



Application of the Disaster Management Cycle: A case study of the Meeriyabedda Landslide in Badulla district, Sri Lanka

Tharushika Sayuri Manik Senadeera and Vithanage Primali Anuruddhika Weerasinghe* 

Department of Zoology and Environmental Management, Faculty of Science, University of Kelaniya, Sri Lanka

Abstract

Disasters are sudden, high-impact events that disrupt ecological systems, displace populations, and damage infrastructure. Effective mitigation and recovery require a systematic application of the disaster management cycle, encompassing pre-disaster, during-disaster, and post-disaster phases—namely, mitigation, preparedness, emergency response, and recovery. In Sri Lanka, literature addressing the integration of all stages remains limited, resulting in insufficient empirical evidence on the effectiveness of full-cycle application and a lack of practical resources for disaster management personnel. This study presents a comprehensive evaluation of the disaster management cycle as implemented during the 2014 Meeriyabedda landslide in the Badulla District—one of the most significant landslide events in Sri Lanka. Pre-disaster interventions included land-use regulation, hazard mapping, early warning systems, and risk monitoring. Immediate response actions involved evacuations to temporary shelters and coordinated relief provided by governmental bodies, NGOs, and community volunteers. Post-disaster efforts focused on resettlement, rehabilitation of affected families, and support systems for orphaned children. Findings highlight the partial effectiveness of implemented strategies but also reveal gaps, particularly in community participation, sustainable land-use planning, and institutional readiness. The analysis underscores the need for enhanced government leadership, expanded public education, and the integration of scientific research into disaster policies. This case study affirms that comprehensive, phase-by-phase implementation and evaluation of the disaster management cycle is essential for reducing vulnerability and building resilience in hazard-prone areas. The insights drawn from the Meeriyabedda experience offer a replicable model for holistic disaster risk reduction across Sri Lanka and similar contexts.

Keywords: Meeriyabedda, Disaster Management Cycle, Landslide, Post-disaster management, Sri Lanka

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1 Introduction

Disaster is a unexpected, destructive, non-selective, and immediate extreme events that severely impact the normal existing conditions of human beings, animals, plants, and destroys other infrastructures (Khan et al., 2008; Maheshika and Sangasumana, 2017). There are two types of disasters as naturally occurring and human-induced. Natural disasters occur due to severe conditions that arise from natural events or hazards like earthquakes, floods, and droughts. Compared to natural disasters, human-induced disasters are infrequent, caused by people and their actions. For instance, pollution, war, and industrial accidents. When all these extreme events surpass the manageable extent, it makes the readjustment process more difficult and results in disastrous

losses of resources, including private and government properties, and becomes a threat to the income methods of people, especially for those who depend on a daily wage (Khan et al., 2008).

Disaster management mainly takes place to avoid disaster, reduce the impacts of disaster, and recover from its losses. (Khan et al., 2008). It can be divided into three main stages as pre-disaster, during-disaster, and post-disaster stages. (Hossain et al., 2024; Khan et al., 2008; Maheshika and Sangasumana, 2017). To reduce the effects of disasters, to plan the response activities, to minimize the hazards created by disasters, and to ensure the normal living patterns of affected communities, there should be mitigation, preparedness, response, and recovery phases, respectively. (Khan et al., 2008). Pre-disaster stage includes activities

*Corresponding author. Email: primali@kln.ac.lk (VPAW)

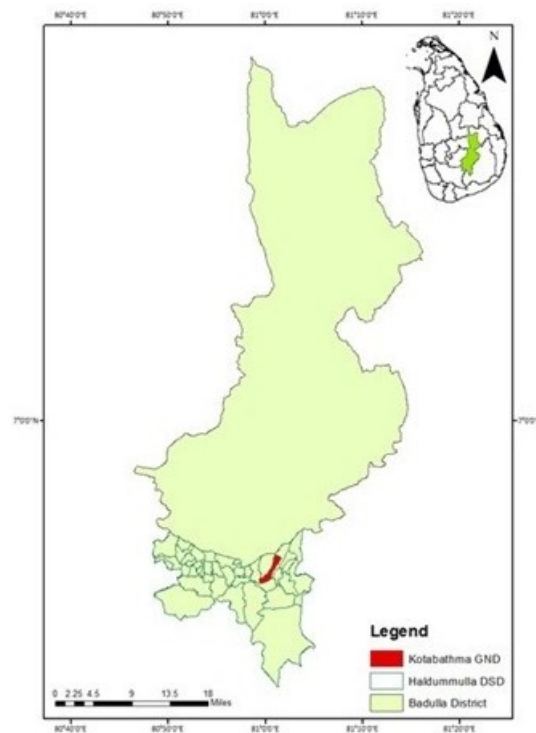


Fig. 1. The map of the study area (Badulla district).

that are taken to avoid disasters, reduce impacts on humans and properties. As preparedness, planning, and awareness programs serve as warnings, enhance the conditions of existing structures, and preparation of villagers, especially those who live in disaster-prone areas. Hazard mapping, assessments of impacts, and vulnerability can be implemented as mitigation measures before any disaster takes place. Immediate response activities that are taken for the disaster victims are included during the disaster stage. In that emergency, responses like search and rescue systems, provision of water, food, sanitation, clothes and security, and medical care services are included. The post-disaster stage contains initiatives taken after the disaster events, which include recovery activities, rehabilitation, and resettlement processes. Basic services and functions needed for the affected communities are restored with the rehabilitation phase (Khan et al., 2008).

Among disasters, landslides have become a main, continual event in the world, including Sri Lanka. Landslides are a geographical event where soil, rock, and other organic materials move extensively downward along the slope, mainly due to the effects of gravity (Maheshika and Sangasumana, 2017; Ranasinghe et al., 2016). It occurs when the stability of the slope area changes, and it is unable to hold its weight (Ranasinghe et al., 2016). Soil type, rainfall, degree of steepness, water drainage patterns, geology of the bedrock, weathering rate, heavy laden soil cover, and formation of land can be identified as the main natural factors, and as human-related activities, improper land use habits and the arrangement patterns of their settlements can be categorized. Climate change is also identified as a causative factor for landslides. Among all these factors, in Sri Lanka, high-intensity rainfall is the crucial factor for the occurrence of landslides. The application of the Disaster Manage-

ment Cycle for different disasters in Sri Lanka is incomplete. There were technical reports, journal articles, and government reports that only focus on a single phase of the cycle, especially the recovery projects in the post-disaster period, but in the current literature, the integration of all phases is inadequate. Therefore, this uncoordinated approach results in insufficient observational evidence about the productivity of complete cycle application, limits the availability of supplementary materials for officers in government sector organizations, authorities, policy makers, and for students, and affects the direction of future research and decisions.

The main objectives of this study are (1) to carry out comprehensive analysis and evaluation of application of full disaster management cycle in pre, during and post disaster phases of Meeriyabedda Landslide event, one of the disastrous events in Sri Lankan history of catastrophes, occurred in the Kotabathma Grama Niladhari Division (GND) in Haldummulla DSD (Divisional Secretariat division), Badulla District, on 29 October 2014 at around 7.30 am, identifying the interrelationship of mitigation, preparedness, response, and recovery phases to strengthen the overall disaster management, (2) to create supporting documents suitable for government officials, relevant authorities, and students, and (3) to emphasize the significance of new policies, strategic plans for future decisions.

2 Methodology

2.1 Study area

Meeriyabedda area is a hilly village, located on the southern slopes of Sri Lanka's central hills near the town of Haldummulla, in Badulla district ($6^{\circ} 54' 37.8''$ N, $81^{\circ} 9' 38.16''$ E) (Fig. 1). Altitude goes up to 907 m. As well as the temperature fluctuates between $19\text{--}27^{\circ}\text{C}$, and the relative

humidity goes up to 95.15% approximately. The area is fed by approximately 380 mm of rainfall throughout the year from both the northeast monsoon and the southwest monsoon, and the main vegetation type can be identified as tea.

2.2 Data collection

Both quantitative and qualitative approaches were employed throughout a 4-month period from January–April 2023 by this study to collect relevant numerical data from secondary sources and to understand the social aspects of landslide management, respectively.

2.2.1 Primary data collection

Primary data related to disaster management, pre-disaster, during, and post-disaster strategies for the case study were obtained through interviews and a seminar with government officials. The interviews were semi-structured and conducted at the Disaster Management Centre (DMC), Colombo, Sri Lanka, with the officials in the Education and Public Awareness division in DMC. The seminar was supervised by officials in the National Building Research Organization (NBRO), Sri Lanka, and all were recorded for qualitative content analysis.

2.2.2 Secondary data collection

All relevant data were collected through a comprehensive literature survey, which included journal articles, conference proceedings, conference papers, government reports, news and press releases, and technical reports, accessed through different databases such as Google Scholar and government databases. Keywords as “Meeriyabedda landslide”, “disaster management”, “disaster management cycle”, “pre-disaster management”, and “post-disaster management” were used to ensure the coverage of the topic.

3 Data analysis and discussion

3.1 Pre-disaster actions

3.1.1 Land use planning and hazard mapping

The Sri Lanka Red Cross Society (SLRCS) has identified risk areas in the Badulla district, and a landslide risk map has been created. NBRO (National Building Research Organization) has zoned the study area as high risk (HR), low risk (LR), and intermediate risk (IR) according to the risk level and limited the development programs mainly in high-risk areas.

3.1.2 Early warning system, public education, and Evacuation planning

After the identification of risk areas, awareness programs were implemented through NBRO, Divisional Secretary, and GN officers. Early warnings were given to the people who live in high-risk areas to evacuate in several years. In 2005, a survey was carried out after a small landslide hit, and it recommended relocating the village. In 2009, DMC, NBRO, and SLRCS trained villagers to be alert for landslide warnings. The same procedure was implemented in 2011 as well.

3.1.3 Regular monitoring

Around 2010–2012, Divisional Secretariat–Haldummulla observed cracks on building walls and road surfaces and immediately informed the NBRO. Considering heavy rainfall as the triggering factor, NBRO identified the high-risk area and provided a report on observed landslide signs and initial recommendations. Early warning and evacuation orders were issued due to heavy rainfall in October 2014.

3.1.4 Summary of actions taken to reduce the landslide risk at Meeriyabedda

In 2005, NBRO gave recommendations to evacuate 75 families living in the Meeriyabedda settlement after the identification of a high-hazard situation in the area, and in 2009, an awareness program was conducted by SLRCS, DMC, and NBRO for the community living in high-hazard areas with the participation of 300 families. Hazard mapping, evacuation drill, and explanation of the mechanism of landslide through role play have been mainly discussed. In 2011, a letter was issued by the NBRO to implement the recommendations given in 2005.

During the month of October 2014, tension cracks on land and buildings, unusual bulges, road deformations, and discoloration of water were observed in the area, and monitoring programs were continued. That guided further communication between the relief officer, DMC, and NBRO officers in Badulla, and the evacuation order was issued by the Grama Niladhari (village officer), the relief officer, and the estate management for the village communities living in the pre-defined high disaster risk area.

3.2 Measures taken at the time of disaster

Immediate actions and measures for damages were taken as follows.

3.2.1 Evacuation

Affected people were evacuated from the landslide area, and people stayed in six main helping camps immediately after the landslide. They were Poonagala Tamil School, Poonagala Sinhala School, Poonagala Primary School, Poonagala Lower Division Kovil, and Koslanda Tamil School. Statistical descriptions of evacuated people are shown in Fig. 2.

As per the instructions given by the President of Sri Lanka, the Minister of Disaster Management directed all Provincial and District Political Authorities, the Agencies under the Ministry of Disaster Management, District and Divisional Secretaries, health Authorities, tri-forces, and police to continue the search and rescue operations and post disaster recovery activities. All hospitals in the area were conducting emergency medical services to minimize health impacts.

The Ministry of Health conducted rapid health assessments. They were already done for the facilities for pregnant ladies, infants, and children. Food, clothing, medicine, and toilet facilities were immediately arranged for the affected people. (World Health Organization, 2014).

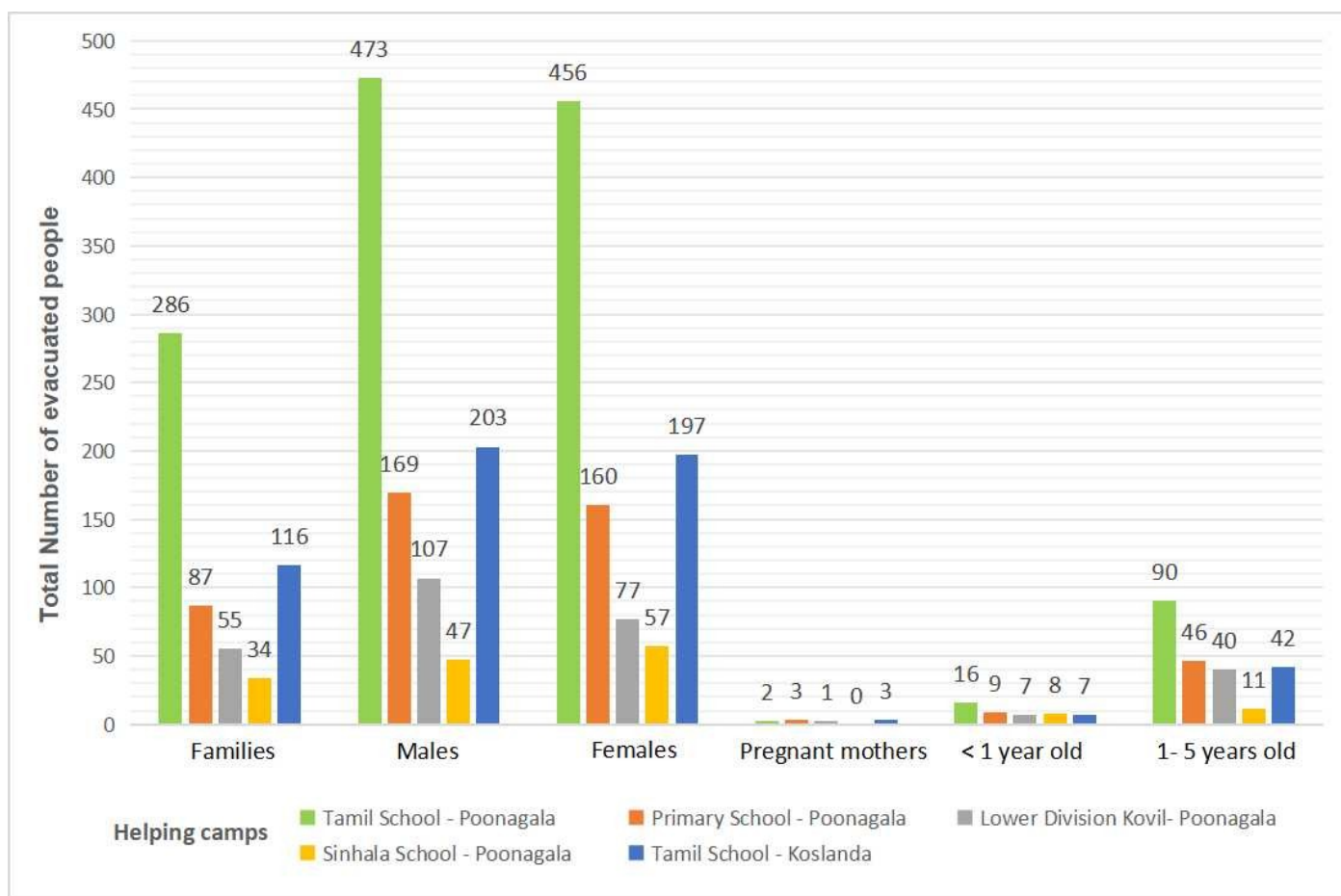


Fig. 2. Main relief camps and demographic details of evacuees.

3.2.2 Donations

The Red Cross Society of China (RCSC) donated USD30,000 to the Sri Lanka Red Cross Society, supporting the ongoing Meeriyabedda landslide operations and aiding the survivors of the tragedy. The Chinese Government donated twenty million rupees to the Sri Lankan Government for the utilization of this operation. Sarvodaya staff and volunteers from the Badulla district center initiated limited relief services for those who were affected by the deadly landslide.

3.2.3 Disaster victims

More than 1067 people were affected, and among them, 346 people in 79 families were affected directly. 37 people lost their lives while 192 people were believed to be missing. Apart from that, their livelihood was also affected. For instance, the annual dairy production in the Meeriyabedda area earned Sri Lankan Rs. 9002662 in 2011. However, it has been reduced to Rs. 1535990 after the disaster. Also, people (35 families) who live in this area have shifted from their agricultural activities to achieve daily salaries, as the site is unpredictable.

3.3 Post-disaster actions (Responses, Recovery, Resettlement, and Rehabilitation)

After the incident, the evacuation of people, which was implemented as an immediate response to the disaster, was done as mentioned above, and then responsible organizations and agents must consider victims' recovery and resettlement. Their basic requirements and other needs must be met, and their mentality needs to be recovered. Therefore, the strategies were implemented with respect to three levels, such as short-term, medium-term, and long-term disaster recovery programs.

3.3.1 Short-term strategies

Children, women, and disabled people of the affected communities were specifically provided with their basic requirements by ensuring the safety of disaster victims. They were school uniforms, bags, shoes, books and other materials for children supporting their education, sanitary items for women, crutches and wheel chairs for disabled people, mattresses, towels, bed sheets, blankets, mobile toilets, water tanks and pumps, roofing sheets, emergency lamps, raincoats, boots, umbrella, mosquito nets and water purification sets.

3.3.2 Medium-term strategies

Temporary shelters with basic requirements, water sanitation facilities, water bowsers, water tanks, and other safety requirements were supplied during the temporary relocation of landslide victims. Also, facilities and other requirements that are needed to continue the education of relocated children were provided.

3.3.3 Long-term strategies

Resettlement process at Makaldeniya. Constructing permanent housing for resettlement of Meeriyabedda landslide victims has different key stages as Establishment of the process, selection of the land, planning and designing, preparation of the land, supplying and procurement of building materials, and provision of necessary infrastructure (Fernando et al., 2017).

On 13 November 2014, the cabinet issued a decision regarding the construction of houses and expected to resettle the victims within one year. Different agencies were involved in this process. For instance, Urban Development Authority (UDA) for the designing and supervising housing construction and site preparation, District Secretariat, Badulla by supplying building materials that follows tender process, Sri Lanka Army for the construct houses, Ministry of Disaster Management for monitoring the progress with key implementing agencies, National building Research Organization (NBRO) for assess in site selection, guiding land development and resilient construction, supervision and monitoring land development and house construction and other structures, District Disaster Management center for coordinate progress of project activities, Ceylon Electricity board for supply electricity for the site and finally the water board for supply water facilities to individual housing units (Fernando et al., 2017).

However, this project was unable to be fulfilled within the time frame due to multiple factors like changing the selected sites due to the protest of the victims, conflict between government agencies regarding the plot size, shortage in supplying building materials, and the urban development authority's withdrawal from the planning process. When considering the site selection, it was managed by the Ministry of Plantation Industries with the consultation of the Ministry of Livestock and Rural Community Development, the plantation sector, and the National Building Research Organisation (NBRO). The initially selected land site was at Malwarn Division, Ampitikanda estate, Maskeliya plantation. However, due to the objections made by the victims, a second site was selected in Makaldeniya Division, Maskeliya Plantation situated 11 km away from Meeriyabedda estate, which is closer to the Koslanda and Poonagala towns.

In planning and designing, the Urban Development Authority carried out the planning of the site and the house plans along with the NBRO structure and its guidelines for land development. According to the NBRO, they recommended a minimum site plot of 15 perches by considering the sloping nature of the terrain to minimize the unsafe cut slopes and to allow the development of drainage systems. But the Urban Development Authority divided the plot into seven perches, and one house plan had a

floor area of 550 sq. ft that included two bedrooms, a living area, a kitchen, and a toilet. However, this proposed plan did not have an adequate drainage system that could affect the natural hydrological systems of the area.

Preparation of land included cutting, filling, and levelling under the direct supervision and monitoring of the UDA, and as mentioned above, the construction of the houses was carried out by the Sri Lanka Army, and all building materials were supplied by the relevant authorities. Electricity, water, and road facilities for the construction site are provided by the other mentioned government agencies. However, this resettlement project did not include the construction of social infrastructures: markets, shops, playgrounds, religious buildings, pre-schools, and schools. Resettled people have to go 5 km to the Koslanda town, 2 km to the Poonagala hospital, 1km to the Poonagala primary school, and 7 km to the Koslanda secondary school (Fernando et al., 2017).

Programme for orphaned children. To support the children who were orphaned by the Meeriyabedda landslide, a child protection center was established, including psychological support. In addition to that, a scholarship scheme was introduced called Helping Hand, which provided a monthly scholarship for their education through the minister. Rs. 500 per month for a child who has lost one parent and Rs. 600 per month for a child who has lost both parents.

3.4 Social and economic impacts

Significant socio-economic impacts can be caused by landslide disasters. The majority of them are negative consequences, including ecosystem destruction, loss of crops, damage to physical infrastructures, mortality, social disruption, and the potential for further hazards. Due to loss of family members, livestock, and crops, people can be affected by either short-term or long-term mental health issues. Further, landslides greatly affect the health system of the country and other essential services like water, electricity, and telecommunication lines. More than 1000 people were affected by the landslide in Meeriyabedda and its surrounding area, 346 people were directly affected who belong to 79 families. Among them, more than 35 people lost their lives.

About 200 children who were studying in the only school in the Meeriyabedda area had to continue their studies in Poonagala and Koslanda as it was demolished by the landslide. However, many children had to discontinue their studies as they were unable to travel to these schools several miles away. But a school has now been officially opened in an unused Bungalow in Meeriyabedda. Physical damage caused by the slide included 63 total buildings, including Houses, Kovil, Community centers, Dairy collection centers, Boutiques, telecommunication centers, and three Estate bungalows. Also, several roads and railroads were washed out.

Both direct and indirect costs are considered by the socio-economic significance of landslides. Direct costs include injury or loss of life, damage to infrastructure and

property, and the loss of resources, and are relatively straightforward to calculate and quantify. As a result of landslides, tax collections on properties have been reduced. Loss of industrial, agricultural, and forest productivity, and tourist revenues, because of the damage to land or facilities, or interruption of transportation systems.

3.5 Emergency planning

The immediate action that needs to be taken is rescuing people who have been subjected to the disaster. Therefore, the injured and trapped people need to be checked by using rescuing teams without direct entrance to the affected area. Another important thing is evaluating the impact caused by the disaster. For that, damaged or broken utilities, damaged roadways, and buildings need to be reported to the relevant authorities with proper observation. And then those damaged properties need to be removed or reinstated as soon as possible because those damaged properties may lead to another impact on the site. All construction should be done sustainably. Their quality and tolerability need to be improved. When considering the awareness of people who live close to the landslide susceptible areas need to be informed to stay away from the landslide area, as there may be danger coming from additional landslides in the future, and the residents must be given information about the conditions through emergency communication techniques such as alarm systems. Apart from that, residents must be on alert for floods, as sometimes floods may be triggered by landslides and debris flows.

3.6 Community-level weaknesses

Considerable weaknesses were identified in the communities, were caused to inhibited the productivity of the preparedness and response phases of disaster management, with respect to the risk of landslides. Mainly, residents in vulnerable areas, especially those who own significant land properties, exhibited strong hesitation to change their native lands into suggested comparatively small plots in low-risk areas, making the option of resettlement less effective (Maheshika). Further, there was a ubiquitous lack of knowledge about landslide risks and the importance of preparedness actions among villagers. Susceptible people as elders, low-income families, and disabled people, face major obstacles in accessing essential disaster response information systems, and during that period, the lack of technical expertise and availability of mobile devices hindered the capability to be updated about landslide warnings and updates of weather provided by the NBRO.

3.7 Effectiveness of the institutional coordination

During and after disaster phases, governmental involvement, collaboration, and support through various organizations, authorities, and institutions are adequate. Especially in rescue missions, evacuations, and temporary resettlement processes. However, in donation distributions as emergency responses, post-resettlement assistance, delay of resettlement constructions, accessibility to livelihood, delay of construction of damaged roads, and other infrastruc-

tures arose with insufficient arrangements among institutions (Maheshika and Sangasumana, 2017).

3.8 Policy gaps

Primarily, the inadequate strength of land use policies relates to environmental standards, creating significant problems for sustainable growth. Many people neglect the existing laws and regulations, which are set by the government, before the start of land clearings of land and construction. That may lead to environmental degradation while increasing the risk of catastrophic events.

3.9 Lessons learned

In respect of preparedness and response for a disaster, knowledge and engagement of communities are insufficient, leading to less effectiveness in efforts of response. To improve the resilience of people, it is critical to intensify the education and awareness sessions among the communities. The resettlement projects of the Meeriyabedda landslide face various challenges, as they extended beyond the expected project timeline. During the initial response stage, the active involvement of government authorities and organizations was sufficient. However, the interconnection of these institutions tends to lessen over time, impeding the success of the recovery. In addition, the practical application of predetermined strategies in the field is difficult when interacting with affected people directly. Because it is combined with the truth that the rehabilitation processes are not thoroughly addressed, as many of them have lost their original lifestyles.

4 Conclusion

In conclusion, careful and well-organized action plans related to the mitigation, preparedness, response and recovery phases within the cycle of disaster management particularly in pre-disaster, during and post-disaster stages doing a significant service to avoid the negative impacts of disasters, protecting human beings and their properties, and preserving the economic stability of the country. It is equally significant the improvement in the involvement of communities towards disaster management plans, accepting policies, while improving their attitudes and awareness. Additionally, to control the illegal human activities related to different land use patterns, which deepen the risks of disasters, strong policies are needed.

Moreover, the integration of all authorities must be more productive and continual throughout all phases of disaster management, instead of limiting the interactions with victims to the short-term post-disaster response period. The preparation of practical strategies is crucial for improving early preparations and building resilience against disasters. First, the association between government organizations, agencies, non-governmental organizations (NGOs), and scientific institutions is important for encouraging a holistic approach to disaster management, allowing the sharing of resources, knowledge, and expertise. Establishing a system for continuous monitoring of emergency planning, preparedness actions to alert communities about potential threats.

Upgrading and strengthening the infrastructure, like roads, bridges, and buildings, will defend people by enhancing their ability to cope with the impacts of disasters.

Furthermore, for well-informed decision creation, more scientific research with expertise in the field is encouraged with governmental support. Developing sustainable land management policies is crucial to alleviating the consequences of unsustainable land use patterns by humans. In addition to stabilizing the slope areas and reducing soil erosion, afforestation and soil conservation programs can be initiated. The construction of proper drainage systems and structural barriers will establish a physical obstruction against the landslides. Also, maintaining a trustworthy communication system and identifying and informing safe and clear evacuation routes, processes will secure the effective and rapid responses of communities in emergencies.

Ultimately, further community education and awareness about disaster early warnings, safety actions are crucial for residents in disaster risk areas to take anticipatory actions in protecting human lives and their belongings. Regarding future research, a thorough cost-benefit analysis of available mitigation and preparedness techniques might be possible to enhance the effective allocation of resources. This kind of analysis will facilitate the identification of cost-effectiveness in disaster management. Further, it is essential to examine the relationship between climate change patterns and with intensity and occurrence of landslides and other disasters in Sri Lanka. Integration of these aspects into the planning of disaster management will strengthen the knowledge about potential risks and will help to create stronger strategies to reduce the impact of climate change on the occurrence of disasters.

Conflict of Interest

The authors declare no conflict of interest.

CRedit Statement

TSMS: Data Collection, Writing Original Draft.
VPW: Conceptualization, Supervision, Writing – Review & Editing

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References

- Fernando, N., Wijegunaratna, E., Prasanna, J., Sivaprakasam, S., Wimaladasa, J., Dhamruwan, M., Rathnasiri, C., 2017. *Impact evaluation of landslide induced displacement and relocation: Relocation of Meeriyabedda landslide victims in Makaldeniya Estate*. NBRO, Sri Lanka.
- Hossain, T., Al, M., Tushar, N., Murshed, S., Basak, U., Islam, A., 2024. Landslide studies in the context of disaster management in Bangladesh—A systematic literature review. *Earth* 5, 784–811. doi:10.3390/earth5040041.
- Khan, H., Vasilescu, L.G., Khan, A., 2008. Disaster management cycle – A theoretical approach. *Management & Marketing Journal, University of Craiova, Faculty of Economics and Business Administration* 6(1), 43–50. URL: <http://www.mnmk.ro/documents/2008/2008-6.pdf>.
- Maheshika, H., Sangasumana, R.P., 2017. Issues and challenges of post-landslide management in Sri Lanka (A case study of Meeriyabedda landslide in Badulla District). *International Journal of Scientific and Research Publications* 7(12), 215–225. URL: <https://www.ijsrp.org/research-paper-1217.php?rp=P727024>.
- Ranasinghe, A.K.R.N., Sirisena, P.M.T.S., Dammalage, T.L., Puswewala, U.G.A., 2016. Integration of radar and optical remote sensing for landslide detection—A case study of Meeriyabedda landslide in Sri Lanka, in: *37th Asian Conference of Remote Sensing (ACRS-2016)*, 2, p. 1363–1372. URL: <http://repo.lib.sab.ac.lk:8080/xmlui/handle/123456789/427>.
- World Health Organization, 2014. *Landslide in Meeriyabedde Estate, Haldummulla Division, Badulla District* (Issue October). URL: <https://reliefweb.int/node/705171>.