

Analyzing Public Sentiment on The 2024 'Galodo' Disaster Using Natural Language Processing (NLP)

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Received: 22-04-2025

e-ISSN : 2987-9140

Accepted: 03-07-2025

Volume : 3 No. 2, (2025)

Published: 01-10-2025

Page : 1-12

DOI: <https://doi.org/10.26740/ijgsme.v3n2.p1-12>

Abstract

This study investigates public sentiment during flash floods (Galodo) in West Sumatra by analyzing Twitter data using Natural Language Processing (NLP) via text2data.com. The research applies Latent Dirichlet Allocation (LDA) for topic modeling to identify dominant themes in public discussions. Findings indicate that 97.9% of sentiments expressed were positive, primarily centered on disaster impacts, situational updates, flood causes, and community reactions to government-led disaster management efforts. The study underscores social media's influence in shaping public discourse during crises. A key contribution of this research is its integration of LDA-based topic modeling with sentiment analysis, specifically targeting Twitter discussions on flash floods in West Sumatra. This methodological approach offers valuable insights into how communities communicate and perceive natural disasters through digital platforms. The results suggest that social media fosters constructive dialogue during environmental emergencies, which can inform crisis communication strategies and enhance disaster response policies. By examining public sentiment and discussion trends, the study highlights the potential of social media analytics for improving disaster management frameworks. The predominance of positive sentiments reflects community resilience and engagement, providing policymakers with data-driven perspectives to optimize emergency responses. This research advances understanding of digital communication patterns during disasters, demonstrating the utility of NLP and topic modeling in crisis-related social media analysis. Ultimately, the findings emphasize the importance of leveraging social media data to gauge public sentiment, enabling more effective disaster communication and policy adaptations in vulnerable regions like West Sumatra.

Keywords: NLP, Disaster, Flood

1. INTRODUCTION

Indonesia's geographical position as a tropical country along the equator results in high rainfall influenced by its location between continents and oceans (Haryoko & Gunawan, 2022). This climatic condition, while beneficial for agriculture and biodiversity, also makes the nation highly vulnerable to natural disasters. According to the National Disaster Management Agency (BNPB, 2024), Indonesia recorded 1,296 disaster events by May 2024, predominantly floods, landslides, earthquakes, and volcanic eruptions. Among these, floods were the most frequent, with devastating cases such as the flash floods in West Sumatra in mid-2024 underscoring the urgent need for improved disaster response strategies (Gernowo & Nurwidyanto, 2021). The increasing frequency of hydrometeorological disasters, driven by climate change and extreme rainfall patterns, has exacerbated Indonesia's disaster risks (Aeni & Anwar, 2024; Heo et al., 2024).

Social media, particularly Twitter, has emerged as a critical platform for real-time public

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communication during disasters (Kemp, 2020). Previous studies have demonstrated its effectiveness in disaster reporting (Cameron, 2012; Chowdhury, 2013) and sentiment analysis for crisis management (Albuquerque et al., 2015). However, despite the wealth of research on disaster management in Indonesia—such as studies on flood mitigation (Fuady et al., 2021), tropical cyclones (Surinati & Kusuma, 2018), and hydro-meteorological modeling (Chrysanti & Son, 2023)—few have explored the intersection of public sentiment and topic modeling in social media discourse during disasters. This gap limits policymakers' ability to assess public perception accurately and develop data-driven strategies for disaster communication and response (Teguh, 2011).

Despite the growing body of research on disaster communication using social media in Indonesia, most studies remain focused on either sentiment analysis or topic modeling in isolation. For instance, Kurniawan et al. (2021) emphasize Twitter's role in information dissemination, coordination, and empathy-building during disasters, yet do not explore integrated analytical approaches. Similarly, Hutabarat et al. (2023) highlight the use of Instagram for disseminating disaster information by government agencies, focusing more on communication strategies than on analyzing public sentiment or thematic trends. Recent literature reviews by Oktavia and Wardah (2025) and Nurdin et al. (2023) also point out a noticeable research gap: while social media's importance in disaster communication is well acknowledged, studies that simultaneously apply sentiment analysis and topic modeling—especially during crises like flash floods—are still lacking. The integration of these two analytical methods in a unified framework remains underutilized, limiting our understanding of both emotional responses and thematic concerns expressed by the public. This research addresses that gap by combining both techniques to offer a more comprehensive view of public reactions and focal issues during the 2024 flash flood in West Sumatra.

To address this gap, this study employs Natural Language Processing (NLP) and Latent Dirichlet Allocation (LDA) topic modeling to analyze Twitter data on the West Sumatra floods (galodo). While existing research has focused on technical aspects of disaster management, such as rainfall-runoff modeling (Ikhwalı et al., 2023) and multi-hazard risk assessment (Heo et al., 2024), this study integrates sentiment analysis with topic modeling to uncover public concerns and emotional responses during crises. This approach aligns with findings from Haryanto et al. (2020), who highlighted the severe socio-economic impacts of floods in Indonesia, and Ummiyati et al. (2024), who emphasized the role of rainfall variability in flood occurrences. By combining these methods, the research provides a comprehensive understanding of how communities communicate about disasters on social media.

The primary objectives of this study are: (1) to examine public sentiment on Twitter regarding flash floods in West Sumatra, (2) to identify key discussion topics using LDA-based topic modeling, (3) to analyze the relationship between sentiment and discussion themes, and (4) to provide actionable recommendations for disaster management agencies. These objectives build upon previous work on Indonesia's disaster management challenges (Teguh, 2011; Fuady et al., 2021) while introducing a novel social media analytics approach to enhance crisis communication.

Previous research has established the importance of social media in disaster communication (Sakaki et al., 2013; Vo & Collier, 2013), yet most studies in Indonesia have focused on physical disaster mechanisms rather than public discourse. For instance, Gernowo &

Nurwidyanto (2021) analyzed flood patterns in tropical regions, while Chrysanti & Son (2023) studied hydro-meteorological models for flood prediction. However, few have explored how public sentiment shapes disaster response—a gap this study aims to fill. By integrating LDA topic modeling and sentiment analysis, the research contributes to both theoretical advancements in disaster communication and practical applications for policymakers.

In conclusion, this study leverages NLP and LDA topic modeling to analyze Twitter data, offering insights into public sentiment and discussion themes during the West Sumatra floods. The findings can help disaster management agencies refine communication strategies and allocate resources more effectively, particularly in flood-prone regions. By bridging the gap between technical disaster research and social media analytics, this study supports Indonesia's efforts to build a more resilient disaster management framework.

2. METHOD

This study employs a computational approach to analyze public discourse regarding flash floods in West Sumatra using Twitter data. The research design integrates quantitative and qualitative methods through natural language processing (NLP) and machine learning techniques, implemented via the text2data.com platform for comprehensive sentiment analysis and topic modeling. The study population comprises all Indonesian-language tweets related to the West Sumatra flash floods between May 11–18, 2024. A systematic crawling process using Tweet Harvest ensured representative sampling of public discourse during the critical disaster period. The dataset, stored in CSV format for further processing, consisted of approximately 1,010 tweets after removing duplicates and irrelevant content.



Figure 1. Data preprocessing workflow

As illustrated in Figure 1, data collection involved multiple stages of text preprocessing to ensure analytical rigor. Raw Twitter data first underwent case folding to standardize text casing, followed by comprehensive cleansing to remove punctuation, special characters, usernames, hashtags, URLs, and retweet indicators. Tokenization then decomposed the text into individual lexical units, preparing it for slang word. Slang words were normalized using a curated Indonesian slang dictionary compiled from online linguistic forums and Twitter-specific colloquialisms. This allowed conversion of informal expressions (e.g., “gws”, “btw”, “bgt”) into standard Indonesian terms, increasing semantic clarity for both sentiment and topic modeling. The final preprocessing stage applied stopwords removal with a customized Indonesian stopwords list to filter out high-frequency but semantically insignificant terms.

These meticulous preparation procedures enhanced data quality for subsequent sentiment analysis and topic modeling.

Sentiment analysis was conducted using text2data.com's NLP-based classification system, which employs machine learning algorithms trained on Indonesian language patterns. The system categorized each tweet as positive, negative, or neutral based on lexical features and contextual cues. Sentiment analysis was conducted using text2data.com's NLP-based classification system, which supports multiple languages, including Bahasa Indonesia. While the platform does not provide public benchmarks specifically for Indonesian, its API documentation states compatibility with multilingual datasets. To ensure reasonable accuracy, we manually verified a subset of classified tweets against human judgment.

Parallel topic modeling was performed using Latent Dirichlet Allocation (LDA) implemented in R. The analytical process involved: (1) constructing a document-term matrix from the preprocessed corpus, (2) determining optimal topic numbers through coherence score evaluation. For topic modeling, we tested several LDA configurations using the ldatuning package in R. The coherence score was computed using the Cv metric across models ranging from 2 to 10 topics. The model with 4 topics yielded the highest coherence score (0.47), indicating optimal semantic interpretability. These topics were then qualitatively reviewed for coherence and relevance to the flood discourse. (3) Generating interpretable topics through iterative model refinement. Visualization techniques utilizing ggplot2 and dplyr packages facilitated the interpretation of topic distributions and their interrelationships.

The integrated analysis revealed distinct patterns in public discourse by cross-examining sentiment and topic modeling results. Sentiment distribution was quantified both across the entire dataset and within specific topic clusters, while topic modeling identified key thematic elements in flood-related discussions. This dual-method approach enabled reciprocal validation, where sentiment trends were contextualized within specific discussion topics, and conversely, topic prevalence was examined through sentiment lenses. The synthesized findings provide nuanced insights into public concerns, perceptions of government response, and community support dynamics during the disaster period, yielding both quantitative metrics and qualitative understanding of social media discourse in crisis situations.

This methodological framework advances disaster communication research by demonstrating how computational social science techniques can extract actionable intelligence from unstructured social media data during environmental emergencies. The study contributes to methodological literature by showcasing the synergistic application of sentiment analysis and topic modeling for crisis discourse analysis in developing world contexts.

3. RESULTS AND DISCUSSION

Findings: Public Sentiment Analysis

The devastating flash floods that hit West Sumatra triggered extensive discussions on Twitter, primarily focusing on disaster response and recovery efforts. Our analysis of 1,020 Indonesian-language tweets containing the keyword "banjir bandang" (flash flood), posted between May 11-18, 2024, revealed significant insights into public sentiment during the crisis. After data preprocessing, 1,010 tweets were analyzed using NLP-based sentiment analysis through text2data.com, showing an overwhelming 97.9% positive sentiment (988 tweets),

with only 1.9% negative (11 tweets) and 0.2% neutral (2 tweets). This remarkably skewed distribution toward positive sentiment, as visualized in Figure 2, suggests strong public approval of relief operations and notable community resilience in facing the disaster. The near absence of neutral posts further indicates high emotional engagement with the crisis event among Twitter users.

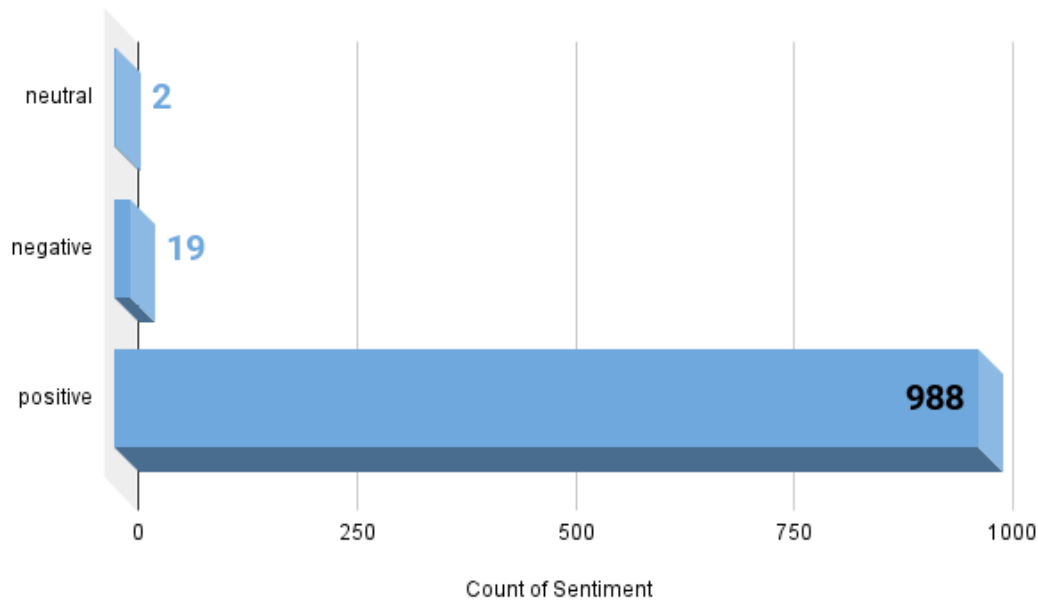


Figure 2. Distribution of Public Sentiment on Twitter Regarding West Sumatra Flash Floods

These findings align with existing literature highlighting Twitter's critical role in disaster communication (Muralidharan et al., 2011; Amen et al., 2022) and its capacity to provide novel informational perspectives during crises (Scarborough, 2018). The predominance of positive sentiment may reflect several factors: effective disaster management by authorities, successful community-led relief efforts, or the Indonesian cultural tendency toward collective solidarity in times of crisis. The minimal negative sentiment is particularly noteworthy as it contrasts with many disaster studies that typically find higher levels of public criticism. This unique public response pattern offers valuable insights for disaster communication strategies and underscores the importance of real-time social media monitoring for emergency management. Further research could explore the specific content of these positive tweets to better understand what aspects of the response resonated most with the affected community.

The figure 2. clearly demonstrates that the majority of responses were positive. This finding aligns with previous research indicating that most opinions expressed on Twitter during disasters tend to be positive, often containing expressions of care, empathy, and offers of assistance (Imperial et al., 2019).

Predicting extreme weather phenomena remains a complex challenge, as hydrometeorological disasters increase economic vulnerability and disrupt community activities (Hikmah et al., 2023; Wahyudi et al., 2023). The Indonesian public responds to extreme weather events on Twitter in various ways that can be categorized as positive, neutral, or negative. Positive responses typically include expressions of hope, prayers, concern, and empathy.

Neutral responses often consist of event reports and warnings, while negative responses generally contain complaints, anxieties, and fears (Saragih et al., 2021). Several exemplary tweets illustrating these sentiment categories are presented in Table 1.

Table 1. Examples of Public Response Tweets Regarding Flash Floods in West Sumatra

Account name	Tweet	Sentiment
parewaminang4	Assalamualaikum Search for flash flood victims in Pandai Sikek, Tanah Datar Regency, West Sumatra Province. Hopefully the victims will be found quickly. Amen, Allahumma, Amen.	Positive
02_suli	Kaili Village Babinsa Serda Ramuddin assisted in distributing basic food aid to victims of the flash flood, which was only accessible by motorbike, in Kaili Village, West Suli District, Luwu Regency.	Positive
KangaJinjinNe ko	It's so sad to see my beloved West Sumatra... flash floods and cold lava, landslides and collapsed roads everywhere... even to South and South Sulawesi which is not connected to Mount Marapi... poor little brothers and sisters are isolated and can't go home	Negative
Rswt20n	So the story is that on this birthday, I didn't just make cake and buy it outside and eat it, but it turned out that the connecting road out of the village was cut off by a flash flood. I can't go through, I'm going to be sad when it's our child's birthday if there's no cake.	Negative
_independen	West Sumatra Flash Flood Victim Data Update: 50 Dead, 27 Missing, Several Affected Locations Remain Isolated	Netral

Source: Data Analysis, 2025

Social media, particularly Twitter, plays a crucial role in crisis response by providing a platform for communities to seek assistance, express emotions, and respond to aid requests. Analysis of social media behavioral patterns can enhance community-level disaster response initiatives. Affected populations frequently turn to social media to request immediate help, whether for debris clearance, supply delivery, or emergency rescue. Other social media users often assist by amplifying these requests or offering direct support (DiCarlo & Berglund, 2021).

This study demonstrates that social media can strengthen disaster management capabilities by incorporating expert assessments, stakeholder perspectives, and public responses. Social media has become increasingly vital for individuals during emergencies as it provides a platform to both seek and offer immediate assistance. Understanding community responses during disaster phases is essential. Vishwanath et al. (2023) emphasize that social media, especially Twitter, contributes significantly to disaster management - the process of minimizing disaster impacts. These platforms generate substantial real-time information that can support relief organizations. Social media users play a critical role in disseminating disaster-related information, with their posts often revealing emotional responses to experienced disasters. These implications can enhance regional disaster adaptability and help build resilience in vulnerable areas (Li et al., 2023; Chen et al., 2022).

Public tweets can serve as a mitigation mechanism to anticipate losses caused by extreme weather conditions. The warning information shared can increase public vigilance, enabling more cautious travel route selection. Furthermore, public complaints can provide valuable evaluation material for local governments to improve disaster preparedness and response measures. The emotional content expressed through social media posts offers insights for developing more empathetic and effective disaster communication strategies.

Topic Modeling Results

This study classified tweets into four distinct topics (Figure 3), with each topic represented by its 2-4 most dominant keywords. The visualization of topic modeling results is presented in Figure 3. The y-axis displays the keywords identified for each topic, while the x-axis represents the β hyperparameter values.

The beta parameter (β) indicates word density within topics - higher beta values signify that a topic predominantly contains those specific words (Wallach, 2009). In other words, topic descriptions can be inferred by examining the relationship between words with the highest β values. This approach allows for clear interpretation of each topic's thematic focus based on its most statistically significant terms.

The topic modeling analysis identified four key themes in public discussions about the West Sumatra floods, each revealing important aspects of community response and concerns. The first topic centered on public hopes and emotional responses, represented by words like "hope," "help," and "quick," reflecting desires for rapid flood relief and victim assistance. A second prominent topic focused on institutional responses, with frequent mentions of "president," "BNPB," and "government," indicating public attention to official disaster management efforts. To support the interpretation of the overwhelmingly positive sentiment observed in Twitter discussions, we incorporated secondary data from verified news sources. These reports reveal that both central and regional governments took prompt and tangible actions in response to the flash flood disaster in West Sumatra. On May 21, 2024, President Joko Widodo personally visited affected areas in Tanah Datar and handed out compensation directly to flood victims, demonstrating national-level commitment to disaster response (Fajri, 2024). BNPB Chief Lt. Gen. Suharyanto also reported that the government had declared an emergency status across five districts following severe floods and landslides that claimed 30 lives in the region (BNPB, 2024). At the regional level, Bengkalis Regent Kasmarni sent IDR 514 million in aid to West Sumatra (Naim, 2024), and the Provincial Government of West Sumatra delivered humanitarian aid to flood-affected areas in Pesisir Selatan (Elfisha, 2025). These coordinated responses across administrative levels provide concrete evidence of government action, which helps explain the dominant positive sentiment expressed by netizens. Hence, the sentiment analysis is supported by factual interventions on the ground, not merely based on online perceptions.

Infrastructure impacts emerged as a third major theme, characterized by terms such as "road," "house," and "cut-off," highlighting the physical damage and transportation disruptions caused by the floods. The fourth topic, marked by words like "rain" and "high," revealed public understanding of the extreme weather conditions behind the disaster. These findings demonstrate how social media analysis can provide multidimensional disaster intelligence, capturing geographical impacts, socioeconomic consequences, real-time conditions, and public-institutional interactions. The results align with established research showing social media's value in disaster management, particularly in identifying urgent needs and improving response effectiveness. Importantly, the study reveals how positive public sentiment, when analyzed alongside specific topics, can guide more targeted disaster response - suggesting that authorities might prioritize victim assistance and infrastructure repair while also developing longer-term prevention strategies like improved urban planning and environmental

protections. This approach enables a shift from reactive crisis management to proactive resilience building, particularly for flood-prone regions like West Sumatra.

The analysis yields several practical policy implications for disaster governance. First, the strong public sentiment around victim welfare and infrastructure damage suggests immediate response efforts should prioritize evacuation operations and transportation route restoration. Second, the clear public recognition of environmental factors contributing to the floods supports calls for enhanced green infrastructure and stricter land use regulations. Third, the frequent mentions of government agencies indicate both public expectations of institutional response and opportunities for improved official communication strategies. These findings complement existing research demonstrating how social media analytics can transform disaster management, from Zhang et al.'s (2019) work on identifying urgent needs to Kryvasheyev et al.'s (2016) findings about improving response effectiveness through public sentiment analysis. By integrating computational analysis of community discourse with traditional disaster management approaches, authorities can develop more nuanced, responsive strategies that address both immediate crisis needs and longer-term resilience building - particularly crucial for vulnerable regions facing increasing climate-related disasters.

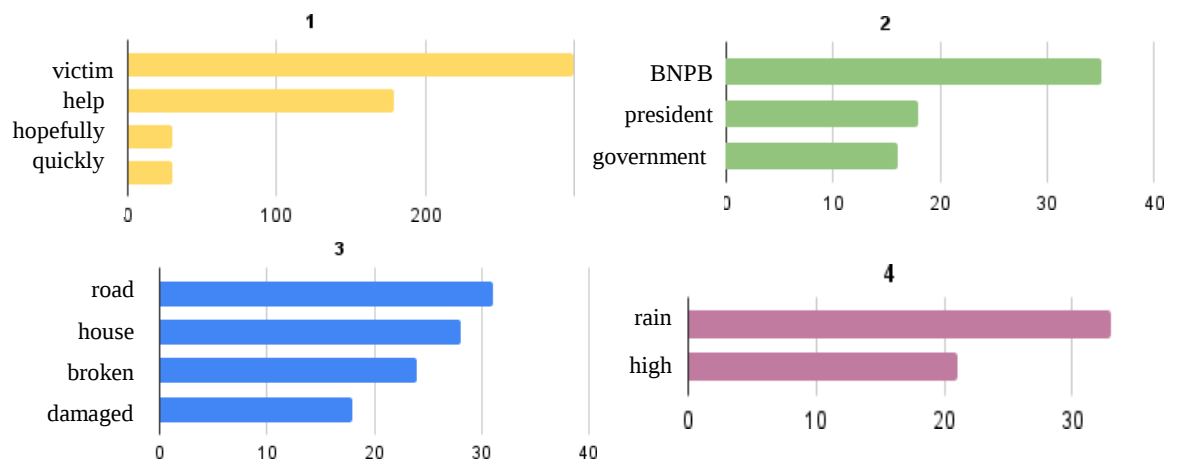


Figure 3. LDA Topic Modeling Results

4. CONCLUSION

This study achieved its research objectives by systematically analyzing public sentiment and discourse patterns regarding the West Sumatra flash floods through Twitter data. The findings reveal an overwhelming predominance of positive sentiment (97.9% of 988 tweets), suggesting strong community resilience and approval of disaster response efforts. Through LDA topic modeling, four key thematic clusters were identified: (1) public hopes for flood recession, (2) evaluations of government performance, (3) real-time situational reports, and (4) causal analysis of the disaster. These results substantively address the study's primary objectives of mapping public perception and identifying critical discussion themes during environmental crises.

The methodological approach combining sentiment analysis and topic modeling has proven effective in capturing nuanced public discourse, fulfilling the study's aim to develop a computational framework for disaster communication analysis. Particularly noteworthy is

how the results demonstrate Twitter's dual function as both an emotional outlet and information-sharing platform during crises, which corresponds with the research objective of understanding social media's role in disaster management.

However, this study has several limitations. First, the data collection period was limited to one week, which may not capture the evolving nature of public sentiment and discussion throughout different disaster phases. Second, the use of Twitter data may introduce sampling bias, as only a subset of the population actively uses the platform—potentially excluding perspectives from less digitally connected communities or regions. Future studies should consider extending the temporal range and incorporating data from multiple social media platforms to achieve a more representative analysis.

For future research, three key directions emerge from this study's findings: (1) incorporation of geolocation data to enhance spatial analysis of sentiment distribution, (2) development of more sophisticated emotional tone analysis to detect subtle negative sentiments like anxiety or fear within predominantly positive discourse, and (3) refinement of topic modeling techniques to better capture evolving public concerns throughout disaster phases. These advancements would further the study's ultimate objective of creating more responsive, data-driven disaster management systems.

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