International Journal on Robotics, Automation and Sciences

A Narrative Review on Big Data and Social Media Behaviour Analysis for Crisis Response in Thailand During COVID-19 and Flooding Events

Chean Khim Toa[*1], Kai Liang Lew, Tan Zhi En, Tan Jie Ying, Yu Jia Xuan and Suleiman Aliyu Babale[*2]

Abstract **– Social media platforms have evolved into critical real-time information hubs during crisis events, generating massive user-generated content that presents both opportunities and challenges for emergency management. Thailand's experience with the COVID-19 pandemic and recurring flood disasters provides valuable insights into leveraging social media big data for crisis response in developing countries. This narrative review synthesizes existing literature on technological frameworks, analytical methods, and practical implementations through comprehensive analysis of published studies and documented case studies. By examining distributed computing platforms, natural language processing, sentiment analysis, and geospatial mapping, this review assesses how Thailand has utilised user-generated content for emergency management. The findings reveal both technological progress and persistent systemic constraints. While initiatives such as the Anti-Fake News Centre demonstrate effective misinformation detection within two hours, significant gaps remain in five key areas, including technological infrastructure fragmentation among 48 disaster management agencies, analytical limitations in Thai-language processing, governance framework deficiencies, stakeholder coordination constraints, and digital inclusivity challenges that exclude vulnerable populations. Despite technological implementations, critical barriers include 96% failure rates in monitoring equipment and limited real-time data integration. The analysis provides a systematic examination of implementation gaps spanning technological, analytical, governance, stakeholder coordination, and inclusivity dimensions while identifying strategic opportunities, including enhanced data quality frameworks, cloud-based scalability solutions, and explainable AI integration, to strengthen Thailand's digital crisis management capabilities.**

Keywords—Big Data Analytics, Social Media Behaviour, Crisis Response, Thailand Disasters, COVID-19, Narrative Review.

[*1]Corresponding Author 1 email: cheankhim.toa@xmu.edu.my ORCID: 0000-0003-0879-4848
[*2]Corresponding Author 2 email: sababale.ele@buk.edu.ng ORCID: 0000-0002-1913-5445
Kai Liang Lew is with Faculty of Engineering and Technology, Multimedia University, Melaka, Malaysia (e-mail: 1132703002@mmu.edu.my).
Chean Khim Toa is with School of Computing and Data Science, Xiamen University Malaysia, Jalan Sunsuria, Bandar Sunsuria, 43900 Sepang, Selangor. (e-mail: cheankhim.toa@xmu.edu.my).
Tan Zhi En is with School of Computing and Data Science, Xiamen University Malaysia, Jalan Sunsuria, Bandar Sunsuria, 43900 Sepang, Selangor. (e-mail: DSC2209998@xmu.edu.my).
Tan Jie Ying is with School of Computing and Data Science, Xiamen University Malaysia, Jalan Sunsuria, Bandar Sunsuria, 43900 Sepang, Selangor. (e-mail: DSC2209997@xmu.edu.my).
Yu Jia Xuan is with School of Computing and Data Science, Xiamen University Malaysia, Jalan Sunsuria, Bandar Sunsuria, 43900 Sepang, Selangor. (e-mail: DSC2209683@xmu.edu.my).
Suleiman Aliyu Babale is with Department of Electrica lEngineering, Bayero University Kano,Kano, Nigeria (email: sababale.ele@buk.edu.ng).

International Journal on Robotics, Automation and Sciences (2026) 8, 1:76-86
https://doi.org/10.33093/ijoras.2026.8.1.8
Manuscript received: 10 Jun 2025 | Revised: 7 Aug 2025 | Accepted: 24 Sep 2025 |
Published: : 31 Mar 2026
© Universiti Telekom Sdn Bhd.
Published by MMU PRESS. URL: http://journals.mmupress.com/ijoras
This article is licensed under the Creative Commons BY-NC-ND 4.0 International License

I. INTRODUCTION

In today's digital landscape, the development of social media has significantly changed how information is shared and consumed globally, particularly during emergencies or crisis events. Platforms such as Twitter, Facebook, and LINE have evolved beyond social interaction spaces to become critical real-time information hubs where public sentiment, emergency alerts, and misinformation proliferate at unprecedented speeds. The massive scale of user-generated content reaching 2.5 quintillion bytes daily presents a dual challenge [1]. While offering valuable insights for monitoring public emotions, tracking emerging issues, and detecting misinformation, the sheer volume, velocity, and variety of data overwhelm traditional analytical approaches. This data deluge has made big data analytics not just useful but essential for governments, researchers, and humanitarian organisations seeking to transform digital noise into actionable intelligence for crisis management [2,3].

Thailand utilises social media data to manage crises, such as floods and COVID-19. While the country has many government agencies, 48 across 13 ministries, involved in crisis management, making coordination challenging, social media has become a key tool. With over 77% internet usage and 50 million Facebook users by 2019, social media provides authorities with real-time information. Thailand has moved from old methods to using big data, setting up an Anti-Fake News Centre, using streaming data for floods, and analysing public sentiment. These efforts, utilising tools such as Apache Spark and natural language processing, enable officials to understand public behaviour, gauge awareness, and provide timely assistance [4,5].

Thailand has advanced technology for big data, but it is not being fully utilised. The main problems are that 48 disaster agencies have separate data systems, Thai language processing is limited, and many rural and vulnerable people cannot access these digital tools. Current research reveals critical shortcomings in data integration between government silos, inadequate predictive analytics for crisis escalation, and insufficient consideration of privacy concerns and ethical implications [6,7]. Existing frameworks predominantly focus on government-centred solutions while overlooking community participation and cross-sector collaboration. These systemic constraints highlight the need for a comprehensive evaluation of how social media big data can be optimally utilised to enhance crisis management in developing digital infrastructures, moving beyond technological solutions to address organisational, social, and policy dimensions.

The primary objective of this paper is to review and synthesize the technological frameworks, analytical methods, and practical applications of social media big data analytics in Thailand's crisis response, with a specific focus on COVID-19 and flood disasters. This narrative review contributes to the field by identifying critical implementation gaps across five dimensions namely technological, analytical, governance, coordination, and inclusivity.

The second objective is to assess the challenges, limitations, and gaps in current research and practice while proposing future directions for enhancing Thailand's digital crisis management capabilities.

The main research question can be stated as follows. How can social media big data analytics be effectively leveraged to enhance crisis response capabilities in Thailand, and what are the key technological, organisational, and social factors that influence its implementation during health emergencies and natural disasters?

The first contribution is to provide a comprehensive analysis of the critical gaps in Thailand's big data crisis response implementation, examining the technological, analytical, governance, stakeholder coordination, and inclusivity challenges that constrain the effective deployment of social media analytics.

The second contribution is to identify emerging trends and strategic opportunities for enhancing Thailand's digital crisis capabilities, including specific recommendations for data quality frameworks, cloud-based scalability solutions, and enhanced misinformation detection systems tailored to the Thai context.

The paper is organised as follows. The Literature Review section outlines the technological frameworks and analytical methods for processing social media big data and reviews the current challenges in implementation. The Discussion and Analysis section provides a critical analysis of implementation gaps and identifies strategic opportunities for enhancing Thailand's digital crisis response capabilities. The Conclusion section summarises the strategic implications for practitioners and policymakers, highlights the main contributions regarding Thailand's crisis response challenges and opportunities, and suggests future work.

II. METHODOLOGY

This paper presents a narrative review of Big Data Analytics (BDA) and social media behaviour analysis for crisis response in Thailand, examining technological frameworks, analytical methods, and implementation challenges through analysis of relevant literature published between 2010 and 2025. The review synthesises 34 sources selected for their contribution to understanding social media analytics applications in crisis management, Thailand's disaster response initiatives, and international emergency management experiences.

Sources were identified through iterative searches in IEEE Xplore, ScienceDirect, Scopus, and Google Scholar, beginning with the terms 'social media analytics', 'crisis response', 'Thailand', 'COVID-19', and 'flood disaster', and expanding to related concepts as themes emerged from initial readings. The search process followed citation chains from key papers, particularly Thai government crisis management documents and recent international studies on social media utilisation during emergencies. The final selection of 34 sources represents literature published between 2010 and 2025, including earlier works on disaster management frameworks and social media

analytics that provided necessary context for understanding the evolution of digital crisis response capabilities. Sources were selected based on their relevance to either the theoretical foundations of social media BDA applications, such as natural language processing and sentiment analysis, or empirical insights into crisis management experiences in developing country contexts.

The literature selection followed a purposive approach, identifying papers that addressed key aspects of social media analytics implementation or its foundational concepts in crisis settings. Sources were organised into four thematic categories based on their primary focus. Thai crisis response initiatives and policy documents provided context for understanding the current implementation landscape and institutional frameworks. International case studies and emergency management experiences offered comparative insights from countries with different technological capabilities and disaster profiles. Technical literature on BDA tools and infrastructure addressed the computational foundations necessary for processing social media data at scale. Social behaviour and communication studies examined patterns of information dissemination and public sentiment during crisis events.

The review process involved reading and synthesising these sources to identify common implementation challenges, successful approaches, and contextual requirements specific to Thailand. Papers were examined for their contributions to understanding the adoption of social media analytics, the relationship between governance structures and crisis response effectiveness, and practical experiences from comparable Southeast Asian contexts. The synthesis focused on identifying convergent findings across different sources regarding implementation gaps, with particular attention to the disparities between Thailand's current capabilities and requirements demonstrated by successful international crisis management systems.

III. LITERATURE REVIEW

A. Technological and Methodological Innovations in Big Data Analytics

Advances in big data technologies have transformed the utilisation of social media data during crisis management. Distributed computing frameworks, including Apache Hadoop and Apache Spark, enable the processing of high-speed, large-scale social media data [8]. Hadoop's MapReduce computational model enables the batch processing of massive datasets across clusters, while Spark builds on this by allowing in-memory processing for faster and iterative computations. The rise of these frameworks has enabled researchers to apply data mining and machine learning algorithms to social media streams in real-time, efficiently and effectively. Spark can process streams 100 times faster than Hadoop in certain cases by caching data in memory, which is crucial for time-sensitive analysis during fast-moving disasters [8]. Alongside these processing engines, the ecosystem of NoSQL databases such as MongoDB and Cassandra provides scalable storage for unstructured social media content [9]. These tools trade the rigid schemas of SQL with flexible distributed data models, providing a more adaptable foundation for handling diverse and rapidly evolving crisis-related data [10]. Such databases excel at handling the heterogeneous text, image, and video data generated on platforms like Twitter and Facebook during emergencies. Table 1 shows the difference between SQL and NoSQL.

TABLE 1. SQL vs NoSQL

	SQL Database	NoSQL Database
Schema	Rigid, predefined structure	Flexible
Scalability	Vertical	Horizontal
Flexibility	Low	High
Data	Structured	Unstructured
Data Type	Tabular and relational data	Text, image, graph

Cloud computing has made it easier to implement big data pipelines for crisis analysis. Cloud platforms provide on-demand computing power and storage, enabling agencies to scale analyses during social media data surges. An analysis of Thai social media during COVID-19 has utilised cloud-based clusters to process millions of Facebook posts and tweets without requiring the investment in physical servers. This on-demand scalability was pivotal as online data expanded to 2.5 quintillion bytes per day globally in the last decade [11]. Additionally, cloud services facilitate collaboration and data sharing across organisations in response to a disaster [10]. In 2019, when COVID-19 first emerged, there were over 49 million active Facebook users in Thailand. In light of this, cloud-backed infrastructure ensures that analytical tools can cope with the nationwide scale of social media platforms during most crises.

Beyond infrastructure, significant methodological innovations have been made in data analytics and AI for crisis-related social media. Natural Language Processing (NLP) techniques extract situational information from tweets, Facebook posts, LINE messages, and other social media platforms. Sentiment analysis classifies the emotion or opinion in social media posts as positive, negative, or neutral, providing valuable insight into public mood and stress levels during a particular crisis. Topic modelling and text clustering automatically identify emerging themes or urgent needs from the deluge of posts. These include clustering tweets by topics like "food shortage", "flooded roads", or "medical help". These NLP methods can reveal patterns that help responders prioritise resources. Image recognition and computer vision technologies enable automated processing of disaster-related photos and videos shared by users. Deep learning models, such as convolutional neural networks (CNNs), VGG-16, and YOLO, can help identify visual cues of damage, like collapsed buildings, fires, and floodwater, in user-posted images. A study demonstrated over 96% accuracy in categorising disaster images by type, such as earthquakes, hurricanes, and others, using deep learning tools. In short, this illustrates the power of AI to make sense of crowdsourced visuals [12]. These

NLP and computer vision advancements enable crisis managers to extract actionable information from unstructured social media content, such as locations, damage severity, and sentiment, that would overwhelm humans reading it manually [13], [14].

Real-time streaming analytics tools represent another key innovation. Traditional batch processing, which analyses data after it is collected, is often too slow during rapidly developing crises. Technologies like Apache Kafka and Spark Streaming have emerged to ingest and analyse social media feeds in real-time [15]. Kafka serves as a high-throughput message broker that can take in millions of tweets or Facebook messages as they are posted, and Spark Streaming then performs on-the-fly computations on these live data streams. This capability enables real-time crisis indicator dashboards that monitor Twitter for earthquake-related posts, potentially detecting seismic events before official sensor networks. Spark's streaming module breaks incoming data into small micro-batches for continuous processing, enabling near-instant analytics with low latency. Spark's ability to handle streaming data with sub-second latency makes it ideal for monitoring social media feeds for emergencies.

By contrast, Hadoop's batch-oriented MapReduce is not as capable of natively processing live data [16]. The integration of streaming platforms enables emergency management centres to receive automatic alerts from social media signals. If an unusual spike in tweets mentions "flood" in a respective language in a specific province, an alert can be triggered for officials to investigate. These technological innovations, ranging from distributed computing and cloud infrastructure to AI analytics and streaming, collectively form the backbone of modern big data approaches to social media crisis analysis. Table 2 shows the comparison between Hadoop, Spark and Kafka.

TABLE 2. Hadoop vs Spark vs Kafka

Category	Hadoop	Spark	Kafka
Processing Model	Batch processing	Batch processing and streaming	Event streaming
Key Components	Hadoop Distributed File System, MapReduce, YARN	Spark Core, Spark SQL, Spark MLlib, Spark Streaming	Kafka brokers, Apache ZooKeeper for coordination
Typical Application	Analytics on large volumes of data	Analysing stream data in real-time	Scalable pipelines for data collection
Notable Features	Considered cost-effective for processing massive data sets	High-level APIs in Java, Scala and Python; machine learning and graph analytics libraries	Ability to handle thousands of messages per second with low latency
Fault Tolerance	Jobs rescheduled if node heartbeat missed; may greatly extend completion times	Data split into Resilient Distributed Datasets (RDDs). If a node fails, its content is recomputed from the original data.	Data replicated to other brokers. If a broker is down, ZooKeeper finds another broker to take over the workload.

B. Applications of Social Media Big Data in Thailand's Crisis Response

Thailand has confronted complex crises ranging from health emergencies to recurring natural disasters. Social media big data analytics have emerged as a vital component of the nation's crisis response. Analysts and agencies extract meaningful insights from real-time, user-generated content across Facebook, Twitter, and LINE platforms to inform decisions, coordinate responses, and monitor public sentiment. Among the notable cases in the Thai context are the COVID-19 pandemic and flood-related disasters, both of which have significantly demonstrated how big data tools can support rapid, scalable, and informed crisis intervention. These cases demonstrate both the versatility of big data technologies and their growing relevance in enhancing national emergency framework resilience and responsiveness.

COVID-19 Infodemic Management and Public Health

When COVID-19 hit Thailand, social media became a source of both news and widespread false information, or an "infodemic." Rumours about cures and vaccines spread on Facebook and Twitter, making people confused and risking their health. To address this issue, the Thai government established the Anti-Fake News Centre (AFNC) in late 2019. The AFNC collaborated with police to identify and correct false social media posts promptly, typically within two hours. This marked a significant step in leveraging big data to combat misinformation during a crisis. Studies have found that fake news often covers conspiracy theories and false health claims driven by fear. The 'garlic cures COVID' myth was a common example that was quickly dealt with. Many Thais shared false information because they were worried and wanted to help others rather than cause harm [17]. Generally, this shows how social media analytics and big data techniques played a key role in shaping Thailand's public health communication strategy during the pandemic.

Social media big data was also extensively utilised in Thailand to track how people were feeling mentally and emotionally during the COVID-19 pandemic. Factors such as ongoing lockdowns, economic pressures, and fear of the virus have caused growing concern about the population's mental health. Since traditional surveys often take time to collect and process, researchers started switching to platforms like Twitter and Facebook for quicker insights. One study looked at over 1.2 million Thai-language tweets to spot signs of stress, depression, and even suicidal thoughts using natural language processing tools, demonstrating the potential for AI-powered social media analysis in the early detection of mental health crises with accuracy rates exceeding 89% [18]. They grouped these tweets by month to create an index that reflected the population's mental health trends and compared it to official health data. The analysis revealed strong correlations between spikes in

distress-related tweets and actual increases in individuals seeking help for depression or suicide. Social media functions as an early alert system for mental health issues, enabling authorities to intervene before conditions deteriorate. Social media sentiment analysis measured public responses to specific COVID-19 policies, including vaccination drives and travel restrictions. Tracking whether tweets were mainly negative or positive gave officials a sense of how well people were likely to accept or follow new rules. These efforts demonstrated how Thailand leveraged big data not only to combat fake news but also to maintain a closer watch on public well-being during a critical period.

Flood Disaster Response and Preparedness

Flooding represents Thailand's most frequent and damaging natural disaster. Social media has grown into a valuable tool for managing crises. A prime example is Thailand's 2011 Great Flood, one of its worst historical disasters. Official communication struggled, so people used platforms like Facebook, Twitter, and YouTube to share updates, ask for help, and organise relief. Community-led Facebook pages, such as "Thaiflood," served as informal crisis centres, and Twitter facilitated the sharing of real-time updates. Studies from that period, carried out by researchers, found that social media helped fill an information gap, with users often posting flood levels and evacuation needs more quickly than traditional sources. Their research also noted patterns, such as higher participation by women on Facebook and the influential role of a small number of highly retweeted Twitter users. They concluded that social media served as an effective grassroots response tool and recommended its integration into formal emergency management strategies. At that time, most official responses still relied on traditional media and emergency hotlines, but the 2011 flood highlighted the potential for real-time, public-driven crisis reporting. That experience prompted Thai authorities to pay closer attention to digital platforms in disaster planning.

In the years that followed, big data tools evolved alongside the increment of social media usage. During the 2021 floods triggered by Tropical Storm Dianmu, platforms like Twitter were used to monitor for early signs of flooding. The advanced 'TriggerCit' system underwent testing during this period. This multilingual platform scans Twitter for flood-related keywords and automatically identifies posts containing visual content, such as photos or videos, that indicate ground-level flooding conditions. In the 2021 Thailand case, TriggerCit captured numerous flood images shared by locals, which were then matched with satellite data to create near real-time maps. The tool was supported by UN satellite services (UNOSAT), which combined crowdsourced content with remote sensing to provide a clearer picture of flood impact [19]. This approach transformed Twitter into a real-time sensor network where smartphone users contribute data to emergency management efforts [20]. Alongside this, Thai authorities also posted official flood alerts on social media and worked with local influencers to spread emergency messages more effectively. In short, this shows an increasing collaboration between public platforms and formal crisis management to enhance communication and improve emergency management efficiency.

Another method that emerged during the 2011 floods was crowdsourced mapping. Volunteers and humanitarian organisations began collecting user-generated data to create live maps of flooded areas. The United Nations utilised a tool called "UN-ASIGN" to collect photos from citizens through a mobile app, where each image was tagged with GPS data and timestamps. UNOSAT collected over 1,000 images to verify satellite-based flood maps. This crowdsourcing method improved situational awareness accuracy and provided emergency responders with reliable ground-level information. This approach demonstrates how crowd-generated data complements official information sources. Similarly, Thai developers took the same action by building public reporting platforms where users could submit flood reports, which were then visualised on shared maps known as "Volunteer Geographic Information (VGI)". Essentially, this has since become a recurring component of Thailand's flood response strategy, ultimately fostering stronger connections between communities and responders. As the volume of user reports grew, new algorithms and tools were introduced to help verify the content shared. Cross-checking reports often do this with sensor data, such as river level readings.

C. Analytical Frameworks and Techniques

A combination of technical tools and analytical approaches enables effective analysis of social media data during crises, such as the COVID-19 pandemic or floods in Thailand. These efforts generally fall into a few key categories. Text-based analysis helps us understand public sentiment and misinformation. Geospatial methods locate affected areas. Network analysis tracks how information flows. Platforms such as Twitter, Facebook, and Instagram provide rich sources of real-time information. However, making sense of this data at scale requires applying techniques like text mining, sentiment analysis, social network analysis, and mapping.

Text Mining

Text mining is a key technique in big data analytics, primarily used to extract valuable information from large amounts of unstructured text. In times of crisis, it can help identify trends, keywords, and hot topics to deepen understanding of the current situation. During the 2011 floods in Thailand, researchers analysed keywords on Facebook and Twitter, such as "น้ำท่วม" (flood), "ช่วยด้วย" (help), and "บริจาค" (donation) to identify the most urgent needs in the disaster area. It can also locate the affected areas more accurately, helping rescue teams arrive on the scene faster, which is more efficient than traditional reporting methods [21].

The same method has also been used to track the spread of public concerns and health issues during the COVID-19 epidemic. A study [22] analysed tweets posted by Thai users and found that high-frequency words included "ไวรัสโคโรน่า" (coronavirus), "วัคซีน" (vaccine), and "ล็อกดาวน์" (lockdown), reflecting people's most significant concerns. These are the actual responses of people during the epidemic and can serve as a crucial reference for modifying health

communication plans. Meanwhile, the timely identification of rumours and disinformation can lead to swift refutations from the authorities, ensuring continued trust among the people.

Sentiment Analysis

Sentiment analysis techniques show the emotional range of public conversations during floods. In such situations, public discussions often reveal a range of emotions. These range from resilience and solidarity to anxiety and distress, highlighting that flood stories can bring out both positive and negative emotions. In the 2017 and 2021 Thailand flood events, sentiment analysis from Twitter social media revealed that sadness and anxiety were the most prevalent emotions expressed, reflecting concerns over property loss, social disturbances, and safety risks. Research comparing tweets related to flood events showed an increase in expressions of sadness during the peak flood season, while sadness declined gradually post-disaster as recovery was underway. Meanwhile, positive sentiments, such as hopefulness and collective assistance, rose with ongoing relief activities [23]. It assisted in enabling the quick identification of anxious and panicked segments by capturing emerging emotional trends on social media, thus maximising resource allocation and psychological aid and enhancing efficiency in disaster relief.

During the COVID-19 crisis, sentiment analysis became a principal means by which government policymakers could discern people's emotional reactions. A survey [22] contained over 100,000 Thai tweets and revealed peaks in negative emotion coinciding with citizen disappointment and uncertainty over policy adjustments. The affective nature of tweets can be classified into a hierarchical order by level of intensity, with anger ranking highest, regularly occupying a percentage from 60.3% to 61.8% of emotion-oriented communications, followed by sadness, fear, joy, disgust, and surprise in succession. Many of the tweets show people's frustration during this crisis. Looking at posts like these can provide an early indication of the growing mental health issues and how close society is to breaking down.

Social Network Analysis

Social network analysis (SNA) is an effective tool for understanding how information flows and spreads on social media. By observing how users interact, SNA can identify key influencers and track the spread of news or updates during a crisis [24]. During the 2011 floods in Thailand, SNA revealed that users with high retweets and popular Facebook community pages acted as "boosters," facilitating the faster spread of information. These accounts served a critical function in spreading real-time updates, allowing grassroots coordinating activities. Community-oriented platforms, such as the "Chiang Mai English News" Facebook group, enabled residents to share up-to-date updates, images, and clips, thereby creating an informal network for information sharing. This grassroots mobilisation in digital form enabled emergency services to identify and prioritise areas that required assistance more accurately. It was also observed that local community leaders, along with local influencers, particularly those involved in women-led initiatives, played a critical role in initiating and sustaining informal yet effective crisis response mechanisms [21]. Their roles demonstrate how social media can facilitate decentralised and inclusive mechanisms for responding to disasters and often bridge gaps in formal institutions.

Since the COVID-19 pandemic, SNA has been utilised to track how information, including misinformation, travels across digital platforms. Thai officials have located rumour clusters and monitored vaccination-related misinformation or untested treatments. Through analysis of these networks, misinformation can be countered on time while encouraging the spread of authoritative information. Social network analysis, or SNA, can identify discrepancies in health information acceptance and trust within different social communities, providing a clearer understanding of health communication in the community and closing communication gaps to disseminate key information to those who need it most, particularly marginalised groups [24].

Geospatial Analytics and Mapping

Geospatial analytics amalgamates social media data with geographic information systems (GIS) to provide maps visualising the spatial distribution of crises. Deriving quality information from crowdsourced platforms is a critical addition to satellite remote sensing in crisis management [25]. Through the integration of geotagged social media data with satellite images, software programs like UN-ASIGN can produce reliable, real-time hazard maps. This integration increases situational awareness, enabling response teams to prioritise better and deploy resources during disasters like Thailand's 2011 and 2021 floods.

During the pandemic, geospatial technology has been leveraged for tracking case distribution and public reaction. Through analysis of where posts related to COVID-19 symptoms, lockdown stories, or testing sites are made, officials can identify infection hotspots on time and optimise responses through lockdown measures and resource deployment. Thailand utilises geospatial platforms to track clusters of infections within packed cities like Bangkok and Chiang Mai. Regional health agencies blended social media geotags with GIS infrastructures to promptly identify newly infected districts and mobilise mobile testing teams [26]. Although limited by restricted geotagging coverage and data privacy concerns, geospatial analytics significantly enhanced general knowledge and response effectiveness during this health crisis.

D. Challenges in Using Big Data for Crisis Response in Thailand

The effective use of big data can significantly enhance crisis response, but Thailand faces several challenges in this area. These challenges can be grouped into technical, organisational, and societal categories, as evidenced by literature on the COVID-19 pandemic and flood disasters in Thailand.

A key technical challenge is ensuring that data from different sources are accurate and compatible. In Thailand, critical databases are often not integrated, leading to fragmented information. Social protection data are stored in separate systems that "do not always talk to each other," making it hard to get a complete picture of who needs help. During the COVID-19 pandemic, the government launched a Big Data initiative to coordinate and integrate government data. However, this project is still in its early stages and has yet to fully address the fragmentation. An official review noted that key data for decision-making were either unavailable, in an unusable format, or not integrated with other databases. This lack of interoperability delayed the timely sharing of data and hindered a unified response to the pandemic.

Thailand's disaster warning and data-collection infrastructure has significant gaps. Many early warning systems are outdated or malfunctioning. Nearly half of the country's weather monitoring equipment does not function consistently, and 96% of these systems failed to report data at least once during the recent floods [27]. Due to these technical limitations, flood forecasts have been only about 33% accurate one day in advance, and warning messages often do not reach communities due to underdeveloped communication networks, such as unreliable SMS alerts. Similarly, during the pandemic, technical issues like inconsistent data formats and legacy IT systems made it difficult to quickly combine health data, travel histories, and testing results for analysis [28].

Big data from non-traditional sources present additional technical challenges in filtering useful information. During floods, Thai agencies and researchers have experimented with using social media posts to monitor flood conditions. However, issues arose with data quality, geolocation, and bias. Posts tended to overrepresent severe events and urban users, making it challenging to verify and map the information accurately [29]. Moreover, while Twitter and Facebook activity have been mined for situational awareness during floods, the absence of robust filtering methods will spread false or misleading information, undermining trust in using these data for crisis management [30]. The sheer volume of data also can overwhelm systems if not managed properly. Ensuring the validity and reliability of such big data inputs. Distinguishing rumours or errors from factual reports is a technical challenge noted in disaster management research [31]. Advanced algorithms and data-cleaning processes are necessary to transform this data into a helpful resource, but these were not entirely in place, leading to potential misinformation or gaps in situational awareness.

Effectively utilising big data in crises demands advanced analytics capabilities and skilled personnel, which are in short supply. Analyses of COVID-19 responses globally have observed that a "limitation of expertise" is among the top challenges for utilising big data technology in pandemic control [31]. In Thailand, there is a shortage of data scientists and analysts in government agencies who are trained to handle large, complex datasets [28]. This skills gap means that even when data are collected, agencies may not comprehensively analyse or utilise them for decision-making. The research study [28] has recommended training a dedicated workforce to lead digital transformation and big data analytics so that Southeast Asian governments can maximise the benefits of big data datasets. Until such capacity is built, technical use of big data in crises remains limited.

In fast-moving crises, such as epidemics or floods, responders require real-time data to inform their decisions. Thailand has struggled to establish real-time data feeds across its agencies. At the start of the COVID-19 pandemic, data on cases, hospital capacity, and contact tracing were collected by different units and not automatically updated on a single platform. In flood scenarios, the absence of an Internet-of-Things (IoT) sensor network means data are not continuously collected from all areas. This lack of real-time, connected data streams hampers the ability to predict and respond to emergencies quickly.

Organizationally, Thailand's government agencies often work in silos, with each agency collecting its data and hesitating to share it. This leads to duplicate efforts and an incomplete overall picture during crises. In the case of flood management, responsibilities are split among as many as 48 agencies across 13 ministries, which often have overlapping roles. As there is no single leader or coordinating body in charge of disaster data, these agencies "rarely work together," resulting in inefficiency during emergencies. The COVID-19 pandemic similarly exposed fragmentation. Health, immigration, and security agencies each held relevant data, but integrating this information was difficult due to a lack of a unified data platform. Organisational coordination goes beyond just having a central plan. It requires active collaboration. In Thailand, data exchange agreements between agencies or between the government and private sector have often been absent or inefficient. During the COVID-19 pandemic, mobile phone data and transportation data could have been useful for tracking movements and potential exposures, but this required coordination with telecommunication companies and strict data privacy safeguards. Any delay or reluctance in these partnerships limited the use of such big data. Similarly, for flooding, data from various departments, such as meteorology, irrigation, and local municipalities, needed to be merged for a comprehensive early warning. However, due to Thailand's centralised yet compartmentalised structure, the flow of information was slow.

Until recently, there was no robust governance framework or strategy for utilising big data in Thailand's public sector. The rules and policies governing data sharing have been unclear, leading some agencies to be cautious about sharing data, possibly due to concerns about legal implications. Recognising this, the Thai government initiated a "Digital Big Data" program through the Ministry of Digital Economy and Society to develop a more coherent approach to government data. However, policy development takes time, and as of 2020, this program was still in its early stages of development. The absence of standard protocols meant that during the COVID-19 pandemic, provinces and ministries sometimes developed their dashboards and systems that were not interoperable. Likewise, in disaster risk management, there is a need

for standardised data formats and an open data policy so that all stakeholders, including governments, the private sector, and researchers, can contribute and access critical information [28]. The current lack of transparent data governance slows down the use of big data in emergencies.

IV. Discussion and Critical Analysis

The comprehensive examination of social media big data applications in Thailand's crisis response reveals significant tensions between technological advancement and practical implementation. While the literature demonstrates substantial progress in developing sophisticated analytical frameworks, the translation of these capabilities into effective crisis management remains constrained by systemic challenges that extend beyond technological limitations. This analysis synthesises the key findings to identify critical gaps and propose strategic directions for enhancing Thailand's digital crisis response capabilities. While this analysis focuses specifically on Thailand, the identified challenges and opportunities have broader implications for Southeast Asian countries with similar digital infrastructure development levels and disaster vulnerability profiles. Countries like the Philippines, Indonesia, and Vietnam face comparable challenges with fragmented data systems, limited local language NLP capabilities, and digital inclusion gaps. The strategic recommendations presented here could serve as a foundation for comparative studies and regional framework development, though country-specific adaptations would be necessary given varying governance structures and technological readiness levels.

A. Identification of Gaps in Research and Practice

Although big data tools such as Spark and Kafka have enhanced real-time processing capabilities, a significant limitation remains the lack of a cohesive, interoperable data ecosystem within Thailand's public sector. Crisis response efforts often involve diverse agencies, such as meteorological, health, and emergency services, each maintaining its own siloed databases. This fragmentation hinders holistic analytics and slows emergency coordination.

During the COVID-19 pandemic, Thailand's provincial and national agencies created their dashboards without standardised protocols, making it difficult to consolidate data for nationwide decision-making. In flood scenarios, hydrological data, community reports, and satellite imagery often reside in separate platforms without seamless integration. This siloed infrastructure results in a fragmented situational picture, which reduces the effectiveness of early warnings and resource deployment.

Another gap involves the reliance on conventional analytical models, which have limited contextual awareness. Although NLP, sentiment analysis, and image recognition have been widely applied, many of these models struggle with domain-specific nuances, especially in local languages and cultural contexts. Thai-language sentiment analysis is hindered by informal syntax, mixed scripts, and slang, which frequently lead to the misclassification of emotional tone or intent [22].

Most studies focus on post-event or near real-time analysis, with less emphasis on predictive analytics. Few initiatives leverage machine learning for forecasting crisis escalation or population behavioural shifts, despite recent advances in AI-powered early warning systems that integrate meteorological and geospatial foundation models [32], [33]. Likewise, while streaming analytics provides real-time insights, most systems lack adaptive learning to refine results based on feedback or evolving patterns.

There is also an insufficient exploration of multimodal analytics, such as the fusion of text, image, video, and geospatial data, which is crucial for fully capturing the complexity of social media inputs during crises.

From a governance perspective, a significant gap remains in stakeholder coordination and strategic data policy. While Thailand's Ministry of Digital Economy and Society has introduced the Digital Big Data program, its scope and enforcement remain limited. During the COVID-19 pandemic, the absence of data-sharing agreements between government bodies and telecom providers impeded effective contact tracing and mobility analysis [28].

Additionally, crisis data usage lacks a robust legal framework to balance transparency, privacy, and the utility of data. This creates hesitancy among public and private actors to collaborate. The inconsistency in data governance standards also undermines cross-agency analytics, especially in times of high urgency.

Moreover, current research tends to focus heavily on government-centred approaches, with minimal attention to the participation of NGOs, academics, or the private sector. Such exclusion limits innovation and diversity in response mechanisms.

Data analytics often overlooks a crucial gap. It gives limited consideration to inclusivity and representation. Social media datasets usually favour urban, digitally literate populations. Meanwhile, rural, elderly, or low-income groups remain underrepresented. Flood maps or sentiment indices based only on Twitter activity may exclude affected populations. These populations lack internet access or prefer alternative platforms such as LINE or local radio.

Moreover, studies rarely examine how gender, language, or socioeconomic status influence digital participation during crises. Current big data analytics frameworks face a trade-off between processing scale and response latency. While Hadoop is good at batch processing, real-time streaming solutions often sacrifice analytical depth for speed. This limitation requires crisis management systems to have a balance between analysis and response capabilities.

B. Emerging Trends and Opportunities

Thailand continues exploring big data analytics for crisis response. Several future directions can enhance its effectiveness. Data quality and reliability present the most pressing challenges in crisis scenarios. The speed of data generation during crises, such as pandemics or floods, often leads to more errors, inconsistencies, or even missing information. Future research should develop more advanced data

preprocessing techniques. Machine learning powers computer techniques that effectively filter noise, manage missing values, and maintain the integrity of collected data in real-time. Real-time validation tools can also ensure that social media monitoring systems process only high-quality data. This reduces manual workload and increases trust in the results. This becomes especially important during health emergencies, where misinformation and unverified claims spread rapidly and hinder practical response efforts. Thailand faced significant challenges during the COVID-19 pandemic, prompting the country to develop effective frameworks. These frameworks use big data techniques to manage social media data and detect misinformation more effectively [17].

The scalability of big data infrastructure represents another critical area as government agencies and humanitarian organisations increasingly adopt these crisis management tools. Cloud-based platforms built on Apache Hadoop or Apache Spark offer flexible and cost-efficient solutions that can handle large volumes of rapidly changing data. As such, these platforms are particularly well-suited for emergencies where real-time data ingestion, storage, and processing are essential. However, the choice of cloud architecture must consider several factors. These factors include budget constraints, data sensitivity, internet reliability, and local technical capacity. In countries that frequently face natural disasters and have varying levels of digital readiness across regions, such as Thailand, it becomes crucial to assess which cloud-based tools are most practical and sustainable. Recent investments in data centres and cloud services in Thailand underscore the country's commitment to enhancing its digital infrastructure to support these needs. Future work should focus on developing benchmarking frameworks that assess different big data infrastructures based on regional needs and the types of crises they address.

Real-time misinformation detection and mitigation constitute another critical future direction. This matter is particularly relevant to Thailand's ongoing struggle with health-related fake news during the COVID-19 pandemic. Challenges remain, even with the success of the Anti-Fake News Centre, in keeping pace with the volume and virality of false content. The usage of NLP models and sentiment analysis in existing systems can enhance their ability to flag harmful content early. Improved misinformation taxonomies and automated fact-checking tools tailored to the Thai language and context are needed to boost efficiency and local relevance. Recent studies have demonstrated the effectiveness of Thai NLP techniques, including transfer learning models such as BERT, ULMFiT, and GPT, in detecting COVID-19 fake news within Thai social media texts [34].

Lastly, there is a growing need for Explainable AI (XAI) in crisis analytics. A system that provides explanations that humans can understand to make informed decisions. It is essential to ensure transparency and interpretability as AI-powered systems take on a greater role in public safety decisions. Tools like SHAP, LIME, and hybrid Neuro-Symbolic AI (NeSy AI) models can help decision-makers understand how predictions are made, allowing non-technical users to trust and adopt the system's outputs. Recent research has shown that XAI techniques are increasingly adopted in disaster risk prediction systems [35].

Future work in data validation, cloud-based scalability, misinformation control, and Explainable AI will be pivotal in optimising the use of big data for crisis response. These areas offer valuable opportunities. Researchers and policymakers can utilise them to enhance Thailand's preparedness and resilience in the event of future emergencies.

C. Strategic Policy Framework for Implementation

Based on the identified gaps and opportunities, this review proposes a multi-level policy framework for enhancing Thailand's crisis response capabilities through integrated social media big data analytics.

At the national governance level, Thailand should establish a unified National Crisis Data Authority to coordinate across the 48 disaster management agencies currently operating under 13 ministries. This authority would enforce standardized data-sharing protocols supported by comprehensive legal frameworks that balance privacy protection with operational utility, while implementing mandatory interoperability standards across all government crisis management systems. Such centralization would eliminate the current fragmentation that prevents effective information sharing and coordinated response efforts during emergencies.

The technical infrastructure requires deployment of a cloud-based integrated data platform accessible to all authorized stakeholders, incorporating real-time streaming capabilities through technologies such as Apache Kafka and Spark Streaming for continuous social media feed processing. Investment in Thai-language natural language processing development through strategic public-private partnerships is essential to overcome analytical limitations in processing informal language, mixed scripts, and regional dialects commonly found in social media communications. Additionally, establishing real-time data validation and quality assurance protocols would address persistent challenges of misinformation and data reliability that currently undermine trust in social media-based intelligence during crisis events.

Community engagement and digital inclusion form the foundation for effective crisis response through social media analytics. Comprehensive digital literacy programs targeting rural communities, elderly populations, and economically disadvantaged groups would expand the reach and representativeness of social media data beyond urban, digitally literate populations. Establishing community-based crisis reporting mechanisms that integrate seamlessly with national systems, including SMS-based reporting and monitored messaging groups, would create multiple channels for information collection. Creating robust feedback loops for continuous system improvement based on operational experiences and community input would ensure the framework remains responsive to evolving needs.

This framework requires phased implementation over three to five years, with year one focusing on

establishing governance structures and developing legal frameworks, years two and three emphasizing infrastructure deployment and pilot testing in selected provinces, and years four and five involving nationwide rollout and system optimization. Regular six-month assessments would evaluate progress against predetermined metrics and enable adaptive modifications based on technological advances, changing threat landscapes, and lessons learned from actual crisis events

V. Conclusion

Big data analytics and social media behavioural analysis have fundamentally transformed Thailand's crisis response capabilities during COVID-19 and flood disasters. Advanced technologies, such as natural language processing, sentiment analysis, real-time streaming analytics, and geospatial mapping, enable authorities to extract actionable intelligence from vast amounts of user-generated content, facilitating the rapid assessment of public sentiment, early detection of misinformation, efficient resource allocation, and improved coordination among government agencies. Thailand's experience demonstrates both transformative potential and critical systemic limitations, including fragmented data systems across 48 disaster management agencies, insufficient analytical capabilities for processing Thai-language content, gaps in data-sharing protocols within the governance framework, and digital exclusion of vulnerable populations due to connectivity and language barriers.

This analysis contributes two critical points to the discussion on Thailand's crisis management. First, it systematically identifies implementation gaps spanning fragmented technological infrastructure, limited analytical sophistication, weak governance frameworks, poor stakeholder coordination, and inclusivity challenges. Second, it identifies strategic opportunities through developing data quality frameworks, implementing cloud-based scalability solutions, building advanced misinformation detection systems, and integrating explainable AI tailored to Thai needs.

Thailand must prioritise developing interoperable data ecosystems, expand investment in advanced analytical capabilities and workforce development, and implement inclusive digital participation frameworks. These findings highlight the need to move beyond purely technological solutions toward comprehensive approaches that address organisational, social, and policy dimensions of digital crisis management. Future research should develop integrated frameworks combining technological innovation with institutional coordination mechanisms, community participation strategies, and ethical governance protocols to maximise social media big data's potential for strengthening crisis resilience in developing countries.

Acknowledgment

We want to thank peer reviewers for helping to review the paper.

Funding Statement

There is no funding agencies supporting the research work.

Author Contributions

Tan Zhi En: Writing – Original Draft Preparation, Review & Editing;

Tan Jie Ying: Writing – Original Draft Preparation, Review & Editing;

Yu Jia Xuan: Writing – Original Draft Preparation, Review & Editing;

Kai Liang Lew: Project Administration, Validation, Writing – Review & Editing;

Chean Khim Toa: Project Administration, Supervision, Writing – Review & Editing;

Suleiman Aliyu Babale: Writing – Review & Editing.

Conflict of Interests

No conflict of interests were disclosed.

Ethics Statements

Ethical approval was not applicable to this research since it did not involve human participants, animals, or sensitive data.

References

[1] A. Gandomi and M. Haider, “Beyond the hype: Big data concepts, methods, and analytics,” *International Journal of Information Management*, vol. 35, no. 2, pp. 137–144, 2015. DOI: https://doi.org/10.1016/j.ijinfomgt.2014.10.007

[2] S. Vieweg, A.L. Hughes, K. Starbird and L. Palen, “Microblogging during two natural hazards events: what twitter may contribute to situational awareness,” *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 1079–1088, 2010. DOI: https://doi.org/10.1145/1753326.1753486

[3] C. Reuter, A.L. Hughes and M.-A. Kaufhold, “Social Media in Crisis Management: An Evaluation and Analysis of Crisis Informatics Research,” *International Journal of Human–Computer Interaction*, vol. 34, no. 4, pp. 280–294, 2018. DOI: https://doi.org/10.1080/10447318.2018.1427832

[4] T. Sakaki, M. Okazaki and Y. Matsuo, “Earthquake shakes Twitter users: real-time event detection by social sensors,” *Proceedings of the 19th International Conference on World Wide Web*, pp. 851–860, 2010. DOI: https://doi.org/10.1145/1772690.1772777

[5] B. Poblete, J. Guzmán, J. Maldonado and F. Tobar, “Robust Detection of Extreme Events Using Twitter: Worldwide Earthquake Monitoring,” *IEEE Transactions on Multimedia*, vol. 20, no. 10, pp. 2551–2561, 2018. DOI: https://doi.org/10.1109/TMM.2018.2855107

[6] A. Wibowo, I. Amri, A. Surahmat and R. Rusdah, “Leveraging artificial intelligence in disaster management: A comprehensive bibliometric review,” *Jàmbá Journal of Disaster Risk Studies*, vol. 17, no. 1, 2025. DOI: https://doi.org/10.4102/jamba.v17i1.1776

[7] Y. Chen, K. Sherren, K.Y. Lee, L. McCay-Peet, S. Xue and M. Smit, "From theory to practice: insights and hurdles in collecting social media data for social science research," *Frontiers in Big Data*, vol. 7, 2024. DOI: https://doi.org/10.3389/fdata.2024.1379921

[8] M. Zaharia, M. Chowdhury, T. Das, A. Dave, J. Ma, M. McCauley, M.J. Franklin, S. Shenker and I. Stoica, “Apache Spark: a unified engine for big data processing,” *Communications of the ACM*, vol. 59, no. 11, pp. 56–65, 2016. DOI: https://doi.org/10.1145/2934664

[9] A.B.M. Moniruzzaman and S.A. Hossain, "NoSQL Database: New Era of Databases for Big data Analytics - Classification, Characteristics and Comparison," *arXiv*, 2013. DOI: https://doi.org/10.48550/arXiv.1307.0191

[10] G. Bello-Orgaz, J.J. Jung and D. Camacho, "Social big data: Recent achievements and new challenges," *Information Fusion*, vol. 28, pp. 45–59, 2016. DOI: https://doi.org/10.1016/j.inffus.2015.08.005

[11] W. Yu, G. Zhao, Q. Liu and Y. Song, "Role of big data analytics capability in developing integrated hospital supply chains and operational flexibility: An organisational information processing theory perspective," *Technological Forecasting and Social Change*, vol. 163, p. 120417, 2021. DOI: https://doi.org/10.1016/j.techfore.2020.120417

[12] A. Asif, N. Schneider, A.K. Copland, C. Huyck and B.T. Adebayo, "Automatic analysis of social media images to identify disaster type and infer appropriate emergency response," *Journal of Big Data*, vol. 8, no. 1, p. 83, 2021. DOI: https://doi.org/10.1186/s40537-021-00471-5

[13] A. Kumar and J.P. Singh, "Location reference identification from tweets during emergencies: A deep learning approach," *International Journal of Disaster Risk Reduction*, vol. 33, pp. 365-375, 2019. DOI: https://doi.org/10.1016/j.ijdrr.2018.10.021

[14] H. Purohit, C. Castillo, F. Diaz, A. Sheth and P. Meier, "Emergency-relief coordination on social media: Automatically matching resource requests and offers," *First Monday*, vol. 19, no. 1, 2013. DOI: https://doi.org/10.5210/fm.v19i1.4848

[15] J. Kreps, N. Narkhede and J. Rao, "Kafka: a Distributed Messaging System for Log Processing," *Proceedings of NetDB '11 (Networking Meets Databases Workshop)*, pp. 1–7, 2011. URL: https://notes.stephenholiday.com/Kafka.pdf

[16] Y. Kryvasheyeu, H. Chen, E. Moro, G. Van Hentenryck and J.urbanowicz, "Rapid assessment of disaster damage using social media activity," *Science Advances*, vol. 2, no. 3, p. e1500779, 2016. DOI: https://doi.org/10.1126/sciadv.1500779

[17] W. Kongkauroptham, P. Ractham, L. Kaewkitipong and E.M. P. Chiu, "Health-related misinformation sharing on social media in Thailand: A case study during the Covid-19 pandemic," *The International Conference on Electronic Business*, pp. 202–211, 2022 URL: https://aisel.aisnet.org/iceb2022/19/

[18] S.P. Pimpalkar and D. Sai Madhavi, "Leveraging Social Media Data to Improve Disaster Response and Recovery Efforts Using Artificial Intelligence Techniques: A Comprehensive Review," *Artificial Intelligence Based Smart and Secured Applications*, pp. 375–400, 2025. DOI: https://doi.org/10.1007/978-3-031-86299-1_26

[19] C. Bono, B. Pernici, J.L. Fernandez-Marquez, A.R. Shankar, M.O. Mülâyim and E. Nemni, "TriggerCit: Early Flood Alerting using Twitter and Geolocation -- a comparison with alternative sources," *arXiv*, 2022. DOI: https://doi.org/10.48550/arXiv.2202.12014

[20] J. Yin, A. Lampert, M. Cameron, B. Robinson and R. Power, "Using Social Media to Enhance Emergency Situation Awareness," *IEEE Intelligent Systems*, vol. 27, no. 6, pp. 52–59, 2012. DOI: https://doi.org/10.1109/MIS.2012.6

[21] M. Imran, C. Castillo, F. Diaz and S. Vieweg, "Processing Social Media Messages in Mass Emergency: A Survey," *ACM Computing Surveys*, vol. 47, no. 4, 2015. DOI: https://doi.org/10.1145/2771588

[22] C. Imvimol and P. Chongstitvatana, "Sentiment analysis of messages on Twitter related to COVID-19 using deep learning approach," *2021 25th International Computer Science and Engineering Conference (ICSEC)*, pp. 363–367, 2021. DOI: https://doi.org/10.1109/ICSEC53205.2021.9684587

[23] P. Gunawong and N. Butakhieo, "Social Media in Local Administration: An Empirical Study of Twitter Use in Flood Management," *2016 Conference for E-Democracy and Open Government (CeDEM)*, pp. 77–83, 2016. DOI: https://doi.org/10.1109/CeDEM.2016.30

[24] S. Gardasevic, I. Vladanovic, D. Barac, M. Maric, and M. Zivanovic, "Public Health Using Social Network Analysis During the COVID-19 Era: A Systematic Review," *Information*, vol. 15, no. 11, p. 690, 2024. DOI: https://doi.org/10.3390/info15110690

[25] X.X. Zhu, J. Wang, R. Bamler, P. Reinartz and M. Eineder, "Geoinformation Harvesting From Social Media Data: A community remote sensing approach," *IEEE Geoscience and Remote Sensing Magazine*, vol. 10, no. 4, pp. 150–180, 2022. DOI: https://doi.org/10.1109/MGRS.2022.3219584

[26] I. Franch-Pardo, B.M. Napoletano, F. Rosete-Verges and L. Billa, "Spatial analysis and GIS in the study of COVID-19. A review," *Science of The Total Environment*, vol. 739, p. 140033, 2020. DOI: https://doi.org/10.1016/j.scitotenv.2020.140033

[27] S. Rattanakhamfu and N. Rukkiatwong, "Our broken system fuels flood crisis," *Thailand Development Research Institute (TDRI)*, 2025. URL:https://tdri.or.th/en/2025/01/our-broken-system-fuels-flood-crisis/ (Accessed 7 August 2025)

[28] F. Thompson, M.L. Hoang, T.H. Ng, and D. Zara, "Harnessing the Potential of Big Data in Post-Pandemic Southeast Asia," *ADB Briefs*, 2021. DOI: https://doi.org/10.22617/BRF210100-2

[29] W. Thanathanphon, P. Kongphukdee, P. Prompinit, P. Rattanapitikon and C. Ouppapong, "Development of Flood Monitoring System from Social Media in Thailand," *IAHR World Congress*, vol. 40, pp. 1450–1455, 2023. DOI: https://doi.org/10.3850/978-90-833476-1-5_iahr40wc-p0795-cd

[30] K. Seneviratne, M. Nadeeshani, S. Senaratne and S. Perera, "Use of Social Media in Disaster Management: Challenges and Strategies," *Sustainability*, vol. 16, no. 11, p. 4824, 2024. DOI: https://doi.org/10.3390/su16114824

[31] Y. Lv, C. Ma, X. Li and M. Wu, "Big data driven COVID-19 pandemic crisis management: Potential approach for global health," *Archives of Medical Science*, vol. 17, no. 3, pp. 829–837, 2021. DOI: https://doi.org/10.5114/aoms/133522

[32] M. Reichstein, G. Camps-Valls, I. Cremer, N.K.D. Marta, S. Ghaffarian, M.D. Mahecha, R. Muetzelfeldt, G. Navacchi, S. Puntsag, D. Thiemig, P. Vicente-Serrano and M. Jung, "Early warning of complex climate risk with integrated artificial intelligence.," *Nature Communications*, vol. 16, no. 1, p. 2564, 2025. DOI: https://doi.org/10.1038/s41467-025-57640-w

[33] G. Camps-Valls, V. Dutt, J. Eyring, N. Gondan, M. Grelik, P. M. Haas, L. Hentgen, R. Iturriaga, M. D. Mahecha, P. Navratil, J. Palacios-Estremera, S. Park, M. Reichstein, R. Scheurer and P. Stier, "Artificial intelligence for modeling and understanding extreme weather and climate events," *Nature Communications*, vol. 16, no. 1, p. 1919, 2025. DOI: https://doi.org/10.1038/s41467-025-56573-8

[34] P. Mookdarsanit and L. Mookdarsanit, "The COVID-19 fake news detection in Thai social texts," *Bulletin of Electrical Engineering and Informatics*, vol. 10, no. 2, pp. 988–998, 2021. DOI: https://doi.org/10.11591/eei.v10i2.2745

[35] S. Ghaffarian, F.R. Taghikhah and H.R. Maier, "Explainable artificial intelligence in disaster risk management: Achievements and prospective futures," *International Journal of Disaster Risk Reduction*, vol. 98, p. 104123, 2023. DOI: https://doi.org/10.1016/j.ijdrr.2023.104123