

From Crisis to Recovery: Optimizing Humanitarian Logistics for Long-Term Resilience in Cianjur

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ABSTRACT

The 2022 Cianjur Earthquake in West Java, Indonesia, registering a magnitude of 5.6, caused widespread damage and triggered 140 aftershocks, disrupting multiple sectors. This study investigates the humanitarian logistics management deployed in response to the disaster, focusing on the coordination and efficiency of aid distribution. Using a qualitative approach and comprehensive literature review, the research outlines how various stakeholders, including government agencies, local NGOs, and affected communities, collaborated to implement an effective logistics system. The findings highlight the importance of transparency, traceability, and inter-organizational coordination in ensuring timely and equitable aid delivery. Moreover, the study emphasizes that effective humanitarian logistics contribute not only to physical recovery but also to the psychological and social well-being of disaster survivors. This research contributes to the discourse on disaster management by offering insights into logistics strategies that support sustained recovery in post-disaster contexts.

ABSTRAK

Gempa Cianjur 2022 di Jawa Barat, Indonesia, yang mencatatkan magnitudo 5,6, menyebabkan kerusakan luas dan memicu 140 gempa susulan, mengganggu berbagai sektor. Penelitian ini menyelidiki manajemen logistik kemanusiaan yang diterapkan sebagai respons terhadap bencana tersebut, dengan fokus pada koordinasi dan efisiensi distribusi bantuan. Menggunakan pendekatan kualitatif dan tinjauan literatur yang komprehensif, penelitian ini menguraikan bagaimana berbagai pemangku kepentingan, termasuk lembaga pemerintah, LSM lokal, dan komunitas terdampak, berkolaborasi untuk menerapkan sistem logistik yang efektif. Temuan penelitian menyoroti pentingnya transparansi, keterlacakan, dan koordinasi antarorganisasi dalam memastikan pengiriman bantuan yang tepat waktu dan adil. Selain itu, penelitian ini menekankan bahwa logistik kemanusiaan yang efektif tidak hanya berkontribusi pada pemulihan fisik, tetapi juga pada kesejahteraan psikologis dan sosial para korban bencana. Penelitian ini memberikan kontribusi terhadap wacana manajemen bencana dengan menawarkan wawasan mengenai strategi logistik yang mendukung pemulihan berkelanjutan dalam konteks pasca-bencana.

1. Introduction

Indonesia is recognized as one of the most disaster-prone countries globally due to its geographical location along the Pacific Ring of Fire and the interaction of several major tectonic plates. This condition exposes the country to various natural hazards, including earthquakes, volcanic eruptions, floods, and landslides, which frequently result in substantial human casualties and economic losses. Among these hazards, earthquakes pose a particularly critical threat because of their sudden occurrence and limited opportunities for early warning.

Cianjur Regency, West Java is located in a seismically active area and is vulnerable to potential earthquake hazard [1], [2]. The Cianjur earthquake in 2022 was a type of mainshock-aftershock earthquake that occurred north of the Cimandiri fault, Rajamandala [2], [3], [4].

The 2022 Cianjur main earthquake measured 5.6 magnitude. This tectonic earthquake in the shallow crust killed 334 people. As many as 13 people were recorded as missing and 593 people suffered serious injuries. The earthquake also had an impact on damage to housing and public facilities. A total of approximately 53 thousand houses were declared damaged with heavy damage reaching 12,956 units, moderate damage reaching 15,196 units, and light damage reaching 25,256 units. Not only houses, damage also occurred to public facilities, such as 540 schools, 272 places of worship, and 18 health facilities. The number of refugees from the 2022 Cianjur Earthquake reached 114,683 refugees from 41,166 families. Socio-economic impacts influence the dynamics of life and post-disaster recovery for the affected Cianjur people [4].

In the disaster mitigation system, reducing disaster risk is one of the focuses to reduce the spread of impacts. There are 3 risk components consisting of hazards, vulnerability, and capacity. These three components include the social, economic, and physical impacts of earthquakes in affected areas [1]. In the post-disaster recovery process, distribution of aid is a key effort to reduce the potentially widespread socio-economic impact. Humanitarian logistics management operates the humanitarian sector, which concerns socio-economic relations. Humanitarian logistics must also be able to adapt to aid targets and environmental changes for the resources involved [5], [6], [7].

The 2022 Cianjur Earthquake presents a relevant case for examining these issues. The Involvement of multiple actors, including government agencies, humanitarian organizations, and local communities combined with the scale of logistical demands provides a valuable context for evaluating the effectiveness of humanitarian logistics governance. Studying this case is essential to identify systemic challenges, best practices and lessons learned that can inform more resilient and adaptive logistics systems in future disaster, [8]. Therefore, this research aims to analyze the governance of humanitarian aid distribution through a humanitarian logistic approach in the context of the 2022 Cianjur Earthquake. By employing a qualitative methodology supported by a comprehensive literature review, this study seeks to contribute both theoretically to the development of improved humanitarian logistics management in Indonesia's disaster-prone environment [9]. In this way, humanitarian logistics management plays an important role in the 2022 Cianjur Earthquake disaster mitigation system.

2. Research Method

This study employs a qualitative research approach to examine the governance of humanitarian aid distribution through a humanitarian logistics perspective in the context of the 2022 Cianjur Earthquake. A qualitative approach is considered appropriate as it enables an in-depth understanding of complex processes, coordination mechanisms, and institutional interactions involved in disaster response and post-disaster recovery. The research design adopts a descriptive-analytical method, focusing on identifying patterns, challenges, and practices in humanitarian logistics management. This approach allows the researcher to analyze how humanitarian logistics principles are implemented in real disaster situations and how they influence the effectiveness of aid distribution.

2.1. Data Sources

The study utilizes secondary data obtained from credible and relevant sources. These include official reports issued by government institutions such as the

National Disaster Management Authority (BNPB), local disaster management agencies, humanitarian organizations, and non-governmental organizations involved in the Cianjur Earthquake response. In addition, academic journal articles, policy documents, and relevant literature related to humanitarian logistics and disaster management are used to strengthen the analytical framework.

2.2. Data Collection Techniques

Data collection was conducted through a systematic literature review. Relevant documents were identified using keywords related to humanitarian logistics, disaster response, aid distribution, and earthquake management. The selected literature was reviewed to extract information regarding logistics coordination, stakeholder roles, distribution mechanisms, and governance challenges during disaster response and recovery phases.

2.3. Data Analysis Method

The collected data were analyzed using qualitative content analysis. This method involves organizing and categorizing data into thematic units to identify recurring patterns and relationships related to humanitarian logistics governance. The analysis compares empirical findings from the Cianjur Earthquake case with existing concepts and frameworks in humanitarian logistics literature, enabling the identification of gaps, challenges, and lessons learned.

2.4. Research Validity

To ensure the credibility and trustworthiness of the study, data triangulation was applied by cross-referencing information from multiple sources, including government reports, humanitarian organization publications, and academic studies. This approach helps minimize bias and enhances the reliability of the research findings.

3. Result and Discussion

3.1. Results

Cianjur Regency is one of the administrative regions located in West Java Province, Indonesia, with a total area of 361,434.98 hectares and an elevation ranging from 7 to 2,962 meters above sea level [1], [3], [4], [10]. As of 2023, its population reached 2,535,002, with an annual growth rate ranging from 1.14% to 3.33%. The geographical structure of Cianjur, dominated by mountainous terrain and bordered by the Indian Ocean in the south, makes it highly prone to geological and hydrometeorological hazards [3]. Furthermore, the existence of numerous rivers increases the risk of flooding, especially during the rainy season.

One of the most impactful natural disasters in the region was the earthquake that occurred in November 2022, measuring 5.6 on the Richter scale [1], [3], [10], [11], [12]. The earthquake severely affected Cugenang District, Cianjur's most densely populated area which is also vulnerable to landslides and flooding. Despite the high disaster risk, the region lacks adequate mitigation infrastructure and access to emergency safety equipment, contributing to the significant loss of life and property during the 2022 event [10].

Historical data indicates that Cianjur has experienced several medium-to-high magnitude earthquakes over the past 300 years, notably in 1834, 1844, 1910, 1912, 2019, and 2022. The 2022 earthquake was initially attributed to the Cimandiri Fault but was later confirmed by the Meteorology, Climatology, and Geophysics Agency (BMKG) to have originated from the newly identified Cugenang Fault, located in the volcanic region east-southeast of Mount Gede. This seismic event caused widespread damage to housing, infrastructure, and agricultural land. Risk assessments indicate that fault zones, seismic characteristics, and geological conditions are critical determinants of earthquake vulnerability. Those are areas with high seismicity and dense fault lines are more prone to landslides, liquefaction, and structural damage, as was observed in Cugenang [2].

From a socio-economic perspective, the earthquake caused significant human casualties: 334 deaths and 593 serious injuries. The government established 375 official evacuation sites and an additional 119 independently organized shelters, hosting over 114,683 displaced individuals from 41,166 households. Vulnerable groups, including children, the elderly, people with disabilities, and pregnant women, were among the affected populations. According to indonesia.go.id, the emergency response phase ended in December 2022, with search and rescue operations concluded. The National Disaster Management Agency (BNPB) reported damage to nearly 55,000 structures, including residential, governmental, and religious buildings, disrupting community livelihoods and economic stability [11].

The agricultural sector was particularly impacted, with its pre-earthquake contribution of 42.80% to the regional GDP and employment absorption rate of 62.99% [3], [13]. The loss of agricultural land due to the earthquake directly reduced employment opportunities, thereby weakening both economic and social resilience. Therefore, effective post-disaster recovery strategies, encompassing aid distribution, rehabilitation, and reconstruction, are crucial to restoring socio-economic functionality without incurring excessive costs or delays.

3.2. The Impacts of Cianjur Earthquake in Socio-Economy Perspective

Earthquakes pose a major threat due to their high potential to cause extensive losses [1]. As natural phenomena, their time, location, and magnitude are difficult to predict accurately. However, this unpredictability does not preclude the possibility of minimizing their impact. An effective disaster mitigation system is crucial in reducing the extent of damage and disruption caused by earthquakes. One of the essential components of disaster response is the distribution of humanitarian aid, particularly during emergency phases [10]. The management of earthquake victims must be comprehensive, timely, and well-targeted to limit the cascading socio-economic consequences of the disaster.

The 2022 Cianjur Earthquake caused 334 fatalities and 593 serious injuries. The government established 375 formal evacuation points and 119 independently managed shelters, accommodating a total of 114,683 refugees from 41,166 families. Vulnerable groups such as persons with disabilities, children, pregnant women, and the elderly were among the most affected. According to official reports, the emergency response status ended in December 2022, and search and rescue operations were formally closed [14]. Data from the National Disaster Management Agency (BNPB) indicate that the earthquake damaged nearly 55,000 buildings, including houses, schools, places of worship, and healthcare facilities. The high volume of damage significantly disrupted daily life. Economic and social resilience were deeply affected [14]. The disruption in economic resilience impacted the ability to fulfill basic needs, while social resilience was challenged by changes in community interactions and cultural stability. Both dimensions are fundamental to human survival.

The earthquake also severely affected the agricultural sector, which had previously contributed 42.80% to the Gross Regional Domestic Product and absorbed 62.99% of employment [3], [13]. The loss of agricultural land caused a decline in job availability and income stability. Post-disaster infrastructure recovery is essential to revitalize economic activity in Cianjur. Immediate reconstruction of critical infrastructure is required. However, due to the scale of destruction, recovery efforts must consider cost-effectiveness and time efficiency, particularly in logistical aid distribution and reconstruction phases.

3.3. Discussion

Indonesia's high vulnerability to natural hazards necessitates robust disaster mitigation mechanisms to minimize impacts, particularly those involving large numbers of victims. Disaster mitigation comprises activities conducted prior to a disaster with the aim of reducing risks and consequences [15], [16], [17]. These

efforts may include mapping hazard-prone areas, constructing earthquake-resistant buildings, promoting public awareness, organizing disaster response systems, adopting technological solutions, and ensuring proper spatial planning and environmental regulation. Mitigation strategies are generally categorized into structural (e.g., physical infrastructure and technology) and non-structural (e.g., regulations and public policy) [16], [18]. In Indonesia, traditional and cultural approaches also play a vital role in shaping public interpretation and response to natural phenomena.

Within the broader disaster management cycle, mitigation represents a pre-disaster intervention, followed by early warning, emergency aid distribution, and post-disaster recovery and reconstruction. These stages require the involvement of multiple stakeholders. Among them, logistical aid distribution is considered a key element for curbing further negative impacts and ensuring the success of recovery programs. Natural disasters impact not only physical structures but also affect the mental and social conditions of communities [11]. Shortages of food, medicine, and shelter, as well as health threats, can disrupt social cohesion and well-being, especially in geographically isolated or underserved areas. In such contexts, efficient humanitarian logistics and infrastructure management become indispensable.

Disasters exhibit diverse characteristics, requiring tailored responses. However, in general, disaster events follow a sequence of phases. In the context of this study, humanitarian logistics management for the 2022 Cianjur Earthquake is conceptualized into three stages: improvement, sustainability, and decline. Each stage captures the evolving roles of actors, logistical processes, and aid systems during the post-disaster management cycle.

3.4. Improvement Stage

The improvement stage in humanitarian logistics management is marked by efforts to gain rapid access to affected areas and prioritize initial emergency responses within the first hours following a disaster. This stage involves key disaster management stakeholders such as the National Disaster Management Agency (BNPB) and the Regional Disaster Management Agency (BPBD) of Cianjur Regency. Immediately following the earthquake on Monday, November 21, 2022, at 13:21 WIB, the Cianjur BPBD reported casualty and damage data to the BNPB's Operations Control Center (Pusdalops) within one hour, at 14:11 WIB. At this point, damage to public infrastructure was still in the process of being verified [19]. This initial reporting indicated strong coordination and responsiveness from local agencies, particularly the Cianjur BPBD.

A second official update was published at 16:15 WIB the same day, in which BNPB confirmed an increase in

the number of fatalities to 17 people, with 19 seriously injured. The structural damage included 343 severely damaged houses, a severely damaged Islamic boarding school, moderate damage to Cianjur Regional Hospital, four damaged government buildings, three damaged schools, one damaged place of worship, one shop, and one café. Road access was cut off in several locations, hampering the evacuation process. To mitigate this challenge, BNPB deployed a helicopter to support evacuation and logistical aid distribution to isolated areas [20].

The third data update was submitted by Cianjur BPBD to Pusdalops at 19:34 WIB. BPBD reported extended damage and casualties in outlying areas such as Rancagoong Village, Limbangsari Village, and Cugenang District. A total of 62 fatalities were recorded, including victims buried under rubble, severely injured individuals, and displaced residents. Additionally, landslides had cut off inter-provincial roads, further delaying access to several affected zones. In response, heavy machinery, 10 lighting units, 100 vel bed units, fuel, and 20 tents were deployed to facilitate recovery efforts [21]. As many of the earthquake-affected regions were also prone to landslides, immediate intervention was necessary to reopen access routes. On the evening of November 21, BNPB provided an additional 47 tents for emergency shelter. Field reports also noted that residents began setting up independent shelters in their yards due to limited evacuation centers.

The post-earthquake response continued to be coordinated by a joint team from BNPB and BPBD Cianjur [22]. To formalize the emergency response framework, the Regent of Cianjur issued a decree establishing an Emergency Response Status for a 30-day period (21 November–20 December 2022). A further report on November 22 recorded an escalation in the number of displaced persons to 5,405 individuals, with 62 dead, 92 injured, and 3,257 houses damaged. BNPB then facilitated inter-agency coordination through virtual meetings with ministries including the Ministry of Social Affairs, Ministry of Health, Ministry of Public Works and Housing (PUPR), BMKG, Basarnas, TNI, and Polri, among others. A one-week emergency response timeline was established to prioritize rescue, victim handling, and restoration of critical infrastructure. BNPB also set up field command posts in the three most affected districts and appointed contact persons from each ministry to facilitate resource synchronization and response acceleration [23].

3.5. Sustainability Stage

The sustainability stage in humanitarian logistics emphasizes the continuity and optimization of post-disaster management programs by various institutions. At this stage, cost-effectiveness and implementation efficiency become central concerns, ensuring that

logistics distribution remains targeted, consistent, and inclusive. During the handling of the 2022 Cianjur Earthquake, the Cianjur Regency Government, in coordination with the National Disaster Management Agency (BNPB), conducted the distribution of aid in phases. Logistical assistance originated not only from central government and local government sources but also from private sector entities, humanitarian organizations, and community initiatives.

As previously described in the improvement stage, several forms of logistical aid had already been delivered just hours after the disaster. This aid prioritized reopening access routes, enabling broader logistical operations. In this study, the researcher specifically examines logistical aid distributed through the BPBD Cianjur logistics warehouse and observes institutional involvement extending through the decline stage. The BNPB-led coordination meetings included representatives from multiple ministries and institutions. These discussions concluded with firm agreements on resource deployment based on each agency's respective duties, scopes of authority, and operational capabilities. Such multisector collaboration was instrumental in ensuring that the sustainability stage of disaster response achieved its efficiency and cost-control targets.

In addition to formal institutional engagement, the local wisdom of "gotong royong", a traditional communal cooperation system, played an integral role. This culturally embedded practice is foundational to community life in Cianjur and was widely observed during aid distribution and post-disaster cleanup efforts. A significant example of logistical operations at the sustainability stage is reported by BNPB on Sunday, November 27, 2022. Aid dispatched from the Bale Rancage logistics warehouse, located in Cianjur District, was delivered to two affected districts, Gekbrong and Mande. The distributed aid included staple food items, daily necessities, and sanitation equipment, which can be seen on Table 1. This phase confirms that effective humanitarian logistics in disaster response requires synergy across levels: national to local, and that integration with community practices can significantly strengthen post-disaster sustainability.

Table 1. List of Logistics Assistance Distributed by BNPB on Sunday (27/11) [24]

Location	Item	Quantity
Gekbrong	Blanket	200 units
	Plastic bucket	200 units
	Mat	200 units
	Rice	200 packs
	Sugar	200 packs
	Canned fish	400 cans
	Cooking oil	200 pack
Mande	Mat	62 units
	Rice	500 kilograms
	Instan noodle	50 boxes
	Baby diapers	25 boxes
	Mineral water	40 gallons
	Sanitation package	20 packages
	Clothes	50 pcs
	Underwear	20 pcs
	Biscuit	7 boxes
	Sanitary napkins	5 boxes
	Instant seasoning	10 boxes
	Canned sardines	1 box
	Blanket	1 sack
Side dish package	1 box	
Women's clothing package	2 sacks	
Rumah Sakit Umum Daerah (RSUD) Sayang Cianjur	Instant noodle	3 boxes
	Blanket	2 boxes
	Mat	1 unit
	Mineral water	5 boxes
	Sarong	2 units

A systematic logistics distribution flow is essential to address the issue of targeting inaccuracies in aid distribution for disaster victims. In the context of the 2022 Cianjur Earthquake, a structured logistics system played a central role in ensuring that relief items reached the appropriate beneficiaries, minimizing delays, and preventing accumulation in non-priority areas. Logistical challenges during disasters often stem from lack of coordination, limited accessibility, and data mismatch between donors and local needs. These issues can result in duplication of aid in some areas while others remain underserved. Therefore, a clear logistical flow, starting from the logistics warehouse to the beneficiary level, is crucial for operational efficiency.

The BNPB, through the Cianjur BPBD logistics warehouse at Bale Rancage, implemented a planned logistics flow which included initial stock classification, packaging, loading, dispatch to priority districts, and final distribution to evacuation sites. The aid distributed included basic necessities, hygiene kits, and family supplies. On Sunday, November 27th 2022, the joint team carried out another round of distribution to Gekbrong and Mande Districts as part of the continuing logistics operation [24]. To illustrate this operation, the logistics distribution flow during the 2022 Cianjur Earthquake can be visualized in the following diagram on Figure 1.

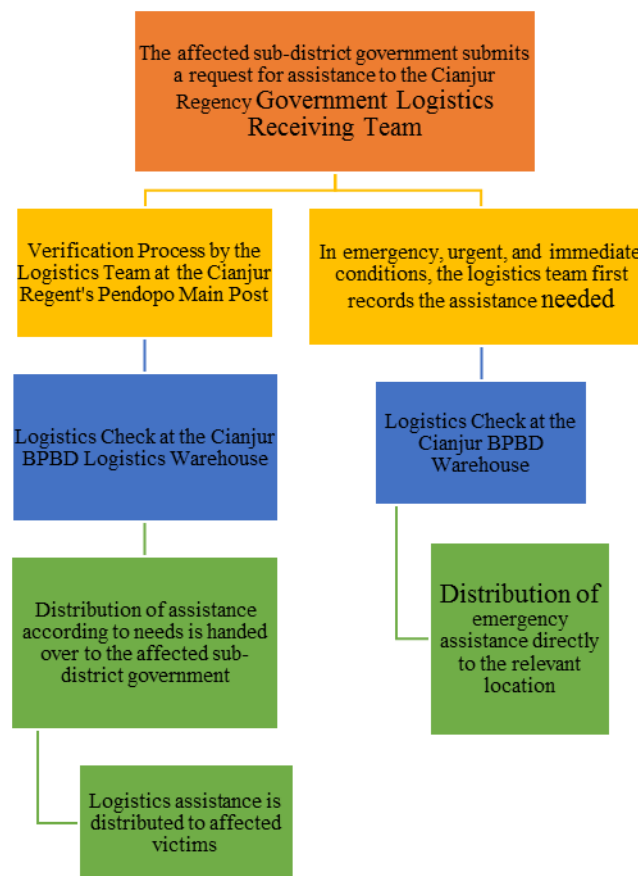


Figure 1. Flow of Distribution of Logistics Assistance for the Cianjur Earthquake 2022

Referring to Figure 1, it can be observed that humanitarian logistics during the 2022 Cianjur Earthquake exhibited a coordinated collaboration between multiple government agencies. The logistics flow, encompassing data collection, verification, logistics checking, and distribution, formed a unified and systematized framework of humanitarian logistics management. The process began with data collection at the sub-district level, involving local government officials to record the needs of affected communities. This was followed by a verification process carried out by the Logistics Team of the Cianjur Regency Government, ensuring that distributed aid matched actual demand. The BPBD Cianjur served as both a stakeholder and policy maker, overseeing warehouse operations, updating logistics inventory, and managing direct distribution to priority areas.

In emergency conditions, this logistics system demonstrated flexibility: inefficient distribution chains that required excess time and resources were reduced or eliminated. Instead, alternative logistical routes and transportation modes were employed to improve delivery speed and accuracy. For instance, the use of BNPB pickup trucks and heavy-duty logistics vehicles was prioritized to ensure aid reached victims without delay [24]. This stage emphasizes responsiveness, cost-efficiency, resource optimization, and time

management, essential components of humanitarian logistics that are particularly critical during prolonged disaster scenarios. By maintaining strategic focus on field needs, the sustainability stage acted as a bridge between immediate emergency response and long-term recovery efforts.

3.6. Decline Phase

The decline stage refers to the strategic transition phase, where national-level operations begin to phase out and responsibilities are increasingly transferred to local actors. This stage includes the formulation and execution of exit strategies, such as the decentralization of distribution activities and the initiation of rehabilitation-reconstruction plans led by regional stakeholders. Following the initial surge of aid from BNPB, central government bodies, and national institutions, the Cianjur Regency Government, in collaboration with local BPBD, regional NGOs, and civil society, undertook the task of mapping out post-disaster strategies. These strategies included house reconstruction, infrastructure rehabilitation, and economic recovery programs. Funding for home repairs, for instance, was handled directly by the national government, while local agencies ensured operational monitoring and aid disbursement in a

phased approach, some of which extended up to a year after the disaster.

The logistics and operational implementation at this stage were supported by various regional apparatuses, including:

- a. BKPSDM (Human Resources and Personnel Agency)
- b. Dinas Sosial (Social Service)
- c. BPBD Cianjur
- d. Dinas Pertanian (Agriculture)
- e. Dinas Kelautan dan Perikanan (Fisheries)
- f. Dinas Perindustrian dan Perdagangan (Industry and Trade)
- g. Dinas Perpustakaan dan Kearsipan (Library and Archives)
- h. Tagana and Satpol PP (Public Order Agency)

This multisectoral coordination illustrates the increasing capacity of local institutions to sustain disaster response independently, reinforcing the resilience of the affected region. The effectiveness of the decline stage is directly tied to two goals: (1) total recovery of affected victims, and (2) institutional learning for future mitigation and preparedness efforts. Additionally, the post-disaster awareness of potential aftershocks drives the urgency of continued improvement in earthquake mitigation systems, urban planning, and community preparedness.

4. Conclusion

The humanitarian logistics management during the 2022 Cianjur Earthquake followed a three-phase progression: improvement, sustainability, and decline. These stages reflect the dynamic collaboration between national and regional stakeholders in responding to a complex emergency. In the improvement stage, efforts focused on ensuring timely access and accurate data collection through coordination between BPBD Cianjur and BNPB via Pusdalops. The sustainability stage emphasized consistent aid distribution and program implementation across multiple institutions, reinforcing the role of inter-agency cooperation. Finally, the decline stage marked the transition of logistical authority from central to local actors, enabling structured recovery processes that reached broader community levels. This staged approach demonstrates how humanitarian logistics can evolve from reactive response to sustainable recovery, contributing to more resilient public service delivery in disaster-prone areas. This study concludes that humanitarian logistics management during the 2022 Cianjur Earthquake reflects the complexity of interrelated factors that demand strategic coordination. Given Cianjur's status as an earthquake-prone area, disaster management

innovations must be grounded in scientific analysis. This research contributes to expanding the perspective on the importance of humanitarian logistics management as a foundation for formulating more responsive and adaptive disaster management policies, both for Cianjur and for Indonesia at large.

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