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Community approach toward disaster resilience

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1. Introduction

Catastrophic natural disasters have undeniably posed threats to human lives as well as their subsistence all over the world. The last decade has shown the tremendous increase in the occurrence of natural hazards annually. Increasing impact of such hazards on lives, livelihood, economic situations, and the food security of vulnerable communities is the matter of concern. Researchers as well as scientists have come up with the common agreement that disasters neither occur accidentally nor are *just an act of God*. Disaster is the convergence of vulnerability and hazardous conditions. Until 1970s terms natural hazard and natural disaster were used interchangeably. The intensity of disaster was measured by amplitude of the hazard caused. But later from the 1990s, with the development of research especially in social sciences and humanities, disaster began to be associated not only with the physical or structural impact but also with social and economic damage caused [63]. Natural hazards, namely, earthquakes, volcanoes, tornadoes, and so forth can be highly intense but not always regarded as a disaster. Any hazard is considered to be disaster if it directly or indirectly hits social and economic as well as environmental conditions of the community. Disaster is related to the resistance toward development where the probability of loss and damage characterizes vulnerability [62]. While it is a universal acceptance that disaster is the occurrence of disruption to the normal community life leading to the injury or death, damage to the property and deterioration of health and health-related services, which is beyond the capacity of authorities to cope with their own resources thus requiring special response and mobilization of resources from outside the affected community [14,47,59]. There is a consensus that magnitude of a disaster should be measured not only by extent of loss of lives or property but

also by development policies failure. Studies have overruled myths those considered negligible contribution of human endeavors over the occurrence of events like drought, floods, cyclones, and so forth. Acts like deforestation; desertification has triggered global warming leading to the absurd climatic patterns. Intergovernmental Panel on Climate Change [33] recognized adaptation to present climate scenario as disaster risk reduction activity, which can increase the community resilience to climatic change. Fig. 6.1 shows the elements of natural disaster.

United Nations Development Program [63] reveals that about 75% of world's total population has been exposed to at least one type of disaster, namely, earthquake, volcanoes, tornadoes, flood or drought and more than 184 deaths per day were reported between 1980 and 2000 [63]. Since the year 2000, these disasters have taken toll of more than 1.1 million of human lives whereas have affected more than 2.7 billion of people [21]. With the prime objective to identify ways of establishing disaster resilience among nations, a World Conference on Disaster Reduction was held in January 2005 in Kobe, Hyogo, Japan. A Framework for Action 2005–15 was formulated (later referred to as Hyogo Framework for Action [HFA]), which was adapted by 169 countries [27] for reducing vulnerability and for DRR assessment [70]. appraised annual average losses from natural phenomenon's, namely, earthquakes, tsunamis, floods, and cyclones amounts to about hundreds of billions of dollars, necessitating US\$6 billion of investment annually in disaster risk management. UNDP advocates risk-informed approach to development and have disbursed over \$1 billion in the year 2018 to strengthen community resilience to shocks and crisis. Studies reveal that disasters and human developments are intimately related to each other. Population explosion beyond the capacity of urban authorities, which fails to cater to the need of basic

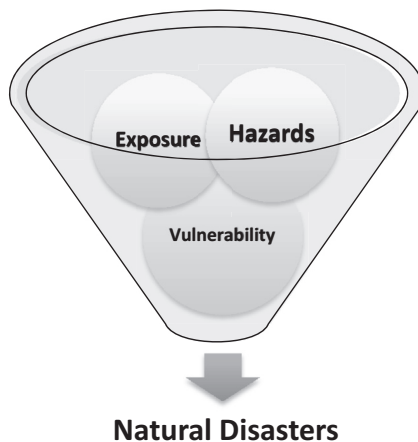


FIGURE 6.1 Elements of natural disaster.

infrastructure, leads to the accumulation of population to the risk-prone areas. Generally poor community becomes socially excluded and are pushed to settle in the marginal areas with least access to resources, early warnings, and preventions, thus increasing their vulnerability. Urbanization can lead to modifications in hazard patterns as well as redefines new types of risks.

In December 2019, a new type of pandemic was identified firstly in Wuhan City, China, which spread quickly across the world [24] (WHO, Jan 2020). The novel coronavirus (COVID-19) is a new type of infectious disease that triggers severe acute respiratory syndrome (SARS) [48]. COVID is the acronym for CO—corona, VI-virus, D-disease. COVID-19 is highly contagious and spreads due to human-to-human contact [11]. The virus spreads through the droplets of saliva or discharge of the nose while coughing, sneezing, or talking [79]. This pandemic has hit almost every part of the world and has caused a detrimental impact on health, social, and the economic life of masses [77]. COVID-19 was declared as a global emergency on January 30, 2020 [57]. Globally there are 15,012,731 confirmed cases while 619,150 people have lost their lives, and in South-East Asia 1,571,317 confirmed cases are reported till July 2020 [73].

2. Hazards, vulnerability, and resilience

Hazard is probability of occurrence of some threatening phenomenon or condition with a potential to cause damage to people, injuries or other health impacts, even loss of lives, damage to their properties, disruption of socio-economic conditions, and environmental degradation in a given area for specific time period. Assessment of the hazard can be made depending upon the level of severity and its impact in the particular area for a specific duration. A natural hazard in our context is the occurrence of geophysical events (hurricanes, earthquakes, forest fires, droughts, and so forth) individually or in combination in different areas (namely, coastlines, hillsides, earthquake faults, and so forth) in different times (specific months, particular time of the day, and so forth). When these consequences pose significant impact on community as well as their habitat then such events becomes disaster. With time, various conceptualizations of the term natural hazards have evolved [51], namely, attributed hazards as a result of some minute perturbations leading to the abrupt change in the landscape [8], expressed it as the presence of harmful elements in the physical environment.

Ref. [7] referred hazard as frequency of occurrence of the phenomenon of returning period whereas vulnerability as the degree of damage done by the hazard depending on its severity. Vulnerability is the condition or circumstances of community which makes it susceptible to the hazard. After examining different definitions of natural disaster it is being clear to identify different vulnerabilities to cope with the impact of hazards on the environment and its interaction with people. In this context several definitions for

vulnerability are stated viz [42]. defined the vulnerability as the extent to which a system is sensitive to and is unable to cope with adverse climate changes [1]. Vulnerability as a measure of shock or stress a social-ecological system is exposed to and its level of susceptibility as well as capacity to adapt [37] is formulated as

$$\text{Vulnerability} = \frac{\text{sensitivity to stress}}{\text{state relative to threshold}} \times \text{probability of exposure to stress}$$

Frequency as well as severity of natural hazards have even more increased and have given a deeper impact on the world in terms of human and their economic loss. Greater resilience is the need of an hour to cope up with abrupt environmental changes [10]. has interpreted resilience as the ability to self-organize, learn, and adapt. Attaining resilience timely after the impact of disaster is one of the prime objectives of United Nations International Strategy for Disaster Reduction (UNISDR) [68] defined resilience as the ability of as exposed community to resist, absorb, adjust, and recover timely and effectively [56]. states resilience as the capacity of community to absorb and recover from exposure of the hazardous event which measures the rate of recovery.

History reveals that no matter the severity or intensity of disaster/crisis, irrespective of the phenomenon like floods, earthquakes, fires, hurricanes, irradiations, bombing, and so forth, earth has always reestablished like a phoenix. Big cities like Hiroshima and Nagasaki, Baghdad, Moscow, Budapest, Tokyo, and so forth are the examples, while from the 12th to 19th century world have witnessed the complete abandon of 42 cities including Centralia, Pennsylvania; Varosha, Cyprus; Prypiat, Ukraine; and so forth after destruction [72]. We cannot escape from the facts that even the most competent and rich government can never guarantee that such disruptive events will not occur. But all the policymakers can frame the effective resilience strategy to mitigate crisis [74]. Resilience strategy focuses on response and recovery operations than on preparedness and mitigation functions [28]. Effective governmental policies for disaster resilience can only be framed after understanding social, cultural, economic, and environmental factors.

3. Community-based disaster management (CBDM) approach

Local community is the first responder to the disaster. So it becomes very important to provide adequate education and awareness regarding preparedness and mitigation techniques at community level especially to the people residing in the vulnerable areas. Community in the current study refers to group of people subjected to common risks or threat [19,40,53,61] and with the capacity to recognize disruptive events. L.J. Carr, a disaster sociologist in

1932 asserted that these communities should be directly involved in planning and preparing for response to disaster, mitigating its effects, thus reducing its risk through community-based disaster management (CBDM) strategy [52]. Community plays a vital role in reducing casualties; disaster losses and increases reduction capacity. CBDM is employed as an effective tool to build the capacity of society for disaster reduction. CBDM is the constructive approach for extrapolating and mitigating future disasters [60]. In [54], it shows that this community approach can help in assessing levels of disaster risk in advance and also enhances the social capacity of preparedness, response, and recovery. In general, CBDM is the approach in which local communities are supported to analyze their vulnerabilities to both natural and human induced hazards and providing resources as well as developing strategies to mitigate the identified disasters. CBDM empowers communities to frame their own strategies with the proactive approach rather than completely relying on the governmental aids. Disaster reduction capacity includes different elements, namely, risk management capacity, early warnings, prevention, disaster information, emergency rescue, CBD reduction at urban and rural levels, science and technology reduction and social mobilization [41]. In the program forum of International Decade for Natural Disaster Reduction (IDNDR) held in Geneva, Switzerland, from July 5–9, 1999, greater attention was paid to community-based action in the disaster reduction. The Geneva Mandate on Disaster Reduction, held in United Nations (1999) on disaster reduction addressed various concerns of risk management related to education, social and economic vulnerability; land use, environment protection etc. It was realized that local communities have greater understanding regarding their habitat and environment and bears more knowledge regarding ways to mitigate the vulnerabilities. Creating leadership among the community can enhance independence as well as self-reliance among them. Geneva Mandate in United Nations(1999) emphasized to construct “disaster—resistance communities” as a disaster reduction goal by expanding risk reduction networks at different levels [69].

Sustained government support, technical assistance and education material is required to apply CBDM approach effectively. But due to insufficient computing techniques of risk assessment as well as lack of legislation, funding etc. various challenges are faced at the time of follow up actions [55]. Community participation is vital for implementing sustainable disaster reduction program at local level which is possible only when local people own the program and shows continuous engagement in such activities. Involvement of community is important in predisaster mitigation as well as in postdisaster response and recovery process.

United Nations office for Disaster Risk Reduction (UNDRR) asserts that the effect of disaster especially on loss of lives can be reduced by making community equipped and prepared.

4. Outline of Total Disaster Risk Management (TDRM)

Asian Disaster Reduction Center is working to establish community resilience among its member countries and establishes the network among them through various programs including exchange of ideas and personnel. For disaster risk reduction at global level, ADRC is cooperating among various UN as well as international bodies, namely, United Nations Office for Disaster Risk Reduction (UNDRR), Asian Disaster Response Unit (ADRU), and so forth. With the prime focus of attaining sustainable development, ADRC in collaboration with United Nations Office for the Coordination of Humanitarian Affairs Kobe (UN-OCHA/Kobe) have framed Total Disaster Risk Management (TDRM) approach as an effective strategy to substantially reduce the adverse effects of natural disaster, particularly in Asia. ADRC asserts that natural disasters are considered to be biggest obstacles to the sustainable development particularly in Asia. Due to geographical as well as geological features, Asia confronts various disasters annually Fig. 6.2.

The concept of TDRM focuses on following elements [16]:

- (1) development of multistakeholder partnership and citizen participation,
- (2) advancement in efficient exchange of information,
- (3) making assessment and evaluation of risks,
- (4) implementation of risk reduction tools and techniques, and
- (5) drafting legal framework of policies, their implementation, and maintenance for disaster reduction.

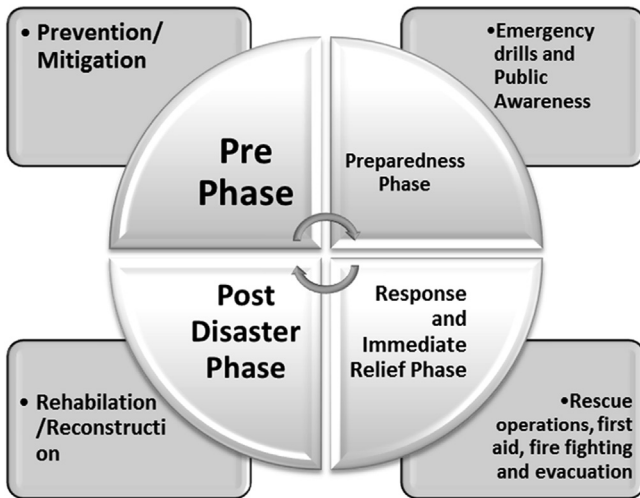


FIGURE 6.2 Disaster reduction cycle.

5. Disaster reduction cycle

Disaster reduction cycle illustrates the plan of government and nongovernment organizations to prevent or reduce the impact of disaster, react during and immediately after the event occurred and finally to take steps for recovery from the disaster. Appropriate and necessary actions taken during the cycle can result into effective early warnings, greater preparedness, reduced impact or even prevention of disaster in the next iterative cycle [44]. The four key activities taken up for disaster reduction are as follows as shown in Fig. 6.2:

- (a) **Before the disaster occurs (predisaster phase):** Activities in predisaster phase aims at preventing or at least minimizing negative effects of future potential hazards. This phase includes building codes and zoning, flood proofing of homes, construction of dams against floods, buying insurance etc.
- (b) **Preparedness phase:** Disaster preparedness is possible by vulnerability analysis based on previous experiences and application of strategies likely to reduce the possibilities that hazard will become disaster. It includes the preparation of disaster management plans at community level. Such preparations may include stocking of food items and water in advance, preparation of community maps, which can reflect vulnerable areas and even evacuation routes, and identification of emergency response team, task forces, and volunteers. Activities like mock drills and public awareness are conducted in this phase.
- (c) **Response and immediate relief phase:** This phase includes all the initiatives taken during or immediately following the event. It is ensured that all the needs of the victims are met and sufferings can be minimized. It is the most important stage where all the plans are finally brought to the action. All the efforts are made to save lives and preventing further property losses. It is also known as *disaster relief phase*. All activities are focused on understanding need of the community, making critical rapid assessments, providing food and nonfood items, first aid and shelter. In this critical phase information is often confusing so search and rescue activities are very strenuous.
- (d) **Postdisaster Phase:** This is the time to bring community back to its normal life or predisaster stage. This is the recovery/rehabilitation/reconstruction phase. Recovery activities can start when disaster is stabilized. It focuses on meeting with the basic needs of people until more permanent and sustainable alternatives can be found. Recovery measures include reconstruction of damaged properties, trauma counseling, temporary housing, and economic impact studies. Documentation of lessons so learned is done.

6. Case studies

6.1 Community-based disaster management approach in Bangladesh

Bangladesh is a low lying deltaic country formed by three major rivers, i.e., Padma (Ganges), Brahmaputra, and Meghna with the long coastal line. The country has low topography with two-thirds of its part lies less than 5 m above sea level. Bangladesh contains 310 rivers and tributaries -[84]. Owing to the geography and climatic pattern, Bangladesh is one of the most disaster prone countries [31]. apprises that in every four to 5 years, country is 65% flooded. Location of the nation is also seismically active, thus keeping the country prone to earthquake as well as tsunami [31]. Studies reveal that approximately 10 million Bangladeshis experience one or more natural hazards per year [26]. Common natural hazards in Bangladesh are tornadoes, floods, earthquakes, drought, tsunamis, arsenic contamination, salinity intrusion and landslides [20]. The country ranks ninth in terms of Global Climate Risk Index 2019 among 10 most affected countries globally for meteorological impact on economy and human fatalities [23]. Bangladesh is located in a tectonically active region. Due to seismic faults some of the major cities of Bangladesh including Dhaka, Chittagong, and Sylhet are always under the threat of massive destruction [45]. Earthquake disaster risk index of Stanford University has declared Dhaka as the most vulnerable cities to earthquakes.

Fig. 6.3 presents an overview of the total number of people killed by various natural disasters from the year 2000–2020. Data has been collected from the source [25]; which is the acronym for data that the Center for Research on the Epidemiology on Disasters (CREED) has been collecting from countries since 1987. It is evident from Fig. 6.3 that Bangladesh has lost its highest lives in catastrophic cyclones.

Over the last two decades, disaster management approach of Government of Bangladesh has shifted from reactive and relief to disaster reduction approach with special emphasis on community-based management. This proactive governmental approach focuses on hazard identification, mitigation, and community preparedness [20]. This paradigm shift approach has certainly shown progress in disaster management, which is evident from the decline in number of deaths as shown in Table 6.1.

In the year 2007, a catastrophic cyclone struck southwest coastal zone of Bangladesh which took 4234 lives, affected over 8.9 million people and caused US\$ 2.3 billion of total damage. In 2009, cyclone Aila along with its associated storm surge killed 190 people affecting 3.9 million people and causing US\$ 270 million of total damage. In the view of a new model, the Government of Bangladesh (GoB) drafted National Plan for Disaster Management (NPDM) (2010–2015) and then its successor (2016–20) for disaster risk reduction and emergency management in which the government has given special emphasis

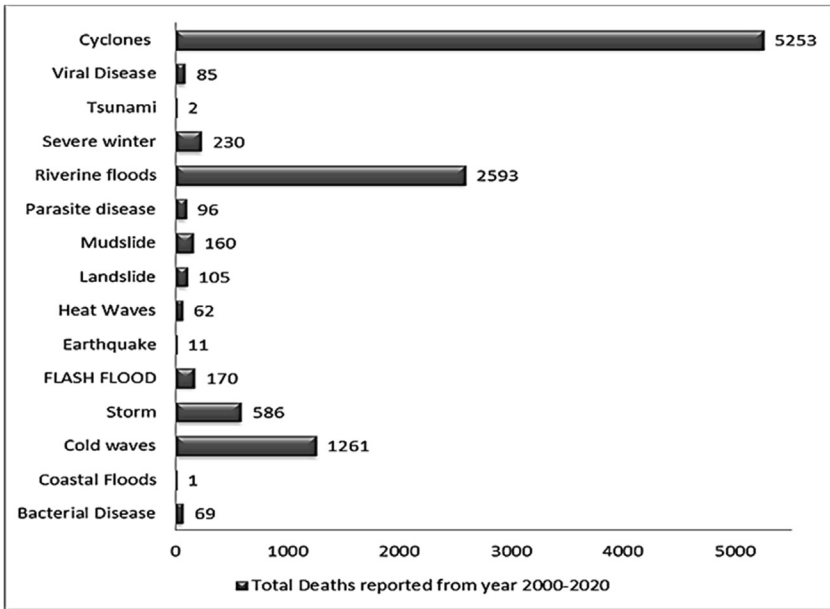


FIGURE 6.3 Disaster mortality losses reported from the year 2000–20 [25].

TABLE 6.1 Data of cyclones struck Bangladesh from 2007 to 20.

Year	Event name	Total deaths	Total affected
2007	Sidr	4,234	8,978,541
2008	Cyclone Reshmi	15	200
2009	Cyclone Aila	190	3,935,341
2009	Cyclone Bijli	7	19,209
2013	Tropical cyclone Mahasen	17	1,498,644
2015	Cyclone Komen	45	2,600,000
2016	Cyclone Roanu	28	1,203,555
2017	Cyclone Mora	7	3,300,012
2019	Cyclone Fani	39	10,045
2019	Tropical cyclone Bulbul	40	251,506
2020	Cyclone Amphan	26	1,100,000

Courtesy: Guha-Sapir D. EM-DAT: the emergency events database. Brussels, Belgium: Universitécatholique de Louvain (UCL) - CRED; n.d. www.emdat.be. [Assessed 1 July 2020].

to community participation from planning to implementation of disaster management policies at a local level. As a result, the death toll in successive cyclone Mahasen in 2013 was 17, during cyclone Komen in 2015 was 45 and most recently cyclone Amphan struck Bangladesh and took 26 lives and caused US\$ 5.8 million of total damage [25]. The decline in the death toll and total damage from year 2007–2020 is evident from the above data which thereby indicates the success level of the national policies as adapted.

In NPDM (2010–2015) [45]; a concept of community involvement is introduced and various activities and roles are assigned to the community, namely, in the coastal zones of the country Cyclone Preparedness Program (CPP) is introduced. Under this program Bangladesh Meteorology Department (BMD) gives early warnings regarding cyclones and its associated storm surges to CPP volunteers, those further passes on the information to local people via microphones, sirens, using loudspeakers of religious institutions (Mosque, Temple etc.), or by beating drums [32]. CPP is run by Ministry of Disaster Management and Relief of Bangladesh which operates over 350 unions and 40 upazilas in 13 coastal districts [4]. CPP volunteers are further divided into teams namely: warning, rescue, first aid, response and shelter. People of coastal areas have planted palms and tall trees around their homes and along the roadside as preparedness action for mitigating risk of tidal surge. Local government also seeks community participation in community risk assessment (CRA) and Risk Reduction Action Plan (RRAP).

[45] has given priority to community representatives for decision making on disaster risk reduction through legal framework and have agreed to provide financial assistance to local authorities for developing coordination with communities, civil societies, and migrants for the management of disaster at the local level.

6.2 Empowering community for disaster risk reduction in Nepal

Nepal is a landlocked country also known as *Himalayan Mountain* between China and India. It is 83% of the total area is covered by mountains and hills while rest 17% of area is flat along the Indian border. Nepal has a wealth of nature and biodiversity but is equally prone to adverse effects of natural as well as human induced hazards, namely, floods, landslides, earthquakes, and so forth. Nepal is characterized by irregular topography, extreme weather conditions, and complicated geological structures with an active tectonic location. The country ranks fourth in terms of Global Climate Risk Index 2019 with 10.50 CRI scores for meteorological impact on the economy and human fatalities [15]. UNDRR (2019) cited Nepal at 11th rank in terms of global risk for earthquake occurrence and its impact [67]. Nepal is among the underdeveloped countries with GDP per capita US\$ 744.7 with annual GDP growth of 7.5% [65]. Fig. 6.4 presents graphically the disaster mortality losses as reported in the year 2000–2020.

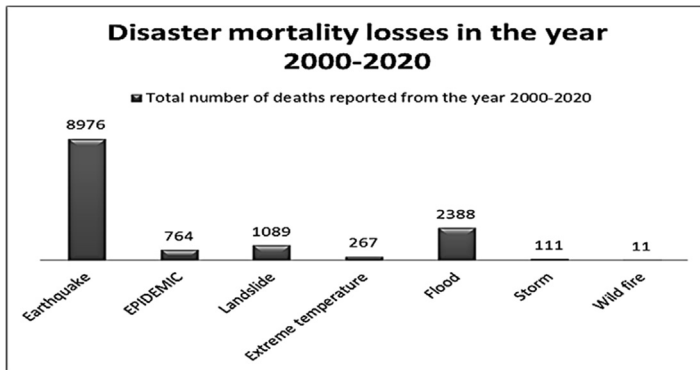


FIGURE 6.4 Disaster mortality losses reported in the year 2000–2020 [25].

Alarming mortality and severe economic loss annually due to natural disaster intrigued interests of government and disaster preparedness activities were taken into consideration. National action plan was enacted in 1996 in which emphasis of role of community in disaster preparedness process at a local level was addressed. Three Year Interim Plan (2007–10) recognized the need to foster the collaboration among government, NGO's and private sectors for providing relief and rescue to the affected people in due time. Government of Nepal (GoN) approved the National Strategy for Disaster Risk Management in 2009 in which collaboration with various stake holders as well as local community was given a special emphasis. Following the directions of Ministry of Home Affairs (MOHA), about 60 District Disaster Relief Committees prepared their District Disaster Preparedness Plan (DDPP). Red Cross societies and other security agencies were also involved in this plan [3]. Table 6.2 summarizes the Socioeconomic impact of disaster on Nepal from 2000 to 2019.

Temporal and spatial variability in climatic patterns has enhanced the variations in the river flow and have led to the increased frequency as well as intensity of floods. Midwestern regions of Nepal are regarded as flood prone areas, which suffer an immense loss of lives, severe damage to properties and production losses annually [18,38,49]. Southern Terai belt, inner Terai and the valley witness regular flooding in the months of June and September due to monsoonal precipitation. Flood event in the year 2008 forced 142 households to evacuate from Holiya Village Development Committee while in 2010, flash flood in Banke district left hundreds of people missing. Devkota & Cockfield, 2014 reported that about 11 people were killed and 2000 houses were struck by floods in Dang region [17]. In 2017%, 80% of the Terai region and its surrounding districts suffered flash floods leading to US\$ 584.7 million total damage [46]. In April 2006, United Nations Development Program (UNDP) launched Community-Based Disaster Management Project (CBDMP) to

TABLE 6.2 Socioeconomic impact of disaster on Nepal from 2000 to 2019.

Disaster	Total no. of deaths	No. Injured	Total no. of affected	Total damages (x1,000 US\$)
Drought	—	503,000	—	—
Earthquake	8,976	20,449	5,810,099	5,174,000
Epidemic	764	—	65,080	—
Extreme temperature	267	200	25,200	123
Landslide	1089	141	374,896	15,000
Flood	2388	958	4,114,069	883,729
Storm	111	787	15,029	—
Wildfire	11	—	—	—

Courtesy: Guha-Sapir D. EM-DAT: the emergency events database. Brussels, Belgium: Universit catholique de Louvain (UCL) - CRED; n.d. www.emdat.be. [Assessed 1 July 2020].

support communities especially from 42 wards of Syangja, Tanahu, Chitwan, Makawanpur, Sarlahi and Sindhuli districts. These, as stated districts reported, are vulnerable to floods, landslides and river cut annually. Fig. 6.5 shows the year wise mortality loss in Nepal due to floods as reported in the year 2000–2020.

Understanding the gravity of menace of a flood, CBDMP extended financial and technical support to the center as well as local government [64]. CBDMP empowers communities to reduce geophysical vulnerabilities by the constructing dykes, spurs, and embankments in their wards. Local people engaged themselves to make bamboo spurs to check the flow of water and stone spurs along the banks of rivers for disaster risk reduction.

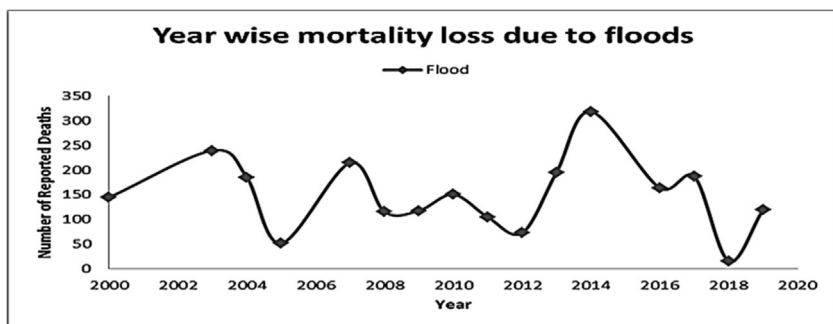


FIGURE 6.5 Year wise mortality loss due to floods reported in the year 2000–20 [25].

Landslide is another natural threat for Nepal resulting in major casualties and damage. Aggravated infrastructural development like construction of buildings in the vulnerable areas, undue increase in construction of roads, expansion of transport infrastructure causes soil erosion, loss of vegetation which in turn leads to destabilization of valley's slope toes [39]. There can be many reasons for landslide like water induced, earthquake, monsoon etc. Ramche Landslide, Rasuwa, activated in 1983 and reactivated on August 14, 2003, Jure Landslide, Sindhupalchowk, 2014, Taplejung Landslides 2015, Flood and landslide in Bhotekoshi 2016 are some of the examples of landslide disaster.

Nepal is situated on the region of a tectonic collision of Indian and Tibetan plates which results in the formation of various seismic faults and fractures. Among them, there are three main fault systems i.e., Main Central Thrust (MCT), the Main Boundary Thrust (MBT) and the Himalayan Frontal Faults (HFF) which makes Nepal vulnerable to earthquake disaster. Recently Gorkha earthquake in 2015 with eight Richter of magnitude struck the country which took 8831 lives, affecting 5.6 million of people and caused US\$ 5.17 billion of total damage [25]. As a consequence, thousands of earthquake induced landslides occurred resulting in loss of mountain topsoil and affecting land productivity. As agriculture is the main source of food security and employment for Nepalis, thus natural calamities affect human settlements, agricultural land, employment etc.

For re-building Nepal after Gorkha Earthquake in 2015, several nongovernmental organizations (NGOs) and community-based organizations (CBOs) came forward and extended their help for reconstruction activities. Global Slum Dwellers International network affiliated NGO's namely The National Federation of Squatter Communities and the National Federation of Women's Savings Collectives are among such organizations those have worked with GoN for providing immediate relief as well as long term recovery [3]. The NGO Federation of Nepal (NFN) runs 6233 member NGO's in about 77 districts with the objective of Sustainable Development Goals (SDGs) bridging the gap between governmental policies and local groups.

An NGO known as "Disaster Preparedness Network Nepal (DPNet Nepal) was established in 1996 which is still active to work closely with the government for risk management of disasters such as earthquake, floods, drought, fire, epidemic etc. those occurs frequently in a rural and urban community. Ministry of Water Resources (GoN) established the Department of Water Induced Disaster Management (DWIDM) on Feb 7, 2000 which takes care of water induced disasters like landslide, flood etc. Water Induced Disaster Prevention Technical Center (DPTC) presently known as DWIDM was established under an agreement between the GoN and the Government of Japan on October 7, 1991 [71]. For disaster risk reduction, DWIDM has been organizing training/workshops/seminars for educating local community

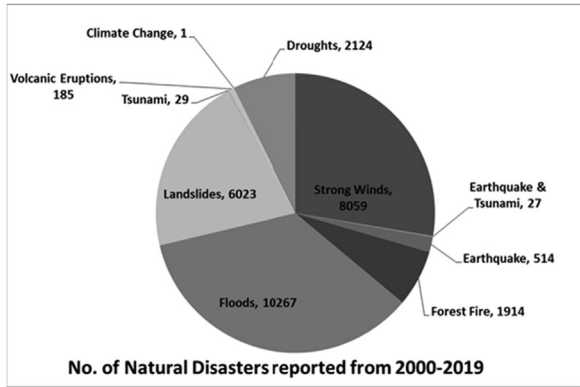
about the disaster and its preparedness. DWIDM prepares inventory map highlighting hazardous zones of entire country so that community can easily locate hazard and evacuation places.

In 1994, National Society for Earthquake Technology in Nepal (NSET) was established realizing the need to initiate community-based earthquake risk reduction program. The Kathmandu Valley Risk Mitigation Program is among various projects under NSET which involves community leaders, local masons, traders and other stake holders in vulnerability assessments process for providing aseismic school buildings [81]. In April 2006, a disaster risk reduction strategy was promoted under ActionAid Nepal program in which schools were considered as the major resource for disaster mitigation. It was realized that buildings of schools can be used as the temporary shelter at the time of the event and beside students can be used as resource for creating mass awareness as disaster preparedness [27]. Disaster Management Committees (DMC) prepares a community-based disaster preparedness plan in which an analysis of vulnerabilities, risk management as well as community participation is done. Special arrangements for first aid skills, mock drills are made for community preparedness.

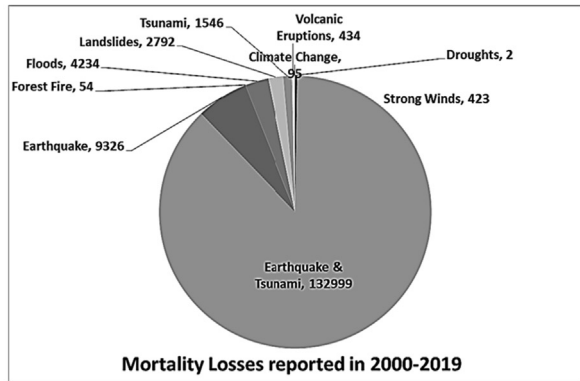
6.3 Reporting on community-based disaster management in Indonesia

In terms of area, Indonesia is the 16th largest archipelago state consisting of 17,508 islands scattered on both sides of the equator. Indonesia is susceptible to various natural calamities mainly because of its location between Asian and Australian continents and within the Indian and Pacific oceans. Due to heavy rainfalls, the county is prone to soil erosion, which further leads to landslides. Hydrometeorological activities result in various disasters like floods, droughts, and an outbreak of communicable diseases etc. The country is most susceptible to frequent earthquakes owing to its location on the edges of Pacific, Eurasian and Australian tectonic plates (EC, ADPC, UNESCAP; 2018) [87]. In addition to this, Indonesia has world's 75% dormant and active volcanoes making the country vulnerable to fire ash and tsunami. Fig. 6.6 shows the pie chart of number of reported natural disasters, disaster mortality losses, directly reported cases in Indonesia from 2000 to 2019.

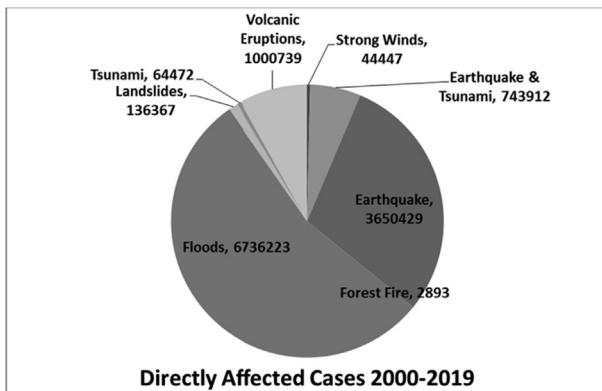
The 2004 earthquake which occurred near the Aceh and Nias islands which subsequently triggered a tsunami in the Indian Ocean is considered the deadliest event in history. Tsunami reached about 15 countries bordering Indian Ocean but Indonesia was worst affected by it. This event killed over 230,000 Indonesians, affected above 2.5 million people and caused US\$ 11.4 billion of total damage. One-third of fatalities were reported in the capital of Aceh province alone [76,78]. Considering the magnitude of reconstruction required post-2004 Tsunami Government of Indonesia created the Agency for the Reconstruction and Rehabilitation of Aceh and Nias BRR (Badan



(i)



(ii)



(iii)

FIGURE 6.6 Shows (1) number of reported natural disasters(2) disaster mortality losses (3) from directly reported cases from 2000 to 2019. *Courtesy: Badan Nasional Penanggulangan Bencana (BNPB). Data informasi bencana Indonesia; n.d. <http://bnpb.cloud/dibi/>. [Assessed 7 July 2020].*

Rekonstruksidan Rehabilitasi Aceh dan Nias) in 2005 to manage reconstruction. Earthquake in Yogyakarta and Central Java in 2006 was another similar destructive event that killed 5782 people and injured about 36,299 people [13]. These events acted as the catalyst for Indonesian government to rethink about existing strategies for resilience development at all levels. Impact of these devastating events was the enactment of the Indonesian Disaster Management Law (DM Law) in 2007. This DM Law governs the disaster management system from preparedness programmes to response and recovery. Later in 2008, National Disaster Management Authority [5] was established to improve the coordination among government agencies, NGOs and other stakeholders. To bring disaster management into the public domain, the role of community in disaster management was realized. Government of Indonesia launched its National Action Plan for Disaster Risk Reduction (NAP-DRR) for 2006–09 in which special emphasis was given to Community-based Disaster Risk Management (CBDRM). The need for building community resilience was perceived in Indonesia during the HFA in 2005 [22]. In the ministry of Indonesia, departments like Home Affairs Department, Social Department and Energy and mineral resource department is working closely with the CBDRM approach as shown in Fig. 6.7.

Community efforts in the reconstruction and rehabilitation process in the Aceh province proved to be very successful in history.

Increased human settlements as well as other anthropogenic activities, namely, deforestation, illegal land capturing of swampy areas, wetlands, etc., have deteriorated the river's conveyance capacity in the country. As a result, Indonesia is worst affected by floods those can be categorized as riverine, flash, tidal and urban floods, especially during monsoons. Flash flooding is one of the frequent events particularly in the region of Seulawah Mountains in Aceh Province. This water inundation carries slit, sediments and other debris which can easily ruin crops, houses etc. and can have long term direct as well as other indirect impacts on people [50]. After the onset of floods there are greater chances of spread of communicable diseases like fecal oral diseases,

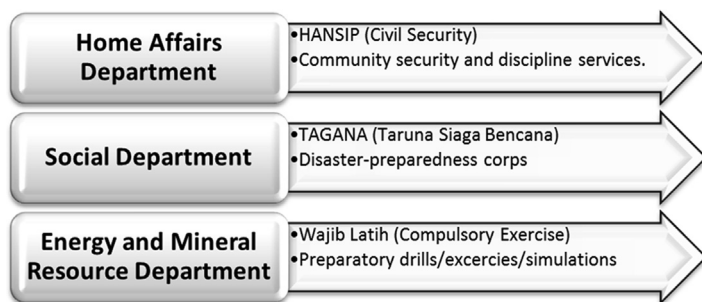


FIGURE 6.7 CBDRM approach of Ministry of Indonesia.

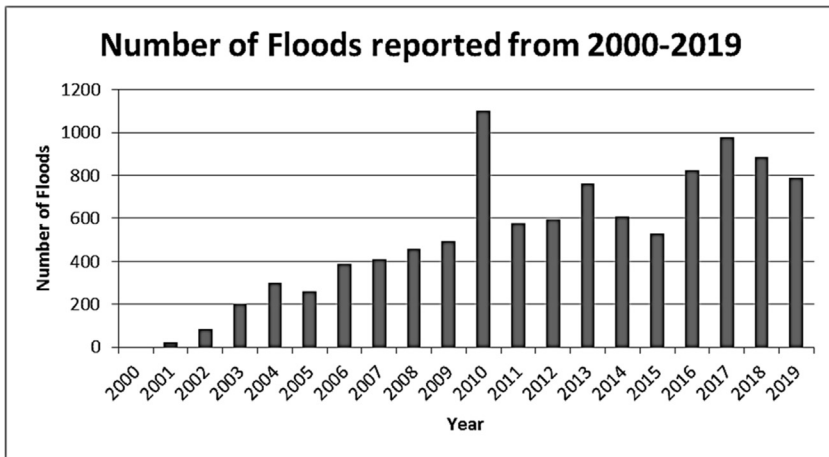


FIGURE 6.8 Number of floods reported from the year 2000–2019. *Courtesy: Badan Nasional Penanggulangan Bencana (BNPB). Data informasi bencana Indonesia; n.d. <http://bnpb.cloud/dibi/>. [Assessed 7 July 2020].*

vector-borne diseases [2]. The year 2010 accounts for a maximum number of occurrence of floods i.e., 1101 events in which about 500 people died, 353,523 people got directly affected whereas 625,202 people got indirectly affected [5]. Badan Nasional Penanggulangan Bencana (BNPB) reports that Bali has witnessed the maximum number of mortality losses i.e., 15,042 followed by provinces Jawa Tengah, Jawa Timur with losses 1007, 996 respectively due to floods from the year 1815–2019 [5]. Fig. 6.8 presents the year wise frequency of floods in Indonesia from 2000–2019.

Mt. Merapi volcano in the central Java and Yogyakarta province is one of the most active volcanoes and consists of dangerous composites [34]. The year 2010 Mt. Merapi volcanic destruction is considered largest-ever eruption killing 322 and affecting 137,140 people [25] with the estimated damages of about US\$360 million as per World Bank office in 2012 [86]. Fly ashes produced due volcanic eruption leads to major losses of crops. Volcanic dust, hot ashes and poisonous gases destroyed vegetation, livestock and all the essentials of local communities.

For reconstruction and rehabilitation post-Mt. Merapi year 2010 eruptions, Government of Indonesia again realized the importance of community participation through Rekompak program. Rekompak program was already proved to be very successful and effective during the post-2006 Aceh Tsunami and Yogyakarta earthquake reconstruction. Rekompak is the acronym for Rehabilitasidan Rekonstruksi Pemukiman Berbasis Masyarakat (Community-based Housing Rehabilitation and Reconstruction) which gives community an equal partnership to work for reconstruction and rehabilitation with local government [89]. In the Rekompak program, local community is empowered

to reconstruct and rehabilitate their own homes as well as public infrastructure under the assistance of task forces which comprises of technical experts, construction supervisors and finance specialists. To minimize the level of corruption funds are directly channeled to communities. Funding was raised by Java Reconstruction Funds (JRF) which was established post-2006 Aceh Tsunami and Yogyakarta earthquake in July 2006. The success of Rekompak approach lies in fostering the sense of ownership and decision making among local community which fills them with the strength to control even situations after the future misfortune. Another key aspect of the Rekompak program is the focus on community preparedness for disaster resilience. Under the guidance of village facilitators, disaster preparedness committees are formed which regularly conduct evacuation drills, training and simulations in which the whole village participates. Communities are trained to identify the hazards and to learn mitigation and preparedness techniques using simulations (World Bank, 2012).

Indonesia is among the “middle-income countries” which is frequently eroded by disasters impelling its government decline to request for humanitarian aid from various international agencies. Different national-international organizations, namely, UNICEF, AusAid, Japan International Cooperation Agency (JICA), International Red Crescent, International Organization of Migration (IOM), European Commission, Asian Disaster Preparedness Center (ADPC), and so forth has extended their support from time to time for disaster mitigation as well as resilience. This scenario has opened the door for many domestic faith-based organisations to play an active role in disaster management. Muhammadiyah, claims to be the largest as well as oldest domestic NGO, which is running several hospitals, clinics, universities, schools etc. nationwide. Muhammadiyah, a social welfare organization was founded in 1912 in Yogyakarta, Central Java [9]. Ironically, people consider bad calamity (*sayyi'ah*) as the anger of God toward sinner and local communities used to perform offering ceremonies to satisfy the spirits. Here faith-based organizations play an important role in providing psycho-social recovery [75].

Past experiences of 2004 Aceh-Niahs earthquake and tsunami, and the earthquake in Yogyakarta and Central Java in 2006 lead Muhammadiyah to establish Muhammadiyah Disaster Management Center (MDMC) with the focus to achieve disaster mitigations and recovery through Sekolah Siaga Bencana (Disaster-Prepared School) and Rumah Sakit Siaga Bencana (Disaster-Prepared Hospital). For disaster response and mitigation, MDMC is providing disaster preparedness training at school level Child Disaster Awareness for School and Communities (CDASC), through Hospital and Community Preparedness for Disaster Management (HCPDM) it is providing training to hospital staff, Volcano Community-Hospital Ring (VaCHRi), thus strengthening the community toward disaster [6]. Faith-Based communities thus play an important role in disaster management.

6.4 India's community-based disaster risk reduction plan

India is prone to a wide range of disasters, in particular earthquake, landslides, floods, cyclones, tsunamis, drought, extreme heatwaves and wildfires. Owing to its unique geo-climatic as well as socioeconomic conditions, India is among the 10 worst disaster prone countries. In 2018, India ranked fifth in the Global Climate Risk Index chart with 18.17 CRI scores [15]. India can be divided into five regions i.e., Himalayan region, the alluvial plains, Indian deserts, the hilly part of the peninsula, and the coastal zone. Each region is vulnerable to one or more disasters, namely, the Himalayan region frequently witnesses earthquakes and landslides because Indian tectonic goes below Eurasian plates in this region. Plane regions are susceptible to floods whereas due to change in oceanic pressure, coastal areas are more prone to cyclones, storms and tectonic movement under the ocean floor causes tsunamis. Himalayan region is a source of various rivers which makes Uttar Pradesh and Bihar victims of floods every year. Western parts of the country including Rajasthan, Gujarat and few areas of Maharashtra are drought prone. Indian Meteorological Department in 2019 declared that year 2018 was the sixth driest year with only 56% of long term average monsoon [82] while the year 2019 stood seventh warmest year since 1901. Another anomaly was seen in the behavior of the Arabian Sea in 2019, where out of eight cyclones, five intense storms were originated over the Arabian Sea -[88].

India has a 7516 km long coastline which is surrounded by Arabian Sea on its left and Bay of Bengal to its right. Studies show that India is exposed to about 10% of the world's cyclones where majority of them originate from Bay of Bengal followed by Arabian Sea in a ratio of 4:1 [21,58]. States along coastline i.e., Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Puducherry, Andhra Pradesh, Orissa and West Bengal along with Andaman, Nikobar and Lakshwadeep Islands are frequently affected by cyclones [21]. reports that Tamil Nadu -Andhra Pradesh, Orissa- West Bengal coasts witness's highest and intense storms during October–December (NE monsoon). Eastern India is more vulnerable to tropical cyclones as compared to the western part [35]. The destructive winds accompanying cyclones cause greater damage. Table 6.3 summarizes the data of cyclones struck India from 2007–2020.

Drought is a complex ecological challenge that causes a serious threat to social, economic as well as environmental conditions. The Indo-Gangetic Plain was among the regions that experienced severe drought in 2015 with a rainfall deficit of 25.8% [43]. From 2014 to 15 India faced a 12% decline and from 2015 to 16, a 14% deficit in rainfall was observed [66]. [25] report apprises that in 2015 about 330 million of people got affected and India faced huge damage of US\$ 3000 million. As per the report presented by Ministry of Agriculture and Farmer's Welfare, Government of India, 266 districts

TABLE 6.3 Data of cyclones struck India from 2007 to 2020.

Year	Event	States
2007	Sidr	West Bengal, Orissa
2009	Cyclone Aila	West Bengal
2009	Cyclone Phyan	Gujarat, Madhya Pradesh, Maharashtra provinces
2010	Cyclone Laila	Andhra Pradesh, Tamil Nadu
2010	Cyclone Jal	Andhra Pradesh
2011	Cyclone Thane	Tamil Nadu, Puducherry
2012	Cyclone Nilam	Andhra Pradesh, Tamil Nadu
2013	Cyclone Phailin	Orissa, Andhra Pradesh, Jharkhand, Bihar, West Bengal, Chhattisgarh
2013	Helen	Andhra Pradesh
2013	Tropical cyclone Mahasen	Andhra Pradesh
2014	Cyclone Hudhud	Andhra Pradesh, Orissa, Chhattisgarh
2016	Cyclone Vardah	Tamil Nadu; Andhra Pradesh
2017	Cyclone Mora	Manipur, Mizoram
2017	Cyclone Ockhi	Kerala, Tamil Nadu, Andhra Pradesh, Lakshadweep islands
2018	Tropical storm Titli	Andhra Pradesh and Odisha
2018	Cyclone Gaja	Tamil Nadu
2018	Tropical storm Phethai	Andhra Pradesh, Odisha
2019	Cyclone Fani	Odisha
2019	Tropical cyclone Bulbul	South Assam, Meghalaya, Tripura, Mizoram, West Bengal, Odisha state
2020	Cyclone Amphan	West Bengal, Odisha state
2020	Cyclone Nisarga	Maharashtra

Courtesy: Guha-Sapir D. EM-DAT: the emergency events database. Brussels, Belgium: Université catholique de Louvain (UCL) - CRED; n.d. www.emdat.be. [Assessed 1 July 2020].

across 11 states were officially declared drought in 2015–16. Andhra Pradesh, Karnataka, Maharashtra and Uttar Pradesh were among the worst affected states [66]. Fig. 6.9 presents the graphical view of losses due to drought in India from the year 2000-2018.

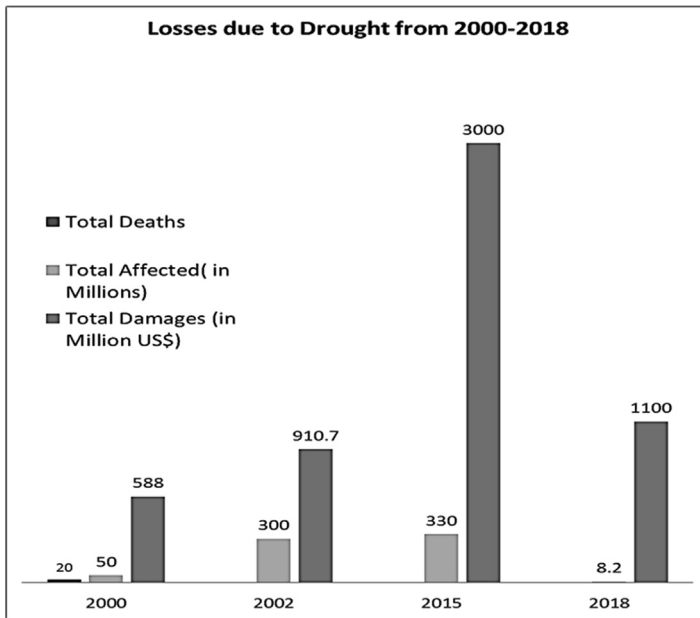


FIGURE 6.9 Losses due to drought reported from 2000 to 2018. *Courtesy: Guha-Sapir D. EM-DAT: the emergency events database. Brussels, Belgium: Universitécatholique de Louvain (UCL) - CRED; n.d. www.emdat.be. [Assessed 1 July 2020].*

Flood is another havoc which the country experiences every year. According to Ref. [21] almost one – eighth part of the country is flood prone owing to its geographical reasons. Monsoons, silted rivers, erodible mountains especially Himalayan range are the factors of floods. Floods bring string of miseries, namely, outbreak of diseases, scarcity of drinking water, agriculture losses etc. along with it. As per the assessment made by the Ministry of Environment and Forest, Government of India [85], by 2030 Himalayan regions of India may witness an increment in temperature up to 2.6°C and increase in intensity by 2%–12% with respect to 1970, consequently rise in glacier melts will increase the frequency of floods in India. In the mountain erodible areas floods can also trigger landslides. While in Western Ghats and coastal zones, a rise of about 1.7–1.8°C in temperature with respect to 1970, may be observed.

Northeast India, the northern portion of Bihar, Uttarakhand, Himachal Pradesh, Jammu, Kashmir, Gujarat, and Andaman and Nicobar Islands are considered to be the most active seismic zone [21]. The Bhuj earthquake of 2001 in the Kutchh district of Gujarat is the most devastating event in the history where death toll of 20,005 was reported whereas about 6.3 million people were affected and 1.79 people were homeless. Gujarat 2001 earthquake caused US\$ 2623 million of total damage [25].

Realizing the need for community as well as other stakeholder participation in disaster risk reduction, the Government of India enacted National Policy on Disaster Management in 2009 emphasizes on disaster prevention, preparedness and mitigation. The need for capacity building among local authorities including Panchayati Raj/Gram Sabha, Municipalities is urgently imperative. The 73^{ed} and 74th constitutional amendments recognize Panchayati Raj and Municipalities as institutions of *self-government*.

Government of India sensitized that capacity building of vulnerable communities along with professionals and personals should be prioritized for developing sustainable livelihoods. Indian Government is disseminating adequate knowledge as well as providing training to the community to tackle any misfortune event.

Under [36], 169 districts across selected most vulnerable 17 states of India, preparedness and mitigation plans at the state, district, block, village and ward were chalked out. At the village level, Village Disaster Management Committee (VDMC) is formed which is responsible for framing and planning disaster preparedness programs across the region. VDMC consists of local NGOs, local representatives, members of youth groups, namely, National Service Scheme (NSS) and Nehru Yuva Kendra Sangathan (NYKS), women groups, local government representatives. At the village level, seasonal calendars are prepared to indicate the best times for conducting mock drills, exercises for disaster preparedness. Similarly, Gram Panchayat Disaster Management Committee (GPDMC) is responsible for the administrative unit intermediate between block and village [36].

State wise various initiatives are taken for disaster mitigation and preparedness. Uttar Pradesh's government used local media as a tool to educate people about the disaster. Various *NukadNataks* (street shows), puppet shows are organized from time to time for creating awareness about various challenges as well as cope up techniques for disaster. The local government of Maharashtra has used auto rickshaws as the carrier for spreading disaster awareness. To spread awareness among children, under SarvSikshaAbhiyan (2000–01) a compulsory subject on Disaster Management was introduced for school students. During the year 2002–03 local government of Jaipur introduced 7 days teacher training program UDAY II in which general awareness about disaster was imparted [29].

Over many years National Cadet Corps (NCC), National Service Scheme (NSS), Nehru Yuva Kendra Sangathan (NYKS), Bharat Scouts are volunteering and extending help for disaster management. National Disaster Management Authority in 2016 initiated ApdaMitra Scheme to train the community for disaster response, thus giving first responders to the disaster a central stage. Volunteers under this scheme stood front line during various misfortune events, namely, Kolhapur flood (2019), Cyclone Fani, Odisha (2019) Sitamadhī flood, and Bihar (2019) [90].

In nutshell, initiatives by GOI of organizing awareness campaigns, mason training, gender equity in disaster management, forming youth groups, namely, NSS, NCC, NYKS, and Bharat Scouts etc. are among the highlights of its disaster management programs. Under Sarv Siksha Abhiyan introduction of Disaster Management as the compulsory subject in the curriculum is another initiative to educate the masses.

6.5 Japan's disaster risk reduction plan

Japan is the island country with four major islands surrounded by more than 4000 small islands in the western Pacific Ocean. Japan Islands are located on the convergent boundaries of Pacific, North American, Eurasian, and the Philippine Sea plates making it tectonically active region. An earthquake under the ocean floor can further lead to tsunamis. In addition to this, Japan has about 10% of active volcanoes of the world those can erupt any time [83]. Despite the small area, Japan has a variety of climates ranging from subarctic to subtropical. Japan faces strong winds from typhoons every year, which can further trigger both floods and landslides.

Japan faces serious natural disasters every year owing to its geophysical conditions. The great Kanto earthquake (1923) is considered to be the worst disaster in the history of Japan that struck Kanto plains and devastated cities of Tokyo and Yokohama which caused mortality losses of about 100,000 [80]. It further triggered tsunami waves as well as a fire break out, which made this disaster an even more destructive and Japan suffered from the total damage loss of about US\$ 600 million [25]. Great Hanshin-Awaji Earthquake in 1995 was another deadly event which hit the city of Kobe, Hyogo prefecture in which about 6437 people were killed 43,792 injuries were recorded and due to fire spread about 104,906 houses were completely burned [91]. The Great East Japan Earthquake in 2011 is the largest recorded earthquake with a magnitude of 9.0 Richter's hit at the coast of Sanriku. Additionally, vibrations near the boundary of Pacific Plate and plates beneath Tohoku area caused under seafloor movements which further triggered a tsunami. In this massive disaster, more than 15,000 people lost their lives while 2681 people got missing as of April 10, 2013. Total damage of about 16.9 trillion yen was faced by Japan [30].

Typhoons add into the miseries of Japanese every summer. Winds associated with typhoons are so much powerful that can blow trees, buildings along with them and can trigger floods as well as landslides. Typhoon Makurazaki in 1945 hit Kyushu, Kanto, and killed 3746 whereas more than 1.3 million people got affected and about US\$ 400,000 of total damage was reported. Typhoon Vera (1959) was one of the disastrous events which affected the almost entire nation, more than 5000 mortality losses were reported while about 1.5 million were affected and total damages of about US\$600000 was suffered by the country [25]. Table 6.4 lists the storms struck Japan from the year 2000–2019.

TABLE 6.4 Data of storms struck Japan from 2000 to 19.

Year	Event name
2000	Kirogi, Saomai
2001	Pabuk, Danas
2002	Halong, Chata'an, Rammasun, Sinlaku
2003	Etau, Maemi, Meari (Quinta)
2004	Dianmu (Helen), Meari (Quinta), Tokage (Siony), Chaba, Ma-on (Rolly), Songda (Nina), Megi (Lawin), Aere (Marce)
2005	Nabi (Jolina), Mawar
2006	Shanshan
2007	Man-Yi, Wipha/Goring, Fitow
2009	Etau, Melor
2011	Roke, Talas, Ma-on
2012	Bolaven, Jelawat, Sanba
2013	Wipha, Man-Yi
2013	Toraji, Fitow
2014	Neoguri, Phanfone, Nakri, Halong, Vongfong
2015	Nangka, Chan-Home, Etau, Noul (Dodong), Goni (Ineng), Dujan
2016	Mindulle, Lionrock, Malakas, Chaba
2017	Lan/Paolo, Talim, Noru
2018	Jebi, Trami, Kong-Rey
2019	Hagibis, Lingling, Tapah, Faxai

Courtesy: Guha-Sapir D. EM-DAT: the emergency events database. Brussels, Belgium: Universit catholique de Louvain (UCL) - CRED; n.d. www.emdat.be. [Assessed 1 July 2020].

The disaster Management plan of Japan includes National, Prefectural and Municipal level as shown in Fig. 6.10.

After the Great Hanshin-Awaji Earthquake in 1995, establishing community-based disaster prevention program was a major objective of Government of Japan. Under the umbrella of Disaster Safe Welfare Communities "BOKOMI" emergency mock drill programmes, first aid training are provided to local vulnerable community. Various NGO's like plus Arts have come forward and have extended their help for community awareness about disasters.

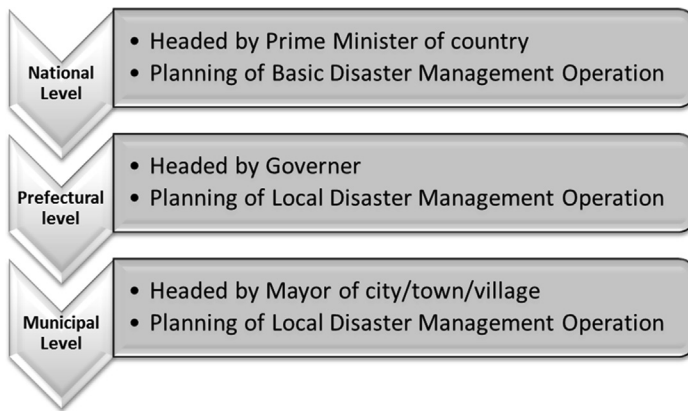


FIGURE 6.10 Scheme of disaster management operation plan.

The community disaster risk management (CDRM) plan includes the involvement of the vulnerable community in identification of disaster risks as well as hazard areas. To share experiences about the Community-Based Disaster Management Plans, the cabinet office held a [12] in Osaka City on March 16, 2019. In this forum, a network of local government officials those are intended to work on CDRM and were named as Chikubo'z. In addition to the involvement of various NGOs, volunteers etc., a wide community associated with research is also working on planning and mitigation of disasters. This network comprises about 57 academic societies till March 2019 [91].

7. Risk mitigation analysis

Our research work reveals that as referred countries are working on the principle of *Prevention is better than cure* and also seeks community participation in community risk valuation and preparedness. All Asian countries have developed a consensus to organize training/workshops/seminars for educating local community about disaster and its preparedness. Special arrangements for first aid skills, mock drills for community preparedness have also been made from time to time. A comparative analysis of disaster mitigation and preparedness strategies of countries under study is given in Table 6.5.

In addition to funds generated by the government of respective countries various other agencies, namely, United Nations Development Program (UNDP), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Children's Fund (UNICEF), European Civil Protection and Humanitarian Aid Operations (ECHO), World Health Organization (WHO), and also extends financial support to as referred countries. Our current study reveals that preparedness and mitigation strategies of

TABLE 6.5 Comparative analysis of disaster mitigation and preparedness strategies.

	Bangladesh	Nepal	Indonesia	India	Japan
Global climate risk index (2017)	9	4	50	14	36
Programmes initiated	Cyclone Preparedness Program (CPP), National Plan for Disaster Management [45], Bangladesh Climate Change Strategic Action Plan (BCCSAP), National Plan for Disaster Management 2010–15.	National Strategy for Disaster Risk Management (2009), District Disaster Preparedness Plan (DDPP), Community-Based Disaster Management Project (CBDMP), Disaster Preparedness Network Nepal (DPNet Nepal), Department of Water Induced Disaster Management (DWIDM), National Society for Earthquake Technology-Nepal (NSET), ActionAid Nepal Program	Agency for the Reconstruction and Rehabilitation of Aceh and Nias BRR, National Action Plan for Disaster Risk Reduction (NAP-DRR), Rekompak program	National Policy on Disaster Management 2009, [36]; National Disaster Management Plan (NDMP), 2019, Indigenous Technical Knowledge (ITK), India Disaster Resource Network (IDRN), India Disaster Knowledge Network (IDKN)	Science and Technology Research Partnership for Sustainable Development (SATREPS), Enterprise Resilience Rated Loan Program, Community Disaster Management Plan forum, Three Year Emergency Response Plan for Disaster Prevention, Disaster Mitigation, and Building National Resilience (Dec 2018)

Disaster management tools	Disaster Management Act (2012), Sendai Framework for Disaster Risk Reduction (SFDRR) 2016–30	Natural Calamity (Relief) Act, 1982, Sendai Framework for Disaster Risk Reduction (SFDRR) 2016–30, Disaster Risk Reduction and Management Act, 2017, Natural Calamity (Relief) Act, 1982, Local Self Governance Act, 1999, National Action Plan for Disaster Risk Management 1996, National Strategy for Disaster Risk Management (NSDRM), 2009, National Disaster Risk Reduction Strategic Action Plan, 2018–2030 (NDRRSAP)	Indonesian Disaster Management Law (DM Law) in 2007	ApdaMitra Scheme, The Disaster Management Act, 2005, PradhanMantriGraminAwaasYojana 2015	[12]; Amended Disaster Relief Act (2018), Sendai Framework for Disaster Risk Reduction (SFDRR) 2016–30, Road Traffic Act, the Flood Control Act, and the Port and Harbor Act, Making Local Areas Resistant to Tsunami Act No. 123, Promotion of Tsunami Countermeasures Act No. 77, Making Local Areas Resistant to Tsunami, Law No. 123 of 2011, Art. 10.
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Continued

TABLE 6.5 Comparative analysis of disaster mitigation and preparedness strategies.—cont'd

	Bangladesh	Nepal	Indonesia	India	Japan
Authorities working	National Disaster Management Council (NDMC), Inter-Ministerial Disaster Management Coordination Committee (IMDMCC); National Disaster Management Advisory Committee (NDMAC); National Platform for Disaster Risk Reduction (NPDRR); Earthquake Preparedness and Awareness Committee (EPAC); and Focal Point Operation Coordination Group of Disaster Management (FPOCG).	National Risks Reduction and Management Authority (NRRMA)	National Disaster Management Authority [5]	National Disaster Management Authority 2005, Cabinet Committee on Management of Natural Calamities, Panchayati Raj/Gram Sabha and Municipalities, Gram Panchayat Disaster Management Committee (GPDMC), District Disaster Management Authority	Disaster Safe Welfare Communities “BOKOMI”, Chikubo’z, a Network of Local Government Officials Working on Community Disaster Risk Management Plans, Japan Meteorological Agency (JMA), Fire and Disaster Management Agency, Establishment of the Megaflood Management Committees

Community participation	Community Risk Assessment (CRA) and Risk Reduction Action Plan (RRAP). NGO Coordination Committee on Disaster Management (NGOCC), Bangladesh Red Crescent Society (BRCS)	Nepal Red Cross, NGO Federation of Nepal (NFN)	Indonesia NGO, faith-based or religious Organizations, Civil Society Organizations (CSOs)	National Service Scheme (NSS) and Nehru Yuva Kendra Sangathan (NYKS), Woman groups, Bharat Scouts, Red cross society	Japanese Red Cross Society, Empowerment of Female Fire Corps Volunteers, NGO's, NPO's
Funding agencies	National/District Disaster Management Fund, Grameen Bank, Proshika, Bangladesh Rural Advancement Committee (BRAC), Association for Social Advancement (ASA)	Princep Disaster Relief Fund, CDP Nepal Earthquake Recovery Fund, Prime Minister Relief Fund, Natural Calamity Relief Fund	Java Reconstruction Funds (JRF), Contingent Fund (Dana Darurat) Government Regulation 44/2012	Chief Minister's Disaster Relief Fund, MGNREGS, PradhanMantriAwasYojana, (PMAY), National Disaster Response Fund (NDRF), National Calamity Contingency Fund, Calamity Relief Fund	Disaster relief fund, Art. 24: Inclusion of funds for the redemption of principal and interest related to small disaster bonds in the standard budget request

Continued

TABLE 6.5 Comparative analysis of disaster mitigation and preparedness strategies.—cont'd

	Bangladesh	Nepal	Indonesia	India	Japan
Disaster response and mitigation	Organizing mock drills for disaster preparedness, Early warnings, Construction and maintenance of cyclone and flood shelters, supply of drinking water and food, first aid.	School Safety Program (SSP), reconstruction of earthquake-resistant schools	SekolahSiagaBencana (Disaster-Prepared School) and RumahSakitSiagaBencana (Disaster-Prepared Hospital), Child Disaster Awareness for School and Communities (CDASC), Hospital and Community Preparedness for Disaster Management (HCPDM, 2009)	People participation through gram sabhas, Organizing mass awareness programmes like nukadnatak, puppet show, disaster education through SarvSikshaAbhyan (2000–01), early warnings, risk assessment at local level, organizing training programmes and mock drills	Japan has implemented an extensive program of building tsunami walls of up to 4.5 m (13.5 ft) high in front of populated coastal areas, tsunami preparedness day-every year on November 5, rescue program workshop, Nuclear Emergency Core Hospitals, community tsunami preparedness measures, School Tsunami Preparedness

government of respective countries stress on community participation in disaster management. Government of Bangladesh has drafted [45] in which priority is given to community representatives for decision making on disaster risk reduction through legal framework and have agreed to provide financial assistance to local authorities for developing coordination with communities, civil societies and migrants for the management of disaster at the local level. Local government also seeks community participation in CRA and RRAP. The prime focus of ActionAid- Nepal program is Disaster Management and Policy Advocacy, Community Empowerment for Disaster Management, Community Led Reconstruction Program. Government of Indonesia have also given key importance to community participation through Rekompak program. Rekompak is the acronym for Rehabilitasidan Rekonstruksi Pemukiman Berbasis Masyarakat (Community-based Housing Rehabilitation and Reconstruction) which gives community an equal partnership to work for reconstruction and rehabilitation with local government. Even the faith-based communities like Muhammadiyah's are playing an active role in disaster management in Indonesia. In 2016 National Disaster Management Authority of India initiated ApdaMitra Scheme to train community for disaster response. Over many years NCC, NSS, NYKS, Bharat Scouts are volunteering and extending help for disaster management. In Japan under the umbrella of Disaster Safe Welfare Communities "BOKOMI" emergency mock drill programmes, first aid training are provided to a local vulnerable community.

Thus, disaster mitigation strategies are adopted by the government of the respective countries. Mutual collaboration for disaster management is also extended and financial support from UN bodies, Asian Development Bank (ADB), World Bank, and so forth is also fetched.

8. Conclusion

Alternative measures for disaster management are undertaken by the governments of Asian countries giving key importance to community involvement in vulnerability assessment, disaster preparedness, mitigation, and resilience. The vulnerable community is first responder to the disaster thus the need of providing them a central stage in disaster management is realized worldwide. Effective community participation, as well as involvement of NGOs, volunteers and other stakeholders, are important elements of DRR. Community participation is vital for implementing a sustainable disaster reduction program at a local level which is possible only when local people own the program and show continuous engagement in DRR activities. The involvement of the community is important in predisaster mitigation as well as in the postdisaster response and recovery process. In this chapter, a brief study of CBDM strategies adopted by different Asian countries, namely, Bangladesh, Nepal, Indonesia, India, and Japan have been presented. As studied countries have come to a consensus that community participation is vital for implementing

sustainable disaster reduction program at local level which is possible only when local people own the program and shows continuous engagement in such activities. The involvement of community is important in pre-disaster mitigation as well as in post-disaster response and recovery process. Thus, CBDM is the dominant approach accepted worldwide.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/B978-0-12-824038-0.00003-1>.

References

- [1] Adger WN. Vulnerability. *Global Environ Chang* 2006;16:268–81.
- [2] Ahern M, Kovats RS, Wilkinson P, Few R, Matthies F. Global health impacts of floods: epidemiologic evidence. *Epidemiol Rev* 2005;27:36–46.
- [3] ALNAP. Nepal earthquake response: lessons for operational agencies. London: ALNAP/ODI; 2015.
- [4] Azad MAK, Uddin MS, Zaman S, Ashraf MA. Community-based disaster management and its salient features: a policy approach to people-centred risk reduction in Bangladesh. *Asia Pac J Rural Dev* 2020;1–26. <https://doi.org/10.1177/1018529119898036>.
- [5] Badan Nasional Penanggulangan Bencana (BNPB). Data informasi bencana Indonesia; n.d. <http://bnpb.cloud/dibi/>. [Assessed 7 July 2020].
- [6] Baidhawzy Z. The role of faith-based organization in coping with disaster management and mitigation: Muhammadiyah's experience. *Journal Indones Islam* 2015;09(Number 02):167–94.
- [7] Blaikie P, Cannon T, Davis I, Wisner B. At risk: natural hazards, peoples vulnerability, and disasters. London: Routledge; 1994.
- [8] Burton I, Kates RW. The perception of natural hazards in resource management. *Nat Resour J* 1964;3:412–41.
- [9] Bush R. Muhammadiyah and disaster response: innovation and change in humanitarian assistance. In: Brassard C, et al., editors. *Natural disaster management in the Asia-Pacific: policy and governance, disaster risk reduction*. Japan: Springer; 2015. p. 33–49. https://doi.org/10.1007/978-4-431-55157-7_3 [Chapter 3].
- [10] Carpenter S, Walker B, Anderies JM, Abel N. From metaphor to measurement: resilience of what to what? *Ecosystems* 2001;4(8):765–81.
- [11] Cascella M, Rajnik M, Cuomo A, Dulebohn SC, Di Napoli R. Features, evaluation and treatment coronavirus (COVID-19). StatPearls Publishing LLC; 2020. <https://www.ncbi.nlm.nih.gov/books/NBK554776/>.
- [12] Community-Based Disaster Risk Reduction. National disaster management guidelines, national disaster management authority (NDMA). India: Ministry of Home Affairs, Government of India; 2019.
- [13] Community-based disaster risk management: experiences from Indonesia. International Organization for Migration (IOM) Indonesia; May 2011.
- [14] Coping with Major Emergencies. WHO strategies and approaches to Humanitarian action. WHO document WHO/EHA/95.1; 1995. https://apps.who.int/iris/bitstream/handle/10665/61335/WHO_EHA_95.1.pdf?sequence=1&isAllowed=y.

- [15] Eckstein D, Hutfils M-L, Wings M. GLOBAL CLIMATE RISK INDEX 2019 who suffers most from extreme weather events? Weather-related loss events in 2017 and 1998 to 2017. *Germanwatch*.V.; 2018. p. 1–36. <https://www.germanwatch.org/en/crri>.
- [16] de Guzman M. Recap of the programme on the 7th of August 2002. In: Regional workshop on total disaster risk management; 2002. p. 1–13. <https://www.adrc.asia/publications/TDRM/19.pdf>.
- [17] Devkota RP, Cockfield G. Perceived community-based flood adaptation strategies under climate change in Nepal. *Int J Glob Warming* 2014;6(1):113–24.
- [18] Devkota RP, Bahracharya B, Maraseni TN, Cockfield G, Upadhyay BP. The perception of Nepal's Tharu community in regard to climate change and its impacts on their livelihoods'. *Int J Environ Stud* 2011;68(6):937–46.
- [19] Dheria A, et al. Evaluating implications of flood vulnerability factors with respect to income levels for building long-term disaster resilience of low-income communities. *Int J Disaster Risk Reduct* 2020;48:101608. Elsevier.
- [20] Disaster Management Bureau. National disaster management policy. Ministry of food and disaster management. Government of the People's Republic of Bangladesh; 2008.
- [21] Disaster Management of India, GOI-UNDP disaster risk reduction programme (2009–2012); n.d.
- [22] Djalante R, Thomalla F, Sinapoy MS, Carnegie M. Building resilience to natural hazards in Indonesia: progress and challenges in implementing the Hyogo Framework for Action. *Nat Hazards* 2012;62:779–803.
- [23] Eckstein D, Hutfils ML, Wings M. Global climate risk index 2019 who suffers most from extreme weather events? Weather-related loss events in 2017 and 1998 to 2017. *Germanwatch*.V.; 2018. p. 1–36. <https://www.germanwatch.org/en/crri>.
- [24] European Centre for Disease Prevention and Control. Outbreak of acute respiratory syndrome associated with a novel coronavirus, China: first local transmission in the EU/EEA – third update. Stockholm: ECDC; 2020.
- [25] Guha-Sapir D. EM-DAT: the emergency events database. Brussels, Belgium: Université catholique de Louvain (UCL) - CRED; n.d. www.emdat.be. [Assessed 1 July 2020].
- [26] Ernst MJ, Islam MF, Gerard JG, Taher M. Bangladesh comprehensive disaster management programme: mid-term review. 2007.
- [27] Gautam D. Good practices and lessons learned disaster risk reduction through schools-kathmandu. National Disaster Risk-reduction Centre Nepal (NDRC Nepal); 2010, ISBN 978-99946-800-9-2.
- [28] Geis DE. By design: the disaster resilient and quality of life community. *Nat Hazards Rev* 2000;1(3):151–60.
- [29] Good Practices in Community-Based Disaster Risk Management, GOI-UNDP Disaster risk Management Programme, National Disaster Management Division, Ministry of Home Affairs, Government of India (2002–2009). <https://tnsdma.tn.gov.in/app/webroot/img/document/library/42-Good-Practices.pdf>.
- [30] Private sector strengths applied: good practices in disaster risk reduction from Japan. UNISDR; 2013.
- [31] Government of the People's Republic of Bangladesh. Bangladesh climate change strategy and action plan 2009. Dhaka: Ministry of Environment and Forests; Government of the People's Republic of Bangladesh; 2009.
- [32] Hossain MA. Community participation in disaster management: role of social work to enhance participation. *J Anthropol* 2013;9(1):159–71.

- [33] IPCC Working Group II. Impacts, adaptation and vulnerability, contribution of IPCC WGII to the IPCC fourth assessment report. Cambridge: Cambridge University Press; 2007.
- [34] Thouret JC, Lavigne F, Kelfoun K, Bronto S. Toward a revised hazard assessment at Merapi volcano, Central Java. *J Volcanol Geoth Res* 2000;100.
- [35] Kumar KKS, Tholkappian S. Relative vulnerability of Indian coastal districts to sea-level rise and climate extremes. *Int Rev Environ Strat* 2005;6(1):3–22.
- [36] Local Level Risk Management: Indian Experience, an Initiative Under GOI-UNDP Disaster Risk Management Programme, National Disaster Management Division, Ministry of Home Affairs, Government of India (2002–2007).
- [37] Luers AL, Lobell DB, Sklar LS, Addams CL, Matson PA. A method for quantifying vulnerability, applied to the agricultural system of the Yaqui Valley, Mexico. *Glob Environ Chang* 2003;13:255–67.
- [38] Marahatta S, Dongol BS, Gurgung GB. Temporal and spatial variability of climate change over Nepal (1976–2005). Kathmandu, Nepal: Practical Action Nepal; 2009.
- [39] McAdoo B, Quak M, Gnyawali KR, Adhikari BR. Roads and landslides in Nepal: how development affects environmental risk. *Nat Hazards Earth Syst Sci* 2018;18(12):3203–10.
- [40] McAslan A. Community resilience. Understanding the concept and its application. *Torrens Resilience Institute*; 2011. www.torrensresilience.org/.
- [41] McBean G, Rodgers C. Climate hazards and disasters: the need for capacity building. *Wiley Interdiscip Rev Clim Change* 2010;1(6):871–84.
- [42] McCarthy JJ, Canziani OF, Leary NA, Dokken DJ, White KS, editors. *Climate change 2001: impacts, adaptation and vulnerability*. Cambridge: Cambridge University Press; 2001.
- [43] Mishra V, Aadhar S, Asoka A, Pai S, Kumar R. On the frequency of the 2015 monsoon season drought in the Indo-Gangetic Plain. *Geophys Res Lett* 2016;43:12102–12. <https://doi.org/10.1002/2016GL071407>.
- [44] National Disaster Management Authority. Guidelines for community-based disaster management. 2014. Retrieved from: <http://www.ndma.gov.in/pdf/draftnationalpolicyguidelinesonCBDM>. [Accessed 11 June 2020].
- [45] National Plan for Disaster Management (2016-2020). Building resilience for sustainable human development. Government of the People’s Republic of Bangladesh Ministry of Disaster Management and Relief; 2007. p. 1–77.
- [46] National Planning Commission. Nepal flood 2017: post flood recovery needs assessment. Kathmandu: Government of Nepal; 2017.
- [47] Natural Disasters Organization Australian emergency manuals series (manual 3). Emergency Management Australia (EMA); 1996. <https://reliefweb.int/sites/reliefweb.int/files/resources/D66AEE7768867E49C1256C3A002CD1EF-ema-manual-1996.pdf>.
- [48] Nicola M, Alsafi Z, Sohrabi C, Kerwan A, Al-Jabir A, Iosifidis C, Agha M, Agha R. The socioeconomic implications of the coronavirus pandemic (COVID-19): a review. *Int J Surg* 2020;78:185–93. Elsevier.
- [49] Sapkota S, Paudel MN, Thakur NS, Nepali MB, Neupane R. Effect of climate change on rice production: a case of six VDCs in Jumla District, Nepal. *J Sci Technol* 2011;11:57–62.
- [50] Sarker AA, Rashid AKMM. Landslide and flashflood in Bangladesh disaster risk reduction approaches in Bangladesh, disaster risk reduction. Japan: Springer; 2013.
- [51] Scheidegger. Hazards: singularities in geomorphic systems. *Geomorphology* 1994;10:19–25.
- [52] Seddiky A, et al. International principles of disaster risk reduction informing NGOs strategies for community-based DRR mainstreaming: the Bangladesh context”. *Int J Disaster Risk Reduct* 2020;48:101580.

- [53] Selby D, Kagawa F. Disaster risk reduction in school curricula: case studies from thirty countries. Geneva, Switzerland: United Nations Children Fund UNICEF 5/7 avenue de la paix, 1211; 2012.
- [54] Shi P, Liu J, Yao Q, Tang D, Yang X. Integrated disaster risk management of China. 2007. <http://www.oecd.org/dataoecd/52/14/38120232.pdf>.
- [55] Sims JH, Baumann DD. Education programs and human response to natural hazards. *Environ Behav* 1983;15(2):165–89. <https://doi.org/10.1177/097133360701900201>.
- [56] Smith K. Environmental hazards: assessing risk and reducing disaster. London: Routledge; 1992.
- [57] Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, Iosifidis C, Agha R. World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). *Int J Surg* 2020;76:71–6. Elsevier.
- [58] Thattai DV, Sathyanathan R, Dinesh R, Harshit LK. Natural disaster management in India with focus on floods and cyclones. ICCIEE 2017, IOP Conf Series: Earth & Environ Sci 2017;80:012054.
- [59] Training Package, WHO/EHA Panafrican Emergency Training Centre. Addis Ababa Updated March 2002 by EHA; n.d. <https://apps.who.int/disasters/rep0/7656.pdf>.
- [60] Twigg J. Characteristics of a disaster-resilient community: a guidance note. London: DFID Disaster Risk Reduction Interagency Coordination Group. DFID; 2007.
- [61] UN development agenda. UN system task team on the POST-2015; n.d. https://www.un.org/en/development/desa/policy/untaskteam_undf/thinkpieces/3_disaster_risk_resilience.pdf.
- [62] UNCHS. Settlement planning for disasters, Nairobi. 1981.
- [63] UNDP- a global report - reducing disaster risk a challenge for development. New York, USA: United Nations Development Programme Bureau for Crisis Prevention and Recovery; 2004. www.undp.org/bcpr.
- [64] UNDP Nepal community-based disaster management practices, 2006–2008.
- [65] UNDRR. Disaster risk reduction in Nepal: status report 2019. Bangkok, Thailand: United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific; 2019.
- [66] UNICEF. When coping crumbles- Droughts in India 2015–2016. 2016.
- [67] UNICEF- for every child, Nepal; n.d. <https://www.unicef.org/nepal/emergency>. [Assessed 23 June 2020].
- [68] UNISDR (United Nations International Strategy for Disaster Reduction). Hyogo framework for action 2005–2015: building the resilience of nations and communities to disasters: extract from the final report of the world conference on disaster reduction (a/Conf.206/6. Geneva: United Nations; 2007. http://www.preventionweb.et/files/1037_hyogoframeworkforactionenglish.pdf.
- [69] United Nations. The Geneva mandate on disaster reduction. In: IDNDR international programme forum. 5–9 July 1999, Geneva; 1999.
- [70] United nations development programme- annual report. 2018. <https://www.undp.org/content/undp/en/home/librarypage/corporate/annual-report-2018.html>.
- [71] UN-SPIDER, Nepal Department of Water Induced Disaster Management; n.d. <http://www.un-spider.org/institutions-guides/nepal-department-water-induced-disaster-management>. [Assessed on 23 June, 2020].
- [72] Vale L, Campanella T. The resilient city: how modern cities recover from disasters. New York: Oxford University Press; 2004.

- [73] WHO Coronavirus Disease. (COVID-19) dash board as accessed on 2020/7/23, 7:02pm CEST; n.d. <https://covid19.who.int/>.
- [74] Wildavsky AB. Searching for safety. Berkeley, CA: University of California Press; 1988.
- [75] Wisner B. Untapped potential of the world's religious communities for disaster reduction in an age of accelerated climate change; an epilogue & prologue, religion, vol. 40; 2010. p. 128–31 (2).
- [76] World Bank. Lessons from the reconstruction of post-tsunami Aceh: build back better through ensuring women are at the center of reconstruction of land and property. Washington D.C.: World Bank; 2011.
- [77] World Health Organization as Accessed on 24 July 2020. https://www.who.int/health-topics/coronavirus#tab=tab_1.
- [78] World Bank. Novel coronavirus (2019-nCoV) situation report — 1. 2011.
- [79] Xu R, Cui B, Duan X, Zhang P, Zhou X, Yuan Q. Saliva: potential diagnostic value and transmission of 2019-nCoV. *Int J Oral Sci* 2020;12. <https://www.nature.com/articles/s41368-020-0080-z>.
- [80] Yohta K. Geographical study of the disaster in Japan. Review article of the special issue on geography in Japan after the 1980s (Part II). *Geogr Rev Jpn B* 2014;86(2):132–7.
- [81] Yodmani S. Disaster risk management and vulnerability reduction: protecting the poor. In: Social protection workshop 6: protecting communities—social funds and disaster management under the Asia and Pacific forum on poverty: reforming policies and institutions for poverty reduction held at the Asian Development Bank, Manila; 5–9 February 2001.
- [82] Annual climate summary 2018. Ministry Of Earth Sciences, India Meteorological Department, Government of India, Climate Monitoring & Analysis Group; May 1, 2019. <http://www.indiaenvironmentportal.org.in/files/file/Annual%20Climate%20Summary%202018.pdf>.
- [83] Community participation in disaster preparedness planning: a comparative study of Nepal and Japan - final report. Asian Disaster Reduction Center prepared by MaiyaKadel; 2011.
- [84] Government of the People's Republic of Bangladesh. Comprehensive disaster management programme (phase II) inception workshop working paper. Disaster Management and Relief Division, Ministry of Food and Disaster Management; 2010.
- [85] INCCA. Indian network for climate change assessment, climate change and India- A 4×4 assessment, A sectoral and regional analysis for 2030. Ministry of Environment and Forest, Government of India; November 2010.
- [86] MDF-JRF Working Paper Series: Lessons Learned from Post-Disaster Reconstruction in Indonesia. Adapting community driven approaches for post-disaster recovery: experiences from Indonesia. Jakarta, Indonesia: MDF - JRF Secretariat The World Bank Office; December 2012. p. 1–91.
- [87] Monitoring and reporting progress on community-based disaster risk management in Indonesia partnerships for disaster reduction-South East Asia phase 4. European Commission, ADPC, UNESCAP; April 2008.
- [88] Statement on climate of India during 2019, India meteorological department. Climate Research and Services (CRS); January 6, 2020. <http://www.indiaenvironmentportal.org.in/files/file/Statement%20on%20Climate%20of%20India%20during%202019.pdf>.

- [89] The World Bank, GFDRR. Building Indonesia's resilience to disaster: experiences from mainstreaming disaster risk reduction in Indonesia program. 2016. <http://documents1.worldbank.org/curated/en/318951507036249300/pdf/106245-REVISED-PUBLIC-Building-Indonesia-s-Resilience-to-Disaster.pdf>.
- [90] White GF. In: Knees AV, Smith SC, editors. Optimal flood damage management: retrospect and prospect. Water research. Baltimore: John Hopkins Press; 1966.
- [91] White paper disaster management in Japan. 2019. http://www.bousai.go.jp/kaigirep/hakusho/pdf/R1_hakusho_english.pdf.