Chapter 1
Understanding Disaster Risk Reduction and Resilience: A Conceptual Framework

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Abstract Disaster risk reduction and resilience should be seen as a concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events. The major threat emanates from an increasingly interconnected and interdependent social, technical, and biological systems and complex risk landscape. In developing countries, disasters represent a major source of risk for the poor and can potentially destroy development gains and accumulated wealth.

It should be noted that while the term "disaster reduction" is sometimes used, the term "disaster risk reduction and resilience" provides a better recognition of the ongoing nature of disaster risks and the ongoing potential to reduce these risks. At a time when climate change is increasing the frequency and severity of extreme weather events, disasters will continue to be major impediments to sustainable development so long as the economic incentives are to develop in hazard-prone locations. Integrating disaster risk reduction into investment decisions is the most cost-effective way to reduce these risks; investing in disaster risk reduction is therefore a precondition for developing sustainably in a changing climate.

In this chapter, an attempt has been made to simplify our understanding of the core idea and processes involved in disaster risk reduction and resilience with an intention to disseminate it into an ever-expanding community of students, researchers, and professionals. A historical approach has been attempted by way of illustrations and data tabulation. It seeks to increase the likelihood that this chapter is fully taken advantage of at the above-stated scales of interest.

Keywords Disaster risk reduction · Resilience · Sustainability · Awareness-raising · Preparedness · Strategies · Conceptual framework

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1 Introduction

Disasters have always threatened human communities (Brunsma and Picou 2008). Disaster events and catastrophes have become routine in the twenty-first century, for example, hurricane Katrina in 2005, the Wenchuan earthquake in 2008, and the Tohoku earthquake off the Pacific coast of Japan in 2011 (Wang et al. 2019) to just name a few. The period between 2019 and the first quarter of 2020 has witnessed the deadly European heat waves, floods in Asia, wildfires in California and Australia, and man-made fire in Amazonia. At a regional level, Asia was the most vulnerable continent with 40% of all disaster events, accounting for 45% of the total deaths and 74% of the people affected by disasters globally (CRED 2020) to the recent cyclonic onslaughts of tropical cyclones battering on both the Indian coasts, cyclone Amphan in the eastern coast of India and Bangladesh, leaving a trail of damage and destruction on one of the poorest global communities.

It is such devastations which leave scars and question the credibility of the political systems and their policies related to disaster risk reduction. They have a moral obligation to provide timely information and credible knowledge base to the afflicted. Their incompetency to deliver timely relief and manage sustainably is alarming.

Estimates have shown that approximately 3.8 million km^2 and 790 million individuals are exposed to at least two natural hazards, while 0.5 million km^2 and 105 million individuals are exposed to three or more natural hazards. In particular, climate change has demonstrated an increase in the magnitude, frequency, and geographic distribution of natural disasters (Maleksaeidi et al. 2017). These statistics demonstrate the critical multi-hazard environment to which the global population is exposed. The combination of human and economic losses, together with reconstruction costs, makes natural disasters both a humanitarian and an economic crisis (Bronfman et al. 2019; Dilley et al. 2005). The underlying processes for both risk and resilience exist within the social order itself; societies, communities, and organizations have the power to reduce risk and become more resilient. Citizen preparedness strategies play a key role in reducing the effects of hazards that cannot be mitigated. Nevertheless, a more concerted effort and focus on managing disasters is the present demand. To manage the underlying process that creates risk, to have a clear approach and understanding towards handling an impending risk and disaster. So a conceptual shift from responding to events to managing risk must be at the fore, acting collectively in handling an existing and a potential risk factor (Olson et al. 2020; Bronfman et al. 2019). Future global catastrophes also threaten the human community as the pandemic spread of diseases and the inevitable daily threat of armed conflict pose risks for the future.

However, scientific study and research in DRR confirm the non-linear change threatening all social, environmental and economic aspects of sustainable development. The Global Assessment Report (GAR 2019) has warned about the correlations of the emerging risks across multiple dimensions and scales. The major threat emanates from an increasingly interconnected and interdependent social, technical, and biological systems and complex risk landscape.

A turning point in the history of disaster risk reduction (DRR) was the intergovernmental commitment through the United Nations to foster disaster risk management (DRM) during the International Decade for Natural Disaster Reduction (1990–1999). The first World Conference on Natural Disaster Reduction in 1994 paved the way for the adoption of the Yokohama Strategy and Plan of Action for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation. The international community prioritized the urgency to tackle frequent occurrence of extreme events through preparedness and recovery. One of the main policy outcomes was the Hyogo Framework for Action 2005–2015 (HFA) (Aitsi-Selmi et al. 2016). The Sendai Framework was endorsed by the United Nations General Assembly following the third United Nations World Conference on Disaster Risk Reduction, held in Sendai, Japan, in March 2015, as the successor to the HFA (UNFCCC 2017).

The United Nations Office for Disaster Risk Reduction (UNISDR) has defined DRR as "the conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development" (UNISDR 2010).

Disaster risk is an intrinsic characteristic of human society, arising from the combination of natural and human factors and subject to exacerbation or reduction by human agency. Disasters have an enormous impact on human development. Globally, events such as earthquakes, floods, and droughts contribute to tens of thousands of deaths, hundreds of thousands of injuries, and billions of dollars in economic losses each year. In developing countries, disasters represent a major source of risk for the poor and can potentially destroy development gains and accumulated wealth (World Bank 2014; O'Brien et al. 2008; Hardin 1968). Since the beginning of the 1990s, the United Nations has been promoting efforts to change the paradigm of disasters, advocating for the incorporation of disaster risk reduction efforts worldwide as a way to reduce the effects of natural hazards on vulnerable communities.

This has been recognized by the UN member states around the world which led to the adoption of the Sendai Framework for Disaster Risk Reduction 2015–2030. Between 2015 and 2030, member states around the world are expected to conduct a variety of efforts within the context of the four priority areas contained in the Sendai Framework, as a way to reduce risks with the goal of minimizing losses due to the manifestation of hazards of natural origin. The four priority areas are as follows:

(i) Understanding disaster risk
(ii) Strengthening disaster risk governance to manage disaster risk
(iii) Investing in disaster risk reduction for resilience
(iv) Enhancing disaster preparedness for effective response and to "build back better" in recovery, rehabilitation, and reconstruction (UN-SPIDER 2019)

Together, these four priorities aim for "the substantial reduction of disaster risk and losses in lives, livelihoods and health in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries" (UNFCCC

2017). The Sendai Framework solidifies a paradigm shift from managing disasters to managing current and future risks, bringing in resilience-building as the core target to be reached by 2030.

The scientific nature of the Sendai Framework visibly calls for stronger understanding of disaster risks and root causes, access to reliable data at the scales where action needs to be taken, developing risk assessment and maps at local level, and long-term multi-hazard and solution-oriented research, strengthening scientific capacity to assess risks (including vulnerability and exposure). It further recommends timely interpretation and use of risk information and cooperation between scientists, policy-makers, and stakeholders to support the science-policy interface through evidence-based decision-making, thereby providing a broader global awareness of the social and economic consequences of natural disasters.

The limiting factor to appropriate implementation of disaster resilience is compounded by poor planning and weak policies. Although the science is well documented, the absence of related data and case studies pertaining to any particular disaster study is a challenge in itself. Sufficient financial support and training for any ongoing DRR research will be a way forward in establishing a strong database for the research community.

Moreover, disasters are avoidable interruption which requires effective systems and sustainable strategies (Turnbull et al. 2013), most developing countries lack the tools, expertise, and instruments to effectively manage and monitor the potential impacts of disasters into their investment decisions (Miyan 2014). The idea of a paradigm shift in understanding DRM as continuum rather than in phases, between pre-, during, and post-disaster situations in countries, which are regularly exposed to hazards, has been proposed by Baas et al. (2008).

In this chapter, the author has not endeavored to create a new knowledge but has rather compiled the existing knowledge on disaster risk reduction and resilience, with an intention to disseminate it into an ever-expanding community of students, researchers, and professionals. It seeks to increase the likelihood that the paper is fully taken advantage of at the above-stated scales of interest.

2 Conceptual Framework for Disaster Reduction

Disasters, caused by natural and man-made hazards, are more frequent, long-lasting, and far more destructive than the previous one. Recognition of the increased impacts of disasters led to the creation of the International Strategy for Disaster Reduction (UNISDR) in December 1999, which serves as secretariat for the International Strategy for Disaster Reduction (ISDR) system and was adopted by the United Nations member states in 2000 (de la Poterie and Baudoin 2015).

The 2030 global policy agenda, comprising the Sendai Framework for Disaster Risk Reduction, the 2030 Agenda for Sustainable Development, the Addis Ababa Action Agenda, the Paris Agreement on Climate Change, the New Urban Agenda, and the Agenda for Humanity, together has strengthened the understanding of the

issue of risk and the means to dealing with them. The common message they convey is on understanding the core aspects of risk creation and propagation – exposure and vulnerability, as well as the hazard characteristics and their dynamic interactions – all aimed at sustainable development and resilience (Aitsi-Selmi et al. 2016).

More recently, in 2019, Mami Mizutori, the Special Representative of the UN Secretary-General for Disaster Risk Reduction, has reflected on the issue succinctly: "The Sendai Framework can be seen as the connecting tissue for all 2030 agreements with its goal on the reduction of existing risks, prevention of the creation of new risks, and building long-term resilience" (Mizutori 2019).

Disaster risk reduction (DRR) is the concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (UNDRR 2018). DRR describes the development and application of policies, strategies, and practices that minimize vulnerabilities and disaster risks throughout a society, to avoid (prevent) or to limit (mitigate and adapt to) the adverse impacts of hazards, within the broad context of sustainable development.

Sharing information and experience for the purposes of public information and all forms of education and professional training is important for creating a culture of safety. Equally, the crucial involvement of local community action and new forms of partnership can be motivated by the acceptance of shared responsibilities and cooperation. Traditionally, disaster management follows four phases of an emergency event such as mitigation (preplanning), preparation, response, and recovery (ISDR 2004).

However, DRM includes and goes beyond DRR by adding a management perspective that combines prevention, mitigation, and preparedness with response. In fact, DRR efforts such as prevention, mitigation, preparedness, networking, local-level insurance, shelter protection, and water provision contribute to poverty reduction, while poverty reduction efforts such as job and livelihood creation and protection could also help to reduce disaster risks. For instance, water and environmental management have emerged as prominent links between DRR and poverty reduction. On a global scale, DRM should be incorporated into poverty reduction policies and initiatives. DRR uses a wide range of options including legal, institutional, and policy frameworks, administrative mechanisms, and procedures related to risk reduction of current and future disasters.

The Hyogo Framework for Action (HFA) has outlined the roadmap for DRR, encompassing governance, risk assessment and early warning, knowledge and education, and reduction of underlying risk factors in the context of development and disaster preparedness and response. The HFA has set five priorities for promoting DRR which are as follows:

- Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.
- Identify, assess, and monitor disaster risks and enhance early warning.

- Use knowledge, innovation, and education to build a culture of safety and resilience at all levels.
- Reduce the underlying risk factors.
- Strengthen disaster preparedness for effective response at all levels.

Hence, the International Council for Science (ICSU), the International Social Science Council (ISSC), and the United Nations International Strategy for Disaster Reduction (UNISDR) have taken a global, multi-, and interdisciplinary program, entitled Integrated Research on Disaster Risk (IRDR) to addressing the challenge of natural and human-induced environmental hazards, mitigating their impacts, and improving related policy-making mechanisms. Strategic goals of the IRDR program (2013–2017) are as follows:

- Promote integrated research, advocacy, and awareness-raising
- Characterization of hazards, vulnerability, and risk
- Understanding decision-making in complex and changing risk contexts
- Reducing risk and curbing losses through knowledge-based actions
- Networking and network building
- Research support

Attainment of these goals would lead to a better understanding of hazards, vulnerability, and risk; the enhanced capacity to model and project risk into the future; greater understanding of the decision-making choices that lead to risk and how they may be influenced; and how this knowledge can effectively lead to disaster risk reduction.

Strategies for DRR include hazard, vulnerability, and capacity assessments. Local-level strategies should be linked with appropriate top-down strategies and local government interventions. Successful DRR creates resilient communities, while ensuring that vulnerability is not increased through development efforts or other externally initiated activity. Therefore, multiple actions with multiple stakeholders are needed for managing the risk of disasters in a way that also promotes development (Begum et al. 2014).

The disaster risk management approach, as represented in Fig. 1.1, is generally accepted to consist of the following:

- Risk assessment and analysis
- Risk management
- Risk communication

2.1 Risks Assessment and Analyses

Risk assessment includes the identification of hazard agents (seen as hazard risk factors, e.g., tsunamis, flooding, oil leakage, and urban fires), exposure and consequence assessment, and risk characterization.

Risk assessment can play a critical role in impact modeling before an event strikes (e.g., in the days leading up to a cyclone), or it can provide initial and rapid

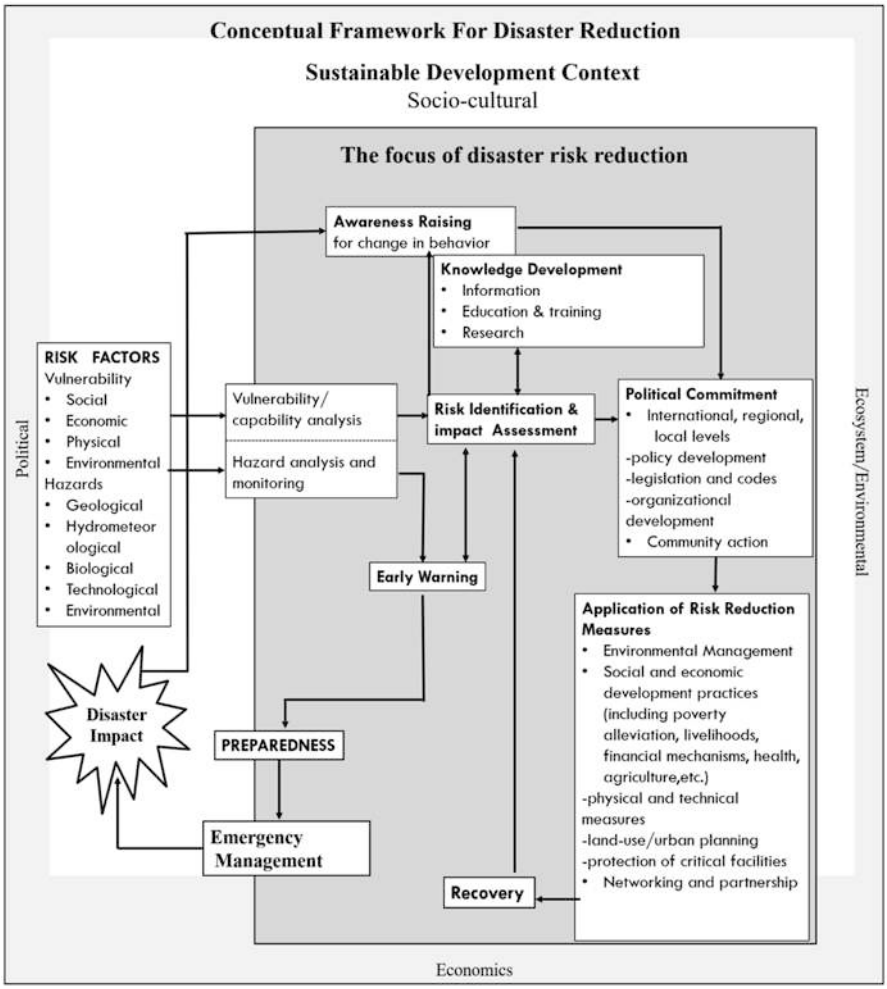

Fig. 1.1 A framework for disaster risk reduction. (*Source:* ISDR 2004, pp. 15)

estimates of human, physical, and economic loss in an event's immediate aftermath. Moreover, risk information for resilient reconstruction needs to be available before an event occurs, since after the event there is rarely time to collect the information needed to inform resilient design and land-use plans (GFDRR 2014).

2.2 Risk Management

Risk management encompasses all those activities required to reach and implement decisions on risk reduction or elimination. Once a risk has been characterized, an informed decision can be made as to what control measures, if any, are needed to

reduce the risks or eliminate the hazard. Control measures can consist of any action for risk reduction or elimination. Often control measures involve reducing the probability of occurrence or the severity of an incident.

Risk management also must start at the lowest possible level of government administration and community with each level accepting responsibility for an appropriate level of mitigation, preparedness, and response and/or recovery activity. This includes strengthening and supporting community-level initiatives on disaster risk reduction and encouraging active participation or involvement of people in the process of risk assessment, planning, and implementation of disaster risk management strategies and activities.

An increase in the frequency of disasters and consequent impact on lives and livelihoods has led communities to develop some coping mechanism/strategies based on their existing capacities.

2.3 Risk Communication to the Public

The risk management process cannot be successful without a plan for providing and receiving information to and from the public, and such end-to-end systems need to be established and effectively functioning well before an emergency occurs.

The Sendai Framework promotes a people-centered approach and the use of a participatory process in decision-making that responds to the needs of users and is sensitive to social and cultural aspects, gender, and age. The severity of the impacts of a disaster depends strongly on the level of exposure and vulnerability (Terry and Goff 2012) in the affected area. Evidence indicates that overall risk has increased worldwide, largely due to increases in the exposure of persons and assets and possibly increases in inequality, which is a shaper of vulnerability, thus calling for greater attention to these dimensions of risk (Cavallo and Ireland 2014).

3 Disaster Scenario

Since the 1980s, there has been an increasing trend in disaster-related losses as total reported losses amounted to US$3.8 trillion. Such events further trap more people in poverty as poor and marginalized households tend to be less resilient and are faced with greater difficulties to recover from their impacts. Disaster risk is increasing mainly as a result of growing exposure of people and assets to natural hazards (World Bank 2019; CRED 2018).

Records maintained by Centre for Research on the Epidemiology of Disasters (CRED) show that disaster frequency appears to be increasing, from about 100 events per decade in the 1900–1940, to 650 per decade in the 1960s, to 2000 per decade in the 1980s. By the 1990s this number had reached almost 2800 events per decade. The increase in reported disasters can be partly explained by a higher

number of small- and medium-level events that are related to natural and human-induced or socio-natural phenomena. While the number of geophysical disasters has remained fairly steady, the number of hydrometeorological disasters has increased significantly over the decades. An increase in global costs of weather-related disasters alone have increased from an annual average of USD 8.9 billion in 1977–1986 to USD 45.1 billion in the 1997–2006 period (O'Brien et al. 2008).

Recent estimates by CRED (2018) show that between 1998 and 2017 climate-related and geophysical disasters killed 1.3 million people and left a further 4.4 billion injured, homeless, displaced, or in need of emergency assistance. In 1998–2017 disaster-hit countries also reported direct economic losses valued at US$ 2908 billion, of which climate-related disasters caused US$ 2245 billion or 77% of the total. This is up from 68% (US$ 895 billion) of losses (US$ 1313 billion) reported between 1978 and 1997.

In absolute monetary terms, over the last 20 years, the USA recorded the biggest losses (US$ 945 billion), reflecting high asset values as well as frequent events. China, by comparison, suffered a significantly higher number of disasters than the USA (577 against 482) but lower total losses (US$ 492 billion). As economic data for such losses are hard to get, the World Bank has calculated that the real cost to the global economy is a staggering US$ 520 billion per annum, with disasters pushing 26 million people into poverty every year. Inequality is even greater than available losses data suggest because of systematic underreporting by low-income countries.

Georeferencing an analytical technique is being employed by CRED, to have an in-depth understanding of EM-DAT data to reveal the relative vulnerabilities of rich and poor and quantify how the human cost of disasters increases in cases where national income levels decline. This has helped reveal the high proportion of loss in low-income countries (130 people per million) to only 18 in high-income countries. This proves that people exposed to natural hazards in the poorest nations were more than seven times more likely to die than equivalent populations in the richest nations (UNDRR 2018; ESCAP/CDR 2017; O'Brien et al. 2008) (Tables 1.1 and 1.2).

3.1 Drivers of Disaster Risk

There is a strong correlation between disaster and development. Inappropriate development can increase levels of vulnerability to disaster risk, and disasters negatively affect poor countries' development. In addition to climate change, the main drivers of risk are poorly planned and managed urbanization, environmental degradation, poverty and weak governance, and gender inequality (UNISDR-WMO 2012).

The major drivers to disaster risk have been the substantial growth of population and assets in at-risk areas. Migration to coastal areas and the expansion of cities in flood plains, coupled with inappropriate building standards, are among the main reasons for the increase. As reported climate-related disasters accounted for 74% (US$2.6 trillion) of total reported losses, 87% (18,200) of total disasters, and 61% (1.4 million) of total lives lost (CRED 2018; World Bank 2014).

Table 1.1 Death toll by disaster type (2018 vs. average twenty-first century)

Event	2018	Average (2000–2017)
Drought	0	1361
Earthquake	4321	46,173
Extreme temperature	536	10,414
Flood	2859	5424
Landslide	282	929
Mass movement (dry)	17	20
Storm	1593	12,722
Volcanic activity	878	31
Wildfire	247	71
Total	10,733	77,144

Source: CRED-UNSIDR (2019)

Table 1.2 Total number of people affected by disaster type (2018 vs. average twenty-first century)

Event	2018	Average (2000–2017)
Drought	9,368,345	58,734,128
Earthquake	1,517,138	6,783,729
Extreme temperature	396,798	6,368,470
Flood	35,385,178	86,696,923
Landslide	54,908	263,831
Mass movement (dry)	0	286
Storm	12,884,845	34,083,106
Volcanic activity	1,908,770	169,308
Wildfire	256,635	19,243
Total	61,772,617	193,312,310

Source: CRED-UNSIDR (2019)

In support of these estimations, based on Intergovernmental Panel on Climate Change (IPCC) reports, it is projected that climate change will increase the frequency and intensity of the most severe weather-related hazards over the decades. In addition to climate change, the main drivers of risk are poorly planned and managed urbanization, environmental degradation, poverty, and weak governance. Disaster vulnerability can be reduced as a direct product of sound development. Effective risk management strategies can help in reducing disasters in the short to medium term, while reducing vulnerability over the longer term. Few countries have the tools, expertise, and mechanisms to consider the potential impact of disaster risk on their investment decisions. They rarely account for disaster losses, collect data, and assess risks systematically. As a result, they are not able to direct the necessary resources to protect their investments and reduce their exposure to future disaster impacts (World Bank 2014).

Over the past decade, more than 1.5 billion people have been affected by disasters that have cost at least US$ 1.3 trillion. Climate change, weak governance, and an increasing concentration of people and assets in areas exposed to natural hazards are driving disaster risk upward, especially in poor and fragile countries (CRED-UNISDR 2018).

Another major underlying driver to disaster risk is the prevailing gender inequality. Research has shown that women are more at risk of being affected by disasters and their aftermath. The multiple levels of discrimination that women are prone to (in education, healthcare, employment, and control of property) are some notable drivers that inevitably make women more vulnerable in and after a crises (Aitsi-Selmi et al. 2016). They are likely to suffer increased poverty rates, higher rates of sexual violence, and a lack of adequate housing in the aftermath of a disaster (Henrici et al. 2010). Likewise, women are not adequately represented in the decision-making authorities, and the sociocultural attitudes and norms hinder their participation when it comes to decision-making (Chineka et al. 2019).

3.2 Disaster Risk Reduction: A Shared Responsibility

In today's world, societies are confronted with rapid change. Therefore, the value of disaster risk reduction can only be realized through rigorous identification and continuous evaluation of the relationships that exist between the beliefs and conditions in which people live, the changing environment people inhabit and depend upon for their livelihoods, and the forces of nature (ISDR-RAED 2011).

Most importantly, disaster risk reduction relies on the consequences of collective decisions made and individual actions taken or not taken. The emergence of a disaster reduction culture is conditioned by the following contexts and processes:

- Political context
- Sustainable development in its three related contexts: sociocultural, economic, and environmental
- Regional considerations linking disaster reduction and sustainable development (ISDR 2004)

In this context, it can be noted that "shared responsibility" attributes to increased responsibility for all. It recommends that state agencies and municipal councils adopt increased or improved protective, emergency management and advisory roles. In turn, communities, individuals, and households are expected to take greater responsibility for their own safety and to act on advice and other information given to them by the government agencies. Shared responsibility is not about equal responsibility; there are some areas in which the state is bound to be more responsible than the community (Wilkins and McCarthy 2009).

4 DRR and Sustainability

Promoting sustainability in disaster reduction means recognizing and making the best use of connections among social, economic, and environmental goals to reduce significant hazard risks. This entails abilities to reduce exposure and aid recovery from infrequent large-scale, but also more common smaller-scale, natural and human-driven events.

The bottom line for any country, especially the poorest, is to build sustainable communities with a social foundation that provides for health, respects cultural diversity, is equitable, and considers the needs of future generations. All countries require a healthy and diverse ecological system that is productive and life sustaining and a healthy and diverse economy that adapts to change and recognizes social and ecological limits. This cannot be achieved without the incorporation of disaster reduction strategies, one of six principles of sustainability supported by strong political commitment. The motivation to invest in disaster risk reduction is very much a poverty reduction concern. It is about improving standards of safety and living conditions with an eye on protection from hazards to increase resilience of communities.

A safer society to withstand disasters may be argued as a case of ethics, social justice, and equity. It is also motivated by economic gains. Socioeconomic development is seriously challenged when scarce funds are diverted from long-term development objectives to short-term emergency relief and reconstruction needs. Environmentally unsound practices, global environmental changes, population growth, urbanization, social injustice, poverty, conflicts, and short-term economic vision are producing vulnerable societies. The impact of development on disasters in an increasingly unstable world should be fully embraced if disaster risk reduction is to yield its expected benefits.

This takes on particular urgency in the face of long-term risks brought about by climate change which goes much beyond environmental degradation or mismanagement of natural resources. Development as usual is blind to risk and fuels disasters which threaten further development (ISDR 2004).

UN Development Programme's (UNDP) disaster risk reduction efforts aim to risk-inform development in line with the goals and targets of the Sustainable Development Goals (SDGs) and the Sendai Framework for Disaster Risk Reduction. This poses a critical threat to achieving the Sustainable Development Goals (SDGs). Specifically, UNDP works with country partners to strengthen national and subnational policy and legal and institutional systems, foster greater coherence of disaster risk reduction and climate adaptation efforts, provide access to risk information and early warning systems, and strengthen preparedness and response measures. Together, these efforts strengthen the resilience of countries and urban and rural communities (UNDP 2020) (Table 1.3).

5 Approaches to Reduce Disaster Risk: International Strategies and Frameworks for Action

5.1 The Yokohama Strategy

The Yokohama Strategy and Plan of Action for a Safer World was adopted in 1994 following the United Nations World Conference on Natural Disaster Reduction, held in Yokohama, Japan. It is the first document providing guidelines at the international level for preparation for and prevention and mitigation of disaster impacts.

Table 1.3 Targets on disaster risk resilience in the Sustainable Development Goals

Sustainable Development Goals	Targets on disaster risk resilience
Goal 1: Ending poverty in all its forms everywhere	Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social, and environmental shocks and disasters
Goal 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production that help maintain ecosystems; that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding, and other disasters; and that progressively improve land and soil quality
Goal 3: Ensure healthy lives and promote well-being for all at all ages	Target 3d: Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction, and management of national and global health risks
Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Target 4a: Build and upgrade education facilities that are child, disability, and gender sensitive and provide safe, nonviolent, inclusive, and effective learning environments for all
Goal 9: Build resilient infrastructure, promote sustainable industrialization, and foster innovation	Target 9.1: Develop quality, reliable, sustainable, and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all
Goal 11: Make cities and human settlements inclusive, safe, resilient, and sustainable	Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations
Goal 13: Take urgent action to combat climate change and its impacts	Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
Goal 15: Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Target 15.3: By 2030, combat desertification; restore degraded land and soil, including land affected by desertification, drought, and floods; and strive to achieve a land degradation-neutral world

Source: ESCAP/CDR (2017)

The Yokohama Strategy was a product of the International Decade for Natural Disaster Reduction (1990–2000) and, more specifically, of the World Conference on Natural Disaster Reduction held in 1994. The importance of community involvement in DRR has been enshrined in these two international events.

5.2 The Hyogo Framework for Action 2005–2015

The following decade (2000s) represents a shift in the way DRR is perceived, moving from a strong focus on coping capacities and relief interventions to an increased attention brought to risk preparedness and prevention.

Hence, DRR became a popular idea with the World Conference on Disaster Risk Reduction held in Kobe, Hyogo, Japan, in mid-January 2005. The conference coincidentally took place in the aftermath of the 2004 tsunami in the Indian Ocean, which affected millions of people and raised public awareness about the so-called "natural" disasters, their risks, and their serious impacts. The outcome of the conference, the Hyogo Framework for Action 2005–2015 (HFA), is probably the most significant international document popularizing the notion of DRR. The 2000–2009 decade is also critical in terms of shifting concerns around disaster issues, with an increased focus on risk preparedness. The focus of this approach is seen evolving both in academia and among major organizations working in the field of DRR (de la Poterie and Baudoin 2015).

5.3 The Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR)

The HFA was a 10-year action plan, effective from 2005 to 2015. During this decade, disasters around the world continued to produce human, economic, infrastructure, and ecological losses, especially in the most vulnerable and poorest nations. A review of the HFA resulted in the Sendai Framework for Disaster Risk Reduction 2015–2030. The scope of the Sendai Framework is broader than the HFA, with an enhanced focus on "large and small, sudden and slow onset of disasters caused by natural and man-made hazards and related environmental, technological, and biological hazards." Thus, commitments to support DRR were renewed when HFA came to an end (Tiernan et al. 2019).

It comprises a voluntary set of targets and priorities to foster increased resilience to present and future hazards and to prevent setbacks to development as the result of small and large disasters. In addition, SFDRR also intends to reflect new challenges that characterize today's world, namely, climate change, increased globalization, and the development of new technologies and expertise in the field of risk prediction and early warning systems (de la Poterie and Baudoin 2015).

6 What Is Disaster Resilience?

Disaster resilience is part of the broader concept of resilience – "the ability of individuals, communities and states and their institutions to absorb and recover from shocks, while positively adapting and transforming their structures and means for living in the face of long-term changes and uncertainty"(Combaz 2014) (Box 1.1).

Box 1.1 Definitions of Disaster Resilience
The Sendai Framework (2015): "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management" (UNFCCC 2017).

Department for International Development (DFID 2011): "the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses – such as earthquakes, drought, or violent conflict – without compromising their longterm prospects."

Hyogo Framework for Action (UNISDR 2005): "the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure" (Combaz 2014).

Resilience can be conceptualized as a characteristic of a system when considered as a whole. Traditionally a "stable" system was defined as strong, static, and resistant to change (Manyena 2006). Now, a stable system is understood as one that is flexible and able to adjust to stress, remaining more or less the same within a range of conditions. A resilient system is one with the best adaptive capacity in the face of extreme stress (Tiernan et al. 2019). It can well be understood as a system which:

(i) Remain stable in the face of external perturbations and stresses
(ii) Recover following a major disruption
(iii) Adapt to new circumstances

This equilibrium- and response-based understanding of resilience has similarly persisted in its application to public policy, where resilience has become an increasingly prevalent expression for understanding the persistence and stability of social systems.

It is hence obvious that the present social science research on resilience often takes on a macrolevel systemic approach which is nearly similar to the study of resilience in natural systems. Resilience is well understood and adopted in ecological and environmental studies which have not found parallels in other disciplines. System is increasingly the subject of analysis in ecology and environmental studies, which has been seen being borrowed by social sciences (Capano and Woo 2017).

This is clearly visible as many international development agencies have used resilience as the basis for linking actions on climate change adaptation (CCA), disaster risk reduction (DRR), social protection, humanitarian response, peace building, and food security programming. Nevertheless, resilience can be seen as a link by having created a common language and goal setting in the diverse post-2015 agreements: the Sendai Framework for Disaster Risk Reduction, the United Nations Sustainable Development Goals (SDGs), the Paris Agreement on Climate Change, and the World Humanitarian Summit framework (Tanner et al. 2017).

6.1 Components of Disaster Resilience

Manyena (2006) opined that disaster resilience has been described as both an *outcome* and a *process*. Practices focused on *outcome* have tended to adopt top-down reactive approaches which can favor the state of affairs and take attention away from inequalities resulting from insecurity and disaster. As a *process*, building disaster resilience involves supporting the capacity of individuals, communities, and states to adapt through assets and resources relevant to their context. Also it may be considered as enhancing people's rights and addressing socioeconomic, gender, and environmental inequalities that exacerbate vulnerability (Combaz 2014) (Table 1.4).

6.2 Resilience in the Global Development Frameworks

Disaster risk and resilience received insufficient emphasis in the original Millennium Development Goals (MDG) agenda, despite the close relationship between disaster impacts and sustainable development. Resilience is a precondition for sustainable development in general and more specifically for fighting poverty, hunger, and malnutrition (UNISDR 2015).

Building on the Yokohama strategy and in recognition of the need to address the multidimensional aspects of disaster risk from a development perspective, the Hyogo Framework for Action (HFA) 2005–2015 provides a strategic and systematic approach to reducing vulnerabilities and risks to hazards, involving the identification of ways to build the resilience of nations and communities to disasters. Although the progress varies from one country to another, the main global achievement is the change of mind-sets from crisis management to risk reduction with an emphasis on prevention and preparedness. The multi-stakeholder and multi-sector nature of the Hyogo Framework for Action provides guidance on how disaster risk reduction contributes to sustainable development (UNSIDR-WMO 2012). Soon after HFA, the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015–2030 besides other areas has focused on the prioritization of health risks from hazards and the need to focus on health resilience. It promotes collaboration among the disaster risk reduction, climate change adaptation, and science communities to develop strategies that protect and manage health risks arising from extreme weather and climate events (Tiernan et al. 2019).

Table 1.4 The core elements of disaster resilience as depicted in DFID's framework

Context	Whose resilience is being built – such as a social group, socioeconomic or political system, environmental context, or institution
Disturbance	What shocks (sudden events like conflict or disasters) and/or stresses (long-term trends like resource degradation, urbanization, or climate change) the group aims to be resilient to
Capacity to respond	The ability of a system or process to deal with a shock or stress depends on exposure (the magnitude of the shock or stress), sensitivity (the degree to which a system will be affected by, or will respond to, a given shock or stress), and adaptive capacity (how well it can adjust to a disturbance or moderate damage, take advantage of opportunities, and cope with the consequences of a transformation)
Reaction	A range of responses are possible, including bounce back better, where capacities are enhanced, exposures are reduced, and the system is more able to deal with future shocks and stresses; bounce back, where preexisting conditions prevail; or recover, but worse than before, meaning capacities are reduced. In the worst-case scenario, the system collapses, leading to a catastrophic reduction in capacity to cope with the future

Source: Combaz (2014), pp. 2

The global development frameworks adopted in 2015 and 2016 are structured around six separate but interrelated agreements: (a) Sendai Framework for Disaster Risk Reduction 2015–2030, (b) 2030 Agenda for Sustainable Development, (c) Paris Agreement under the United Nations Framework Convention on Climate Change, (d) Agenda for Humanity, (e) New Urban Agenda, and (f) Addis Ababa Action Agenda of the Third International Conference on Financing for Development. Building resilience to disasters is a common theme in these frameworks. Collectively, they provide a comprehensive global framework for the secretary general's call for a "shared understanding of sustainability, vulnerability and resilience" (ESCAP/CDR 2017).

Resilience is featured prominently throughout the Sustainable Development Goals and is regarded as a quality to be "built," "developed," and "strengthened," as a tool to reduce the exposure of people to hazards, and as a foundation for inclusive economic growth and prosperity. The term is also used in relation to inclusive and safe cities and high-quality and reliable infrastructure. Disaster risk reduction and resilience is clearly embedded in nine of the goals and associated targets. These goals and targets are expected to stimulate action over the next 15 years in areas of critical importance for a sustainable and resilient future (ESCAP/CDR 2017).

6.3 Rationale for a Resilience Approach to Disasters

Disaster resilience programming aims to save lives while protecting infrastructure, livelihoods, social systems, and the environment. There is a growing recognition of both the severity of natural and man-made disasters and of the inadequacy of international efforts to reduce vulnerability to them, as can be gathered from the following as put forward by Combaz (2014):

- *The frequency and severity of weather-related hazards is increasing*. Climate change "contributes to more frequent, severe, and unpredictable weather-related hazards such as droughts, tropical cyclones, floods, and heat waves."
- *Exposure to all hazards is increasing*. Exposure to natural and man-made disasters has increased and is likely to continue to increase with the effects of climate change. Over the next two to three decades, increasing exposure and vulnerability due to economic and urban development "will have a greater influence on disaster risk than climate change."
- *Disasters have set back development*. It is well documented that disasters have set back development gains, aggravated poverty, and increased vulnerability. Such negative impacts reflect and worsen inequalities, such as gendered and generational inequalities.
- *Disasters and resilience related to natural hazards, violent conflict, or state fragility share commonalities and connections, but interventions generally treat these contexts separately.* For instance, state fragility, vulnerability to climate change, and the risk of mortality from drought seem closely associated. Yet conflict prevention and DRM are treated separately, with limited crossover and little documented integration.
- *Disaster resilience has historically been underfunded.* Spending on emergency humanitarian assistance has been growing over the years. It has been argued that greater emphasis should be placed on building capacities to reduce vulnerability and support communities to recover themselves.
- *Traditional humanitarian and development approaches have been inadequate.* Humanitarian relief is targeted primarily at saving lives rather than reducing vulnerabilities; development assistance has not been sufficiently focused on building community capacity for adaptation; and approaches to DRR have often been decoupled from development, rights, and power imbalance.
- *Responsibilities and roles need to be better balanced between the fields of development and humanitarian action.* Disaster prevention requires long-term development expenditures in addition to humanitarian aid in emergencies.

6.4 Benefits of Disaster Resilience

Responses to disaster risk are enhanced with resilience which gives a careful consideration for hazards, exposure, risk, vulnerability, and capacity. Building resilience to natural hazards can have far-reaching positive effects in fragile states and violent conflicts. Evidence from a range of countries supports the potential contribution of disaster resilience to the following:

Saving lives Disaster prevention has helped limit loss of life to disasters in a number of developed and developing countries. In Bangladesh, for example, the fact that far fewer people were killed by a cyclone in 2008 (3000) than by a similar one in 1970 (almost 500,000) is attributed to better disaster prevention.

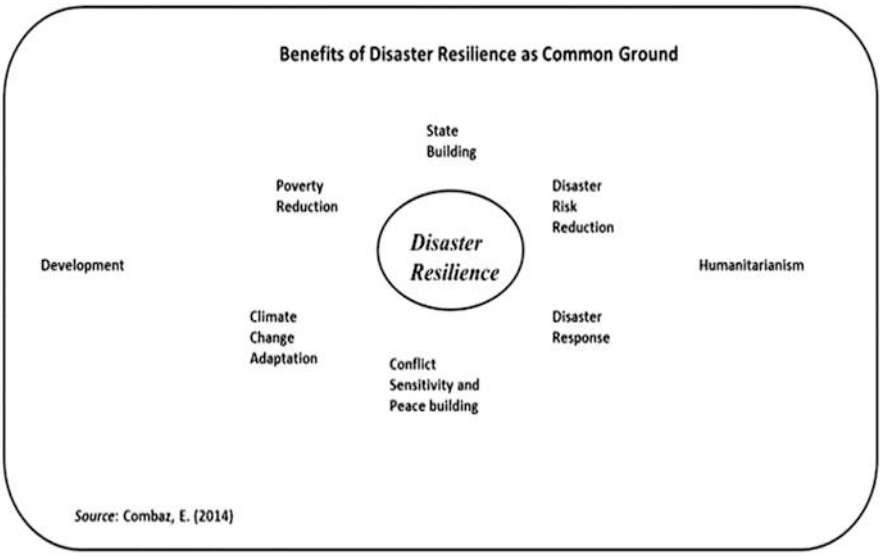

Fig. 1.2 Benefits of disaster resilience. (*Source*: Combaz 2014, pp. 7)

Protecting infrastructure and livelihoods A careful implementation of disaster prevention techniques has been found to curtail the cost of property damage from all hazards.

Protecting social systems Community-based DRR has had a positive impact on social resilience through altering attitudes and behaviors toward risk.

Protecting the environment Increased disaster resilience has in some cases been associated with behaviors that preserve the natural environment.

Supporting broader resilience in contexts of violent conflict or fragility Countries with well-performing institutions are better able to both prevent disasters and reduce the likelihood of disaster-related conflict (Fig. 1.2).

7 Challenges for Development Policies

Evidence has it that a multidisciplinary approach to disaster management which involves partnerships of various organizations and community groups plays a critical role during times of disaster (Malalgoda et al. 2010). As the situations confronted by policy-makers have increased in complexity, resilience has increasingly become a topic of interest to governments.

Leadership is sought to drive improvements in disaster resilience. The responsibility for leadership is binding upon all partners within their sphere of influence in a coordinated manner, so as to maximize the benefits from limited resources. The increasing complexity surrounding disasters calls for a more coordinated effort among all stakeholders by widening the circle of responsibility. By collaborating and strengthening existing partnerships among governments, businesses, the non-government sector, and communities, it can help authorities and civilians alike in disaster prevention, preparedness, response, and recovery (Wilkins and McCarthy 2009).

New data are continuously being generated about hazard and risk assessment science with a potential to improving our knowledge for hazardous events. This knowledge will not lead to significant reductions in losses from natural disasters if it is improperly transferred from science to policy. This transfer can be hindered by difficulties in the communication of scientific results and in their use for decision-making purposes (De Marchi 2014). The process of knowledge transfer from science to policy and the implementation of multi-risk assessments can be also hindered by existing institutional barriers and features of the existing governance systems. In the science domain, the implementation of multi-risk hazard is hindered by existing patterns of exchange among researchers and practitioners. Historically, the process of risk assessment for geological hazards evolved differently from meteorological hazards.

Currently, the comparison of different risks and their integration into a multi-risk assessment, as well as communications among different risk communities, present a number of difficulties due to differences in methodologies and the levels of uncertainty in hazard and risk assessment, different languages, definitions of concepts, and the manner in which risk and hazard are represented. The efficiency of governance systems to address multi-risks depends not only on regulatory and institutional frameworks but also on the capacities of the systems at different levels, from local to global, that are called upon to deal with risks and to entail risk policy and politics (Komendantova et al. 2016).

The rising burden of losses related to disaster and crises suggests that more compelling business cases are needed for investments to build resilience and protect human and environmental systems from damage. Cost-benefit analysis (CBA) has traditionally been used for more straightforward single investments (such as whether to build a new bridge), where data can either be readily estimated from existing documentation or easily measured from observable phenomena (Shreve and Kelman 2014). Some types of investment in resilience lend themselves more easily than others to strong business cases. This can lead to bias in decision-making, with the choice reflecting the available data rather than the best course of action.

In the literature, there are arguments which blame inherent administrative weaknesses. The local governments do not include or work with the people and which has left gaps for improvement further making it difficult to make decisions regarding the provision of reasonable solutions for disaster-related problems. Local governments are experiencing competing priorities along with limited resources, governments fail to allocate financial resources to disaster management programs,

and this will affect the proactive decision-making process related to mitigation and preparedness activities (Tanner et al. 2017).

8 Criticism for Disaster Resilience

As noted by Combaz (2014), there have been criticisms from various quarters with regard to the implementation of disaster resilience. It has been opposed on the ground that it's been a relabeling of long-standing approaches as resilience building, if this has no meaningful effect on how humanitarian or poverty reduction programs are implemented. Moreover, as a concept, disaster resilience has been depoliticized, placing too much responsibility on the individual and wider society rather than on state, who have the political power to address the underlying causes of vulnerability to disasters. It has also been suggested that the discourse of disaster resilience could stigmatize individuals and communities with low levels of resilience.

While there have been substantial and enabling investments in climate science, neither science-funding bodies nor educational foundations have made resources available for "risk and resilience science," particularly in low- and middle-income countries where students cannot easily pursue DRR as a field of study or research. Evidence shows that this represents one of the most substantial obstacles to advancing the field (Ofir and Mentz 2015).

9 Summary and Conclusions

The rise in disasters globally makes careful planning and a holistic approach to DRR critical. Disasters are now believed to be a manifestation of poor planning and weak policies. Focusing on all elements of disaster risk management (all four phases of the disaster cycle, i.e., mitigation, preparedness, response, and recovery) helps to consider how a wide range of activities associated with technology, development, governance, risk management, risk communication, and local capacity influence and approach disaster risk.

Factors such as climate change and globalization mean that actions in one region may have an impact on disaster risk in another and vice versa. This is compounded by growing vulnerability resulting from unplanned urbanization, underdevelopment, and competition for scarce resources and points to a future where disasters will increasingly threaten the world's economy and population. A disaster's severity depends on how much impact a hazard has on society and the environment. The scale of the impact in turn depends on the choices made in life and for the environment. These choices are related not only to the adoption of means for growing food, or where to build homes, but most importantly the nature of governance, from how the top officials and financial system work and even what are being taught in schools. Each decision and action makes the system more vulnerable to disasters – or more resilient to them.

The purpose of disaster risk management is to reduce the underlying factors of risk and to prepare for and initiate an immediate response should disaster hit. The concept of "building back better" implies to initiate DRR activities also during recovery and rehabilitation. The paradigm shift to conceptualize DRM as continuum (and no more in phases) reflects the reality that the transition between pre-, during, and post-disaster situations is fluid, particularly in countries, which are regularly exposed to hazards.

There is a strong correlation between disasters and development. Inappropriate development can increase levels of vulnerability to disaster risk, and, in turn, disasters can negatively affect poor countries' development. On the other hand, unsound development policies will increase disaster risk – and disaster losses. DRR which involves every part of society, every part of government, and every part of the professional and private sector seeks to restrict such losses. Integrating disaster risk reduction into investment decisions is the most cost-effective way to reduce these risks; investing in disaster risk reduction is therefore a precondition for developing sustainably in a changing climate.

The countries with the highest exposure to disaster risk often have low capacity to mitigate them. Since 1980, more than two million people and over $3 trillion have been lost to disasters caused by natural hazards, with total damages increasing by more than 600% from $23 billion a year in the 1980s to $150 billion a year currently.

However, if countries should act decisively, they can save lives and assets. Most developing countries lack the tools, expertise, and instruments to effectively manage and monitor the potential impacts of disasters into their investment decisions.

Disaster risk assessment has multiple dimensions and is now best understood by considering interdependencies between disciplines. This has created a positive synergy toward multidisciplinary research involving collaboration between geophysical, social, and engineering scientists. Moreover, it is expected that scientific training in the future should facilitate the development of scientific and technical skills that can integrate knowledge from different disciplines and produce holistic risk and impact information that addresses hazards, exposure, vulnerability, and capacity building. This integrated research with participation of at-risk communities will help co-produce knowledge related to hazards and disasters.

In the global context, under the prevailing pandemic and global lockdowns and economic downturns, one of the best practices has been observed by an increasing participation of the nongovernment and community organizations in meeting societal needs. They have come forward in providing relief in the form of food aid to the underprivileged most of whom have lost their jobs and means of livelihoods, in the aftermath of the super cyclone Amphan hitting the eastern coast of India in the state of West Bengal, which has crippled the lifeline and infrastructure. In these challenging times, the activities undertaken by these NGOs and community organizations are commendable. It is through their endurance that relief in the form of food, clothes, and tarpaulins to provide shelter has reached the affected people deep in the deltaic areas of the Sundarbans where maneuvering through wet soil and decimated resources was by itself daunting.

It can be concluded on the note that disaster resilience is not a stand-alone activity that can be achieved in a set timeframe nor can it be achieved without a joint commitment and concerted effort by all sectors of society. But it is an effort that is worth making, because building a more disaster-resilient nation is an investment into the future.

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