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Review Article

Community-Based Disaster Risk Reduction: Overcoming Barriers to Build Stronger Communities

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ABSTRACT

Community-Based Disaster Risk Reduction (CBDRR) plays a vital role in strengthening local communities' resilience against natural hazards and man-made disasters. This paper aims to examine the role of CBDRR in enhancing the resilience of local communities to both natural hazards and man-made disasters. It emphasises the crucial importance of active community involvement throughout all stages of disaster management, from preparedness and mitigation to response and recovery. Furthermore, the paper also looks into the key factors that contribute to the successful implementation of CBDRR, including institutional support, capacity development, inclusive strategies, and modern technologies. Additionally, it discusses the challenges and opportunities in building strong partnerships between local communities and external stakeholders, which are essential for ensuring the sustainability of these efforts. Finally, the paper offers recommendations to improve the effectiveness of CBDRR initiatives, drawing on insights gained from past disaster experiences. The findings highlight the necessity of continuous monitoring and evaluation of CBDRR programmes to maintain their relevance and effectiveness as risks evolve. Incorporating lessons learned from past disasters into future planning also plays a crucial role in helping communities strengthen their resilience over time. Ultimately, by fostering collaboration between communities, governments, and various organisations, CBDRR lays the foundation for a comprehensive disaster management framework capable of meeting future challenges and supporting long-term sustainable development.

KEYWORDS

Disaster; CBDRR; community resilience; preparedness; capacity building; institutional support; participatory approach.

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1. 1. Introduction

In the realm of disaster risk reduction, particularly within community settings, grasping the overarching global trends of disaster occurrences is key to fostering stronger, more resilient communities (Cvetković, 2024; Cvetković, 2024b). Between 1900 and 2021, records indicate a staggering 25,836 disasters worldwide. Of these, 69.41% were categorised as natural disasters (16,567 incidents), with the remaining 30.59% attributed to man-made, primarily technological, causes (9,269 incidents) (Cvetković, Renner, Lukić, & Aleksova, 2024). These trends underscore the critical need for community-level preparedness (Kabir, Hossain, & Haque, 2022; Rajani, Tuhin, & Rina, 2023; Sergey & Gennadiy, 2022; Starosta, 2023; Sudar, Cvetković, & Ivanov, 2024; Zareian, 2023), as droughts and floods often result in the most significant loss of human life, while storms and earthquakes inflict the most severe economic damage (Cvetković et al., 2024). With climate change intensifying both the frequency and severity of disasters, particularly hydrometeorological events, the vulnerabilities faced by low-income regions are further magnified. This escalating risk profile underscores the need for resilient, community-centred risk reduction strategies (Aleksova, Lukić, Milevski, Spalević, & Marković, 2023; Lukić et al., 2013). Equipping local communities with knowledge about these patterns can significantly bolster their ability to engage in effective disaster risk reduction (Fu & Zhang, 2024; Haque, Khan, & Choudhury, 2024). Integrating disaster education into CBDRR frameworks enhances communities' adaptive capacity, facilitating intergenerational knowledge transfer and strengthening the foundation for long-term resilience. Community-based risk reduction (CBRR) is a critical component of disaster risk management (DRM), fundamentally emphasising the involvement of local communities throughout every phase of disaster management (preparedness, mitigation, response, and recovery) (Cvetković, 2024; Cvetković & Šišović, 2024; Grozdanić & Cvetković, 2024). This method goes beyond merely addressing risks, as it also promotes a more profound sense of community responsibility in actions such as mitigation, preparedness, response, and recovery efforts (Cvetković et al., 2019; Cvetković, Lipovac, & Milojković, 2016; Cvetković, Nikolić, Nenadić, Ocal, & Zečević, 2020; Cvetković, Roder, Tarolli, & Dragićević, 2018; Cvetković, 2018; Mano, & Rapaport, 2019). The use of advanced technologies, such as GIS, UAV and mobile early warning systems, provides critical support for CBDRR by enabling precise hazard monitoring and enhancing the timeliness of community responses (Aleksova, Milevski, Dragićević, & Lukić, 2024; Alberto Carrara, Cardinali, Guzzetti, & Reichenbach, 1995; Antonini Carrara, Guzzetti, Cardinali, & Reichenbach, 1999; Coppock, 1995; Daud, Ugliotti, & Osello, 2024; Milevski, Aleksova, Lukić, Dragićević, & Valjarević, 2024; Milevski, Dragicevic, & Georgievska, 2013; Milevski, Dragicevic, & Radevski, 2017).

By placing local stakeholders at the heart of these processes, CBRR taps into the communities' existing knowledge, skills, and resources, resulting in solutions that are better suited to their specific needs and circumstances (Gero, Méheux, & Dominey-Howes, 2011; Nkombi & Wentink, 2022). In the literature, numerous studies (Lansakara, Dé, Petterson, & Wickramasinghe, 2023; MacAskill, 2019; Niboye & Farai, 2020; Nkombi & Wentink, 2022; RajeevM, 2014; Shaw, 2012, 2014; Witvorapong, Muttarak, & Pothisiri, 2015; Wu, Yang, Wang, & Jaeger, 2022; Zubir & Amirrol, 2011) emphasize the necessity and importance of comprehensive community involvement in disaster risk reduction processes. On the other hand, Titz, Cannon, and Krüger (2018) explicitly warn about the potential pitfalls of overreliance on the concept of community in disaster studies. Their well-articulated critique highlights how "community" often serves as a moral license for external actors' interventions while neglecting the inherent heterogeneity and internal conflicts within communities, underscoring the need for a critical reassessment of this concept. For these reasons, the authors of this paper aim to address these challenges by considering inclusive strategies that do not assume community homogeneity but instead acknowledge and incorporate marginalised groups and perspectives. By focusing on participatory methodologies, this approach enables the identification of diverse interests and needs within communities, effectively avoiding elitism and the capture of benefits by local elites.

When community members actively participate, the strategies for reducing risk become more rooted in the actual conditions they face, which ultimately strengthens their resilience against both natural and man-made hazards (Baudoin, Henly-Shepard, Fernando, Sitati, & Zommers, 2016; Cvetković, Tanasić, Ocal, Kešetović, Nikolić, & Dragašević, 2021). Additionally, CBRR advocates for cooperation between local communities and external organisations (Cvetković, 2024a), paving the

way for a risk management framework that is not only more sustainable but also more inclusive in the long run (Haque, Khan, & Choudhury, 2024).

It is an indisputable fact that community-based disaster risk reduction (CBDRR) strategies have been promoted for nearly two decades. Furthermore, numerous pieces of evidence directly or indirectly confirm their effectiveness without delving into deeper philosophical or ethical dilemmas and considerations. For instance, a study encompassing approximately 11,000 communities analysed disaster risk reduction at the local level. The results highlighted the advantages of this concept, particularly in terms of reducing disaster losses (Wu et al., 2022). Additionally, research shows that community participation in disaster risk reduction significantly enhances societal resilience and preparedness in various ways (Shaw, 2012). Such results can be attributed to the fact that local communities possess institutional, legal, economic, and other social mechanisms that enable them to participate in and stimulate various processes for reducing vulnerability within a society.

Moreover, through different planning and decision-making processes, local communities can establish the foundation for effective disaster risk reduction. All measures can thus be tailored to the specific needs and diverse levels of vulnerability within the community. Such a participatory approach not only empowers communities but also improves their capacities for disaster management. A study conducted in Thailand revealed that active participation of local communities increased the likelihood of households undertaking various disaster risk reduction activities, such as preparing disaster kits and closely following disaster-related news (Witvorapong, Muttarak, & Pothisiri, 2015). Additionally, diverse community-driven approaches have proven effective in integrating local knowledge and practices into disaster risk reduction strategies (Lansakara et al., 2023).

Despite these numerous advantages, significant challenges in engaging communities in disaster risk reduction processes cannot be overlooked. Low levels of citizen motivation for personal and collective protection (Cvetković, 2016; Cvetković & Filipović, 2020), limited awareness (Tuladhar, Yatabe, Dahal, & Bhandary, 2015), restricted knowledge (Spiekermann, Kienberger, Norton, Briones, & Weichselgartner, 2015), inadequate physical and material resources (Nguyen, Ginige, & Greenwood, 2018), lack of time and funding (MacAskill, 2019), difficulties in aligning local and national disaster risk reduction policies and programs (Shaw, 2014), poor approaches by local authorities (Malalgoda, Amaratunga, & Pathirage, 2010), and a lack of trust in local institutions (Bang, 2013; Kong, de Villiers, Ntloana, Pollard, & Vogel, 2020) all present barriers to successful and effective community participation in disaster risk management and reduction.

Based on that, this paper examines the role of CBDRR in strengthening the resilience of local communities to both natural and human-made disasters. It highlights the crucial importance of community participation throughout all stages of disaster management, from preparedness and mitigation to response and recovery. The paper also identifies key factors essential for the effective implementation of CBDRR, including institutional support, capacity building, inclusive strategies, and the integration of modern technologies. Furthermore, it discusses the challenges and opportunities associated with fostering strong partnerships between local communities and external stakeholders, which are vital for ensuring the long-term sustainability of these initiatives. Finally, the paper offers recommendations for enhancing the effectiveness of CBDRR efforts, drawing on lessons from past disaster experiences.

2. Definition and importance of CBDRR

As mentioned earlier, CBDRR is centred around the active involvement of local communities in disaster risk management, with an emphasis on reducing vulnerabilities and enhancing resilience through localised strategies and actions (Heijmans, 2009). This approach engages communities at the grassroots level, enabling them to identify, assess, and address disaster risks in ways that are tailored to their specific conditions and resources (Maskrey, 1989). A key element of CBDRR is its inclusive nature, where participation from all community members, including marginalised groups, ensures that disaster mitigation measures reflect the diverse needs and circumstances present (Allen, 2006).

Furthermore, CBDRR empowers communities to take the lead in resilience-building efforts by drawing upon their knowledge and experiences to design and implement activities that bolster safety and preparedness (Shaw, 2003). This collaborative framework fosters partnerships among local communities, government agencies, and other stakeholders, enabling the co-creation of disaster management plans that are both community-driven and tailored to local contexts (Fernandez, Uy, & Shaw, 2012).

Thus, CBDRR is crucial because it focuses on empowering individuals living in the most vulnerable areas by placing them at the heart of all disaster risk reduction efforts (Bull-Kamanga et al., 2003; Copeland, Comes, Bach, Nagenborg, Schulte, & Doorn, 2020). This approach enables local communities to identify the specific hazards and weaknesses they face, utilising their knowledge and resources to build resilience. By doing so, CBDRR supports long-lasting, sustainable strategies that genuinely address the needs and capabilities of the community (Cvetković & Šišović, 2024; Dhyani, Karki, & Gupta, 2020). What is central to CBDRR is enhancing a community's ability to handle threats independently, thereby reducing the need for external aid. Through education and training, community members acquire the skills necessary. This is not just a response to disasters, but also a means to recover and adapt to future challenges that may arise. Furthermore, we can say that CBDRR strengthens social ties by involving everyone in the community, including those who are often marginalised, ensuring that resources and responsibilities are distributed fairly (Cvetković et al., 2019; Haque, Khan, & Choudhury, 2024).

This approach also enables local initiatives to connect with broader national disaster management strategies. By fostering collaboration among communities, governments, and various organisations, CBDRR enhances coordination and ensures that resources are utilised more efficiently, resulting in a more cohesive and comprehensive response to disasters.

Essentially, CBDRR empowers communities to take charge of their safety and future, helping to create a more resilient and sustainable environment for everyone. Similarly, its significance lies in how it empowers communities to become active participants in managing disaster risks, rather than passive recipients of aid (Cvetković & Svrdlin, 2020; Fu & Zhang, 2024). This shift fosters a sense of responsibility and ownership, which plays a crucial role in ensuring the long-term effectiveness of disaster mitigation efforts. When communities are directly involved in planning, execution, and monitoring, they are more likely to be proactive in taking protective measures (Vidović, Beriša, & Cvetković, 2024). Another important focus of CBDRR is long-term sustainability. By drawing on local resources and practices, the approach ensures that interventions are both culturally appropriate and economically viable (Goyal, 2019; Haque, Khan, & Choudhury, 2024).

By blending traditional wisdom with modern techniques, communities gain a deeper understanding of the risks they face and develop effective strategies to mitigate those risks (Cannon, 2008; Dhyani, Karki, & Gupta, 2020). This not only addresses immediate dangers but also strengthens the community's ability to adapt to future challenges, whether from climate change, economic shifts, or other pressures (Rifat & Liu, 2020). The importance of CBDRR extends beyond reducing immediate risks—it's about building resilience throughout the entire community. It strengthens social, economic, and environmental systems, ensuring communities are better equipped to prepare for whatever may come (Vicarelli et al., 2024). In this way, CBDRR lays the groundwork for long-term recovery and development, allowing communities to emerge from crises stronger than before.

3. Overview of Current Disaster Risk Reduction Approaches

Disaster Risk Reduction (DRR) encompasses a broad spectrum of strategies designed to reduce vulnerabilities and minimise disaster risks in various societies (Cannon, 2008; Cvetković & Milašinović, 2017; Cvetković & Svrdlin, 2020; Jha, 2020; Kemp, 2007). Over time, DRR has undergone significant development, particularly under the guidance of global frameworks such as the Sendai Framework for Disaster Risk Reduction (2015-2030). This framework advocates for a structured approach to managing disaster risks through prevention, mitigation, preparedness, and fostering resilience (Cannon, 2008; Cvetković & Milašinović, 2017; Cvetković & Svrdlin, 2020; Jha, 2020; Kemp,

2007; Shaw, 2014). Among the most effective DRR strategies is directly engaging communities in risk reduction efforts.

Community-based approaches are vital for strengthening local resilience and ensuring that response mechanisms are customised to the specific characteristics of each area (Aleksandrina, Budiarti, Yu, Pasha, & Shaw, 2019; Copeland et al., 2020; Cvetković & Filipović, 2018; Goyal, 2019; Hochrainer-Stigler et al., 2021; Razak, Hignett, & Barnes, 2018; Rifat & Liu, 2020; Tiernan, Drennan, Nalau, Onyango, Morrissey, & Mackey, 2019). By empowering local populations to participate actively in disaster preparedness, response, and recovery, these efforts ensure that communities are well-equipped to serve as first responders when disaster strikes. Research highlights that local communities are crucial in the aftermath of disasters because they can mobilise resources and respond more swiftly than external aid organisations (Zubir & Amirrol, 2011).

In addition to community involvement, nature-based strategies are increasingly recognised as both cost-effective and sustainable methods for reducing disaster risks (Vicarelli et al., 2024). These approaches capitalise on ecosystems—such as wetlands, forests, and coastal barriers—to mitigate the impact of natural disasters, including floods and storm surges (Faivre, Sgobbi, Happaerts, Raynal, & Schmidt, 2018). For example, the European Union has been a strong proponent of ecosystem-based strategies that not only reduce disaster risks but also support biodiversity conservation and climate adaptation. These initiatives offer a wide array of benefits across urban, rural, and natural settings, including enhanced social cohesion and economic resilience (Faivre et al., 2018).

Cutting-edge technologies and policies based on scientific research are also at the forefront of modern DRR efforts (Dhyani, Karki, & Gupta, 2020). The Sendai Framework emphasises the importance of investing in science and technology to enhance disaster risk management, although challenges remain in translating scientific innovations into effective policies. Technological advancements such as artificial intelligence (AI) and improved communication tools are essential for addressing the new challenges posed by climate change and refining existing DRR strategies (Khan, Ouaissa, Ouaissa, Fayaz, & Ullah, 2024). Strengthening the link between scientific knowledge and policy-making will help ensure that evidence-based strategies are effectively integrated into disaster risk reduction programs (Izumi, Shaw, Djalante, Ishiwatari, & Komino, 2019).

Taking a comprehensive approach to disaster risk reduction involves combining different aspects of risk management, from assessing hazards to reducing vulnerabilities and building capacities (Baruh, Dey, & Dutta, 2023; Chakma, 2023; Cvetković, 2024; El-Mougher, Abu Sharekh, Abu Ali, & Zuhud, 2023; Iftikhar & Iqbal, 2023; Islam, 2023; Starosta, 2023; Tanasić & Cvetković, 2024; Vidović, Beriša, & Cvetković, 2024). Urban areas, in particular, face significant disaster risks due to their high concentration of people and infrastructure (Bull-Kamanga et al., 2003). Rockefeller Foundation 100 Resilient Cities (100 Resilient Cities — Pioneered by the Rockefeller Foundation, 100RC) directed towards providing support for the development of resilient cities about physical, social economic challenges of the 21st century, believes that the resilience of cities represents the higher capacity of individuals, communities, institutions, private sector and civil systems to survive, adapt, grow regardless of the type of chronic stress or acute shock to which they are exposed (Gacic & Micovic, 2020). Strengthening urban resilience is, therefore, a crucial part of DRR, focusing on preparing cities to endure and recover from disasters (Etinay, Egbu, & Murray, 2018). Urban resilience frameworks stress the importance of adapting to changing disaster risks while aligning global sustainable development goals with DRR strategies (Lall & Deichmann, 2012). Integrating disaster risk management frameworks into urban planning processes is crucial for enhancing the resilience of cities against future disasters (Cvetković et al., 2021).

The integration of advanced technologies, such as GIS, remote sensing, UAVs, and predictive modelling, into disaster risk management enhances risk forecasting, vulnerability assessment, and response strategies (Al Shafian & Hu, 2024; Nayak & Zlatanova, 2008). Additionally, incorporating climate change projections is essential for ensuring that DRR frameworks remain adaptive to evolving risks, thereby enhancing long-term resilience. Today's disaster risk reduction strategies emphasise the importance of community engagement, nature-based solutions, technological innovation, and integrated approaches. By blending traditional methods with innovative practices, DRR efforts are becoming increasingly effective at reducing vulnerabilities and mitigating the impacts of

disasters. Further refinement of these approaches, particularly through stronger science-policy integration and increased collaboration among stakeholders, will be crucial in addressing the increasing frequency and intensity of global disasters.

4. The role of Local Communities in Disaster Risk Reduction

When disasters hit, local communities are often the first to respond because they're closest to the action and directly impacted by the aftermath (Cvetković et al., 2021). Additionally, their importance in disaster risk reduction stems from their intimate knowledge of their local environment—the risks it poses, the needs of its people, and its vulnerabilities (Cannon, 2008; Cvetković & Milašinović, 2017; Jha, 2020). This makes them crucial players in any disaster response (Izumi et al., 2019). Despite this, local communities are often not provided with the formal support, resources, and training they need to fully realise their potential in reducing disaster risks (Allen, 2006).

In reality, much of the heavy lifting in disaster response at the community level relies on the ability of locals to react quickly when a disaster unfolds (Gero, Méheux, & Dominey-Howes, 2011). People tend to band together, drawing on available resources and social connections to organise immediate responses, offer essential help to those affected, and start rebuilding once the disaster has passed (S. S. Zubir & H. Amirrol, 2011). While this shows a commendable level of adaptability and solidarity, these efforts are often informal. They might not be as effective as they could be without proper coordination with government agencies and other institutions (Cvetković, Dragašević, Protić, Janković, Nikolić, & Milošević, 2022; Iftikhar & Iqbal, 2023; Razak, Hignett, & Barnes, 2018).

Local communities face numerous challenges in disaster risk reduction. For one, there's a shortage of financial resources (Cvetković et al., 2021). Many also lack the training needed to manage risks effectively, and access to modern technology that could boost resilience is often limited (Gero, Méheux, & Dominey-Howes, 2011). Furthermore, there's often a disconnect between national and local disaster risk reduction strategies, which can lead to a gap between planning and implementation (Kabir, Hossain, & Haque, 2022; Kemp, 2007). As a result, communities frequently find themselves having to improvise their responses when crises occur. That said, the capacity of local communities to contribute to disaster risk reduction goes far beyond their current role (Cvetković et al., 2021). In an ideal world, these communities would be fully integrated into disaster management systems, with their roles and responsibilities clearly defined through laws and regulations (Izumi et al., 2019). This would mean stronger institutional support, regular training, and consistent access to the resources necessary to implement preventive measures (Cvetković et al., 2021; Dhyani, Karki, & Gupta, 2020; El-Mougher et al., 2023).

Improving risk reduction planning within communities is another area that needs attention (Starosta, 2023). By involving local actors in creating risk management strategies, it's possible to develop plans that address the specific needs and challenges of each area (SZubir & Amirrol, 2011). Engaging citizens in identifying risks, planning evacuations, and building infrastructure designed to withstand disasters would represent a shift from a reactive approach to a proactive one, minimising damage and saving lives (Gero, Méheux, & Dominey-Howes, 2011; Starosta, 2023).

Education and awareness-raising are also crucial for empowering local communities (Cvetković et al., 2021; Starosta, 2023). Continuous learning about potential hazards and disaster preparedness is key to building a resilient culture. With better-informed citizens, communities would be in a stronger position to take proactive steps, such as reducing exposure to risks through more thoughtful urban planning and the protection of natural resources (Cvetković et al., 2021). Alongside education, formalising the role of local communities within civil protection frameworks is essential (Izumi et al., 2019). This formalisation would involve clearly defining tasks and responsibilities for local actors, ensuring they receive ongoing training, and equipping emergency response teams adequately (Gero, Méheux, & Dominey-Howes, 2011; Starosta, 2023). Additionally, establishing strong communication channels between local communities and higher government levels is vital for improving coordination and ensuring a faster response when disasters strike (Zubir & Amirrol, 2011).

GIS and Remote Sensing support disaster risk reduction by enabling precise hazard mapping, vulnerability assessments, and real-time monitoring. These technologies allow local communities to identify risk zones, develop targeted mitigation strategies, and enhance response efficiency through data-driven decision-making. By integrating spatial data and environmental monitoring, GIS and Remote Sensing contribute to proactive risk management and bolster community resilience.

Social bonds within communities also play a significant role in disaster risk reduction (Cvetković et al., 2021). When disaster strikes, strong ties among residents can accelerate the mobilisation of aid and resources (Starosta, 2023; Zubir & Amirrol, 2011). Supporting initiatives that strengthen community solidarity will enhance overall resilience (Gero, Méheux, & Dominey-Howes, 2011). Volunteer groups and local associations can contribute significantly to offering help and support, and reinforcing these organisations should be a priority when building community capacity (Zubir & Amirrol, 2011). Ultimately, local communities should be at the centre of the recovery and rebuilding process following disasters (Izumi et al., 2019). Recovery efforts should not only focus on returning things to the way they were, but also be seen as an opportunity to build back better, thereby increasing resilience and reducing the risk of future disasters (Cvetković et al., 2021; Zubir & Amirrol, 2011). Ensuring that residents have a voice in decisions about reconstruction and development will lead to projects that are not only sustainable but also better equipped to handle future crises (Cvetković, Lipovac, & Milojković, 2016; Zubir & Amirrol, 2011).

5. Core concepts and principles of CBDRR

CBDRR offers a proactive approach to managing disaster risks by empowering local communities to identify, mitigate, and respond to potential hazards (Cvetković et al., 2021; Fu & Zhang, 2024; Haque, Khan, & Choudhury, 2024). This method emphasises the importance of local knowledge and fosters broad community engagement, aiming to build resilience at the grassroots level (Cvetković, 2024). A key principle of CBDRR is the belief that communities aren't just passive beneficiaries of aid—they are active players in shaping their strategies for dealing with risks (Baruh, Dey, & Dutta, 2023; Bull-Kamanga et al., 2003; Copeland et al., 2020). Local people often have a deep understanding of their surroundings, the threats they face, and the vulnerabilities within their environment (Cvetković, 2024; Cvetković et al., 2021; Fu & Zhang, 2024; Haque, Khan, & Choudhury, 2024). This local expertise makes them particularly well-equipped to implement effective risk-reduction strategies. By engaging community members throughout the entire disaster management process—whether it's in assessment, planning, execution, or monitoring—CBDRR fosters a sense of ownership and accountability that's essential for long-term sustainability (Cvetković, 2024; Cvetković et al., 2022; Cvetković et al., 2024; Z. Nkombi & G. J. Wentink, 2022; Rajani, Tuhin, & Rina, 2023).

Participation is one of the fundamental pillars of CBDRR (Cvetković, Lipovac, & Milojković, 2016; Dhyani, Karki, & Gupta, 2020; Gero, Méheux, & Dominey-Howes, 2011; Vicarelli et al., 2024). To be truly effective, risk reduction efforts must incorporate the voices of everyone in the community, particularly those who are often overlooked or marginalised (Cvetković et al., 2021). When all segments of the community are involved in decision-making, the resulting strategies are more inclusive and better reflect the diverse needs of the population (Cvetković, 2024). Involving the community also strengthens the collective sense of ownership over the process, which in turn motivates people to take an active role in ensuring the success of the initiatives (Fu & Zhang, 2024; Haque, Khan, & Choudhury, 2024). Also, another cornerstone of CBDRR is building capacity within the community (Bull-Kamanga et al., 2003; Cannon, 2008; Cvetković, 2024). This means equipping local people with the knowledge, skills, and resources they need to manage disaster risks independently (Cvetković, 2024). Whether through education on preparedness, hands-on training for disaster response, or providing tools to strengthen technical know-how, capacity building empowers communities to handle emergencies more effectively (Cvetković et al., 2021). Regarding that, over time, this focus on self-reliance not only improves immediate response efforts but also builds long-term resilience, reducing the community's dependence on external aid (Kabir, Hossain, & Haque, 2022; Rajani, Tuhin, & Rina, 2023; Starosta, 2023).

Sustainability is crucial in CBDRR (Cvetković et al., 2020; Cvetković et al., 2022; Cvetković et al., 2024; Cvetković et al., 2021). Effective risk reduction requires ongoing, adaptable efforts that are embedded within the community's social, economic, and environmental context (Cvetković, 2024). This means that CBDRR initiatives should be designed with longevity in mind, allowing them to evolve with changing conditions (Cvetković et al., 2021). When these efforts draw from local traditions and resources, they become more culturally relevant and sustainable. By incorporating disaster risk reduction into everyday life, CBDRR helps create communities that are better equipped to thrive in the face of future challenges (Fu & Zhang, 2024; Haque, Khan, & Choudhury, 2024). Central to the CBDRR approach is a thorough risk assessment, which involves pinpointing and evaluating the specific hazards and vulnerabilities present within the community (Cvetković, 2024). Unlike top-down approaches where outside experts conduct assessments, CBDRR prioritises the community's direct involvement (Cvetković et al., 2021). This ensures that the assessment reflects local realities and considers the actual experiences of the people affected. The insights gained through this participatory risk assessment inform the development of strategies tailored to the community's unique needs (Cvetković, 2024; Fu & Zhang, 2024; Haque, Khan, & Choudhury, 2024).

Collaboration is another important key element of CBDRR (Cvetković, 2024). Successful disaster risk reduction often requires partnerships between local communities, governments, non-governmental organizations, and other stakeholders (Cvetković et al., 2022; Faivre et al., 2018; S. S. Zubir & H. Amirrol, 2011). By building strong partnerships, CBDRR can leverage the strengths of various actors, improve coordination, and ensure that larger networks and resources support local initiatives. These partnerships help connect local efforts with broader disaster management strategies, creating a more cohesive and integrated approach (Cvetković et al., 2022; Faivre et al., 2018; Zubir & Amirrol, 2011). Resilience lies at the core of CBDRR's objectives (Fu & Zhang, 2024; Haque, Khan, & Choudhury, 2024). The ultimate goal is to create communities that can not only survive disasters but also recover and bounce back stronger. Building resilience is about more than just reducing immediate risks—it's about strengthening the community's ability to adapt and thrive in the face of future challenges (Cvetković, 2024). By focusing on resilience, CBDRR helps ensure that communities are better prepared for whatever lies ahead, whether it's a natural disaster, the impacts of climate change, or socio-economic pressures. In essence, the principles of CBDRR—participation, capacity building, sustainability, risk assessment, partnership, and resilience—all work together to empower communities to take control of their safety and future (Cvetković, 2024). By placing communities at the forefront of disaster risk reduction, CBDRR promotes a more sustainable and resilient world for everyone (Cvetković, 2024).

6. Comparison of CBDRR with other disaster risk reduction models

CBDRR is a strategy that centres on empowering communities to manage disaster risks themselves (Hochrainer-Stigler et al., 2021). Unlike more traditional disaster risk reduction (DRR) models, which often take a top-down approach, CBDRR focuses on getting local people involved directly (Cvetković et al., 2019; Cvetković, Lipovac, & Milojković, 2016; Cvetković & Milašinović, 2017). As a result, this approach offers several significant advantages but also presents distinct challenges. Additionally, one of the most significant differences between CBDRR and other approaches is the extent to which it involves the community (Tiernan et al., 2019). We observed that in many of the more typical DRR models, decisions are typically made by governments or experts, with limited input from the local people who are affected (Islam, 2023). These models tend to advocate for broad, one-size-fits-all solutions that may not always align with the unique needs of a specific area (Fernandez, Uy, & Shaw, 2012). Additionally, CBDRR takes a different approach, involving community members at every step of the process, from identifying risks to implementing strategies. Specifically, this means that the solutions are based on local knowledge and priorities, making them much more relevant to the people they're meant to help.

Another key aspect of CBDRR is its focus on helping communities build their capacity to handle risks (Fernandez, Uy, & Shaw, 2012). Unlike other models that often rely on outside experts to intervene, CBDRR focuses on providing local people with the training and resources they need to

manage disasters independently (Vicarelli et al., 2024). Specifically, the goal is to create systems that endure, allowing the community to continue managing risks effectively even after external aid is no longer available (Shaw, 2003). When it comes to assessing risks, CBDRR also stands out. Traditional models often rely on experts to analyse risks, but they can sometimes overlook finer details that local people may be more aware of (Rajani, Tuhin, & Rina, 2023). To sum up, CBDRR changes that involve community members directly in the assessment process, leading to solutions that are more accurate and practical for their specific situation (Hochrainer-Stigler et al., 2021).

Sustainability is another significant advantage of CBDRR. Instead of focusing solely on short-term fixes, such as building defences or providing temporary aid, CBDRR works to integrate disaster risk reduction into the daily lives of the community (Etinay, Egbu, & Murray, 2018). It's about addressing the root causes of vulnerability, ensuring that efforts to reduce risks continue long into the future, and helping the community become stronger and more resilient over time (Hochrainer-Stigler et al., 2021). Collaboration is a big part of the CBDRR model as well. In more traditional approaches, larger organisations often lead the process, with communities playing a more minor, more passive role (Cvetković, 2024; Cvetković & Šišović, 2024; Fu & Zhang, 2024). To sum up, CBDRR flips this around, encouraging genuine partnerships between communities, governments, and NGOs. This helps share resources and knowledge, giving local people a bigger voice in making decisions that affect them (Tanasić & Cvetković, 2024).

That said, CBDRR isn't without its challenges. Its success depends a lot on how engaged and organised the community is, which can vary (Vidović, Beriša, & Cvetković, 2024; Zareian, 2023). If a community lacks strong leadership or resources, it can be more challenging to implement CBDRR effectively. Additionally, while CBDRR is effective in addressing local risks, it may struggle to tackle larger-scale disasters that require coordination across regions or countries (Tanasić & Cvetković, 2024). Taken together, CBDRR shines because of its focus on engaging communities, building local capacity, and ensuring that disaster risk reduction is sustainable in the long term (Bull-Kamanga et al., 2003). While other models might deliver quicker results or handle larger disasters more easily, CBDRR focuses on creating lasting resilience by integrating disaster risk reduction into everyday life (Cvetković et al., 2019; Fernandez, Uy, & Shaw, 2012; Sergey & Gennadiy, 2022). To sum up, the choice between CBDRR and other models depends on the situation, the scale of the risk, and what the intervention is aiming to achieve (Etinay, Egbu, & Murray, 2018; Gero, Méheux, & Dominey-Howes, 2011).

7. Key success factors in implementing CBDRR programs

Critical elements in successfully implementing CBDRR programs are essential for ensuring long-term resilience against various disasters (Cvetković & Šišović, 2024). In other words, foremost among these is the active involvement of the community at every stage of the process. In other words, this isn't just a procedural formality but the foundation for creating programs that cater directly to the community's unique needs (Cvetković et al., 2021). Above all, programs tend to be more successful when community members contribute to planning, execution, and evaluation, as this harnesses local knowledge and experience (Gero, Méheux, & Dominey-Howes, 2011; Goyal, 2019). Such involvement also fosters a sense of ownership, which in turn supports the long-term viability of these initiatives.

Beyond community involvement, robust institutional support is indispensable. Specifically, this support, often provided by local authorities, non-governmental organisations, and other stakeholders, offers essential policies, financial resources, and technical assistance (Shaw, 2014; Tanasić & Cvetković, 2024). In other words, institutional backing is critical not only for implementing programs but also for ensuring their relevance over time (Shaw, 2014; Tanasić & Cvetković, 2024). It strengthens the capacity of communities to manage risks independently and recover more effectively after disasters (Cvetković et al., 2021). Therefore, building community capacity is another vital aspect, achieved through various training and education programs. These programs cover disaster preparedness, first aid, risk assessment, and the skills necessary for an effective emergency response (Tier-

nan et al., 2019). Such training equips community members with the necessary tools to act in critical situations, significantly mitigating the impact of disasters. In other words, by fostering a proactive rather than reactive approach, these programs enhance the community's ability to manage risks (Bull-Kamanga et al., 2003; Cannon, 2008).

Inclusivity is equally crucial for the success of CBDRR programs, and addressing the needs of all community members, particularly vulnerable groups such as women, children, the elderly, and people with disabilities, is essential for effective disaster risk reduction (Shaw, 2014; Tanasić & Cvetković, 2024). As a result, when these groups are actively involved in decision-making, programs become more comprehensive and practical. Neglecting their needs can result in less effective solutions and heightened risks for the entire community (Cvetković et al., 2021). Indeed, effective communication and information sharing are also key to the success of CBDRR initiatives. Clear and timely communication about risks, resources, and protective measures is critical for program success. Establishing reliable channels for information exchange enables quicker community responses during disasters and more efficient resource mobilisation to assist those affected (Rajani, Tuhin, & Rina, 2023; Starosta, 2023).

For sustainability, CBDRR programs must emphasise long-term planning and community resilience rather than focusing solely on immediate goals. Integrating disaster risk reduction into the community's day-to-day activities and development plans is crucial for ensuring the long-term success of these programs. Also, we can say that sustainable initiatives continue to operate beyond the initial project activities, remaining relevant through ongoing risk assessments and updates to protective measures (Cvetković et al., 2021). Lastly, regular monitoring and evaluation of programs are essential to adapting to changing conditions and community needs. Through consistent monitoring and evaluation, programs can be refined based on feedback and new challenges, ensuring their continued relevance and effectiveness (Shaw, 2014; Starosta, 2023). This ongoing process helps identify areas needing improvement, thereby contributing to the long-term resilience of communities in the face of disaster risks (El-Mougher et al., 2023; Razak, Hignett, & Barnes, 2018).

The following Table 1 provides a structured comparison of the advantages, disadvantages, and opportunities for improvement in Community-Based Disaster Risk Reduction (CBDRR) initiatives.

Table 1. Overview of advantages, disadvantages, and opportunities for Improvement in CBDRR

Advantages	Disadvantages	Opportunities for Improvement
Promotes local ownership and sustainability of disaster risk reduction initiatives.	Assumes communities are homogeneous, ignoring internal divisions and power dynamics.	Conduct detailed assessments of community structures and dynamics to ensure inclusivity.
Leverages local knowledge and practices to ensure culturally appropriate solutions.	Vague definitions of 'community' can lead to poorly targeted interventions.	Provide clear, context-specific definitions of community in project frameworks.
Builds capacity and empowers local actors to effectively manage disaster risks.	The risk of benefits being disproportionately controlled by local elites, excluding broader community participation and equity.	Establish mechanisms for transparent resource allocation and equal participation.
Strengthens social cohesion and community resilience.	Requires significant time, resources, and expertise to engage communities effectively.	Increase funding and technical support for grassroots-level training and facilitation.
Improves disaster preparedness through participatory methods.	Limited trust in external actors and institutions can hinder collaboration.	Build long-term partnerships between communities and external agencies to foster trust.
Fosters self-reliance by empowering communities to take proactive measures for their safety.	Community resources may be inadequate to sustain disaster risk reduction efforts.	Provide training programs and establish resource-sharing systems within the community to support its members.

Encourages intergenerational knowledge transfer of traditional and modern disaster practices.	Lack of formal documentation may lead to the loss of valuable traditional knowledge.	Integrate disaster education programs into schools and community workshops to enhance disaster preparedness and resilience.
Enhances social capital by building trust and cooperation among community members.	Existing social divisions can hinder collaboration and shared responsibility.	Organise inclusive community activities to strengthen bonds and resolve conflicts.
Integrates nature-based solutions, such as wetland restoration and afforestation.	Initial costs and expertise for implementing nature-based solutions may be lacking.	Collaborate with environmental organisations to access funding and technical support.
Improves early warning and response systems by involving communities in their development.	Technological barriers may limit access to advanced early warning systems.	Establish partnerships with technology providers to ensure access to affordable solutions.

8. Recommendations

Based on the analysis and key findings of this study, several recommendations have been proposed to enhance the implementation of CBDRR programs. First and foremost, local communities must continue to receive ongoing support from government agencies, non-governmental organisations, and other relevant stakeholders. This support should encompass financial backing, technical guidance, and training to ensure that CBDRR programs remain sustainable over the long term. Moreover, formalising the role of these communities through legal frameworks can further empower them to implement preventive measures and respond to disasters more effectively.

Additionally, education and continuous training are essential in enabling communities to accurately identify, assess, and respond to disaster risks. Regular training sessions covering areas such as risk assessment, first aid, evacuation protocols, and other critical aspects of disaster risk management are essential. These training programs should be adapted to meet the specific needs of the communities, with particular attention given to vulnerable groups such as women, children, the elderly, and people with disabilities, ensuring that no part of the community is overlooked.

Another important aspect is promoting a participatory approach in both the planning and execution of these programs. Involving all parts of the community, particularly marginalised groups, is crucial for the success of CBDRR initiatives. A participatory approach helps create solutions that are specifically tailored to the community's unique circumstances, leading to greater efficiency and sustainability. Therefore, actively involving these groups in decision-making processes is essential to ensure their needs and concerns are addressed. At the same time, improving communication and information exchange is another crucial factor. The effectiveness of CBDRR programs relies heavily on clear communication within the community and between the community and relevant authorities. Establishing reliable communication channels for the timely dissemination of information about risks and protective measures is critical. This includes the development of early warning systems and regular campaigns to raise awareness about disaster risks.

CBDRR programs should also prioritise building long-term community resilience rather than focusing solely on short-term objectives. Integrating disaster risk reduction into the community's everyday activities and local development plans is essential to ensure the sustainability of these programs. Therefore, continuous monitoring and updating of strategies based on new risk assessments and community feedback are recommended to keep the programs relevant and practical. Strengthening collaboration between communities and external partners is also crucial, as the success of CBDRR programs often depends on the ability to work together effectively. Strengthening partnerships among local communities, government agencies, NGOs, and international organisations can provide access to additional resources and expertise, thereby improving coordination during disaster response efforts.

Ultimately, we can conclude that incorporating new technologies into disaster risk management represents a significant step forward. By integrating modern technologies such as artificial intelligence, GIS, drones, and social media into these programs, communities can enhance risk assessment, streamline information sharing, and improve disaster response coordination. This can make CBDRR programs more effective and enable quicker resource mobilisation when disaster strikes.

9. Conclusions

The deployment of CBDRR programs has proven to be an effective means of strengthening communities' resilience to disasters. By prioritising active community engagement, developing locally tailored solutions, and fostering collaboration with external partners, CBDRR empowers communities to manage their disaster preparedness and response efforts better. However, the success of these initiatives hinges on several key factors, including ongoing institutional support, continuous capacity building through education and training, and the integration of modern technologies. Moreover, ensuring that planning and implementation processes are inclusive and participatory is crucial for safeguarding the interests of all community members, particularly those who are most vulnerable.

To maximise the effectiveness of CBDRR programs, it is essential to establish dependable communication systems that enable the timely sharing of risk-related information. Additionally, focusing on long-term strategies that weave disaster risk reduction into the community's routine activities can help sustain these efforts over time. Strengthening partnerships between local communities and various organisations is another vital element, as it can provide access to additional resources, expertise, and improved coordination during disaster response operations. In light of the growing challenges posed by climate change and the increasing frequency of disasters, adopting a comprehensive, community-centred approach to disaster risk management is essential for building resilient communities that can effectively respond to and recover from future crises.

Equally important is the ongoing monitoring and evaluation of CBDRR programs to ensure they remain relevant and practical over time. By regularly reassessing the risks and needs of the community, programs can be adjusted to stay responsive to evolving circumstances. Additionally, incorporating lessons learned from previous disasters into future planning efforts allows communities to build on their experiences and further enhance their resilience. This adaptive approach not only improves the immediate effectiveness of disaster risk reduction efforts but also fosters a culture of continuous learning and improvement. Therefore, creating an environment where feedback and innovation are actively integrated into CBDRR programs is crucial for ensuring their long-term success and sustainability in the face of growing disaster risks.

Despite the success of CBDRR, there are gaps in integrating advanced technologies for real-time hazard assessment and damage evaluation. The current use of UAVs and remote sensing within CBDRR frameworks remains underutilised, limiting their potential for informed decision-making and timely response. Future advancements could focus on incorporating UAVs and remote sensing data to enhance hazard mapping, early warning systems, and post-disaster recovery, which will improve the overall effectiveness of CBDRR. This integration is crucial for scaling CBDRR initiatives and strengthening resilience against diverse disaster risks.

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