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MORALITY BEFORE KNOWLEDGE

Sustainable emergency response management

Aduma Lestariastuty Situmorang[1,*]
[1] *Department School of Environmental Sciences, Universitas Indonesia,; Central Jakarta City, 10430, Indonesia.*
*Correspondence: aduma.lestari@ui.ac.id

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ABSTRACT

Background: Climate change and disasters pose complex challenges to sustainable development, disrupting economic, environmental, and social systems. This study explores sustainable emergency management by analyzing theoretical frameworks, governance structures, and local adaptation strategies, with a case study focused on the 2018 earthquake, tsunami, and liquefaction in Central Sulawesi, Indonesia. **Methods**: This study employs a qualitative-descriptive approach based on literature reviews and secondary data analysis, aiming to identify best practices and existing gaps in emergency response programs. **Findings:** The findings highlight that effective emergency response requires coordinated action among government agencies, communities, and humanitarian actors. Community participation, data-driven decision-making, inclusive governance, and cultural approaches are key elements that support long-term resilience. However, major challenges remain, including a lack of coordination, inadequate data sharing, and overreliance on short-term assistance. The case of Central Sulawesi shows that integrating local knowledge and national cluster systems into emergency operations significantly improves recovery outcomes. **Conclusion**: This study concludes that sustainable emergency response must be multisectoral, combining social, economic, and environmental perspectives with strong governance, transparency, and inclusive planning. To improve future responses, emergency management must prioritize community engagement, establish clear coordination mechanisms, and promote adaptive knowledge-based strategies. **Novelty/Originality of this article:** The novelty of this paper lies in its emphasis on sustainable resilience as a knowledge-driven and community-centered process. By highlighting Indonesia's experience, particularly in Central Sulawesi, this study provides insights into how disaster-prone countries can strengthen disaster governance and enhance their capacity to recover and adapt, not only to current risks but also to future challenges in a changing climate.

KEYWORDS: climate change; disasters; sustainable emergency response.

1. Introduction

Climate change, global warming and disasters not only bring direct impacts and losses to humans but also become obstacles to sustainable development, with profound economic, environmental and social impacts (Çakmakçı et al., 2023). Disaster risks caused by climate change result in the intensity and frequency of disasters becoming increasingly complex and harder to predict, thereby increasing the likelihood of disaster risk (Cui et al., 2021). A disaster is an unexpected and sudden event beyond a society's ability to cope, resulting in a serious disruption in society that has significant economic, social, environmental and political impacts on society (Zokaee et al., 2021), threatening human life, natural systems and key infrastructure (Cui et al., 2021). The impacts are diverse: in addition to loss of life, injury and disease, they also destroy property and cause social and economic disruption,

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infrastructure damage and environmental degradation (Twigg, 2015). Increasingly systemic disasters that trigger increased disaster risks such as poverty, climate change, pollution, uncontrolled population growth in hazard-prone areas and biodiversity loss require serious efforts to strengthen disaster risk reduction governance (UNDRR, 2000).

In simple terms, disaster management and disaster management are comprehensive efforts and approaches taken to address most or all disaster risks to reduce human suffering and environmental damage (Coppola P, 2011), which include: Mitigation, Preparedness, response and recovery, as also regulated in Law No. 24 of 2007. While emergency response management can be defined as a comprehensive framework of processes, policies and actions aimed at minimizing the adverse impacts of disasters, emergencies and crises on individuals, communities and society as a whole (Swindell & Stacy, 2024). Emergency response management is carried out to save lives; prevent injuries; protect property and the environment. Government agencies and even communities are important frontline role holders to help with recovery including during emergency response. The government in this case has a very critical function in coordinating and allocating effective resources with strong leadership including to issue emergency declarations, and manage disaster response and recovery operations and encourage collaboration with nongovernmental organizations and other keystakeholders to assist government efforts by providing essential services and support to affected communities (Swindell & Stacy, 2024).

Each country in this case has developed a timeframe which is a stage in disaster management, including in Indonesia. The Indonesian government through National Development Planning Agency/*Badan Perencanaan Pembangunan Nasional* (BAPPENAS) has set a timeframe in the recovery process through the emergency response phase, early recovery transition, rehabilitation and reconstruction and new relocation. The timeframe ranges from 2 to 4 weeks post-disaster, as illustrated in Figure 1. The focus of search, rescue and evacuation programs in emergency response management is explained in Table 1. From the table we can learn that the stages and rescue programs in emergency response are very requires a solid data management system to ensure that all affected communities, family members and individuals can receive help as quickly as possible.

Table 1. Focus of emergency response program

Activity	Period	Needs in data management
Search and rescue	0–72 hours	database for matching buildings with possible survivors and the capabilities of search and rescue teams
Emergency trauma care	0–24 hours	assessment of residual hospital capacity, monitoring of bed availability, and tracking of evacuated patients
Secondary emergency trauma care	1–30 days	assessment of projected needs for specialized secondary care (burns, paraplegic, and so on)
Emergency routine care	ongoing from day 1	monitoring emergencies and essential drug stocks (insulin, cardiovascular drugs, and so on)
Primary health care	ongoing	assessment of needs for temporary essential primary health care
Identification and burial of dead	1–15 days	centralized list of identified and unidentified bodies, descriptions, photos, fingerprints, and possibly DNA
Tracking of missing persons	day 1 to day 90	centralized databases of missing persons and children with missing parents
Communicable disease control	-	epidemiological surveillance system based on presumptive symptoms or syndromes for each potential epidemic disease
Water	ongoing	database for matching needs, priorities, and resources
Food	initiated in the first week and ongoing	assessment of national stocks, needs, and pledges, combined with nutritional assessments among vulnerable groups

Shelter	-	assessment of housing damage and central database on the number and location of internally displaced persons
Psychosocial assistance	first month and beyond	assessment of needs for psychosocial assistance and medical mental health care

(Amin & Goldstein, 2008)

Various efforts have been made jointly by the government, international community, private sector and other key stakeholders including donor agencies to minimize the potential damage caused by disasters. However, it has also been found that many disaster management programs fail and are not sustainable at the local level after the end of the program or project (Arain, 2015). Sustainable resilience is about strengthening resilience to climate and disasters for sustainable development. However, building sustainable resilience is not just about making technical progress or investing in infrastructure but also building communities from the disaster preparedness, response and recovery process (The ASEAN Secretary, 2024).

Fig. 1. Phase of disaster recovery process in indonesia
(LIPI, 2019)

The topic of sustainable emergency response management is very important as a foundation to follow up the post-earthquake development process which includes rehabilitation and reconstruction as well as build back better which is the beginning to encourage sustainable development from both economic, socio-cultural and environmental aspects. This paper will present the theoretical framework of a knowledge-based approach to achieve sustainable disaster management objectives that are relevant, fast, effective and targeted. The writing of this paper is expected to be a reference to improve the quality of implementation of disaster management, rehabilitation and reconstruction programs with the coordination system that is most likely to be focused can be identified in the early stages of the post-disaster scenario.

2. Methods

This study uses a qualitative descriptive approach that aims to explore and analyze sustainable disaster emergency management in the context of climate change and sustainable development. Data collection techniques were carried out through a comprehensive literature review of various scientific literature, national regulations, institutional reports, and policy documents from relevant government agencies and international organizations. This study also refers to secondary sources such as scientific journals, official publications from the National Disaster Management Agency/*Badan Nasional Penanggulangan Bencana* (BNPB), LIPI, and The ASEAN (Association of Southeast Asian Nations) Secretary that discuss disaster management systems, governance frameworks, and the role of local actors in the emergency response process.

As a case study, this research highlights the experience of Central Sulawesi Province in dealing with earthquakes, tsunamis, and liquefaction that occurred in 2018. This study examines the response of the central and regional governments, coordination mechanisms

between stakeholders, and community involvement in the emergency response phase to rehabilitation and reconstruction. The researchers analyze the dynamics of local community adaptation based on community characteristics and available local resources, and examine how the national cluster-based approach is implemented at the field level. By combining theoretical approaches and contextual data, this study aims to formulate strategies that can support the sustainable strengthening of community resilience in facing future disaster risks.

3. Results and Discussion

3.1 Sustainable concepts in emergency response

The adverse impacts of climate change and extreme weather events pose a serious threat to livelihoods, and hinder sustainable growth and development. The total number of disaster events and associated economic and humanitarian losses has increased continuously since the 1980s (GFDRR, 2015). The alignment of all planned investments and interventions with the four priority areas according to the Sendai Framework is a key strategy that should inform not only disaster management, but also development policies, plans, programs and projects (Imperiale & Vanclay, 2021).Disaster emergency response encompasses a wide range of activities, including efforts to increase preparedness and reduce risk, needs assessment, damage and loss assessment, emergency relief, and long-term recovery (Amin & Goldstein, 2008). Effective disaster management requires close collaboration and coordination between various agencies and stakeholders at all stages of the disaster management cycle.

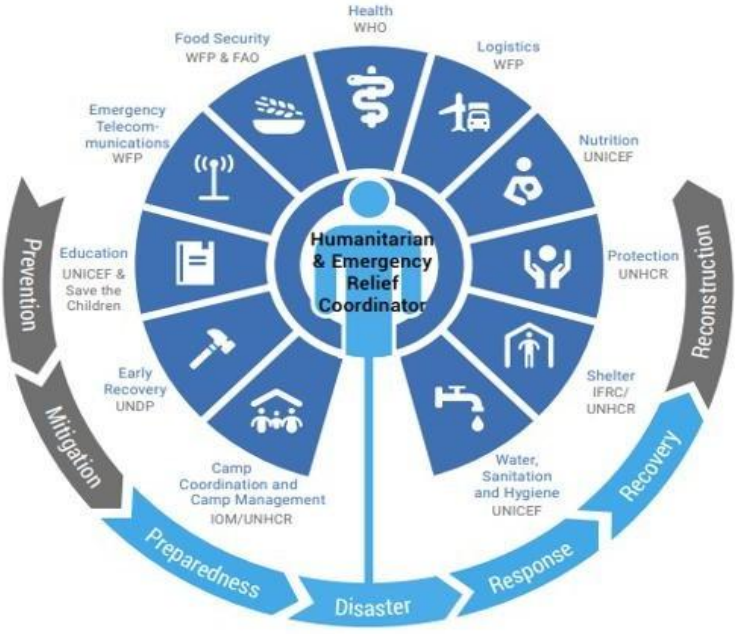

Fig. 2. Humanitarian coordination cluster approach
(IFRC, 2021)

The increasingly complex and massive impact of disasters on people's lives from economic, social, development and even environmental aspects requires collaborative efforts from all parties. Each institution has a specific role in reducing risk, preparing for emergencies, responding to disasters, and facilitating recovery efforts to build resilient communities (Samudra, 2024). One example of a concrete effort to ensure sustainable disaster management, for example, the Global Humanitarian Movement initiative has established a working system with a cluster approach, as shown in Figure 2. The cluster

approach can simply be defined as a set of structures, processes, principles and commitments to coordinate humanitarian action when national governments request international support and this approach aims to make the humanitarian community better organized and more accountable to the people affected by the crisis (IFRC, 2021). Sustainable emergency response management can be seen from various aspects and perspectives, which include aspects: social, economic, technological and environmental.

3.2 Social aspects and community participation

Community resilience and disaster response capabilities are closely related to community participation in disaster prevention planning and disaster management (Lin & Lee, 2023). To build sustainable community resilience after a disaster, recovery process strategies can be used in two phases, namely before the crisis (pre-disaster) and after the disaster occurs. Strategies applied before a disaster occurs can be done to prepare the community well in handling the impact of the crisis is considered as a pre-disaster strategy while after a crisis occurs to help and support the community in the recovery or post-disaster phase (Zokaee et al., 2021). One of the important elements of sustainable disaster management is community participation in every stage of disaster management (Arain, 2015), which is supported by social learning and transformation towards sustainability is an important interrelated process and is at the core of resilience in communities, and of any disaster risk reduction practice and community resilience building (Imperiale & Vanclay, 2021). Community-based disaster management systems should utilize social capital and community participation to promote post-disaster community capabilities and resilience (Lin & Lee, 2023). Community resilience includes social processes (cognitive and interactional) that enable social learning at the local community level, and result in transformation towards sustainability (Imperiale & Vanclay, 2021). According to Farni et al. (2019), the community-based development process will be more efficient, effective and sustainable because: community group members can be more dynamic in developing activities, human values and social values, for example; honesty, sincerity, trust, sacrifice, togetherness, unity, cooperation and solidarity among each other. The empowerment process runs more effectively and efficiently. The process of caring for each other among members. Consolidation of shared power between the weak and the strong in a society. Groups can develop and institutionalize collective responsibility, build solid character among members, the learning process/interaction among members, and the development of members' businesses. Reorient the bureaucracy to support community empowerment and social capital investment. Achieving a match between the wishes of the community with the ability to pay and manage, with what is provided by the aid agency

3.3 Science and technology

The increasing frequency and severity of natural disasters nowadays forces the discovery of more effective and efficient disaster management strategies including from the aspect of science and knowledge. Knowledge-based analysis is an important factor in making good and valuable decisions during emergency response to plan effectively even before starting the reconstruction program (Arain, 2015). A knowledge-based approach will help the emergency response management team to identify needs, assess available resources, and the timeliness of allocating those resources (Arain, 2015). In addition to the science aspect, technology is also an important element that is very supportive in ensuring the relevance, speed, efficiency and sustainability of the emergency response process. By utilizing this technology, we can predict, respond and recover from disasters more effectively, potentially saving human lives and minimizing infrastructure damage (Krichen et al., 2024). One example of the application of technology in disaster management is satellite imagery. This technology can be used to detect places with potential natural disaster threats before they occur, resulting in an early warning system that can be used to

plan and respond to disasters (Krichen et al., 2024). These techniques can be used to create maps and models that illustrate the extent of damage caused by natural disasters, helping decision-makers prioritize response efforts and allocate resources wisely (Krichen et al., 2024). Data, visualization and analysis of crisis situations available in real time can be done thanks to technological tools that will certainly facilitate better decision- making and emergency response. However, in many cases, implementation and maintenance costs, concerns over data privacy and security, and the need for skilled personnel are the main reasons for this some examples of barriers and limitations in the application of technology to support disaster management and emergency response (Krichen et al., 2024).

3.4 Economic aspects

The total number of disaster events and associated economic and humanitarian losses has increased continuously since the 1980s (GFDRR, 2015). Furthermore, GFDRR (2015) reported that economic losses due to extreme weather events are in the range of 150-$200 billion US dollars per year due to the increasing amount of damage that occurs in rapidly developing urban areas in low- and middle-income countries (GFDRR, 2015). The risk of economic losses also occurs in Indonesia, which is ranked 37 out of 180 most disaster-prone countries according to data from The World Risk Index in 2019. An effective, efficient and sustainable emergency response process will greatly affect post-disaster economic resilience. The very systemic impact of disasters, especially from an economic aspect, requires efforts to involve all parties including the community in disaster risk reduction and preparedness (Swan-Keig et al., 2024). Economic resilience supported by post-disaster rescue funds will encourage the degree of sustainability of economic system development and accelerate post-disaster recovery not only from disaster risk reduction and preparedness (Swan-Keig et al., 2024) time aspect, but also the rescue efforts (Zhang et al., 2021). A more in-depth and comprehensive analysis of the impact of economic resilience on post-disaster recovery would help identify the role of resilience in reducing disaster losses (Zhang et al., 2021).

United Nations Office for Disaster Risk Reduction (UNDRR) states that investments in strengthening institutional governance in DRR can be made through improved competencies, plans, guidelines, funding and clear coordination across sectors (UNDRR, 2000). Thus, in formulating post-disaster recovery strategies and schedules, the government needs to thoroughly consider the level of economic development itself to ensure that the rescue budget can support the achievement of disaster recovery programs and the pursuit of economic resilience (Zhang et al., 2021). In addition, the government also has a very strategic role in coordinating institutions involved in disaster management by updating village resilience plans and preparedness plans (GFDRR, 2010) and also encouraging private sector participation in risk reduction through roles, incentives and regulations (World Bank, 2019).

3.5 Environmental aspects

Aspects of improvement in terms of environmental ecology include the size and quality of soil, water, climate, and biological resources essential for life that must be saved after a disaster. For example, with more efficient use of natural resources to reduce the impact of emergency response programs on the environment and adapt to climate change (Çakmakçı et al., 2023), to support the viability and health of the ecological system as a whole and maximize income while maintaining asset stocks. The participation of all members of society to be actively involved in preserving the environment by not jeopardizing future resources and supporting sustainable development as part of the effort to end poverty towards peace, prosperity through the participation of all parties (Haghighi & Takian, 2024). This definition encourages all parties to ensure the fulfillment of current human needs without jeopardizing the needs of future generations by bringing up how humans can

live in harmony with nature; or a system that benefits both humans and the earth (Henderson & Loreau, 2022)

3.6 Challenges and opportunities

Disaster mitigation, preparedness, response and recovery are the end result of complex political and administrative interactions, and the outcomes cannot be easily controlled or anticipated (Waugh & Straib, 2006). In the implementation of disaster emergency response, some opportunities that can be improved in an effort to ensure a sustainable emergency response program can be done through: collaboration with all key stakeholders is a necessary foundation in dealing with natural and technological disasters and the impact of terrorism (Waugh & Straib, 2006). Another opportunity to ensure a sustainable emergency response program is to build partnerships with other programs as part of the program of poverty reduction and public sector reform efforts and create holistic and integrated program synergies that contribute to the reduction of potential disaster risks (Collymore, 2011). Collaborative networks are a fundamental component of any emergency response (Waugh & Straib, 2006).

Involvement of community members with local knowledge, expertise and wisdom (Swindell & Stacy, 2024). The participation of citizens and community organizations is the best way to improve the effectiveness of post-disaster recovery and reduce the potential for loss of life and property damage (Lin & Lee, 2023). Addressing social vulnerability and promoting equality is essential to ensure that vulnerable populations are not disproportionately affected by disasters (Swindell & Stacy, 2024). Despite some of the opportunities that can be maximized in encouraging accelerated recovery during emergency response, we are also aware of some of the challenges that often occur during emergency response such as: another challenge in the recovery process is that most aid is focused on direct assistance to affected people while exposure to disasters including losses in productivity and well-being are not included in the design and evaluation of reconstruction programs (Tiwari & Shukla, 2022). Limited sharing of specific information on who is doing what and with what resources due to lack of transparency. Lack of coordination among relevant organizations and institutions, which often becomes a drawback and reduces the efficiency of work and the effectiveness of measures taken to improve disaster resilience (Sarker et al., 2020). Given that Indonesian society is very rich in culture and social capital, community-based preparedness includes the use of culture-based approaches, facilitating strong relationships and participation as communities learn and increase their capacity according to the local context (Andreastuti et al., 2023).

3.7 Case study of emergency response management in Central Sulawesi province

The earthquake, tsunami and liquefaction disasters that occurred in Central Sulawesi province on September 28, 2018 caused serious disruption to the livelihoods of local communities in terms of economic, social, cultural and environmental aspects. After the disaster occurred, there were several characteristics of local communities in dealing with the disaster. From the characteristics of the community and the way the community adapts in the emergency response period, we can learn that community actions are strongly influenced by the characteristics of the population and local resources which ultimately form two different types of adaptation in the community when a disaster occurs, especially in the emergency response and adaptation phases (Yulianto et al., 2021).

The experience of handling the earthquake, tsunami and liquefaction disasters in Central Sulawesi shows that the national disaster management team through National Disaster Management Agency/*Badan Nasional Penanggulangan Bencana* (BNPB) has this function to facilitate integrated efforts in disaster management disaster management (Andreastuti et al., 2023). In response to this situation, the government Indonesia seeks to take various concrete steps including during the emergency response period with post-

disaster economic, social, cultural, and psychological recovery programs such as programs provide advocacy and counseling services, assistance to stimulate economic activities at the community level and forms of training to communities (IFRC, 2022).

Table 2. Community typology during emergency response

Adaptation to Environment	Uncertainty in the need for humanitarian logistical assistance	Community actions in meeting humanitarian logistical needs
Self-evacuation	The need for a safe location for temporary evacuation	Moving away from coastal areas and liquefaction locations and staying in the open area
	Needs help for evacuation • Evacuation assistance for injured and dead • The need for assistance for rescue teams and volunteers	Sharing assistance among communities • Information on volunteers and other responders providing assistance
	Need for clean water	Sharing assistance among communities • Waiting for clean water assistance from local government
Staying in Palu City: displaced people living in the open or in the field	The need for assistance to consumption logistics • Food and drink • Goods for toddlers and children • Clothes and blankets • Oil and gas • Telecommunication services • Power supply	• Loot shops and supermarkets • Sharing assistance among communities • Asking for assistance through radio postings • Selling items • Sharing information on needs and requesting for assistance • Texting, even if intermittent • Requesting for emergency PLN, Telkom services • Requesting assistance, e.g. generator set
	Needs for shelter and emergency tents	• Asking for assistance, such as emergency tents • Sharing assistance between relatives
	Need for security	• Just waiting for the help of security forces from the TNI and Polri
Moving out from Palu City	The need for assistance for transportation facilities and infrastructure, including fuel for vehicles	• By air evacuation and assistance through Hercules aircrafts by TNI • By land route

(Yulianto et al., 2021)

Efforts and approaches taken by the government, starting from the national level, to the regions supported by all key stakeholders, starting from the emergency response phase to the rehabilitation and reconstruction process. After the earthquake and tsunami that hit the Central Sulawesi Province, the Indonesian government made various disaster management efforts in the context of implementing emergency response and recovery of the community and the Central Sulawesi region with stages as shown in Figure 3.

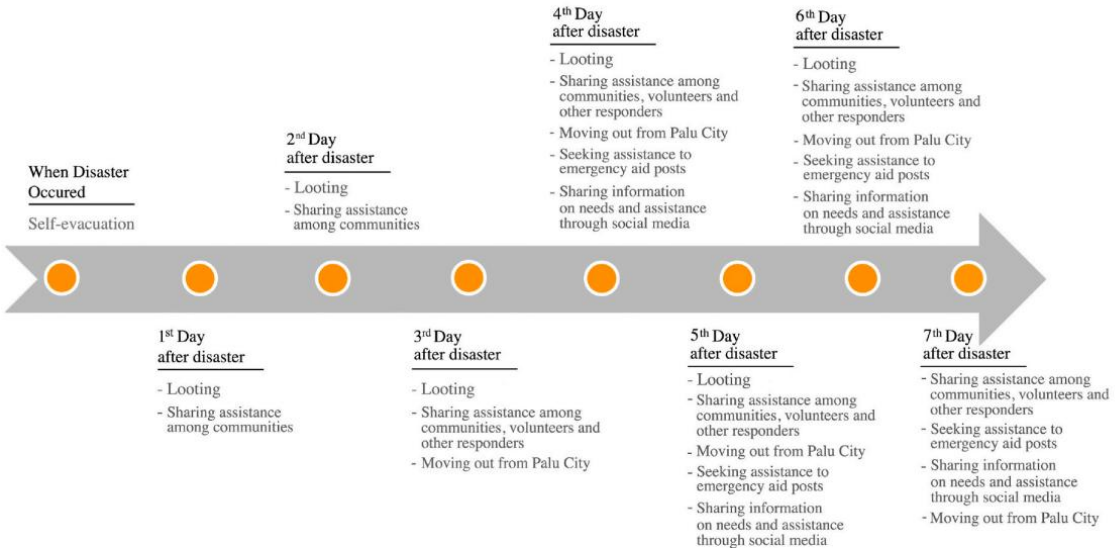

Fig. 3. Community adaptation in the emergency response period (Yulianto et al., 2021)

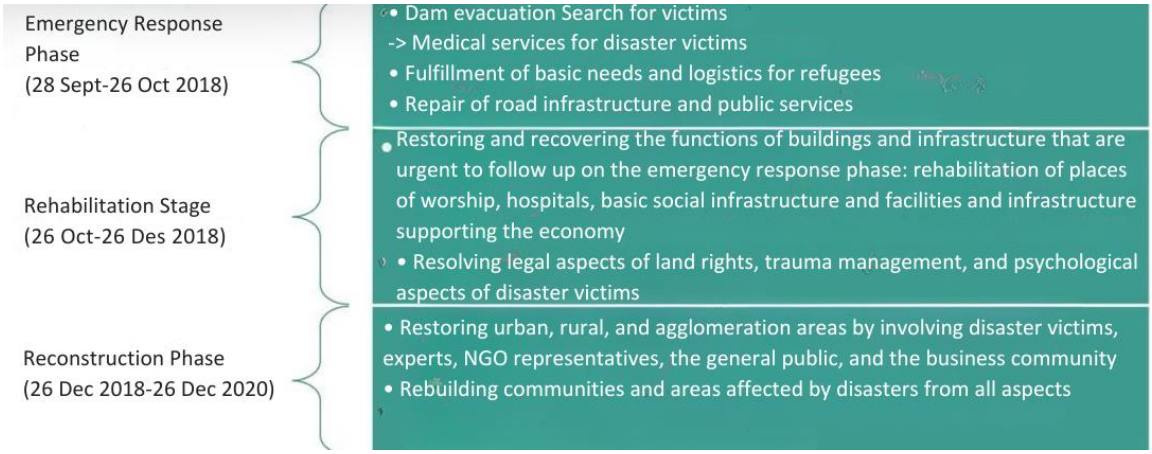

Fig. 4. Emergency response, rehabilitation and reconstruction in central sulawesi (Pemerintah Provinsi Sulawesi Tengah, 2018)

During the disaster management phase, Indonesia has an institutional system that manages science, and other institutions responsible for social aspects, including evacuation, refugee management, rehabilitation and reconstruction. One concrete example is through the efforts of the Indonesian government together with the Central Sulawesi government to adopt a global cluster approach with a national cluster system for disaster management. These efforts are certainly supported by the availability and access to information, social protection, education, training and skills development for disaster management (Andreastuti et al., 2023). Cluster approach is a coordination model approach by grouping humanitarian actors based on work clusters to provide a more capable emergency response implemented in large- scale disaster events or requiring international assistance in a multi-sectoral response with broad participation from international humanitarian actors.

3.8 Strategies and recommendations

A sustainable emergency response program can be achieved by implementing emergency and disaster response plans by ensuring procedures, roles, and responsibilities of various stakeholders including establishing early warning systems, implementing training and capacity building activities, and solid coordination with relevant agencies and organizations (Samudra, 2024). Some recommendations as part of the effort to create a

sustainable emergency response program include: build strong collaboration and cooperation to build regional resilience of partners and stakeholders to mobilize diverse strengths with various expertise, resources, and technologies. Involving local communities in the planning and implementation of emergency response programs to help ensure that their needs are met. The process can be done by utilizing community participation as part of the key framework elements that serve as the main pillars of resilience including realizing sustainable emergency response programs, through: (i) community engagement; (ii) inclusive governance; (iii) integrated approaches; (iv) capacity building; and (v) data-driven decision-making. Resilience is local and contextual should prioritize community-centered approaches to effectively address the unique needs and vulnerabilities of communities. This perspective ensures that resilience strategies are not only relevant but also inclusive, actively involving local voices in the decision-making process (The ASEAN Secretary, 2024). The government should implement awareness-raising programs to enable local communities to prepare for and protect themselves from potential disaster events through training, awareness building (Sarker et al., 2020), followed up by mainstreaming disaster risk reduction into development programs. Ensure good governance of emergency response management through transparency and accountability that helps build trust with affected communities and donors. This can be done through data-driven emergency response management where information on funds, proposals, procurement, and project monitoring is publicly available (The ASEAN Secretary, 2024).

4. Conclusions

The emergency response period is a process carried out to save lives and reduce the potential impact of material losses after a disaster. The disaster emergency response program is a critical period for saving lives and reducing potential losses. This phase must be implemented with measurable indicators to ensure resilience in the face of potential future risks. Therefore, the approach during the emergency response period must also be multisectoral and multidisciplinary from economic, social, scientific and environmental aspects to ensure that the program is targeted, effective and efficient and contributes to support sustainable rehabilitation and reconstruction programs. Strong governance and leadership are the most critical milestones, especially for governments at all levels to ensure the quality of the program to truly build a resilient future for the community. This is very much in line with recommendations that encourage the government to focus on prioritizing and strengthening the implementation of community-based disaster management and increasing community awareness and resilience to disaster prevention through quality recovery services, improving social inclusion, and bringing transparency and accountability (Lin & Lee, 2023). Through sustainable resilience, we can ensure that communities are not only prepared for disasters but also equipped to adapt and thrive in the face of future challenges (The ASEAN Secretary, 2024).

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Author Contribution

The author was responsible for the conceptualization, data collection, analysis, and manuscript writing. All aspects of the research, including the formulation of research questions, literature review, and interpretation of findings, were conducted independently. The author also reviewed and approved the final version of the manuscript.

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References
Amin, S., & Goldstein, M. (2008). *Data against natural disasters*. The World Bank.

Andreastuti, S. D., Paripurno, E. T., Subandriyo, S., Syahbana, D. K., & Prayoga, A. S. (2023). Volcano disaster risk management during crisis: Implementation of risk communication in Indonesia. *Journal of Applied Volcanology, 12*(1), 1–20. https://doi.org/10.1186/s13617-023-00129-2

Arain, F. (2015). Knowledge-based approach for sustainable disaster management: Empowering emergency response management team. *Procedia Engineering, 118*, 232–239. https://doi.org/10.1016/j.proeng.2015.08.422

Çakmakçı, R., Salık, M. A., & Çakmakçı, S. (2023). Assessment and principles of environmentally sustainable food and agriculture systems. *Agriculture, 13*(5), 1–27. https://doi.org/10.3390/agriculture13051073

Collymore, J. (2011). Disaster management in the Caribbean: Perspectives on institutional capacity reform and development. *Environmental Hazards, 10*(1), 6–22. https://doi.org/10.3763/ehaz.2011.0002

Coppola, D. P. (2011). *Introduction to international disaster management* (P. Chester & G. Chalson, Eds.; 2nd ed.). Elsevier.

Cui, P., Peng, J., Shi, P., Tang, H., Ouyang, C., Zou, Q., Liu, L., Li, C., & Lei, Y. (2021). Scientific challenges of research on natural hazards and disaster risk. *Geography and Sustainability, 2*(3), 216–223. https://doi.org/10.1016/j.geosus.2021.09.001

Farni, I., Zin, R. M., & Alzahri. (2019). Community base development at the implementation of rehabilitation and reconstruction project after earthquake in West Sumatera. *IOP Conference Series: Materials Science and Engineering, 620*(1), 012049. https://doi.org/10.1088/1757-899X/620/1/012049

GFDRR. (2010). *Estimation of post-disaster needs for recovery and reconstruction*. World Bank.

GFDRR. (2015). *The triple dividend of resilience*. World Bank.

Haghighi, H., & Takian, A. (2024). Institutionalization for good governance to reach sustainable health development: A framework analysis. *Globalization and Health, 20*(5), 1–12. https://doi.org/10.1186/s12992-023-01009-5

Henderson, K., & Loreau, M. (2022). A model of Sustainable Development Goals: Challenges and opportunities in promoting human well-being and environmental sustainability. *Ecological Modelling, 475*, Article 110164. https://doi.org/10.1016/j.ecolmodel.2022.110164

IFRC. (2021). *Humanitarian coordination cluster approach*. IFRC.

IFRC. (2022). *Disaster recovery in Indonesia*. IFRC.

Imperiale, A. J., & Vanclay, F. (2021). Conceptualizing community resilience and the social dimensions of risk to overcome barriers to disaster risk reduction and sustainable development. *Sustainable Development, 29*(5), 891–905. https://doi.org/10.1002/sd.2182

Krichen, M., Abdalzaher, M. S., Elwekeil, M., & Fouda, M. M. (2024). Managing natural disasters: An analysis of technological advancements, opportunities, and challenges. In *Internet of Things and Cyber-Physical Systems* (Vol. 4, pp. 99–109). KeAi Communications Co. https://doi.org/10.1016/j.iotcps.2023.09.002

Lin, B. C., & Lee, C. H. (2023). Constructing an adaptability evaluation framework for community-based disaster management using an earthquake event. *International Journal of Disaster Risk Reduction, 93*, 103774. https://doi.org/10.1016/j.ijdrr.2023.103774

LIPI. (2019). *Laporan kaji cepat penanganan pasca bencana di Palu, Sigi dan Donggala: Pemulihan tempat tinggal dan penghidupan*. LIPI.

Pemerintah Provinsi Sulawesi Tengah. (2018). *Rencana induk pemulihan dan pembangunan kembali wilayah pascabencana Provinsi Sulawesi Tengah*. Pemerintah Provinsi Sulawesi Tengah

Samudra, A. A. (2024). *Disaster in the ring of fire and black swan earthquake theory: Techniques for disaster management with modern technology and local wisd*om. Samudra Biru.

Sarker, M. N. I., Pe ng, Y., Yiran, C., & Shouse, R. C. (2020). Disaster resilience through big data: Way to environmental sustainability. *International Journal of Disaster Risk Reduction, 51*, 101769. https://doi.org/10.1016/j.ijdrr.2020.101769

Swan-Keig, L., Waring, S., & Alison, L. (2024). Taking ACTION: Identifying factors that affect public willingness to engage in emergency preparedness activities. *Journal of Contingencies and Crisis Management, 32*(1), e12555. https://doi.org/10.1111/1468-5973.12555

Swindell, B., & Stacy, J. (2024). *20,000 ft. view: An introduction to emergency management*. ATU Faculty OER Books and Materials.

The ASEAN Secretary. (2024). *20 years after the Indian Ocean tsunami*. ASEAN org.

Tiwari, P., & Shukla, J. (2022). Post-disaster reconstruction, well-being and sustainable development goals: A conceptual framework. *Environment and Urbanization ASIA, 13*(2), 323–332. https://doi.org/10.1177/09754253221130405

Twigg, J. (2015). *Disaster risk reduction*. Humanitarian Policy Group Overseas Development Institute.

UNDRR. (2000). *The human cost of disasters: An overview of the last 20 years (2000-2019)*. United Nations Office for Disaster RISK Education.

Waugh, W. L., & Straib, G. (2006a). Collaboration and leadership for effective emergency management. *Public Administration Review, 66*(SUPPL. 1), 131–140. https://doi.org/10.1111/j.1540-6210.2006.00673.x

Waugh, W. L., & Straib, G. (2006b). Collaboration and leadership for effective emergency management. *Public Administration Review, 66*(SUPPL. 1), 131–140. https://doi.org/10.1111/j.1540-6210.2006.00673.x

World Bank. (2019). *Strengthening the disaster resilience of Indonesian cities - A policy note*. https://openknowledge.worldbank.org/handle/10986/31304

Yulianto, E., Yusanta, D. A., Utari, P., & Satyawan, I. A. (2021). Community adaptation and action during the emergency response phase: Case study of natural disasters in Palu, Indonesia. *International Journal of Disaster Risk Reduction, 65*, 102557. https://doi.org/10.1016/j.ijdrr.2021.102557

Zhang, Z., Cui, P., Hao, J., Li, N., Zeng, Z., Liu, Y., Zou, Q., Huang, C., & Wu, S. (2021). Analysis of the impact of dynamic economic resilience on post-disaster recovery "secondary shock" and sustainable improvement of system performance. *Safety Science, 144*, 105443. https://doi.org/10.1016/j.ssci.2021.105443

Zokaee, M., Tavakkoli-Moghaddam, R., & Rahimi, Y. (2021). Post-disaster reconstruction supply chain: Empirical optimization study. *Automation in Construction, 129*, 103811. https://doi.org/10.1016/j.autcon.2021.103811

Biographies of Author

Aduma Lestariastuty Situmorang, Department School of Environmental Sciences, Universitas Indonesia,; Central Jakarta City, 10430, Indonesia.

- Email: aduma.lestari@ui.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A