Analysing the Initial Emergency Phase during Operational Response of the 2025 Senyar Cyclone in Aceh, Indonesia

NAOMI ZAKINA | DIVISION OF RISK MANAGEMENT AND SOCIETAL SAFETY| LTH | LUND UNIVERSITY, SWEDEN

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Naomi Zakina

Supervisor
Tove Frykmer

Lund 2026

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Number of pages: 44
Illustrations: 2
Tables: 3

Keywords
Early phase disaster response, 72-hour window, multi-actor coordination, high-reliability network.

Abstract
This study examines how Indonesia's networked emergency response system performed during the first 72 hours of the Cyclone Senyar disaster in Aceh and what conditions influenced its reliability. Guided by a high-reliability network (HRN) perspective, this research investigates how coordination and collective capacity shape the system's ability to maintain performance under extreme time pressure and multi-jurisdictional flooding. The study adopts a qualitative case study design with an abductive logic of inquiry, drawing on 15 semi-structured interviews conducted online between February and March 2026 with key municipal actors in Aceh Tamiang, North Aceh, and Pidie Jaya. Data were analysed using directed qualitative content analysis, combining deductive coding based on high-reliability organisation (HRO), high-reliability preparedness networks (HRPN), and HRN theories with inductive coding of emerging themes.

The findings reveal a pattern of partial reliability: while the system did not collapse entirely, reliability was sustained primarily at the tactical and community level through local actors' improvisation, autonomous decision-making, and community solidarity, whereas it broke down at the institutional and systemic level, where coordinated command, shared situational awareness, and collective preparedness were absent. Three clusters of conditions shaped this outcome: pre-existing structural fragility, crisis-activated breakdown in communication and preparedness, and compensatory mechanisms that mitigated but did not replace systemic reliability. The study concludes that an effective 72-hour response in Indonesia requires pre-established network-level conditions for cooperation and coordination. Future research should prioritise access to national-level actors not captured in this study and conduct a comparative study across different decentralised governance systems.

Riskhantering och Samhällssäkerhet
Lunds Tekniska Högskola
Lunds universitet
Box 118
221 00 Lund
Sweden

http://www.risk.lth.se

Telefon: 046 - 222 73 60

Division of Risk Management and Societal Safety
Faculty of Engineering
Lund University
P.O. Box 118
SE-221 00 Lund
Sweden

http://www.risk.lth.se

Telephone: +46 46 222 73 60

Acknowledgement

I would like to express my sincere gratitude to everyone who has contributed, in various ways, to the completion of this master's thesis.

First and foremost, I thank myself for persevering through all the ups and downs, doubts, and exhaustion that accompanied this journey. Completing this thesis has been a personal challenge, and I am grateful for the resilience that allowed me to reach the finish line.

I am deeply indebted to my supervisor, whose patience, understanding, and continuous support have guided me from the early stages of this research to its final form. Thank you for taking the time in your busy schedule, for your thoughtful feedback, and for your unwavering willingness to read, comment, and correct my work.

I also extend my appreciation to all the participants for their time, openness, and invaluable contributions to this research.

Finally, I gratefully acknowledge the generous financial support provided by the Indonesian Endowment Fund for Education (LPDP), which made this Master's journey possible.

Summary

The first 72 hours following a disaster are widely recognised as the critical window that determines survival rates and shapes long-term recovery outcomes. When Tropical Cyclone Senyar struck Aceh Province in late November 2025, it became one of the most severe hydrometeorological disasters in Indonesia's recorded history, displacing over 242,200 people across 52 cities and exposing significant gaps in the country's emergency response system. Despite two decades of institutional development since the 2004 Tsunami, the response revealed a persistent distance between regulatory idealism and field reality.

This thesis examines how Indonesia's networked emergency response system performed during the first 72 hours of Cyclone Senyar in Aceh and what conditions influenced its reliability. The study applies an integrated theoretical framework that combines High Reliability Organisation (HRO) theory, High Reliability Preparedness Network (HRPN) theory, and High Reliability Network (HRN) theory to assess performance at three analytical levels: the organisational level, the preparedness network, and the governance network. A qualitative case study design guided by the abductive logic of inquiry was adopted, with data collected through 15 semi-structured interviews across three actor groups (government officials, humanitarian volunteers, and affected community members) in Aceh, specifically in three of the most severely affected municipalities: Aceh Tamiang, North Aceh, and Pidie Jaya.

The findings reveal a pattern of *partial reliability*: the system did not fail entirely, but it did not perform reliably either. At the institutional level, all five HRO reliability principles collapsed within the first hours of the disaster; anomaly detection was undermined by infrastructure collapse, situational awareness became impossible when the Provincial and Municipalities Operations Control and Data Centre (Pusdaop) shut down entirely, and coordinated command fragmented across constitutionally separate administrative levels. At the tactical and community levels, however, reliability persisted: field coordinators assumed autonomous decision-making authority, community members improvised evacuation tools, and Acehnese social solidarity served as unplanned operational infrastructure, sustaining populations that formal systems could not reach.

Three clusters of conditions produced this pattern. *First*, pre-existing structural fragility: chronic underinvestment in collective preparedness, including degraded equipment, dormant coordination forums, and a lack of joint training, meaning the network entered the emergency already compromised. The absence of inter-organisational trust between government agencies and civil society organisations, and the activation of the cluster coordination system only 14 days after the disaster, further eroded the relational foundation needed for coordinated action. *Second*, crisis-activated breakdown: a six-day warning-to-action gap resulted from the

convergence of cognitive, technological, and political factors. Actors interpreted Senyar through familiar annual-flooding frames, lacked real-time monitoring infrastructure, and depended on newly appointed local political leaders without emergency-management competence to authorise mobilisation. When the disaster struck, the simultaneous collapse of electricity, telecommunications, and road infrastructure triggered a complete breakdown of coordination, amplified by constitutional ambiguity over authority between provincial and municipal governments under Indonesia's regional autonomy law. *Third*, compensatory mechanisms - community solidarity, tactical improvisation, and military radio networks prevented complete failure, but did so unevenly, leaving the most geographically and socially isolated communities most exposed.

The discussion situates these findings within the integrated theoretical framework. The findings confirm the core propositions of HRO, HRPN, and HRN: reliability loss without sustained investment, collective preparedness requires joint institutional effort, and governance switching demands pre-established latent ties. However, the study also surfaces a condition that warranted more explicit consideration at the outset: whether Indonesia's constitutionally decentralised governance architecture met the underlying assumptions of these frameworks, which were developed in high-capacity, stable governance contexts. This oversight, identified retrospectively, is offered as a methodological caution for future applications of these frameworks in decentralised governance settings. In practice, the findings suggest three adjustments to existing mechanisms: clearer operational triggers for the provincial coordination authority under the current Indonesian Emergency Response framework; mandatory pre-disaster activation of cluster coordination mechanisms; and an emergency management orientation for newly appointed regional leaders, integrated into existing handover procedures.

The study concludes that the partial reliability observed during the Senyar response is perhaps best understood not as an exceptional outcome produced by an unusually severe disaster, but as an outcome shaped by the cumulative absence of investments that reliable systems require, such as investments in collective preparedness, inter-organisational trust, and governance mechanisms capable of functioning under pressure. Future research should pursue comparative applications of the integrated framework across different decentralised governance systems, longitudinal tracking of whether organisational learning translates into institutional change, and early access to national-level actors to address the blind spot left by the absence of National Disaster Management Agency perspectives in this study.

List of Abbreviations

BAPPENAS	:	Badan Perencanaan Pembangunan Nasional or National Planning Agency
BMKG	:	Badan Meteorologi, Klimatologi, dan Geofisika or Meteorological, Climatological, and Geophysical Agency
BNPB	:	Badan Nasional Penanggulangan Bencana or National Disaster Management Agency
BPBA	:	Badan Penanggulangan Bencana Provinsi Aceh or Aceh Province Disaster Management Agency
BPBD	:	Badan Penanggulangan Bencana Daerah or Local/Municipal-level Disaster Management Agency
BTS	:	Base Transceiver Station
CSO	:	Civil Society Organisation
DRM	:	Disaster Risk Management
FPRB	:	Forum Pengurangan Risiko Bencana or Disaster Risk Reduction Forum
HRO	:	High-Reliability Organisation
HRPN	:	High-Reliability Preparedness Network
HRN	:	High Reliability Network
ICS	:	Incident Command System
NAO	:	Network Administrative Organisation
NGO	:	Non-Governmental Organisation
PDNA	:	Post-Disaster Needs Assessment
Pusdaop	:	Pusat Data dan Operasi or Operations Control and Data Centre
SAR	:	Search and Rescue
SIH3P	:	Siste Informasi Hidrologi, Hidrometeorologi, dan Hidrogeologi or Integrated Hydrometeorological Information System
SKPDB	:	Sistem Komando Penanganan Darurat Bencana or Disaster Emergency Command System
SOP	:	Standard Operating Procedure

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1 INTRODUCTION

1.1 Background

In emergency response management, the first 72 hours following a disaster are widely regarded as a non-negotiable window that fundamentally determines mortality rates and long-term recovery outcomes (Kohn et al., 2012; Hafid et al., 2022). The probability of survival decreases dramatically over time: from near-certain rescue within 24 hours to approximately 20% after 72 hours (Oral et al., 2026). Beyond this threshold, delays do not merely compound fatalities; they multiply the cost of suffering and impose an exponential logistical burden on already-strained systems (Holguín-Veras et al., 2013, p.1). The first 72 hours, therefore, mark the boundary between effective intervention and irreversible loss.

The emergence of Tropical Cyclone Senyar in late 2025 exposed the vulnerabilities of Indonesia's emergency response management under conditions of high-impact, multijurisdictional flooding that rapidly stretched the capacity of existing response mechanisms (Arif, 2025; Herlambang, 2026; MSF, 2026; Syarif, 2026). As a country located on the equator, Indonesia is considered safe and rarely experiences cyclones (Latos et al., 2023). However, this historical rarity has direct institutional consequences: Indonesia's response system has been shaped predominantly by more familiar hazard profiles, such as earthquakes, tsunamis, and seasonal flooding (Ayuningtyas et al., 2021; CFE-DMHA, 2025). Before Tropical Cyclone Senyar was formally formed, the disturbance had already triggered a compound event of extreme rainfall, flash floods, and landslides across Sumatra Island (Arif, 2025; Syarif, 2026). Thus, cyclone-specific response capacity was severely underdeveloped, rendering Senyar not only a rare meteorological event but an institutionally unfamiliar hazard. By early 2026, the One Disaster Data reported a catastrophic impact of 1,178 deaths, with hundreds still missing, and over 242,200 people displaced, affecting 52 cities across three provinces (BNPB, 2026). In Aceh, the most severely affected province, the destruction of critical lifelines, including electricity, telecommunications, and transportation, has reportedly significantly hampered the initial response (BNPB, 2026; Human Initiative, 2026; Lai, 2025). Despite two decades of progress in disaster management since the 2004 Tsunami, the response to Cyclone Senyar revealed a significant gap between regulatory idealism and field reality (Ayuningtyas et al., 2021; Hendrawan et al., 2025). Taken together, these conditions raise a question beyond operational speed: whether Indonesia's emergency response system has (or not) the capacity to maintain function under conditions it was not designed to anticipate.

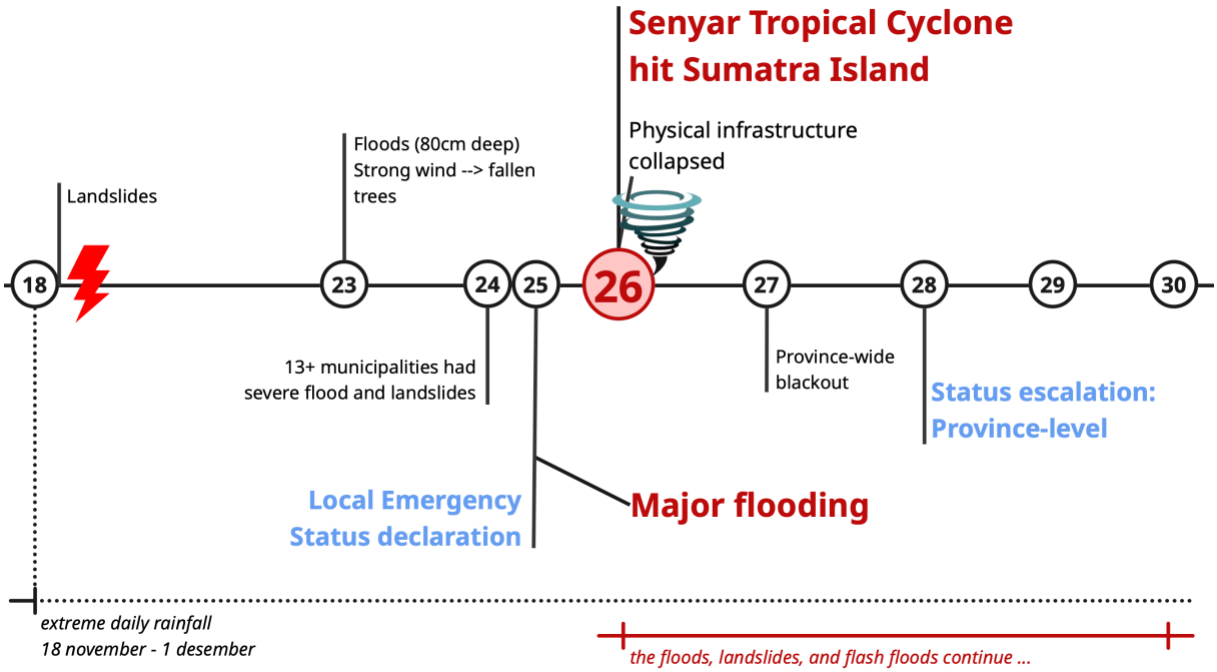

Figure 1 Chronological Timeline of Disaster

Indonesia's emergency response system is formally structured and grounded in regulatory frameworks. According to Regulation No. 3/2016 of the National Disaster Management Agency (2016), the system operates through a structured hierarchy in which command authority scales with the severity of the disaster, from the municipal to the provincial to the national level. The structure is supported by six functional clusters and complemented by a penta-helix coordination network that integrates government, military, NGOs, the private sector, academia, media, and communities (Ruswandi & Maarif, 2023). In contrast to the more standardised Incident Command System (ICS) in the United States (FEMA, 2017), Indonesia's system reflects a hybrid network configuration: while command authority is formally organised in a top-down manner, implementation involves decentralised actors across multiple administrative levels and community-based networks.

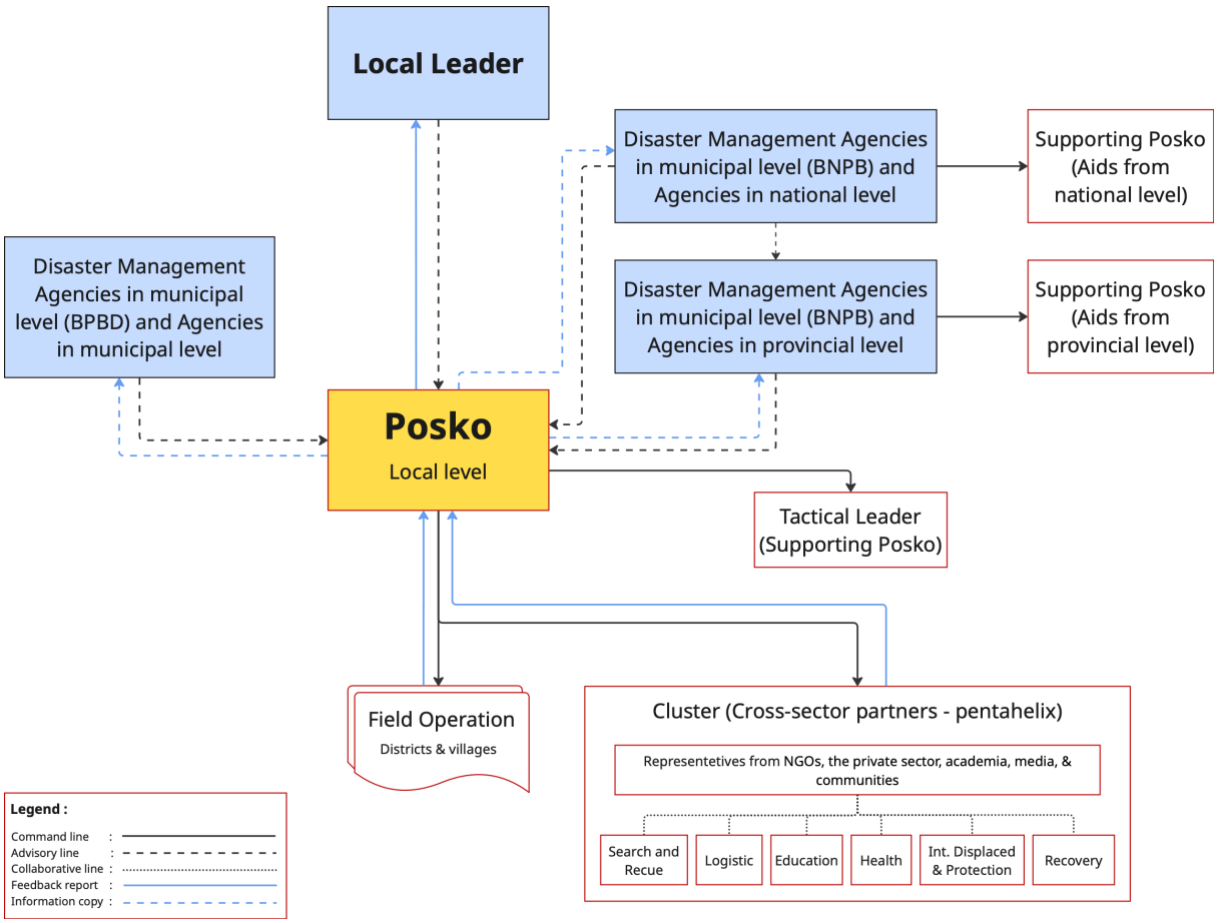

Figure 2 Indonesia's Emergency Response System

Sources: Regulation No. 3/2016 of the National Disaster Management Agency (2016) and Guidelines of Municipality's Disaster Command System Implementation (2023)

Within this network, the system is designed to facilitate coordinated actions during the early and emergency stages of the response (Ruswandi & Maarif, 2023, pp. 3–4). However, the interaction between hierarchical command authority and distributed multi-actor coordination raises an important question about how such arrangements perform under conditions of systemic stress in practice. Indonesia's hybrid network configuration does not map neatly onto the governance assumption embedded in existing disaster coordination frameworks, which were developed in a context where unified command and symmetrical actor capacities could be assumed. In this regard, applying a high-reliability network (HRN) lens offers a useful perspective to explore how it works and what influences its successful operation under uncertain and time-critical conditions (Hu et al., 2022).

1.2 Research Problematisation

Existing empirical research on 72-hour emergency response in Indonesia remains fragmented. Most studies examine the golden hour through sectoral lenses, medical or logistics response, limitedly exploring how inter-organisational coordination and governance reliability interact during unfamiliar and time-critical conditions (Hafid et al., 2022; F. D. Putra, 2023).

The case of Cyclone Senyar offers a theoretical and empirical window into this gap. At the theoretical level, the HRN framework provides an ideal standard for how multi-actor coordination should function during a crisis. However, existing studies have predominantly been conducted in developed-country contexts, where inter-organisational command authority is relatively structured and the governance environment is stable (Comfort, 2007; Kapucu & Garayev, 2011; Moynihan, 2009; Wolbers & Boersma, 2013). This model assumes a level of functional alignment where actors automatically synchronise under a central command (Nowell & Steelman, 2015). In contrast, Indonesia's emergency response system operates within a constitutionally decentralised system. This raised a question about how reliability mechanisms operate in settings where command authority is fragmented and actor capacities are asymmetrical.

The case also provides an empirically grounded opportunity to explore the questions. With a formally structured emergency response system, Aceh provides a context in which the relationship between formal structure and operational performance can be examined in detail. The disaster unfolded under conditions characterised by infrastructural disruption and institutional unfamiliarity. These conditions make the first 72 hours a critical window to examine how networked systems attempt to coordinate under pressure. Understanding how the system performed under these conditions and what conditions shaped that performance has both theoretical and practical relevance for disaster governance in decentralised settings.

1.3 Research Purpose and Question

This study aims to examine the reliability of the networked response during the critical 72-hour of Cyclone Senyar in Aceh. By applying a high-reliability network (HRN) perspective, the study explores how coordination and collective capacity influence the system's ability to maintain performance in a time-critical emergency environment. This study argues that achieving a reliable response within the first 72 hours requires more than logistical efficiency; it hinges on the fulfilment of network-level preconditions. Consequently, this leads to the following research questions: the first assesses how the system performed during the disaster through the HRO and HRN lenses, while the second explores whether the system was capable (or why not capable) of responding before the disaster struck through the HRPN lens.

RQ1: How did Indonesia's emergency response system perform during the first 72 hours of the Senyar Cyclone disaster in Aceh?
RQ2: What conditions influenced the reliability in this case?

2 CONCEPTUAL FRAMEWORK

This thesis applies an integrated framework that combines three complementary theories to examine how Indonesia's emergency response system performed during the first 72 hours of Cyclone Senyar and the conditions that influenced its reliability. Each theory operates at a distinct analytical level (organisational, preparedness network, and governance network), and together they provide the conceptual tools needed to assess both the system's operational performance and the conditions that shaped it.

2.1 High Reliability Organisation (HRO)

The analysis begins at the organisational level, drawing on High Reliability Organisation (HRO) theory. Originally developed to explain how high-risk sectors (nuclear power, aviation, and emergency medicine) maintain consistent performance under volatile conditions, HRO conceptualises reliability as an actively sustained state rather than a static achievement (Roberts, 1990, p. 161; Weick & Sutcliffe, 2007, pp. 2–3). Organisations achieve this through five operational principles: preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise (Weick & Sutcliffe, 2007). These principles function as continuous practices that prevent small anomalies from escalating into systemic failures (Weick et al., 1999, pp. 88–89).

In this study, HRO provides the foundation for assessing the organisational conditions that should be in place during an emergency. However, applying HRO logic to Senyar Cyclone was immediately hampered by the reality that the response was not carried out by a single organisation. In practice, the Regional Disaster Management Agency operated within the cluster system involving multiple organisations and agencies. The following theories, namely High-Reliability Network (HRN) and High Reliability Preparedness Network (HRPN), extend HRO logic by arguing that reliability must be distributed across the network (Berthod et al., 2017; Ginter et al., 2006), making HRO's five principles the baseline prerequisites that the multi-actor system must collectively meet to respond reliably during a crisis.

2.2 High Reliability Network (HRN)

As the response expands from a single organisation to a multi-organisation and multi-agency network, the critical point of reliability shifts to a network system defined as one that maintains coordinated performance under systemic stress. According to Hu et al. (2022) and Kapucu & Garayev (2011) a reliable emergency response network is characterised by high levels of information sharedness, inter-organisational trust, and governance capacity. These elements serve as the benchmark for evaluating the 72-hour response in Aceh.

HRN theory, developed by Berthod et al. (2017), argues that reliable networks do not rely on a single governance model but dynamically transition between three modes: participant-based

governance (horizontal collaboration), lead-organisation governance (a dominant coordinator), and network administrative organisation (a dedicated administrative entity). A rapid shift toward a more assertive mode when crisis intensity increases, termed switching, is the critical transition mechanism for reliable crisis response. However, switching cannot occur without a key precondition: the presence of stable, trust-based ties among core actors, at a minimum in the form of latent ties built and maintained before the crisis (Berthod et al., 2017, p. 16). Without these ties, the network lacks the relational foundation needed to shift governance modes effectively when conditions demand it. In this study, HRN is used to assess whether the existing emergency response system was able to perform the necessary governance switching during the first 72 hours of Senyar Cyclone and, where switching failed, to identify which preconditions were missing.

2.3 High Reliability Preparedness Network (HRPN)

Establishing whether the network was able to switch governance modes during the crisis, however, raises a prior question: was the network in a position to do so when the Senyar Cyclone struck? This requires shifting the analytical focus to the preparedness phase that preceded the crisis.

Achieving network-level reliability during an emergency depends on how reliably the network was prepared before the crisis. Ginter et al. (2006) argue that in multi-actor emergency systems, preparedness is not the responsibility of any single organisation but a collective capacity that must be jointly built, tested, and maintained across the network, through sustained investment in joint planning, cross-institutional simulations, and the continuous maintenance of coordination mechanisms outside disaster periods.

In this study, HRPN is used to assess whether the collective preparedness conditions necessary for reliable network activation were in place before Senyar Cyclone struck Aceh. The analytical question shifts from whether individual organisations were ready to whether the network possessed a shared, actionable capacity that could be activated when the crisis emerged.

2.4 Integrated Framework Analysis

These three theories form a hierarchical and mutually reinforcing framework. HRO establishes baseline reliability standards at the organisational level. HRN examines whether the network can transition effectively between governance modes once a crisis emerges. HRPN assesses whether those standards are collectively invested in during the preparedness phase. Together, they enable an analysis that moves beyond identifying what was missing in the system to examining why those conditions were not fulfilled and how failures at one level amplified failures at others, providing the conceptual foundation for the findings and analysis. In terms of the research questions, RQ1 (how the system performed during the first 72 hours)

is assessed through the combined lens of HRO and HRN, while RQ2 (what conditions influenced reliability) is addressed through HRPN.

3 METHODOLOGY

3.1 Research Design

The study adopts a qualitative case study approach guided by an abductive logic of inquiry. A case study design enables an in-depth investigation of a phenomenon within its real-life settings (Yin, 2018), which, in this case, is the coordination processes among emergency response actors during the first 72 hours of Cyclone Senyar in Aceh. Given the popular newspaper articles about severe infrastructure damage (Lai, 2025; N. Putra & Finka, 2025; Utama, 2025), the case study approach provided a mechanism to capture how this context shaped the actors' responses and overall coordination efforts.

The study was guided by an abductive logic inquiry, which enables iterative movement between theoretical frameworks and empirical data throughout the research process. Meaning that abductive reasoning allows the researcher to begin with a certain theory anchor; in this case, HRO theory was chosen in the early stage of the study as the initial analytical guide because it provides the foundational principles of organisational reliability. However, as the data collection progressed, it became evident that the response to the Senyar Cyclone was not carried out by a single organisation but co-produced across a multi-actor network. This empirical reality necessitated extending the analytical frame to the network level, centring the High Reliability Network (HRN) as the overarching performance benchmark (Berthod et al., 2017; Hu et al., 2022; Kapucu & Garayev, 2011). This abductive shift reflects the iterative logic of inquiry guiding the study, in which conceptual framework anchors are refined as empirical evidence unfolds.

3.2 Data Collection

Data were collected through semi-structured interviews (video calls) conducted via Zoom or WhatsApp, serving as the primary analytical source, supplemented by grey literature such as regulations and formal documents that provided contextual background and analytical reference points throughout the research. Semi-structured interviews were conducted online from February to March 2026.

3.2.1 Primary data collection

Semi-structured interviews were selected as the primary data collection method since they allowed the researcher to maintain focus on the critical response constraints of the 72-hour window while remaining flexible enough to probe emerging narratives (Creswell & Creswell, 2013; Moerman, 2016).

Participants were recruited using a snowball sampling strategy, conducted entirely online via WhatsApp and Instagram messages, given the ongoing recovery conditions in Aceh. Snowball is well-suited to research contexts where the population of interest is embedded

within specific professional or social networks and cannot be easily identified through a formal sampling frame (Gierczyk et al., 2024). The general criteria of the participants: 1) must be involved during the first 72 hours of responses, preferably the person who was the system keeper, or the high-level officials, frontline agents, or field staff and rapid response team personnel; 2) must have lived in the affected area; and 3) must have direct knowledge, experience, or influence on the topic.

Moreover, three groups of participants were drawn from government officials, humanitarian volunteers, and affected community members to gain broader and more genuine results, given the nature of multi-actor network collaboration efforts. Initial contact was made through formal channels with the Aceh Provincial Disaster Management Agency (BPBA) via official Instagram accounts and WhatsApp messages. However, the delayed response prompted the researcher to pursue alternative entry points in parallel through professional academic networks via a WhatsApp message from a University Syah Kuala lecturer. This facilitated access to the first government participant, the Regional Development Planning Agency, in one of the affected municipalities. Unfortunately, the first participant withdrew from the research and suggested a referral to the Local Disaster Management Agency (BPBD) in another affected municipality (which is considered one of the top three affected areas, as explained in section 3.4 and Appendix 2). The second participant, who is the suggested Local Disaster Management Agency (BPBD), was then contacted. Subsequently, government contacts were obtained through participant referrals. Volunteer participants were reached through a regional volunteer network that connected the researcher to the provincial Red Cross public relations office, which in turn facilitated access to unit heads across the three focal municipalities. Community participants were identified through volunteer referrals.

Interview protocols differed by participant group to reflect on their distinct roles and authority within the response network. For government officials and humanitarian volunteers, each interview began by tracing the chronological sequence of events and the decisions made by actors during 72 hours, before moving to more structured questions guided by the HRO principle, which focused on five thematic areas:

- When did they recognise the disaster as qualitatively different from annual flooding?
- What are the most significant operational constraints during the first 72 hours?
- How do leadership and decision-making authority emerge on the ground when formal response systems are disrupted?
- What is the role of informal and community-based actors in filling operational gaps before the official responders arrive?
- Reflection on what the experience revealed about emergency responses?

Meanwhile, for the affected community members, questions focused on:

- What was the immediate response when the infrastructure was disrupted

- How the local community organised evacuation and resource sharing in the absence of official responders

To ensure context-specific data, the geographic scope is deliberately narrowed. While 18 municipalities were affected, the study prioritised the three most severely affected areas identified in the Post-Disaster Needs Assessment (PDNA) (see Appendix 2): Aceh Tamiang, North Aceh, and Pidie Jaya (BAPPENAS, 2026). Although most of the participants operated at the municipality-level, the analysis focuses on interorganisational network dynamics at the provincial response level, treating municipal-level accounts as evidence of how the broader network functioned in practice.

Initially, 25 participants were contacted, but only 17 agreed to be interviewed by phone or Zoom meetings. Following iterative screening for relevance to the three focal municipalities, two participants were excluded, resulting in a final sample of 15. One local-level government agency declined to participate, and the National Disaster Management Agency (BNPB) authority did not respond to interview requests. The absence of the latter represents a notable gap in the data, discussed further in the limitations section.

Table 1 List of Participants

Role	Scope	Area	Number of Participant
Government	Local	Aceh Tamiang	1
		Aceh Utara	0
		Pidie Jaya	3
	Regional	Aceh	2
Volunteer	Local	Aceh Tamiang	2
		Aceh Utara	2
		Pidie Jaya	2
	Regional	Aceh	1
Community	Local	Aceh Tamiang	1
		Aceh Utara	1
		Pidie Jaya	0
Total participant			15

Source: Personal/researcher's documentation, 2026

3.2.2 Secondary data collection

Secondary data collection drew on two categories of sources: 1) grey literature and 2) academic resources. Grey literature was identified through targeted Google searches and used across different parts of the thesis. Regulatory frameworks informed the introduction and served as analytical reference points during coding. The Post-Disaster Needs Assessment (BAPPENAS, 2026) justified the three focal municipalities from which the participant came.

News sources and institutional reports, especially the BMKG and BPBD dashboards, contextualised the disaster scale and timeline. Meanwhile, the local government emergency response system provided background context for the introduction.

Three formal operational documents were obtained from the participant and used for confirmatory purposes: 1) a contingency plan from the Local Disaster Management Agency at one of the affected municipalities; 2) a summary (table) of emergency status declarations across 18 municipalities provided by BPBA, including declaration dates, extensions, and duration; and 3) the organisational structure of Posko[1] at the provincial level. These documents were used informally to cross-reference accounts of the response as narrated by interview participants.

Academic literature was identified via ScienceDirect and Google Scholar, using combination keywords related to emergency response management, high-reliability systems, large-scale disasters, disaster governance, hybrid response systems, and developing countries, supplemented by author-based searches for Kapucu, Comfort, Weick, and Berthod. Given the specificity of research on emergency management networks and high-reliability systems, literature selection was not restricted by publication year. Instead, sources were selected based on their relevance to the study's theoretical framework and contextual conditions of the case study.

3.3 Data Analysis

Data were analysed using a qualitative content analysis, specifically adopting the directed approach defined by Hsieh & Shannon's (2005). This approach operated at two levels simultaneously: a deductive level in which the theoretical framework (HRO, HRN and HRPN) provided an initial coding structure (Hsieh & Shannon, 2005), and an inductive level, in which new codes emerging from participants' narratives were captured through open coding and categorised as emerging findings (Becker, 2024).

The analytical process followed five steps: firstly, audio recordings were transcribed using an AI-assisted transcription service specialised in Indonesian-language audio, namely transkrip.com. Given that several participants spoke with strong regional accents and occasionally used Acehnese terminology that the automated system could not accurately capture, all transcripts were manually curated by the researcher to ensure accuracy. Each transcript was then cleaned and reviewed to redact personally identifiable information in accordance with the informed consent procedure (Creswell & Poth, 2018). Then, the finalised transcripts were imported into NVivo for systematic data management.

[1] The Posko, or Emergency Command Post, functioned as a central coordination hub for collecting information on disaster impacts, conducting rapid assessments, formulating response strategies, and coordinating actions across sectoral agencies.

Secondly, a preliminary deductive coding frame was developed based on the theoretical framework. The frame drew on three theoretical sources: HRO, HRPN, and HRN. This frame included initial code labels and their clear definition to ensure consistency (Schreier, 2012).

Table 2 Deductive Codes from HRO, HRN, and HRPN

No	Deductive codes	Operational definitions
1	Anomaly detection	Continuous monitoring of early warning signs and system vulnerabilities. The actors involving active identifications, verification and discussion of early warning signs.
2	Situational sensitivity	Actors capacity to resist oversimplification of complex or evolving situation including sign or early warning.
3	Operational awareness	The network's capacity to monitor operational status in real-time and identify system weaknesses or information gaps across strategic and tactical levels during emergency response operations.
4	Emergency adaptation	Evidence of improvisation, adaptation, and recovery actions under escalating operational stress
5	Decentralise decision-making	Operational decision-making authority delegated to field-level experts
6	Latent ties	Pre-existing cross-sector relationships established before disaster/crises periods to gain inter-organisational trust
7	Network preparedness	Planning, budgeting, and training during pre-event to support a good or effective transitioning action to emergency response

Sources: (Berthod et al., 2017; Ginter et al., 2006; Hu et al., 2022; Weick & Sutcliffe, 2007)

Thirdly, transcripts were analysed line by line in NVivo, complemented by Microsoft Excel for further pattern mapping and analysis. Initially, 15 transcripts were coded inductively through open coding, capturing both direct quotations and contextual interpretations (Flaim & Speckart, 2016) in relation to participants' full answers and the research questions. Simultaneously, the researcher wrote analytic memos to track the researcher's reasoning and evolving ideas throughout the coding process. After a 7-day interval, a theory-driven deductive re-coding was conducted independently from inductive coding, applying the a priori framework systematically across all transcripts. This 7-day interval was chosen as an intra-coder reliability check, or re-coding of segments, to assess the consistency and stability of both inductive and deductive codes in this mostly single-coder study.

Fourthly, cross-group comparison was initially planned to identify patterns or differences across government, volunteer, and community participants (Flaim & Speckart, 2016).

However, given the fundamentally different authority and experiential contexts of each group, direct comparison proved analytically unproductive, since the accounts were too contextually distinct to be meaningfully compared on a similar basis. Cross-group analysis was therefore set aside, and each group's accounts were treated as distinct but complementary evidence of how the broader network functioned under time-critical conditions.

Finally, inductive and deductive coding results were systematically compared using Microsoft Excel to identify similarities or different patterns and gaps in findings. Codes were then clustered and integrated into unified categories according to the three theoretical sources: HRO, HRPN, and HRN. Emergent codes, those not anticipated by the theoretical framework, identified and incorporated via conventional content analysis (Hsieh & Shannon, 2005).

Meanwhile, triangulation was used both for validity checking and for complementary insight 25/06/2026 11:55:00. Interview data were cross-referenced with the groups and secondary documents to determine whether the narrated response converges with the recorded reality. It is important to offset biases inherent in research on public officials: recall errors, social desirability, guarded responses, and politically shaped narratives.

3.4 Limitations

There are four potential limitations that could affect the study's findings: the solo researcher, scope, bias, and the absent of national-level data. First, as a single researcher, I am subject to interpretative subjectivity. Intra-coder consistency checks and supervisor review were applied as mitigation strategies, but the absence of a second independent coder remains a constraint on analytical reliability.

Secondly, this study adopts an analytical scope: limiting the analysis to the first 72 hours of emergency response and to the network interactions among three focal municipalities in Aceh province (Uhr & Frykmer, 2024). This delimitation also reflects both the research question's focus and participants' recommendations, but this means findings should not be generalised to the broader Sumatran flood response or to disaster types beyond large-scale hydrometeorological events.

Thirdly, since the study relies on participant stories and experiences, which carry four potential biases (SRA, 2021), including 1) recall bias, such as incomplete memories from participants; 2) social desirability bias, particularly among government participants; 3) language barriers, requiring terminological adaptation between researcher and participants; and 4) politically motivated participants. An anticipatory strategy to minimise these issues is using flexible interview protocols and triangulation with secondary documents (Creswell & Creswell, 2013). Moreover, snowball sampling through an informal network introduced a selection effect: participants may not fully represent the diversity of actors involved in the

operation response, particularly those most peripheral to the formal coordination structure (Biernacki & Waldorf, 1981; Gierczyk et al., 2024). The limitation is particularly pronounced for community participants who were limited in number and identified solely through volunteer referrals without any additional selection criteria, raising questions about whether the accounts captured reflect the broader community experience or primarily those already connected to formal volunteer networks.

Lastly, the absence of national-level data represents a significant empirical gap. The national disaster management agency (BNPB) did not respond to interview requests, meaning that the national government's perspectives, including the rationale for not escalating the disaster to the national level, could not be captured or confirmed. This gap is acknowledged and discussed further in Chapter 5.

3.5 Ethical Considerations

Ethical guidelines and anticipatory strategies were implemented throughout the research process following Creswell (2013) and the Social Research Association (SRA, 2021), as seen in Table 2.

Table 3 Ethical Considerations and Anticipatory Strategies

Stages	Descriptions	Anticipatory Strategies
Data collection	• Given to the sensitivity of political and social dynamics, such as the limitation of basic infrastructures, ongoing response and recovery mechanism of Sumatran Floods across regions (SRA, 2021).	• The interview process and data exchange were carried out online through email or any preferable media to minimise direct and intense engagement with local community or government agency in the field in Aceh Province. This approach reduced risks to potential harm and disruption in the field for both researchers and participants while still enabling the collection of valuable insights into local dynamics through informed intermediaries.
	• Distribute the power dynamics equally, minimising researcher influence on participant's responses; and avoiding	• The participant received clear written and verbal information about researcher positionality, research purpose, what participation entails, voluntary participation, data use and

Stages	Descriptions	Anticipatory Strategies
	harm (Creswell & Creswell, 2013).	confidentiality protections (SRA, 2021, pp. 5–6). • Attention was paid to avoiding leading question throughout the interview process (Creswell & Creswell, 2013).
Data analysis, interpretation, and reporting	• Protecting the confidentiality of participant personal information. • Avoiding cherry-picking result or stereotyping although there might be contradictive narratives.	• Anonymous transcripts were implemented, raw data was separated into "special" storage, and digital metadata was managed carefully. • Multiple perspectives (even contradictory findings) were accommodated and judgemental language was avoided (Creswell & Creswell, 2013)

4 Result and Analysis

This chapter is organised into two parts. Section 4.1 addresses RQ1 by examining network performance during the first 72 hours of the Senyar Cyclone response. Section 4.2 addresses RQ2 by analysing the conditions that shaped that performance.

4.1 Network Performance During the First 72 Hours

Network performance is assessed through the lens of HRO principles, latent ties (HRN), and network preparedness (HRPN). The HRPN concept was used to capture the pre-crisis conditions that directly shaped operational capacity during the 72-hour window. Phenomena that the deductive framework alone could not anticipate are presented as emergent findings in the following section.

4.1.1 Reliability Principles in the Emergency Phase

This section presents findings on how the five reliable principles manifested (or failed) during the first 72 hours of the Cyclone Senyar response. The analysis proceeds principle by principle, but a cross-cutting pattern emerges consistently: each principle shows evidence of implementation at the tactical and community levels, while collapsing at the institutional and systemic levels. This variation between tactical functionality and systemic failure is the defining characteristic of the network's performance during the emergency phase.

Preoccupation with failure

At the beginning of the emergency phase, the capacity of anomaly detection broke down rapidly and completely at the institutional level. Three of six government participants reported that an analytical evaluation was conducted nightly as part of the response operation during the emergency period. One of those participants explicitly acknowledged that this response operation could not be conducted as planned.

> *"Every night we conduct analysis and evaluation. What has been done, what has been achieved, what hasn't. But at our Posko[2] (command post), the operational plan did not run as theory intended…"* (R6)

The breakdown was not a failure of will but was triggered by the collapse of the infrastructure (electricity, communication, and transportation). The weather observation tower owned by the Meteorology, Climatology, and Geophysics Agency (BMKG), installed across Aceh Province, went offline due to the power system collapsing. As a result, the strategic command lost the vital data input needed to detect anomalies.

[2] The Posko functioned as a central coordination hub for collecting information on disaster impacts, conducting rapid assessments, formulating response strategies, and coordinating actions across sectoral agencies.

> *"...what was actually happening was not that the field conditions were improving, but rather that the weather measurement tools installed across Aceh [...] had all gone offline."* (R6)

The consequence was a strategic command operation in near-total information blindness during the most critical window of the response. The data reaching the provincial command post did not come from a specially designed monitoring system, but rather from improvised channels, military radio networks and reports from survivors who had managed to escape from the affected areas.

In contrast, at the tactical and community level, anomaly detection remained partially operative. Volunteer organisations, particularly the Indonesian Red Cross, maintained daily planning-evaluation meetings and real-time documentation of community needs through a dedicated service questionnaire, continuing these practices even as institutional mechanisms around them failed.

> *"...every team that goes to the field has what we call a feedback team. [...] they ask about feedback from the survivors: 'How was today's service? Any criticisms or suggestions for improvements?' From that feedback, we report it to the [...] leaders and management..."* (R2)

This contrast between institutional collapse and tactical persistence illustrates the central pattern of the emergency phase: reliability was not absent, but it was displaced downward. It is sustained by the adaptability of the frontline actors rather than by the functioning of the system designed to support them.

Reluctant to simplify

During the emergency phase, the principle fails precisely when it is most needed: during the transition from a common annual flood to an unprecedented cyclone and large-scale disaster. Across all 15 participants, a uniform cognitive pattern was documented: the incoming event was consistently interpreted through the lens of prior flood experience, even as on-the-ground evidence contradicted that frame. This interpretative closure reflects a structural condition: the risk knowledge available to actors at all levels is almost entirely constructed through repeated exposure to annual flood events that, in terms of threat character and intensity, differ from those in Senyar. Since the reference point is only relatively manageable, actors' interpretation of new signals is shaped by that reference point rather than by the extreme scenario. Consequently, Senyar falls outside the region's accumulated experience that had equipped actors to recognise the possible.

"... what we imagined was a slow-onset flood. It turned out to also have a sudden-onset character. […] no matter how tactically skilled or quick-thinking a person is, they would have struggled at that moment." (R6)

"... this disaster was truly beyond prediction. Never in Aceh's history has there been flooding of this scale. This is new history for the people of Aceh." (R14)

The operational consequences of this cognitive closure were immediate and severe. The response systems had been designed for a slow-onset scenario, in which rising water levels would provide sufficient lead time for a gradual evacuation, as reflected in the testimonies of one government participant and three volunteer sector participants. When Senyar manifested instead as a sudden-onset event, the golden time available to each household shrank to a window so narrow that even those who had been warned and prepared found themselves unable to act effectively.

"...if the duration had been 8-12 hours, I believe they could have survived." (R6)

"...the water level rose very quickly; what at first was only about knee-high reached up to the knees in just a few seconds..." (R9)

"...the condition of the water was strong and fast. Within minutes, it eventually reached the rooftops of houses…" (R10)

At the community level, the simplification took a particularly consequential form: residents who had been warned chose to remain in their homes, anchored by the belief, reasonable given all prior experience, that the water would recede soon as it always had. In some cases, however, awareness of the threat did not translate into action, not because of interpretative failure, but because the available options were structurally close, for example, a community that lived in a valley flanked by flood-prone rivers on one side and landslide-prone hillsides on the other. Recognising the danger clearly, they could not safely evacuate in either direction.

"... there were people we wanted to evacuate, together with the military and police office at the district level. But their families didn't allow it because the water was still waist-high; the family thought they could still manage…" (R15)

"... my aunt didn't want to leave. She thought the water would recede. By morning, it had risen dramatically. She said, 'I thought it was only ankle-deep." (R8)

> *"...never in history has it rained for seven days without the river rising [...] So they were already anxious, already preparing, belongings had been moved to higher positions. But they didn't dare evacuate to a higher point. Because the rain continued like that, they feared being trapped or caught in a landslide. That community lived in a valley, flanked by hills on one side and a river on the other. It is a place that collects water..."* (R9)

It is important to note that the disregard for early warning patterns was not universal. A small number of communities, predominantly those in villages with consistent annual flooding histories and identified as municipalities' top-priority areas in the risk analysis plan, demonstrated faster evacuation times. Familiarity with recurring inundation had produced a localised risk awareness that translated into immediate action when water levels began to rise.

> *"...villages that regularly experience flooding were already on alert before it happened..."* (R1)

> *"...in these two districts, because they flood every year, when the water discharge rose high enough, residents immediately left their homes and sought safe ground..."* (R10)

These cases are analytically significant not because they contradict the broader findings, but because they illuminate the underlying logic. The communities that responded more effectively were not better informed through formal channels; rather, they became more knowledgeable and accurate about risks through accumulated local experience, which gave them a greater understanding of or sensitivity to environmental cues.

Sensitivity to operations

Of all five reliable principles, operational awareness experienced the most complete and rapid collapse. All 15 participants converged on this finding. The collapse was triggered by the simultaneous failure of three interdependent infrastructure systems. The electricity grid went down, which took the mobile network base station (BTS) offline, since most lacked independent power backup. This eliminated mobile communication across the affected region's radio systems; the design backup for exactly this scenario proved non-functional in most municipalities, having been progressively abandoned as smartphone-based communication made them seem outdated. This condition was compounded when the Provincial and Municipality Operations Control and Data Centre (Pusdaop[3]) was shut down due to an electrical problem, leaving systemic awareness blind.

[3] The institutional nerve center designed to collecting, processing, and presenting disaster data, disseminating information, and facilitating inter-agency communication and coordination to ensure swift and accurate emergency response (BPBA, 2019).

"…communication was totally cut off. Total blackout. Because most of the base stations were no longer online. It turned out they relied entirely on the state electrical company as the primary electricity provider here, with no backup system. So, communication via mobile phone was no longer possible." (R7)

"At that time, Pusdaop […] had no electricity supply at all. […] Everything had shut down. […] The same thing happened in all 18 cities and municipalities. […] Automatically, all information supply and exchange activities were zero — completely zero." (R6)

"…in disaster management, we use radio systems. We tried to activate the radio system. Unfortunately, in several municipalities, the radio systems also didn't (work)… I suppose because it had become too easy, access via phone, via WhatsApp. So the traditional communication pattern (failed)." (R7)

"We no longer have a radio. Since we got mobile phones, gradually the radio disappeared…" (R4)

The operational consequences of this total communication blackout extended beyond inconvenience. The strategic command could not assess how many people were affected, where the most critical needs were located, or what resources were available and where. The fundamental informational prerequisites for a coordinated response could not be answered.

"…it was very difficult to communicate. So, we didn't know what was happening there. We had no way to be there. That was the burden. We wanted to send logistics, but to where? To how many people? What items? We couldn't answer any of those questions." (R7)

"…at the beginning we didn't even know what type of disaster it was, whether it was a regular flood, flash flood, or something else…" (R10)

In the absence of a functioning communication infrastructure, the network reverted to methods that predated the technological systems it had come to depend upon entirely. Information was gathered through physical messengers, word-of-mouth networks at evacuation points, and accounts from survivors who had managed to reach accessible areas. Military radio networks, operated by military units at the municipality level, became the primary, and in many areas the only, functioning channels for strategic information flow.

"...it turned out there was a village-level military liaison officer who had a radio. That radio was the one that could connect to the command post. Because the Municipal-level Disaster Management Agency didn't have a radio, it no longer worked." (R14)

"...information supply came from military units in the districts. From municipal-level military command to Regional/Province-level military command, then to us at the Posko. Because the deputy IC came from the military. So, we relied on whatever information the military units could supply." (R6)

Commitment to resilience

Resilience during the Senyar emergency was demonstrable. However, it emerged almost entirely from below: from community solidarity, tactical improvisation and grassroots ingenuity rather than from institutionally planned redundancy. At the community level, self-organised evacuation began well before the formal response mechanism could reach affected areas. Residents evacuated neighbours, relatives, and elderly members using whatever was at hand. A 2000-litre water storage tank was cut open to create an improvised flotation device; an excavator was repurposed to reach residents on the rooftops; plastic cans became personal flotation devices for self-evacuation.

"...we evacuated using whatever equipment we had. The super big water storage, we cut it up to evacuate the residents we could reach." (R15)

"...we used an excavator to evacuate our people who were on the rooftops of family houses." (R15)

"...he used jerry cans, there were jerry cans floating by, he grabbed one and paddled himself to higher ground where the other residents had gathered." (R10)

The social fabric of Acehnese communities proved to be a form of operational infrastructure in its own right. Unaffected communities established communal kitchens in mosques; residents spontaneously shared necessary food without formal coordination; and volunteers pooled personal funds when formal response funds were unavailable during the first 72 hours.

"...for the first day of evacuation, it was entirely community-driven. They voluntarily donated rice (one muk per household equals 250 grams net of rice) to the mosque as they could. And at that time, we helped each other. Government assistance hadn't arrived yet. That first period, until about a week in..." (R4)

"...while waiting for rescue efforts, family-based assistance also took place. Family ties and kinship patterns in Aceh are close. For example, once family A was in a safe position, the neighbour next to them would evacuate others. That's how it wove together so seamlessly..." (R6)

"...finally reverted to the most traditional way of life, carrying collectively, piggyback. At the first blockade point, each person carried 20 kilograms of logistics. Back to the most traditional ways [...] human powered. Not efficient, but enough to keep communities alive..." (R6)

However, the critical analytical point is that the resilience observed during the Senyar response was not a product of system redundancy by design or of emergency planning that had anticipated and prepared for extreme cases, especially during infrastructure collapse. Instead, it was a compensatory response that emerged and was sustained by community social capital that remained functional. This distinction matters for how resilience is interpreted as an adaptive capacity of Acehnese communities, not as a reliable response system.

Deference to expertise

This principle emerges in Senyar's response operation as a necessity when the formal command chain becomes non-functional. When the communication with strategic command was severed, field coordinators and squad commanders assumed full decision-making authority for their operational areas. This transition was described by 2 out of 6 government participants and 5 participants from the volunteers as instinctive and immediate (squad commanders determined safer evacuation routes, reconciled conflicts that arose due to the insistence of survivors' requests for immediate evacuation; while the emergency field coordinator took over Red Cross municipalities' service duties and built communication with other actors when the entire managerial team was unavailable onsite). Participant added that there was no formal handover of authority in this regard.

"Once we're at that level of emergency, it's no longer possible to contact higher levels. That's when we have a field coordinator. [...] They're the one who makes the decisions." (R2)

"One rubber boat, one leader to make decisions. [...] That's the squad commander. They back up their team. They make the final call. There's a procedure for it." (R16)

Institutional boundaries dissolved correspondingly. Personnel from different organisations spontaneously merged into unified evacuation teams, without formal task orders or role-delineation agreements. As administrative requirements were set aside, the operative principle

became the main guide, rather than procedural requirements, as 3 of 7 volunteer participants highlighted: the important thing is that volunteers are safe and victims are helped.

The functional result of this decentralisation was positive: tactical operations continued, decisions were made, and evacuations proceeded even when the formal system had ceased to function as designed. However, the reliance on field-level autonomy also exposed the limits of decentralisation without coordination. Squad commanders could act decisively within their immediate operational areas, but they had no visibility of what was happening elsewhere in the network, and there was no mechanism to aggregate their actions into a coherent strategic picture. In other words, this principle sustained tactical performance but could not substitute for the systemic coordination that had collapsed. It preserved the ability of individual units to function; it could not restore the network's ability to function.

4.1.2 Latent Ties

Findings indicate that latent ties were present within the network, but only partially and unevenly distributed. Among volunteer organisations, functional ties existed, but their character varied. Three out of seven participants indicated that they were peers who had worked alongside one another in previous yearly emergencies and maintained informal contact over time, particularly within organisations or actors with shared operational experience, dating back to the 2004 tsunami. These kinds of personal ties activated quickly and functioned as informal coordination shortcuts. Another participant added it as either a personal connection built at the managerial level (between unit heads, field coordinators, and the organisational leader) or a product of formal institutional agreements.

> *"...It was only connections. When I got to know person A, or person A had a contact, A would send my number. […] There was no formal letter, no formal audience to offer assistance. Everything happened through connections. From one to A, A to B, to C..."* (R9)

> *"...It was experience, really. Not closeness or anything personal. From prior experience, I know I need to communicate readiness. From an initial assessment, you can see the gaps, who can be worked with, and who cannot..."* (R8)
> *"...NGOs have traces of the previous tsunami. So, he had friends in our organisation, who immediately contacted it. Or they had friends at other organisations, they went straight there, without going through the government..."* (R9)

At the field level, collaboration between government agencies and volunteer organisations also appears during evacuation operations. Participants described working alongside BPBD, firefighters, the military, the police, Red Cross volunteers, and SAR teams in the same

operational areas. However, this collaboration emerged spontaneously at the point of need rather than from pre-established coordination agreements, actors arriving at the same locations, dividing tasks informally, and working together without prior relational groundwork.

> *"…on 26th to the 29th, the jointly effort happened naturally. When we gathered in the field, we said, 'Let's divide the tasks.' Each organisation took part. […] in each task force team that moved out, every organisation was included. It happened organically, spontaneously."* (R10)

> *"…we were together with the municipality, along with SAR, Red Cross volunteers, and other organisations, military and police, to evacuate residents trapped by the flood…"* (R12)

At the intergovernmental level, latent ties were effectively absent. The cluster coordination system, designed as the primary mechanism for multi-actor coordination at the provincial scale, had not been tested prior to Senyar and was activated only 14 days after the disaster, well beyond the 72-hour window. Provincial and municipal agencies had interacted only under normal operating conditions, producing institutional familiarity without the relational depth needed for rapid trust-based coordination under pressure.

> *"…unfortunately, all five components of the pentahelix don't know each other yet. They have to be introduced first."* (R7)

> *"…at the beginning we were all playing individually, each on their own…"* (R3)

4.1.3 Network Preparedness

Findings indicate that collective preparedness capacity was structurally insufficient across four dimensions: resource and equipment readiness, early warning integration, joint training and exercises, and the vitality of formal coordination structures. Although this section draws on HRPN concepts, its inclusion here reflects its role as a contextual condition that directly shaped network performance during the 72-hour window, rather than as a primary evaluative lens.

Resource and Equipment Readiness

The material foundation of the response network was compromised before the disaster began. Across 5 out of 6 government groups and one volunteer, participants consistently described a resource environment characterised by equipment that was degraded, absent, or financially inaccessible when needed. Vehicles were inoperable due to unresolved maintenance backlogs;

rubber boats and life jackets were either severely limited or entirely absent in several municipalities, and logistical aid stock was limited.

> *"...rubber boats for evacuation, life jackets, extremely, extremely limited."* (R6)

> *"...we don't have the equipment for this kind of disaster response: rubber boats for evacuation, lighting equipment [...] Not limited, simply not there. And the volunteers deployed to the field were also limited."* (R10)

> *"...some vehicles were broken because the spare parts hadn't been maintained or repaired for a long time..."* (R1)

The timing of Senyar compounded these deficits in a structurally significant way. The disaster struck at the fiscal year-end, when remaining budget allocations had already been returned to central accounts. The network, therefore, entered the emergency phase not merely under-resourced but without an immediately accessible financial mechanism for rapid resource mobilisation, a condition that one participant described as being caught between a closed budget cycle and an open disaster.

> *"...if we want to mobilise resources, we need a budget. And at that point, the accounts had just been closed, everything returned. And then the unexpected happened."* (R7)

Early Warning Integration

The absence of an integrated real-time flood monitoring infrastructure meant that the network's capacity to translate warning signals into timely operational decisions was structurally constrained from the outset. In most localities, river levels were still being monitored manually by fire service personnel, a method that, while operationally present, could not provide the continuous automated data streams needed to trigger faster institutional responses. The integrated hydrometeorological information systems available in other provinces had not been established in Aceh.

> *"...in East Java there's already SIH3P, an integrated hydrometeorological information system connecting BMKG, irrigation agencies, such as BBWS[4], and BPBD. In Aceh, we don't have that yet."* (R1)

> *"...it's been recommended for years to procure flood detectors. But because the costs are high..."* (R14)

[4] Balai Wilayah Sungai or Large River Basin Organisation, a regional government agencies under the Ministry of Public Works and Housing whose responsible for managing river basins, flood control, irrigation, and water resource in their specific regions.

This technological gap meant that the six-day window between early warning and the disaster's full impact, a window that a well-prepared network could have used for pre-positioning resources and preventive evacuation, could not be operationalised effectively. The network possessed a warning system in name; it lacked the monitoring infrastructure to act on it in practice.

Joint Training and Exercise

The data show that joint training and cross-institutional exercise were largely absent from the practices described by both participants. No actor in government or volunteer reported engaging in regular joint drills, tabletop simulations, or shared-scenario-based exercises that would allow different agencies to rehearse evacuation routes, test communication protocols, or coordinate responses under pressure. Where training was mentioned, it tended to be confined to individual organisations and not framed as a collective effort, suggesting limited institutionalisation of joint exercise routines and a relatively narrow circle of practitioners responsible for maintaining them. The gap was further compounded by the fact that Formal Disaster Risk Reduction meetings, which should serve as a platform for multi-actor communication, had become functionally dormant. Consequently, the multi-actor pentahelix did not engage in regular pre-event meetings or joint exercises, leaving the cluster coordination system completely inactivated and untested before Senyar.

> *"There used to be a forum on disaster-related issues in the council during the previous period, and it was quite active. Now, in this new period, such forums have not yet been established…"* (R7)

> *"…and lately, even though everyone is part of the forum, you can see it's become somewhat dormant…"* (R10)

4.1.4 Emergent Findings

Besides the three preceding sections, the Senyar Cyclone emergency also generated two phenomena that, inductively, emerged from the participants' accounts and could not be incorporated into the deductive framework derived from HRO, HRN, and HRPN. These codes, namely goal displacement and authority ambiguity, were retained as emergent findings, reflecting dynamics that arose from the interaction between systemic stress and the structural features of Indonesia's decentralised governance architecture.

Goal Displacement

High-reliability frameworks assume that designated response actors remain operationally available throughout a crisis; their role is to respond, not to be affected. Senyar violated this assumption at scale. Because the disaster struck simultaneously across 18 districts with

extraordinary speed and intensity, a significant portion of the designated response workforce was itself caught in the event. Three government participants mentioned that personnel who would ordinarily have been mobilising resources and coordinating evacuation were instead securing their own families and households.

> *"Each of us tried to save ourselves, really. Making sure our own families were safe… Once they were safe, we went to Posko"* (R1)

> *"...Let alone ordinary civilians, I think even military units, and all, were in a state of panic trying to save themselves…"* (R6)

> *"…each of us tried to save ourselves. Making sure our own families were safe […] Because everyone was affected. The people we assumed would be on standby all had to save themselves and their families."* (R14)

The operational consequence was immediate: agencies that were expected to be fully staffed and operationally ready found themselves with reduced personnel precisely when demand was at its highest. This was not a failure of individual commitment; it was a structural consequence of a disaster that exceeded the geographic and temporal assumptions built into the response system's design. The system had not been designed for a scenario in which responders and victims occupied the same space at the same time.

Goal displacement was also manifested at the organisational level (based on two volunteer testimonies). Several agencies that should have been directing outward, coordinating with other actors, instead turned inward, prioritising the restoration of their own disrupted operations. This inward orientation further reduced the network's collective coordination capacity at its most critical moment.

Authority Ambiguity

The second emergent phenomenon concerns the structural disconnect between political authority and technical command that became operationally consequential during the emergency. Under Indonesia's decentralised governance system, provincial and municipal governments are constitutionally separate entities: the Governor holds no directive authority over Local Leaders. Under normal conditions, this arrangement is managed through coordination and consensus. Under crisis conditions, when speed of decision and clarity of command are essential, it produced authority ambiguity about who held legitimate authority to direct collective action.

> *"The province is one entity; the cities and municipalities are another. And they have no relationship that is directive in nature…"* (R7)

> *"There's a command post, and if we're talking about provincial status, all commanding should be at the province. But the local leaders also have their own Posko, and they are regional heads who do not answer to the Governor. So, there's a command chain that doesn't connect..."* (R7)

This ambiguity was compounded by a leadership transition problem. Several local leaders had been recently appointed and had not yet developed an adequate understanding of emergency response mechanisms. Decisions requiring political authorisation, including the formal declaration of emergency status and the mandating of full resource mobilisation, were delayed precisely when speed was most critical.

> *"...If the local leaders understand, great. If not, it's over. Especially since the new local leaders haven't been trained yet or given an understanding of the command system. […] Disaster management requires political consensus. Politicians make the decisions. Without their concern, knowledge of SOPs, or procedures, we're helpless."* (R7)

The consequence was that the network could not consolidate around a unified command, in which coordination remained fragmented. Without clear authority and preestablished coordination agreements, actors fragmented under pressure rather than converging on a collective response, with each unit operating within its own operational area without a mechanism to aggregate actions into a coherent strategic picture.

This failure had a cascading operational effect. Evacuation orders could not be issued directly by the provincial command to communities; they required authorisation through the Local Leader, who in turn had to understand the situation, assess its severity, and make a timely decision. Where Local Leaders were experienced and engaged, this chain functioned. Where they were not, it stalled.

> *"...We cannot issue evacuation orders directly to the community. It must go through the local Disaster Management Agency, which also needs authorisation from the local leaders. If the local leaders understand, great. If not, it's over…."* (R7)

Taken together, goal displacement and authority ambiguity produce a network that was simultaneously undermanned, structurally fragmented and unable to establish the unified direction that crisis coordination requires. Individual actors and units continued to function, sometimes effectively, but the network as a whole could not consolidate into the coherent, collectively directed system that reliable emergency response

demands. As such, the Senyar response demonstrated partial reliability, meaning it was sustained at the tactical and community levels through improvisation and social solidarity, and at the field level through autonomy, but was absent at the systemic level, where coordinated institutional action was required.

4.2 The Conditions that Influence Reliability in the Senyar Case

This section addresses RQ2 by analysing the conditions that shaped network reliability in the Senyar case. Three clusters are identified: pre-existing structural fragility, crisis-activated breakdown mechanisms, and compensatory dynamics that prevented complete system failure.

4.2.1 Pre-Existing Structural Fragility

Building on the preparedness conditions identified in section 4.1.3, this section examines the structural roots of those conditions and their implications for network reliability. The response network entered the Senyar emergency already compromised. This fragility was not produced by the disaster; it was revealed by it. Two dimensions are identified: chronic underinvestment in collective preparedness capacity and the absence of inter-organisational trust across the network.

Chronic Underinvestment

Chronic underinvestment reflects how insufficient the material and institutional foundations for collective preparedness were prior to Senyar's arrival. Participants across the government group consistently described a budget environment in which disaster preparedness competed poorly against other sectoral priorities. Operational cuts, reported as high as 50%, were not anomalies but reflections of a structural pattern in which readiness investment was treated as expendable under normal conditions and urgent only after a disaster had already occurred. Compounded by the fiscal year-end timing and very little remaining emergency funds, the chronic underinvestment transformed into acute financial paralysis.

> *"…We know that Aceh is a disaster-prone region. But the funding allocated for mitigation is inversely proportional to that risk…"* (R6)

> *"…perhaps this is the impact of budget cuts or efficiency measures. […] and indeed, attention to disaster management beforehand has been somewhat limited. […] Because funding is limited, they are also unable to work to their full capacity."* (R1)

> *"…our preparedness, actually, […] our investment is still low, I would say, in early warning systems and everything related to that…"* (R7)

> *"...the mindset is not yet 'better safe than sorry.' The money is used for other things, and the budget for disasters is only released when the flood actually comes..."* (R14)

The Absence of Inter-Organisational Trust

As mentioned in section 4.1.2, latent ties within the network were unevenly distributed: present in personal, experience-based form among volunteer actors, but effectively absent at the intergovernmental level. This unevenness mattered as a condition because without pre-established trust, actors had no relational foundation on which to build rapid consensus on authority, role division, and operational priorities when the formal communication infrastructure collapsed.

Among volunteer organisations, ties activated quickly because they were rooted in shared operational histories. Among government actors across administrative levels, interactions had occurred only under routine conditions, producing institutional familiarity without the relational depth needed for rapid coordination under pressure.

> *"...there needs to be trust-building first, between the government and the CSOs. And this has to happen before the disaster, in the pre-disaster phase. Now we're trying to do it directly, spontaneously. [...] Orchestrating ministries, regional governments, districts and municipalities, CSOs, and all the others. Then we use the Pentahelix, with all five components working together. But unfortunately, none of the five know each other yet. So, they have to be introduced first."* (R7)

The cluster system, designed as the coordination mechanism for exactly this kind of multi-actor emergency, was activated only 14 days after the disaster. Its late activation was not a logistical failure but a relational one: the trust and familiarity required for it to function had not been built during the preparedness phase and could not be constructed under emergency conditions.

4.2.2 Crisis-Activated Breakdown

The second cluster of conditions concerns mechanisms directly triggered and amplified by the disaster itself. Two are identified: the warning-to-action translation gap and the coordination breakdown that followed infrastructural collapse.

Warning-to-Action Translation Gap

Despite the availability of early warning, approximately six-days elapsed between the release of the hazard warning and substantive action on the ground. This was not primarily a communication failure; the warning was received. The issue was a translation failure, in

which the warning could not be translated into timely operational decisions due to the convergence of three mutually reinforcing factors.

The first was cognitive. As documented in Section 4.1.1, actors at all levels interpreted the incoming threat through the frame of annual flooding experience. Risk knowledge had been built almost exclusively through repeated exposure to events that were different from Senyar in both character and intensity. When the only available reference points are events that behaved predictably and remained manageable, the interpretive frameworks actors use to read new signals are calibrated to those reference points, not to scenarios that lie beyond them.

The second factor was technological. The absence of real-time flood monitoring systems meant that local actors had no independent data stream to challenge their interpretive frames or accelerate decision timelines. Manual river monitoring could not provide the continuously processed data needed to trigger faster institutional responses.

The third factor was political. Formal resource mobilisation, including the issuance of evacuation orders, required authorisation from local leaders, as mentioned by two participants from a government group. Where leaders lacked understanding of emergency response mechanisms, this authorisation was delayed. The warning-to-action chain was therefore only as fast as its slowest political link, and in a post-election period with newly appointed leaders, that link was structurally weak. Together, these three factors produced a preparedness window that was structurally incapable of being used effectively, regardless of the warning's quality.

Coordination Breakdown

When the disaster struck, the simultaneous failure of electricity, telecommunications, and road infrastructure triggered a breakdown in coordination that was both immediate and total. The findings reveal that this collapse was not simply an act of nature; however, it was the predictable consequence of a system designed without meaningful redundancy. Mobile communication infrastructure had no independent power backup; radio systems had been allowed to degrade; no pre-positioned satellite communication equipment was available at the municipal level.

The breakdown in coordination interacted directly with the fractured institutional architecture identified in Section 4.1.4. Under normal conditions, the ambiguity in command authority between provincial and municipal levels is managed through ongoing communication and negotiation. When communication collapsed, this management mechanism disappeared, leaving the fractured architecture unmediated and operationally paralysing at precisely the moment when clear command was most needed. The two conditions amplified each other: infrastructural collapse made coordination impossible; fractured institutional architecture made it unclear who should coordinate, even if communication had been restored.

4.2.3 Compensatory Mechanisms and Their Limits

The third cluster of conditions concerns the dynamics that prevented complete system failure and what their character reveals about the reliability that was achieved.

Hybrid Adaptation

As formal coordination mechanisms collapsed, operational continuity was maintained through adaptive practices that emerged spontaneously from frontline actors and communities. At the community level, self-organised evacuation, improvised flotation devices, mutual aid networks, and communal food preparation sustained populations that formal logistics chains could not reach (see 4.1.1). The social fabric of Acehnese communities, norms of mutual aid, dense kinship networks, and communal solidarity functioned as an operational infrastructure that no formal system had planned for, but that the response could not have functioned without. At the tactical level, field coordinators assumed full decision-making authority, institutional boundaries dissolved into unified evacuation teams, and military radio networks substituted for civilian communication infrastructure, sustaining a minimum level of strategic information flow when all designed channels had failed.

The Structural Limits of Compensation

The analytical significance of hybrid adaptation lies not only in what it achieved but in what it reveals. A response that depends on community improvisation and military radio networks to maintain basic operational continuity is not a reliable system that happened to face extraordinary circumstances; it is a system whose reliability was always contingent on conditions outside its design and beyond its control.

This is sharpened by the uneven distribution of compensatory capacity across the affected population. Communities with strong mutual aid networks could absorb systemic failures; those without such networks remained most vulnerable. Areas within reach of military radio infrastructure received strategic support; those beyond did not. The case of a village which illustrates this most starkly: residents recognised the threat clearly and had prepared as best they could, yet were trapped not by ignorance but by geography, a valley flanked by flood-prone rivers on one side and landslide-prone hillsides on the other, with no safe evacuation route in either direction, regardless of warning quality or preparation level. Hybrid adaptation filled gaps but did not resolve the structural vulnerabilities that produced them. And it did so unevenly, leaving the most geographically and socially isolated communities most exposed precisely when the formal system had ceased to function.

5 Discussion

This chapter discusses the findings presented in Chapter 4 in relation to the theoretical framework and existing literature. It reflects on what the results confirm or challenge across HRO, HRPN, and HRN, considers dimensions the framework alone could not explain, and examines the broader implications for theory and practice.

5.1 Discussion

The findings from the Senyar response are largely consistent with the predictions of HRO, HRPN, and HRN when reliability conditions are absent. At the organisational level, the collapse of all five reliability principles confirms Weick and Sutcliffe's (2007) argument. They argued that reliability is an actively sustained state; when investment ceases, the principles erode. At the preparedness network level, the finding that formal coordination structures existed but were functionally dormant directly confirms Ginter et al.'s (2006) argument that collective preparedness is a product of sustained joint investment, not structural designation alone. At the network governance level, the finding that volunteer networks with shared crisis histories activated quickly while government-CSO and pentahelix coordination fragmented, converging only 14 days after the disaster, is consistent with Berthod et al.'s (2017) and Hu et al.'s (2022). Both studies argued that reliable network performance depends on pre-established inter-organisational trust. The specific relational gap was not between government levels that did interact under normal conditions, but between the formal government system and civil society, a boundary that pre-disaster coordination mechanisms had not crossed.

Beyond relational deficits, the findings surface a structural condition that, in retrospect, warranted more explicit consideration at the outset of this study: constitutional authority architecture. HRO and HRN scholars have acknowledged that these frameworks assume relatively stable organisational structures and clear governance arrangements as preconditions for their application (Comfort, 2007; Kapucu & Garayev, 2011; Moynihan, 2009; Wolbers & Boersma, 2013). While these assumptions align well with top-down, centralised, or politically stable governance settings, this study cautiously departs from that ideal-type context by applying the same framework to Indonesia's constitutionally decentralised system. The extent to which Indonesia's governance architecture met those assumptions had not been explicitly interrogated before the analysis, an oversight that only became visible in hindsight through the abductive process of moving between theory and data, as the empirical data revealed the mismatch between the framework's implicit premises and the decentralised realities on the ground. Under Indonesia's regional autonomy law (Law of the Republic of Indonesia Number 23 of 2014 concerning Regional Government, 2014), governors hold coordination mandates without directive authority over Local Leaders. This means that even where actors are willing to coordinate, the authority structure required to consolidate command does not exist by

design, a condition that, as Smoke (2015) notes, is characteristic of extensively decentralised systems where executive power dispersion can hinder timely emergency response.

Two process-level dimensions also shaped how those conditions played out in practice. First, the six-day window between early warning-to-action and substantive action reflects not individual cognitive error but a network-level failure to build shared interpretations of a qualitatively new threat. Actors at all levels read the incoming event through familiar frames calibrated to annual flooding, and no collective process existed to challenge or revise those frames in time, which relates to a condition directly linked to the absence of reluctance to simplify and sensitivity to operations in HRO (Weick & Sutcliffe, 2007). Second, the capacity to coordinate beyond formal structures depended heavily on the relational ties actors (including trust, norms, and social solidarity) had built prior to the crisis (Kapucu & Garayev, 2011). Where those ties existed, predominantly at the community level, they functioned as unplanned but consequential operational infrastructure. Where they were absent, particularly between government agencies and civil society organisations at the governance network level, coordination had to be constructed from scratch under emergency conditions, precisely when there was neither time nor institutional foundation to do so, confirming Berthod et al.'s (2017) argument that switching cannot occur without stable, trust-based ties built before the crisis.

The core propositions of Kapucu and Garayev (Kapucu & Garayev, 2011) and Berthod et al. (2017), that reliable networks require pre-established trust, collective preparedness, and clear authority structures, were developed from high-capacity governance contexts but are not inherently context-specific. The Senyar findings confirm these propositions from the opposite direction: by demonstrating what partial reliability looks like when all three conditions are absent simultaneously. It is fair to assume that any multi-actor emergency response network operating within a constitutionally decentralised system, with asymmetrical actor capacities and limited pre-disaster coordination investment, faces structurally similar reliability challenges, regardless of disaster type or geographic setting. What the Senyar case adds is a reminder that applying these frameworks in decentralised contexts requires explicit interrogation of whether the governance architecture meets their underlying assumptions, a condition this study identified retrospectively rather than by design, and one that warrants attention in future applications of these frameworks in similar settings.

Practically, the findings suggest three adjustments within existing mechanisms rather than new regulation (Alcántara-Ayala et al., 2025; Djalante et al., 2011; D. I. Putra & Matsuyuki, 2019): clearer operational triggers for provincial coordination authority under the existing Indonesian Emergency Response System framework (Municipality-level Emergency Disaster Command System Implementation Instructions, 2023); mandatory pre-disaster activation of cluster coordination mechanisms; and emergency management orientation for newly appointed regional leaders integrated into existing handover procedures, treating the post-

election leadership gap as a predictable, recurring vulnerability rather than an exceptional circumstance.

5.2 Limitation

The findings of this study should be read with four limitations in mind. The integrated framework evolved iteratively throughout the research process, reflecting genuine empirical complexity, but all three theories were developed in high-capacity governance contexts and do not fully account for the political economy dynamics that shaped the Senyar response. Methodologically, snowball sampling through informal networks introduced a selection effect; as a solo researcher, interpretive subjectivity was mitigated through intra-coder checks and supervisor review, though not eliminated. The most significant data gap concerns the absence of national-level respondents (the National Disaster Management Agency (BNPB) did not respond to interview requests), leaving the central government's decision not to escalate to national disaster status unverified; government respondents also carried social desirability risk that made candid accounts difficult to systematise. Finally, where the discussion extends beyond what the data directly supports, the language is intentionally tentative, as these are interpretive propositions offered for consideration rather than conclusions that the data can fully sustain.

6 Conclusion

This study examined how Indonesia's networked emergency response system performed during the first 72 hours of Cyclone Senyar in Aceh and what conditions shaped its reliability. The findings reveal a pattern of partial reliability: the system did not fail entirely, but it also did not perform reliably either. Reliability was sustained at the tactical and community level through field-level improvisation, autonomous decision-making, and community social solidarity. However, it collapsed at the institutional and systemic level, where coordinated command, real-time situational awareness, and collective preparedness were required but absent.

Three clusters of conditions produced this pattern. Pre-existing structural fragility, including chronic underinvestment in collective preparedness and the absence of inter-organisational trust between government and civil society, meant the network entered the emergency already compromised. Crisis-activated breakdown, such as the warning-to-action translation gap and total infrastructural collapse without designed redundancy, exposed and amplified those pre-existing vulnerabilities. Compensatory mechanisms, including community solidarity, tactical improvisation, and military communication infrastructure, prevented complete failure but could not substitute for systemic reliability and did so unevenly, leaving the most geographically and socially isolated communities most exposed.

Theoretically, the integrated application of HRO, HRPN, and HRN proved productive in diagnosing these conditions. The findings confirm core propositions across all three frameworks while surfacing one condition this study did not sufficiently interrogate at the outset: whether Indonesia's constitutionally decentralised governance model met the frameworks' underlying assumptions of stable authority structures. The oversight, identified retrospectively through the abductive analytical process, is offered as a methodological caution for future applications of these frameworks in decentralised governance contexts.

Practically, the findings point to three adjustments within existing mechanism: clearer operational triggers for provincial coordination authority, mandatory pre-disaster activation of cluster coordination, and emergency management orientation for newly appointed leaders as part of standard handover procedures. Three directions for future research emerge from this study. First, comparative studies applying the same integrated framework across different decentralised governance systems, beyond Indonesia and beyond hydrometeorological disasters, would help establish whether the assumption gaps identified in this study recur in similar governance contexts. Second, longitudinal research tracking whether the organisational learning participants described translates into institutional change would address a gap this study could not capture within its 72-hour scope. Third, future studies

should prioritise access to national-level actors from the outset, as the absence of BNPB perspectives in this study left a significant blind spot in the institutional analysis.

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Appendix 1: Disclaimer on the use of generative AI Tool

The authors acknowledge the use of AI (Grammarly and Transkrip.com) for completing certain parts of this document. The scope of its use is outlined as follows:

- Reviewing grammatical errors and providing alternative phrasing for different words and sentences.
- Transcribing interview records from the participants

Appendix 2: Interview guideline

The interview protocol presented here reflects the initial design of the study, which was primarily guided by HRO theory. As the research progressed through an abductive logic of inquiry, the analytical framework expanded to incorporate HRPN and HRN, including the concepts of network preparedness and latent ties. Consequently, probing questions related to these dimensions emerged organically during interviews rather than being systematically pre-designed. This evolution is acknowledged as a limitation of the study's methodological design and is discussed further in Chapter 5.

Translated from Indonesian to English

A. *For government agencies and humanitarian volunteers:*
    1. Could you tell me a bit about yourself?
    2. Could you describe the first moment you realised that this flood was different from the annual one?
    3. During the first 72 hours, we know that all team members were exhausted. What was the most time- and energy-consuming task: evacuating people or resource mobilisation due to fuel shortage, broken access routes, or a dysfunctional head-post due to flooding? Why?
    4. When the formal response system or SOP were disrupted, how did leadership emerge on the ground during evacuation? Who usually took the initiative to act?
    5. When official responders are delayed due to limited personnel or broken roads, which informal groups (e.g., village youth, truck-owner middlemen, or mosque administrators) stepped in to support evacuation and logistics before the official team arrives?
    6. When did the situation start to feel somewhat under control (e.g., on the fourth or fifth day)? How were coordination efforts rebuilt after the initial disruption?
    7. Reflective question:
       Looking back at the chaos of the first 72 hours, what was the most important lesson that changed your perspective on what 'disaster response' really means?

B. *For affected communities:*
    1. Could you tell me a bit about yourself?
    2. When the water suddenly rose what did you do first? How did people alert or communicate with each other?
    3. During the first three days before formal response and aid arrived, what were the most urgent needs that residents could not obtain because the roads were cut off?
    4. When government officials or volunteers couldn't reach your village, who among local residents or community groups took the initiative to organize the evacuation? What tools or resources did they use?

Appendix 3: Recap calculation of loss and damage for reconstruction phase

No.	Municipalities	Damage and Loss Value		Total Loss and Damage (in thousands)
		Damage (in thousands)	Loss (in thousands)	
1	Aceh Tamiang	USD 1.914.484	USD 547.617	USD 2.462.101
2	Aceh Utara	USD 1.098.742	USD 533.526	USD 1.632.269
3	Pidie Jaya	USD 442.361	USD 553.381	USD 995.742
4	Aceh Timur	USD 418.911	USD 147.316	USD 566.226
5	Aceh Tengah	USD 389.083	USD 58.218	USD 447.301
6	Bireun	USD 322.146	USD 114.914	USD 437.060
7	Gayo Lues	USD 301.020	USD 62.647	USD 363.667
8	Bener Meriah	USD 270.530	USD 70.621	USD 341.151
9	Kota Langsa	USD 182.132	USD 29.936	USD 212.068
10	Pidie	USD 161.493	USD 47.521	USD 209.014
11	Aceh Tenggara	USD 76.842	USD 23.992	USD 100.834
12	Nagan Raya	USD 74.627	USD 22.770	USD 97.397
13	Aceh Selatan	USD 79.689	USD 13.919	USD 93.608
14	Aceh Singkil	USD 85.247	USD 316	USD 85.564
15	Aceh Barat	USD 68.459	USD 8.648	USD 77.107
16	Kota Lhokseumawe	USD 68.711	USD 1.904	USD 70.615
17	Kota Subulussalam	USD 33.203	USD 4.286	USD 37.489
18	Aceh Besar	USD 13.996	USD 891	USD 14.888
TOTAL		**USD 6.001.676**	**USD 2.242.423**	**USD 8.244.099**

Adapted table from the Governor's Decree (Kepgub) of Aceh No. 300.2/68/2026 regarding the Post-Hydrometeorological Disaster Rehabilitation and Reconstruction Plan Document for Aceh Province 2026–2028, obtained from the National Development Planning Agency, 2 February 2026 (BAPPENAS, 2026).

This table outlines the selection criteria used to prioritize and identify the target municipalities for this study, based on the participants' regional distribution.