

Review Article

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Public Health Emergency Response and Recovery in Limited Resource Setting: Lesson learned from Hanang District Floods and Landslide in Tanzania

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Abstract

Objective: In December 2023, floods and landslides in Hanang District, Northern Tanzania, caused severe casualties, infrastructure damage, and community displacement. We describe the public health emergency response and lessons learnt during this disaster to guide future mitigations.

Methods: Retrospective data collection during the disaster was made through quantitative (description of casualties) and qualitative (interviews and focus groups) approaches to provide insights into psychosocial support, coordination, and other response pillars. Microsoft Excel (2019) was used for quantitative data analysis, and MAX Qualitative Data Analysis was used to manage qualitative data.

Results: Soft tissue injuries, bruises, and lacerations were the most common (60.43%), with 87.77% of casualties recovering and a notable fatality rate of 12.23%. Mental health and psychosocial support reached over 3300 individuals, offering depression assessments and family reconnections. Establishing a dual-level public health response team and implementing the Incident Management System demonstrated the country's response efficiency.

Conclusions: The public health emergency response to the 2023 floods and landslides in Hanang District was largely effective. This demonstrated strong coordination, capacity, and resilience of Tanzania health system; however, the fatality rate highlighted a need for further investment to improve future disaster prevention, preparedness, and response.

Floods are among the most frequent and devastating natural disasters globally, causing widespread disruption to communities, infrastructure, and public health systems. These disasters can be triggered by several factors, including excessive rainfall, river overflows, dam failures, and poor drainage systems.^{1,2} The frequency and severity of floods have increased in recent years, largely driven by climate change, which has led to more unpredictable weather patterns and severe storms.² The direct impacts of floods on public health include injuries, waterborne diseases, and loss of access to clean water and sanitation, while secondary effects often involve food insecurity, displacement, and economic strain.

Like many other countries, Tanzania is experiencing the growing effects of climate change, including erratic rainfall patterns, increased droughts, and floods.³ These events pose significant risks to public health, agriculture, infrastructure, and the economy. In August 2023, the Tanzania Meteorological Authority (TMA) issued an alert predicting above-normal rainfall in at least 10 regions of the country with 5 regions anticipated to experience normal to above-normal rainfall from September–December 2023, potentially extending to early January 2024. The alert

heightening concerns over flooding and its potential public health impacts, such as waterborne diseases due to water contamination and damage to sanitation systems.^{4,5}

In response to these predictions, the Ministry of Health (MoH) developed a multi-faceted response plan aligned with the National El Niño Contingency and Anticipatory Plans from September 2023-June 2024. Despite these efforts, the Hanang District in Northern Tanzania was severely affected by floods and landslides in December 2023 following intense rainfall. This event resulted in significant casualties, extensive destruction of infrastructure, and displacement of communities, underscoring the serious implications of climate-induced flooding in resource-limited settings.

Floods, one of the most common and devastating natural disasters, have increasingly impacted various areas worldwide.^{1,2} They result from multiple factors, including excessive rainfall, river overflow, dam breakage, and inadequate drainage systems. In recent years, the frequency and severity of floods have escalated, a trend closely associated with the broader climate change phenomenon. Climate change has led to more intense and unpredictable weather patterns, causing prolonged heavy rains and severe storms that overwhelm natural and man-made water management systems.²

This study describes the public health response and lessons learnt from the devastating floods and landslides in Hanang District Council in Manyara Region of Northern Tanzania in December 2023.

Material and Methods

Data Collection

In this study, we collected retrospective and most current data during the public health emergency responses in the Hanang District. Quantitative data from Public Health Emergency Operation Centre (PHEOC) repository were analyzed to evaluate disease outbreak prevention trends and casualties' characteristics. Qualitative data was gathered through interviews and focus group discussions with frontline responders, including the district council-level health management team and national-level staff from the Emergency Preparedness and Response Unit (EPRU), providing valuable insights into psychosocial support; coordination, water sanitation and hygiene (WASH) and Risk Communication & Community Engagement (RCCE).

Data Management and Analysis

Quantitative data was entered, cleaned, and analyzed using Microsoft Excel (version 2019). Qualitative data from interviews and focus group discussions were managed using MAXQDA and organized into theme-based concepts.

Ethical Considerations

Ethical clearance was sought from the University of Dodoma Institutional Ethical Review Committee. A study permit was obtained from the MoH and further administrative permits to access the areas that experienced/were experiencing floods and landslides in Hanang district were obtained from the President's Office -Regional Administration and Local Government (PORALG). The study adhered to ethical standards, ensuring voluntary participation, confidentiality, and anonymity of interviewees. Informed consent was obtained from individuals participating in the interviews.

Results

Description of Areas Affected by Floods and Landslides

Floods and landslides occurred in the Hanang District Council, situated in the Manyara Region of Northern Tanzania. The flooding and mudslides profoundly impacted 4 wards in Hanang District, namely Gendabi, Jorodom, Ganana, and Katesh the administrative hub of the district⁶ (Figure 1). The natural disasters left a stark imprint in the affected wards, with 7306 individuals of 8340 (88%) displaced from their homes being from Gendabi; followed by Ganana, 1712 of 8378 (20%); and Jorodom, 91 of 4605 (2%). In addition to Katesh (district's administrative center) counting 265 (2%) individuals displaced from their homes, it also hosted 13 084 residents from the most affected areas/wards.

Description of Health Emergency Response Management Coordination

Under the coordination of the Prime Minister's Office⁷ (the mandated government structure for coordination of disaster management in the country), the Public Health Response through the implementation of the Incident Management System (IMS) structure shown in Figure 2 was led by an Incident Manager (IM). The national and sub-national PHEOC were activated and involved in daily meetings as well as supervision of fieldwork across various pillars. These activities included generating daily Situation Reports (SitReps), mobilizing resources (financial, human, and materials), and managing transportation facilities for response activities.

Description of Case Management Operations

During the flooding and landslides crisis, the case management team immediately provided care and treatment to victims of all age groups. The primary goal was to minimize the repercussions on the affected individuals, showcasing a commitment to mitigating the impact of the disaster.

Description of Casualties

The casualties showed a tendency to affect both gender on an equal dimension, with females (52.00%) slightly on the higher side than males (48.00%). The most affected age group was 25-44 (30.22%) years old, followed by younger age groups. Soft tissue injuries, bruises, and lacerations were the most common injury types (60.43%) reported, while head and spinal injuries were less frequent, although with serious consequences. Despite most casualties recovering (87.77%), the fatality rate was notably high at 12.23% (Table 1).

Description of Mental Health and Psychological Services

Mental health and psychosocial support (MHPSS) initiatives were provided to the affected population, including depression assessments, psychological first aid, basic needs, and family reconnections. These services reached 3380 individuals. Interviews with community, spiritual, and local leaders revealed historical perspectives linking the recent tragedy to unusual seismic activities, reminiscent of events in 1964 and 2011. Elders recalled simultaneous rockslides on the opposite sides of the mountain where the land slide occurred and speculated on mystical causes.

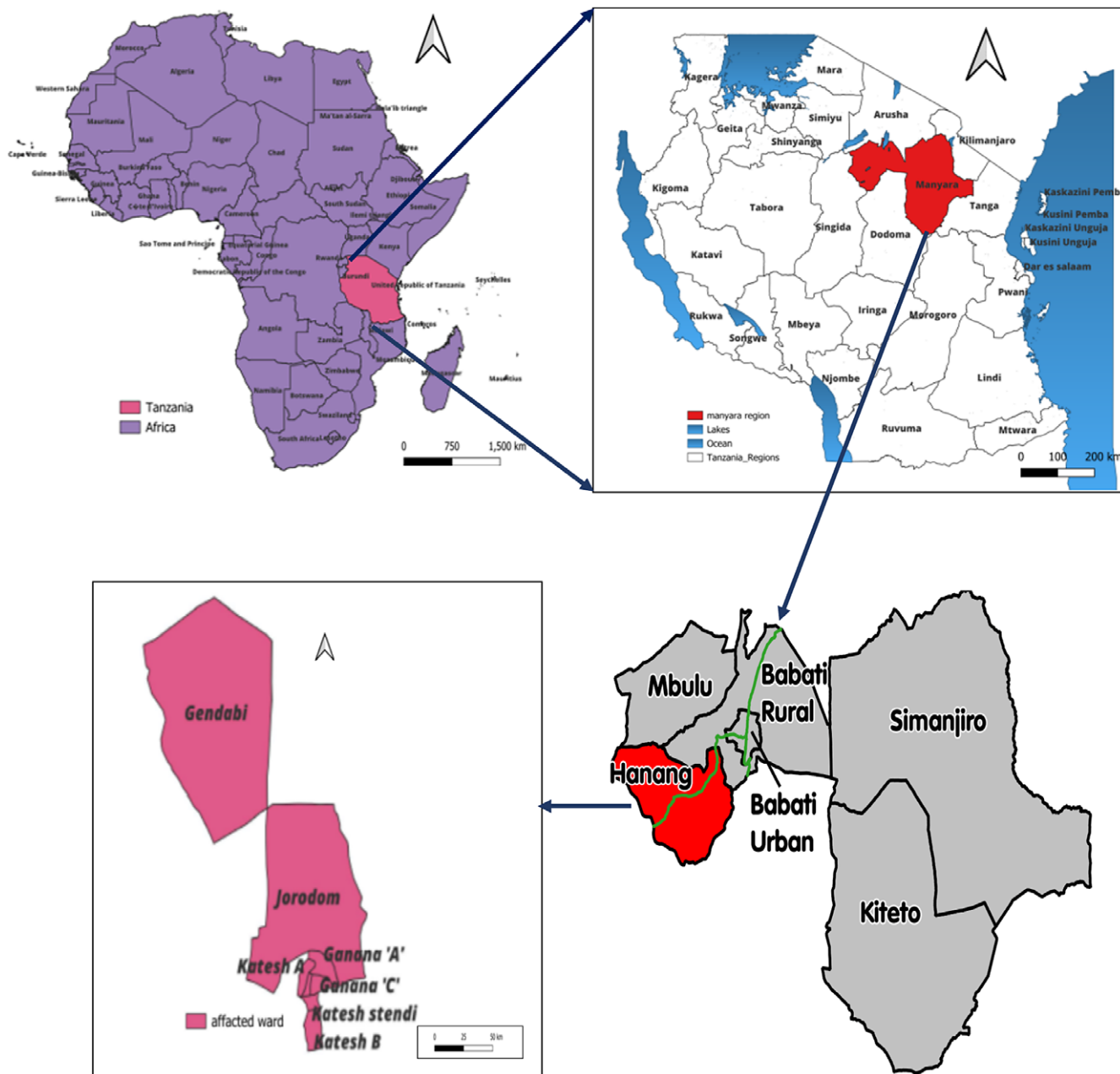


Figure 1. Map of Tanzania showing the call out of the areas that experienced flooding and landslides in Hanang district.

Description of Disease Outbreak Prevention and Control

In response to the flood emergency, intensified disease surveillance was implemented to detect emerging health threats promptly. By December 20 2023, there were 70 reported cases of diarrhea, with 19 (27.40%) affecting children under 5. These cases were evenly distributed between males and females, ranging in age from 7 months to 71 years. Of these, 12 were diagnosed with dysentery, while the remaining 58 were classified as other types of diarrhea based on laboratory findings.

Description of Water, Sanitation, and Hygiene

During floods and landslides, 14 water infrastructures and 92 latrines were severely damaged. This led to clean water shortage and increased health risks from potential waterborne diseases.

Emergency measures included installing water storage tanks, setting up temporary water distribution points, and distributing water purification tablets. The Ministry of Water rehabilitated damaged water infrastructure, ensuring clean water access through rebuilt intake sources and distribution networks. These efforts aimed to address immediate needs and improve hygiene practices in the affected communities.

Risk Communication and Community Engagement (RCCE)

Awareness campaigns on the construction and use of improved toilets, environmental sanitation, and the importance of using clean and safe drinking water (through boiling and the distribution of water treatment tablets, i.e., Aqua tabs) were conducted across various locations. A total of 7898 households, representing 86.40% of the targeted 9144 households, were reached and engaged.

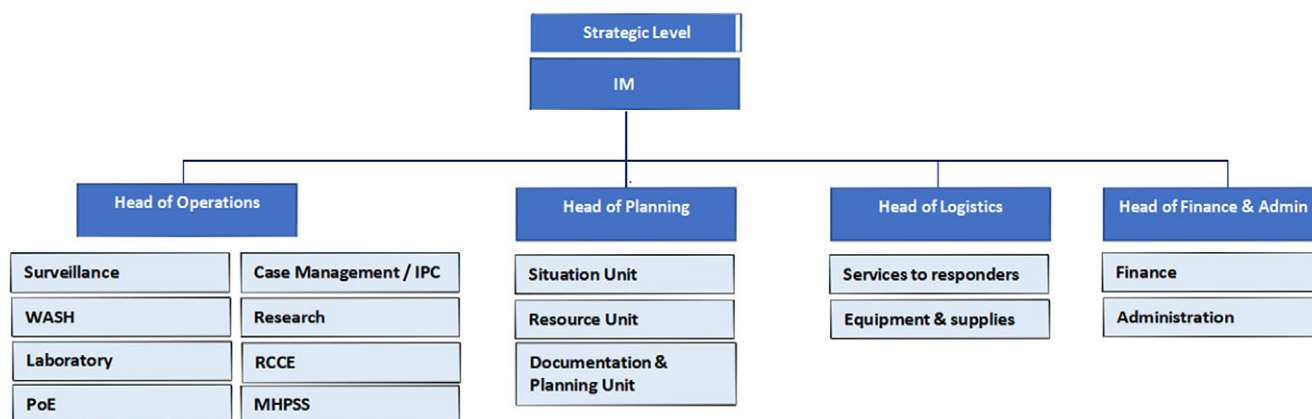


Figure 2. Tanzania Public Health IMS structure.

Table 1. Characteristics of casualties in Hanang floods and landslides (*n* 139)

Variables	Frequency (percentage)
Sex	
Female	72(52)
Male	67(48)
Age group (years)	
0–4	15(10.79)
5–14	32(23.02)
15–24	27(19.42)
25–44	42(30.22)
45–59	15(10.79)
60+	8(5.76)
Type of injury	
Soft tissue injury, bruises, and lacerations	84(60.43)
Cut wound	27(19.42)
Spinal injury	6 (4.31)
Head injury	6(4.31)
Fracture of femur	5(3.60)
Visceral injury	2(1.44)
Chest injury	2(1.44)
Fracture of humerus	1(0.72)
Rib fracture	1(0.72)
Fracture of clavicle	1(0.72)
Dislocation (knee)	1(0.72)
Polytrauma	1(0.72)
Aspiration pneumonitis	1(0.72)
Severe anaemia	1(0.72)
Outcome	
Survived	122(87.77)
Died	17(12.23)

Vaccines

Efforts to strengthen immunization services included providing health education to Ward Executive Officers (WEOs), Village Executive Officers (VEOs), Chairpersons, and Religious Leaders. The health education focused on the importance of sustaining the immunization services against prioritized vaccine-preventive diseases to minimize additional public health threats; and forms were distributed to help identify zero-dose and under-vaccinated children in their respective villages.

Description of Health Facilities Preparedness Capacity

Manyara Regional Referral Hospital (MRRH) was strengthened to enhance its readiness in responding to emergencies including the victims that would need health care and hospitalization. Strengthening initiatives included developing response plans and ensuring availability of important services such as an Emergency Medicine Department (EMD), intensive care units (ICU), operating theatres, x-rays, CT scans, and a blood bank. These measures ensured comprehensive care during public health emergencies.

Discussion

This study describes public health emergency prevention, preparedness, and response to the floods and landslides in limited resource settings. The proactive measures taken by the Tanzanian government demonstrate a commendable level of preparedness to address public health emergencies. The establishment of a dual-level public health response team, consisting of multidisciplinary experts, and the implementation of the IMS structure at the national and sub-national levels, underscore the importance of having a coordinated and strategic approach. The emphasis on various pillars, including coordination, case management, surveillance, and WASH, reflects a comprehensive strategy to address different facets of the crisis.

The challenges posed by limited resources become apparent in the aftermath of disaster in many countries.⁸ The floods and landslides in Hanang, which caused significant casualties and infrastructure destruction, reflect similar disasters in other countries. For example, India's 2013 Uttarakhand floods and Mozambique's

Cyclone Idai in 2019 underscored the importance of early warning systems and international collaboration; while the Philippines' response to Typhoon Haiyan highlighted the value of community-based disaster risk reduction.^{9,10} These examples offer critical lessons for strengthening Tanzania's preparedness and response strategies.

A robust and resilient health system is imperative to ensure effective preparedness, response, and recovery from health crises, such as epidemics and disasters. Decentralized structures, such as Local Government Authorities (LGAs), play a critical role in disaster management, as demonstrated in various countries. In Mozambique, the National Institute for Disaster Risk Management and Reduction (INGD) collaborates with local governments to implement contingency plans, coordinate disaster response, and enhance community resilience.¹¹ This decentralized approach ensures timely decision-making and better resource distribution during crises like cyclones and floods. Drawing from lessons of past events, Tanzania's Health Sector Strategic Plan July 2021-June 2026 (HSSP V) emphasizes the pivotal role of LGAs in coordinating and allocating resources for disaster management within their authority.¹² This entails enhancing their capacity in areas such as early warning systems, emergency response planning, and community engagement. By integrating lessons learned from previous plans and acknowledging the critical role of decentralized structures, the next HSSP VI (July 2026-June 2031) can foster a more resilient health system capable of mitigating the impact of disasters on local communities.

The age group distribution of the affected population, with a considerable number being working-aged and school-aged, underscores the complexity of public health interventions needed in disaster settings. This is consistent with findings from other similar disasters, such as the 2013 Uttarakhand floods in India, where a large proportion of the impacted population was in the working and school-age groups, necessitating targeted health and educational support systems.

The number of deaths in Hanang District is notably higher than those recorded during the Kagera Earthquake but lower than the fatalities from the fuel tanker explosion in Morogoro. However, it remains significantly lower than those observed in other catastrophic events such as Cyclone Idai in Mozambique and Typhoon Haiyan in the Philippines, where large-scale destruction led to extensive loss of life. The health system's resilience in managing emergencies in Tanzania is illustrated by the Manyara Regional Referral Hospital (RRH)'s ability to handle all cases locally, resulting in fewer deaths compared to other countries facing similar natural disasters in the 21st century.¹³ In addition, the proactive engagement with community health workers, the rapid response in disease surveillance, and the focus on WASH practices illustrate a commitment to preventing disease outbreaks in the wake of disaster.

Hanang landslides and floods outlined the same challenges often faced by many low- and middle-income countries (LMICs) during natural disasters, where fragile WASH infrastructure exacerbates the impact of such events on public health. Studies from LMICs highlight the critical importance of rapid response and coordinated efforts to mitigate the spread of waterborne diseases in post-disaster settings. For instance, research by Loo et al. (2012) emphasizes the effectiveness of emergency water supply interventions, including the distribution of water purification tablets and the establishment of temporary water distribution points, in preventing disease outbreaks following floods and landslides in LMICs.^{14,15} Similarly, findings from UNICEF underscore the significance of hygiene education campaigns and the engagement of community health

workers in promoting safe water practices and sanitation behaviors among affected populations, contributing to improved health outcomes in disaster-affected communities.^{6,16} These insights underscore the relevance and effectiveness of the response strategies outlined in the scenario, providing valuable evidence for guiding future disaster response efforts in LMICs contexts.

Lessons Learned from the Flooding and Landslide Events in Hanang District

Coordination and strategic planning

- [1] Effective crisis management in resource-constrained settings is highly dependent on coordination and collaboration among stakeholders for resource mobilization and allocation.
- [2] The proactive response by the Tanzanian government, guided by the National El Niño Contingency Plan, demonstrates the value of foresight and strategic planning in addressing the health impacts of natural disasters.
- [3] Establishing a dual-level public health response team with multidisciplinary experts, supported by the IMS at both national and sub-national levels, reinforces the importance of a coordinated, strategic approach.
- [4] A holistic crisis response requires addressing multiple pillars, including coordination, case management, surveillance, and WASH.

Strengthening local capacities

- [1] Strengthening the capacities of LGAs in early warning systems and emergency response planning is crucial for resilience-building and decentralized disaster management.
- [2] Incorporating lessons learned from past events into strategic plans is essential for improving the preparedness and response capabilities of local communities.

Public health response

- [1] Active involvement of community health workers and robust disease surveillance systems is vital in preventing disease outbreaks following disasters.
- [2] Prioritizing hygiene education, safe water practices, and sanitation behavior among affected populations significantly improves health outcomes in disaster-affected communities.

Infrastructure and multisectoral collaboration

- [1] The events highlighted the vulnerability of WASH infrastructure in LMICs, particularly during natural disasters.
- [2] There is a critical need for rapid emergency responses and collaboration among sectors (e.g., Ministry of Water, health, education, and urban planning) to effectively address disaster challenges.
- [3] Leveraging research and multisectoral collaboration lays a strong foundation for enhancing disaster response and building resilience in LMICs.

Conclusion

The public health emergency response in Hanang District reflects effective coordination, capacity, resilience, and challenges inherent in resource-limited settings. The coordinated efforts, proactive planning, and immediate response highlight the resilience of the health system. Ongoing investments and capacity-building are essential to enhance overall preparedness and response capabilities for future emergencies.

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