CHAPTER 6

Resilience
A Conceptual Note

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Saturday, 25 April 2015, was a bright spring day in Nepal's central mid-hills. At 11:56 a.m., the ground started to move with a murmur, and the shaking in-creased substantially and lasted for 56 seconds. An earthquake of a 7.6 magnitude had struck, with its epicenter was Barpak, Gorkha District. Buildings came down and the air was filled with thick dust. The tremors continued throughout that day and night. There was a major aftershock of 6.9 magnitude the next day, on 26 April. Two weeks after the main shock of 25 April, on 12 May, a third shock of 6.2 magnitude occurred causing further losses of lives and damages to property. The aftershocks, which gradually became intermittent, waned in magnitude, but continued for almost a year. The first three shocks caused significant damages in 14 districts while 18 other districts were affected to a lesser de-gree. About 9,000 people were dead.

Disaster audit

An audit would show that not only is Nepal a multi-hazard country by nature but that it also faces certain human-related technological hazards. One taken (See Box 6.1) on the situation prior to Gorkha Earthquake shows differences along class, gender and caste lines determined the scale of impact on individuals, households and communities. Disaster preparedness, risk reduction and management efforts were insufficient, and post-disaster efforts were largely guided by the rescue of those affected and other immediate response measures rather than long-term reconstruction. In almost all cases, victims received cash compensation, but its distribution was poorly organized and, in the case of relief materials, some received them and others did not. Furthermore, responses coordinated by the state and supported by humanitarian organizations were *ad hoc*. Communities and neighbours were the first responders, and, in most cases, support stopped after the first-order distribution of relief (i.e. food, water and emergency shelter).

Because state support for recovery and reconstruction was limited, recovery efforts were mostly autonomous and victims remained as deprived or even sank further into deprivation. The lack

Box 6.1

My two paisa: An Audit

I was in my office in Baluwatar, Kathmandu when the first wave hit. As the intensity increased, I frantically rushed outside. A second later a wooden rack smashed into the place I had stood. The rickety concrete building in front of my office was swinging ominously. With both palms over my head, I huddled on the side of a small wall that would offer some safety in case the building collapsed. While in that position for about two minutes, I thought of nothing except my own safety. As the shaking subsided, I looked again at the building in front of me. It had stopped swinging and, fortunately, had not collapsed. I stood up, took out my mobile phone and called my wife, mother, and sons, other members of my family and my friends. At home, everyone was out in the open area and, like everybody else in the areas hit by the earthquake, we spent the next two nights outdoors.

On Tuesday, three days after the first shock, I went to the office around midday. As I sat in my chair I received a call from a media person from Hong Kong. He asked about the earthquake, the damage and the way forward. I had worked on climate-related disasters, read and done a few writings on earthquake disaster, but this quake was too big and catastrophic for me to be specific. I answered in broad terms, "This disaster must be seen as a clarion call for better preparedness." As I hung up, I thought of my visit to Muzaffarabad after the 2005 earthquake there and the devastation it had caused. The number of deaths from Gorkha Earthquake was indeed high but, fortunately, not as high as it had been in Muzaffarabad. The day and time of its occurrence probably saved many. In my stressed mental stage, however, I had forgotten to ask his name and the name of his paper. I do not know if he ever published anything.

Like everyone else, I did my bit to contribute to the immediate relief efforts: I provided cash and essential materials to the victims through local groups in the affected areas. Since I had little capacity to help much in the response, I decided to focus on what I was able to do: undertake a disaster audit of the year prior to Gorkha Earthquake. I had hoped that this endeavour would provide lessons to understand Nepal's disaster landscape and help the nation move forward. This audit, published in Nepal's largest daily, Kantipur, revealed that Nepal had faced seven major disasters in that one year (Table 6.1). Subsequently, with the help of my colleagues, I expanded the article into a book, *Nepal ma Bipad*, and published it in 2016.

Table 6.1

Details of disasters from April 2014 to April 2015

In Everest Region, on 18 April 2014, at 6:30 a.m., a chunk of ice dislodged that caused avalanche at about 5,800 meters	The avalanche buried and killed 16 high-altitude mountaineering guides.
On 2 August 2014, a landslide occurred in Jure, Mankha VDC of Sindhupalchowk District. It deposited 6 cu m of rock and muck in the Bhote Koshi River, blocking it and creating a 55 m high temporary dam with a 0.47 sq km reservoir. The depth of the water close to the dam was 47.8 m. The Nepal Army breached the dam 37 days later.	The landslide killed 145 people, injured 27, displaced 436, and destroyed property worth NPR 130 million. The temporary reservoir inundated a two km stretch of the Kathmandu-Kodari Highway, bringing movement from Kathmandu to Tatopani to a halt. The customs and other government offices were closed and revenue collection dropped. A number of hydropower stations along the Bhote Koshi River and its tributaries were inundated, transmission lines were damaged and 67 MW of electricity were no longer transmitted to the Integrated Nepal Power System. A rumor about a possible breach of the temporary dam and the flood's affecting lower reaches of the river and North Bihar began to spread. The Government of Bihar issued a warning and evacuated a section of the population in North Bihar.
On 14 August, 2014, the districts of Surkhet, Dang, Kailali and Bardiya in Western Nepal experienced a 9 hr downpour. The rain gauge in Chisapani, Kailali District recorded 493 mm of rain from 14 to 15 August.	The cloudburst caused massive flooding in Surkhet, Banke, Bardiya and Kailali, damaging property and taking lives. Disrupted livelihoods brought misery to women, children and disabled. About 222 people died, 84 were injured and almost 100,000 directly affected.

In October 2014, the influence of hurricane Hud Hud in the Bay of Bengal extended to Nepal's central mountain region, including the districts of Manang and Mustang. The region received a large amount of snowfall on 14 October blocking Thorang-La pass, which lies between Manang and Mustang districts.	Many tourists and trekkers were trapped in snow, 35 died and some disappeared.
On 25 October, 2014, the VDCs of Shrinagar, Karki Baadaa, Seri, Srikot, Khamaale and Kotdanga of Nepal's Mugu District experienced a heavy hailstorm.	The storm damaged rice paddy worth NPR 130 million planted. The 2,608 households affected farmers did not receive immediate relief because the existing legislation had no provision for providing relief for damages caused by hailstones and the district office did not have the financial resources to help.
On 4 March, 2015, a Turkish Airlines Airbus 330 skidded off the runway at Tribhuvan International Airport and was stuck in the grass on the side.	Although nobody was hurt, the aircraft prevented the regular operation of the runway, closing Nepal's only international airport for four days, to the dismay of thousands of Nepali nationals and foreigners.
On the first week of April 2015, flu epidemic spread in the western hill district of Jajarkot.	Twenty-eight people were killed and many more were infected.

Based on Dixit et al. 2016a

of local elected representatives added to the woes as already overstretched secretaries of village development committees (VDCs) were tasked to support rescue, relief and mitigation efforts. The capacity to deal with technical disasters was limited: though trained in disaster rescue and relief, Nepal's security agencies proved not to possess the necessary tools, equipment or skills for dealing with air crashes and breaches of temporary dams. In addition, the

government had invested little in preparedness. A retired Nepal Army General admitted, "We had had lots of training, but when the earthquake struck, we were caught unaware."[1] The combination of lack of preparedness, ignorance, poverty, fragile infrastructures, degrading livelihood sources, limited employment opportunities and ineffective implementation of policies exacerbated the plight of the victims, and the issue of the psychological impact of disaster on people was largely unrecognised.

While these limitations still remain, in the aftermath of Gorkha Earthquake, terms like "build back better" and "resilience" have become commonly used. The term "build back better," a catchword of the Sendai Framework, to which the government of Nepal is a signatory, has, from an engineering perspective, a straight forward connotation: it can refer to pre- and post-disaster contexts. The reconstruction of a damaged building must be better than the original. The meaning of "resilience" in relation to recovery and reconstruction is unclear. In the introduction to their book *Resilience,* Zolli and Healy[2] write, "The resilience frame suggests a different complementary efforts to mitigation; to design our institution, embolden our communities, encourage innovation and experimentation and support our people in ways that will help them be prepared and cope with surprises and disruption even as we work to fend them off."

The key message of their work is clear: "be better prepared to deal with disruptions." But what does better preparation mean in practical terms? Any approach aiming to be better prepared to deal with disruptions requires simultaneous attention to a number of details. The first is the nature of the event that disrupts the normal functioning of a society. That event could be a high-magnitude, low-probability event such as Gorkha Earthquake or a 100-year flood, or it could be a high-probability, low-intensity event with high cumulative impact like droughts and persistent air pollution. In addition, the way either category of events affects people is dependent on the basic attributes of an individual, household and community, such as income, alternative sources of livelihood, education, skills, and access to information, as

well as on how different contending voices find salience in the public space.

The impacts of hazards even depend on the integrity of the affected natural ecosystem and its services as well as on the quality of human-built infrastructures and the services they provide. A degraded ecosystem and a poorly-built and -managed infrastructure already providing poor services are likely to be harmed more than a healthy ecosystem and robust infrastructure when a hazard disrupts them, causing deaths and worsening the quality of services. In almost all cases, policies, norms, practices and behaviour mediate the quality of the natural ecosystem, infrastructure and access to services from them.

We shall use the above-described approach to examine the disruptions caused by the 2015 earthquake and then to propose how this line of enquiry nudges us towards resilience by reducing disruption and loss.

Resilience and vulnerability

Resilience and adaptive capacity are inversely related to vulnerability, the condition of harm and defencelessness. In a practical sense, adaptive capacity is conceived as the ability of people to shift strategies and/or modify natural and human systems as conditions change in order to achieve their goals.[3] Coping, in contrast, implies barely keeping up. Adaptive capacity depends primarily on people having assured access to basic services like drinking water, food, and energy as well as a continuous flow of information across scales and boundaries. The notion of adaptation complements the idea of enhanced resilience.

When circumstances are right, individuals, families, communities, businesses, economies and ecosystems can readily deal with shocks that disrupt normal functioning. Simply put, resilience is the inner strength to deal with various pressures, and, in face of adversity, everyone possesses this strength to a certain degree. According to Resilience Alliance, "resilience is the ability to absorb disturbances, to be changed and then to re-organize and still have

the same identity while retaining the same basic structure and ways of functioning." While useful, this definition is incomplete unless it is linked to society and people because different hazards and shocks disrupt society in a context of underdevelopment, continuing poverty, joblessness, marginality and lack of choices, all conditions common in Nepal. These conditions, all of which increase vulnerability, also lower resilience.

From the perspective of minimizing vulnerability to hazards, using the concept of resilience presents challenges, particularly in terms of defining a resilient system, determining the criteria of resilience and assessing the distributional benefits of such a system. Resilience implies bouncing back in the aftermath of a shock. There is limited agreement on either the definition or application of resilience beyond the assumption that being resilient is good and that it is a useful concept for describing and explaining how socio-ecological systems behave after a disruption caused by a hazard. The idea of being resilient should not, however, obscure the fact that it is related to vulnerabilities and their embedded causes. Resilience-thinking both offers prospects for more integrated and effective policy-making towards sustainability[4] and helps unpack the complex dynamics of social-economic-environmental system.

Resilience entails progress and wellbeing even when faced with external shocks. Resilient individuals, households and communities have the ability to deal with shocks and crises, progress and ultimately attain wellbeing. Those with resilience overcome sources of harm while without it lose out. Since many underlying vulnerabilities are structural and systemic[5], all efforts at reducing vulnerability or building resilience must consider both systems and institutions as central elements. The Institute of Social Anthropology at the University of Basel recognizes this interdependence and suggests, "The concept of resilience is related to reactive capabilities of people to cope with, recover from and adjust to various risks and adversities and their proactive capacity to create options and anticipate responses to health risks and adversities". Thus, the presence of quality systems and the capacity to benefit from them are important.

Understanding resilience in this way takes us away from the idea of simply returning to the state prior to disruption or return to earlier state. Indeed, it can be argued that resilience does not mean recovery of a system to its original state at all. Zolli and Healy (2012) suggest that "resilient systems may have no base line to return to. They may reconfigure themselves continuously and fluidly to adapt to ever changing circumstances while continuing to fulfil their purpose. "The concept of resilience[6] as it emerged from ecology recognizes the overall, emergent function of a system and the qualities, services, and role that it serves within a larger system that may adapt to stresses created by various shocks."[7]

For example, a patch of forest provides multiple services, such as clean air, flood moderation, wood for fuel, medicinal and aromatic plants, localized cooling due to transpiration and carbon sequestration. A wildfire or landslide would disrupt the forest and its functions would be lost. Subsequently, however, trees would regrow and begin to again provide similar services. The composition of the forest, however, would no longer be the same. It might include new species or even previous species might be differently configured. A shock or stress may transform the constituents of the system but the functional quality of that system and the services it provides can return.

The above ecological sense of the term "resilience" is not the commonly held sense of that term in the development sector, which has greater ontological diversity than ecology does and therefore requires an awareness of how resilience will be framed and used by different actors.[8] Framing the idea of resilience leads to a number of logical questions: what does a system comprise, what are the sources of vulnerability and how will an analysis of vulnerabilities help build resilience? To answer these questions, we must visit the Nepali hazardscape and, within it, seek to understand the use of knowledge about hazard exposure; the status of the natural ecosystem and the built environment, the roles of users and agencies, and the policy context. The answers will help shape the operationalization of resilience into a post-disaster context more effectively.

Knowledge of hazard exposure: The fact that Nepal sits on top of the line at which the Indian and Eurasian tectonic plates collide is widely known. Earthquakes are endemicin this region, where the subterranean plates move together at the rate of two cm per year. Long before 2015, many experts had warned that a major earthquake would hit central Nepal, but the government and Nepali civil society were slow to act. Robert Piper, who headed the UN Resident and Humanitarian Coordinator in Nepal from 2008 to 2013 wrote in *The Guardian in 2013,* "A perfect storm of earthquake and poor governance could cripple Nepal."[9] Despite the widespread inactivity, some groups did work on improving earthquake awareness and safety and scenarios of earthquake damage in Kathmandu Valley developed. Rural areas, however, received little attention. In addition, perhaps unsurprisingly in a nation as oblivious to mental health issues as Nepal, negligible attention was paid towards the emotional impact an earthquake might have. The resultant lack of support for people may have resulted in some survivors developing post-traumatic stress disorder and other psychiatric complications after the earthquake. A kind of social amnesia about what a major earthquake could do seemed to prevail.

Condition of homestead: According to the Post Disaster Needs Assessment (PDNA), conducted after Gorkha Earthquake, damage to private homes accounted for about 75 per cent of the total loss caused by the earthquake and most of that damage occurred in settlements outside the capital. Many post-earthquake audits showed that deficiencies in design, poor quality of construction and inadequate assessment of the local geology and site characteristics exacerbated the devastation. The design (size and details) of homestead components, the selection of materials and construction practices were all flawed to various degrees, and the existing regulatory mechanisms were both inadequate and ineffective in addressing those flaws. The earthquake also significantly damaged government buildings and service infrastructures.

Poor construction was a key reason for the destruction of many houses. Most of the damaged rural homes were made of unbroken stones cemented with mud mortar. Concrete with steel

reinforcement was used in many new houses but with grossly inadequate detailing. While the right to own a home and land was promoted as a political slogan, making safe homes was not recognized as a priority. Low-income and marginalized families were largely excluded from efforts to disseminate the knowledge, technology and income-generating support needed to practice safe construction. Even today, the government's focus on the affected districts has not extended to providing them with equipment, such as concrete cutters, needed to rescue trapped people from collapsed building in time.

Organizations and users: The lack of coordination within and across government agencies and non-governmental organizations was a major gap seen in the immediate aftermath of the earthquake. This gap continues to plague efforts during not only disaster situations but also during normal operations. Moreover, disaster management efforts have remained limited to responding to emergencies. As time passes, the pre-disaster status quo is increasingly reinstated, and disaster risk reduction efforts still have not been mainstreamed into development thinking, processes and actions. Sectoral agencies still do not consider disaster risk reduction to be their mandate. In many cases, the equipment needed for the immediate rescue of people, for example, those trapped in fallen houses, and for the controlled breach of landslide dams have yet to be stocked and standard operating procedures have yet to be developed. Efforts to provide immediate support to help people recover from emotional trauma are not taken seriously even though what people experience or how they react to hazards is influenced by their mental condition.

Since 2011, the National Emergency Operation Center, under the aegis of the Ministry of Home Affairs, has coordinated disaster management tasks but its use of basic information for rescue and relief is still limited. Credible information relating to rescue, relief and recovery services, including disaster-resilient building technology for low-income families, marginal groups, local communities and users in rural areas, is hard to come by.

Context of Policies: When the earthquake struck, the Natural Calamity Relief Act of 1982, a law limited to rescue and relief actions, governed Nepal's disaster responses. In 2017, the Parliament endorsed a new disaster risk reduction and management act but the direction in which it will be used in the aftermath of the 2017 election and the new political context of the country remains to be seen. Instruments such as the local disaster management planning guidelines are yet to be grounded locally for effective implementation in Nepal's new governance structure.

Interdependence

Gorkha Earthquake proved that it is not an earthquake itself that kills, but poorly built houses. We have little control over the occurrence of natural hazards. Even in the pre-climate change era, the impacts of high-intensity rainfalls and prolonged periods of drought depended on exposure, the quality of ecological and human-built systems, the location of families in the socio-political hierarchy and institutional practices. Today, human actions continue to change the character of precipitation and thereby ecological systems. Indeed, we are in an era in which we are so close to climate thresholds that we may reach a new uncertain normal.

In the following section, we discuss systems, agents and institutions and how their creative marshalling may help us deal with changes in exposure patterns and build resilience.

Systems: The functioning of human society depends on services obtained from natural and human-built elements or systems. A system is a combination of "elements connected together to form a whole, thereby possessing properties of the whole rather than of its component parts".[10] Both natural and human-built systems consist of components, and parts that are interrelated and interdependent and that directly and indirectly influence one another continually to maintain the system's functioning. Thus, taking a systemic perspective helps us unpack a given society's behaviour and performance. Human-built systems include infrastructures

and their services and functions (e.g. water supply, wastewater treatment, roads, transmission lines, food storage, health services, education and finances). Natural ecosystems consist of agricultural land, parks, wetlands, forests and ponds. They serve as the first line of defence in dealing with many hazards including that from climate change. Together, the elements of physical infrastructure and ecological and social systems provide key services, such as the production and distribution of energy, food, water and other provisions, and can help build the characteristics of resilience.[11]

Agents: People get services from and manage systems. The performance of a system depends on a multitude of factors, including human behaviour and interests, both of which are difficult to control or predict. Broadly, there are three main types of agents—government, market and civic groups—each with different behavioural incentives under different circumstances. With respect to the management of system components, understanding the behaviour of agents is central to building resilience and adaptive capacity. Agents can deliberate, conduct independent analysis, interact voluntarily and make strategic choices in the face of new information, and developing their capacity to do so is an important part of resilience-building.[12] Socially or economically marginalized agents generally have the lowest levels of access to resources as well as to systems and the services that they produce. As a result, such agents are among the first affected when the flow and stock of goods and services provided by a system is disrupted. Such marginalized populations, along with similarly marginalized institutions, have the least political, economic and technical ability to address failure and to improve the management of a system. Thus, they are the most vulnerable to systemic shocks.

Institutions: Institutions within a society either create opportunities for people to manage systems and to access services from them or constrain them from doing so. Both informal and formal "rules in use" govern the expectations of agents. Institutions shape the behaviour of agents and modulate interactions among them in response to stress.[13] Thus, institutions can play a positive role in the development and management of systems but can also create

hindrances. Institutional factors can often limit the scope of action which agents take in response to stresses on systems. For example, with regard to livelihood, employment and food security, patriarchy, caste and other discriminatory social practices can impede actions taken to achieve wellbeing as can institutional constraints such as prices and policies. At the same time, institutions play a key role in resilience-building.

The above discussions imply that resilience, or vulnerability, is an outcome of interaction among four factors—exposure, agents, systems and institutions. The question is what aspects of each of the four help minimize vulnerability and which build resilience. Marginalized people, who depend upon fragile human-built systems with limited service delivery and are constrained by institutional context, are the most vulnerable when exposed to hazards. Building their resilience would entail addressing or removing sources of marginality, avoiding the fragility of systems, and understanding institutional reforms that collectively help minimize vulnerability to increased exposure. Clearly, better understanding of hazards is crucial.

Tyler and Moench (2012) have elaborated the characteristics of systems and agents while Friend and Klune (2013) focus on institutional attributes that foster resilience. Both provide an analytical basis to deal with uncertainty and with planning to build resilience and adaptive capacity. In the following sections, we present those characteristics of systems, agents and institutions that take us conceptually towards building resilience.

Systems: Societies invest in building many types of systems which provide basic services, help people undertake economic activities and create opportunities for people to deal with the problems they face. Some of these systems include water and food supply and the environments within which they function. Other systems supply energy, enable mobility through transport and help people communicate. The performance of the systems in achieving resilience depends on the following three characteristics.

Flexibility and diversity in key components: Flexibility is the ability of a component to function under a broad range of condi-

tions. Flexible components minimize the chance that the system they are part of will experience total failure when it is subjected to stress. The idea of flexibility is also linked to the ability to shift approaches and strategies to avoid pathway lock-in. Diversity, the number of qualitatively different system components that provide the same function or service, is another contributor to resilience. Having multiple components as opposed to a central node provides safety against a site-specific threat and makes a system more resilient.[14] In an earthquake recovery scenario, diversity would include the ability to access various types of seismic-resistant designs and to modify them to suit different regions.

Redundancy and modularity: Redundancy is a measure of the number of different system components that work parallel to each other, providing an identical service and serving as spare capacity for each other. In a system designed with multiple nodes, the failure of one component does not cause the entire system to fail.[15] In the disaster recovery process, for example, multiple roads to the same location provide a degree of redundancy: if one is blocked, another can be used. Modularity, on the other hand, is the number of system components that are identical and can easily replace each other. For example, building elements such as doors, windows and wall materials can be made modular because, if the element fails, it can be replaced in a short time. Redundant characteristics help enhance resilience but have cost and managerial implications because they require additional investment and an appropriate commodity chain must support their provisions. Modularity also adds to cost and, perhaps, from the perspective of resource use perspective, is inefficient as keeping backups comes at a price.

Safe failure: The discipline of engineering suggests that a system that experiences a partial or gradual failure is more resilient than one that suffers a sudden collapse. To take an example from flood management, an approach based on building embankments or levees experiences sudden failure if even a single embankment is overtopped, but an approach that preserves open flood plains experience only gradual inundation as flood levels rise. Where irrigation is concerned, exclusively rain-fed systems are vulnerable

to sudden failure where droughts are common, but groundwater can provide a buffer if there is no rainfall for an extended period. A house retrofitted or built with structural elements to resist seismic shock is safer than, say, a poorly built house even if cement-sand-mortar is used in both.

Agents: While the characteristics mentioned above are necessary to build resilience, in and of themselves, they are insufficient for achieving it if the characteristics of those managing and operating the infrastructures are not considered. While a bridge built with a very high factor of safety is robust, when a flood or an earthquake destroys it, it cannot return on its own without the application of human knowledge, skill and design faculty. Resilience is higher if those involved in operation and management are resourceful and responsive and can learn from experience.

Resourcefulness: Having access to a variety of interlinked social and physical resources is a key attribute of those with the responsibility to operate and manage, if they are to be able to act effectively, or innovatively, during and after a hazard strikes and in its aftermath. In the case of recovery from an earthquake, agents who have access to social networks, financial resources and technical skills can acquire or borrow material, knowledge or money to re-build. They are more resilient than those who are isolated and cannot mobilise or do not have access to such support.

Responsiveness: How an individual responds to stress or new information depends on their worldview, the source of disruptions they and the incentives they have. Market agents, for example, tend to respond quickly to prices and economic opportunities but discount information about long-term risk. They may respond in ways that decrease overall system functioning (e.g. by hoarding during periods of food shortage). Civic society groups, in contrast, use information to highlight long-term risks. Government departments, on the other hand, tend to resort to tested procedures though such procedures may not suit emerging realities and may prevent them from responding effectively to local needs for building resilience. Government departments may also be impeded by bureaucratic inertia, a considerable

problem as the rigid worldview that often characterizes public policy can resist responding in new ways even as the status quo continually changes.

Ability to learn: The ability to learn refers to social, educational and institutional factors that enable agents to learn as conditions change and to switch strategies accordingly. In the case of disaster recovery, the ability to learn is evidenced by the adoption of new techniques and elements such as community groups and other local organizations that support members without allowing the constraints, which often characterize institutional rules, debilitate learning.

Institutions: Institutional resilience, as discussed below, requires recognizing the role of access rights and entitlements, decision-making processes, information flows and the application of new knowledge.[16]

Access rights and entitlements: Rights and entitlements to use key resources and access systems and their services are clear in a resilient system. Institutions that differentially constrain rights and entitlements limit access to the systems or services that they provide to some groups and thus reduce resilience. Structures of rights and entitlements should not prevent specific groups from accessing critical systems or capacities. Instead, they should enable collective action and foster access to basic resources.

Decision-making processes: Decision-making processes, particularly in relation to development and systems management, should follow the widely accepted principles of good governance, including transparency, accountability and responsiveness. These processes include the recognition that the most affected groups can provide legitimate inputs to decision-making processes and that they should if such processes are to be transparent, representative and accountable. Creating opportunities for diverse stakeholders to provide inputs to decisions is necessary and dispute-resolution processes must be accessible and fair. The processes must also be seen as fair.

Information flows: Households, communities, businesses and other decision-making agents should have access to accurate

and meaningful information that enables them to make judgments about risk and vulnerability. Such information helps people evaluate options for building resilience and making strategic adaptation choices.

Application of new knowledge: Organizations that support the production, exchange and application of new knowledge enhance resilience. Many organizations are designed to meet a single function. They are focused on preserving and maintaining existing structures, authority, procedures and practices. Organizations created to build flood-control structures, for example, are interested only in pursuing that strategy and do not consider alternatives. Such narrow-mindedness impedes the building of resilience. Multi-functional organizations, on the other hand, tend to be open to alternative strategies. Building resilience requires innovations in reducing risk and is dependent on generating new knowledge in the face of changing circumstances.

Systems, agents and institutions that lack one or more of the above characteristics are likely to be less resilient than those that possess them all and will not help build people's capacity to adapt. Deficient systems and institutions deprive socially and/or economically marginalized communities and often increase their vulnerability when faced with a hazard. For example, such communities often lack access to finances and other key resources essential for a strategy-shift after they face a hazard-induced stress. In addition, they are frequently locked in social or political relationships that limit their ability to respond to emerging constraints and to learn from experience. The idea of resilience, therefore, can itself be a potential entry point for achieving societal transformation[17] by promoting adjustment to different kinds of shocks, both climatic and non-climatic.

Operationalizing the above conceptions requires a new way of conducting business, one which minimizes the risks of natural and manmade hazards through preparedness while at the same time progressing towards defined goals. The required approach requires helping humans build their inner strength and enabling them to successfully deal with all kinds of natu-

Table 6.2

Approaches to building resilience in Nepal

Systemic Elements	Problems	Solutions
Knowledge of hazard exposure	Social amnesia and limited appreciation of geology, geography, safety and preparedness	Strengthen capacity to monitor, analyse and disseminate information about multiple- hazard exposure and risks. Invest in interdisciplinary studies of and education on various aspects of disaster risk management and include community science in the process. Transition from hazard-specific rescue and relief to multi-hazard risk management with an understanding that unattended small hazard risks accumulate and worsen disaster impacts.
Quality of homesteads	Little incentive for constructing safe homes, lack of support for making choices, limited awareness	Develop and apply region-specific codes for homes and increase the building capacity of rural municipalities and municipalities to implement safe practices. Promote use of safe and climate-friendly materials. Accord special attention to low-income and marginalized families. Look at homes not in isolation but as part of a livelihood system, community connectedness, social solidarity and culture.
Role of agencies	Ineffective coordination and implementation	Strengthen the capacity of the National Emergency Operation Centre and Department of Hydrology and Meteorology so they can play a greater role in information collection and standardization than they currently do. Begin capacitating rural municipalities and municipalities in creating local level data base for indicators to be used in building local resilience.
Policy context	Top-down and bureaucratic with no opportunities for continuous and reflective learning	Create a mechanism of systemic review and continuous learning as the disaster legislation and other guidelines are implemented in close coordination with coordination with rural municipalities and municipalities.

Source: Dixit et. al. (2016)

ral and human-induced shocks. Transitioning to a resilient future requires overcoming deficiencies in policies and practices, building the capacity of agencies by promoting institutional learning, applying the knowledge gained, and reflecting upon and adjusting to new realities as conditions change. For Nepal, this approach includes focusing simultaneously on the elements identified in Table 6.2.

Concluding observations

The 2015 Gorkha earthquake and its aftershocks have created ruptures across Nepal's development sectors, disciplines and administrative and political realms at all scales, from local to national. Subsequent other hazards also created ruptures through perhaps not as great. The multiplicity of hazards means that in many cases, the impacts cascade through each other. Gorkha Earthquake has, for example, increased the incidence of landslides, which have, in turn, increased the risk of floods. In the hills, tremors altered the dynamics of water springs already stressed by erratic rainfall and changes in land use.

All human-built and natural ecosystems are exposed to various types of shocks. A landslide could, for example, lead to the failure of a forest patch on a hill slope, while simultaneously damaging houses, a bridge, a section of a highway or livelihoods dependent on that forest. Under certain circumstances, such a forest patch would be able to regenerate itself, but the damaged house, bridge and section of the highway could not revert to their pre-landslide state on their own. In the case of human-built infrastructure, the quality of construction as well as operation and management are important in building resilience.

It must be accepted that no human-built system can be made totally safe or fail-proof. There will be a threshold of hazard beyond which any infrastructure is liable to fail. Theoretically, incorporating higher factors of safety in the design of an infrastructure or the choice of materials and construction methods will enable that infrastructure to withstand a higher magnitude of external stress. In-

creasing safety factors comes at a price, however, and often a high one, and even all the safety features we can think of still cannot guarantee that failure will be averted. Moreover, the reconstruction of damaged infrastructure is not simply about assembling materials to produce a functional built-form; it is also about ensuring that the system built will be maintained and also upgraded to provide the services it has been designed to provide.

The processes of recovery and rebuilding of elements damaged by past disasters have to be systematic, reflective and iterative. They must aim to address the multi-hazard context rather than just one specific disaster. To integrate resilience into disaster risk reduction, we must focus on building knowledge, avoiding design and managerial flaws, creating and implementing better policies and building the capacities of users and organizations.

Resilience-building is a process which operates within a dynamic social and political scene. The quality of the natural ecosystem and the human-built systems in which people live must be considered. The majority of people in Nepal rely on ecosystem services as sources of livelihood. People are also increasingly dependent on human-built systems (i.e. energy, potable water, transportation, telecommunication, waste management, and the like) to maintain their lives, access markets and employment, communicate with each other, overcome disaster impacts, and so on. In these efforts, the knowledge to analyse problems and find solutions is important. It is equally essential to acknowledge that people may go through a feeling of 'survival guilt' when they realize the loss of their near and dear ones. Since this feeling can become a disaster in and of itself, efforts towards addressing the guilt syndrome will help build resilience.

Past ruptures are opportunities to put in place mechanisms designed to prevent the reproduction of the vulnerabilities that caused the ruptures in the first place. If existing vulnerabilities are not addressed, they will exacerbate the impacts of future disasters, lower development gains and further embroil low-capacity populations in the cycle of marginalization. To avoid such a future, resilience, in it true sense, can be a useful lens. ■

Notes

1 Personal communication with retired general Victor J. B. Rana.
2 Zolli and Healy (2012).
3 ISET (2008).
4 Leach (2008).
5 Friend and Klune (2013).
6 Holling (1973) and Walker et al. (2004).
7 *ibid*. Note 3.
8 Dixit et al. (2018).
9 Piper, R. 2013. "A perfect storm of earthquake and poor governance could cripple Nepal". *The Guardian* January 12. https://www.theguardian.com/commentisfree/2013/jan/12/perfect-storm-earthquake-cripple-nepal
10 Checkland (1981).
11 Tyler and Moench (2012).
12 *ibid*.
13 *ibid*.
14 Godschalk (2003).
15 *ibid*.
16 *ibid*. Note 5.
17 Pelling and Manuel-Navarrete (2011).

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