

# A10

## CLIMATE CHANGE: INTEGRATING INDIGENOUS AND LOCAL KNOWLEDGE INTO ADAPTATION POLICIES AND PRACTICES

A case study from Nepal

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### Introduction

Available literature on indigenous and local knowledge<sup>1</sup> provides ample argument and evidence of how indigenous peoples and local communities have been adapting for generations to climate-induced hazards and risks by developing situation-specific livelihood practices and building the resiliency of their households and communities. However, in recent years, increasingly frequent and ferocious climate extremes have revealed the limitations of indigenous and local knowledge and this has motivated local communities to adapt to the new situation by combining indigenous knowledge with modern scientific knowledge systems. In fragile and vulnerable Nepal, the dire need to cope with natural and climatic hazards has, for centuries, led local people to make necessary changes to their institutional and behavioural practices to ensure not only their personal security and that of their environment, but also security in supplies of water, food and energy. Much of this indigenous knowledge was gathered in the ages-old practice of shifting cultivation and traditional livelihood systems, and the closeness to nature that swidden farming and subsistence living entailed. In recent decades there has been a general shift from traditional and shifting cultivation to cash-crop plantations and agroforestry in Nepal, but local communities still cling to a wealth of knowledge that arose from swidden and traditional farming and forestry on the country's steep slopes. The people have built climate resilience into community infrastructures supplying drinking and irrigation water, traditional bridges and trail

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networks and have also developed collective actions to protect and manage forests and biodiversity. Recognizing the inadequacy of their indigenous knowledge to cope with extreme events, local communities are now integrating suitable scientific tools and technologies into their plans for adapting to climate change and variability. This may involve switching strategies and modifying or transforming traditional practices for dealing with both climatic and non-climatic shocks and disturbances. This chapter argues, therefore, that while indigenous knowledge provides a strong foundation for framing local and national adaptation policies and plans for action, integration of the two knowledge systems makes the policies more robust, practical and cost effective, especially in countries such as Nepal.

Government and donor agencies around the world are already using both indigenous and scientific knowledge systems to deal with risks, hazards and vulnerability induced by climate change. This approach is advocated by a number of national and international organizations (IPCC, 2007; UNFCCC, 2013). Recognizing the high relevance of indigenous and local knowledge systems in climate-change adaptation, especially in the context of developing countries, this chapter recommends the integration of both knowledge systems while mainstreaming climate-risk management in national policies and plans, particularly those for the green sector. It is recognized that these knowledge systems face limitations when it comes to responding to climate-change challenges because: (a) knowledge about future climate is uncertain; (b) context and location-specific indigenous and local knowledge will become inadequate to deal with the high-exposure nature of climatic shocks; and (c) local knowledge is the only knowledge available to cope with climatic and natural disasters at local level. Therefore policy-makers, while prioritizing the need to adapt to cope with the impacts of climate change, should move to integrate indigenous and local knowledge with modern scientific knowledge by learning from local communities who have long been adapting to climate and socio-economic changes. The trend of integrating both knowledge systems based on local situations should help policy-makers to develop multi-level, multi-hazard and multi-disciplinary adaptation plans and create policies, strategies and programmes to build resilience. This study argues that for effective climate-change adaptation, the policy process should involve dialogue with both indigenous and scientific communities. Situation-specific scenarios and models can then be developed and evaluated jointly. Developing this type of knowledge and, from it, formulating appropriate practices requires that the whole process, including the formulation of sub-national and local adaptation policies and plans, should be driven by an inclusive national adaptation policy. While scientific research on climate-change vulnerability and impacts are critical to developing appropriate resilience-building solutions, traditional forms of knowledge and the wisdom they offer help to reinforce adaptive capacity as a strategy for building resilience. This chapter recommends that governments synthesize and integrate scientific and indigenous knowledge and practices to proactively identify current and future risks and hazards. From this, they can adopt the multi-dimensional adaptation and resilience-building measures practised by indigenous and local communities in order to minimize climate-induced

risks. This will help to better implement climate-change policies, the Paris Climate Agreement and Sustainable Development Goals (SDGs).

## Policy context

Climate change is causing rapid increases in temperature, extreme precipitation events and increased frequency of flooding in Nepal (NCVST, 2009; MoEnv, 2010; Karki et al., 2011; Selvaraju et al., 2014). The average increase in temperature in Nepal is higher and faster than the global average (Karki et al., 2011), and winter temperatures are increasing more than summer temperatures (Practical Action, 2011). The monsoon rainfall – especially the pre-monsoon rainfall – is increasing and winter showers are decreasing, with marked regional variation (Bartlett et al., 2011). Extreme weather events such as flash floods are increasing due to sudden and heavy monsoon rainfall and summer droughts. Overall, Nepal is likely to become wetter in the east and drier in the west. Current estimates put the average annual increase in temperature for Nepal as a whole at about 0.06 degrees Celsius per annum (NCVST, 2009; ICIMOD, 2013). Across the country, precipitation patterns show no particular trend, with pockets of increases and decreases (see Figures A10-1 and A10-2).

The Asian Development Bank and The World Bank have been helping Nepal to enhance the resilience of its people and infrastructure to climate change through their Strategic Programme of Climate Resilience (SPCR). In this context, considering indigenous and local knowledge and practices (ILKP) has been given importance because of widely prevalent evidence of indigenous and local practices of adaptation to different kinds of changes and challenges. These knowledge systems can assist in the formulation of climate-sensitive policies, plans and programmes.

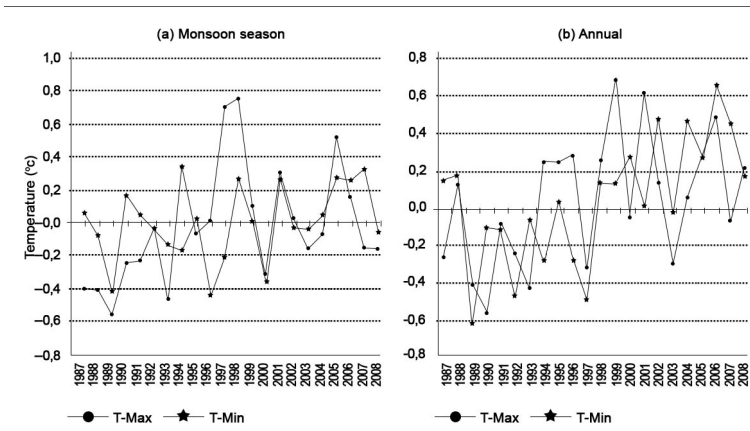


FIGURE A10-1: Minimum and maximum temperature trends in Nepal, 1987 to 2008.

Source: Selvaraju et al. (2014)

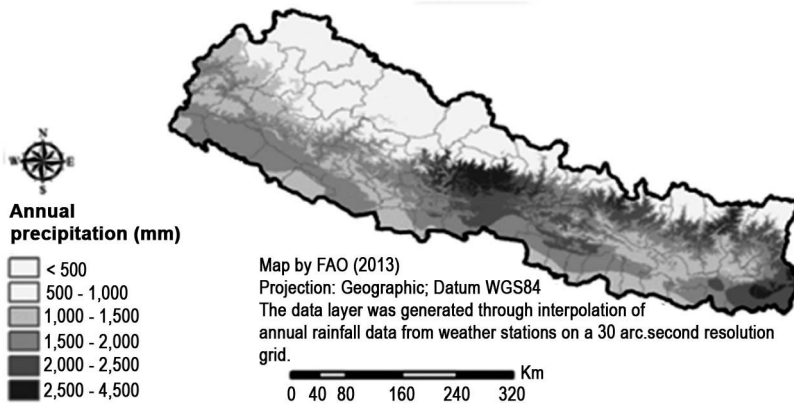


FIGURE A10-2: Annual precipitation in Nepal.

Source: Selvaraju et al. (2014)

## Policy imperatives and issues

Indigenous peoples and local communities in Nepal are disproportionately vulnerable to natural and environmental disasters caused by both non-climatic and climatic drivers. Contributing to this vulnerability are a high rate of poverty, soil erosion and deforestation, loss of biodiversity, atmospheric pollution, including black carbon -- the most strongly light-absorbing component of particulate carbonaceous matter, and a generally low capacity and inequality.

The diverse indigenous communities of Nepal have developed a rich traditional knowledge and, along with it, good practices for creating, maintaining and improving their livelihoods through the use of natural and community-built resources (Sherpa et al., 2013). Historically, local communities have adapted well to different kinds of change, including climate change (Gurung and Bisht, 2014). Centuries of experiential learning have given them a comprehensive understanding of the structure and functions of the interconnected human-environmental systems in which they live. They have constantly innovated and used their knowledge in order to live in harmony with nature; to procure food, water, energy, medicines, building materials and other necessities from their local ecosystems. Their knowledge of, and skill in using, their environment and the relationship between the environment and their social systems forms an integral element of their adaptive culture, capacity and identity (Gurung and Bisht, 2014). This helps them to develop mechanisms for adjusting to stress and improving their adaptive capacity (Nepali, 2007; Bk, 2010).

This chapter highlights a variety of specific knowledge, practices and insights for different livelihood-related themes, including shifting cultivation, that were identified through interactions and observation and recorded in study areas. These practices help vulnerable communities to better adapt to the growing impacts of climatic change because they have been developed through the use of adaptive skills and experienced

learning. They are also diverse, practical, flexible and cost-effective since they use local knowledge, local raw materials, local technicians and local institutions. This knowledge and associated practices were initiated by, and are owned and managed by, the various communities. They are situation-specific and adaptive to changes in human-environmental systems. Indigenous and local knowledge and practices can help Nepali communities to respond to the urgent and immediate effects of climate change, for example by making their shifting cultivation practices more resilient through rotational agroforestry. They can also help people and their institutions to prepare long-term adaptation strategies, plans and programmes.

Nepal is a mainly hilly and mountainous country that is ecologically fragile, geologically unstable and environmentally vulnerable (Shrestha, 2007; Shrestha and Aryal, 2011). In recent years, climate change has exacerbated these vulnerabilities. With more than one-quarter of its population living below the poverty line (NPC, 2010), Nepal faces multiple risks of climate-induced hazards striking its poor indigenous and local people. An integrated and inclusive strategy for managing the country's natural, human, cultural, physical and financial resources needs to be formulated to build resilience of community assets, infrastructure, institutions and systems. This will require the systematic documentation, evaluation, development and dissemination of new or synthesized knowledge and effective practices combining both indigenous and modern sciences (World Bank, 1998; Mukhopadhyay, 2009). Since adaptation and natural resource management are essentially a local response developed to fit a particular context, locally evolved mechanisms and practices are better options than external technology and know-how for responding to immediate threats, such as water shortages, flood disasters and infrastructural damage (Berkes et al., 2000; Nakashima et al., 2012). A blend of approaches and methods drawn from both modern science and indigenous knowledge can provide practical and effective options for improved disaster-risk reduction, preparedness and adaptive-response planning (Mukhopadhyay, 2009). Unlocking the ingenuity, capacity and skills of indigenous people and their institutions can facilitate better responses to these threats than costly and often unavailable scientific knowledge and tools (Chaudhury, 2012; Naess, 2013; Lebel, 2013). While locally driven practices such as community-based forests and water management systems have been successful in reducing the adverse impacts of environmental degradation, unsustainable development activities, such as the use of heavy machines to construct hillside roads, have resulted in large-scale land degradation and increased threats to human livelihoods. For this reason, it is crucial that climate-change risk managements consider indigenous and local knowledge, and that this should be mainstreamed into development policies, plans and programmes (ADB, 2011).

### **The relevance of indigenous and local knowledge in shifting cultivation**

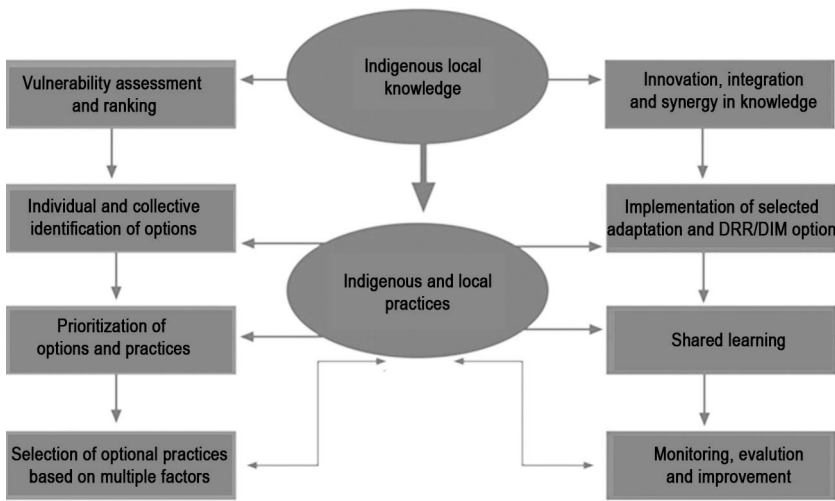
Literature on the application of indigenous, traditional and local knowledge in climate-change adaptation and mitigation is both comprehensive and vast (Nakashima et al.,

2012; Prakash, 2013). Best practices in the use of indigenous knowledge for improving adaptation procedures, available tools and application of gender-sensitive approaches are also well documented (UNFCCC, 2013). Recent publications document the rapidly expanding role and relevance of indigenous and local knowledge in climate-change adaptation in agriculture, disaster-risk management and resilience-building efforts at both local and national levels (World Bank, 1998; UNISDR, 2011; Thaman et al., 2013). Over the years, local people have used their knowledge and practices to adjust to changing economic, ecological and social circumstances. They continue to do so, to reduce the hazards and risks imposed on them by climate change, and these adjustments have developed into indigenous adaptation practices (Anik and Khan, 2012). These practices are helping communities to minimize disaster risks and formulate cost-effective and participatory adaptation measures to prepare them to respond better to disasters (Nakashima et al., 2012). The fact that local practices have evolved to allow adaptation to climatic risks is a response to changes in weather and climate over centuries. Thus, these practices can be called climate-adaptation practices, and adaptive shifting cultivation is one such example. The logic is that indigenous resiliency is the basis for these adaptive practices (Prakash, 2013).

The specific indigenous and local knowledge that communities use to adapt to climate change comprises knowledge of (a) the seasons; (b) historical storm patterns; (c) the colour of rain-bearing clouds; and (d) wind patterns, including direction and wind types (e.g. wind from the west dries crops and wind from the east is cool and brings rain). This indigenous knowledge enables people to plan their agricultural activities and adopt management practices, such as setting irrigation schedules and constructing shelters, wind breaks, storm walls and homestead fences (Mukhopadhyay, 2009). Local communities predict rain and hailstorms that may damage crops and property by judging the colour of clouds and the sound of thunder, as well as the duration of drought (Gearheard et al., 2010).

As shown in Figure A10-3, indigenous knowledge is the basic information available to local people for making decisions related to community preparedness and peer learning. Indigenous and local knowledge is dynamic and is continually influenced by internal innovation and experimentation involving local culture, ethos and values, as well as by interaction with external systems and outside knowledge. As mentioned earlier, the role and importance of indigenous and local knowledge in climate change adaptation has been recognized globally (IPCC, 2007; Mukhopadhyay, 2009; UNFCCC, 2013; Gautam et al., 2013). The main reason for elevating its importance in climate-change adaptation is that adaptation is a socio-economic problem and there is an urgent need to tailor responses to location-specific vulnerabilities. Indigenous knowledge is seen as a practical resource enabling people to respond to climate change because the knowledge system is embedded in local cultures and values.

The relevance of indigenous knowledge in facing climate change has been growing because it is needed for the rapid validation of scientific knowledge. The application of outside knowledge requires an understanding of social context that only indigenous and local knowledge can address (Naess, 2007). For example, in



**FIGURE A10-3:** Application of indigenous and local knowledge in climate-change adaptation and disaster-risk reduction in Nepal.

*Source:* Adapted from Srinivasan (2004)

Nepal, farmers in the hills have developed agroforestry models to overcome frequent floods, drought, landslides and high rates of soil erosion – the problems with the biggest effects on food production. Farmers on the Tarai plains, on the other hand, have adapted to recurrent floods by constructing bamboo houses that are both time- and cost-effective as well as flood-adaptive. Indigenous knowledge is the basis upon which these communities build resilience as it often anticipates disasters before they occur (ICIMOD, 2007; Nakashima et al., 2012).

Indigenous and marginalized local populations are highly dependent on natural resources, rain-fed agriculture and fragile dwellings and are without social support networks. Therefore they are highly exposed and sensitive to different impacts of climate change. Nevertheless, they have adapted to both natural hazards and human-induced climate-related disasters such as floods and landslides (Lutui, 2013) and have shown how innovative and resilient they can be in the face of high climate variability by adjusting their cropping calendars and modifying their houses. The basis for this resilience is indigenous knowledge and traditional institutions (Fujieda and Kobayashi, 2013), which, by its very evolutionary and functional nature, is concerned with coping with and adapting to unpredictable, diverse and changing situations. Indigenous practices are known to meet the general requirement that knowledge contributes to natural resource management and human social development (Berkes et al., 2000). In the context of climate-change adaptation, the approaches and processes of indigenous knowledge are natural responses to changes people have traditionally faced. Thus, a large number of indigenous practices currently exist that have the potential to facilitate adaptation to both present and changing climatic conditions. They offer strong evidence as a basis upon which to formulate policy.



Adaptation responses vary from tackling the risks of disaster due to extreme weather events, such as flooding, to dealing with changes in species and shifts in rainfall events. Indigenous and local knowledge about natural and managed ecosystems helps communities to adjust their practices in agriculture and animal husbandry and their management of land, water and other ecosystem services. This gradual adjustment of on-going practices constitutes what is currently known as local communities' coping mechanisms and autonomous adaptation practices (Prakash, 2013). A large body of literature provides more insight and additional information in support of this argument (Klooster, 2002; Pandey, 2004; Lebel, 2013; Naess, 2013). It is useful to point out that several agencies and researchers (Egeru, 2012; Lebel, 2013; UNFCCC, 2013) are developing uniform approaches, processes and participatory mechanisms for working with indigenous knowledge in local communities. This study joins those efforts.

### **Conceptual framework and data collection methods**

The conceptual framework for the research from which this chapter was drawn comes from global recognition of indigenous and local practices for adaptation to climate change (UNFCCC, 2013). It identifies a number of practices employing indigenous, traditional and local knowledge and analyses their application for adaptation to climate change and building resilience. Data collection involved case studies in five different sectors: water, forestry, rural transport, settlements and housing and social institutions. It drew on examples from 18 districts of Nepal. The cases were selected on the basis of: (a) the traditional practices of indigenous groups and cultures; (b) the relevance of these practices for climate-change adaptation; (c) their coverage in existing literature; and (d) their potential to be scaled up. The sectors were chosen according to their relevance to Nepal's climate and development plans and their importance in meeting the needs and priorities of indigenous and local communities. Primary data and information were collected from key informants and household representatives. Secondary information was collected from an extensive literature review, national and district-level stakeholder workshops and focus-group discussions.

The main premise of the conceptual framework is that indigenous and local communities have long used traditional knowledge to make different adaptive responses to the impacts of variable climate to minimize their vulnerability and to meet their livelihood needs. Their measures include subtle or subconscious adjustments to their practices as well as spontaneous inventions and innovations of suitable techniques and actions. Such adaptive responses tend to be 'autonomous', in that actions by individuals, households and organizations are undertaken on their own initiative, in response to opportunities and constraints arising from shocks and stresses to their livelihoods as a result of climatic change and other factors (ISET, 2008). This study makes a clear distinction between 'adaptation to' and 'coping with' an adverse situation. Both before and after facing climatic disasters, indigenous and



local communities apply their knowledge and skills to both minimize the damage and rehabilitate their systems to their pre-disaster levels. ISET (2008) refers to ‘well-adapted systems’ in which communities are ‘doing well’ despite (or because of) changing conditions. Indigenous communities are able to ‘do well’ by shifting and readjusting their adaptive strategies using locally developed knowledge in order to respond flexibly and effectively. After generations of living with climatic risks, these communities have developed the capacity and procedures – either collectively or individually – that are both resilient and sufficiently flexible to respond to climate change.

Indigenous communities also use their knowledge and skills to assess risks from various hazards and to plan and execute actions that reduce risks through ‘anticipatory and proactive adaptation’ before disasters occur (Ajani et al., 2013). ‘Reactive adaptation’ comes in the aftermath of disasters. Since impacts on a specific region and its population cannot be attributed directly to climate change, proactive adaptation is their prime focus, by building institutional and individual capacity to adapt. Reactive adaptation (McGray et al., 2007; World Bank, 2009) will still be necessary in the aftermath of a climatic disaster because of the need to maintain resiliency of community assets, livelihood and local infrastructure. Because local adaptive responses tend to vary for different built infrastructures and natural systems (see Figure A10-4), suitable reforms need to be made regularly to governance arrangements, traditional institutions, community level policies and rules and monitoring mechanisms. These actions can be characterized as indigenous resilience-building practices (Srinivasan, 2004; Prakash, 2013).

The study was designed according to four principles or guidelines: (a) the methods selected were systematic and qualitative in nature; (b) they utilized participatory tools and instruments; (c) research participants, especially key informants and households, were selected purposively; and (d) the study used a process-based framework incorporating mixed methods of social-science research. This multi-method approach met the objective of data triangulation required in all applied social-science research (Yin, 2003a, 2003b; UoM, 2010) and ensured that the process included the in-built cross-checking of primary data in order to ensure accuracy and reliability (Putt, 2013).

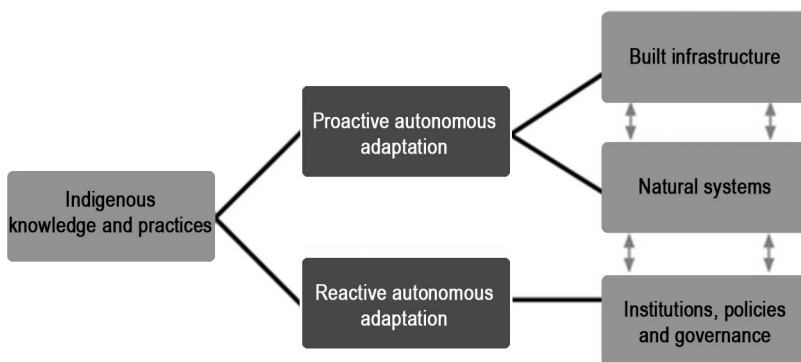


FIGURE A10-4: Indigenous practices and adaptation to climate change.

Insights derived from both indigenous and local knowledge and scientific understanding, and incorporating both into a synthesized form, is central to building resilience or reducing vulnerability. This study assumes that vulnerability is highest when marginalized individuals, households, communities and groups who depend on fragile systems (both natural and human-built) are exposed to climate change. The key to building resilience is use of the knowledge, skills and tools available to human society to minimize exposure, avoid marginalization and improve the ability of these systems to withstand shocks or recover quickly. Institutions play a critical role in mediating transformation towards a more resilient future.

Resilience to climate change is understood as a characteristic that enables a system (including an ecosystem), individual households, community groups, households or organizations to maintain well-being in the aftermath of climate shocks. A strategy of combining technological flexibility with sustainable development helps to build such resilience (Thompson, 1994), and efforts to build resilience are enhanced if responses to a shock are quick and the response strategy promotes flexibility and diversity as well as a transparent flow of indigenous and scientific information. By generating a synthesized form of knowledge, such a strategy can help to adjust to the uncertainties that climate change entails. The key findings of the study are mainly focused on policy-relevant information, insights and messages. They are discussed below for each of the five themes considered relevant by indigenous communities in the context of adapting to climate change.

### **1. Local water management**

- Local water-use practices are climate-adaptive, and these need to be recognized when introducing new water-management systems in order to ensure ownership and sustainability. At present, many successful indigenous and local water-management practices fail to receive government priority and are at risk of being lost. To ensure their continuity, government agencies should pay attention to sustaining indigenous and local knowledge in water management.
- Indigenous water practices follow catchment boundaries and therefore national and local policies and regulations should also follow basin-wide management. This would ensure equitable water allocation that recognizes indigenous use rights and considers the demand and supply balance as well as accepted social norms and values.
- Rapid and unplanned urbanization is posing new challenges to indigenous systems for managing supplies of drinking and irrigation water. Local government bodies are unable to address these challenges without support from higher levels in government and public policies that recognize links between local rights, quality of services (food production from irrigation and drinking water), real estate development, land-use changes and reconciling competing demands for water.

- Recognizing the critical nature of water in adaptation strategies, scarce water resources need to be managed efficiently and equitably. Practices based on indigenous and local knowledge and bottom-up processes provide grounded evidence for reforming public policy on climate-change adaptation so that it can effectively help to reduce vulnerability to risks associated with climate change.
- Indigenous and local practices such as maintaining traditional ponds and farmer-managed irrigation systems need to be integrated with the wider promotion of techniques such as rainwater harvesting and use of drip irrigation and sprinklers, as well as conserving ponds and wetlands to make more efficient and effective use of water. Such efforts should also attempt to enhance the productivity of water through multiple uses. Such strategies promote diversity, one of the key characteristics of resilience, as helping in adaptation to climate change.

## ***2. Community-based forest and pasture management***

- Indigenous and local forest- and pasture-management practices have evolved from cultural knowledge, the principles of collective work, community-based institutions and a thorough understanding of local ecosystems. Therefore, these practices should be recognized by government agencies as both climate-adaptive and resilient.
- Supportive policies, along with institutions with wider capacity and technical backstopping, should be developed to improve and sustain the adaptive and resilient qualities of indigenous forestry practices.
- The government should promote integration and synergy between contemporary and traditional community-based forest- and pasture-management practices by providing economic and policy incentives.
- Indigenous forestry practices have thrived in places where access to resources is guaranteed and tenure security is in place under the principle of 'care and share'. The Government of Nepal should provide proper ownership rights to forest resources and allow equitable sharing of benefits to promote the adaptation of forests to change.
- Social and gender inclusion and equity remain key objectives in indigenous forestry. Income-generating and livelihood-enhancing activities based on the commercial use of non-timber forest products can promote the development of inclusive and improved resilience through community-based forestry.
- Technical capacity-building, forest protection and regeneration and management of forest and pasture resources based on collective action are essential prerequisites for developing resilient forest-management practices and need continuous support.

### **3. Rural transport infrastructure**

- Traditional bridges, trails and tuins (metal-wire river crossings) developed by communities provide critical transportation and communication links, thereby contributing to local adaptation and disaster-risk reduction efforts.
- Nepal's indigenous suspension-bridge building practices are effective climate-resilient technologies as they are low-cost and locally built. They should be promoted in order to bolster community resilience and adaptive capacity.
- While designing and constructing new rural roads and bridges, efforts should be made to integrate traditional technologies and practices.
- Road- and bridge-building policy needs to consider improving or retrofitting indigenous local transport infrastructures based on feasibility and costs. Government engineers should regularly consult local communities when deciding on modes of rural transport.
- The indigenous and local culture of voluntary work while building and maintaining rural transport infrastructure should be promoted as part of community-based adaptation.

### **4. Settlements and housing**

- The Government of Nepal should recognize that indigenous and local communities face a disproportionate risk from disasters due to their nature-based livelihoods and settlements on marginal and fragile lands.
- Developing the resilience of settlements and housing should be based primarily on ensuring human safety, including improved access to food, water, reliable energy with a low carbon footprint and the availability of social-support networks.
- The role of practices and technology based on indigenous knowledge should be taken into consideration when planning for stronger resilience in traditional settlements. There is a need to develop skills and reinforce capacity to reduce hazards and risks in such settlements.
- An understanding of local perceptions, culture, economic behaviour and collective action is necessary when designing and developing climate-resilient and adaptive housing and settlements.
- In planning community-based disaster management there should be an assessment of institutional capacity and an understanding of how traditional social institutions provide safety nets to vulnerable groups.

### **5. Traditional social institutions**

- The critical role played by traditional social institutions in leading and guiding communities to preserve their cultural and natural environment needs to be recognized to ensure effective climate-change adaptation.
- The credibility of traditional social institutions in the community enables local people to smoothly introduce and popularize new knowledge, practices and

innovations. These institutions could be adapted to build climate resilience into all development sectors.

- The strengths of traditional institutions lie in developing the knowledge base of people's core livelihood issues (e.g. the *Amchi* system of Upper Mustang region<sup>2</sup> and the *Shingi Nawa* system of Khumbu region<sup>3</sup>).
- There needs to be greater advocacy for the integration of traditional informal institutions into the formal institutional framework to achieve greater complementarity, effectiveness and sustainability in adaptation work.
- The proven and popular knowledge, skills and insights of indigenous and local women on environmental issues make it easy to address local changes by utilizing women's social capital. Women should therefore play a central role in developing adaptation strategies and plans.
- Indigenous and local communities have been responding to environmental change and variability for hundreds of years. The knowledge and practices thus developed deserve to be recognized and should form the basis for planning adaptation strategies in Nepal.

### Analysis of findings

In examining the relevance of indigenous and local knowledge and practices to national and local adaptation, the implications of the study's findings for Nepal's efforts to boost its capacity to deal with the vulnerabilities and risks associated with climate change must be called into question. Global assessments rank Nepal as highly vulnerable to multiple drivers, so it is clear that reducing vulnerability is dependent upon effectively allocating resources to build resilience and adaptive capacity. Nepal has begun programmes such as the National Adaptation Programme of Action (NAPA) and Local Adaptation Plans of Action (LAPAs) to respond to the country's vulnerabilities. The government is also implementing long-term resilience-building measures to develop a comprehensive knowledge base that will integrate climate-change resilience into development policies, plans and programmes. The NAPA was drafted to help meet the country's medium- and long-term needs and priorities with regard to climate-change adaptation. At national and district levels, projects and initiatives are also being implemented to enable Nepali institutions to better adapt to climate change. In addition to this, government agencies, non-governmental organizations, international non-governmental organizations and community-based organizations are assessing vulnerability and implementing different programmes and activities for adaptation, mitigation and disaster-risk reduction. These activities have generated meaningful information on the nature of vulnerabilities, impacts and adaptation options in different sectors and parts of the country, but this is not yet a part of the mainstream policy process. Planned and on-going projects and programmes related to climate-change adaptation in Nepal need to address the gaps in recognizing, understanding and applying indigenous and local knowledge and practices. It is equally important to provide immediate and appropriate responses that reduce the vulnerability of local communities, especially women, to the impacts

of climate change. The knowledge, skills, practices and technologies of indigenous people can be implemented alongside these measures to develop effective and inclusive adaptation plans. It has been found that local communities are replacing existing indigenous knowledge related to traditional bridges, trails, treks and irrigation schemes rather than creatively using it alongside modern technologies. It might not be possible to widely replicate specific traditional technologies in proposed adaptation plans, but the institutional and social-knowledge systems may be useful in responding to context-specific challenges of climate-change adaptation. Table A10-1 shows how the practices documented in this study can contribute to both climate-change adaptation and disaster-risk reduction in the study areas.

Local communities are engaged in actions to build resilience and adaptive capacity by applying indigenous and local knowledge. An important feature of their strategy is that they address both climatic and non-climatic stresses. Using as a basis several practices observed in the course of this study, lessons have been drawn that are useful for mainstreaming indigenous and local knowledge into on-going efforts to build resilience and adaptive capacity. The indigenous adaptation practices discussed above

**TABLE A10-1: Indigenous adaptation and risk-reducing practices in selected districts of Nepal.**

<i>Community assets and infrastructure</i>	<i>Climatic and non-climatic stress</i>	<i>Indigenous-knowledge practices used in different types of adaptation and resilience-building responses</i>
Water resources	Drying up of sources.	Protecting forest, planting deep rooted trees, conserving traditional ponds and wells to augment water supply with alternate or additional sources.
	Damage to infrastructure (canals, pipelines).	Seeking help from modern technology and integrating it with indigenous-knowledge practices.
	Frequent and longer cycle of floods and drought.	Collaborating with government agencies and/or upstream communities, soil- and water-conservation farming.
	Extreme events.	Adaptation and community-based disaster management.
Forest and pasture resources	Forest encroachment and overgrazing.	Social fencing and inclusion of landless and squatter families into forest-user groups.
	Habitat destruction and fragmentation.	Community protection and enforcement of conservation rules; rotation grazing and stall-feeding animals.
	Productivity decline.	Planting non-timber and medicinal plants, broad-leaf trees and grasses and restricting their use.
	Forest fire.	Preventive measures through awareness and community-based fire management.
	Invasive species. Landslides and soil erosion.	Annual cleaning and timber-stand improvement. Biological measures, planting of grasses and shrubs and banning open grazing.

**TABLE A10-1 (cont.):** Indigenous adaptation and risk-reducing practices in selected districts of Nepal.

<i>Community assets and infrastructure</i>	<i>Climatic and non-climatic stress</i>	<i>Indigenous-knowledge practices used in different types of adaptation and resilience-building responses</i>
Rural transport infrastructure	<p>Increased number, frequency and source of hazards and risks.</p> <p>Shortage of traditional skills and raw materials.</p> <p>Extreme events.</p> <p>Push for modern technologies and motorable roads.</p> <p>Lack of policy support.</p>	<p>Responsive adaptation; community-based repair, restoration and maintenance work.</p> <p>Joining government- and NGO-supported training and capacity-building activities, 'learning by doing' in collective activities, use of alternative local materials.</p> <p>Conserving watersheds, protecting forests and strengthening river banks using gabion mesh wire and biological measures.</p> <p>Reviving traditional wisdom and integrating it with modern technologies.</p> <p>Mobilizing bottom-up public support and advocating this approach.</p>
Settlements and housing	<p>Flash floods and inundation due to floods.</p> <p>Poor design and construction.</p> <p>Landslides and slope failures.</p> <p>Lack of early warning system (EWS).</p> <p>Lack of disaster preparedness.</p>	<p>Adapting the design and construction of houses to minimize damage (in the hills) or adapting to live with annual floods (in the Tarai plains).</p> <p>Retrofitting or revising designs like raising the plinth level or replacing thatch/mud houses with flat roofs.</p> <p>Planting grasses and trees reinforced by stone-filled check dams.</p> <p>Using and putting up warning signs, improving coordination and collaboration within and outside communities and linking indigenous-knowledge methods with modern technology such as mobile phones and FM radios.</p> <p>Selecting sites and building temporary shelters; practising proactive climate-change adaptation and disaster-risk reduction measures; planting bamboo around settlements.</p>
Traditional social institutions	<p>Lack of awareness regarding climate change.</p> <p>Declining participation.</p> <p>Lack of adaptive capacity.</p> <p>Lack of finance.</p>	<p>Inviting indigenous-knowledge leaders and climate-change experts to collectively build the knowledge base and awareness level.</p> <p>Holding annual events, festivals and entertainment to attract people so information about the usefulness of indigenous knowledge can be disseminated.</p> <p>Integrating capacity-building activities and externally-supported events to revive interest in indigenous knowledge.</p> <p>Mobilizing institutions such as Aama Samuha and Dhikur for raising funds during festivals and also avoiding flaws in such arrangements.<sup>4</sup></p>



provide a number of messages that reflect Nepal's climate-change policy (GoN, 2011a). The NAPA recognizes the importance of indigenous knowledge and calls for implementation of adaptation measures based on local knowledge, skills and technologies. In order to further enhance the value of local knowledge, an effort should be made to collect, synthesize, disseminate and utilize traditional knowledge, skills, practices and technologies related to climate adaptation and climate impact. This will pave the way for improving traditional technologies and broadening their use in adaptation. To date, indigenous and local knowledge has not been effectively synthesized with modern knowledge and the implementation of indigenous and local practices has been ineffective. This gap highlights a lack of practical approaches and processes for the integration of indigenous and scientific knowledge. At present, the two systems are evolving in parallel. The gap between them should be bridged so that indigenous knowledge can be mainstreamed into on-going adaptation programmes. Concerned agencies can use the findings of this research to develop common approaches, processes and mechanisms for promoting the exchange of knowledge and shared learning between the indigenous and scientific communities. Approaches and guidelines should be developed for practitioners and researchers seeking to collect, disseminate and utilize indigenous knowledge related to climate-change adaptation. There is already a policy provision (GoN, 2011a) for studying and improving traditional knowledge, but it has not been adequately implemented. Furthermore, there is insufficient action to enable the co-production of practical knowledge-based tools to meet the diverse needs of Nepal's adaptation programmes. This can be achieved through continuous dialogue between holders of indigenous knowledge and natural and social scientists, to co-produce a synthesized knowledge system tailored to the local context. This dialogue will need to be reflexive and foster the creative iteration needed to transcend disciplinary and ideological boundaries.

### **Integration of indigenous and modern practices**

Practices based on indigenous and local knowledge are open to scientific knowledge in order to remain adaptive and resilient, while integrating indigenous knowledge with scientific approaches to planning, designing and implementation can increase the effectiveness of adaptation programmes. The irrigation and community-forestry sectors analysed in this study do integrate such practices, but no systematic guidelines have yet been produced. Developing and adopting a synthesized knowledge system will have to reconcile the worldviews that each system espouses and maintains (Berkes, 2009; Thaman et al, 2013). Their different perceptions, views of nature and understanding of climate change present challenges when choosing and applying adaptation solutions, because the two systems have different ways of developing new knowledge (Berkes, 2009). Despite this, partnerships between them should be fostered through regular exchanges; dialogues and joint piloting work (Table A10-2). The development of successful integration processes could have the following consequences (Srinivasan, 2004):

1. an equitable participatory approach;
2. knowledge exchanges;
3. collaborative processes;
4. mutually rewarding learning experiences;
5. problem-focused, demand-driven and project- or pilot-based approaches;
6. building the capacity of all stakeholders;
7. public awareness;
8. a culture of continuity and sustainability;
9. periodic participatory assessment of targets and how well they have been achieved; and
10. outreach strategies, knowledge exchanges and adaptation of technologies.

Recent research on building the resilience of urban food systems and ecosystems emphasizes the importance of transferring and integrating a range of information using a shared-learning dialogue, and including indigenous and modern scientific techniques into the local social, political and cultural context (Dixit and Khadka, 2013; Dixit et al., 2014). Shared learning brings together stakeholders with different perspectives, information, knowledge and power on a common platform for conversation using a participatory problem-solving approach. It is a non-extractive approach that reinforces mutual learning by considering the likely patterns and trajectories of future economic and social changes. Integrating different forms of information should foster iterative deliberation that promotes the exchange of sector- or group-specific knowledge and the perspectives of both local practitioners and external experts in order to improve the quality and effectiveness of decision-making. Table A10-2 indicates different integration strategies followed by the Nepalese study communities.

The shared learning process should create effective communication between indigenous and scientific communities. It should also increase the speed of dissemination and utilization of integrated knowledge that supports different options for climate-change adaptation and disaster-risk reduction. While development approaches based on indigenous knowledge can provide mechanisms for participatory approaches, scientific methods can systematically document those indigenous practices. Integration can be improved by observing the following procedures (Prakash, 2013):

1. building awareness of the two practices;
2. sharing individual perceptions;
3. encouraging participation by targeting specific adaptation issues;
4. pursuing collective visions for a common adaptation solution to reduce vulnerability or risk;
5. initiating joint experimentation at pilot level;
6. validating different knowledge systems;
7. assessing jointly-developed strategies;
8. applying the most suitable approaches; and
9. disseminating results and expanding outreach.

**TABLE A10-2:** Contribution of indigenous and local knowledge and practices to adaptation and resilience building in Nepal.

<i>Working strategy applied by indigenous and local communities</i>	<i>Adaptation Action</i>	<i>Collaborating Partners</i>
Integration of modern and traditional technology	- Building concrete foundations to replace traditional trash dams to divert river water and attempt other innovations.	DoLIDAR
	- Lining of canals to minimize loss and making cemented weirs to divide water into lower-order canals with equity as a guiding principle.	DoI
	- Replacing wooden funnels with metal ones and using plastic pipes in place of open channels to improve flow in water mills.	NGOs
	- Planting local species of medicinal plants, grasses and fast-growing trees to increase income and benefits from forests.	DoF and
	- Grafting pear branches (scion) on to Mayal ( <i>Pyrus pashia</i> ) root stock.	DoLS
	- Using metal wires in place of chains to construct traditional suspension bridges.	DoA
	- Using engineering alignment and construction techniques to rehabilitate trails and treks.	DDC
- Combining micro-credit support with <i>aama samuha</i> to form Women's co-operatives (see endnote 4).	DSCO	
Synergy	- Improving the <i>amchi</i> system of Tibetan traditional medicine by using scientific methods to test the quality and processing of drugs to improve treatments (see endnote 2).	Dept. of Ayurveda
	- Accredited training course in Tibetan medicine approved for practice in the <i>amchi</i> system.	NGOs
	- Replacing tuins and chain and wooden bridges with modern suspension bridges.	DDC Helvetas
	- Establishing improved water mills and machine-run mills side-by-side with traditional water mills.	NGO/DDC
- Using the <i>shingi nawa</i> system to operate by SNP authorities as a part of buffer-zone management system (see endnote 3).	DNPWC/ SNP	
Adapting or retrofitting	- Using brick, cement, timber and tins, as well as other construction technologies, to reconstruct ground floors of traditional mud and tile houses to make flood-adaptive shelters.	Private sector, government, community
	- Wooden and chain bridges strengthened with modern suspension-bridge technologies.	
	- Installing water storage tanks to supply water through traditional stone water spouts in Lalitpur.	
	- <i>Tuins</i> strengthened by using strong wires and gravity ropeway technologies in Dhading.	

**TABLE A10-2 (cont.):** Contribution of indigenous and local knowledge and practices to adaptation and resilience building in Nepal.

<i>Working strategy applied by indigenous and local communities</i>	<i>Adaptation Action</i>	<i>Collaborating Partners</i>
Others	<ul style="list-style-type: none"> <li>- Knowledge exchange and partnerships, facilitating national and regional networks of indigenous knowledge practitioners (e.g. <i>amchis</i> from Mustang and Ladakh regularly share their knowledge).</li> <li>- <i>Aama samuha</i> (Mothers' groups) – a gender-sensitive practice.</li> </ul>	<ul style="list-style-type: none"> <li><i>Amchi</i> associations</li> <li>Co-operatives</li> </ul>

*Note:* DoLIDAR: Department of Local Infrastructure Development and Agriculture Roads; DoI: Department of Irrigation; NGO: Non Governmental Organization; DoF: Department of Forest; DoLS: Department of Livestock Services; DoA: Department of Agriculture; DDC: District Development Committee; DSCO: District Soil Conservation Office; DNPWC: Department of National Parks and Wildlife Conservation; SNP: Sagarmatha National Park.

## Policy constraints, challenges and limitations

When using indigenous and local knowledge and practices to plan and implement local adaptation programs, the following constraints need to be addressed:

**Recognition:** Indigenous knowledge and practices still lack formal legal recognition, even though Nepal's climate-change policy has recognized them and suggested policy measures for their wider application (GoN, 2011a, 2011b). The recommended policy provisions have not been well implemented because there is no regulation providing a mandate to either government or non-government agencies to study and document indigenous knowledge and make use of it in their activities.

**Levelling the playing field:** Indigenous-knowledge systems lack the financial and institutional support that modern knowledge systems receive. There has been little research into how they can be amended for use in adaptation and resilience-building efforts.

**Winning trust and confidence:** Indigenous communities have different worldviews and cultures from those of scientific and development communities. If the two are to work together effectively, they should build mutual trust and confidence. In cases where intellectual property rights are involved, the holders of indigenous knowledge may be reluctant to share it.

**Integration and synergy:** Indigenous communities need to become more open to learning from, integrating into and developing synergies with modern knowledge partners. In order to do this, they need to be made aware of approaches to, and mechanisms and forums for, engaging in dialogue. More importantly, both indigenous and scientific communities need to become motivated to work together.

**Capacity-building and networking:** Indigenous communities are unaware of local, national and global climate-change issues and future trends. They lack the capacity to

make their adaptive practices more resilient and avoid their improper use. They need to extend their networks of users and increase their participation in capacity-building activities conducted by development agencies. Immersion courses, curricula revision and capacity-building modules need to reflect the needs, priorities and experiential processes of indigenous communities.

### **Limitations of indigenous practices**

There are several limitations to the application of indigenous and local knowledge and practices. Since most of these practices evolve in a limited geographical region and within the confines of a particular culture, community or society, they are applicable to that area only, and may not work in others. As climate change is a relatively recent phenomenon it has not yet been fully assimilated into indigenous knowledge and practices. Most local communities only began experiencing the impacts of climate change about 20 years ago and international agencies and government organizations only began assessing these impacts five to 10 years ago (UNFCCC, 2013). As a result, indigenous communities have little experience in integrating indigenous knowledge into modern climate-change adaptation processes and government organizations, international and domestic non-governmental organizations and community-based organizations have no solid base from which to evaluate their efficacy. For this reason, agencies and governments are reluctant to acknowledge that indigenous knowledge and practices can be a key factor in adapting to climate change. For their part, indigenous communities prefer to put their trust in knowledge acquired through practices that have been refined over generations rather than what they view as technological experimentation (UNFCCC, 2013).

Although the case studies illustrate a number of adaptive and resilient indigenous practices, these practices are only applicable to current climate variability and may not be effective in addressing the future impacts of climate change, particularly the likely increase in extreme events (Prakash, 2013). Indigenous knowledge cannot solve all of the problems and challenges that climate change creates. It reflects the cultural values and technical knowledge of the local people in a specific geographical area, so it is site-specific, which means that no particular practice can easily be scaled up and replicated without being tested in and tailored to different locations. Indigenous knowledge and practices are also more effective as preventive measures, rather than as tools to repair extreme damage. That said, indigenous knowledge and practices could be used as a starting point for adaptation-related decision-making.

### **Policy implications**

Since adaptation is essentially and inevitably a local activity, indigenous and local knowledge should play a crucial role in all adaptation-related decision-making processes. Without building on the traditional wisdom and practices of indigenous and local communities, Nepal's different adaptation plans of action such as NAPA

and LAPA will not succeed. For any such activities to succeed, they should be contextualized to a specific culture, location and society. Adaptation plans should therefore be customized to local socio-ecological systems and institutional frameworks.

There needs to be an understanding of, and insights into, existing indigenous and local knowledge and practices, and these should be a prerequisite to launching local adaptation programmes. In this sense, the most important recommendation of this study is that indigenous and local knowledge should be recognized as practical knowledge that should form the foundation of adaptation and sustainable development. Indigenous and local knowledge and practices have the potential to address climate-change issues and should be viewed as a valuable resource for all agencies working in the area of adaptation to climate change.

It is clear that improving the effectiveness of adaptation and resilience-building efforts demands the enhancement of governance capacity at all levels, from national to sub-national and local; of public, private, community and civil society organizations and traditional institutions. Capacity-building efforts need to consider both planned and autonomous adaptation measures across all sectors. This effort needs to be backed by management of knowledge to promote adaptation to climate change, particularly in the country's marginalized regions and among marginalized individuals, households and groups. This study has shown the existence of multiple types of knowledge, incorporating multiple views about the direction of climate change, its impacts, vulnerabilities, risks and potential responses. For these reasons, adaptation to climate change in Nepal is a complex but immediate imperative, due to the country's development deficit and its potentially high vulnerability to climatic stress.

## Conclusions

This chapter reviewed and analysed the climate-change issues, challenges and adaptation priorities from the perspective of indigenous, poor and marginalized groups. It examined the sources, types and nature of climatic and non-climatic vulnerability faced by local communities. The perceptions of local communities about climate change were compared with inferences drawn from observed changes in weather. Both local perception and scientific analysis of historical trends indicate that average temperatures in Nepal are rising and rainfall is becoming more erratic.

The practices developed and adopted by local communities are capable of responding to stresses in a multi-sectoral context. A multi-dimensional approach would be more effective in dealing with vulnerability than an approach that focuses only on a single issue because vulnerability is by its very nature multi-dimensional. Local communities and their institutions need to be prepared to successfully deal with climate-change vulnerabilities. This means building their capacity to enhance (or develop) indigenous and local knowledge and practices so that they are equipped to deal with the challenges of building resilience.

Indigenous knowledge is not well recognized – in a formal sense – as a source of knowledge for designing and planning local adaptation measures. This can be viewed as both a limitation and an opportunity. The Government of Nepal’s climate-change policy stipulates that 80% of the budget for climate-change adaptation should be allocated to local-level activities. Mainstreaming indigenous and local knowledge would create avenues to meet this target, so long as the government recognizes and promotes it. Sometimes, government agencies and the scientific community may view local knowledge as inadequate to deal with the complex challenges faced by Nepali societies and communities. Moreover, the fact that indigenous and local knowledge is site-specific means that while it would be most useful in local adaptation, there may be limitations to the wider application of specific aspects of it.

Indigenous and local knowledge and practices should be recognized as a basis for implementing or revising LAPAs. The application of this knowledge to climate-change adaptation is relatively new; therefore, its promotion and utilization should begin with the removal of policy barriers and the provision of financial support for building the capacities of traditional social institutions. Both the government and development agencies should support indigenous and local knowledge and practices so that they can be more effectively integrated with scientific knowledge.

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## Notes

1. Indigenous, traditional and local knowledge generally refers to knowledge and know-how developed over several generations and linked to a specific place, culture or society. These knowledge systems are dynamic in nature and exist among people who live as a part of natural ecosystems. This chapter uses the nomenclature employed by the Inter-governmental Platform on Biodiversity and Ecosystem Services to describe indigenous and local knowledge systems. Indigenous local practices refer to indigenous, traditional and local knowledge systems as described in Nakashima et al. (2012).
2. *Amchi* is the name for a doctor practising Tibetan medicine, an ancient system of healing highly respected and trusted in Mustang and other communities influenced by Tibetan culture and widely practised on the Tibetan plateau.
3. *Shingi Nawa* is a custom practised by the Sherpa community (*Shingi* = wood or trees; *Nawa* = to ask) where a leader (old and wise and selected by the community) prepares a calendar specifying the dates for cutting trees.
4. *Aama Samuha* is a self-organized traditional institution initiated by the Gurung community as a mothers' group for a social welfare management, promotion of indigenous culture such as dance, songs and local cuisine, social engagement and collective actions. Savings and credit operations have been added in recent years. *Dhikur* is a traditional credit association that was established by Thakalis, Gurungs and Bhotas for raising capital for investment in trade and business. It has grown and is undertaking different financial transactions as an informal rural bank.