



International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 03, March 2026)

Community-Based Flood Disaster Risk Reduction: Implications for Sustainable Flood Management in Afghanistan

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Abstract-- Floods are among the most destructive natural hazards globally, causing loss of life, infrastructure damage, and economic disruption. Afghanistan is particularly vulnerable due to mountainous terrain, rapid environmental degradation, weak infrastructure, and limited disaster management capacity. Community-based disaster risk reduction (CBDRR) has emerged as a sustainable approach to minimize flood impacts by engaging local communities in hazard identification, risk assessment, early warning, and mitigation measures. This review synthesizes literature on CBDRR strategies, highlighting global best practices and their relevance to Afghanistan. Key challenges—limited technical capacity, weak institutional coordination, insufficient resources, and climate change—are discussed. The findings indicate that integrating community-based initiatives with national flood management policies, early warning systems, and sustainable land-use planning can significantly enhance local resilience. Policy recommendations include establishing community-managed monitoring systems, training local volunteers, promoting small-scale protective infrastructure, and supporting participatory planning. This review provides a roadmap for policymakers, practitioners, and researchers to strengthen community engagement and achieve sustainable flood management in Afghanistan.

Keywords-- Community-Based Disaster Risk Reduction; Flood Management; Resilience; Early Warning Systems; Afghanistan

I. INTRODUCTION

Floods are among the most frequent and devastating natural hazards worldwide, causing substantial loss of life, damage to infrastructure, and severe economic disruption [1, 2]. In recent decades, the frequency and intensity of flood events have increased due to rapid urbanization, land-use changes, deforestation, and the growing impacts of climate change [3-6]. According to the United Nations Office for Disaster Risk Reduction, floods account for a significant proportion of global disaster losses and disproportionately affect developing countries where disaster management capacity and infrastructure are limited [7]. Effective disaster risk reduction (DRR) strategies are therefore essential for minimizing the impacts of flood hazards and enhancing community resilience [8].

Traditionally, flood management has relied heavily on structural measures such as dams, levees, embankments, and protective walls to control water flow and reduce flood damage [9, 10]. While these engineering interventions can provide immediate protection, they often require significant financial investment, technical expertise, and long-term maintenance [11].



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In many developing countries, including Afghanistan, the implementation and sustainability of large-scale structural measures remain challenging due to limited financial resources, weak institutional capacity, and complex geographical conditions [12]. As a result, there has been increasing recognition of the importance of integrating non-structural approaches with conventional engineering solutions to achieve more sustainable flood management [13].

In this context, community-based disaster risk reduction (CBDRR) has emerged as a critical approach for addressing disaster risks at the local level [14]. CBDRR emphasizes the active participation of local communities in identifying hazards, assessing vulnerabilities, and implementing mitigation and preparedness measures [15]. By incorporating local knowledge, indigenous coping strategies, and community participation, CBDRR strengthens local resilience and improves the effectiveness of disaster management interventions [16]. The concept is strongly supported by international frameworks such as the Sendai Framework for Disaster Risk Reduction, which highlights the importance of community engagement and local capacity building in reducing disaster risks and enhancing resilience [17].

Afghanistan is highly vulnerable to natural hazards, including floods [18], droughts [19], earthquakes [20], and landslides [21]. Floods, in particular, represent one of the most destructive hazards affecting the country, frequently resulting in significant loss of life, displacement of communities, and damage to agricultural lands and infrastructure [2, 12]. The country's mountainous terrain [22], rapid environmental degradation [23-35], deforestation [26-28], and inadequate drainage systems [29] contribute to increased flood susceptibility [2].

Furthermore, limited institutional capacity, lack of early warning systems, and insufficient community preparedness exacerbate the impacts of flood disasters in many regions [30]. According to the World Bank, strengthening local resilience and improving disaster risk management are essential priorities for reducing vulnerability to natural hazards in Afghanistan [31]. Community-based approaches have shown considerable potential in improving flood preparedness, response, and recovery at the local level [32]. Through community awareness programs, local disaster management committees, participatory planning, and small-scale mitigation measures, communities can play a vital role in reducing disaster risks and enhancing adaptive capacity [33]. In many parts of the world, community participation has proven effective in improving early warning dissemination, strengthening evacuation planning, and supporting sustainable flood management practices [34]. However, despite the increasing recognition of CBDRR, there remains a need to systematically review the existing literature and assess the potential of community-based approaches for flood disaster risk reduction in the Afghan context [12].

Therefore, this review aims to synthesize existing research on community-based flood disaster risk reduction and examine its implications for sustainable flood management in Afghanistan. The study reviews global experiences of community-based flood management, identifies key strategies and best practices, and evaluates their applicability to the Afghan context. In addition, the review discusses major challenges associated with implementing community-based DRR, including institutional limitations, financial constraints, and climate-related uncertainties. By highlighting the role of community participation in disaster risk management, this study provides insights and policy recommendations for strengthening sustainable flood resilience in Afghanistan (**Figure 1**).



Figure 1. Conceptual framework illustrating the role of community-based approaches in reducing flood disaster risks and promoting sustainable flood management.

II. METHODOLOGY

2.1 Research Design

This study adopts a systematic literature review approach to synthesize existing knowledge on community-based approaches to flood disaster risk reduction and their implications for sustainable flood management. The review focuses on identifying key themes, strategies, and challenges associated with community participation in flood risk management, with particular relevance to Afghanistan. A systematic review methodology was employed to ensure transparency, reproducibility, and comprehensive coverage of relevant literature. The literature selection and screening process followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which is widely used to improve the rigor and transparency of systematic reviews (**Figure 2**).

2.2 Data Sources

Relevant literature was collected from multiple academic databases and institutional repositories to ensure comprehensive coverage of peer-reviewed studies and technical reports. The primary databases used in this review include Google Scholar, Scopus, and Web of Science. In addition, reports and publications from international organizations such as the United Nations Office for Disaster Risk Reduction, World Bank, and United Nations Development Program were reviewed to obtain policy-related insights and regional assessments of disaster risk in Afghanistan.

2.3 Search Strategy

A comprehensive keyword-based search strategy was applied to identify relevant literature. The search included combinations of keywords related to disaster risk reduction, community participation, and flood management. The primary search terms included:

- community-based disaster risk reduction
- flood disaster risk management
- community resilience to floods
- sustainable flood management
- community participation in disaster management
- flood vulnerability and adaptation
- disaster risk reduction in Afghanistan

Boolean operators (AND, OR) were used to refine search results and improve the relevance of retrieved studies. The search primarily focused on studies published between 2000 and 2024, as this period reflects the growing global emphasis on community-based disaster management and climate adaptation strategies.

2.4 Inclusion and Exclusion Criteria

To ensure the quality and relevance of the reviewed literature, specific inclusion and exclusion criteria were applied.

2.4.1 Inclusion Criteria

- Peer-reviewed journal articles, books, and institutional reports
- Studies focusing on disaster risk reduction or flood management
- Research addressing community-based approaches to disaster risk reduction
- Studies discussing flood vulnerability, resilience, or adaptation strategies

2.4.2 Exclusion Criteria

- Studies not related to flood hazards or disaster risk reduction
- Publications lacking sufficient methodological detail
- Non-English publications
- Articles focusing exclusively on engineering structures without community involvement



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2.5 Literature Screening and Selection

The literature selection process followed the PRISMA framework, which involves four main stages: identification, screening, eligibility, and inclusion. Initially, a large number of records were identified through database searches and institutional reports. Duplicate records were removed, and titles and abstracts were screened to eliminate irrelevant studies. The remaining articles were then subjected to full-text review to determine their relevance to the research objectives. After applying the inclusion and exclusion criteria, the most relevant studies were selected for final analysis. The selected literature was analyzed using a thematic approach to identify key trends, strategies, and challenges related to community-based flood disaster risk reduction.

2.6 Data Analysis

The selected studies were systematically analyzed using qualitative synthesis methods. Key information extracted from each study included publication year, study location, research focus, methodology, and major findings related to community-based disaster risk reduction. The analysis focused on identifying common themes, including community participation, early warning systems, local knowledge integration, and small-scale mitigation strategies. The findings were then synthesized to highlight best practices and lessons learned from global experiences of community-based flood management and to evaluate their potential applicability to the Afghan context.

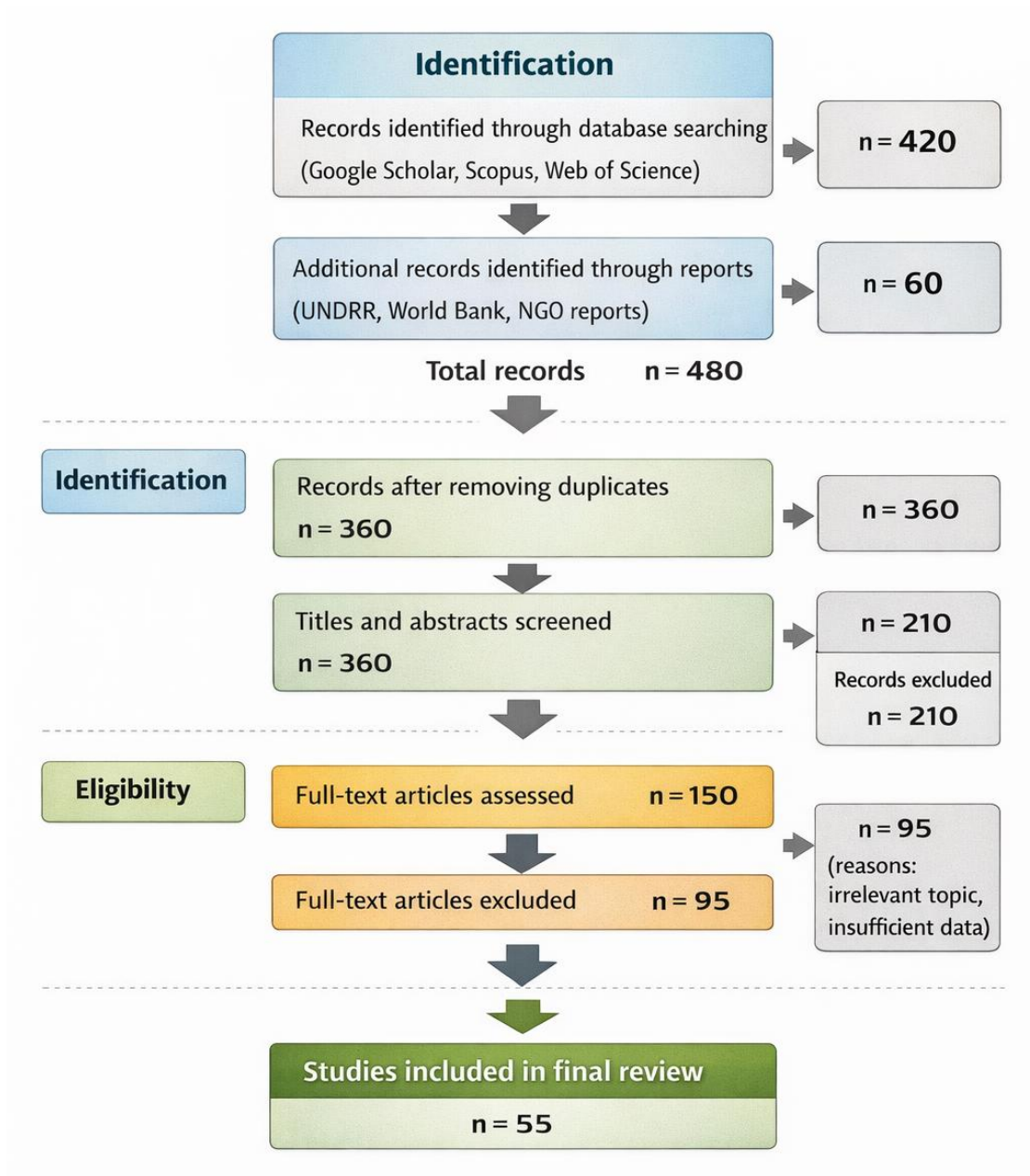


Figure 2. PRISMA flow diagram illustrating the literature selection process for the review.

III. FLOOD HAZARDS AND VULNERABILITY IN AFGHANISTAN

Afghanistan is highly susceptible to natural hazards, with floods being among the most frequent and destructive [35].

The country's complex topography, predominantly mountainous terrain, arid to semi-arid climate, and rapidly changing land-use patterns contribute to its heightened vulnerability [2].

Flood events in Afghanistan are often seasonal, occurring during spring snowmelt and intense summer rainfall, and are exacerbated by deforestation, soil erosion, and poorly planned urban expansion [36].

3.1 Major Flood Events in Afghanistan

Historical records and recent studies indicate that Afghanistan has experienced numerous severe flood events over the last two decades, reflecting the country’s high vulnerability to hydro-meteorological hazards [37, 38]. For instance, the Kabul River floods during 2005–2006 were triggered by heavy rainfall, leading to widespread inundation in Kabul and its surrounding districts [39]. These floods resulted in over 100 fatalities and caused extensive damage to infrastructure, including roads, bridges, and residential areas. Similarly, in 2010, Nangarhar Province experienced devastating flash floods that destroyed homes, agricultural lands, and key transportation routes, affecting thousands of residents [40, 41].

In 2014, severe flooding struck the northeastern provinces of Badakhshan Province and Takhar Province, where intense rainfall combined with rapid snowmelt triggered both flash floods and landslides [42]. These events caused over 50 deaths and led to substantial economic losses, particularly in remote and mountainous communities [43].

More recently, during 2018–2019, seasonal floods impacted western and northern regions, including Herat Province and Balkh Province [44, 45]. These floods caused significant damage to urban infrastructure, irrigation systems, and agricultural lands, underscoring the increasing exposure of both rural and urban settlements to flood hazards. Overall, these events demonstrate that floods in Afghanistan are frequent, often localized, and highly destructive, particularly in mountainous and riverine areas where topography and climate intensify flood risks (**Table 1**) [46].

Table 1.

Selected Major Flood Events in Afghanistan (2000–2022)

Year	Province(s)	Type of Flood	Impacts	Reference
2005–2006	Kabul	Riverine	>100 deaths, infrastructure damage	[47]
2010	Nangarhar	Flash Flood	Thousands affected, crop loss	[48]
2014	Badakhshan, Takhar	Flash Flood & Landslide	50+ deaths, displacement	[49]
2018–2019	Herat, Balkh	Seasonal Floods	Urban infrastructure & agriculture damaged	[50]

3.2 Geographic and Climatic Factors Influencing Floods

Afghanistan's flood hazards are shaped by a combination of physical geography, climate variability, hydrology, and land-use changes [12]. Approximately 75% of the country is mountainous, dominated by the Hindu Kush, Pamir, and Koh-i-Baba ranges, where steep slopes facilitate rapid surface runoff during heavy rainfall or snowmelt, often triggering flash floods [36]. The country's arid to semi-arid climate further amplifies flood risk, as most precipitation occurs in winter and spring, and extreme rainfall events or early snowmelt can cause sudden increases in river flow [2].

Major rivers, including the Kabul, Helmand, and Amu Darya, exhibit pronounced seasonal variations, and abrupt surges in water levels during storms or snowmelt frequently led to riverbank overflow and inundation of adjacent plains [51]. Additionally, land-use changes such as deforestation, soil degradation, and unplanned urban expansion reduce infiltration and enhance surface runoff, while poorly maintained drainage systems in urban areas further exacerbate flood vulnerability, particularly in densely populated settlements [52–56]. **Figure 3** presents a Digital Elevation Model (DEM) of Afghanistan, illustrating the country's mountainous terrain, river valleys, and low-lying flood-prone areas, which contribute to the spatial variability of flood risk.

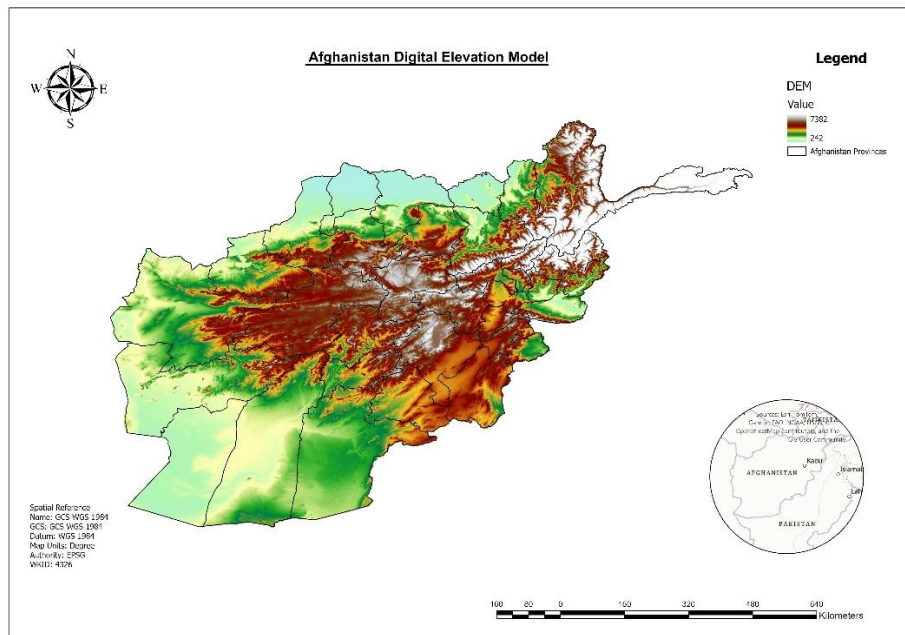


Figure 3. Digital Elevation Model (DEM) of Afghanistan showing major mountain ranges, river valleys, and flood-prone lowlands.

3.3 Vulnerable Provinces and Communities

Certain provinces and communities in Afghanistan are particularly vulnerable to flooding due to a combination of geographical location, socioeconomic factors, and infrastructure limitations (**Figure 4**).

Provinces such as Nangarhar, Kabul, Herat, Balkh, Badakhshan, Takhar, and Kunduz frequently experience flash floods and river overflows, making them high-risk areas [12].

Within urban centers, informal settlements along rivers in Kabul and Herat are especially susceptible, as poor drainage, low-quality housing, and proximity to floodplains increase exposure to flood hazards [35]. Rural populations, particularly those dependent on agriculture in flood-prone valleys, face risks including crop loss, soil erosion, and water contamination.

Socioeconomic conditions further exacerbate vulnerability, as households with limited income, inadequate access to emergency services, and weak social networks are more likely to suffer loss of life, property damage, and displacement during flood events [2].

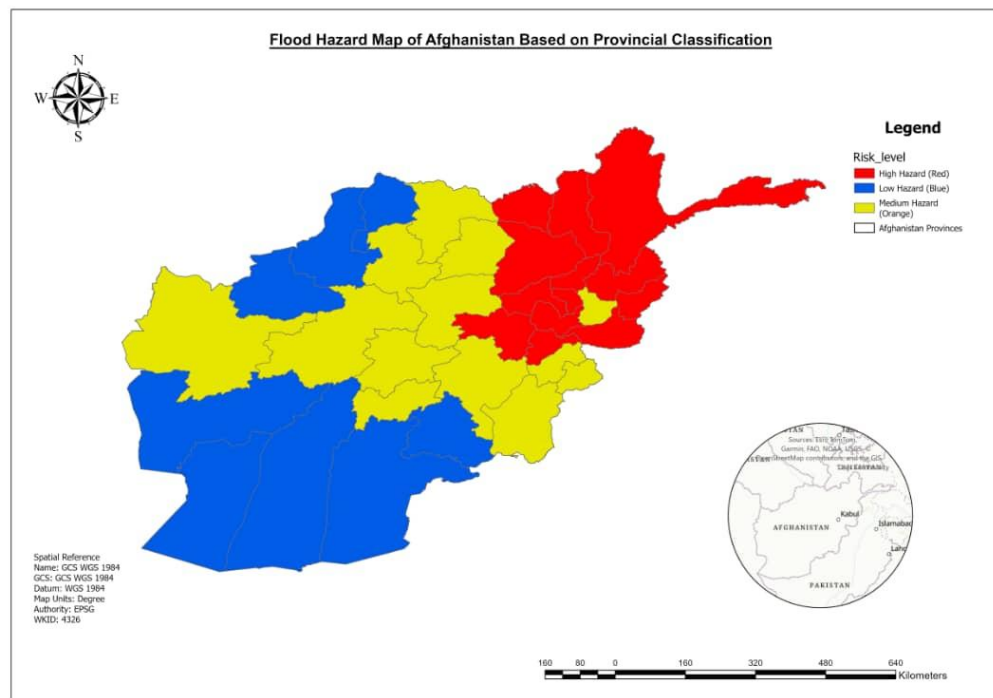


Figure 4. Map of flood-vulnerable provinces and communities in Afghanistan, highlighting areas at high risk due to geographic, climatic, and socioeconomic factors.

3.4 Socioeconomic Impacts of Floods

Table 2 shows the flood events in Afghanistan have wide-ranging socioeconomic consequences, including:

1. *Human Loss and Displacement:* Fatalities, injuries, and temporary or permanent displacement of communities are common. Flash floods often result in sudden impacts, leaving little time for evacuation.

2. *Damage to Infrastructure:* Roads, bridges, irrigation systems, schools, and health facilities are frequently destroyed, disrupting transport, education, and healthcare services.

3. *Agricultural Loss:* Floods destroy crops, livestock, and irrigation networks, threatening food security and livelihoods, especially in rural communities.

- 4. *Economic Costs:* Rebuilding infrastructure and repairing damages places significant strain on local and national budgets, particularly in resource-constrained areas.
- 5. *Social Vulnerability:* Floods exacerbate poverty, reduce access to clean water, and disrupt social

cohesion, particularly in marginalized communities. The combination of geographic, climatic, and socioeconomic factors underscores the need for targeted disaster risk reduction strategies, including community-based approaches, to reduce flood vulnerability and enhance resilience.

Table 2.
Socioeconomic Impacts of Floods in Afghanistan

Impact Category	Description	Example	Reference
Human Loss	Fatalities & injuries	>100 deaths, Kabul 2005	[37]
Infrastructure	Roads, bridges, schools	Nangarhar 2010	[48]
Agriculture	Crop & livestock loss	Badakhshan 2014	[57]
Economy	Repair costs, market disruption	Herat 2018	[58]
Social	Displacement, poverty	Informal settlements	[59]

IV. CONCEPT OF COMMUNITY-BASED DISASTER RISK REDUCTION (CBDRR)

4.1 Definition of CBDRR

Community-Based Disaster Risk Reduction (CBDRR) refers to a bottom-up approach to disaster management that emphasizes the active engagement of local communities in identifying hazards, assessing vulnerabilities, and implementing preparedness, mitigation, and recovery strategies. CBDRR integrates local knowledge, indigenous coping mechanisms, and participatory planning to strengthen community resilience against natural hazards, including floods, earthquakes, and landslides.

4.2 Principles of Community-Based Risk Management

CBDRR is guided by several core principles:

Participation: Community members actively participate in hazard assessment, decision-making, and implementation of risk reduction measures.

Local Ownership: Communities take responsibility for managing local risks and developing mitigation strategies

Integration of Knowledge: Scientific knowledge is combined with local and traditional knowledge to design effective interventions.

Sustainability: Emphasis on low-cost, locally feasible measures that can be maintained over the long term.

Capacity Building: Strengthening the skills, resources, and organizational structures within the community

4.3 Role of Local Knowledge and Participation

Local knowledge provides valuable insights into historical flood patterns, seasonal river behaviors, and traditional coping strategies, which are often overlooked in top-down interventions.

Community participation ensures that risk reduction strategies are context-specific, culturally appropriate, and widely accepted.

4.4 Importance of Community Resilience

Community resilience refers to the capacity of individuals, households, and communities to anticipate, cope with, and recover from disasters. CBDRR fosters resilience by enhancing preparedness, enabling faster recovery, and minimizing social and economic impacts (**Figure 5**).



Figure 5. Global framework illustrating the role of community-based disaster risk reduction in strengthening resilience and promoting sustainable disaster management.



V. COMMUNITY-BASED APPROACHES TO FLOOD DISASTER RISK REDUCTION

5.1 *Community Participation in Flood Preparedness*

Active participation in flood preparedness enhances local capacity to respond to hazards. Key strategies include:

- *Awareness Programs:* Community education campaigns, workshops, and school-based programs to increase understanding of flood risks and safety measures.
- *Local Disaster Committees:* Establishing village or neighborhood committees responsible for coordinating flood preparedness and response activities.
- *Training and Capacity Building:* Conducting regular drills, first aid training, and risk assessment workshops to strengthen community skills.

5.2 *Early Warning Systems and Community Response*

Early warning is crucial for minimizing flood impacts. Community-based strategies include:

- *Community-Based Monitoring Systems:* Locally managed river gauge stations, rainfall monitoring, and citizen reporting networks.
- *Communication and Evacuation Strategies:* Use of mobile alerts, sirens, and community messengers to disseminate warnings, coupled with clearly defined evacuation routes.

5.3 *Local Flood Protection Measures*

Community-led structural measures can complement larger-scale engineering solutions:

- *Small Protective Walls:* Low-cost stone or sandbag barriers constructed along riverbanks or around homes.
- *Riverbank Stabilization:* Planting vegetation and using local materials to reduce soil erosion and control water flow.
- *Drainage Improvement:* Community cleaning and maintenance of canals and drains to reduce localized flooding.

5.4 *Role of Indigenous Knowledge*

Traditional coping strategies have long supported flood resilience:

- *Traditional Flood Adaptation Practices:* Raising houses on stilts, storing food and water in elevated areas, and seasonal relocation of livestock.
- *Community Adaptation Practices:* Locally developed warning signals, communal flood response plans, and cooperative rebuilding after floods. These strategies collectively contribute to building local flood resilience and enhancing preparedness (**Figure 6**).



Figure 6. Key components of community-based flood disaster risk reduction linking hazard analysis, community engagement, mitigation, early warning, and resilience.



VI. CHALLENGES IN IMPLEMENTING CBDRR IN AFGHANISTAN

Despite its potential, several challenges hinder the implementation of CBDRR in Afghanistan:

- *Limited Technical Knowledge:* Communities often lack training in flood risk assessment and mitigation techniques.
- *Financial Constraints:* Local populations and municipalities have limited budgets to construct protective infrastructure or implement early warning systems.
- *Weak Institutional Coordination:* Lack of collaboration between government agencies, NGOs, and local communities reduces program effectiveness.
- *Lack of Early Warning Infrastructure:* Absence of sufficient flood monitoring stations and communication channels delays response.
- *Climate Change Impacts:* Intensifying rainfall, rapid snowmelt, and unpredictable flood patterns increase the complexity of planning and mitigation.

VII. IMPLICATIONS FOR SUSTAINABLE FLOOD MANAGEMENT

To achieve sustainable flood management, CBDRR approaches must be integrated with government planning, policy, and institutional support:

- *Integration with Government Planning:* Community interventions should align with provincial and national disaster management frameworks.
- *Policy Development:* Policies should support local participation, resource allocation, and small-scale mitigation measures.
- *Institutional Support:* Strengthen local institutions to provide technical guidance, training, and funding.
- *Capacity Building and Education:* Regular training programs, awareness campaigns, and participatory workshops enhance long-term resilience. **Figure 7** illustrates how community-based DRR, infrastructure, environmental management, and national policy interact to achieve sustainable flood management in Afghanistan.



Figure 7. Integrated framework showing how community-based DRR, infrastructure, environmental management, and national policy interact to achieve sustainable flood management.



VIII. FUTURE RESEARCH DIRECTIONS

The review identifies several areas for future research:

- *Integrated Flood Risk Assessment*: Combining hazard, exposure, and vulnerability analyses at community and provincial levels.
- *Use of GIS and Remote Sensing*: Mapping flood-prone areas, tracking seasonal changes, and supporting participatory planning.
- *Climate-Resilient Infrastructure Development*: Designing community-level structures adaptable to future climate variability.
- *Assessment of Social and Economic Vulnerability*: Evaluating the socioeconomic determinants of flood resilience to guide interventions.

IX. CONCLUSION

Floods remain one of the most destructive natural hazards in Afghanistan, causing significant damage to infrastructure, agriculture, and local livelihoods. The country's complex topography, climate variability, and limited disaster management capacity increase its vulnerability to flood events. Traditional structural measures alone are often insufficient to address these challenges. This review highlights the importance of Community-Based Disaster Risk Reduction (CBDRR) as an effective approach to improving flood preparedness and resilience. Community participation, local knowledge, early warning systems, and small-scale mitigation measures can significantly reduce flood risks, particularly in vulnerable rural areas. Despite its potential, the implementation of community-based flood management in Afghanistan faces challenges such as limited technical capacity, weak institutional coordination, and insufficient resources. Strengthening community awareness, improving early warning infrastructure, and integrating local participation into national disaster management policies are essential steps toward sustainable flood risk reduction.

Overall, combining community-based approaches with government planning and sustainable development strategies can play a critical role in enhancing long-term flood resilience in Afghanistan.

Author Contributions:

S.U., M.A.S., F.A.A., G.S.F., M.A.H.S., M.E.T., J.R., M.Y.S., A.M., E.B., S.H., and A.M. contributed to the **conceptualization and methodology**. **Data Collection and Literature Review**: S.U., M.A.S., F.A.A., G.S.F., and M.A.H.S.; **Formal Analysis**: S.U.; **Visualization and Figures**: S.U.; **Writing—Original Draft Preparation**: S.U.; **Writing—Review and Editing**: S.U., M.A.S., F.A.A., and G.S.F.; **Supervision and Project Administration**: S.U. All authors have read and approved the final manuscript.

Funding: This research was supported by Community World Service Asia under the project titled “Enhancing Resilience of Afghanistan through Integrated Risk Reduction (MoFA DRR Phase 3 – Year 2)”. The funding organization had no role in the study design, data collection, analysis, interpretation, or decision to publish the results.

Data Availability Statement: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Acknowledgments:

The authors would like to express their sincere gratitude to Community World Service Asia for providing financial and technical support through the project “Enhancing Resilience of Afghanistan through Integrated Risk Reduction (MoFA DRR Phase 3 – Year 2)”. We also acknowledge the support of local stakeholders, field staff, and community members who contributed to data collection and implementation of this study.

Conflicts of Interest: The authors declare no conflicts of interest.

Clinical Trial Registration: Clinical trial number: Not applicable.

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