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From Rainfall to Rumors: Interpreting the 2024 Bangladesh Floods Through Numbers, Narratives, and Information Gaps

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Key Points:

- Hydrometeorological analysis shows extreme monsoon rainfall and MJO dynamics contributed to the 2024 transboundary Bangladesh floods
- Misinformation suggesting intentional release from Indian dams highlights the need to manage both physical flood risks and social narratives
- A pilot early warning system on the Feni and Gomati rivers offers an actionable path to revitalize transboundary flood management

Supporting Information:

Supporting Information may be found in the online version of this article.

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Abstract

When severe floods struck southeastern Bangladesh in August 2024, competing explanations emerged. Meteorological analysis revealed that extreme precipitation was exacerbated by the Madden-Julian Oscillation and jet stream dynamics. However, alternative narratives proliferated on social media, particularly claims that India deliberately released water from upstream dams. This study synthesizes hydrometeorological data and social media analysis to examine the divergence between scientific evidence and social narratives. Despite hydrometeorological explanations, misinformation attributing floods to intentional dam releases gained traction because it aligned with existing sentiments in Bangladesh. While these narratives did not appear to materially impact disaster response in 2024, similar patterns elsewhere demonstrate the potential harm. Effective flood management requires aligning scientific data with narratives that motivate collective action. We argue that both India and Bangladesh face mutual vulnerabilities that give misinformation its power but can also facilitate cooperation. Drawing on the water diplomacy literature, we propose a pilot flood early warning initiative on the Feni and Gomati rivers, combining data sharing with community-based outreach through locally trusted individuals and institutions, as a practical first step toward strengthening transboundary flood preparedness, countering divisive misinformation, and achieving a flood-resilient system.

Plain Language Summary

In August 2024, devastating floods struck southeastern Bangladesh, affecting nearly 6 million people. While scientific data showed the floods resulted from extreme rainfall driven by weather patterns, including the Madden-Julian Oscillation and jet stream dynamics. Yet rumors spread on social media claiming India deliberately released dam water to flood Bangladesh. This study examines both the meteorological findings and the social narratives. We found that misinformation gained traction because it aligned with longstanding fears about upstream water control and gaps in data sharing between the two countries, despite clear evidence that rainfall, not dam releases, caused the flooding. Our analysis shows that effective flood management requires more than scientific data: it needs narratives that motivate collective action and collaboration in river basins shared between countries. We argue that both India and Bangladesh face vulnerabilities that make them susceptible to misinformation, but these same vulnerabilities can provide a basis for working together. Using ideas from the field of water diplomacy, we recommend a pilot flood early warning project on the Feni and Gomati rivers that pairs upstream data sharing with community outreach through trusted local messengers. This could serve as a first step toward better flood preparedness and a flood-resilient cross-border system.

1. Introduction

Flood hazards today unfold in two intertwined domains: the physical landscapes shaped by hydrometeorological processes, and the digital, discursive arenas where people interpret and contest them (Di Baldassarre et al., 2013; Sivapalan, 2015). In this second arena, numbers derived from measurement, modeling, and forecasts coexist with narratives shaped by identities, values, and lived experiences. Recent literature on sociohydrology underscores the importance of this duality, highlighting that flood outcomes are not determined solely by exposure to hazards but emerge from coupled interactions between natural and human systems (Di Baldassarre et al., 2019). Indeed, natural hazards become disasters only when they intersect with human vulnerability, defined as the social, political, and economic conditions that limit a community's capacity to cope (Wisner et al., 2004). In the digital age,

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these underlying vulnerabilities are increasingly revealed and reinforced through the narratives that spread during a crisis. Effective disaster governance, therefore, requires attention to both the numbers that characterize exposure and the narratives that shape public response. When these numbers and narratives diverge—especially through misinformation or politicized storytelling—public trust can erode, coordinated action can falter, and collective capacity to respond can weaken. For instance, in flood-prone Assam, India, Leong (2018) found that communities with similar levels of exposure and infrastructure exhibited markedly different response capacities depending on whether their prevailing narratives were shaped by agency and institutional trust or by neglect and fatalism.

These challenges are amplified in transboundary contexts, where physical hazards intersect with complex governance structures and historical grievances that span cultural and political borders (Boin, 2019; Olsson, 2015). In South Asia, the India-Bangladesh border hosts numerous shared river systems where upstream-downstream dynamics create asymmetric flood risks (Arfanuzzaman, 2025; Barua et al., 2018). Despite the decades-long existence of formal bilateral cooperative mechanisms, like the Joint Rivers Commission (JRC) established in 1972, operational frameworks for real-time data sharing and coordinated flood response remain underdeveloped for smaller basins prone to flash floods. While extensive research has examined either the technical aspects of monsoon flooding in Bangladesh (Mirza, 2002, 2003; Shahid, 2010) or the governance challenges of transboundary water management (Aktar, 2021; Baten & Titumir, 2016; Parven & Hasan, 2018), few studies have integrated hydrometeorological analysis with information dynamics during actual flood events. This gap is critical: as digital communication transforms how hazard information spreads, understanding the interplay between scientific evidence and social narratives becomes essential for effective response (Haddow & Haddow, 2013; Palen & Hughes, 2017; Tim et al., 2017).

The 2024 Bangladesh floods illustrate this tension. Hydrologically and meteorologically, the floods were consistent with well-documented drivers: intense monsoon rainfall influenced by the Madden–Julian Oscillation (MJO) and regional jet stream dynamics. Yet alternative explanations proliferated on social media, including claims that India deliberately released water from the Dumboor Dam. These competing explanations did not arise in isolation: as Barua et al. (2025) note, water governance across South Asia is often marked by bureaucratic opacity and politicized communication, creating conditions in which mistrust can amplify or even generate misleading narratives during crises. This presents a critical challenge in crisis contexts, where effective responses often depend on the rapid integration of both scientific assessments of numbers to characterize the scope of the hazard and trusted narratives to motivate and coordinate action (Aerts et al., 2018; Vasileiou et al., 2022). When the two align, collective action is facilitated; when they conflict, confusion and mistrust can hinder it. In Bangladesh, these conflicting perspectives on the flood emerged at a politically sensitive moment, with popular uprising already challenging the state's legitimacy. In this paper, we examine the 2024 Bangladesh floods in terms of both hydrometeorological findings and sociopolitical narratives to better understand how their divergence can impact emergency response and future preparedness by addressing two interconnected questions.

1. What were the actual hydrometeorological conditions of the August 2024 floods, and can the dam release hypothesis be scientifically evaluated?
2. What narratives emerged during the flood, and how did they diverge from scientific evidence?

To answer these questions, we integrate multiple analytical approaches: comprehensive hydrometeorological analysis using satellite and ground-based observations, hydrological assessment of river responses and flood mechanisms, qualitative analysis of social media narratives, and examination of governance structures and bilateral cooperation mechanisms. Our analysis demonstrates that the floods primarily resulted from natural meteorological processes, yet misinformation attributing them to intentional dam releases gained traction due to underlying institutional gaps and historical mistrust.

Addressing this divergence requires more than correcting the factual record. Misinformation about floods often gains traction not because it is technically accurate but because it speaks to legitimate grievances and long-standing vulnerabilities. Understanding what makes certain narratives compelling is therefore as important as establishing what natural processes contributed to the floods. This recognition points toward the need to revitalize the bilateral institutions that have left those grievances unaddressed. In the Discussion, we draw on the water diplomacy literature to chart a path from diagnosis to action. We first examine the growing threat that misinformation poses to flood management. We then argue that the competing narratives documented in Section 4, though polarized, share a common root in mutual vulnerability, and that recognizing this shared condition can shift the entry point for cooperation from contested blame toward practical problem-solving. We close by

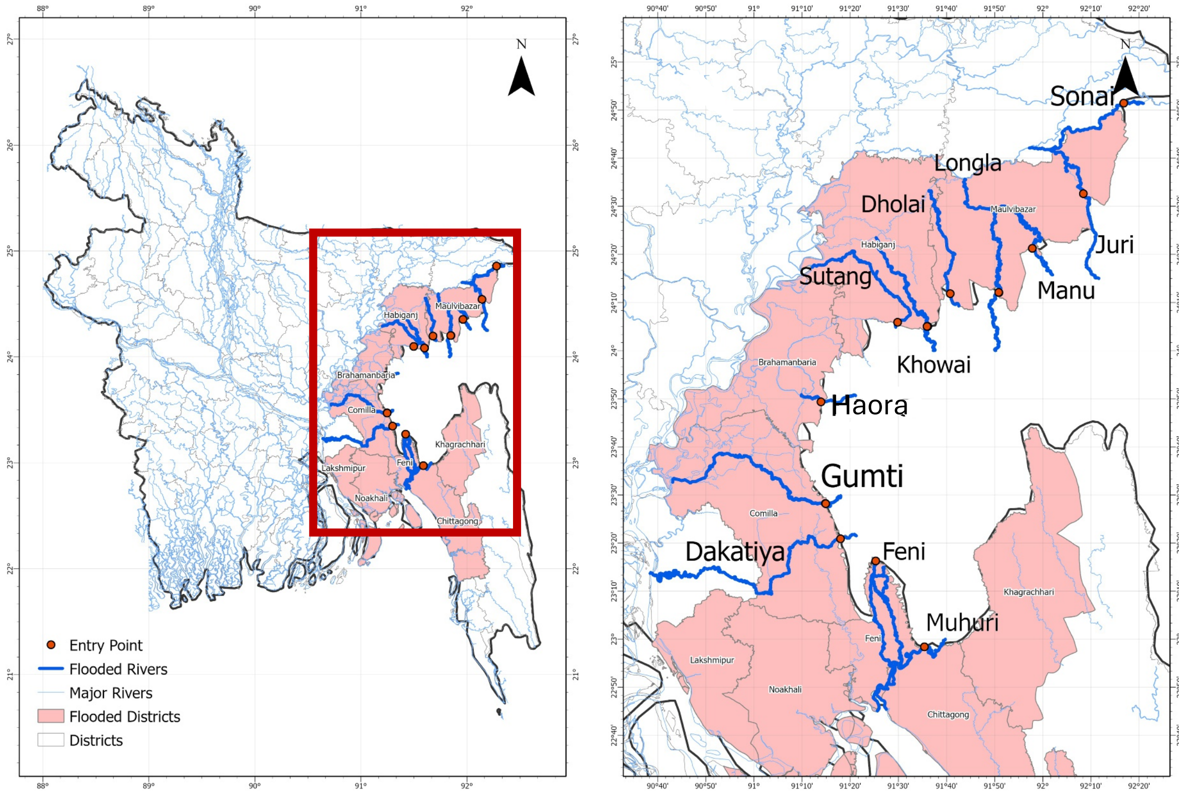

Figure 1. Map depicting the flood-affected areas in Bangladesh during August 2024, highlighting transboundary river systems. The shaded regions indicate districts impacted by flooding, while the blue lines represent flooded rivers. Red circles denote the entry points of transboundary rivers into Bangladesh.

outlining a pilot initiative for improving flood early warning on the Feni and Gomati rivers, intended both to reduce flood harm and to build institutional capacity to counter divisive misinformation.

2. Study Area and Data Sets

2.1. Study Area: Transboundary River Systems in Southeastern Bangladesh

The study area spans nine districts in southeastern Bangladesh, extending from the Tripura–Bangladesh border to the lower Meghna estuarine region (Figure 1). This region is intersected by 12 transboundary river basins that originate in the hill tracts of northeastern India, particularly Tripura, Meghalaya, and southern Assam, before flowing south and southwest into Bangladesh. These rivers include the Feni, Gomati, Manu, Khowai, Haora, Dakatia, Muhuri, Dhalai, Longla, Sonai, Sutang, and Juri.

Unlike the major Ganges–Brahmaputra–Meghna (GBM) system, these basins are relatively small to medium in scale. Individual drainage areas range from approximately 650 to 5,500 km^2, based on HydroSHEDS Level-6 basin delineations (Lehner et al., 2008). Although modest in size compared to the GBM mainstem rivers, their collective influence during extreme rainfall events is substantial. Simultaneous flooding across multiple basins can generate compounding impacts across southeastern districts, particularly where settlement and infrastructure are concentrated along low-lying floodplains.

The upstream–downstream configuration characteristic of these transboundary systems introduces structural hydrological asymmetries. Headwater catchments in India's northeastern hill regions commonly exceed 500 m in elevation and locally surpass 1,000 m above mean sea level. These steep uplands drain into the low-lying deltaic and coastal plains of Bangladesh, where elevations are typically below 20 m and rarely exceed 50 m above mean sea level. The pronounced relief gradient promotes short hydrological response times and rapid runoff concentration during high-intensity monsoon precipitation events (Chow et al., 1988; Dingman, 2015). Such asymmetries in topography and jurisdiction are widely recognized as defining features of risk and governance challenges in transboundary basins (Sadoff & Grey, 2002; Zeitoun & Warner, 2006). This rapid hydrological transmission contrasts with the larger and more slowly responding Ganges and Brahmaputra systems, where basin scales exceeding one million square kilometers allow multi-day forecasting lead times under operational flood forecasting frameworks (Emerton et al., 2016; Hopson & Webster, 2010).

Southeastern Bangladesh receives approximately 2,000–3,500 mm of annual rainfall, of which 70%–80% occurs during the June–September monsoon season (Hossain, 2014; Shahid, 2010). Monsoon rainfall is driven primarily by moisture-laden southwest winds carrying weak tropical depressions from the Bay of Bengal, with orographic enhancement from the Meghalaya plateau intensifying precipitation in northeastern regions (Shahid, 2010). The region's hydrology is therefore strongly monsoon-driven. Under typical seasonal conditions, flooding develops as cumulative rainfall across upstream basins raises river levels over several days (Mirza, 2003). In contrast, northeastern Bangladesh is particularly susceptible to flash flooding associated with intense rainfall over steep, short headwater catchments draining from the Meghalaya Plateau (Mirza, 2003). The August 2024 event was anomalous in both intensity and spatial coherence, with simultaneous extreme rainfall across multiple southeastern basins generating compound fluvial responses that exceeded typical seasonal patterns.

Compared to the more extensively regulated mainstem rivers of the Ganges–Brahmaputra system, the southeastern transboundary basins are only partially regulated. While localized infrastructure such as the Dumboor hydropower project on the Gomati River exists in Tripura (Majumder et al., 2015), most of these basins function primarily as rainfall-driven systems, with storage capacity that is small relative to peak monsoon discharge. Cross-border hydrometeorological data exchange mechanisms are more limited for these smaller basins than for the major international rivers, contributing to information asymmetries during extreme events. These physical and institutional characteristics together define the hydrological and governance context within which the August 2024 flood event unfolded.

2.2. Data Sets

Our comprehensive analysis of the August 2024 Bangladesh floods utilizes multiple data sets spanning meteorological, hydrological, satellite, soil, geospatial, and social media sources.

The hydrological and climatological analysis utilizes three key data sets: CHIRPS 2.0 for precipitation (Funk et al., 2015), ERA5 for zonal wind speed (Hersbach et al., 2020), and data from the Australian Bureau of Meteorology for the Madden-Julian Oscillation (MJO) phases. The CHIRPS 2.0 data set provides high-resolution (0.05°) gridded precipitation estimates from 1981 to the present, combining satellite observations and interpolated station data. This data set effectively removes systematic biases, making it a reliable source for analyzing precipitation patterns in data-sparse regions. For wind speed analysis, ERA5 reanalysis data from the European Center for Medium-Range Weather Forecasts (ECMWF) was used. ERA5 provides hourly atmospheric data with a 0.25° spatial resolution and includes a detailed vertical structure from the surface to different pressure levels.

For our analysis, wind speed was analyzed at 250 hPa, focusing on the u and v wind components to assess the role of atmospheric circulation in driving extreme weather patterns. The Madden-Julian Oscillation (MJO) data, sourced from the Australian Bureau of Meteorology (available from https://www.bom.gov.au/climate/mjo/), were used to examine the phases and amplitudes of the MJO during the flood event. We utilize the Wheeler and Hendon (2004) MJO RMM index (Wheeler & Hendon, 2004), which is calculated based on daily equatorially averaged (15°S–15°N) outgoing longwave radiation (OLR) and zonal winds at 850 and 200 hPa from the NCEP–NCAR reanalysis. The MJO is a major driver of tropical weather variability, characterized by eastward-moving pulses of cloud and rainfall, with phases typically recurring every 30–60 days.

Water level and rainfall data for different river stations and districts were collected from the Bangladesh Water Development Board (BWDB) and Bangladesh Meteorological Department (BMD). The BWDB maintains a network of monitoring stations across affected river basins following the Flood Forecasting and Warning Center (FFWC) network (https://ffwc.rimes.int/app/home). Daily precipitation data from ground stations were measured starting from 9 a.m. Bangladesh time, while satellite measurements start from midnight Coordinated Universal Time (UTC).

We used Sentinel-1 C-band Synthetic Aperture Radar (SAR) data for flood extent mapping. The data were acquired in Interferometric Wide (IW) swath mode with 10-m spatial resolution. Dual-polarization data (VV and VH) were used to increase surface water detection reliability.

Soil permeability data across flood-affected districts were obtained from the Bangladesh Agricultural Research Council. Watershed boundaries for the 12 transboundary river basins were delineated using the HydroSHEDS database (Lehner & Grill, 2013), which provides hydrologically conditioned elevation data derived from the Shuttle Radar Topography Mission (SRTM). Basin boundaries were used to calculate area-averaged precipitation anomalies and assess spatial coherence between rainfall patterns and flood impacts.

Social media posts were collected from X (Twitter) and Facebook platforms by searching for trending hashtags related to the 2024 Bangladesh floods. The data set includes post content, engagement metrics (views, likes, comments, shares), and temporal information. The complete social media data set is publicly available through the Harvard Dataverse (Rabb et al., 2025).

3. Methods

3.1. Statistical Analysis Methods and Anomaly Calculation

Building on previous studies (Cheng & AghaKouchak, 2014; Coles, 2001; Kao & Ganguly, 2011; Kharin et al., 2007), we applied Generalized Extreme Value (GEV) theory to estimate return levels of extreme precipitation events during the flood event. The GEV distribution, derived from block maxima theory, quantifies extreme precipitation intensity. For a given duration (e.g., daily data from CHIRPS2.0), we extract the Annual Maximum Precipitation (AMP) series and fit a GEV model to estimate its parameters. Extreme rainfall statistics are commonly expressed as T-year rainfall depths, representing the expected occurrence of an annual maximum precipitation event exceeding a threshold within a T-year period. Further details on GEV can be found in prior studies (Coles, 2001), and its application in climate models is discussed extensively (Cheng & AghaKouchak, 2014; Ghosh et al., 2012; Kao & Ganguly, 2011).

Standardized precipitation anomalies for the monsoon period (June–August) were calculated for nine transboundary river basins relative to the long-term average from 1981 to 2024. The standardized anomaly for each basin was computed as:

$$\text{Anomaly} = (\text{Observed} - \text{Mean}) \,/\, \text{Standard Deviation}$$

Here, the mean and standard deviation are calculated from the 44-year baseline period (1981–2024).

To assess whether the annual maximum and mean precipitation for 2024 are significantly higher than historical values (1981–2023), we performed an one tailed one-sample *t*-test. This test compared the 2024 precipitation to the distribution of historical values, with the null hypothesis stating that no significant difference exists. Locations with a p-value less than 0.01 were considered to have experienced a statistically significant increase in precipitation, indicating potential extreme weather anomalies in 2024.

3.2. Satellite Imagery Analysis

Water extent mapping was performed using Sentinel-1 C-band Synthetic Aperture Radar (SAR) data. The images were preprocessed using standard procedures, including thermal noise removal, radiometric calibration, terrain correction, and speckle filtering.

Flooded areas were identified based on the characteristic low backscatter values of open water due to specular reflection. A threshold-based classification approach was applied using calibrated VV polarization imagery. Inundated pixels were delineated by comparing backscatter intensity to a reference (pre-flood) image, allowing detection of newly inundated areas during the flood event.

Due to orbital and acquisition constraints, cloud-penetrating SAR imagery was not consistently available for all districts on all dates. Therefore, Brahmanbaria and neighboring areas, where data were available before and during the flood (11, 21, and 23 August), were selected to represent typical inundation patterns. The extracted flood maps were overlaid on administrative boundaries for spatial reference. A broader view of the regional SAR imagery is shown in Figure S3 of Supporting Information S1.

3.3. Social Media Analysis

To understand how narratives surrounding the floods may have impacted emergency response, we analyzed social media posts using inductive qualitative content analysis. For an informative review of inductive versus deductive analysis for qualitative methods, see (Bingham & Witkowsky, 2022) and for a review of content analysis, see (Krippendorff, 2018). The purpose of our analysis was not to produce representative statistics about social media discourse, but rather to identify the mechanisms by which information environments interact with flood risk. Specifically, we sought to clarify how narratives shared in response to floods gain traction, reinforce group identities, and erode institutional trust, with particular attention to how misinformation can carry consequences for both immediate emergency response and, through self-reinforcing dynamics, longer-term flood preparedness. Qualitative methods are well suited to this aim. Inductive content analysis enables the identification of thematic patterns from limited data (Bingham & Witkowsky, 2022; Krippendorff, 2018).

We focused on social media posts with high levels of reach, which we define as receiving more than 1,000 views. As many previously open social media research tools (e.g., the Twitter API or CrowdTangle) have changed or been removed in recent years, systematic large-scale collection was not feasible; this practical constraint reinforced our decision to prioritize depth of qualitative analysis over breadth of coverage. We analyzed only posts made between 20 August 2024, and 30 September 2024, as our main focus was the initial reaction online due to its potential impact on the immediate emergency response. For each search query, we examined the first 100 results inside our date range, then selected high-reach posts from that superset. In total, we included 85 posts in our inductive analysis. Our findings need to be understood and interpreted with consideration given to these scope and sampling constraints.

The main subset of social media data was taken by using X's search feature to find posts with the hashtags "#FloodInBangladesh" and "#FloodsInBangladesh" on X (Twitter), as well as the search query "flood in Bangladesh." Results were ordered using the built-in X filter "Top."

An additional subset was gathered from Facebook threads discussing a hydrologist's interpretation of the events, which was made known to one of the researchers through personal connections and gained significant reach. Posts that were originally written in Bangla, Hindi, Urdu, or Arabic were translated to English using machine translation through Google Translate.

4. Results

4.1. Analysis of Numbers: Meteorological and Hydrological Observations

Bangladesh is one of the most hazard-prone countries globally (Rumpa et al., 2023; Tohan et al., 2024), and a recognized climate change hotspot (Eckstein et al., 2018; Imran et al., 2023). Its location in the Ganges-Brahmaputra-Meghna delta and subtropical monsoon climate creates exceptional susceptibility to extreme weather events (Caesar et al., 2015; Haque & Nahar, 2023; Imran et al., 2023; Palash et al., 2020). Projections suggest temperatures could rise 1.5–2.7°C by mid-century (Cook & Lane, 2010) and higher temperature are already contributing to more frequent severe flooding (Ahmed et al., 2017). While economic growth has improved resilience in some areas, persistent inequities and fragile infrastructure continue to amplify disaster risks. The August 2024 floods were exceptional in both severity and location. Unlike typical monsoonal floods that affect the north and northeast, these floods struck the southeastern districts, including Feni, Comilla, and Noakhali. These areas are not severely flood-prone. Yet the 2024 floods affected 5.8 million people, displaced over 502,000 into evacuation shelters, and isolated more than one million (Inter-Cluster Coordination Group-Humanitarian Coordination Task Team, 2024). Economic losses reached USD 122 million in fisheries and USD 34 million in livestock, with over 7,000 schools closed, affecting 1.75 million students (Inter-Cluster Coordination Group-Humanitarian Coordination Task Team, 2024). Figure 1 shows the affected districts and 12 flooded transboundary river basins across nine districts. Upstream in Tripura, India, floods caused over 30 fatalities and displaced 149,000 people across 800+ relief camps, impacting 1.7 million individuals (Sphere India, 2024). These floods subsequently flowed downstream, exacerbating flooding in Bangladesh's southeastern regions. The flooding resulted from intense regional precipitation exceeding 100-year return periods in some areas, with peak rainfall occurring 18–22 August. Multiple districts recorded nearly 200 mm/day (BWDB and CHIRPS 2.0), with Feni exceeding 300 mm/day according to Bangladesh Meteorological Department data. Indian regions recorded 153–182 mm on 21 August. This extreme precipitation resulted from three converging factors: severe monsoon conditions, the MJO, and Central Asian jet stream positioning.

This section presents a multi-scale analysis of meteorological and hydrological conditions during the August 2024 event: monsoon precipitation patterns and historical context; large-scale atmospheric phenomena, including MJO and jet stream dynamics; river water level responses; satellite-documented flood extent; and flood mechanism characterization distinguishing fluvial versus pluvial contributions. This integrated analysis establishes the natural drivers behind the floods and evaluates competing explanations.

4.1.1. Severe Monsoon Precipitation

Bangladesh experiences high variability in summer monsoon precipitation, with eastern regions receiving 15–30 mm/day compared to 10 mm/day elsewhere (Figure S1a in Supporting Information S1). Using CHIRPS 2.0 data (Funk et al., 2015) from 1981 to 2024, we analyzed precipitation characteristics in flood-affected districts. While 2024 showed normal mean annual precipitation (Figure S1d in Supporting Information S1), annual maximum precipitation was significantly higher (99% confidence level) than historical records in Lakshmipur, Feni, and Noakhali (Figure S1c in Supporting Information S1). This indicates that total annual rainfall in 2024 was not abnormal, but rainfall intensity during the flood event was unprecedented, contributing to unexpected severity as these regions were unprepared for such extreme precipitation.

To understand the temporal and spatial characteristics of the extreme rainfall that drove the flooding, we analyzed precipitation patterns during the critical flood period. Figure 2a shows the temporal precipitation distribution during 14–22 August, 2024, using BWDB ground station and CHIRPS 2.0 satellite data. The spatial distribution of precipitation is provided in Figure S2 of Supporting Information S1 using CHIRPS 2.0 satellite data. Minor discrepancies between ground and satellite measurements can be attributed to different data collection approaches and daily tabulation methods. BWDB measurements start at 9 a.m. Bangladesh time, while satellite measurements begin at midnight UTC. However, both sources consistently show peak rainfall around 19 August 2024, with continued substantial precipitation through 21–22 August that compounded flood impacts. The most intense rainfall (>200 mm/day) occurred on 19 August in Noakhali, Feni, Lakshmipur, and Khagrachhari, emphasizing the simultaneous heavy precipitation across India and Bangladesh that contributed to flood severity. Generalized Extreme Value analysis (Figure 2c) confirms extreme rainfall events with 45-, 100-, and 30-year return periods in Lakshmipur, Noakhali, and Feni, respectively. This unprecedented precipitation event left communities unprepared for the subsequent flooding. To place this event in historical context and assess its statistical significance across the broader region, we examined precipitation anomalies across affected transboundary basins. The August 2024 floods affected 12 transboundary river basins between India and Bangladesh. To assess precipitation anomalies, we estimated monthly standardized area-averaged precipitation anomalies for the monsoon period (June–August) relative to 1981–2024 averages in nine larger river basins (Figure 2d). Results show statistically significant deviations (95% confidence level) from historical norms in six basins: Feni, Gomati, Dakatia, Haora, Sutang, and Manu Rivers.

4.1.2. Influence of the MJO and Jet Stream Patterns

Large-scale atmospheric conditions during August 2024 were consistent with patterns previously associated with enhanced precipitation over the Bay of Bengal region. The Madden–Julian Oscillation (MJO) was predominantly in phases 2 and 3 during this period, phases linked to increased convective activity and above-normal rainfall over South Asia and the Bay of Bengal in prior studies (Anandh & Vissa, 2020; Mishra et al., 2017; Pai et al., 2011; Zhang, 2013). Figure 3b presents spatially averaged daily precipitation totals over eastern Bangladesh, color-coded by MJO phase. Peak rainfall on 19–20 August coincided with phase 2 conditions, when the Real-time Multivariate MJO (RMM) amplitude exceeded 1, indicating an active event (Wheeler & Hendon, 2004). Although this temporal alignment is consistent with prior evidence linking MJO phase to enhanced extreme rainfall frequency over the Indian subcontinent (Anandh & Vissa, 2020; Mishra et al., 2017), these studies demonstrate modulation of rainfall probability rather than direct event-scale triggering. The MJO is therefore interpreted here as an intraseasonal background influence that may have increased the likelihood of sustained convection during the event period, rather than as a deterministic driver of the flooding.

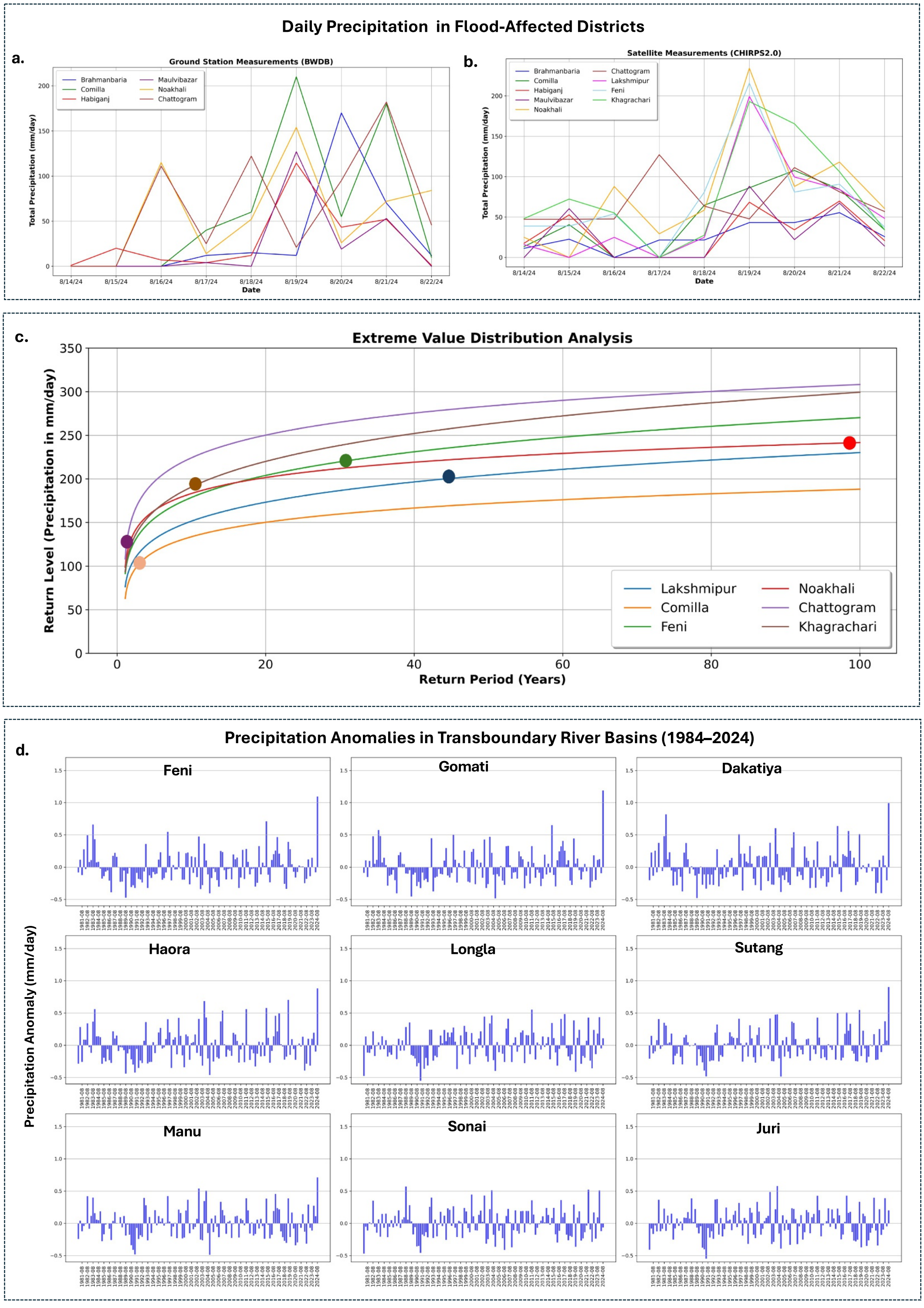
Daily Precipitation in Flood-Affected Districts
a.
Ground Station Measurements (BWDB)
Brahmanbaria
Comilla
Habiganj
Maulvibazar
Noakhali
Chattogram
Total Precipitation (mm/day)
Date
b.
Satellite Measurements (CHIRPS2.0)
Brahmanbaria
Comilla
Habiganj
Maulvibazar
Noakhali
Chattogram
Lakshmipur
Feni
Khagrachari
Total Precipitation (mm/day)
Date
c.
Extreme Value Distribution Analysis
Return Level (Precipitation in mm/day)
Return Period (Years)
Lakshmipur
Comilla
Feni
Noakhali
Chattogram
Khagrachari
d.
Precipitation Anomalies in Transboundary River Basins (1984–2024)
Feni
Gomati
Dakatiya
Haora
Longla
Sutang
Manu
Sonai
Juri
Precipitation Anomaly (mm/day)

Figure 2.

Upper-level circulation patterns during the event were also consistent with enhanced large-scale ascent over eastern Bangladesh. Figure 3a presents ERA5 reanalysis wind fields at 250 hPa (Hersbach et al., 2020), showing strengthened upper-tropospheric flow over northern India and Bangladesh on 19 August. Enhanced upper-level winds can support convective development by increasing divergence aloft and promoting vertical motion. The positioning of the subtropical jet during this period coincided with peak rainfall, suggesting that mid-latitude circulation features may have contributed to a dynamically favorable environment for sustained precipitation.

This interaction between intraseasonal tropical variability and upper-level circulation patterns illustrates the multi-scale nature of the August 2024 event. Rather than acting independently, monsoonal moisture supply, MJO-modulated convection, and upper-level dynamical support likely interacted to produce conditions conducive to extreme rainfall. The flooding is therefore interpreted as the result of coupled large-scale and regional atmospheric processes rather than a single dominant driver.

4.1.3. Water Levels, Extent, and Mechanisms

The extreme precipitation documented above triggered a cascade of hydrological responses across southeastern Bangladesh's river systems. Water level changes in southeastern Bangladesh rivers were analyzed using 15 August as the baseline, with data from BWDB ground stations. Figure 4a shows marked increases starting 19 August, peaking 21 August in the Gomati, Feni, and Haora rivers. Water levels rose 6–7 m from baseline in some locations, with the sharp 19–20 August increase demonstrating the substantial impact of extreme rainfall on flood severity. The timeline of meteorological events (Figure 4b) supports this flood progression.

To complement the ground-based measurements, satellite observations provide a comprehensive view of the flooding's spatial extent and temporal evolution. Sentinel-1 SAR imagery maps flood extent in Brahmanbaria district (Figure 5), selected for high-quality satellite data availability during the flood period. The 11, 21, and 23 August snapshots demonstrate rapid water body expansion, coinciding with peak rainfall and river levels, visually validating our hydrological analysis and supporting the flood's fluvial character.

Understanding the physical processes behind the inundation requires distinguishing between different flood generation mechanisms. The August 2024 floods resulted from complex fluvial (river-based) and pluvial (rainfall-based) mechanisms varying by location and timing. Figure 6 shows how precipitation intensity and soil permeability determined flood dynamics. Fluvial flooding dominated, evidenced by: (a) clear lagged correlation between upstream rainfall and downstream river rise (Figure 4a); (b) Sentinel-1 imagery showing progressive water spread from river channels (Figure 5); (c) natural flood wave propagation patterns; and (d) simultaneous extreme rainfall across all 12 transboundary basins.

Pluvial flooding was dominant initially, particularly where rainfall exceeded infiltration capacity. On 19 August, southern districts like Lakshmipur and Feni received >200 mm/day over moderate-to-slow permeability soils, causing Hortonian overland flow. By 21 August, fluvial mechanisms dominated as rivers overtopped banks across saturated floodplains. The soil permeability classification is based on Bangladesh Agricultural Research Council data, with a detailed map provided in Figure S4 of Supporting Information S1.

To test whether floods resulted from natural rainfall versus dam releases, we evaluated the Dumboor Dam on the Gomati River. Originally 15 MW capacity, the dam now produces only 2–4 MW due to sedimentation and degradation (Majumder et al., 2015). Its scattered geography lacks steep head differential, preventing meaningful flood surge generation. Satellite analyses showed the most intense rainfall occurred downstream of the dam in southeastern Bangladesh. University of Washington research (Das et al., 2025), utilizing IMERG precipitation

Figure 2. Multi-scale precipitation analysis for the August 2024 flood event in southeastern Bangladesh. Panel (a) daily precipitation totals from BWDB ground stations in flood-affected districts during 14–22 August 2024. Panel (b) daily satellite-derived precipitation estimates from CHIRPS 2.0 for the same districts and period. Both data sets show peak rainfall occurring around 19–20 August. Panel (c) extreme value distribution analysis of daily precipitation, showing estimated return levels for selected districts across different return periods. Colored curves represent fitted return level estimates, and filled circles indicate the maximum observed daily precipitation during the August 2024 event at each location. Estimated return periods suggest that peak rainfall corresponded approximately to 45-year (Lakshmipur), 100-year (Noakhali), and 30-year (Feni) events, highlighting the severity of the episode. Panel (d) June–August precipitation anomalies (1984–2024) for nine transboundary river basins, calculated as area-averaged anomalies relative to the 1984–2024 climatological mean. The 2024 monsoon season shows positive anomalies across multiple basins, including Feni, Gomati, Dakatia, Haora, Sutang, and Manu. Precipitation data are derived from CHIRPS 2.0 (Funk et al., 2015) and BWDB observations; basin delineations are based on HydroSHEDS (Lehner & Grill, 2013).

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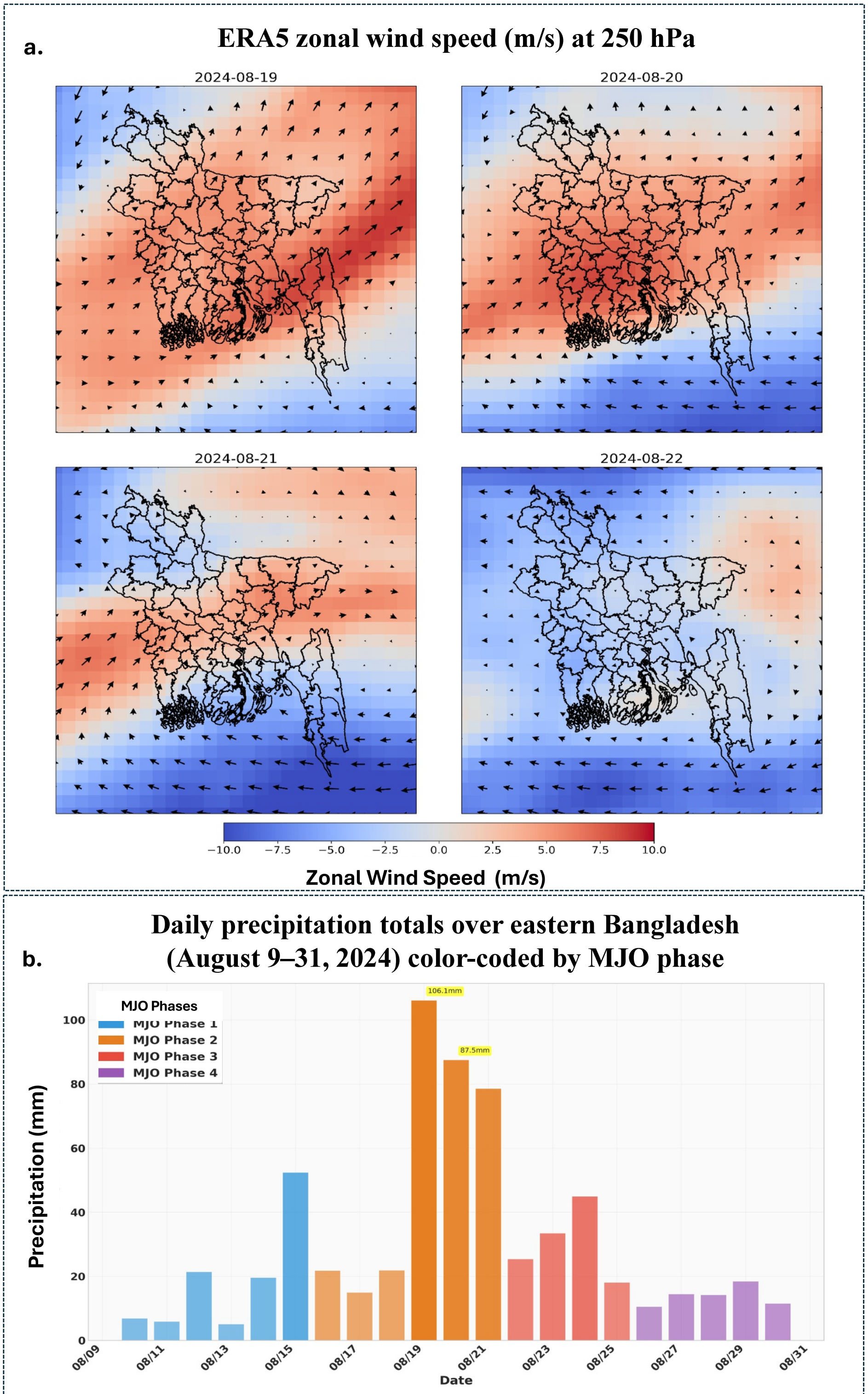

Figure 3. Influence of large-scale atmospheric phenomena on the August 2024 flood event. Panel (a) shows zonal wind speed at 250 hPa from ERA5 reanalysis data (Hersbach et al., 2020) for 19–22 August, 2024, illustrating jet stream dynamics. Strong northeastward wind patterns funneled moisture directly into eastern Bangladesh, with maximum wind speeds on 19 August creating ideal conditions for moisture convergence and intense rainfall. Panel (b) displays daily precipitation totals from 10 to 30 August, 2024, color-coded by Madden-Julian Oscillation (MJO) phases: phase 1 (blue), phase 2 (orange), phase 3 (red), and phase 4 (purple). Rainfall peaks on 19–21 August coincide with phase 2, when the MJO was most active with RMM index exceeding 1. The interaction between tropical (MJO) and mid-latitude (jet stream) systems created extreme conditions resulting in widespread flooding. MJO data from Australian Bureau of Meteorology.

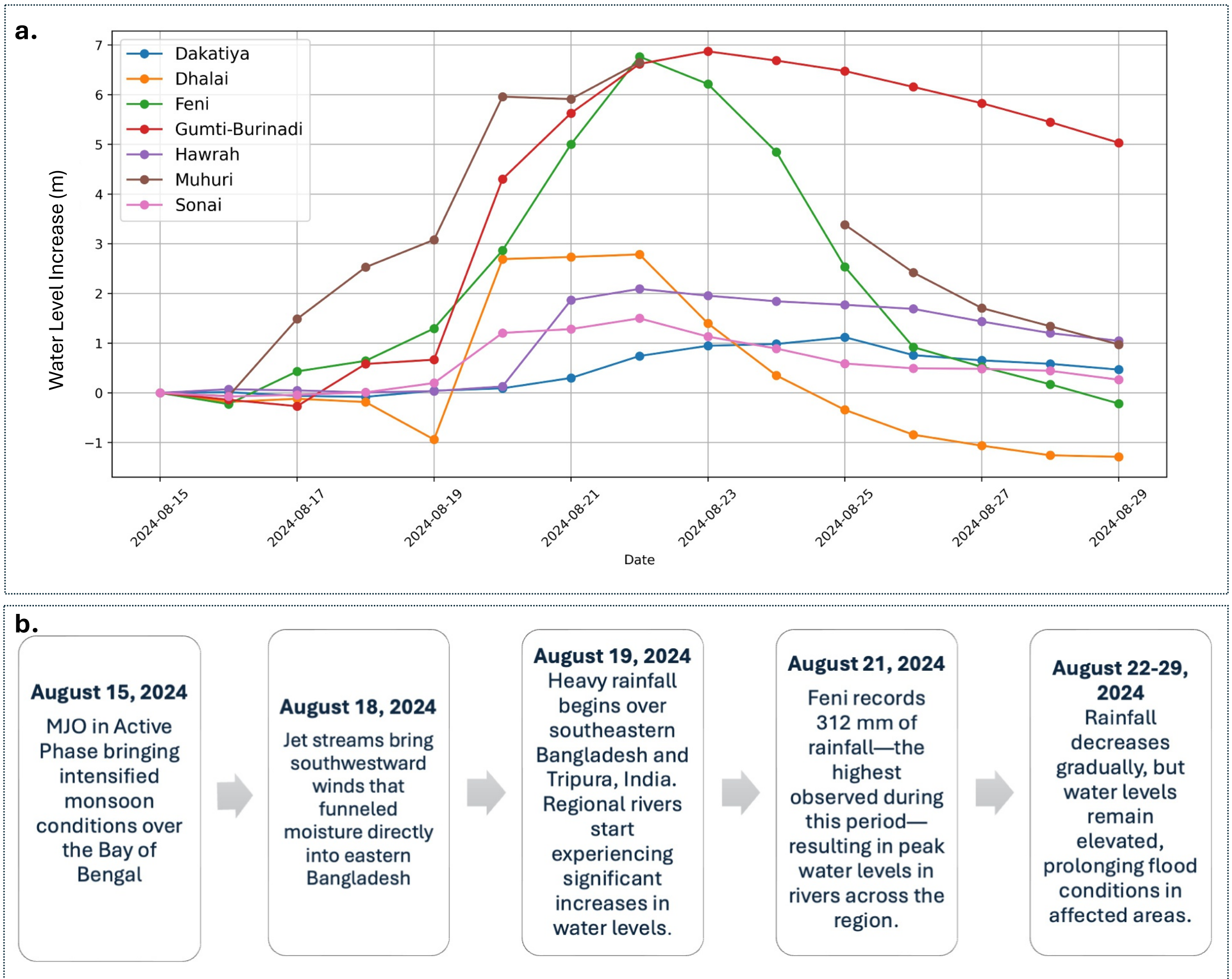

Figure 4. The progression of water levels in transboundary rivers during the August 2024 flood event in southeastern Bangladesh. Panel (a) shows a time series of water level changes from 15 to 29 August (the change is estimated with respect to the water level on 15 August 2024). Panel (b) presents a timeline of key events of the flood.

and SWOT satellite data, confirmed that the heaviest rainfall occurred outside the dam's influence zone. The Reservoir Assessment Tool also confirmed no abnormal outflow and that peak flooding coincided with local precipitation, rather than reservoir discharge (Das et al., 2025). At the same time, localized hydraulic factors may have influenced the duration and spatial distribution of inundation. Flood control embankments and drainage infrastructure in southeastern districts can restrict lateral floodplain connectivity (Choudhury et al., 2004) and impede outflow under extreme rainfall conditions, potentially prolonging waterlogging in low-lying coastal areas (Islam et al., 2023). Such effects are characteristic of embanked deltaic systems and represent internal hydraulic modulation rather than an upstream forcing mechanism. Taken together, the hydrometeorological evidence indicates that the August 2024 floods were primarily fluvial in origin, driven by extreme basin-scale precipitation, with secondary pluvial contributions and localized hydraulic constraints shaping impact patterns on the ground.

4.2. Analysis of Narratives: Social Media and Geopolitical Tensions

The hydrometeorological analysis above establishes that the August 2024 floods were driven by extreme natural precipitation, not by deliberate dam operations. Yet the attributes that made the event physically severe also gave pre-existing divisive narratives their potency. The suddenness of flooding across multiple transboundary basins, combined with the limited upstream data visibility described in Section 2.1, meant that data-based explanations had to compete with narratives rooted in lived experience, historical grievance, and identity (Ecker et al., 2022; Oyserman & Dawson, 2020). The sociohydrological framework discussed in the Introduction clarifies that flood outcomes depend not only on the physical conditions but on how it is interpreted within coupled human-water

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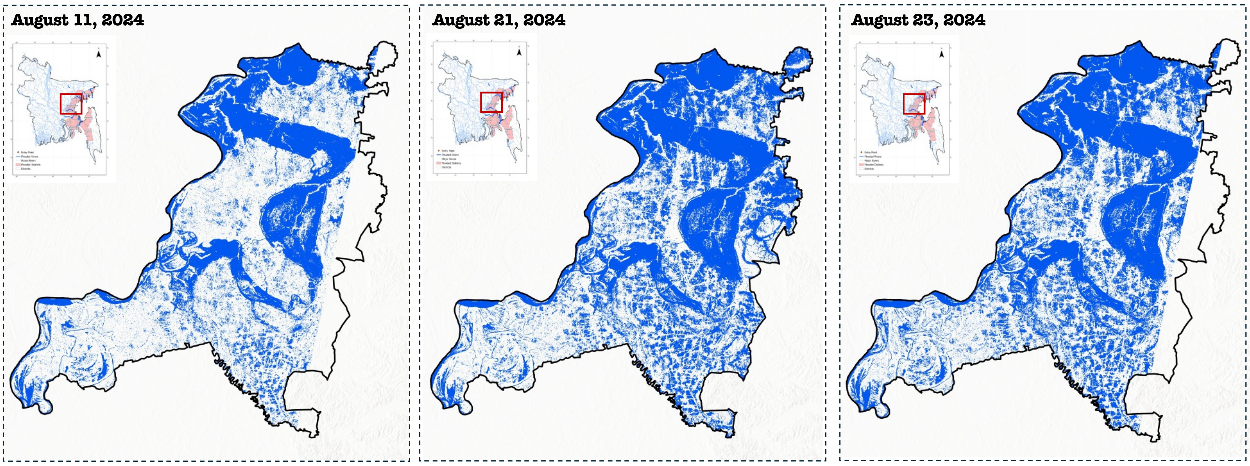

Figure 5. Water extent maps derived from Sentinel-1 SAR imagery for Brahmanbaria district in eastern Bangladesh. Blue areas represent detected water surfaces. The left panel (11 August) shows normal water conditions before the flood event, the center and right panels (21 August and 23 August) show extensive water coverage during the peak of flooding. Brahmanbaria was selected for visualization as it was one of the affected areas with available SAR imagery during the flood period. The full extent of available SAR imagery is provided in Figure S3 of Supporting Information S1.

systems (Di Baldassarre et al., 2013, 2019). This section analyzes narratives shared on social media in the immediate aftermath of the floods. As stated in our methods Section 3.3, the goal of this analysis is not to characterize the prevalence or distribution of any particular viewpoint, but to identify the mechanisms by which narratives, especially those driven by misinformation, might impact emergency response and signal longer-term compounding risks to flood governance and management.

As news of the floods spread, conflicting narratives emerged where Bangladeshis claimed India intentionally flooded the area, and where Indians asserted Bangladesh deserved the floods. These unproven allegations and hostile sentiments spread on social media (Ashraf et al., 2024; Daily Star, 2024a) and led to protests in the days following the floods (Daily Star, 2024c). Political officials stoked the flames by claiming on national television

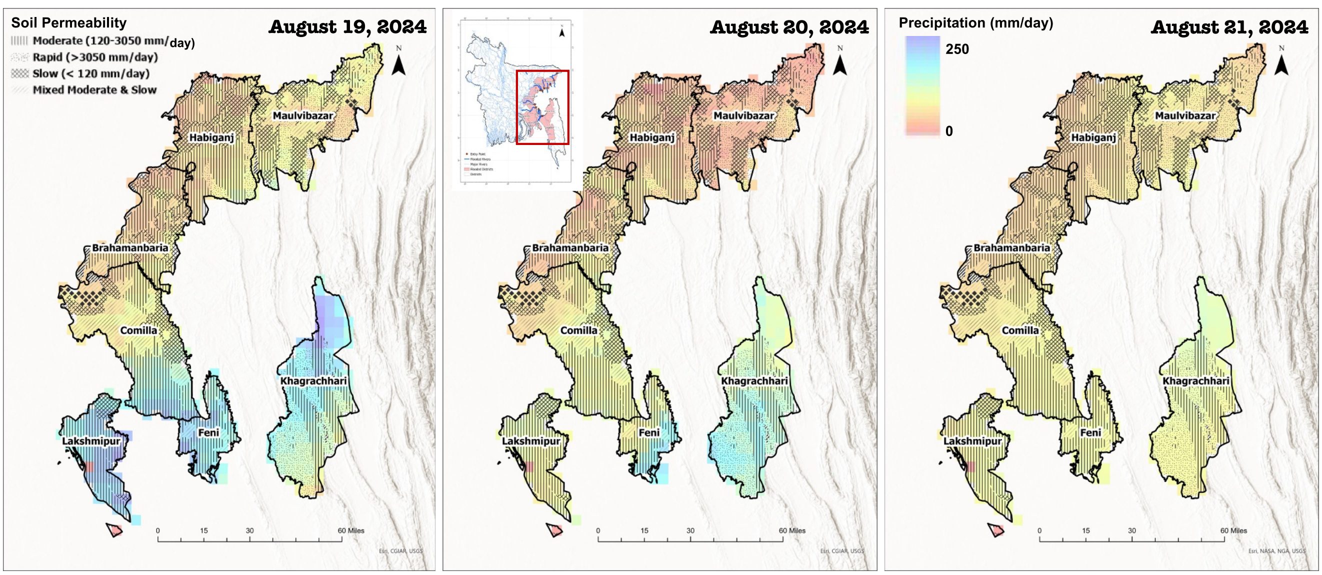

Figure 6. Evolution of precipitation and its interaction with soil permeability during the August 2024 flood event. Panel (a) 19 August—Initial pluvial phase: Heavy rainfall (>200 mm/day) in southern districts (Lakshmipur, Feni, Khagrachhari) overlapped with moderate-to-slow permeability soils, triggering Hortonian overland flow. Panel (b) 20 August—Transitional phase: Rainfall shifted slightly northward, with continued accumulation in the south, initiating fluvial flooding. Panel (c) 21 August—Dominant fluvial phase: Broadly distributed precipitation across districts with moderate permeability sustained river overflow. This sequence illustrates how spatial and temporal rainfall patterns over varying soil conditions influenced the transition from localized pluvial flooding to widespread fluvial and compound flooding.

Table 1
An Inductive Qualitative Analysis of Major Narratives Extracted From a Small Sample of Social Media Posts Discussing the Floods

Overarching theme	Narrative	Data set sources
India intentionally harmed Bangladesh	The floods are the result of India opening the Dumboor Dam (no mention of warning or other details)	14, 19, 22, 37, 41, 61, 62, 70, 72, 73, 76, 79
	India opened the gates without informing Bangladesh	14, 18, 19, 22, 25, 58, 68, 71, 73
	India is inhumane, hateful, or worthy of hate	5, 14, 18, 19, 25, 59, 60, 71
	India historically weaponizes water against Bangladesh	5, 23, 25
	India opened the gates without considering the impact on Bangladesh	1
	India opened the gates as revenge for Sheikh Hasina	18
Bangladesh deserved harm	The floods are karmic revenge on Bangladesh for its threats to India or Hindus, or for being Islamic	30, 38, 55, 65, 82, 85
Other explanations are illegitimate	Saying the floods were a natural disaster is Indian propaganda	3, 6
	Hindus are defending India's crimes	4, 7
	Blaming India is Bangladeshi propaganda	84
	Bangladeshi political officials (including Muhammad Yunus and student movement leaders) are not to be trusted	32, 34, 35, 42
Blame should cease and cooperation should be the focus	Aid should be sent to Bangladesh	16, 17, 28, 64, 67, 74
	Focus on facts, not on blaming	2, 11, 21
	Focus on cooperation	16, 54
Scientific or infrastructural explanations for the flooding	The floods were a result of natural weather	2, 11, 15, 16, 21
	The floods were partially driven by climate change	16, 29
	The Bangladeshi government and citizens were not prepared	29, 83
	The floods were not caused by India opening dams	2, 11, 15, 16, 21, 81, 82

Note. Numbers in the "Data set Sources" column refer to social media post IDs from our data set, hosted with the Harvard Dataverse at (Rabb et al., 2025).

that India had "shown "inhumanity" by opening a dam without prior notice causing floods in Bangladesh" (Daily Star, 2024b). News outlets, including the *Daily Star* and *DW*, reported on this misinformation (Ashraf et al., 2024; Daily Star, 2024a), and it became a point of contention.

To analyze the nature of competing narratives surrounding the floods, we collected a small sample of posts ($n = 85$) from the social media platforms X (Twitter) and Facebook (popular news sources for Bangladeshis, as reported by DataReportal (We Are Social and Meltwater, 2024)) by searching for trending hashtags. To find common themes and narratives in the limited social media data, we conducted an inductive qualitative content analysis (for an informative review of inductive vs. deductive analysis for qualitative methods with small sample size, see the Methods section).

We find five overarching themes in the data: (a) that India intentionally harmed Bangladesh, (b) that Bangladesh deserved harm, (c) that other explanations (differing from the individual poster's preferred one) are illegitimate, (d) that blame should stop and the focus should be on cooperation, and (e) that there are scientific or infrastructural explanations for the floods. More details about the themes and sub-themes can be found in Table 1, including references to our data used for thematic analysis, which is hosted on the Harvard Dataverse (Rabb et al., 2025).

What is revealing is that within themes 1, 2, and 3, there are messages containing worldview cues that show aspects of identity, trust, and in- and out-group formations (Ecker et al., 2022; Oyserman & Dawson, 2020; Pennycook & Rand, 2021; Pereira & Van Bavel, 2018; Schwarz & Jalbert, 2020; Stanley, 2015; Van Bavel & Pereira, 2018). These cues play on existing social and cultural aspects of Indian and Bangladeshi identities and political worldviews. In many cases, such worldview-reinforcing cues can prohibit the adoption of a more scientific or empathetic explanation of events, such as themes 4 and 5 (Cikara et al., 2014; Cikara & Van Bavel, 2014). This creates a problematic positive feedback loop: narratives blaming India, if believed, further erode trust in India's water-related institutions (Ognyanova et al., 2020), making future misinformation that targets those same institutions harder to correct (Ecker et al., 2022). Similarly, messaging that plays on existing in-/out-group divisions (e.g., India vs. Bangladesh, Hindus vs. Muslims) stands to decrease empathy for out-group members among in-group believers (in both directions), reducing the capacity of in-group believers to process information about out-group members logically (Cikara et al., 2014; Cikara & Van Bavel, 2014).

5. Discussion

While our data analyses suggest that the 2024 Bangladesh floods resulted from an extraordinary confluence of hydrometeorological conditions, it also revealed that the same events were interpreted by many as deliberate harm, an extension of historical injustice, or political betrayal. Focusing on the number based analyses of floods alone obscures the narrative based aspects of this socio-political context. As Barua et al. (2025) argue, such narrative based understanding is just as important as hydrological knowledge, yet it remains systematically undervalued in flood governance. Communities' collective memory, trust in institutions, and willingness to act collectively shape outcomes across the full cycle of flood mitigation, preparedness, response, and recovery (Viglione et al., 2014). Accurate data on rainfall, river levels, and flood extent are indispensable. But data alone cannot sustain the collective memory, institutional trust, and coordinated action that effective flood management requires. Narratives fill that gap, shaping how communities perceive risk and motivate action in ways that numbers cannot. We need a synthesis of both.

Flood management is most effective when numbers and narratives are aligned. For India and Bangladesh, improving outcomes for transboundary flash flooding requires cross-border collaboration to strengthen the technical and quantitative dimensions and to build narratives that can inspire collective action and counter misinformation. Water diplomacy emerged as a framework for managing complex water networks through negotiated approaches that synthesizes technical analysis with the competing values and perspectives of affected parties (Islam & Susskind, 2012; for a recent comprehensive treatment, see Islam et al., 2026). In the remaining discussion, we draw on this literature to argue for a path toward that collaboration by examining (a) the growing risks that misinformation poses to flood management, (b) a basis for cooperation beneath the competing narratives of Section 4, (c) the institutional spaces where that cooperation might take shape, and (d) a specific pilot project that could serve as a practical first step.

5.1. Misinformation as a Growing Threat to Flood Management

Not all misinformation causes harm. Local narratives about natural hazards—whether entirely accurate or not—can galvanize donations, heighten awareness, and spur positive action. However, misinformation is harmful when it distorts risk perception, undermines institutional credibility, disrupts coordination, or deepens social division. In crisis conditions, this malignant form gains both speed and reach. Technical analyses are already at a disadvantage because they're often harder to process, understand, and remember than simpler narratives whether accurate or not (Schwarz & Jalbert, 2020). Once misinformation takes hold, its alignment with existing beliefs, political grievances, or deep-seated mistrust of institutions makes it remarkably resistant to correction (Ecker et al., 2022). Recent flood events illustrate how quickly this dynamic can disrupt disaster response.

For example, during the 2018 floods in Kerala, India, online rumors spread claiming that the Army had halted rescue operations due to imminent failure of the Mullaperiyar dam. One widely cited video showed a person in apparent military attire urging immediate self-evacuations and claiming inside information from the Prime Minister's Office, creating confusion and contributing to "unnecessary panic" during the emergency response. While there was no documented pause in rescue operations nor credible threat of dam failure from official sources, the narrative resonated because it aligned with longstanding political tensions, fears, and safety concerns over Tamil Nadu's operation of the century-old dam (Pierpoint, 2018).

Another prominent example occurred in the aftermath of Hurricane Helene in 2024, when federal emergency workers in the United States temporarily suspended door-to-door operations in response to threats of armed violence (Seminera & Brumfield, 2024). These threats coincided with unfounded claims that the federal government planned to seize property under the guise of disaster relief—narratives that resonated deeply in the remote mountain communities of western North Carolina, many of which harbor deep skepticism toward federal institutions (Klasa et al., 2025). Fortunately, no aid workers were harmed. However, the rumors did force operational changes, such as transitions to stationary aid stations, in ways that have the "potential to seriously hamper storm response efforts or prevent people from getting assistance quickly" (FEMA, 2025).

These cases illustrate a dynamic that the sociohydrological literature identifies as self-reinforcing (Di Baldassarre et al., 2013, 2019): flood events aggravate pre-existing social vulnerabilities, giving latent divisive narratives sudden potency that can disrupt disaster response and erode the institutional capacity needed to manage future flood risk. The 2024 floods in Bangladesh highlighted the need to revitalize bilateral institutions, not only to address the purely technical challenges posed by transboundary flash floods, but also to counter the growing risks of misinformation within an increasingly politicized disaster discourse (Barua et al., 2025). While we did not find evidence that misinformation materially impacted emergency response during the 2024 Bangladesh floods, the conditions for future harm are already in place. These conditions include deep historical mistrust that shapes how flood events are interpreted, and dormant bilateral institutions whose decades-long erosion has left little capacity to counter divisive narratives when they emerge. These are precisely the conditions under which the self-reinforcing dynamic Di Baldassarre et al. (2013) describe can accelerate.

But revitalizing these institutions requires collective action and innovation across borders, which isn't easily motivated by number-based statements alone. The statement "the August 2024 floods were driven by natural phenomena" is accurate, but it offers little inspiration or guidance for reducing future flood-related harm. In contrast, although many narratives shared in the aftermath of the disaster were based on misinformation, they inspired action (e.g., student protests) (Daily Star, 2024c) and articulated demands for a different future. As Kuo and Marwick (2021) argue, compelling false narratives "do not exist in a vacuum but are successful precisely because they are congruous with extant inequalities." In each of the cases described above, misinformation drew its power not from technical plausibility or accuracy but from alignment with pre-existing fears and grievances. Simply reasserting the efficacy of number-based analyses rarely closes that gap. Instead, we argue that reducing future flood harm requires engaging with the underlying vulnerabilities that give misinformation its power but which, when viewed as a mutual concern, could also create a stronger collaborative narrative to build a flood resilient system.

5.2. Mutual Vulnerability as a Basis for Cooperation

The narratives documented in Table 1 range from calls to "focus on facts, not blaming" to claims that "India intentionally harmed Bangladesh." These positions appear so far apart that readers may justifiably question whether cooperation is really within reach. In such situations, the literature on principled negotiation suggests that parties look beyond stated positions to the underlying interests that drive them (Fisher et al., 2011). Research on misinformation and political belief formation makes a similar point: people adopt narratives that speak to their needs, desires, and fears (Jost et al., 2003; Oyserman & Dawson, 2020). When seeking common ground, both frameworks direct the parties' attention beneath the surface of *what* is said and to the underlying reasons *why* it is said. For example, many of the narratives expressed in Table 1 can be traced back to a common desire to ease a growing sense of vulnerability. Those advocating to "focus on facts, not blaming" might be driven by a hope to cool the country's political climate amid ongoing turmoil. Those claiming that "India intentionally harmed Bangladesh" may be speaking out from a deep sense of injury, neglect, and helplessness.

This sense of vulnerability can be found on both sides of the border, albeit for different reasons. On the Bangladeshi side, Majumdar (2014) describes fear of India as a larger military state that helped liberate Bangladesh but could also turn on it, compounded by fear of Indian control of upstream water sources. For example, the Farakka Barrage, which is referenced multiple times in our data set (Rabb et al., 2025, posts 2, 22, 25, 37, 41), was commissioned in 1975 to divert Ganges water into the Bhagirathi-Hooghly river system. This was done to maintain navigation at Kolkata port, but reduced dry-season flows into Bangladesh and remains a defining grievance in bilateral water relations (Kawser & Samad, 2016). This is further exacerbated by the day-to-day realities of a highly securitized border. As Shahriar (2021) notes, Bangladeshi fears of Indian border militarization exist alongside simultaneous Indian fears of cross-border extremism, creating tensions that frequently map onto religious identities. With respect to flash flooding in particular, inadequate visibility into upstream conditions in India remains a key limitation that hinders Bangladesh's capacity for self-determination and underlies feelings of injustice, resentment, and vulnerability (Kibler et al., 2014). Under the existing JRC framework, India shares real-time water level data from some stations on nine major rivers, including the Brahmaputra, Barak, Teesta, and Ganges, during the monsoon season (Hasib, 2024). Data sharing on smaller, flashier rivers is more limited. Along the Gomati, for instance, the bilateral arrangement covers only the Amarpur gauge, while two stations at Sonamura, less than 2 km from the Bangladesh border and the last Indian measuring points before the river enters Bangladesh, fall outside it (Basu, 2024). Over 30 years ago, a regional workshop on transboundary flash flood warning flagged similar concerns over data-sharing limitations on the Gomati and the broader neglect of small border rivers in flood forecasting (Disaster Forum, 1995). As one delegate summarized the Bangladeshi position: “We need information otherwise we are vulnerable.”

As the upstream party, India can largely manage its own flood risk without Bangladesh's cooperation, but it remains vulnerable in other ways. India has invested in Special Economic Zones within Bangladesh, some of which are located in regions directly impacted by the August 2024 floods (bdnews24.com, 2024; PricewaterhouseCoopers, 2016). India has also recently re-negotiated agreements on inland water transit and railway passage to connect mainland India to its North Eastern Region through Bangladesh, whose continuity depends on stable bilateral relations (Murshid, 2011; Shawon, 2024). More broadly, India has strategic interests in counterbalancing China's rising regional influence in South Asia, an effort that is undermined when anti-Indian sentiments intensify in neighboring states (Yasuda et al., 2020). Overcoming that dynamic is harder when India harbors its own grievances. Majumdar (2014) notes that a longstanding perception within India holds that Bangladesh is ungrateful, on the basis that India helped liberate the country in 1971, yet faces criticism and suspicion in return. The recent change in government within Bangladesh and the surge in anti-Indian narratives documented in this study highlight how quickly these vulnerabilities can escalate. Rather than confronting anti-Indian sentiment by doubling down on positions that may be factually accurate (e.g., “we are not responsible for the floods”), India may better serve its own interests by pursuing collaborative projects that address Bangladesh's underlying concerns.

Within the water diplomacy literature, the explicit and mutual acknowledgment that neither party can address its vulnerabilities alone is called active recognition of interdependence and is one of the three enabling conditions for long-term transboundary cooperation (Choudhury & Islam, 2018). This recognition shifts the entry point from contested narratives about blame toward a material reality: both countries stand to lose when cooperation stalls, and both stand to gain when it advances. Interdependence, in this sense, isn't just a diagnosis but a foundation for an alternative narrative that can motivate collective action.

Recognizing mutual vulnerability can also change how factual corrections to misinformation are received (Ecker et al., 2022). When corrections come from within a cooperative frame, they're less likely to be dismissed as self-serving. A statement that acknowledges Bangladesh's legitimate fears of upstream water control while being clear that the evidence in this case doesn't support political interference is harder to dismiss outright. Such messaging can be particularly effective when delivered by trusted officials or community members (Ruggeri et al., 2024; Schwarz & Jalbert, 2020; Van Bavel et al., 2020). However, the reality is that it can be risky and ineffectual for individuals to speak out without institutional support. In the aftermath of the 2024 floods, a Bangladeshi hydrologist posted a detailed technical analysis on Facebook that simultaneously criticized India's broader record on transboundary water policy and challenged the claim that the floods were caused by intentional dam releases (Rabb et al., 2025, post 2). Even this balanced position provoked backlash: respondents attacked his Hindu identity, dismissed him as an “Indian broker,” and questioned his standing to comment because he works abroad (Rabb et al., 2025, posts 3–7). His experience illustrates how corrections that conflict with group-level beliefs can trigger identity-threat responses, leading recipients to discredit even in-group sources rather than revise the belief (Ecker et al., 2022). The most resilient counter-narratives are not carried by individuals but by healthy bilateral institutions taking effective, public steps to address underlying vulnerabilities.

5.3. Creating Space for Cooperation at Multiple Levels

The existing bilateral institutions between India and Bangladesh are largely dormant with respect to addressing transboundary flash floods. The primary formal venue for bilateral collaboration on transboundary rivers is the Joint Rivers Commission (JRC), established in 1972 (India and Bangladesh, 1972). Below the ministerial level, the JRC's expert committees are intended to serve as more fluid spaces where substantive technical collaboration can happen. In practice, the committee most relevant to flood outcomes, the Indo-Bangladesh Experts on Flood Forecasting and Warning Systems, has not met since 2004 (Joint Rivers Commission Bangladesh, 2023). When formal channels stall, the water diplomacy literature advocates a multi-track approach in which official negotiations, unofficial expert dialogs, and hybrid arrangements advance in parallel rather than in sequence (Yasuda et al., 2020). The early 1990s saw a flourishing of non-governmental “Track II” initiatives on flood management that brought together experts from India and Bangladesh in unofficial cooperative dialogs

(Chataway, 1998). Much of that energy dissipated after the 1996 Ganges Treaty (Disaster Forum, 1995; Japan International Cooperation Agency, 2003), a reminder of what can happen when cooperation consolidates into a single formal channel rather than advancing on multiple tracks simultaneously. More recently, the Brahmaputra Dialog has sought to demonstrate that formal and informal tracks can coexist and reinforce one another (Barua, 2018; Barua & Vij, 2018; Yasuda et al., 2020). At the practitioner level, Indian and Bangladeshi flood forecasting officers have repotedly established a social media messaging group for real-time coordination alongside the formal JRC mechanism (Hasib, 2024). What these experiences suggest is that multi-track cooperation benefits from a shared nucleation point: a specific, bounded problem that can narrow collective focus while progressively drawing on the people, ideas, and institutional resources necessary to address it (Islam, 2025; Smith & Islam, 2019).

5.4. A Practical Starting Point: Flood Early Warning on the Feni and Gomati

The Feni and Gomati rivers offer a focal point. Both were at the center of the 2024 disaster, both fall outside existing data-sharing arrangements (Barua et al., 2025), and both have been described as "marginalized" in flood forecasting since at least 1995 (Disaster Forum, 1995). We propose a pilot flood early warning system (FEWS) on these two rivers, designed to operate across the multiple diplomatic tracks described above: giving the dormant Indo-Bangladesh expert committee on flood forecasting a concrete agenda to reconvene around, while opening space for unofficial technical exchanges and community-level engagement that don't depend on ministerial schedules. Of course, an effective FEWS requires more than upstream data. It depends on localized understanding of flood risks, technical monitoring, timely dissemination of meaningful warnings, and community preparedness to act (UNISDR, 2006).

Even apart from cross-border collaboration, Bangladesh needs to build the community-level systems that turn a forecast into a warning that reaches people in time to act. Across Bangladesh, 70% of flood-affected households report receiving no warning at all between 2015 and 2020 (Bangladesh Bureau of Statistics, 2023). This gap persists even in basins like the Brahmaputra where operational frameworks provide multi-day lead times (Emerton et al., 2016; Hopson & Webster, 2010). The value of upstream data depends entirely on whether warnings reach people in time to act. This means pairing rainfall thresholds with locally trusted messengers and treating community members as active participants, a decentralized approach that Barua et al. (2025) identify as essential for breaking down rigid water bureaucracies. Pilot projects within Bangladesh have demonstrated that mobile-phone-based flood warnings can achieve high rates of community trust and responsive action (Cumiskey et al., 2015), and in analogous South Asian transboundary settings, informal kinship-based communication via mobile phone already functions as a de facto warning mechanism across national borders (Rahman et al., 2018). It is at this level that the synthesis of numbers and narratives becomes most tangible. A technically sound forecast has no value if those it's meant to protect don't receive it, understand it, or trust its source. Effective community engagement can also counter misinformation directly: households that have experienced a functioning early warning system are better positioned to evaluate competing claims about flood causation.

But for transboundary rivers prone to flash-floods, none of this matters without visibility into upstream conditions. India holds the key to data-sharing protocols for the pilot basins. The barrier here is political, not technical. Both countries were already independently sharing hydrological data with Google when the Teesta basin flooded in October 2021, yet bilateral data sharing had closed for the season, leaving Bangladesh's Flood Forecasting and Warning Center without the upstream data it needed to issue warnings (Flood Forecasting and Warning Centre, 2021), even as Google's flood warning system sent smartphone alerts to roughly 3,000 Bangladeshis. Data sharing is often seen as a loss of strategic political leverage, which may explain why countries are more willing to share data with a private company than with each other. Framing this project as a bounded commitment on two rivers keeps the initial ask manageable: a collaboration, not a concession. The scope needs to extend beyond water level readings to include dam operating rules and notification of automatic gate releases, the absence of which directly fed the Dumboor Dam narrative. Providing this transparency is a practical step toward what Barua et al. (2025) describe as "depoliticizing disasters," bypassing rigid water bureaucracies to enable the rapid cross-border communication necessary for effective early warning. Evidence from elsewhere in Bangladesh suggests that even a few hours of advance warning can reduce household flood losses by amounts equivalent to several months of typical earnings (Islam et al., 2024). India's cooperation could unlock that potential and facilitate mutual trust building.

6. Conclusions

This paper asked two questions: what physical conditions resulted in the August 2024 floods, and what narratives emerged in their aftermath? Our hydrometeorological analysis pointed to extreme monsoon precipitation, amplified by MJO dynamics and jet stream positioning. Our social media analysis, on the other hand, found competing narratives ranging from accusations of intentional harm to calls for cooperation and scientific explanation. Among the former, claims that India deliberately released water from the Dumboor Dam find no support in our data. Yet such narratives gained traction because they aligned with existing identity-based divisions and longstanding grievances over upstream water control. Correcting the factual record matters, but it is not enough when misinformation draws its power from unaddressed vulnerabilities. A pilot FEWS on the Feni and Gomati would address those vulnerabilities directly: giving Bangladesh the upstream visibility it lacks while giving India a credible demonstration of cooperative intent. Progress on these two rivers could help break the bilateral "logjam" that has stalled joint initiatives across multiple domains (Vij et al., 2020), positioning data sharing not just as a necessary condition for effective flood warning but as an enabling condition for broader regional cooperation and mutual benefit (Choudhury & Islam, 2018). Effective flood governance requires both the numbers that characterize risk and the narratives that motivate collective action. By investing in this kind of project, India and Bangladesh can begin to build a narrative of shared problem-solving: one that undercuts the growing risks of misinformation by addressing the grievances that give it power.

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

Availability Statement

Precipitation data from CHIRPS 2.0 can be accessed at https://data.chc.ucsb.edu/products/CHIRPS-2.0/global_daily/netcdf/p05/. ERA5 reanalysis data for zonal wind speed is available through the Copernicus Climate Data Store at https://www.ecmwf.int/en/forecasts/datasets/archive-datasets/reanalysis-datasets/era5. The Madden-Julian Oscillation (MJO) phase data from the Australian Bureau of Meteorology is accessible at http://www.bom.gov.au/climate/mjo/. Watershed boundary data set is available in HydroSHEDS at https://www.hydrosheds.org/products/hydrobasins. The social media narrative data set used in this study is publicly available through the Harvard Dataverse repository (Rabb et al., 2025) at https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/Q7MA3J. Water level and rainfall data from various river stations and districts in Bangladesh were obtained from the Bangladesh Water Development Board (BWDB) and the Bangladesh Meteorological Department (BMD). These data sets are available upon request through the following contacts. Bangladesh Water Development Board (BWDB), https://www.bwdb.gov.bd/, email: dir.processing@bwdb.gov.bd; and Bangladesh Meteorological Department (BMD), https://live8.bmd.gov.bd/, email: info@bmd.gov.bd.

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