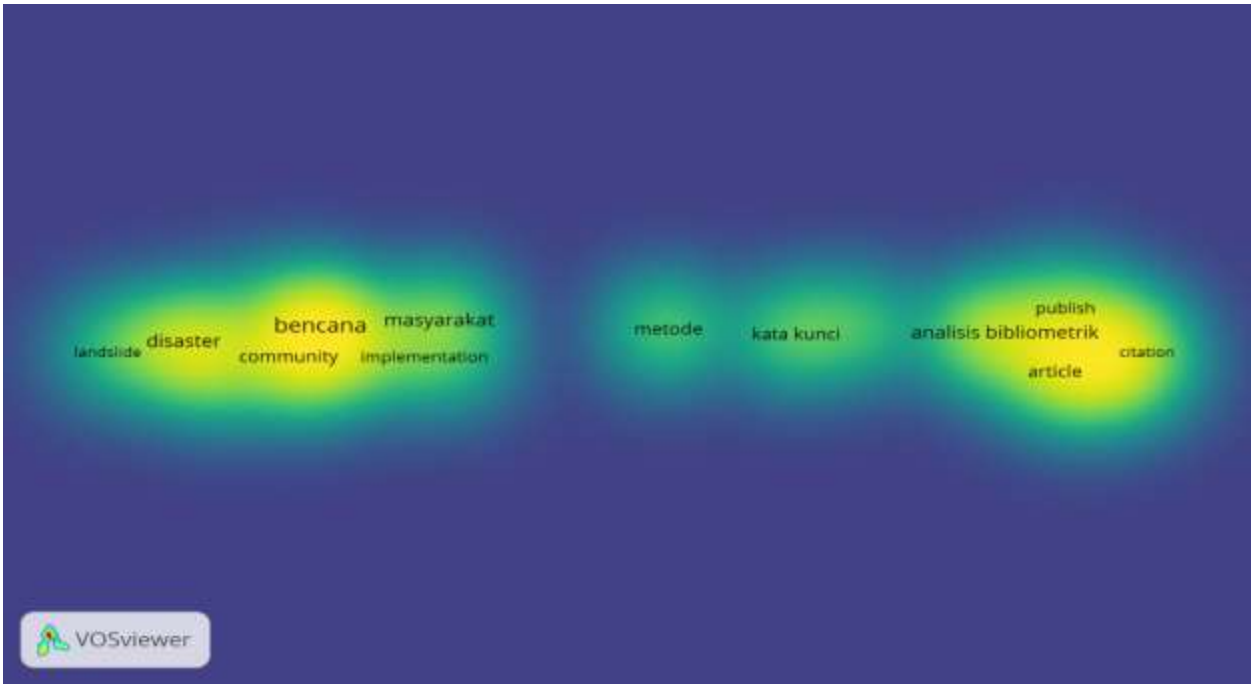

Figure 5 The density visualization shows two main areas of density: the disaster cluster on the left and the bibliometric analysis cluster on the right. Yellow indicates keywords with the highest frequency of occurrence in the literature. This map illustrates the concentration of research focus divided between substantive disaster issues and bibliometric analytical approaches.

This density visualization shows the concentration of keyword density in two separate main regions, marked by yellow to green areas indicating higher occurrence intensity. On the left, the cluster with the strongest density is seen around the words "disaster," "community," and "masyarakat." The yellow color in this area indicates that these themes are the most frequently appearing focus in the disaster literature. Nodes such as "landslide" and "implementation" remain visible in the green zone, indicating moderate but still significant connections. This pattern illustrates the strong research focus on substantive disaster issues and the role of communities as a crucial element in risk management.

In the middle area, the density is lower, with green and turquoise colors dominating the words "methods" and "keywords." This indicates that the methodological topic is in a transitional position, not as high in intensity as the disaster or bibliometric clusters, but still has a significant influence as a bridge. This position indicates that discussion of methods and keyword selection strategies is used consistently but not as a primary theme. This zone serves as a conceptual bridge

connecting substantive exploration and analytical approaches in academic publications. This moderate density demonstrates how methodological elements support the overall structure of the research without dominating the discourse.

The right side of the visualization shows a high-density cluster of bibliometric analysis themes, articles, citations, and publications, indicated by the bright yellow area. This indicates that bibliometric approaches are a frequently occurring research focus, reflecting a new trend in disaster knowledge mapping. This density also indicates that recent literature increasingly emphasizes evaluating the quality, quantity, and impact of scientific publications. The more intense color indicates that bibliometric themes are not merely supporting but have become a strategic approach to interpreting research developments. Thus, this density map demonstrates the presence of two important centers of gravity: substantive disaster studies and complementary bibliometric analytical studies.

- Discussion

This density visualization reveals a pattern of keyword concentration in two separate main areas, demonstrating a clearly segmented research focus. In the left cluster, topics such as disaster, society, and community show very high occurrence intensity. The bright yellow color in this area indicates that disaster-related issues and the role of society in mitigation are the primary focus of attention in the analyzed literature. Words such as implementation and landslide also appear in areas with lower, but still significant, intensity, indicating subthemes related to policy implementation and specific types of disasters that receive attention. This confirms that disaster studies are not only theoretical but also highly applicable and based on social context.

In the center of the map, there is a zone with a relatively lower green to blue density compared to the two main clusters, occupied by keywords such as methods and keywords. This area indicates a transitional thematic position, connecting substantive and analytical studies. The central position of the word "method" illustrates that the discourse on research approaches and keyword selection techniques is a crucial link between disaster studies and bibliometrics. Although not as intense as the main cluster, this methodological aspect plays a crucial role in ensuring the

quality and validity of the research conducted. This zone reflects how modern disaster research increasingly integrates technical aspects into the analysis and development process.

The right side of the visualization is dominated by a bright yellow area indicating a high intensity of keywords such as "bibliometric analysis," "article," "citation," and "publish." This indicates that the bibliometric approach has become a significant focus in recent research, reflecting the evaluation patterns of scientific publications in the field of disasters. This high density indicates that bibliometric studies are not merely a supporting tool but have become strategically important in measuring the productivity, influence, and trends of research development. This phenomenon aligns with technological advancements and the need to systematically map science to provide a comprehensive overview of the rapidly expanding literature.

The depiction of these two contrasting main clusters indicates a dual focus in current disaster research: substantive studies and complementary methodological studies. The substantive focus on disasters highlights practical and social issues that directly impact communities and the environment, while the bibliometric focus provides quantitative analytical tools to measure and map the progress of this research. These two clusters, while distinct in orientation, demonstrate an essential interconnection through a central zone that connects methods and keywords. This reinforces the argument that the development of modern science requires a synergy between a deep understanding of the subject matter and a systematic analytical approach.

Overall, this density map provides a comprehensive overview of the dynamically evolving disaster research landscape, with a strong emphasis on the integration of substantive studies and analytical methodologies. This visualization helps researchers, policymakers, and academics understand the patterns of theme concentration and identify priority areas and those requiring further development. Furthermore, the presence of a methodological connecting zone demonstrates the importance of innovation in research approaches to support deeper exploration and knowledge mapping. Thus, this map is not merely a statistical representation but also a strategic tool for formulating more focused and impactful research directions in the future.

D. CONCLUSIONS AND SUGGESTIONS

- Conclusion

The density visualization shows two main focuses in disaster research: substantive studies related to disaster issues and the role of society, and methodological studies that use a bibliometric analysis approach to map trends and patterns of scientific publications. The high frequency of keyword occurrences in these two clusters indicates the importance of both aspects in the development of disaster science. The connecting zone occupied by keywords related to methods and keywords indicates a strong integration between substantive and methodological studies, which strengthens the validity and comprehensiveness of the research. Thus, the current development of disaster research is supported by the synergy between thematic understanding and a systematic analytical approach.

- Recommendations

For the future development of disaster research, it is recommended that researchers further optimize the integration between substantive studies and bibliometric methods to strengthen the validity of research results and provide a more holistic picture of research trends. Furthermore, more in-depth exploration of less dominant subthemes, such as the implementation of specific policies and certain types of disasters, is needed to broaden the scope of the study. New technologies and analytical approaches can also be adopted to capture research dynamics in real time and more accurately. Finally, cross-disciplinary collaboration between disaster experts, methodologists, and stakeholders can enrich the perspectives and applications of research findings, making them more relevant to community needs.

BIBLIOGRAPHY

Akbar, H. M. (2024). *Implementasi Kebijakan Desa Tangguh Bencana* (Jurnal). Neopolitea. https://journal2.unfari.ac.id/index.php/neopolitea/article/download/1347/425

Aria, M., & Cuccurullo, C. (2017). *bibliometrix: An R-tool for comprehensive science mapping analysis.* Journal of Informetrics, 11(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

Badan Nasional Penanggulangan Bencana (BNPB). (2012). *Peraturan Kepala BNPB Nomor 1 Tahun 2012 tentang Pedoman Umum Desa/Kelurahan Tangguh Bencana.*

https://bnpb.go.id/berita/perka-bnpb-no-1-2012-tentang-pedoman-umum-desa-kelurahan-tangguh-bencana

Badan Nasional Penanggulangan Bencana (BNPB). (n.d.). *Katalog Ketangguhan.* https://katalogketangguhan.bnpb.go.id/

Badan Nasional Penanggulangan Bencana (BNPB). (2021). *Kurikulum Diklat Fasilitator Desa Tangguh Bencana* (Panduan). https://etangguh.bnpb.go.id/wp-content/uploads/2021/07/Kurikulum-Diklat-Fasilitator-Desa-Tangguh-Bencana.pdf

Badan Standardisasi Nasional (BSN). (2017). *SNI 8357:2017 Desa dan Kelurahan Tangguh Bencana.* https://katalogkesiapsiagaan.bnpb.go.id/wp-content/uploads/2021/11/SNI-Destana.pdf

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). *How to conduct a bibliometric analysis: An overview and guidelines.* Journal of Business Research, 133, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Putri, R. Y. (2019). *Dampak Implementasi Program Desa/Kelurahan Tangguh Bencana* (Studi di Kelurahan Tanjung Benoa, Badung). Widyapublika. https://www.ojs.unr.ac.id/index.php/widyapublika/article/view/630

Putri, Y. E. P. (2023). *Efektivitas Program Desa Tangguh Bencana di Kabupaten Bolaang Mongondow* (Tesis). IPDN Eprints. https://eprints.ipdn.ac.id/13208/1/yonargesi_301307_efektivitas%20program%20desa%20tangguh%20bencana%20di%20kabupaten%20bolaang%20mongondow%20provinsi%20sulawesi%20utara.pdf

Ramadhan, R., Husein Maruapey, M., & Rusliandy, R. (2025). Implementasi Program Kelurahan Tangguh Bencana dalam Sistem Peringatan Dini Bencana di Kota Bogor. *Ranah Research : Journal of Multidisciplinary Research and Development*, *7*(4), 3120–3131. https://doi.org/10.38035/rrj.v7i4.1533

van Eck, N. J., & Waltman, L. (2010). *VOSviewer, a computer program for bibliometric mapping.* Scientometrics, 84(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3