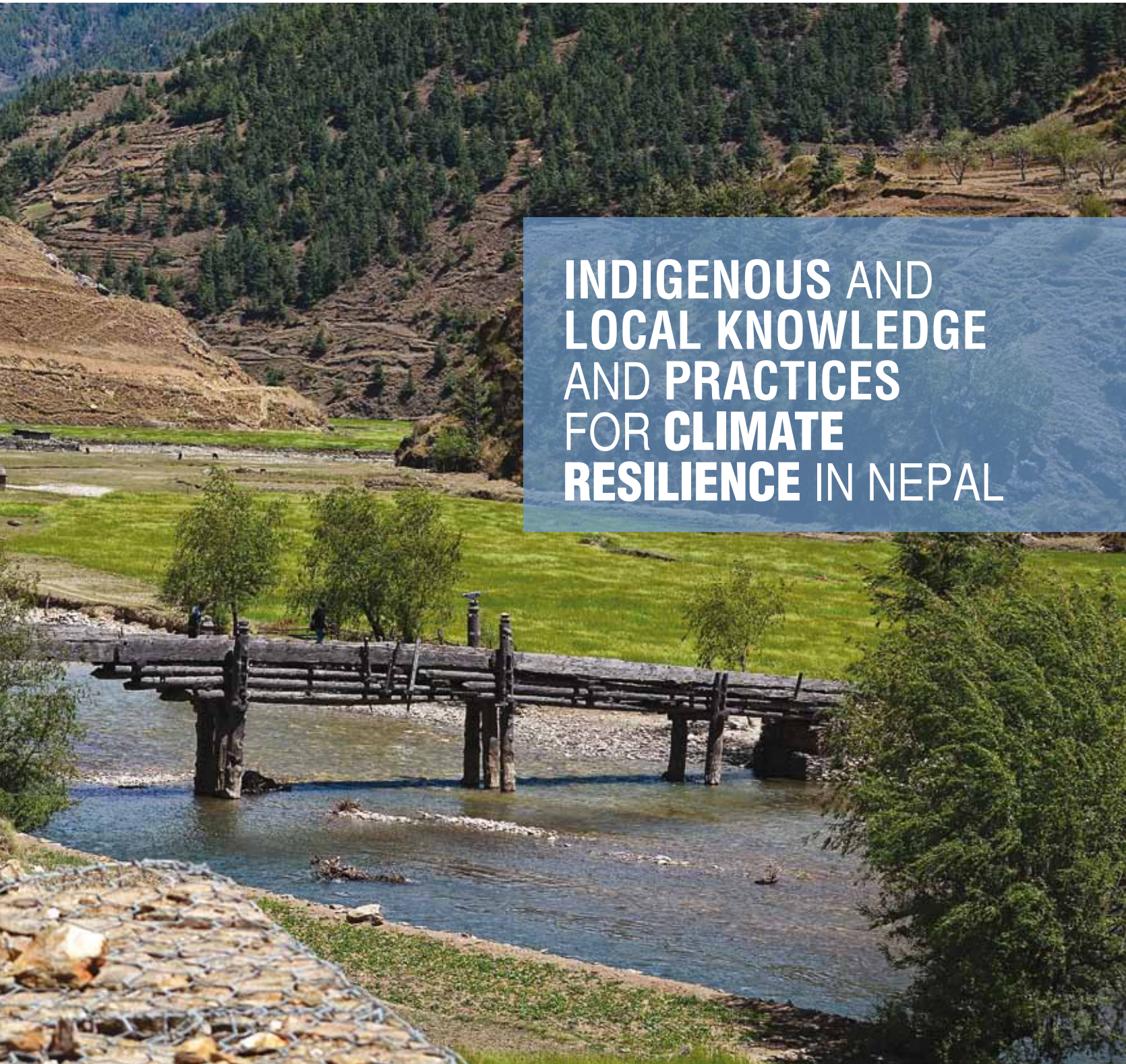
GOVERNMENT OF NEPAL
MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT

MAINSTREAMING CLIMATE CHANGE RISK MANAGEMENT IN DEVELOPMENT
ADB TA-7984 NEP: INDIGENOUS RESEARCH (44168-012)



INDIGENOUS AND **LOCAL KNOWLEDGE** AND **PRACTICES** FOR **CLIMATE RESILIENCE** IN NEPAL

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KNOWLEDGE SUMMARY

The findings of this study reinforce widely held views that indigenous and local knowledge and practices (ILKP) help local communities adapt to climate change risks. In Nepal communities have dealt with natural climatic variability and other changes for centuries by innovating and institutionalizing ILKP in managing local natural resources and infrastructure development. ILKP are enriched, sustained and improved over time by succeeding generations and hence these are time tested and specific to local needs and priorities. ILKP, in general, are known to enhance resilience, reduce disaster risks to ecosystem and livelihood resources and create adaptation solutions to deal with climate change vulnerability and impacts. They can enable local communities and their institutions to prepare adaptation strategies, develop and implement plans and actions. Many of the ILKP can be integrated with scientific knowledge, tools and practices to support adaptation actions by switching strategies, modifying or transforming existing norms and behaviors while dealing with both climatic and non-climatic shocks and disturbances. In their present form, however, and without external support ILKP will not be able to deal with the extreme events that climate change is likely to bring about though IKLP may help provide initial understanding of potential adaptive practices.

Government and donor agencies have used formal scientific knowledge and practices together with ILKP to address development needs and disaster risks. However, both knowledge systems face limitations when it comes to responding to climate change challenges because: a) knowledge about future climate is uncertain, and b) context and location specific ILKP will become inadequate to deal with low probability high exposure climatic shocks. The exact nature of the impacts remains difficult to predict and the challenge is complicated further by multiple stressors. How do we prioritize which climate change impacts to adapt to? This is a difficult but important question and one that does not have a clear answer. Climate change is likely to disproportionately affect rural and urban populations who lack access to clean water for drinking, sanitation and irrigation and whose livelihoods depend on agriculture, wage labor and ecosystem services.

This study argues that for effective climate change adaptation ILKP and scientific knowledge communities must work together to generate new knowledge and improved practices that are situation specific. Developing new synthesized knowledge requires the integration of both knowledge systems. It also requires greater participation of local communities who are particularly vulnerable to the risks associated with climate change. While scientific research on climate change projections and impacts are critical to developing appropriate adaptation solutions, the traditional forms of knowledge and wisdom they offer help reinforce adaptive capacity as a strategy for building resilience.

Integration of the two knowledge systems should: (a) promote effective communication of weather and specific hazard information; b) improve mobility during and after extreme climate events; (c) link women and other traditional groups with local financial institutions to access funds for risk spreading before, during and after extreme climatic events; (d) diversify livelihoods through access to a range of options; (e) provide education on local language and practical skills necessary to understand climate change, its risks and livelihood strategies tailored to each situation; (f) ensure rights to organize into groups and express views through diverse public, private and civil society organizations; and (g) synthesize scientific as well as indigenous practices to proactively identify hazards, analyze and minimize risks and attain social and economic wellbeing. Details of case studies on local water management; forest and pasture management; rural transport infrastructure; settlements and housing; and traditional social institutions are provided as a separate case reports.

EXECUTIVE SUMMARY

The impetus for this report comes from the global recognition of indigenous and local practices for climate change adaptation (UNFCCC, 2013). The report details the findings of a study conducted under the Mainstreaming Climate Change Risk Management in Development Program (MCCRMDP), a technical assistance initiative of the Asian Development Bank (ADB) in support of the Government of Nepal (GoN). This study formed a part of the Pilot Program on Climate Change Resilience (PPCR) currently implemented by the Ministry of Science, Technology, and Environment (MoSTE), Government of Nepal (GoN). It concludes that for Nepal to become a climate resilient country, local communities must fully participate in and contribute their rich local knowledge and practices to climate change adaptation and resilience-building. Their participation is crucial for the success of Nepal's long-term adaptation plans and programs, especially in sectors such as natural resource management and institutional capacity building.

The report identifies a number of indigenous, traditional and local knowledge and practices and analyzes their applications for climate change adaptation and resilience-building at the local level. The report is based on case studies encompassing five thematic sectors - water, forestry, rural transport, settlements and housing and traditional social institutions - and draws on examples of ILKP from 18 districts of Nepal. The cases were selected based on: a) the traditional practices of indigenous groups and cultures; b) the relevance of these practices for climate-change adaptation; c) their coverage in literature; and d) their potential to scale up. The sectors were also selected based on 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 for the study were collected from key informants and household representatives. Secondary information was collected through an extensive literature review, national and district-level stakeholder workshops and focus group discussions (FGDs).

In Nepal, rural and urban populations lacking minimal access to water for drinking, sanitation and irrigation and whose livelihoods depend on agriculture, wage labor, ecosystem services, rain-fed agriculture, fragile dwellings and those without social support networks are most likely to be affected by climate change. Large sections of indigenous and local communities fall into this category and are disproportionately vulnerable to natural and environmental disasters triggered by both climatic and non-climatic drivers and changes. Climate change impacts are expected to be visible in terms of rising temperatures, uncertain and extreme rainfall events, landslides, floods, droughts and glacier melt. Nepal's high rates of poverty, erosion and deforestation, the loss of biodiversity and pollution combined with low institutional capacity to respond to these changes and inequalities prevailing in Nepalese society have been responsible for producing climate change vulnerability .

Nepal's considerable ethnic and social diversity combined with its rich biological diversity has contributed to the evolution of rich local knowledge and practices

(ILKP). These practices, evolved through generations by testing and learning, help many communities cope with and adapt to the growing challenges posed by climatic and non-climatic changes.

The diverse ethnic, social and cultural groups across the country have developed rich local knowledge and practices to support, maintain and improve their livelihoods through managed use of natural and community-built resources (Sherpa et al., 2013). These knowledge and practices have sustained the livelihoods of people in diverse physical, social and ecological contexts, especially where market led opportunities and/or external support are grossly deficient. Despite the externalities imposed by changes in climate and other drivers, social groups across the country have adapted to the stresses emerging from changes of different forms (Gurung, 2005). This has been possible with the comprehensive understanding of the structure and functions of the interconnected human-environment systems in which they live. This understanding has led them to secure food, water, energy, medicines, building materials and other necessities from ecosystem based resources. People's knowledge and skill in accessing and managing services from ecosystems together with strong social networks that they develop form an integral part of their adaptive culture, capacity and identity (Gurung, 1994). This cultural knowledge and learned behavior helps them develop mechanisms for adjusting to stress and improving adaptive capacity (BK, 2010; Nepali, 2007).

The study documents a spectrum of knowledge, practices and insights relevant to the four thematic sectors identified through research across 18 socially and economically diverse districts in Nepal. These practices were found to be practical, flexible and cost-effective since they involved the use of local materials, local technical know how and local institutions in their development and promotion. These practices were not only community-initiated, -owned and -managed but were also situation-specific and adaptive to changes in human-environmental systems.

The study findings highlight how ILKP are integral to autonomous adaptation. Furthermore, local knowledge and practices are linked to traditional institutions that create a supportive environment for their evolution, inter-generational transfer and improvement. Due to their evolutionary nature, local knowledge and practices quickly adjust to the changing dynamics of climate change and its impacts.

Case Study Sector-specific Key Messages

Local water management

- The study identified locally developed water use practices that are climate-adaptive. These adaptive practices were specific to farmer managed irrigation systems (FMISs), community managed drinking water systems and traditional water mills. These practices have highlighted how local knowledge needs to be incorporated into agency supported intervention programs in traditional water systems; the goal being to ensure local ownership and sustainability. Many successful indigenous and local water management practices do not receive due recognition from government and development organizations when they are

designing support programs and there is therefore a risk that these practices will get lost.

- Indigenous water practices follow watershed boundaries and the success of these practices demonstrate how national and local level water resources management plans also need to follow basin-wide management approach. This approach would ensure equitable water allocation that recognizes indigenous use rights, considers the demand and supply balance as well as establishes the need for conservation of water sources for sustained water production to support multiple uses in downstream areas.
- Rapid and unplanned urbanization has presented challenges to indigenous systems of drinking and irrigation water uses to the extent that these systems are no longer in a position to meet the community's water needs. Market forces emerging from urbanization weaken the traditional institutions because of people making different choices when it comes to technology and water management practices. This situation requires new knowledge and practices to respond to the impending challenges. Options based on local knowledge and practices alone would be inadequate to respond to the challenges.
- ILKP are based on bottom-up processes and provide grounded evidence of how people have managed water systems for multiple uses – irrigation, drinking, water mills and hydro-electricity. Exploring these practices for management, benefit sharing, resource sustainability and dispute resolution would produce important lessons to reform public policies on climate change adaptation (CCA).
- ILKP such as traditional ponds and FMISs need to be integrated into the wider promotion of water conservation techniques such as rainwater harvesting, use of drip and sprinklers, as well as conservation of ponds and wetlands to make more efficient and effective use of precipitation. These options provide examples of how traditional and modern technology and practices can be blended and incorporated into relevant local level adaptation planning and resilience building.

Forest and pasture management

- Indigenous and local forest and pasture management practices have evolved from cultural norms, traditional values, contextual demand, collective behavior, community-based institutions and a good understanding of local ecosystems. Government agencies should, therefore, recognize and promote them as climate-adaptive and resilient practices in climate change adaptation.

- Indigenous forestry practices have thrived in locations where access to resources is guaranteed and tenure security is in place under the principle of `care and share'. The GoN should specify property rights to forest users and allow equitable sharing of benefits among local users to promote better adaptation of forest resources to climate change. Government agencies should also promote integration between contemporary and traditional community-based forest and pasture management practices by providing economic and policy incentives.

- Social and gender inclusion and equity are key to successful indigenous forest management practices. Integrating these elements into the system is often possible with local innovations that combine conservation and commercial

uses of resources. Conservation of forest species together with commercial use of under-story vegetation, such as non-timber forest products and pasture resources can promote resilience building through community based forestry.

Rural transport infrastructure

- Traditional bridges, trails and *tuins* (cable river crossing) developed by communities provide essential transportation and communication links at the local level and support 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 and their management and upkeep is possible without much external support. Promotion of these systems can help build community resilience and adaptive capacity.
- Road and bridge building policy needs to consider improving and/or retrofitting indigenous local transport infrastructure bearing in mind feasibility and costs. Government engineers should regularly consult with community members to learn about ILKP when deciding on modes of rural transport.

Settlements and housing

- The GoN should recognize that indigenous and marginalized communities who have nature-based livelihoods and who are settled on marginal and fragile lands face a disproportionate risk from climatic hazards and disasters.
- The resilience-building of settlements and housing must first focus on human safety and then on improved access to food, water and low carbon-energy options and the availability of social support networks.
- ILKP in settlement planning and shelter development should be taken into consideration when looking at shelter building in the areas that are at risk of recurrent disasters. Skill development and capacity programs and integration of modern and local skill and practices in settlement and housing construction can help build resilience to recurrent floods and other natural hazards.
- An understanding of local perceptions, culture, economic behaviour and collective action is a prerequisite to the design and development of climate resilient adaptive housing and settlement.

Traditional social institutions

- The GoN needs to recognize the critical role that traditional social institutions play in leading and guiding communities to preserving their cultural and natural environment as well as in ensuring effective CCA.
- The credibility of traditional social institutions in the community enables local people to innovate and popularize new knowledge and practices. CCA interventions that involve communities and development partners should aim to strengthen these traditional institutions. They are well placed to do this because of their strong roles in maintaining social order, promoting collective action and conflict resolution.
- Integrating traditional institutions into the formal institutional framework can achieve greater complementarities, effectiveness and sustainability. In order to do this it is necessary to build the capacity of traditional social institutions so they can advocate for integration.

- The proven effectiveness of women's knowledge, skills and insights into local level water and forest management enable women groups to contribute to the household economy and ensure effective management of resources. The role of women in natural resource management in water and forest observed in the case study districts is worth scaling up and replicating in other areas.

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Foreword

Nepal is a country of immense geographical and social diversity. At the same time Nepal is very rich in natural resources and storehouse of biological diversity. Nepal strives to achieve sustainable economic growth through wise use of its natural resources. In recent time, climate change has emerged one of the issues of high concern both in international and national arena which has significant negative impacts on environment with consequences on ecosystems, their services and the livelihoods of people that depend on them. Nepal has negligible contribution on global greenhouse gas emission; however, Nepal among the most vulnerable countries in the world due to the impacts of climate change. Nepal has prepared National Adaptation Programme of Action on Climate change in 2010 and climate Change Policy in 2011 to deal with climate change impacts. In order to address the impact of climate change, this Ministry has undertaken a research study on exploring, documenting and promoting the local and indigenous knowledge being practiced by communities since centuries which is equally important in adapting with the changing climate. This research study was completed under this Ministry through Pilot Project for Climate Resilience (PPCR) with the financial support of Climate Investment Fund (CIF) and administered by Asian Development Bank (ADB).

I believe integrating scientific knowledge with indigenous and local knowledge (ILK) can contribute enhancing resilience and adaptation impacts. This report is a summary of the study on ILK which includes key findings from detailed analysis of ILK in the context of climate change adaptation in five sectors (rural transport, local water management, forest and pasture management, human settlement and housing and traditional social institutions) in 18 districts of Nepal. The assignment was undertaken during 2014 by a research team of Institute for Social and Environmental Transition-Nepal (ISET-Nepal) and Integrated Development Society-Nepal (IDS-Nepal).

This study of ILKP in the context of climate change is the first of its kind in Nepal and provides opportunities to integrate local and indigenous knowledge into Nepal's adaptation efforts. The

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study also contributes to the global knowledge pool of ILK and climate change that can be used to shape both national and international policies.

I would like to thank Dr. Madhav Karki and his team from ISET-Nepal and IDS-Nepal for their hard work in undertaking this study and also producing this comprehensive report. Thanks goes to the CIF and ADB for their continuous financial and technical support.

Finally, I would also like to thank Mr. Mahendra Man Gurung, Joint Secretary and National Programme Director and Dr. Jay Ram Adhikari, Under Secretary and National Programme Manager for guiding the study. I wish this document will become learning and guiding documents for those striving to promote and use ILK with modern knowledge of climate change adaptation.

Krishna Chandra Paudel, PhD
Secretary
5 February 2015

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The study team has greatly benefitted from the keen interest taken and excellent mentoring provided by senior officials of the Ministry of Science, Technology, and Environment (MoSTE) of the GoN. In particular, the authors would like to extend their gratitude and deep appreciation to Mr. Mahendra Man Gurung, the National Project Director and Joint Secretary, and Dr. Jay Ram Adhikari, National Project Manager and Under Secretary (Technical), for their guidance and co-operation.

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ACRONYMS

ADB	Asian Development Bank
AMIS	Agency Managed Irrigation systems
BTCB	Baglung Type Chain Bridge
BZM	Buffer Zone Management
CAA	Civil Aviation Authority
CAPAs	Community Adaptation Plan of Actions
CBA	Community Based Adaptation
CBDM	Community Based Disaster Management
CBFM	Community Based Forest Management
CBOs	Community Based Organizations
CC	Climate Change
CCA	Climate Change Adaptation
CDR	Central Development Region
CF	Community Forestry
CoF	Collaborative Forestry
DDC	District Development Committee
DHM	Department of Hydrology and Meteorology
DLW	District Level Workshop
DNPWC	Department of National Parks and Wildlife Conservation
DoA	Department of Ayurveda
DoF	Department of Forest
DoLIDAR	Department of Local Infrastructure Development and Agriculture Roads
DoLS	Department of Livestock Services
DRR	Disaster Risk Reduction
DWIDP	Department of Water Induced Disaster Prevention
EbA	Ecosystem based Adaptation
EWS	Early Warning System
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FMIS	Farmers Managed Irrigation System
FPM	Forest and Pasture Management
GCAP	Global Climate Adaptation Partnership
GLOFs	Glacier Lake Outbrust Floods
GoN	Government of Nepal
HH	Household
HHI	Household Interview
ILC	Indigenou Local Communities
ILK	Indigenous and Local Knowledge
ILKP	Indigenous and Local Knowledge and Practices
ILKS	Indigenous and Local Knowledge Systems
ILP	Indigenous and Local People
INGOs	International Non Governmental Organizations
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

IPCC	Inter-governmental Panel on Climate Change
IUCN	International Union for Conservation of Nature and Natural Resources
JTWB	Jumla Type Wooden Bridge
KII	Key Informant Interview
LAPA	Local Adaptation Plan of Action
LBOF	Landslide Blocked Lake Outbrust Flood
MCCRMD	Mainstreaming Climate Change Risk Management in Development Program
MoSTE	Ministry of Science, Technology and Environment
NAPA	National Adaptation Program of Action
NAPs	National Adaptation Plans
NGOs	Non Governmental Organizations
NPC	National Planning Commission
NRM	Natural Resource Management
NTFPs	Non Timber Forest Products
PAC	Practical Action Consulting
PPCR	Pilot Program for Climate Resilience
PRA	Participatory Rural Appraisal
SFM	Sustainable Forest Management
SNP	Sagarmatha National Park
TA	Technical Assistance
TSB	Traditional Suspension Bridges
TSI	Traditional Social Institutions
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations. International Strategy for Disaster Reduction
UNPFII	United Nations Permanent Forum on Indigenous Issues
UNU	United Nations University
VDCs	Village Development Communities
WDR	Western Development Region

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CHAPTER I

BACKGROUND AND RATIONALE

1.1 BACKGROUND

Indigenous knowledge and local practices (ILKP) are increasingly recognized and used as a valuable resource for planning climate change adaptation (IPCC, 2007, 2010a; UNFCCC, 2013). Vulnerable communities use indigenous practices to plan adaptation and disaster risk reduction activities at the local level. ILKP are also specific to agriculture and animal husbandry, natural resource management, rural transport, human dwellings, traditional medicine and biodiversity conservation (Barber et al., 2014; Nakashima, 2012; Berkes et al., 2000; World Bank, 1998).

Realizing the value of ILKP in Nepal's climate change adaptation and resilience-building works, the Asian Development Bank (ADB) supported this study of the Indigenous Practices for Climate Change Adaptation in Nepal, one of several components of the GoN's Pilot Program for Climate Resilience (PPCR) being implemented by the Ministry of Science, Technology & Environment (MoSTE).

The study outputs are intended mainly for use by the ADB's technical assistance program - the Mainstreaming Climate Change Risk Management in Development Program (MCCRMDP) –on behalf of the GoN. The aim is to increase the adaptive capacity and resilience building skills of local communities and their organizations to climate change. The expected outcome of the study is increased capacity of the GoN and its institutions to incorporate safeguards for vulnerable and disadvantaged groups, indigenous peoples, women, children and senior citizens in the development programs, policies and practices while addressing the effects of climate change (ADB, 2011).

Indigenous and local knowledge system (ILKS) encompasses dynamic and culture specific knowledge, practice and belief. The system evolves through adaptive processes based on the location specific learning-by-doing behavior and intergenerational transmission. The concept of ILKS can be understood through a number of cultural and linguistic attributions: indigenous and traditional knowledge (ITK), traditional ecological or environmental knowledge (TEK), ethno-science, indigenous science, folk science and farmers' and pastoralists' knowledge. ILKSis generally more predominant in mechanical and ethnic/tribal societies than in developed and organic societies. ILKS is also closely interlinked with governance and institutions (Agrawal, 2008) since the indigenous knowledge holders are the custodians of the knowledge and the institutions play critical roles in production and integration of knowledge in adaptation and change. ILKS lose relevance when removed from the control of the culture and society where it has evolved and is practiced (Agrawal, 2002). Coexistence and coproduction of ILKS and contemporary knowledge systems foster generations of integrated and synthesized knowledge to meet the new challenges emerging from climate change and natural and manmade disasters.

1.2 STUDY RATIONALE

There is no doubt that the climate in Nepal is changing: temperatures are increasing and rainfall patterns are becoming erratic and less predictable. These changes will

have significant adverse impacts on Nepal's economy (ADB, 2014; IDS-Nepal, PAC and GCAP, 2014). During the last five years, Nepal experienced more extreme monsoon rainfall and devastating floods than ever before (Devkota, 2014; Karki, 2014). The occurrence of flash floods in Surkhet valley in 2014, Darchula in 2013, Seti River in Pokhara in 2012 and Koshi in 2008 signify more frequent occurrences of floods of catastrophic magnitude in Nepal. These extreme events led to high loss of life, livelihood and property though not all these events are attributable to extreme climate events. Institutional failure (Dixit, 2009; Shrestha, 2010) caused the Koshi embankment flood in 2008. An avalanche falling and blocking Seti River and its subsequent breach caused the Seti River flood in 2012. At the same time small-scale droughts, glacial lake outburst floods, avalanches, landslides and slope failures are recurrent events during the monsoon every year. The long-term impact of these events on Nepal's development infrastructure, natural resources and local institutions are alarming with consequences for food, water, energy and ecological security (FAO, 2014; ADB, 2014).

Largely a hilly and mountainous country, Nepal is ecologically fragile, geologically unstable and environmentally vulnerable (Shrestha, 2007; Shrestha et al., 2011; Shrestha et al., 2014). In recent years climate change has exacerbated these vulnerabilities. With more than one-fourth of its population living below the poverty line (NPC, 2013), Nepal faces multi-faceted vulnerability and the potential impacts from climate change top the list. In Nepal, large sections of the rural and urban population who lack minimal access to water for drinking, sanitation and irrigation, and whose livelihoods depend on agriculture, wage earning, ecosystem services, rain-fed agriculture, fragile dwellings and those with weak social support networks are most likely to be affected by climate change. To address this situation, adaptation and resilience-building requires integrated and holistic management of natural, human, cultural, physical and financial capitals. This approach requires continued generation of new and synthesized knowledge and effective practices to help support formulation and implementation of development policies, strategies and practices to meet the emerging challenges. This knowledge can come from both indigenous as well as contemporary science and technology practices (World Bank, 1998; Mukhopadhyay, 2009).

Since adaptation is essentially a local response, locally developed mechanisms and practices are better options than external approaches in responding to immediate climate risks, such as water shortages, crop failures, flood disasters, accelerated soil erosion and mass wasting and infrastructure damages (Nakashima et al., 2012; Berkes et al., 2000). A blend of approaches and methods and practices drawn from both modern science and traditional knowledge can provide practical and cost effective options for improved disaster risk reduction, preparedness and adaptive responses (Mukhopadhyay, 2009). Unlocking the capacity of indigenous knowledge, practices and institutions can facilitate better responses to these threats than relying solely on scientific knowledge and tools that are either unavailable or costly to practice at the local level (Naess, 2013; Lebel, 2012; Chaudhury, 2012).

The growing impacts of climatic disasters have serious implications for the resilience-building capacity of Nepal's economy and ecosystems (FAO, 2014).

Climate change impacts have affected the durability and functioning of both public and private infrastructures and community assets. In addition, human activities such as cultivating sloping land, converting forestland, conventional mining and haphazard infrastructure development such as roads, bridges, dams and reservoirs and unplanned human settlements have introduced a spectrum of human-induced hazards to the existing range of natural hazards.

While locally driven practices such as community-based forests and water management systems have been successful in reducing the adverse impacts of environment degradation, un-sustainable development activities, such as use of heavy machines and equipment in hill road building, have resulted in large-scale land degradation and increased human-induced physical hazards. For this reason, it is crucial to mainstream climate change risk management alongside the promotion of ILK into development sector policies, plans, programs and institutions (ADB, 2011).

1.3 PURPOSE, OBJECTIVES AND QUESTIONS

Purpose of the study

The purpose of the study is to document indigenous knowledge and practices and their relevance in responding to and building climate change adaptation in the specific local context. The traditional or local practices are those that a group with a specific ethnic/social/cultural identity have practiced over a long period of time, evolving through continuous processes of learning-by-doing and trial and error. The study aims to identify a list of good practices around the application of ILKP for use by adaptation planners and policy makers. The study forms a part of a technical assistance to strengthen Nepal's system of generating, managing and promoting knowledge for use as an input to make the country climate-resilient (ADB, 2011).

The study makes a distinction between the autonomous adaptation practiced by communities and the planned adaptation introduced by the government and development organizations. Where possible, the study identifies how and where the application of indigenous knowledge has supported autonomous adaptation. The study also makes the case for blending indigenous local knowledge with contemporary scientific knowledge and practices in adaptation planning. It also identifies key climate change adaptation issues and priorities of different communities representing Nepal's ethnic, social and geographic diversity. In particular, the study analyzes ILKP with a special focus on indigenous people, marginalized groups and women. The report begins with community specific perceptions of climate change effects and local level responses stemming from indigenous knowledge and practices and their contribution to climate change adaptation and resilience building. The report goes on to suggest approaches to integrate adaptive ILKP into climate change policies and programs at the national and sub-national levels.

Research objectives

The overall objective of the study was to identify, compile and analyze indigenous and local knowledge and practices that provide insights into strategies for climate

change adaptation and resilience building in Nepal. In particular, the study's specific objectives were as follows:

- Analyze climate change issues and adaptation priorities from the perspective of diverse social, cultural and linguistic groups and capture the views of women within these groups.
- Identify, analyze and document adaptation practices based on indigenous and traditional knowledge (ITK)-based adaptation ways of recognizing climate change impacts in their livelihood environment and the measures they take to cope with or benefit from these changes.
- Recommend how indigenous adaptation practices can be integrated into the country's development programs and policies with particular reference to the MCCRMDP and other components of the PPCR.

The focus was on examining climate-sensitive development sectors and vulnerable regions of Nepal. Research themes (development or livelihood sectors), locations (districts) and participants were selected through systematic processes of consultations with national and district level stakeholders and an extensive literature (including grey literature) review.

Research questions

The study team formulated a set of research questions to identify reliable, relevant and applicable ILKP in the context of climate change adaptation in Nepal and develop a case for their up scaling and replication (Putt, 2013; UoM, 2010). The research questions were as follows:

a. What are the key considerations for adopting ILKP for increasing adaptive capacity and resilience to climate change in Nepal?
b. What lessons and insights can be drawn from past research/studies on indigenous knowledge and practices specific to climate change adaptation and resilience building in Nepal?
c. How can autonomous adaptation practices inherent in ILK be linked with planned approaches to climate change adaptation?
d. Which ILKP can be up-scaled and replicated?
e. How gender-sensitive are the identified ILKP?
f. What are the key practical and methodological challenges in pursuing the practices identified?

1.4. SCOPE

This report documents and analyzes findings from select cases of ILKP related to climate change and development in 18 districts of Nepal. It provides an overview of published scientific and grey literature on ILKP and includes primary information collected from the field. Selected case examples from specific indigenous and local groups presented in this report are reflective of ILKP that can be found in other parts of Nepal. The study recognizes that case examples from specific locations and contexts presented in this

report are only a sub-set of a much wide rrange of communities and contexts within the country, hence this study may not be considered comprehensive.

The study aspires to assist the concerned agencies of the GoN in developing policies and programs that incorporate elements of ILKP in responding to climate change impacts, adaptive responses and resilience building. Climate change responsive ILKP have been documented and analyzed specific to farmer-managed irrigation systems (FMIS), community managed-drinking water systems, forest and pasture management, settlements and housing, bridges and trails and traditional social institutions in the selected districts of Nepal. The report also identifies key elements of resilience in people and their institutions, as well as ways to improve livelihoods and increase social equity (Naess, 2013).

1.5. DEFINITIONS AND CONCEPTS

1.5.1. Indigenous knowledge and practices

The term ILKP used in this report follows the definition by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). The IPBES defines indigenous and local knowledge as “the multi-faceted arrays of knowledge, know-how, practices and representations that guide societies in their innumerable interactions with their natural surroundings. This interplay between people and place has given rise to a diversity of knowledge systems that are at once empirical and symbolic, pragmatic and intellectual, and traditional and adaptive” (ICSU, 2002; Berkes, 2012). This study is also based on an understanding of ILKP evolving over time, “acquired through accumulation of years of experiences of local people and passed on from generation to generation”(Mukhopadhyay, 2010).

Indigenous knowledge includes culture- and society-specific knowledge on subsistence practices (e.g. agriculture, animal husbandry and slash and burn agriculture); traditional medicine (e.g. use and ethno-botanical knowledge of medicinal plants for human and animal usage); and celestial knowledge as it influences human living, weather forecasting and disaster prediction (Nakashima et al., 2012; Pandey, 1998; Jolly et al., 2002). Social Institutions have their roles in supporting continuation of ILKP (Agrawal, 2008; UNFCCC, 2013).

The relevance of indigenous knowledge to climate change adaptation is also highlighted in reports from the Intergovernmental Panel on Climate Change (IPCC). The IPCC (2007) identifies the value of indigenous knowledge as “an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change”. It elaborates further stating, “indigenous or traditional knowledge may prove useful for understanding the potential of certain adaptation strategies that are cost-effective, participatory and sustainable” (IPCC-XXXII/Doc 7, 2010). These concepts and definitions help to frame the research by considering ILKP to be inclusive ofthe knowledge and practices that help vulnerable local communities to respond to climate change induced vulnerability and to develop adaptive options.

In the context of CCA in Nepal, this research attempts to develop an understanding of ILKPs assuming that specific characteristics of the knowledge stream make them relevant for local adaptation and resilience building efforts. The research uses the following properties of ILK:

a) Knowledge found locally and specific to different situations and culture;
b) Tacit (unspoken or implicit) knowledge gathered through interaction among and observation of community members, which is easily disseminated;
c) Transmitted orally from generation to generation or self-learned, getting refined in the process of transference;
d) Practical knowledge that is applied rather than theoretical;
e) Experiential learning which is specific to a locale; and
f) Constantly changing as it is regularly improved upon (Warren et al., 1995; Berkes, 2012; Nakashima et al., 2012).

Indigenous knowledge has played an important role in solving local problems, including those related to climate variability, impacts and associated vulnerability. Since indigenous and local people live close to natural resources, they quickly observe the changes around them and adjust their activities to adapt to the changes, which is how ILKP evolve (Tebtebba Foundation, 2013).

1.5.2. ILKP and climate change adaptation

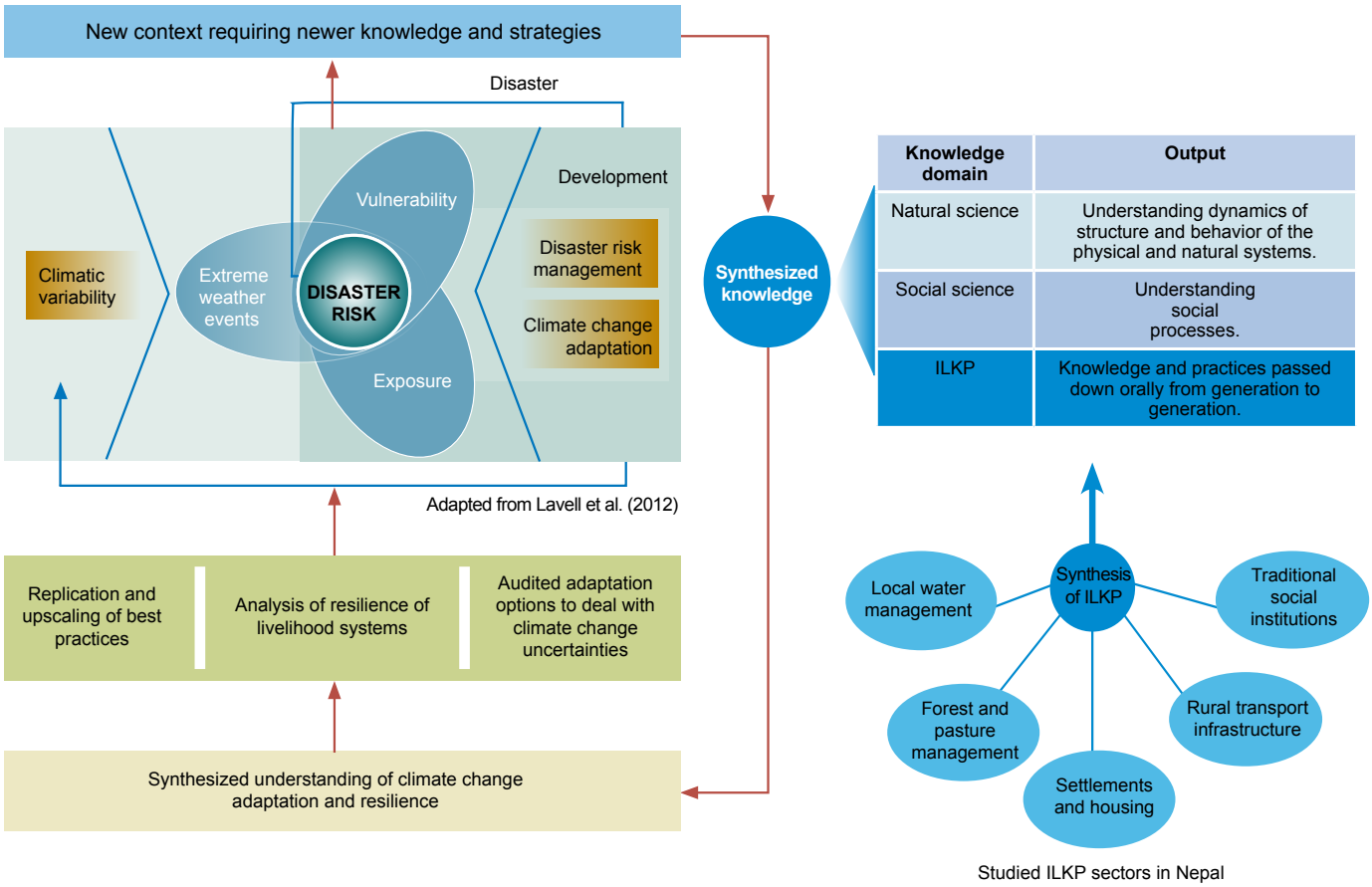
The literature on the application of indigenous, traditional and local knowledge in climate change adaptation and mitigation across diverse countries and societies is comprehensive and vast (Nakashima et al., 2012; Prakash, 2013). Recent literature includes documentation of the best practices on indigenous knowledge for adaptation and available tools and application of gender sensitive approaches (UNFCCC, 2013). Other recent literature highlights the rapidly expanding roles and relevance of ILKP in climate change adaptation, disaster risk management and resilience-building efforts at both local and national levels (World Bank, 1998; UNISDR, 2013; Thaman et al., 2013).

Over the years, people have used their knowledge and practices to adjust to changing economic, ecological and social dynamics in their locality. People continue to do this to reduce the hazards and risks imposed on them by climate change and these adjustments have evolved over time into indigenous adaptation practices (Anik, 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). Figure 1 illustrates how indigenous practices can be located within the domain of climate change risk reduction strategies. Local climate adaptive practices have emerged in response to changes in weather and climate for centuries and this is why indigenous adaptive practices can be called climate adaptation practices. The logic is that intrinsic resilience is the outcome of indigenous adaptation practices (Prakash, 2013).

Specific ILK and information that communities could use to adjust their cropping practices and outdoor activities pertain to: a) seasons b) historical storm patterns c) the color of rain-bearing clouds and d) wind patterns, direction and types (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 develop management practices such as setting irrigation schedules and constructing wind breaks and homestead fences appropriately (Mukhopadhyay, 2010). Local communities can predict rain and hailstorms that may damage crops and property by judging the color of clouds and the sound of thunder as well as the duration of drought (Gearheard et al., 2010).

Figure 1: Locating ILKP in CCA and DRR



ILK is the basic information available to the local people for community preparedness through peer learning- and informed decision-making. ILKP is dynamic as it is continually influenced by internal innovation and experimentation as well as through interaction with external knowledge and practices. The role and importance of ILK in climate change adaptation has been recognized globally (UNFCCC, 2003 & 2004; IPCC, 2001, 2007; Mukhopadhyay, 2009; GIZ, 2013; Gautam et al., 2013). The main reason for increasing emphasis on ILK in climate change adaptation is that adaptation is a pressing global and local environmental and socio-economic problem and there is an urgent need to tailor responses to location-specific vulnerability.

ILK enables people to develop effective responses to climate change because the knowledge system is embedded in local culture and norms. For example, in Nepal, farmers in the hills have developed different agro-forestry models to overcome frequent drought, landslides and high rates of soil erosion. Similarly, farmers in the Tarai have adapted to recurrent floods by constructing bamboo houses that are time and cost-effective. These examples demonstrate that ILKP are the core of this community resilience,due essentially to their strength in anticipating disasters before they occur (ICIMOD, 2007b).

The livelihoods of marginalized sections of population are generally dependent on resources that are highly exposed and sensitive to climate variability (e.g. rain-fed agriculture, fragile landscape and dwellings and the absence of a social support network). Consequently, they have no choice but to adapt their practices to cope with recurring extreme events and disasters (UNESCO/UNU, 2013). Alongside this people innovate with cropping system, modify the dwelling environment and diversify their livelihoods to adapt to the prevailing stresses. All these efforts help build resilience in the face of recurrent disasters. At the core of these adaptive practices are ILKP and traditional institutions(Fujieda, 2013). This knowledge and associated practices are becoming more valuable as communities make efforts to build resilience to the potential future impacts of climate change.

ILK by its very nature is evolutionary and relevant at the local context and contributes to building capacity at the household and community levels to adjust to changing situations, including climate variability and disasters. Indigenous knowledge contributes to building social capital that carries value in securing and enhancing livelihood opportunities (Berkes et al., 2000). The approaches and processes leading to the evaluation of ILK in the context of climate change adaptation are thoughtful responses that the people design and practice when dealing with changes and the consequences they have historically faced. In this context, the study focuses on a number of indigenous practices that have relevance and potential in facilitating adaptation to both current and future trends of climate and the impacts emerging from those changes.

Adaptation responses vary from preparing for the risks of disasters caused by extreme weather events to the changes in the resources and their production at the ecosystem and landscape levels. Indigenous and local knowledge on natural and managed ecosystems help communities adjust their practices in agriculture, forestry, animal husbandry, land, water and other natural resource systems. The gradual adjustments to on-going practices constitute what is currently known as community coping capacity[1] and autonomous adaptation practices[2] in the face of climate change and other stressors[3].

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1 People or organizations dependent on available resources and limited abilities to face larger consequences of disaster impacts and become more vulnerable. They cope and are unable to adapt.

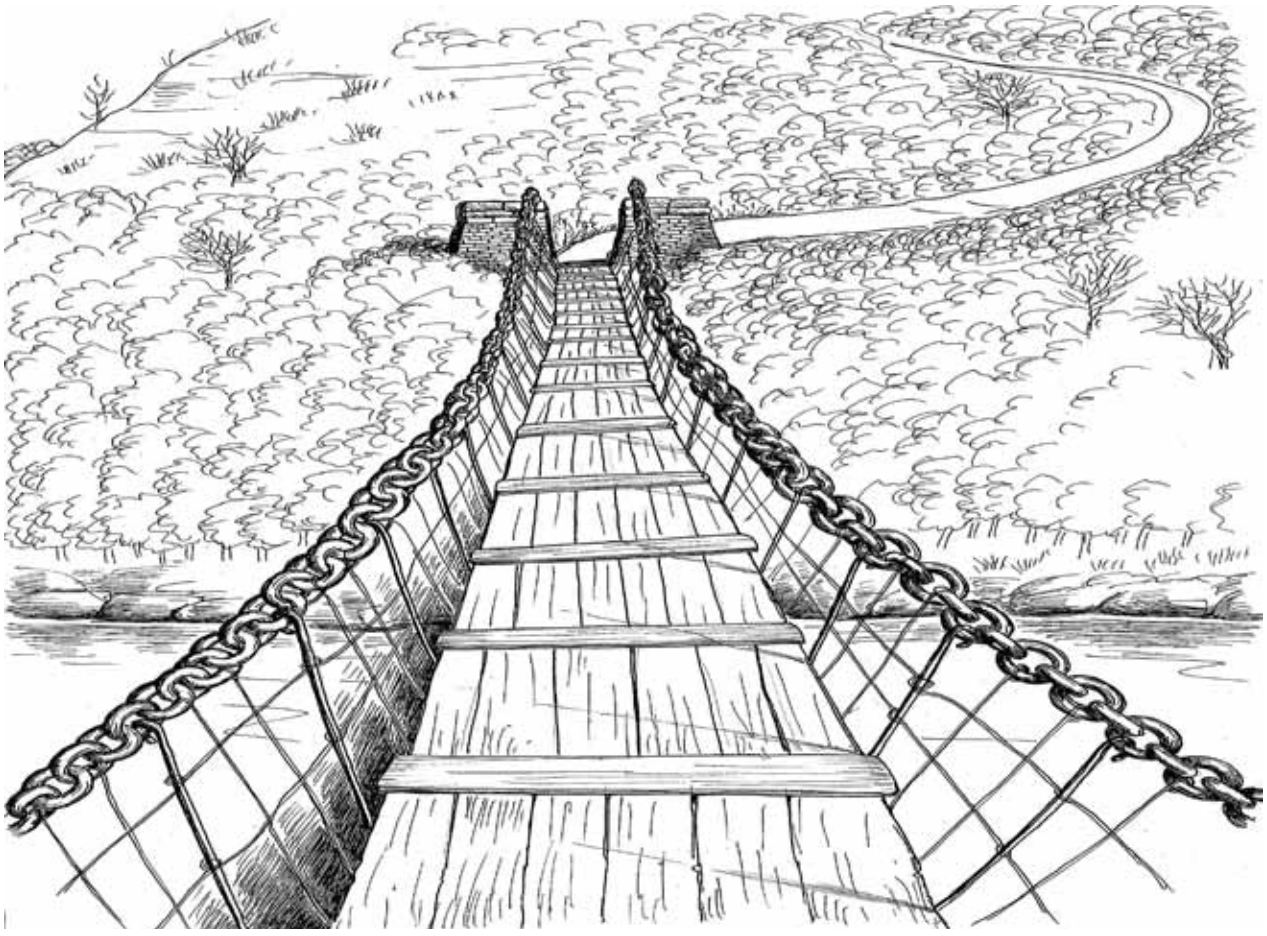
2 The IPCC explains autonomous adaptation as one that “does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems”; This contrasts with planned adaptation that “is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state” (IPCC, 2007).

3 For more information on this see: (Naess, 2013; Ruelle, 2011; Klooster, 2002; Lebel, 2012; Pandey, 2004).

It is useful to point out that despite gaps in the use of ILKP (Table 1) several agencies and researchers (UNFCCC, 2013; Lebel, 2012; Egeru, 2012) have attempted to develop uniform approaches, processes and participatory mechanisms to work with indigenous communities and promote local knowledge and practices. This study also aims to document these types of approaches, identify gaps and suggest ways of overcoming them. The analysis attempts to demonstrate that in Nepal ILKP help communities to adapt to climatic changes by giving concrete examples of what to do and how to do it. It clarifies the role and relevance of ILKP in reducing the vulnerability and enhancing resilience of the indigenous and marginalized communities in the 18 districts.

1.6 TRENDS AND GAPS IN USING ILKP

International recognition of the role of ILKP in CCA only emerged in 2007 when the IPCC's fourth assessment report called for increasing focus on adaptation challenges (IPCC, 2007). As a result, development agencies, analysts and researchers shifted their focus to carrying out impact assessment of climate change vulnerability and adaptation at the national, sub-national and local levels. The result of this shift in



Baglung Type Chain Bridge

focus has been the emergence of a global discourse on the relationship between adaptation and ILK (Agrawal, 2008) thereby recognizing the key role of ILK in CCA. Both adaptation efforts and the use of ILK focus on situation-specific adaptation responses designed to minimize community vulnerabilities.

When facing climate change challenges, it is crucial that climate change managers, policy and decision makers understand, value and use widely practiced ILKP. In Nepal, ILK systems have been ignored in the past but are gradually becoming more valued (MoSTE, 2010). This is also the case in many other developing countries. Often scientific knowledge on climate change is largely unavailable to or incomprehensible for local communities. For local communities, adaptation is the first priority and to successfully adapt,strategies need to address the local context and ILK can be strategically weaved into those efforts (Nakashima, 2012). The fundamental impetus of using ILKP lies in reducing vulnerability that emerges from the intersection of exposure, sensitivity and adaptive capacity (IPCC, 2007; MoEnv, 2010). By understanding the trends and gaps in the use of indigenous and local knowledge, adaptive strategies can be enhanced which can help reduce exposure and sensitivity in the local context (Table 1).

Table 1: Trends and gaps in the use of indigenous and local knowledge for adaptation in the study areas

Trends & gaps	Forecasting and early warning	Vulnerability assessment	Adaptation planning	Implementation
Thematic sectors: Local water management systems Forest and pasture management Rural transport infrastructure Settlement and housing	**Trend:** At local level, ILK holders and traditional social institutions are using ILK to forecast rainfall and droughts **Gaps:** DHM and its Early Warning Division do not incorporate ILK in weather and flood forecasting or early warning in case of extreme climatic events	**Trend:** ILK is used mostly by INGOs, NGOs, and CBOs to carry out participatory vulnerability assessment; **Gaps:** The framework consists of a series of steps to carry out vulnerability assessment and service delivery; the gap remains in not mentioning the application of ILK in visioning and planning suitable adaptation options	**Trend:** A large number of local adaptation plan of actions (LAPAs) and community adaptation plan of action (CAPAs) have been prepared by development agencies using participatory processes which includes ILK **Gaps:** The GoN has prepared NAPA, which does not explicitly require application of indigenous knowledge and practices for local level planning (i.e. LAPA). (GoN, 2011). There is a lack of explicit guidelines to use ILK	**Trend:** 1. Since very few LAPAs and CAPAs have gone into implementation, it is not clear how different agencies, if any, are using ILK or ITK in implementing adaptation plans 2. Department of Water Induced Disaster Prevention (DWIDP), Dept. of Local Infrastructure Development and Agriculture Roads (DoLIDAR) and Department of Forest (DoF) do use some local technologies in their work, albeit minimally **Gaps:** Absence of policy guidelines, approaches, processes, and working mechanisms for using ILKP; especially in implementing local level adaptation plans
Cross cutting sectors: Traditional social institutions Gender and Governance	**Trend:** Local level institutions such as Monasteries, Local Leaders' *shingi nawa* issue early warning signals based on their accumulated knowledge **Gaps:** Lack of common database	**Trend:** Using PRA techniques for vulnerability assessment of gender and social inclusion issues **Gaps**: Lack of methodologies and processes	**Trend:** Use of standard gender mainstreaming and social inclusion methods **Gaps:** Using ILKP to carry out planning and visioning of CAA	Trend: GOs, I/NGOs, and CBOs developing and using their own implementation modalities such as CBA, EbA, CBDM, Gap: No clear mechanism and process exist

CHAPTER II

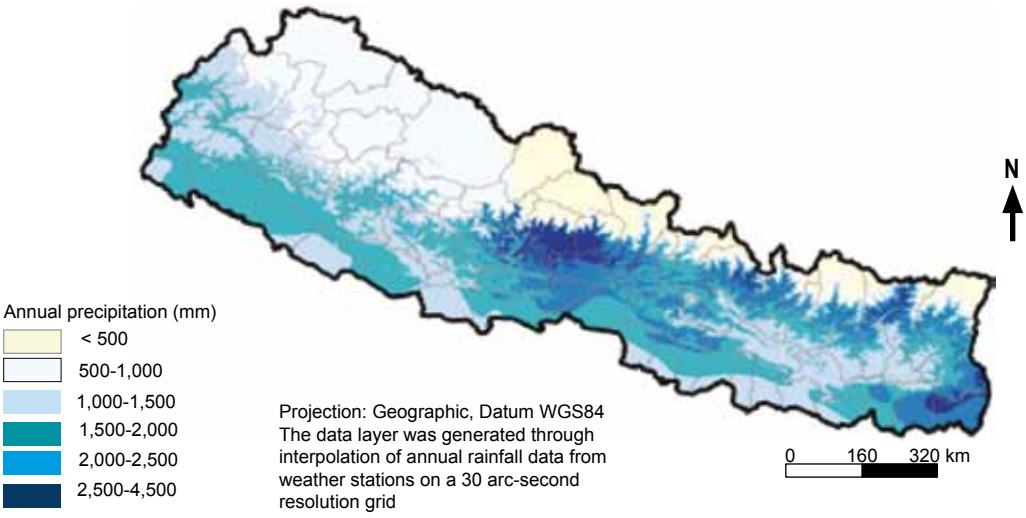
CONTEXTUALIZING ILK AND CCA IN NEPAL

2.1. CURRENT AND FUTURE CLIMATE TRENDS

Nepal is experiencing incremental climate change impacts, including rapid temperature rise, extreme and irregular precipitation events and increase in the frequency of floods, landslides and droughts resulting in huge losses of life and property (FAO, 2014; Karki et al., 2011; NAPA, 2010; NCVST, 2009). Changes in Nepal's climate system are already noticeable. The average annual temperature rise between 1961 and 2005 has been at approximately 0.05°C/year (FAO, 2014). The average increase in temperature in Nepal is higher and more rapid than the average global increase. Within Nepal, temperatures in the High Himalayas are increasing at a faster rate than those in the Tarai plains (NCVST, 2009; Sudmeier-Rieux, et al., 2012). Also, monsoon and pre-monsoon rainfalls are increasing and winter showers are decreasing with marked regional variations (FAO, 2014; Gautam et al., 2013; Karki et al., 2011; Shrestha et al., 2012; Duke Univ.WWF, 2011).

Monsoon rainfall patterns are also changing. Uncertainty of rainfall season is becoming more prominent- monsoon season is becoming shorter, there is shift in the onset and cessation of monsoon and there are increased instances of short period heavy rainfall events. The rainy season has moved later in the year and westerly rainfall during winter has become weaker (Devkota, 2014; Gautam, 2013). Though the average amount of annual precipitation has not changed significantly, pockets of increasing and decreasing rainfall patterns reflect high regional variation in rainfall distribution across the country (FAO, 2014; Duke Univ./WWF, 2011) (Figure 2). Extreme weather events are becoming more common, such as cloudbursts, snowstorms and torrential rains with flash floods that cause heavy loss of life and property. Rise in temperature has increased the incidences of wild fires, and a decline in food and biomass productivity. In the Western Tarai, heavy monsoon rains and flash floods have become increasingly common, while the Eastern Tarai is characterized by cycles of extreme rainfall events and heavy monsoon floods and longer droughts.

Figure 2: Annual precipitation map of Nepal



Source: FAO (2014)

Projected climate trends for Nepal are alarming (Kulkarni et al., 2013). The increasing number of days of heavy and irregular rainfall is expected to cause more water-induced disasters (Devkota, 2014). The NCVST (2009) has projected an annual average temperature rise of 1.3°C in Eastern Nepal by 2030, 1.8°C by 2060 and 4.70C by 2090. Kulkarni et al. (2013) estimate that the annual average temperature for central and eastern Himalaya - which covers the whole of Nepal - will rise by 1-2°C between 2011–2040; by 1-3 °C between 2041–2070; and by 3-5°C between 2071–2098. Temperature rise to this level is projected to produce definite consequences to Nepal's glaciers and water resources (Table 2a).

In the high Himalaya, rapid glacier-melt and formation of glacial lakes have created a high risk of glacial lake outburst floods (GLOF) and shortage of water for drinking and irrigation (ICIMOD, 2012). In Mustang, the rapid rise in temperature and high dependence on snowfall for water for domestic use and agricultural production has created climate-driven forced migration on an unprecedented scale. The entire population of three villages -Samzong, Yara and Dheye- are prepared to move because of flash floods caused by summer rains and the water shortage caused by reduced snowfall and early melt (KFS/SUPSI, 2012).

The annual rainfall volume in Nepal is expected to increase marginally until the end of the century (Table 2b). Paradoxically, both the number of heavy rainfall events and the average length of droughts are expected to increase. Climate change is, therefore, expected to create new hazards and risks that make all sectors of Nepal's economy and society increasingly vulnerable. Adapting to uncertainties and risks requires new knowledge and capacity, which can only be found by consolidating crosscutting inquiries and knowledge. ILKP are really valuable when it comes to meeting this goal.

Table 2a: Temperature projection for Nepal

	Mean annual temperature (°C)				
Region	**Observed**	**1961-1990**	**2011-2014**	**2041-2070**	**2071-2098**
Western Himalaya	9.9	7.9	9.6	11.2	12.5
Central Himalaya	8.9	9.2	10.8	12.4	13.5
Eastern Himalaya	13.6	15.1	16.5	18.0	19.2

Source: Kulkarni et al., (2013)

Table 2b: Precipitation projection for Nepal

	Summer monsoon rainfall (mm)				
Region	**Observed**	**1961-1990**	**2011-2014**	**2041-2070**	**2071-2098**
Western Himalaya	86	97	114	106	105
Central Himalaya	546	692	717	785	855
Eastern Himalaya	1042	1130	1140	1204	1270

Source: Kulkarni et al., (2013)

Nepal can minimize these climatic risks and avert more serious impacts of climate change by building resilience into all aspects of development to increase human wellbeing, by qualitatively improving adaptation capacity and by proactively practicing knowledge-gathering, -development and -management. While planning strategies and actions to reduce and manage the impacts of climate change, indigenous peoples and marginalized populations warrant particular attention due to their disproportionate vulnerability (Nakashima, 2012).

2.2. SOCIAL, ETHNIC AND GENDER CONTEXTS OF ILK AND CCA IN NEPAL

Nepal is known for its geographical, ecological and ethnic, cultural and linguistic diversity. The Census of 2011 recognized 126 indigenous caste and ethnic groups, 123 mother-tongue languages and nine religions (CBS, 2011). As defined by Nepal's Indigenous/Nationalities Act of 2002, "people having their own mother tongue, distinct traditional values, and cultural identities, including social structure and written/non-written history, are indigenous nationalities" (Rimal, 2011).

Women's participation in resource management is vital in the effort to improve family livelihoods and adopt a resilience-building strategy (Gurung & Bisht, 2014). In traditional Nepali society, caste and gender-based division of labour on historically set cultural factors and social norms is common (Bhattachan, 1997). This is primarily because the traditional division of labour within the home and society is based on strong social taboos, the physical capability of each gender and cultural and religious practices (Gurung, 1994). Since social roles are divided along gender lines and occupational castes, it is imperative that adaptation is gender-sensitive and inclusive.

Indigenous people and disadvantaged groups as well as women are among the first to face the direct consequences of climate change due to: a) their high dependence upon and close relationship with natural and environmental resources (UNPFII, 2008; Tebtebba Foundation, 2013); b) their settlements being most commonly located in fragile landscapes and on marginal lands (IUCN, 2008); c) their low position in the power structure, decision making, governance and connectedness, and d) their weak adaptive capacity in the face of new and rapid changes such as those related to climate change (Nakashima, 2012). Rapid temperature rise, extreme rainfall events and the increasing frequency and intensity of floods and droughts and the associated loss of lives and property affect indigenous and underprivileged people first and often disproportionately (Nakashima et al., 2012).

In most cultures and societies gender-based inequalities mean that women, children and older people are more vulnerable than men during and after natural disasters (UNDP/BCPR, 2004). In many parts of the world, women rely on the local forest, water, animal and land resources to earn an income and support livelihood. Most women lose their lives during floods and other natural disasters while trying to save their children and assets (Shrestha, et al., 2008).

Literature highlights gender inequity as a key challenge in climate change adaptation and disaster risk reduction in South Asian countries including Nepal (Rehman, 2013; Acharya, 2012). In Nepal, gender inequity plays a major role in limiting the participation of women in decision-making, resource allocation and preparedness for floods and other natural disasters (CARE-Nepal, 2009). Gender inequity interacts with other social differences in Nepal to create complex impacts (Nelson, 2011). It also magnifies existing inequalities (Aguilar, 2007; Dhakelman et al., 2008) further reinforcing the disparity between women and men to deal with climate change. Men who seem reluctant to support a change in practices consider it unfair for women to take the lead in governance and management. Women can use their knowledge and skills to respond to some of the threats from climate change and to get themselves out of poverty but most of the time they do not have access to power and resources that would enable them to turn knowledge into solutions.

Nepali women are known to have extensive knowledge and good social networks within their communities, and thereby play an important role in managing water, food production and storage and livestock rearing. While the changing social conditions have created opportunities for women empowerment, it has also placed an additional burden on them as women endure multiple workloads. Female-headed households in particular face additional challenges due to increased roles beyond the household and farm, such as negotiating with government and development workers in securing their resources or mobilizing support services and more recently in engaging in maintaining canals. Women's groups are strong local institutions that have helped empower women through social networking, creation of learning spaces and provision of economic support by improving access to small loans through cooperatives and local financial institutions.

Nepal has enacted policies, plans, programs and mechanisms to address climate change issues (GoN, 2011). These plans and programs only acknowledge that women and men are disproportionately impacted by climate change and differ in their capacity to adapt to the changes. To better address the gender issue, there is a need to develop suitable mechanisms and clear methodological procedures, both of which are currently lacking. While it is assumed that the benefits secured for a community will be accessed equitably, this is not the reality. Both the National Adaptation Program of Action (NAPA) and the Climate Change Policy have made it mandatory to disburse at least 80% of the budget available for adaptation for activities at the local level, but these have not specified focusing on resource allocation for women or other vulnerable groups (GoN, 2011).

CHAPTER III

INDIGENOUS AND LOCAL PRACTICES

3.1 RESEARCH METHODOLOGY

The methodology used comprised of a) a conceptual framework; b) a design framework; c) a literature review; d) a research approach and tools and e) case study methods. A summary is provided in the following sections.

3.1.1 Conceptual framework and design

The premise of the conceptual framework is that diverse communities across Nepal have been using ILKP in developing adaptive responses to the impacts of climate change in an attempt to minimize vulnerability and sustain their livelihoods. The measures they have taken include subtle or sub-conscious adjustments in their practices as well as spontaneous innovations of suitable techniques and actions in day-to-day management of livelihood resources. These adaptive responses by the community tend to be 'autonomous', meaning that actions by individuals, households and organizations are undertaken on their own in response to the opportunities and constraints produced by climatic change and other stressors (ISET, 2008). The study makes a clear distinction between adaptation and coping, as coping entails an undesirable state of living while adjusting to the stresses. As conceived by ISET (2008) "in well-adapted systems communities are doing well despite (or because of) changing conditions." People cannot, however, 'do well' unless they are able to shift strategies using resilient systems that help them respond flexibly. As a result, at its core, adaptation is about the capacity to shift strategies and to develop systems that are resilient and sufficiently flexible to respond to the changes.

People also use their knowledge and skills to assess risks from hazards, to plan and to execute actions that reduce risks through "anticipatory and proactive adaptation" (Ajani et al., 2013; Ayeri et al., 2012) and "reactive adaptation" in the aftermath of disasters. Local adaptive responses vary depending on the type of built infrastructure and natural systems. It is therefore important that there are regular reforms in governance arrangements, traditional institutions, community policies and rules and monitoring mechanisms. These actions can be characterized as indigenous resilience-building

Figure 3a: Indigenous practices and climate change adaptation

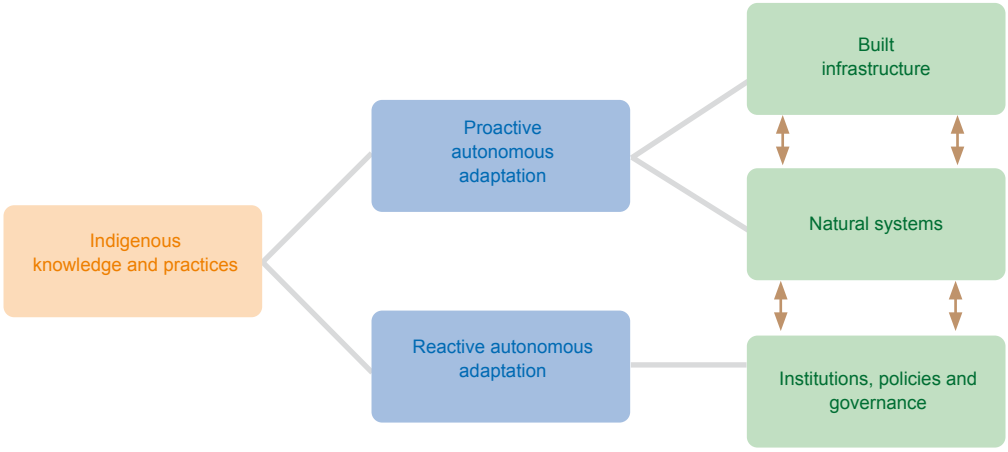
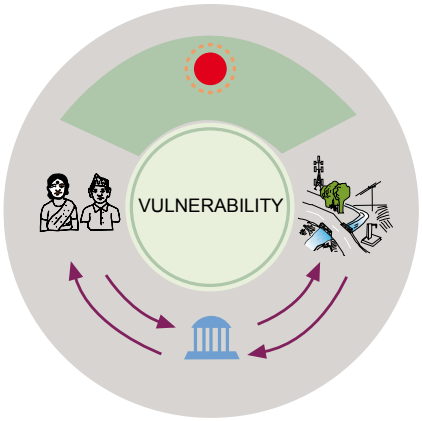


Figure 3b: Framework for building climate resilience using synthesized form of ILK and modern science knowledge



practices (Srinivasan, 2004; Prakash, 2013). The elements include exposure, system, agents and institutional framework shown in figure 3b.

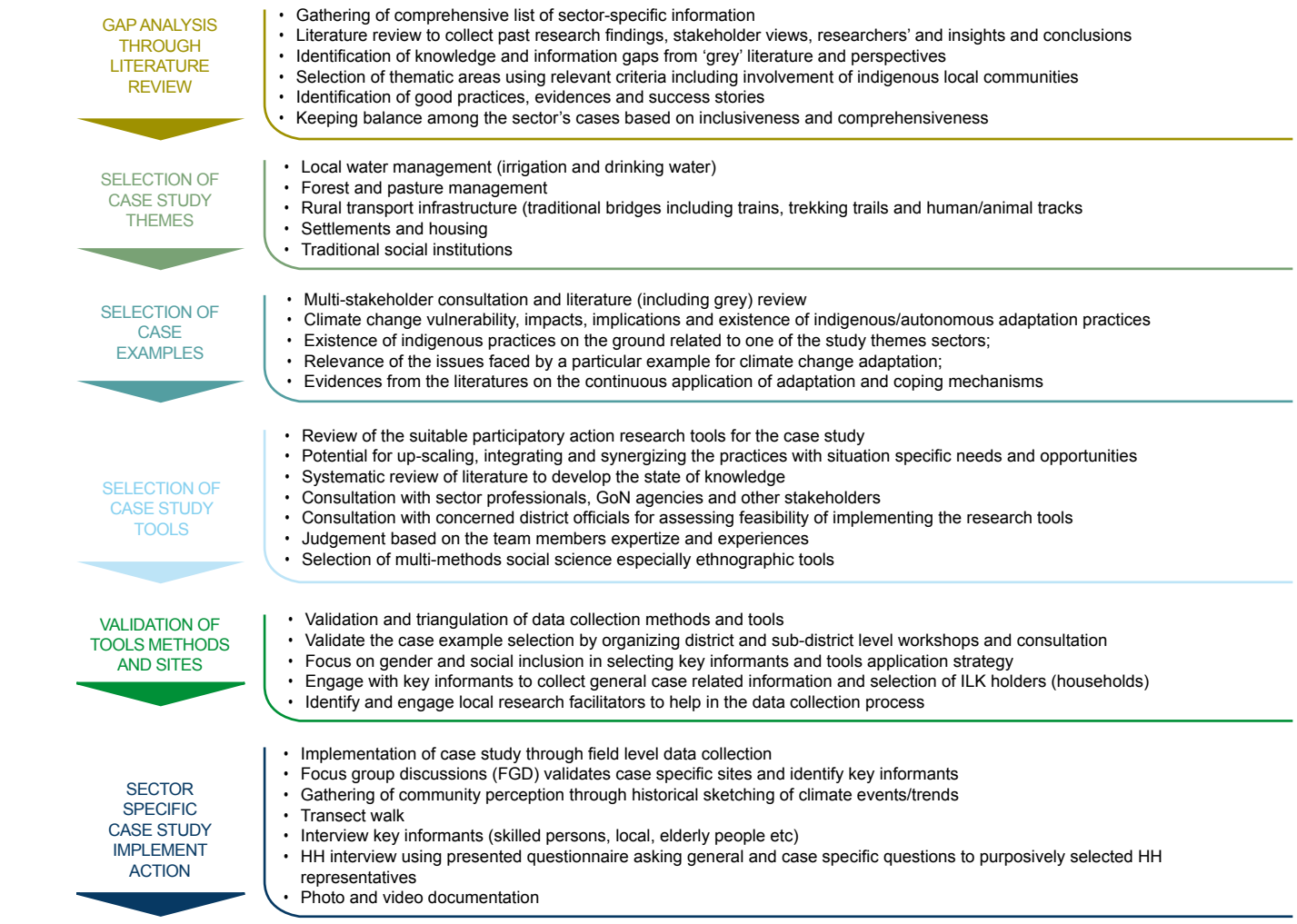
Insights derived from both ILK and scientific understanding and their synthesized form is central to building resilience (or reducing vulnerability). This study assumes that climate change vulnerability is highest when marginalized individuals, households, communities and groups depending on fragile systems (both natural and human made) are exposed to climate change. The key to building resilience is using the knowledge, skills and tools available to minimize exposure, avoiding marginalization and improving systems resilience. Institutions play a critical role in mediating transformation towards a more resilient future (See Figure 3b).

		Knowledge context	
Elements	**Explanation**	**Scientific**	**ILK**
Exposure 	Encompasses the direct and indirect impacts that affect systems and agents.	Historically collected data on temperature, precipitation, flow etc. but suffers from low spatial coverage and duration. Climate modeling based on low resolution imagery, complex monsoon dynamics, poorly understood feedback processes in the atmosphere, complex geologic terrains Global circulation and other models that project future scenario about temperature and precipitation embody high uncertainty	Colour and names of clouds, wind flow direction, religious and cultural days believed to be associated with rainfalls.
Systems including ecosystems 	Foundations that enable people to adjust as exposure changes.	Modern systems are gradually replacing technical artefacts (or elements of the traditional systems)	Communities use indigenous knowledge to get provisioning, regulating, supporting and cultural ecosystem services and manage the stocks. Poorly understood links among ecological components, Lack of valuation of ecosystem services, growing environmental degradation such as pollution, inadequate policies to enhance benefits from ecosystem services Traditional skills and technologies are used in drinking water, irrigation, settlements and housing rural bridges and water mills
Agents 	Capacities of individuals, households, communities, business, government agencies that help them adjust by securing services for wellbeing.	Many are marginalized due to historical, structural and political factors and cope with climate related shocks. They possess low capacity to respond to new hazards that climate change brings. Disappearing indigenous knowledge, poor communication, spontaneous migrations, high extant vulnerabilities, increasing poverty, cultural gaps, illiteracy, gender inequality and social discrimination,	
Institutions 	Rules and social conventions that guide interaction of agents with each other and access to benefits from systems.	Macro institutional context such as tax systems, property rights and democratic governance play major role in making or failing resilience-building efforts.[1] Local level institutional context such as voting, customary rights, traditional collective practices and decentralization intertwine with indigenous knowledge domain and unpacking the later context can foster integration of ILK with scientific methods to achieve transformation to a more resilient future.	

Climate resilience should be understood as an inherent or acquired characteristic that enables the system (including an ecosystem), individuals, households, community groups and organizations to take actions that promote development in the aftermath of climate shocks. A strategy that combines technological flexibility with sustainable development helps in building resilience (Thompson, 1994). Resilience building efforts are enhanced if responses to a shock are quick and the response strategies promote flexibility and diversity as well as integration of indigenous and scientific information. Knowledge that combines a number of different approaches can help communities adjust to the uncertainties that climate change will bring.

Based on this conceptual framework, the study design was prepared following four principles or guidelines: a) the methods selected were systematic and qualitative in nature; b) emphasis on participatory tools of inquiries and analysis; c) selection of participants, especially key informants and households,using purposive sampling

Figure 4: Research framework and process



techniques[4]; and d) a process-based framework incorporating mixed methods of inductive learning(Figure 4). This multi-method approach meets the objective of data triangulation required in all applied social science research (Yin, 2003 a and 2003b; UoM, 2010) and ensures that the process includes in-built crosschecking of the primary data to obtain accuracy and reliability (Putt, 2013).

3.1.2 Methods and tools

The research methodology is based on the framework and structure illustrated in Figure 4. This framework describes the logical sequencing of the steps adopted in the execution of the research. The framework helped define the social, cultural and technical domains of indigenous practices that guided the design of the qualitative data collection and analytical tools such as focus group discussion and community perception analysis (Schensul et al., 2009). Key informants and households were interviewed to collect quantitative data. The qualitative information collected was complemented by case discussions with practitioners, observations made during transect walk in the study locations and shared-learning from the indigenous practices of concerned groups and individuals. In order to capture the gendered dimension of the practices documented, gender-sensitive checklists and questionnaires were used.

Gender and social differences in the context of climate change vulnerability, impacts and adaptation response were considered integral to the study. Disaggregated analysis of the primary data and a summary analysis of the secondary data were used to capture the views of both men and women belonging to different ethnic groups. Quantification of the responses by gender and social groups helped assess differential perceptions of climate change, vulnerability and impacts. Structured vulnerability and the need for gendered and inclusive adaptation responses were considered based on informants' learned behavior expressed during key informant and household interviews using analytical techniques employed by Lambrou and Piana (2006).

The case-study approach was selected as the main research methodology due to proven strength in making process analysis and therefore wide use in applied social science research (Yin, 2003a; Yin, 2003b; Brown, 2008). It is a qualitative method based on a clear rationale and locally customized tools that ensure the validity and reliability of the collected evidence by properly demonstrating the results (Brown, 2008). In this study, the approach involved the systematic investigation of ILK systems and practices covering multiple dimensions. The following sections provide a brief description of the geographical space and thematic sectors covered in the study.

3.2 CASE-STUDY SECTORS, PRACTICES AND DISTRICTS

The selection of the case study as the main research method helped in the collection of both qualitative and quantitative information within the stipulated timeframe. This provided required flexibility in investigating the selected cases through participatory observation, discussion, interviews and analysis of both primary and secondary

[4] The district level stakeholder consultation identified the focus group discussants, and in turn, the FGD participants identified the key informants knowledgeable on the case. The key informants respondents further identified the households knowledgeable or experienced on the case.

data. The findings were analyzed by looking beyond the individual cases, utilizing the collective observations and insights garnered by the researchers during the field trip and through stakeholder interactions. Detailed information on individual cases was collected through intensive interaction with key informants, participants in FGDs and household members.

3.2.1. Case-study sectors

The sectors needed to have a clear focus on indigenous, traditional and local knowledge and practices that were relevant to climate change adaptation and disaster risk reduction. They also had to be development-relevant and climate-sensitive infrastructure-related. With these considerations in mind, the selection was based on the relevance of the sectors to Nepal's climate and development issues and their importance to meeting the needs and priorities of indigenous and local communities. The selection process also considered inputs from: i) the sectors under the PPCR Component 3, ii) the recommendations of participants in the national stakeholder consultation, and iii) a review of relevant published and grey literature.

Five development, livelihood and infrastructure-related case-study sectors were considered relevant for the study. These included:

- Local water management
- Forest and pasture management
- Rural transport infrastructure management
- Settlement and housing
- Traditional social institutions

3.2.2. Case examples

The selection of case examples was based on- a) indigenous practices followed by indigenous groups and cultures, b) relevance of the practice to climate change adaptation, and c) potential for replication and scaling up. This process helped prepare a short list of sector specific relevant case examples for detailed study. Above all, the selected case examples were expected to illustrate indigenous resilience and adaptation practices that were ensured through the informed judgement of researchers. The proposed framework incorporates all of these insights.

To make the selection, adaptation and resilient ingenuity in the case examples were identified using the formulation of Prakash (2013), which suited the study context and objectives: "a traditional practice may be considered a climate change adaptation strategy if it enhances the resilience of ecological and economic systems and assures the livelihoods of local people at the times of climate fluctuations and monsoon variability".

3.2.3. Case-study districts

The study was conducted in 18 districts of Nepal selected to capture the diversity of ethnic groups and ecological and development contexts of the country. Using the information gathered from the assessment of literature on ILKP in Nepal and the study's objectives, the researchers prepared a long list of possible case study examples, which included both strong and weak examples of the application of indigenous practices to CCA and resilience building.

This list was evaluated in three ways. First, the climate change-related implications for each sector were analyzed. Second, sector-specific stakeholders, including professionals, representatives of concerned ministries and departments, academics and development practitioners were consulted. Finally, at least two to four case examples in each case study were selected for examination. In total, 31 case studies spread across the country's three ecological and five development regions were identified for detailed inquiry. The aim was to maintain a balance between social, ethnic, ecological and physical factors and systems - a balance that was important to meet the objectives of the study. The list of the districts, location and their key features (Figure 5a) and climate change vulnerability ranks(Figure 5b and Table 3) were over arching considerations in the selection of case themes and case examples in the 18 districts included in the study.

3.3 COLLABORATION WITH GOVERNMENT AGENCIES

The district development committee (DDC) was made the principal entry point to proceed with the research inquiries at the identified case study sites. In order to use the field time efficiently and to simplify logistic management, efforts were made to conduct more than one case study in some districts (Figure 5a). The selection of case studies was also based on researchers' prior knowledge and personal communication with key informants. Finally, workshops organized at both national and district level helped validate the selection of districts, case study themes and examples identified for the case study.

Figure 5a: Case districts, sectors and case examples selected

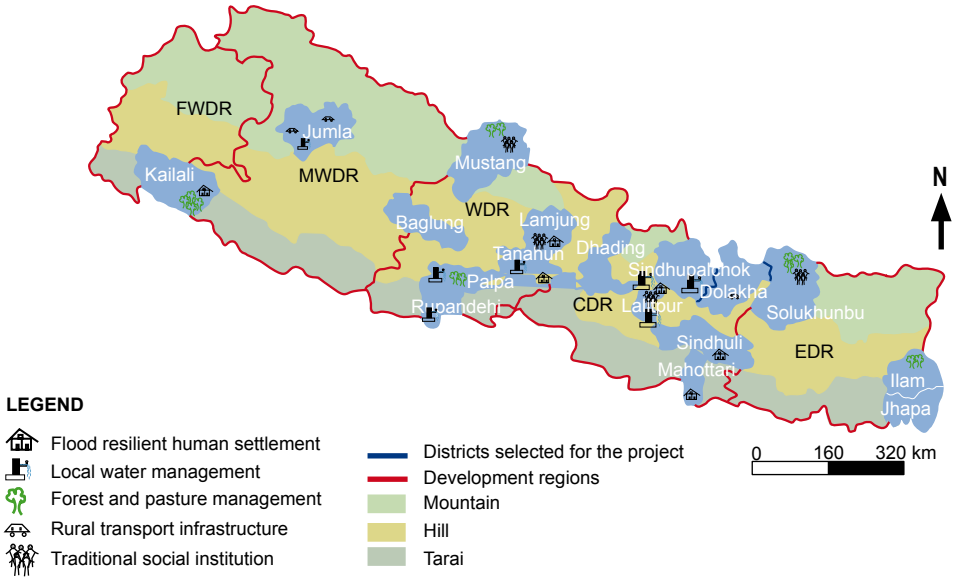
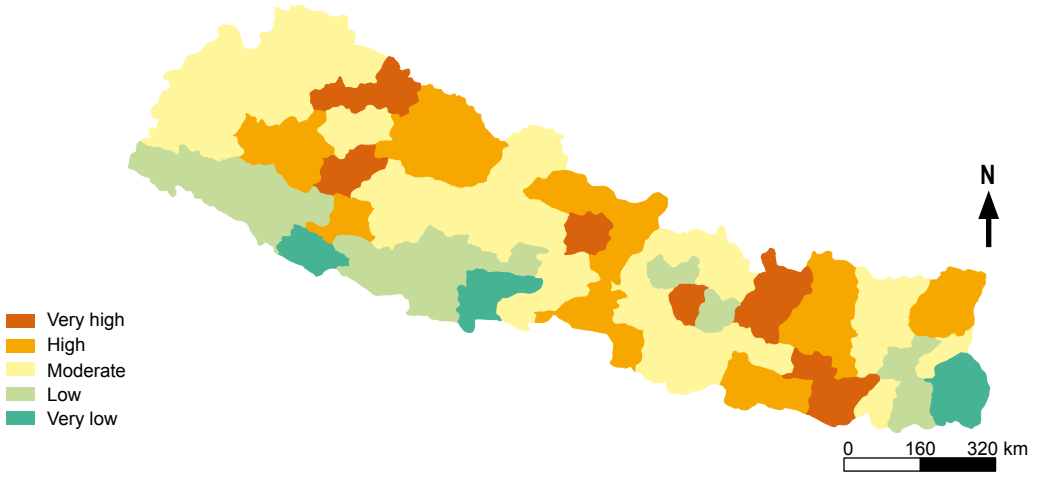


Figure 5b: Vulnerability ranking of districts

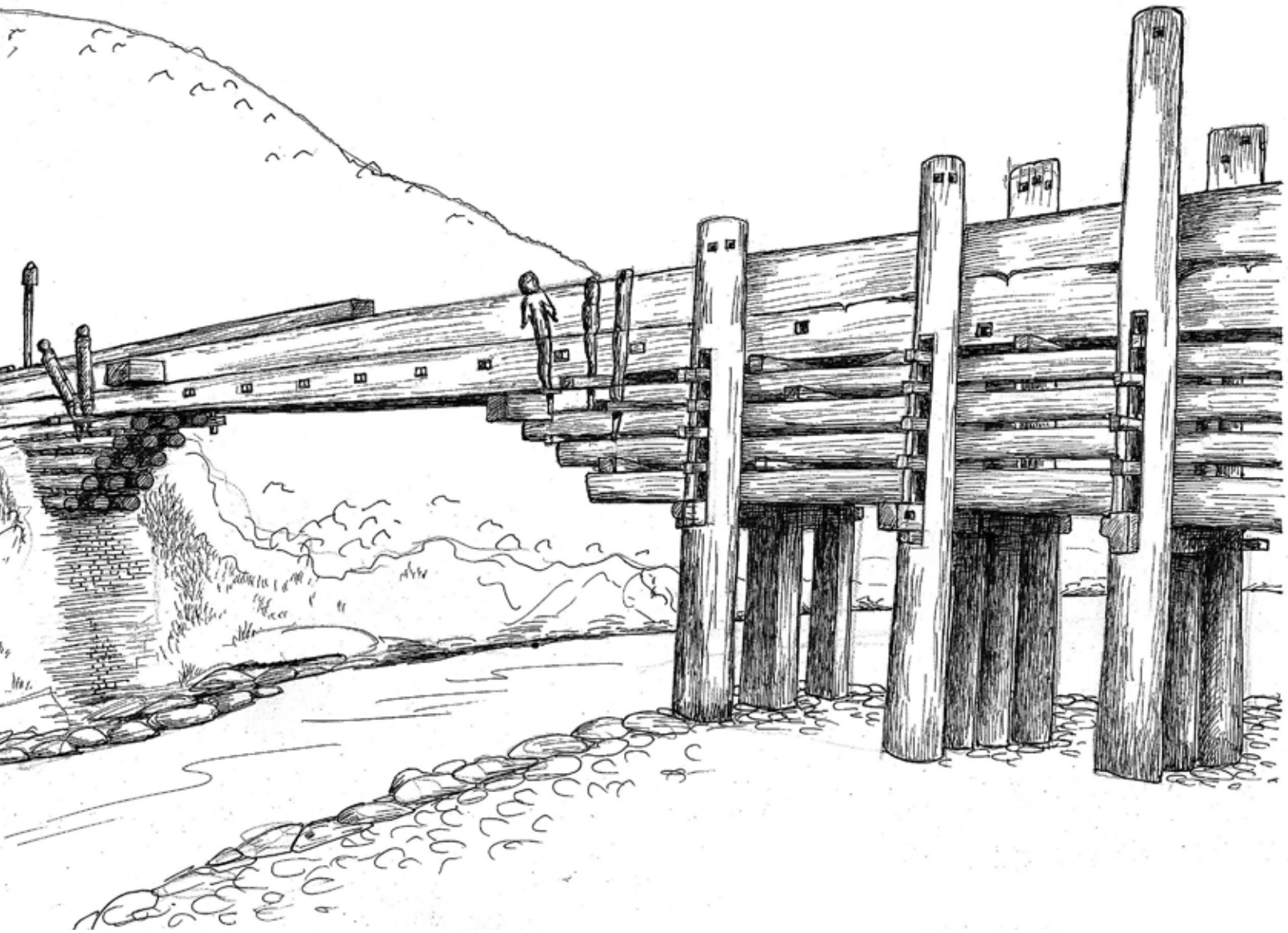


Source: MoSTE (2010)

Table 3: Selected case districts and their climate change vulnerability ranking

Vulnerability Index	Tarai	Inner Tarai	Mid-hills	Mountains	Number
Very high (0.61-0.786)			Lamjung, Bhaktapur, Dolakha,		3
High (0.787-1.000)	Mahottari		Dhading	Solukhumbu	3
Moderate (0.356-0.600)		Sindhuli	Baglung, Tanahu, Sindhuplachok	Jumla, Mustang	6
Low (0.181-0.355)	Kailali		Lalitpur		2
Very Low (0.0 -0.18)	Jhapa, Rupandehi		Palpa, Ilam		4
Total	**4**	**1**	**10**	**3**	**18**

Source: MoSTE (2010)



Jumla Type Wooden Bridge

CHAPTER IV

FINDINGS

4.1 OVERVIEW

The main focus of this report is to document and analyze community-based indigenous knowledge and practices related to water, forest, rural transport, housing and settlements and traditional institutions. In attempting to do this, traditional social institutions (TSIs) have been treated as a crosscutting theme and the gender dimension has been considered integral to all sectors. The findings on indigenous and local practices (ILPs) in this chapter are presented specific to the five sectoral themes covered in the study. These are divided into two sections: findings common to all sectors and a summary of case studies.

4.2. COMMON FINDINGS

Findings common to all five case-study sectors and districts are presented under the following sub-headings:

- Socio-economic characteristic of the participants;
- Community perceptions of climate change; and
- Recorded climate trends.

4.2.1 Socio-economic characteristic of the participants

Composition of research participants
A total of 1,070 ILK holders and stakeholders were consulted and their views on the study inquiries were solicited through household interviews (HHIs), key informant interviews (KIIs), focus group discussions (FGDs) and district-level workshops (DLWs). Of them, 744 (69.5%) were male and 326 (30.5%) were female. The water management and TSI sectors had the highest and lowest number of participants respectively. Considering gender representation by sector, the highest percentage of women (37.3%) participation was in the TSI sector, followed by settlements and housing sector (35.6%).

With the participation of just 22.6% of women, the water management sector had the lowest percentage of women participation (Annex A-1 and Figure 6). Looking at the number of female participants in research activities, the HHI had the highest and the DLW had the lowest (Figure 6). The main reason for the low participation of women in the DLW was because of a smaller presence of women in the government, non-government and academic institutions at the district level.

Socio-economic features of the HHI respondents
The primary source of data in producing socially differentiated climate change perceptions and adaptation was through the HHIs. A total of 238 household representatives were interviewed to encompass the differences in the demography and economy. In addition, the interviewees also provided information on general perceptions of climate change issues, their impacts and the possible role of ILKP in supporting and/or facilitating adaptation measures. The tables and figures below summarize the demographic and socio-economic composition of the interviewees as well as their perceptions of climate change.

Figure 6: Percentage of the participants by gender during the study activities

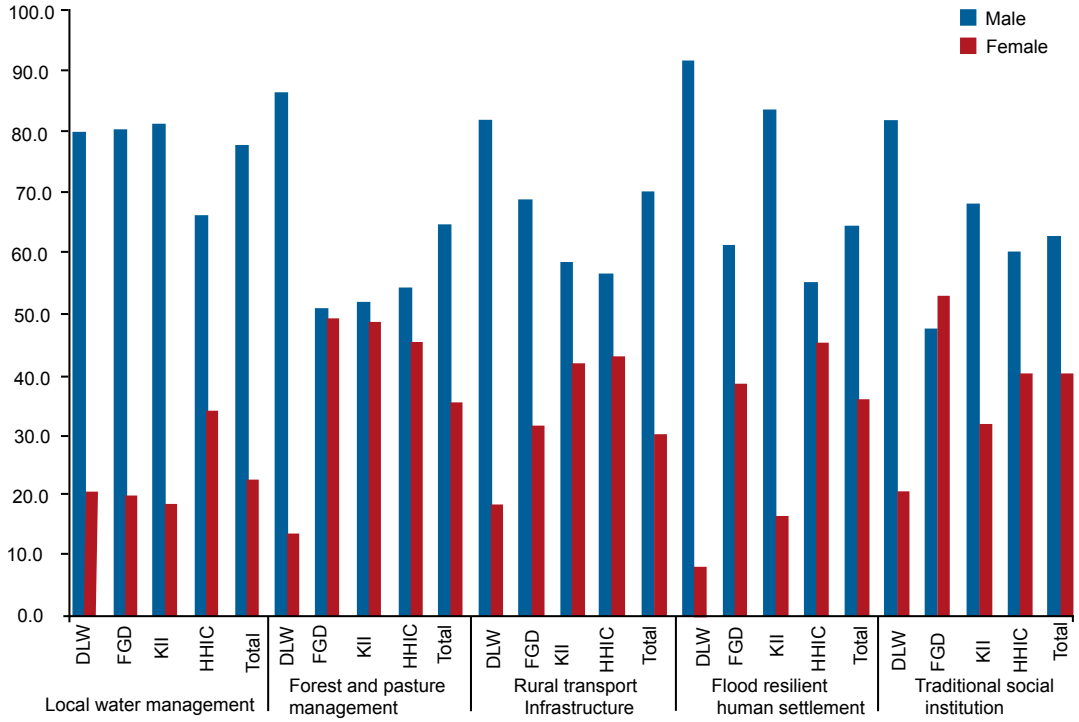


Table 4: Caste/ethnic categories of the respondents

Caste/Ethnicity	No. of respondents	Respondents %
Chhetri/Brahmin	81	34.00
Janajati	141	59.2
Dalit	15	6.3
Muslim	1	0.4
Total	**238**	**100.0**

The majority of those selected for the interviews (59%) belonged to indigenous ethnic groups followed by "upper–caste" Brahmins and Chhetris (34%) (Table4). The percentage of respondents from indigenous ethnic groups was higher in the mountain districts than in the Middle Hill and Tarai districts (Figure 7).

In terms of language use, the majority of respondents spoke Nepali (45% reported as their mother tongue) followed by Newari, Gurung and other languages (Figure 8a). Regarding the origin of household heads or representatives, about 65% were born in the same village, 20% elsewhere in the district and 14% from other areas in the country. The household-head respondents of the TSI sector had the highest percentage of people who were born locally (80%). The majority of households earned their livelihood

Figure 7: Caste/ethnicity of the respondents

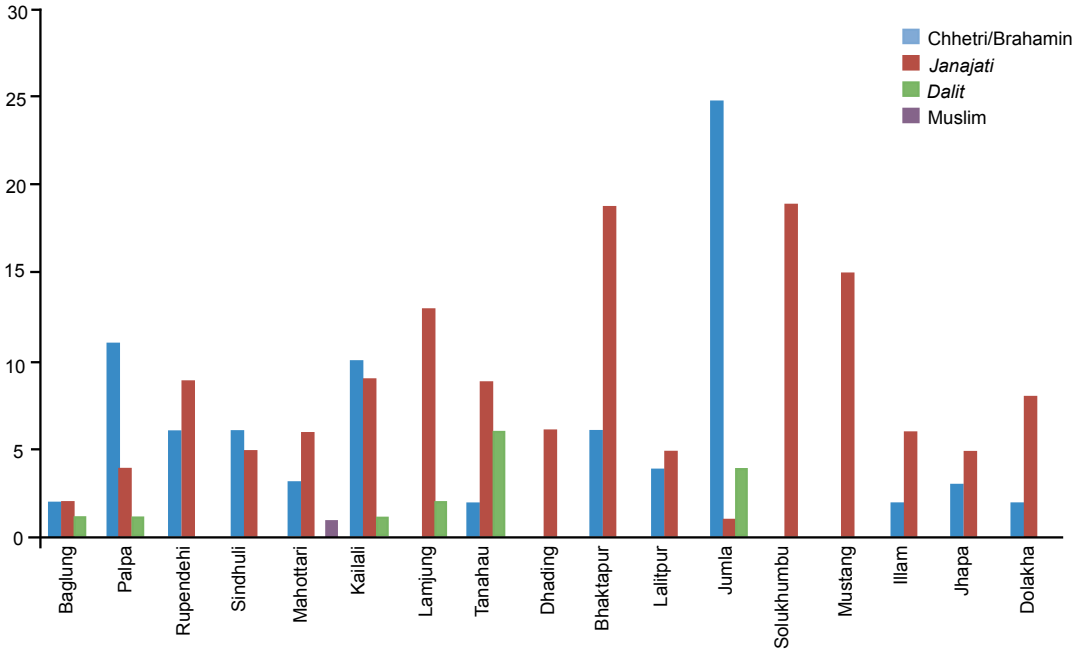
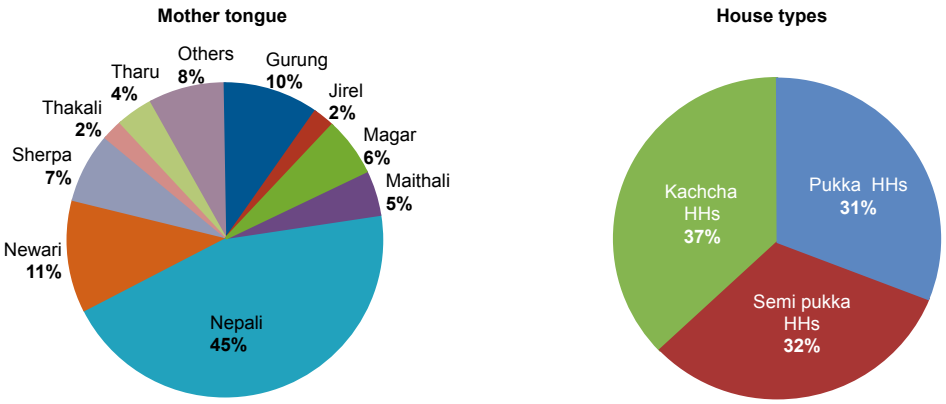


Figure 8 (a) and (b): Respondents' linguistic characteristics and types of house ownership



through traditional agriculture (65%), the rest through business (15.5%), service (7.1%) and remittance (4.2%). Only about 12% had sufficient food throughout the year while about 14% had sufficient food for less than three months (See Annex A-2).

The largest proportion of respondents (37%) lived in thatched (kachha) houses and the owners of concrete (pukka) and semi-concrete houses were almost equal in number (31% and 32% respectively) (Figure 8b). With regards to drinking water sources, 46% had private taps and 34% used public or communal taps. The remaining respondents used other sources such as rivers, ponds, wells (surface

and dug), tube wells and spring water (Annex A-6). Most of the respondents (92%) owned their own land and house (Annex A-7).

As shown in Annex A-1, 58% of HHI respondents were male and 42% were female. The TSI and forest management sectors were the most closely balanced in terms of male and female participants. In terms of geography, the male and female participation ratio in the Tarai region was the most asymmetrical and was most balanced in the mountain districts (Annex A-1).

4.2.2 Community perceptions of climate change

Gender disaggregated perceptions

There are variations of respondents' experience of climate change events and their effects depending on gender and sector (Table 5, 6 and 7). Annex A-4 displays the multiple indicators of climate change impacts observed. Regarding the relationship between climate change and gender, 55.5% of women and 64% of men felt that climate

Table 5: Climate change experience

Response type	Frequency	Per cent
Yes	226	95.0
No	12	5.0
Total	**238**	**100.00**

Table 6: Perception regarding impact on men and woman by gender

Respondents	Climate change affects women differently than men		Total
	Yes	No	
Male	89	50	139
Female	55	44	99
Total	**144**	**94**	**238**

Table 7: Sector wise experience of climate change

Sectors	Experienced climate change impacts		Total
	Yes	No	
Water management	56	3	59
Forest and pasture management	43	1	44
Rural transportation	46	5	51
Settlement and housing	66	3	69
Social institution	15	0	15
Total	**226**	**12**	**238**

change affected women differently than the men (Table 6). Both men and women felt that the risk of climate change was greater (Annex A-5) for the women. When asked about the sector bearing the highest impacts of climate change, an overwhelming majority (over 90%) felt that all sectors face nearly equally impacts (Table 7).

A significant proportion of respondents (95%) reported that they had experienced some form of climate change impact in their villages and communities over the past 10 years. The proportion of male respondents experiencing climate change and related impacts was slightly higher (96%) compared to female respondents (92%). Around 87% had observed multiple indicators of climate change such as extreme rainfall, longer periods of drought and higher frequency of landslides and floods (Annex A-4 and Table 8a). Most agreed that temperatures have been increasing and that the rainfall patterns have become more uncertain. Respondents in all districts revealed that there were more hot days, fewer rainy days and more extreme events such as torrential rains, landslides and heat and cold waves. They also revealed changes in the onset and cessation of monsoon. Community perceptions of changing weather patterns generally match the historical trends of temperature and rainfall changes.

When asked whether ILKP helped adapt to climate change, 72% responded that it was helpful (Table 8b).

Table 8a: Observed multiple climate change indicators (snowfall, fog, hailstone, lightening strike, thunderstorm and mist)

Response type	Frequency	Percent
Yes	207	87.0
No	31	13.0
Total	**238**	**100.0**

Table 8b: Indigenous knowledge helped adapt to climate change events

Response type	Frequency	Per cent
Yes	171	71.8
No	67	28.2
Total	**238**	**100.0**

4.2.3 Recorded climate trends

Temperature and rainfall data were obtained from the Department of Hydrology and Meteorology (DHM) for the period between 1977 and 2009. Historically collected temperature and rainfall data from the country's three eco-physical regions—the Tarai, Hills and Mountains—and four development regions (the data from Mid- and Far-West regions were lumped because there are fewer weather stations in the Far-West region) were subjected to linear regression analysis to establish annual trends. In all cases, districts in all ecological regions saw a slight increase in average

Figure 9: Annual average temperature

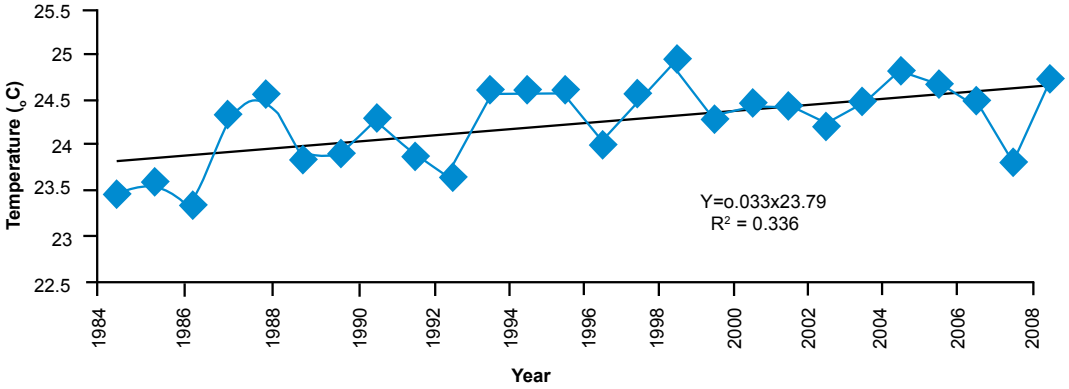
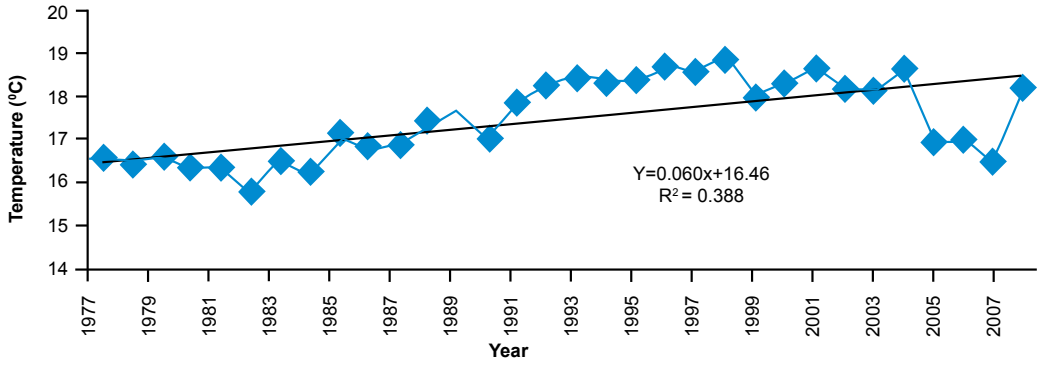


Figure 10: Annual average temperature in CDR



annual temperature (although the trend was noted to be weak with R2 values 34, 25 and 24, respectively) over 32 years of recording (Figure 9).

Average annual temperatures increased in all development regions except in the western development region (WDR). Figure 10 illustrates the increasing trend in the districts of Dhading, Dolakha, Lalitpur, Bhaktapur, Mahottari and Sindhuli in the central development region (CDR).

The trend of average annual rainfall revealed that the rains in the Tarai districts increased slightly, but decreased in the Hill and Mountain districts. The rainfall trend in the Hill districts of Baglung, Tanahu, Lamjung, Dhading, Bhaktapur, Lalitpur, Sindhuli, Ilam and Palpa is presented in Figure 11.

In all development regions, the trend in rainfall whether increasing or decreasing were noted to be weak. Figure 12 shows the rainfall trend for the study's CDR districts.

Figure 11: Annual average rainfall in the midhill districts

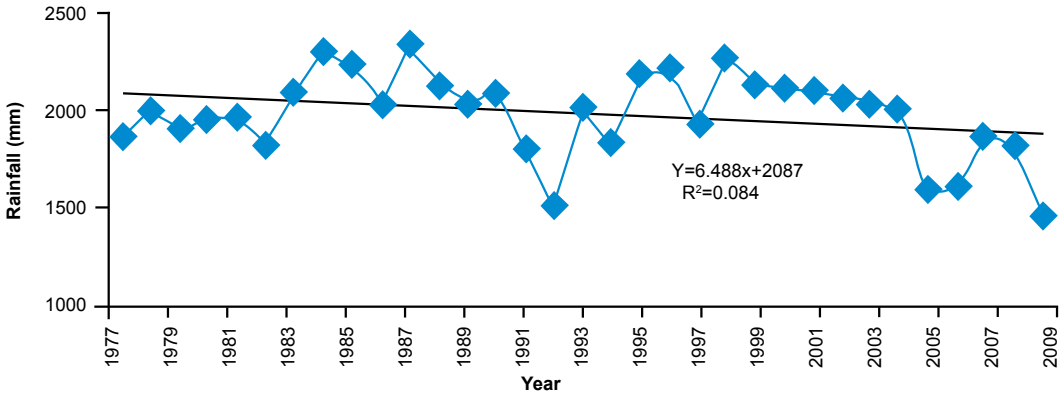
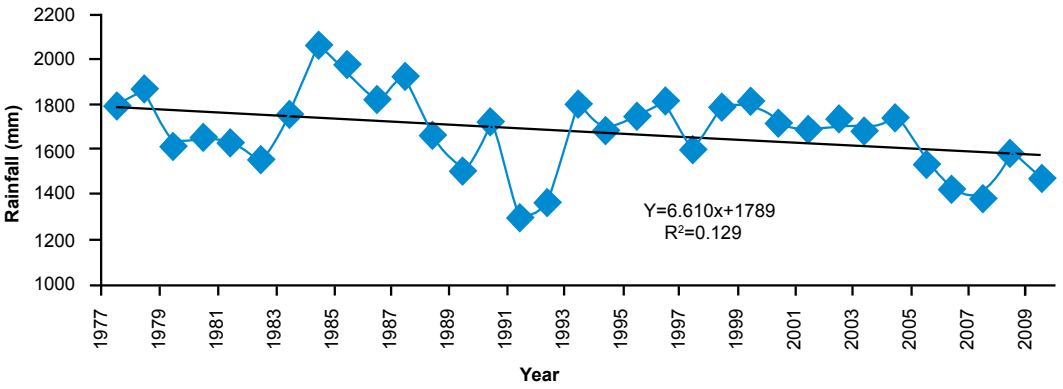


Figure 12: Average annual rainfall in CDR



4.3 CASE STUDY RESEARCH FINDINGS

The following sections highlight the findings specific to the five case study themes. Each case is presented with an introduction, a discussion of its relevance to climate change adaptation, key findings on adaptive practices and recommendations on possibilities of replication and/or scaling up to make the practices more effective for climate change adaptation and resilience-building. The analysis is not limited to the study theme or the geographical context of the focus; rather attempts were made to derive inferences for broader ecological and social context and the climate change issues facing the country.

4.3.1 Local water management systems

Case introduction

The case studies include farmer-managed irrigation systems (FMIS), community-managed drinking water systems and traditional water mills. The scale of the FMISs

analyzed varied from small systems in Jumla District to a large irrigation system serving more than 20,000 households in Rupandehi. The four case examples of FMIS are the Sorah-Chattis, Argali, Giri Khola and Raj Kulo irrigation systems in Rupandehi, Palpa, Jumla and Bhaktapur Districts, respectively. The case examples of community-managed drinking water systems studied included stone waterspouts of Patan in urban Lalitpur, the community managed water supply system in Godavari of rural Lalitpur and a community-managed drinking water system in Bandipur village in Tanahu District. In addition, information was gathered on the traditional water mills in Talamarang and Dukuchaur VDCs of Sindhupalchok District.

Given the agrarian nature of Nepal's economy and society, water consumption is highest in irrigation. The source of water is monsoon rains and, historically, farmers have adapted to the variability of rainfall (amount and timing) by building local irrigation systems to support water-intensive paddy cultivation that dominates Nepal's agriculture. As a result, there are rich and diverse indigenous water management practices. As climate change proceeds, the availability of adequate water and its sustainable management will be a key determinant of successful adaptation (Wilby & Desai, 2010) because of the necessity of water in maintaining food production. Successful adaptation also involves managing water to mitigate water-induced disaster. Several of the well-established indigenous water management practices address both 'too little' and 'too much' water scenarios and work to manage water equitably in both the situations. In other words, Nepal's indigenous water management practices are keys to integrating CCA and climate-induced DRR.

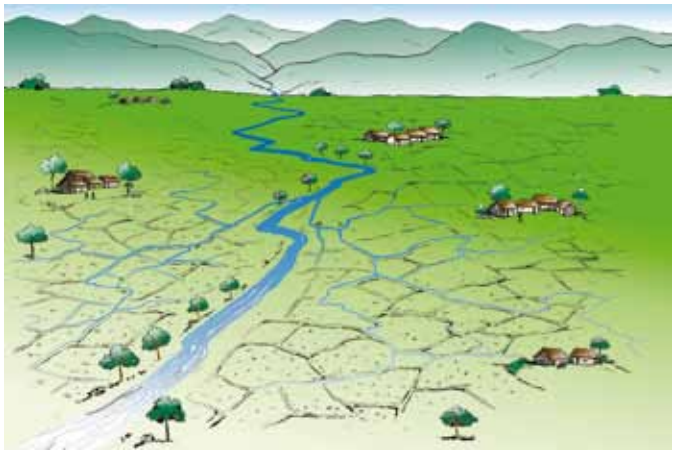
These practices have been tried and tested in the changing socio-political and climatic contexts. Knowledge accumulated through centuries of work in this area has provided local communities with the technical, social and institutional capacity they need to manage water using good governance practices. Local and indigenous communities have used local indicators to assess changes in local climate and adjusted their practices accordingly. These indicators have helped them meet their local water needs using their tested knowledge and practices.

With the change in the socio-environmental context, some local water management systems have persisted while others have ceased to function. This case study presents examples of successful water management systems and analyzes their ILKP-based adaptive features that have enabled the community to adapt to challenges posed by both climatic and non-climatic drivers.

Relevance for climate change adaptation

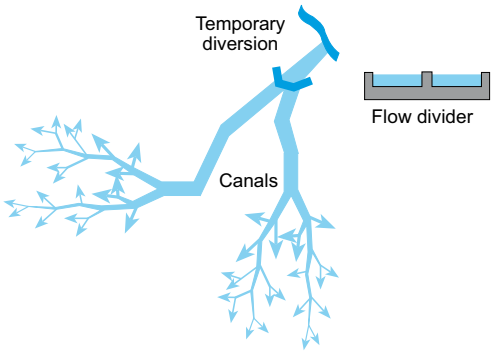
All the systems studied face threats from climate change that limit the opportunity of maintaining continued system performance with the ILKP alone. Changes in local hydrology due to the more erratic rainfall pattern and source depletion and siltation are direct climate-related consequences undermining the diversion of water. Unregulated interventions like rapid urbanization have resulted in encroachment on canals and irrigation appurtenances. Raj Kulo in Bhaktapur, for example, has been irreversibly damaged by unplanned urbanization despite the evidence of great indigenous skill (Kayastha & Shrestha, 2005; Becker-Ritterspach, 1995) in

Schematic of farmer and agency managed irrigation systems

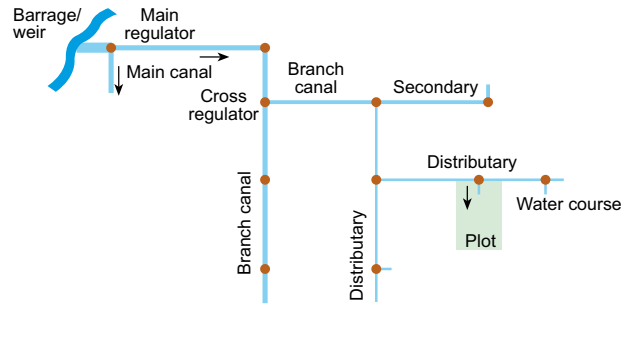


Farmers' managed irrigation system

Agency managed irrigation system



Tara Prasad Bhond: Locally made divider, 16-36 Mauja irrigation system



Marchawar irrigation system canal

Source: Dixit (2002)

Traditional stone spouts in Lalitpur

Water distribution in Argali community

adaptation. Leakage from canals and the disposal of solid and liquid waste in canals and in rivers are serious challenges to the operation of FMISs, as isthe uncontrolled extraction of sand and stones from the riverbed. The elevation of the Tinau River bed, which is diverted into Sorah-Chattis FMIS, has significantly lowered due to sand and boulder mining from the riverbed, necessitating upstream shift in the location of the diversion structure.

Most of the FMISs studied had adaptive and resilient practices, including the diversion or extraction of water, the transfer of water from source to farm lands, distribution of water amongst farm plots and the maintenance and upkeep and governance of the system. These practices are rooted in the knowledge based in the community's culture of collective action and experiential learning. There are two reasons that the Argali and Sorah-Chattis irrigation systems were more adaptive and resilient than those examined in Bhaktapur and Jumla districts: i) institutional evolution to respond to emerging externalities, and ii) gradual integration of indigenous and modern technologies.

The low level of awareness among farmers on climate change and associated risks is another challenge as is decreasing interest among the younger generation in irrigation (or, more broadly, in farming) as a vocation. The fact that young people are not educated about ILKP hinders the opportunity of continuation of FMIS and other local water practices. The culture of participatory collective community work has been weakened and ILKP is not being transferred from one generation to the next. In addition, deforestation and poor land management threaten the performance and viability of small FMISs. Addressing these challenges requires strategic responses that recognize water management as being central to the success of all types of adaptation and resilience-building activities.

Local water management practices are unique because the framework and the network in which people participate fosters collective ideas and actions while building

social capital that strengthens their capacity to build resilience. FMIS managers change their rules and regulations when socio-environmental changes demand adjustments in management and governance. Given the growing demands on water, a range of interventions and investments are required for CCA at the local level. The integration of technology based on ILKP along with new water management techniques has the potential to generate community understanding and support for innovation. This approach promotes incremental transformation towards a systematic approach to address climate change challenges.

Key findings

The key findings are as follows:

- The origin of indigenous irrigation management practices is related to the cultural, religious and dietary needs of local people, who depend on irrigated rice farming to meet food needs, income and use of rice grains in rituals and festivities.
- The tradition of rice cultivation led to the evolution of different types of indigenous water management systems, of which FMIS is the most researched and widely recognized.
- A FMIS is locally designed with bottom-up planning and management and exhibits strong community ownership. Successive generations have been continuously adding to and enriching these types of systems.
- Well-governed local water management practice has helped local communities sustain their livelihoods. By necessity, such water management practices are adaptive therefore demonstrating strong links to CCA.
- The sustenance and improvement of FMISs can be attributed to the strength of locally evolved institutions, stringent enforcement of socially sanctioned rules and continuous innovation, including embracing modern technology such as lining channels with cement and use of concrete diversion structures.
- The GoN has recognized indigenous practices in water management and has integrated some of these practices in agency-managed irrigation systems (AMIS), and responsibilities have been handed over to users committees. The Policy on Irrigation (1992) has provided a framework for the hand over of agency-managed irrigation schemes to farmers' users groups for operation, allocation of water and management. In this jointly managed approach, the responsibility of managing the distribution of AMISs and raising water fees has been entrusted to users committee while the responsibility of headwork that diverts water remains with government agencies. The success of these efforts has been mixed as the irrigation sector faces challenges from urbanization, the growing dissociation from farming among the younger generation and commoditized labor (Moench & Dixit, 1999). Climate change is further complicating the required response.
- Many successful community irrigation management practices have been discontinued and are in a state of disrepair because government programs do not integrate them into mainstream development efforts.
- Depletion of water sources and water shortages are two of the most common issues affecting drinking water systems in the Mid Hills and Mountains. Increased rainfall variability and rising competition among users and uses of water are adding to the stresses. Community-based management strategies provide a local institutional base to begin adaptation efforts.

- Local water resources are common-pool resources shared among local households and communities based on historical, cultural and ecological grounds. When the use of these resources extends beyond hydrological boundaries new stress elements around water uses may result in perpetuating disputes between upstream and downstream users. Climate change may exacerbate disputes as erratic rainfall and rising temperatures alters the local hydrological regime.

Recommendations

- Locals engage in the multi-purpose use of water by diverting it for irrigation, running water mills and generating hydro-electricity among other purposes. Multiple water use can help foster multi-functional institutions that undertake diverse functions and spread the risks caused by environmental stresses.
- Local water management practices need to be made resilient by integrating indigenous and modern techniques such as rainwater harvesting, cement–lining of channels, pond and well construction and water source development and conservation to adapt to the increasing impacts of climate change.
- Building awareness on climate change impacts – specifically its impact on water - will help locals better understand the implications of climate change and enable them to adjust to new constraints as they emerge. Being prepared for the unexpected should be a key strategy in adapting to climate change impacts. ILKP is useful in ensuring that these strategies are rooted in the local context.
- Rapid urbanization poses a significant challenge to local water management. In many cases local governments will be unable to address this challenge without support in the form of policies and legislation on land use and urban water management. Conservation of arable land, land-use regulation and water rights, both statutory and customary, should form part of the local and national policy on adaptation.
- National and local policies and regulations should recognize the historical uses of water, the demand-and-supply balance and indigenous management practices. These practices can form a key part of the strategies to enhance capacity to adapt to climate change. The knowledge base on indigenous water management could be used to link local adaptation efforts to national climate change strategies by promoting the use of such systems through national programs and policies.

4. 3.2. Forest and pasture management

Case introduction

The strong tradition of harnessing forest and pasture resources to meet the needs of communities across the country evidence ILKP presence in resource management. A diverse range of indigenous and local forestry and pasture management practices are in use throughout the country. The basic tenet of all of them is to maintain a good balance between natural processes and human activities (Sherpa et al., 2013; Karki et al., 1993; Chhetri & Pandey, 1992). This makes all of them inherently adaptive to change. These practices can significantly contribute to CCA strategies because they have multiple functions, are run by time-tested institutions and rest on community participation and ownership.

Forest ecosystems provide a variety of products and services to support the livelihoods of millions of underprivileged and marginalized Nepalese people. They play an important role in reducing vulnerabilities and strengthening the resilience of farmers in the face of climate variability by providing a safety net during times of crisis when agricultural crops fail. A number of different community-based indigenous forest and pasture management cases were examined for the lessons they offer in developing climate change-resilient strategies. ILKP was incorporated in Nepal's globally recognized community forestry (CF) approach that forms the foundation of a successful natural resource management policy.

The case studies describe different aspects of indigenous and local forest and pasture management practices drawn from five socio-culturally and ecologically

Forest and pastures in Nepal




distinct regions in Nepal. It covers their evolution, operation and governance, as well as the specific knowledge and practices they espouse. It also includes key elements of different types of indigenous, traditional and local management practices, with a particular focus on adaptive characteristics. The examples selected cover knowledge and practices developed and used by different ethnic and caste groups to both enhance their access to and control over livelihood resources and climate change impacts. Table 9 presents salient features of the examples.

Table 9: Salient features of the selected case examples

No.	Name of the Example	District	Major Ethnic/Caste Composition	No. of CFUGs / BZUGs covered	Approximate Area (ha)	Approximate number of users/ beneficiary (HH)
1	Community Based Forest Management, Madan Pokhara	Palpa	Brahmin, Chhetri, Kumal, others	3	246	200
2	Community Based Forest Management, Sati Karnali and Bhageswor	Kailali	Tharu, Brahmin, Chhetri, *Dalit*, others	2	284	500
3	Community Based Forest Management, Bhedichok, Ilam	Ilam	Limbu, Gurung, Brahmin, others	1	200	650
4	Buffer Zone Based Forests & Pasture Management, Khumjung	Solukhumbu	Sherpa	10	NA	1912
5	*Mukhiya* system of Pasture Management, Kobang and Chungzung	Mustang	Lho-ba and Thakali	2	234	150

Relevance for climate change adaptation

Forest and pasture resources provide a diverse range of goods and services to meet the multiple needs of indigenous and local communities in Nepal. In the case study areas, local users have developed a variety of practices to sustainably manage forest resources. Although the practices are diverse, they have one feature in common: the practices are responsive to the local environment and socio-economic context, and as a result are adaptive, flexible, scalable and inexpensive. They also conserve soil, water and biodiversity as well as protect vital livelihood and development infrastructures by enhancing the resilience and adaptive capacity of ecosystems. They deliver multiple functions in addressing multi-dimensional vulnerability.

Livelihood assets, sources of income, social class and status, gender and poverty determine both vulnerability and capacity to adapt to climate change (Moench & Dixit, 2004; UNFCCC, 2013). Practices are adaptive and resilient when they enable local communities to take suitable actions using their knowledge and experience to shift strategies to stresses that a changing climate produces on services from ecosystems such as forests. Local adaptation activities include both proactive and

reactive measures and employ a range of indigenous tools and actions for the restoration, conservation and management of forest resources.

Forest resources include fodder grass for animals and medicinal herbs for primary health care and maintaining them balanced can ensure forest-derived benefits for forest users (CIFoR, 2010). The adaptive practices include the restoration of water sources for drinking and irrigation through afforestation, reforestation and protection activities. Vulnerable and socially marginalized groups depend on forest and pasture resources for food, firewood and shelter during floods. Forest and pasture management should therefore be the cornerstone of climate change adaptation strategies. Strategies such as these should focus on reducing or avoiding the loss of forest cover, restoring forest productivity, conserving biodiversity, improving benefits to people through the cultivation of Non Timber Forest Products (NTFPs), distributing timber products and promoting eco-tourism.

Key findings

- Indigenous forestry practices are situation-specific: they are based on the changing weather and climatic, geographical, cultural and historical contexts of local forest users.
- Generally forests in the Tarai, Middle Hills and Mountains are managed for NTFPs, including medicinal plants, fodder and firewood, grazing and eco-tourism, but local and regional variations exist within the management system.
- Climate change has implications for species composition, biodiversity and productivity. Invasive species have affected the supply of fodder, firewood, medicinal plants and forest ecosystem services to the people in largely negative but occasionally positive ways. More in-depth analysis is needed to ascertain the social, economic, political and environmental impacts of these changes in the long term.
- The practices reflect the historical dependence of local communities on forest resources as well as the generational transfer of knowledge defined by collective action, community ownership and sharing of benefits.
- Indigenous practices are multi-purpose since forests themselves are systems with multiple layers of mixed species producing services with high intrinsic value in terms of clean water yield and other ecosystem services.
- Community forestry is integrative, innovative and synergistic. The prevalence of diverse forestry management systems, including community-based forest management (CBFM) systems, such as community forestry, collaborative forestry, leasehold and buffer zone forestry, promotes local level biodiversity all of which contributes to resilience building.
- Local organizations are critical in helping users manage forests with community-based strategies that stem from local culture, social norms and traditional practices to ensure ownership, accountability, equity and transparency in management. These conditions are the key to successful adaptive actions.
- New knowledge is constantly generated through the use of these practices, thereby encouraging experiential learning and the development of new skill sets and promoting the intra and inter-generational transfer of knowledge. But there is no systematic approach to document, synthesize and use the knowledge for CCA and DRR.

- Equitable benefit-sharing is an important strength of CBFM. The full and active participation of all stakeholders, including those users still excluded and violators of community rules and norms, is needed to achieve effective adaptation and resilience-building. The implementation of these measures need to be examined within the context of four forest management system in Nepal that broadly fall under four types of property regimes—private, state, common and open access (Bromley, 1989) as well as Nepal's prevailing social relations, cultural practices and political structure (Ostrom, 1990; Nightingale, 2003; Ojha et al. 2009; Koirala & Wiersum 2013). Patterns of resource governance and the ways stakeholders contest and negotiate resource-sharing continue to determine the benefits from management of forest and pasture. This is no simple task given that in Nepal's fast changing social–political milieu, the notion of governance, negotiation and contestation are themselves undergoing adjustments.

Recommendations

- Given the clear impacts of climate change, indigenous forestry practices need to use their inherent strength of collective action to promote proactive adaptation to ensure the continued availability of forest goods and services.
- Programs currently being implemented in Nepal should incorporate global scientific knowledge and technical know how in a language that is understood by forest users. Scientific and technical knowledge needs to be integrated with local knowledge to make the practices more resilient and better able to address climate change vulnerabilities.
- Management needs to be more inclusive and the institutional capacity of user and buffer zone committees and other traditional institutions such as *Nawa* and *Mukhiya* need to be enhanced and strengthened.
- The rehabilitation of degraded forests through enrichment plantation, social protection and the cultivation of under-cover vegetation with economic value should be prioritized.
- The building of technical capacity and awareness is necessary to make community forest users groups (CFUGs) more resilient, thereby enabling them to manage a variety of changes, including climate change.
- The recognition of traditional forestry practices can serve as an incentive to innovate and scale up indigenous and local practices.
- National policies should promote complementarities between scientific approaches for forest and pasture management using indigenous practices such as those found in Sagarmatha National Park (SNP).
- Supporting income-generating and livelihood-enhancing activities by promoting the commercialization and value-chain development of NTFPs will build the resilience of forest-dependent communities.

4.3.3 Rural transport infrastructure (bridges, trails and *tuins*)

Case introduction

Indigenously built suspension bridges, *tuins* (cable river crossings), *fadke* (log bridges), trails and trekking tracks are vital means of mobility, especially in the hilly regions. Traditional suspension bridges (TSB), in particular, have played a major role in meeting

the transportation and communication needs of communities in remote regions of Nepal. Many hill communities have built and maintained these local infrastructures that use local materials and indigenous technology, which enable people to cross rivers and rivulets and facilitate their mobility to access market and support services.

TSBs are cost-effective because they use simple technologies developed by local technicians. In many remote areas, locally built temporary bridges, *phadke* and *tuins*, are made from bamboo, vines and wooden slats using traditional and indigenous knowledge and skills. For some people, they are the only means of moving around the area and damage to these bridges has serious and adverse effects on their lives and livelihoods. Climate change-induced disasters, such as floods and landslides and mass wasting along the river banks, have increased the risk of damage to these infrastructures. The destruction of TSBs, for example, disrupts communication and transport systems in remote villages and can lead to food insecurity and the disruption of essential services during and after the disaster. The case studies focus on these traditional means of maintaining the mobility of humans and animals as well as the movement of goods and services.

The case study examines two TSBs: a Baglung-type chain bridge (BTCB) in Hatiya VDC, Baglung District and a Jumla-type wooden bridge (JTWB), known as Ranka Bridge or *Kotesangu* in the local vernacular in Jumla District. The JTWB has evolved over a period of two to three centuries and is one of approximately 300 wooden bridges in the district. All the bridges are built using Cedrus deodar (Himalayan cedar) logs. This case study looks at *tuins* in Dhading District as well as long trails and trekking routes in Jumla, Baglung, Dolakha and Solukhumbu Districts. The bridges, *tuins* and trails all have vital roles in helping people deal with climatic hazards and risks and are also useful in the context of CCA.

Rural roads and paths such as *goreto* (trails for human movement) and *ghodeto* (tracks for horses, donkeys and mules as well as humans) are maintained and repaired by local people through voluntary participation and indigenous management practices. Because they are made of earth, they are highly vulnerable to climate change, especially the effects of intense monsoon rains and resultant erosive forces producing mass wasting.

Relevance to climate change adaptation

For local communities, well-maintained all-season transport that allows for the free movement of people is essential for survival and rescue and relief operations during and after a disaster.

Roads and paths are relevant to CCA and DRR because the ability to commute is a key element of adaptation. In their identification of specific points of entry for communities Moench & Dixit (2004) suggest carefully targeted transport development support that would enhance the ability of people to migrate or commute in order to obtain access to agricultural or non-agricultural sources of income outside drought- and flood-affected areas.

Climatic hazards have increasingly undermined the utility of this transport infrastructure, in particular the BTCB, JTWB and Dhading *tuins*, especially during the monsoon season.

Local people recognize the need to make their traditional bridges, trails and tracks more capable of withstanding the risks associated with climate hazards. On-going infrastructure development programs have also affected locally built trails because they have relied on the haphazard use of excavators and uncontrolled mining of sand, gravel and boulders that increase environmental risks to this infrastructure. Often these bridges are built with the expectation that they will be damaged or even destroyed in an extreme climate event but they can be rapidly rebuilt with local resources reducing lengthy disruptions associated to transport of materials and specialized skills and machine and equipment from outside. The fact that this type of infrastructure can be so readily rebuilt makes them highly adaptable, as local people still possess the knowledge and skills necessary to repair or rebuild them.

Key findings

- Indigenously built suspension bridges, trails, trekking tracks and *tuins* have provided affordable and accessible means of mobility for the Nepali population.
- This type of rural infrastructure is becoming increasingly exposed to physical interventions, socio-economic changes and climate change-induced hazards such as extreme events. The impact on the infrastructure is significant. Every year flash floods sweep away trail bridges while landslides regularly damage trails and cut off villages from adjoining areas and the rest of the country.
- For centuries indigenous and local communities have been building and maintaining suspension bridges, temporary river-crossings and human and animal trails and tracks using their ILKP which provide insights into historical community-based technology and can be used to create resilient local infrastructure as part of CCA.
- The adoption of modern rural transport technologies that fail to incorporate indigenous and local technology has been a major reason for the loss of indigenous knowledge and skill in the transport sector. This has also led to the loss of livelihood among marginalized populations and a reduction in the adaptive capacity of traditional technologies.
- In developing these practices local communities have used their understanding of location-specific vulnerabilities and local knowledge-base to meet local needs. For example, BTCB, JTWB and the Dhading *tuins* were constructed using local skills and materials.
- Traditional bridge technology has been integrated with national programs on suspension bridge construction. The technical manuals of these programs (by agencies such as DoLIDAR and HELVETAS) include insights from ILK. Although the use of traditional technologies is in decline, they are required because all-weather transport facilities are essential for implementing community-based disaster management and CCA measures.
- Baglung District has developed a policy of promoting BTCB on seasonal and low-span rivers. Policies like this help integrate traditional and modern bridge-building technologies.

Recommendations

- Systematic promotion of ILKP in the rural infrastructure sector is needed to build adaptive and climate change-resilient systems.

- Promoting eco-tourism and home stays and developing hotels and restaurants along trails will attract tourists to rural areas. An increase in tourism to these areas would have a positive effect on local economies and would create alternative livelihood opportunities for local populations. Diversification of livelihoods is part of building adaptive capacity (Moench & Dixit, 2004).
- Location-specific knowledge is important for policy making and must be used for dialogue among disciplines and sectors. It will therefore be necessary to mobilize community support to advocate for the protection and promotion of indigenous knowledge, skills and technologies in the development of resilient rural infrastructures.

4.3.4 Settlement and housing

Case introduction

In the event of a disaster communities in vulnerable habitats, in both rural and urban settlements, face the risk losing their livelihood assets. The poor in particular

Indigenously built rural transport systems in Nepal





are physically and socio-economically vulnerable in the face of climate, water-, and human-induced hazards. According to ICIMOD (2013), indigenous and marginalized poor people in Nepal are most vulnerable to disasters because they live in settlements in fragile terrains exposed to risks from flash and seasonal floods and landslides. Both low-probability fast-onset extreme events, such as flash floods and high-probability slow-onset events, like health hazards, increasingly threaten settlements and human security in Nepal. To deal with the greater risks indigenous communities have been applying ILKP to adapt to emerging challenges.

In many areas of Nepal, local communities implement indigenously developed measures to prepare for or minimize flood and landslide risks to their dwellings and shelter. More recently, infrastructure options with the blending of conventional engineering and bioengineering options that integrate engineered and local knowledge are becoming popular to make the human habitat and their dwellings climate-resilient (Parry et al., 2007). This case study explores the practices of local communities in planning and developing their dwellings' resilience to climate change risks.

The case study also explores the physical and socio-economic vulnerability of settlements and the risks of rural housing in selected districts. It aims to answer the broad question on how to increase resilience and promote CCA by specifically examining shelters and settlements. Seven case studies from Jhapa, Mahottari, Sindhuli, Bhaktapur, Tanahu, Lamjung and Kailali districts are presented to assess the vulnerability of settlements located in fragile and hazard-prone zones. It is likely that they will be at greater risk from increasingly frequent and extreme climatic events.

Relevance to climate change adaptation

Settlements in the Middle Hills and Mountains are exposed to landslides, flash floods, forest fires and snowstorms. In the Tarai and inner Tarai regions, settlements are exposed to monsoon floods, heat and cold waves and wild fires. Small to medium-sized towns in the Tarai, such as Jaleshwor and Dhangadi, are becoming more exposed to flooding in recent times. Increased flood risks are triggered by the recurrence of extreme rainfall, population growth, unplanned settlements and constrained natural drainage caused by the construction of embankments, settlements and roads.

For centuries, indigenous communities have been developing their dwellings and homes to adapt to changing weather and natural hazards. These adaptive knowledge and practices are helping them adapt to extreme events in the face of climate change. Since communities are known to respond to multiple stressors (Prakash, 2013; Nakashima et al., 2012), the adaptive responses of most communities are aimed at reducing multi-dimensional vulnerability. Ingenuity in site selection, design of shelter and construction practices aims to make family infrastructure more resilient, including risks from climate change.

The key challenges associated with the planning and development of rural and urban dwellings and shelter include: i) unplanned and haphazard road construction that intervenes with the landscape and pattern of natural drainage, ii) damaged infrastructure such as bridges and trails and human shelters caused by floods,

landslides, slope failures and wild fires, and iii) risk of disease epidemic resulting from drainage congestion and unsanitary living conditions. All of these threaten local infrastructure and endanger lives and livelihoods. Overcoming these challenges requires climate-sensitive planning, design, construction and management of dwellings following the principles of anticipatory or pro-active adaptation.

Key findings

- Studies in Jhapa and Mahottari show that local communities have used local knowledge to select human dwellings that are located along smaller streams to build embankments and river control measures that minimize the risk of bank cutting. However, these communities are unable to develop the level of safeguards required to protect from threats posed by larger streams and rivers. They also lack capacity to plan and develop large-scale protection without external support.
- Communities in Chure areas of Sindhuli District have adopted biological measures such as planting bamboo and grasses along the slope and along the seasonal streams in order to reduce flood risks to settlements.
- In Sindhuli and in some other case study districts, CFUG Committee have enforced rules such aszero grazing and no felling of green trees and shrubs in degraded forest land to restore vegetation growth to offer protection against streambank erosion.
- In Mahottari and Kailali districts, locals had raised the plinth level or height of houses, toilets, hand pumps and wells and had also constructed trenches and embankments to protect dwellings from flooding.
- The construction of low-cost houses with bamboo walls and thatch roofs minimizes losses and reduce the cost of rebuilding and restoration after the passage of floods and other natural disasters (Mahottari District).
- Keeping household belongings on raised wooden platforms and constructing height-adjustable beds enables people to quickly move valuables to higher levels, saving them from floods (Jhapa, Mahottari and Kailali districts).
- Transferring valuables to safer places (Mahottari) reduces vulnerability and keeping stoves and light utensils mobile to facilitate their immediate transfer to floodwater-safe shelters (Mahottari and Kailali districts) speeds evacuation.
- Redesigning or retrofitting houses to adapt to rising temperatures, intense rainfall and flash floods (Tanahu and Sindhuli) is part of adaptation.
- Developing early warning systems that use modern technology and ILK and constructing shelters for people affected from floods and landslides (Jhapa District) helps ensure that people are better prepared for disasters.

Around 60% of respondents reported that they use ILKP to respond to normal annual floods and landslides. In Kailali, traditional mechanisms and adaptation strategies were found in handling the unexpected and extreme monsoon flood events that have become common in recent years

Recommendations

- GoN agencies, INGOs and NGOs should consider the risks and vulnerability of human settlements in the planning process of all kinds of infrastructure

development works based on the knowledge of previous hazardous events, the current context and the likely future scenario. These institutions must promote and design resilient settlements and housing.

- Local level agencies such as DDCs and VDCs should initiate activities to raise people's awareness of the level of risks and vulnerability so that they can better understand the likely risks from climate change and other stressors on their dwellings. Awareness building activities should aim to use and promote IKLP wherever applicable to encourage them to take anticipatory adaptation measures. Locally available mediums such as community radio stations, social groups- youth clubs and mother's groups, social institutions- schools and religious/cultural organizations, can be engaged in disseminating knowledge and information.
- To improve the capacity of local people to recover in the aftermath of disaster, government departments, donors and support agencies must focus on improving access to support services. Use of ILKP in these efforts can help identify options to reach the victims of natural disasters in rescue and evacuation and post disaster rehabilitation.
- The GoN should reform existing policy and formulate regulations, derived from IKLP, to maintain wetlands, ponds and green spaces as buffers against floods.

Indigenous settlements and buildings in Nepal





4.3.5 Traditional social institutions

Case introduction
The main objective of the case study is to understand the role and contribution of traditional social institutions (TSIs) in maintaining social order, management of livelihood resources and promotion of ILKP. This also helps to understand how TSIs help create a supportive environment and facilitates adaptive practices of different social groups in addressing climate change vulnerabilities.

The validity of TSIsis their grounding in ILKP. According to Agrawal (2002), TSI and ILKP cannot be separated as one cannot function without the other. The need for experiential and shared learning, testing and developing synthesized knowledge and understanding is important for ILKP. Because the ongoing learning process is rooted in people's institutions and organizations, it is important to recognize the local institutions and their roles in generating knowledge to facilitate adaptation. Therefore local and traditional institutions play a central role in social networking and shaping people's responses in building resilience and adaptive capacity. Organizational capacity and historical credibility enables TSIs to maintain legitimacy as well as influence people in appropriation of natural resources.

In both their original and contemporary forms, TSIs exist in all of the case study locations and are endowed with specific roles and responsibilities. Traditionally, *Guthis* command communal religious, social and agricultural work; *kulharis* maintain irrigation systems; *Dhikur* provide credit; *mukhiyas* govern; and *amchi* provide health services. Contemporary forms of institutions also exist which include user groups, such as community forest user groups, farmer-managed irrigation groups and mothers' groups. These groups have their defined roles in governance and management of natural resources and development activities, including management of forests and water systems, providing credit, organizing socio-cultural events and managing women's cooperatives. All user groups support their members and help ensure access to goods and services.

The governance system of TSIs shapes the response of a community to support the needs of the most vulnerable groups of people to environmental challenges. TSIs influence collective response and provide access to resources. This study, through six diverse TSI case examples, examines local management systems that influence social groups' access to and use of resources in the face of climate change vulnerabilities and adaptation practices. This section examines the structure, functions and governance of selected TSIs in the context of the growing relevance of ILKP to CCA and DRR.

Relevance for climate change adaptation:
Adaptation and resilience-building requires technical and institutional capacity and knowledge is key to the whole process. The acquisition of knowledge, especially new knowledge, is an on-going and iterative process. Such a process sustains the social institutions and organizations that enact strategies and disseminate information about how to adapt to emerging socio-environmental challenges. Since

the magnitude of future hazards may limit the capacity of TSIs to address them, it is important to explore appropriate pathways that enhance the capacity of TSIs by integrating ILKP with modern knowledge and practices. Social institutions not only influence vulnerable groups' access to and use of assets and resources, but also play an important role in local-level planning and implementation (Agrawal, 2008).

Traditional practices and governance systems of indigenous people are not only directly linked to their human development but also to their institutional capacity and resilience. Assessment of TSIs' capacity to access knowledge and boosting this capacity through sharing and promotion of ILKP is the key to developing a local adaptation strategy (Sherpa et al., 2013). Despite the need for sharing and promoting ILKP, very few studies have examined the relationships between indigenous traditional organizations' governance practices and local vulnerability, risks and adaptation practices.

Key findings

The findings reinforce the notion that TSIs play a central role in systematic development and promotion of ILKP by maintaining social order and collective action and co-production among diverse social groups. This role of TSI is instrumental in the promotion of adaptation.

- The *Guthi*[5] of the Prajapati clan from Bhaktapur demonstrate collective unity of people in the areas of social reforms, education and awareness building and increasing access and connectivity to support services of the government and development organizations. However, this system has not addressed the issue of gender inequality and women continue to be excluded from key decision-making processes.
- The *Dhikur* system practiced by the Thakali and the *Lo-bha* peoples of Mustang District has strengthened an age-old informal collective financial management system designed to facilitate savings and resource mobilization among members. This community-based financial capital is used to increase access to assured local finance and related risk distribution.
- The *mukhiya* system of Mustang District has developed a procedure to manage socio-cultural functions and events.
- Some of the TSIs have upgraded and strengthened their knowledge and subsequently turned into legal entities that are sustained and have been recognized and accepted by the formal system. The *amchi* system is one such example as it is part of an accredited course[6] in the nation's informal education system.
- TSIs sustain the culture of community involvement by promoting collective accountability, self-sufficiency, good governance and conflict resolution.
- The *mukhiya* system is an example of a well-functioning informal organization

[5] Traditional institution of Newar communities that functions as a social service provider for specific purposes and needs.

[6] Government and/or academic institution approved primary health care training course for Tibetan Traditional Medicine (Sowa Rugpa) medical practitioners.

Knowledge transfer and women's activity supporting roles of TSI

that manages the social, economic and judicial affairs of the community. This social capital is a valuable resource for promoting CCA and DRR.

- The mothers' group of Lamjung District is a women-led informal institution that actively fosters adaptation to changing livelihoods by, for example, imparting skills and knowledge to daughter-in-laws for them to manage home-stay tourism.
- TSIs play a valuable role in facilitating networking, mobilization, governance and learning forums to promote adaptation and disaster management activities.
- TSIs face several challenges from social, environmental and technological transitions. The scarcity and limited availability of natural resources, overharvesting of medicinal herbs, declining interest among the younger generation in TSIs and the lack of support from the government are some of the most pressing challenges.
- In some cases ILK has been successfully used and integrated in to the formal system. The *Nawa* system followed by the Sherpa community in Khumbu region has been integrated with the formal government system to implement management of SNP. It has been blended with formal regulatory mechanisms and management approaches to achieve the sustainable use of natural and agricultural resources.

Recommendations

TSIs can facilitate the adaptation and resilience-building efforts of a community involving the following pathways:

- Integration of ILKP in programs such as Local Adaptation Plan of Action (LAPA) and Community Adaptation Plan of Action (CAPA)can be made mandatory and this process can be focused on women and marginalized groups to enhance their understanding of risks from climate change. The objective should be to

help them identify solutions and develop their capacity to make appropriate decisions around adaptation.

- MoSTE and other GoN agencies need to take stock of TSIs in their program areas with the objective of creating a data base and draw lessons from the role that TSIs can play in local adaptation. The GoN needs to make the learning available to those involved in adaptation including capacity-building activities. The knowledge also needs to be used while formulating policies and developing a framework of action.
- Programs on environmental management implemented by MoSTE, MoFALD and MoFSC should extend support (institutional, financial and materials) to women's groups to build their leadership in climate adaptation and resilience-building.
- Supporting women's traditional skills and knowledge a can help indigenous and local communities identify options for improving livelihoods and resilience building.

CHAPTER V

ANALYSIS

5.1. ROLE AND RELEVANCE OF ILKP FOR CCA IN NEPAL

Climate change has been exerting more stress on the already overstressed human-environmental system of Nepal. Findings from recent studies (FAO, 2014; ADB, 2011) suggest that infrastructure and livelihoods of the Nepali population will be impacted by climate change, as climate related risks will multiply the stresses that households and communities already face. Because the livelihoods of a large proportion of Nepali population depend upon agriculture, forestry, pastureland and water, the impacts of climate change will negate development gains and increase multi-faceted vulnerabilities facing the poor and marginalized communities.

The ILKP identified in this study can to some extent help address multiple stresses and multi-faceted vulnerabilities. The knowledge possessed by local communities can be integrated into livelihood systems which will help strengthen the resilience of local communities. Strategies such as these should help minimize the damage from more frequent shocks produced by climate variability and resulting impacts. A number of studies (UNFCCC, 2013; Prakash, 2013; Nakashima et al., 2012; Oxfam, 2011; BK, 2012) suggest that indigenous practices can play a key role in reducing climate change vulnerabilities and promoting adaptation. The application of ILKP in CCA is an emerging idea in research and practice (Dahal, 2013) though their integration in policy making remains inadequate. It is therefore, very important to develop further the knowledge base around ILKP. This will help answer an important question: which adaptation strategy and ILKP can produce success in CCA and DRR and how? Understanding this will be critical to supporting and developing local level adaptation plans and actions.

Planning for and managing the adaptation process is a complex task that involves decision-makers at various levels of government as well as experts and local stakeholders. It is only recently that the role of ILKP has been recognized as a fundamental element of local level adaptation (Nakashima et al., 2012; UNFCCC, 2013). The fourth assessment report (AR4) of the IPCC called for more attention on validation and promotion of ILKP in adaptation (IPCC, 2007) and their integration in planning and implementation of adaptation strategies (IPCC, 2010).

5.2. EXAMPLES OF INDIGENOUS LOCAL PRACTICES

Most of the ILKP discussed earlier meet the two key criteria of any successful adaptation strategy: flexibility to deal with multiple stressors and cost effectiveness. The ILKP documented above help local communities to understand, predict and respond to climate change hazards and risks (Naess, 2013). This grounded and flexible knowledge system makes the local communities better suited to adaptation. They are relevant to the local adaptation and resilience-building needs of Nepal's diverse communities. Table 10 summarizes the indigenous knowledge and practices relevant to different thematic sectors in the course of this study.

The study provides new insights to the growing collection of indigenous, traditional and local practices for CCA and DRR. Local communities are trying to deal with climate change impacts along with other environmental and social stresses that combine to produce risks to their lives, livelihoods and assets. The findings on the application of ILKP in natural resource management (e.g. water and forestry) suggest that when communities face stresses, they attempt to adapt by changing management practices. This might involve more stringent rules around conservation and appropriation of the resources. Traditional institutions have a key role to play in evolving and enforcing these management adjustments.

Indigenous communities and their practices are helping to address even macro-level challenges, such as reducing flood risks (e.g. Mahottari District). Many similar efforts are being implemented through TSIs, and in the processes of promoting local practices demonstrate a clear link between local practices and TSIs (Agrawal, 2008). The flood reduction effort studied in Mahottari District demonstrates this interdependence where ILKP focuses on reducing local vulnerability and threats to livelihoods in the interrelated social and environmental systems.

ILK can play a significant role in assessing, planning, implementing and monitoring adaptation programs in Nepal, especially at the sub-national level. Stakeholders at local levels can apply, review and evaluate the efficacy of using ILKP in local level adaptation. However, practitioners are still not confident about ILKP capacity/strength to deal with climate change vulnerabilities. This limitation may be because the validation of ILKP to CCA and DRR is still in its early stages in Nepal. It is hoped that the confidence of practitioners will grow with evidence of the grounded practices of ILKP producing enduring successes in CCA.

Most of the practices presented in Chapter 4 are still evolving. Communities have not yet tested whether they meet the criteria for successful adaptation and resilience-building. While this concern remains, these practices have been in use for generations and have responded to on-going changes albeit with varying degrees of success. This produces an obvious opportunity to promote ILKP for local level adaption though it is also important to establish their value in resilience building efforts.

ILKP support autonomous, anticipatory and proactive adaptation efforts (IPCC, 2007). They can play a key role in multiple tasks related to CCA, such as vulnerability assessments, community-based natural resource management, livelihood improvement and diversification and disaster risk reduction. All of these contribute to resilience-building. These responses can be observed both at the household and community levels.

5.3. SOCIAL AND GENDER DIMENSIONS

The study involved all key stakeholders, especially women, in the course of undertaking the case studies and in the interaction forums so that the documentation of ILKP would allow for an examination of gender sensitivity of the adaptation practices. In the face

of CCA, gender and social differentials remain major barriers to successful adaptation. Women and disadvantaged social groups, such as *Dalits*, are disproportionately affected by climate change. Gender inequality and exclusion of disadvantaged groups hinder successful community adaptation because these groups have limited or no access to services from ecosystems or those from human built systems.

Women and girls often engage in the time consuming, difficult and unsafe task of collecting fuel wood and fodder from the forest. In the districts such as Mahottari (Tarai), Kailali (Tarai) and Sindhuli (Inner Tarai), and Jumla (Mountain) depletion of forest resources has forced women to carry loads over longer distances thereby increasing their workload. Similarly, in SNP, though women are allowed to collect fodder and fuel wood, the distance to the forest from the homestead increases the work burden on women as they need to travel longer distances.

Women use trails and bridges for their daily needs and when floods or landslides destroy the trails or bridges, they are affected the most. In Jumla, women perform about 90 per cent of household and agricultural works and their lives are closely connected to rural trails and local bridges and river crossings. Women in Baglung and Solukhumbu districts use feeder trails everyday to commute for their livelihoods. But transport development in rural areas has focused on expansion of motorable roads rather than improving the conditions of trails and tracks that most rural women use for local transportation on a daily basis. For women, rural transport is a vital lifeline because it enables them to collect water and fuel wood. However, less attention has been given to assessing how this lifeline is threatened by climate change risks.

Because men and women have such defined gender roles, their exposure to risks and perception is different. Women are more likely to be affected by floods and other disasters because of the roles they perform in the homestead and farmstead and also because women have less access to productive assets, economic resources, health and education, decision-making roles and other opportunities. During and after floods, when unhindered mobility is crucial, women from Tarai districts are more deeply affected because of socio cultural barriers and taboos such as the practice of *ghumti* (females using the veil in front of males and seniors).

Most indigenous and impoverished local communities in Nepal are vulnerable to climate change impacts as they are located in remote mountains and on marginal and hazard-prone areas such as high-altitude pasture lands and the Chure hills (BK, 2012). Most of these people are pushed into these areas as a result of inherent structural, socio-economical and institutional factors. They attempt to cope with climate change hazards, risks and disasters based on their ILKP and access to local and external support services.

To determine whether ILPs were inclusive and gender sensitive, the researchers considered their applicability, reliability and effectiveness with respect to the use of ILPs in reducing, for example, gender inequity. The presence or absence of these three attributes may determine whether or not women and indigenous people receive adequate attention during the design phase of adaptive strategies. In order to make

adaptation and resilience-building processes gender-sensitive and socially inclusive, proper targeting and allocation of financial and other supports in on-going programs would be necessary.

The UNFCCC (2013) recently released a set of guidelines for mainstreaming gender issues in adaptation programs. The guidelines conclude that gender-sensitive CCA requires continuous attention to gender in all components and at all stages of the adaptation process, from vulnerability assessments to implementation, monitoring and evaluation. In addition, it is necessary to create an enabling environment and establish proper leadership among women.

Indigenous and local women in the study areas have gender-specific indigenous knowledge and skills that they use to adapt to climate change-related impacts and vulnerabilities. However, they lack the power, social space and access to resources (e.g. tools and finances) to turn knowledge into adaptive solutions. The ILPs relating to water and transport infrastructure are especially weak when it comes to involving, understanding and obtaining the perspectives of women and *Dalit* communities.

Men's interests dominate local customs, rules and cultural norms, and they appear reluctant to support changes in TSIs, even if the practices are considered unfair to women. The social norms in FMIS in Palpa (Argali) and Rupandehi (Sorah-Chattis) districts are examples of discriminatory rules and cultural norms.

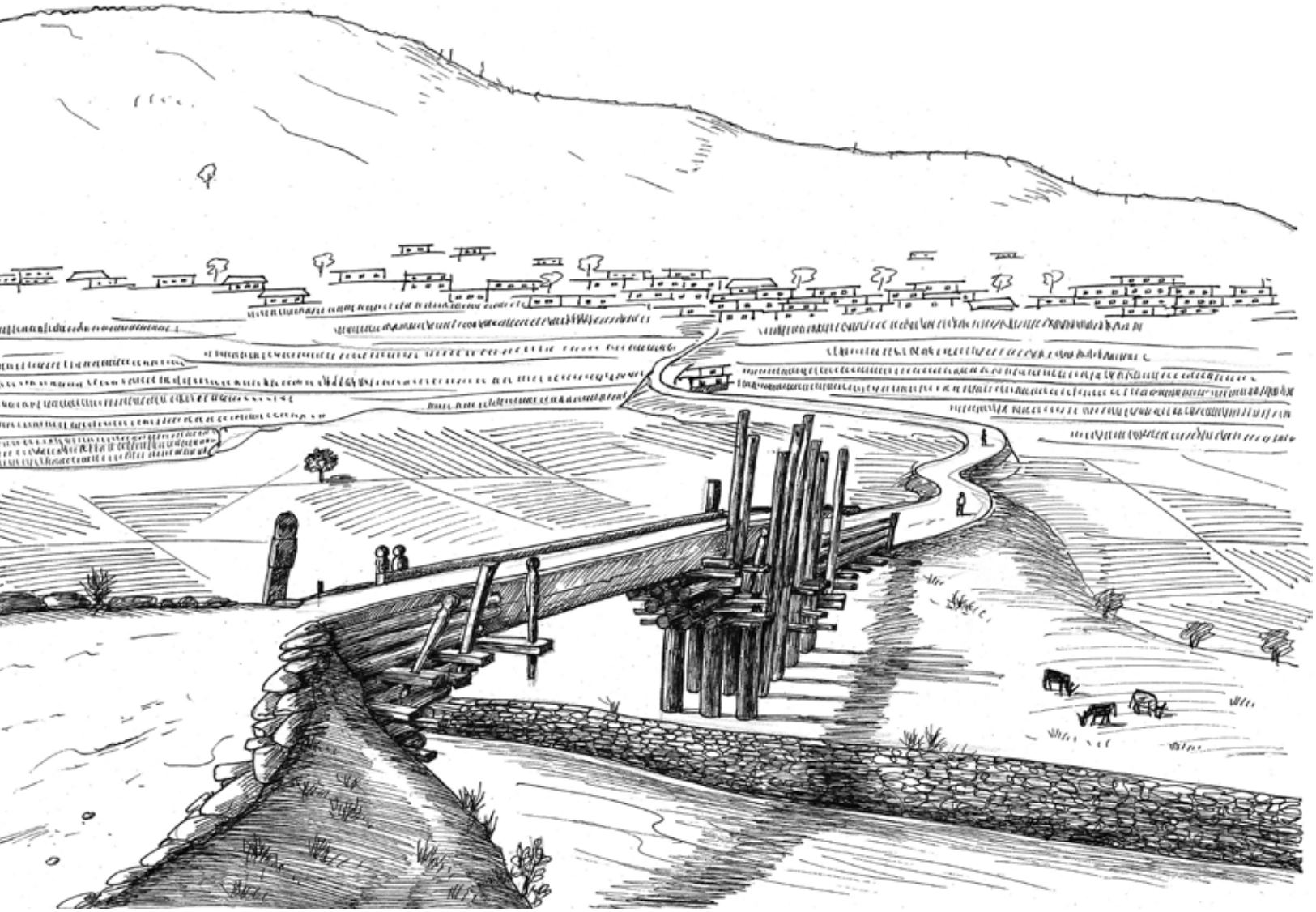
Although women have also been involved in physically demanding activities such as collecting stones, carrying logs and cleaning irrigation canals their contribution has not been recognized. More recently, there has been growing recognition of women's contribution to the households' economy but their role in decision-making is still limited. As more men emigrate in search of jobs outside the country and the associated feminization of agriculture, women have been forced to become more involved in physically demanding activities in crop and livestock farming.

When it comes to planning for indigenous adaptation practices, gender-specific issues, knowledge and practices are not automatically included. For example, in Jumla and Baglung districts, traditional bridge design, construction and maintenance work rarely involves women. The exclusion of women is not universal across all societies, resources and development contexts. In community-based forest, pasture and habitat management programs, women participate in management and even assume key decision-making positions. Gender-sensitive adaptation planning and implementation requires strategic thinking and action to mainstream gender concerns in adaptation.

There appears to be a general understanding that Nepal is rich in ILKP. While this is positive, awareness about the roles that ILKP can play in the CCA process is limited. This is largely due to the fact that there is a lack of documentation and validation of ILKP's successes in climate change adaptation. Despite this, communities continue to use ILKP because of its merits in mitigating stresses and/or modulating the impacts from climate change.

Equally important is the appreciation and confidence among different groups of stakeholders and practitioners in recognizing the value of ILKP when it comes to climate change adaptation and resilience building. ILKP is seen as being of lower value and there is a deliberate bias towards “foreign technology and practices” which are seen as more sophisticated in design and implementation, operation and maintenance. This can be addressed by improving stakeholders and practitioners’ techniques and tools to scale up, replicate and monitor the use of ILKP. Equally important is building an understanding that “foreign technology and practices” become more relevant and add value when appropriately integrated with ILKP.

The potential for using ILKP for CCA in Nepal is promising, but requires evaluation of their effectiveness in CCA in diverse physical, social and ecological contexts. A lack of understanding about the value and relevance of ILKP limits opportunity for its use and promotion.. It is also necessary to recognize the limitations of ILKP when mainstreamed into modern knowledge systems. Research which focuses on establishing the value, relevance, efficacy, effectiveness and efficiency of different options of ILKP would help to address this lack of understanding/knowledge gap.



River, flood plains and settlements in Jumla

CHAPTER VI

IMPLICATIONS, CONCLUSIONS AND RECOMMENDATIONS

6.1 IMPLICATIONS OF THE RESEARCH FINDINGS

This study has examined the implications of ILKP for the on going efforts in Nepal and support current initiatives addressing climate change vulnerabilities. Global assessments rank Nepal as highly vulnerable to the effects of climate change, and reducing this vulnerability requires focused attention, efforts and effective allocation of resources to build resilience and adaptive capacity of people, especially those belonging to marginal and disadvantaged groups. The GoN has endorsed NAPA and LAPA to respond to the urgency of addressing climate change impacts at the national and local levels. The MoSTE is also implementing the PPCR in order to develop "a comprehensive knowledge base to integrate climate change resilience into development policies, plans and programs".

The NAPA was drafted to help meet the country's medium and long-term needs and priorities with regard to CCA. Development programs and projects at the national and district levels have been framed to demonstrate sensitivity to climate change vulnerability and contribute to addressing them implicitly. Alongside the government institutions, development agencies have been asked to be sensitive to climate change vulnerabilities and likely impacts when pursuing sector specific development programs. In addition, government agencies, development organizations (I/NGOs) and CBOs are engaged in assessing climate vulnerability and plan and implement different types of adaptation, mitigation and disaster risk reduction activities as part of their on going development efforts. These activities have generated meaningful information on climate change vulnerability, impacts and adaptation options specific to different sectors and across different social and ecological contexts. However, these efforts have yet to be systematically documented into a synthesized knowledge base.

Unfortunately only a small number of programs run by government agencies and development organizations focus on integrating ILKP in a meaningful way though they have supported communities in Nepal build their adaptive practices and local level resilience for generations (GoN, 2011). This limitation is being partly addressed by PPCR, which has accorded priority to ILK. This focus will generate valuable insights for integrating ILK with contemporary knowledge and technology to produce new knowledge and options that are best suited to the social, economic and ecological diversities of the country and level of climate change impacts it will face.

Planned and on-going projects and programs relating to CCA in Nepal must address the existing gaps in recognizing, understanding and applying ILKP. It is also important to highlight how ILKP can produce value for marginalized groups of the population especially, women and ethnic groups, by learning from local experience on adaptation and resilience building that has used ILKP. The knowledge, skills, practices and technologies that the indigenous population possess need to be analyzed for their relevance and applicability for climate change adaptation before undertaking their large-scale promotion and dissemination.

There is a tendency to replace structures and systems built using ILK, such as traditional bridges, trails, trekking routes and irrigation schemes, with modern

materials and so called “engineered” techniques rather than creatively combining old and new technologies. This limits the opportunity of innovation around local technology and practices and perpetuates dependence on “foreign technology and practices” which carries sustainability implications. It might not be possible to widely replicate specific traditional technologies in adaptation plans, but the institutional and social knowledge systems may be useful in responding to context specific challenges of CCA. Baglung chain bridges and Jumla wooden bridges, for example, provide useful insights on the possibility of local technology innovations that should not be overlooked. Table 10 shows how the practices documented in this study can contribute to both CCA and DRR in the study areas and beyond.

Table10: Indigenous local adaptation practices in selected districts

S.N.	Community assets and infrastructure	Climatic and non-climatic stress	ILKP used in adaptation and resilience building responses
1	Water resources	Drying of water sources	Protecting forest and ground cover. Conserving traditional ponds, building new ponds and spring sources; Protection of existing water sources;
		Damages caused to Infrastructures due to landslide and mass wasting	Use of HDPE pipes for cross drainage and water conveyance along landslide prone zones; Use of flexible diversion, head control and canal drops (e.g. gabion and brushwood check dams); Integration of bioengineering with conventional structural options;
		Scarcity of water at the source	Use of proportional weirs; Timed distribution considering available water at the source; Parallel contour canals to intercept seepage from upstream areas;
		Frequent and longer cycle of floods and drought	Adjustments in cropping system and crop calendar; Adoption of drought and flood tolerant crop varieties in the cropping system;
		Extreme events	Early warning and response system based on observed flood stages; Quick communication of distress message within the community; Assured labour resource mobilization for system restoration in post-disaster stage;
2	Forest and pasture resources	Forest encroachment and overgrazing	Social fencing and inclusion of landless and squatter families in the user groups;
		Habitat destruction and fragmentation	Community protection and enforcement of conservation rules; rotation grazing, and stall feeding of animals;
		Productivity decline	Planting non-timber and medicinal plants and grasses; Regulated extraction of forest resources;
		Forest fire	Preventive measures through awareness building; Community based fire fighting and management;
		Invasive species	Early detection of invasive species; Annual cleaning and timber stand improvement;
		Landslides and soil erosion	Integration of biological and cultural measures together with mechanical and structural measures for landslide and erosion control;

	Rural transport infrastructure	Increased number, frequency and source of hazards and risks	Selection of geologically stable sites for local bridge and river crossings; Community based repair, restoration, and maintenance;
		Shortage of traditional skills and raw materials	Integrating with government and NGO supported training and capacity building activities; Use of alternative local materials;
		Extreme events	Informed decision on selection of site and design of structures conserving extreme events in the past; Integration of bioengineering measures with the conventional structural options;
		Push for modern technologies	Integration of traditional wisdom and skills with modern technologies;
4	Settlements and housing	Flash floods and inundation due to floods	Adapting the design and construction of houses to minimize damage from landslides and mass wasting (e.g. control of toe cutting and benching hill slopes in the Hills) or adapt to live with annual floods (e.g. development of houses on raised grounds, construction of drainage trench in Tarai);
		Poor design and construction	Retrofitting or revising design and construction such as raising the plinth level or replacing thatch/mud houses with brick and CGI roof covering;
		Landslides and slope failures	Benching of hills slopes together with integration of bioengineering measures (e.g. grass planting) for anchoring and drainage of loose soil mass,
		Lack of early warning system (EWS)	Using and putting up warning signs; Use of modern technology for information dissemination and communication (e.g. use of cell phones and FM radios);
		Lack of disaster preparedness	Fixing sites and temporary shelters for use in the events of emergency; Maintaining stock of food, dried vegetables and emergency medicines for use in the period of natural disasters and emergency;
5	Traditional social institutions	Lack of awareness regarding climate change	Organizing public gatherings, such as, festivities and music/dance programs to disseminate relevant messages on climate change and emerging risks and the preparedness thereto
		Erosion of people's participation	Transforming traditional institutions into multifunctional entity
		Lack of financial resources	Initiating local resource mobilization involving micro-finance through Aama Samuha and *Dhikur* or organizing events for fund raising during festivals.

ILK forms an important part of local communities' development strategies in all kinds of livelihood activities. An important feature of their strategy is that the communities address both climatic and non-climatic stresses. This synergy in ILKP in addressing climatic and non-climatic drivers makes them relevant to address multifaceted vulnerability in the local context. Using several case examples of ILKP specific to different resource sectors, this study has drawn lessons for mainstreaming ILK into on-going efforts to build resilience and adaptive capacity. These lessons are discussed below under the following headings: a) implementation; b) policy and planning; c) knowledge development; d) institutional framework; and e) monitoring and evaluation.

Implementation

Indigenous practices based on ILK are `no-harm' and `no-regret' autonomous adaptation responses to stress. By using proactive adaptation techniques, the practices identified in this study have helped minimize the impacts of those stresses - climatic and otherwise. It will be useful to build on these practices to make them more effective in resilience-building strategies. It is important, therefore, that all adaptation programs at the local level, especially LAPAs and CAPAs, include ILKP as a starting point for their implementation.

Policymaking and planning

ILK has not been effectively synthesized with modern knowledge and practices and thishas limited their promotion and made it harder to establish wider relevance. This gap highlights the lack of practical approaches and processes that would successfully integrate ILK into on-going adaptation programs. Some of the indigenous adaptation practices discussed in Chapter 4 however, provide a number of messages for Nepal's climate change policy (GoN, 2011). The NAPA recognizes the importance of ILK and calls for implementation of adaptation measures based on local knowledge, skills and technologies. Developing LAPAs (by the USAID supported project in Khumbu region) and CAPAs (USAID funded Hariyo Ban project) have focused on integrating local knowledge, experiences and expertise of the communities and their local institutions. In order to further enhance knowledge, the process must begin with the collection, synthesis, dissemination and utilization of climate adaptation and resilience building traditional knowledge, skills, practices and technologies. This will pave the way for improving traditional technologies and make them more widely used in adaptation.

Knowledge development

Indigenous and contemporary adaptation knowledge systems are evolving in parallel. Concerned agencies can use the findings of this research to develop common approaches, processes and mechanisms for promoting the exchange of knowledge and sharing of learning between the indigenous and scientific communities. Approaches and guidelines for practitioners and researchers need to be developed in order to collect, disseminate and utilize ILK related to CCA. Policy emphasis for studying and improving traditional knowledge already exists (GoN, 2011) but this has not been given sufficient attention. Furthermore, there is insufficient action to promote and enable the production of practical knowledge based-tools to meet the diverse needs of Nepal's adaptation programs. This can be achieved through continuous dialogue between indigenous knowledge holders and natural and social scientists to co-produce a synthesized knowledge base to address the local needs and priorities. The dialogue will need to be reflexive and foster creative iteration necessary to transcend disciplinary and ideological boundaries.

Institutional framework

ILKP cannot flourish without the support of local institutions (Agrawal, 2008). In the case study areas and throughout Nepal, TSIs have evolved together with ILKP. However, lack of coordination with TSIs during implementation of development programs remains a major challenge to be addressed. Both national and local plans for adaptation recognize the role and function of local institutions albeit in

a limited and narrow way. Even when local institutions are active, their standard of implementation is poor and they have capacity gaps. This study underscores the critical role that TSIs play in a society. It also highlights where intervention for institutional reform needs to begin. Implementing the lessons from this study will help to improve coordination and institutional performance at the local level and foster partnerships between TSIs and the more formal state systems. An effective working relationship was achieved in the management of the buffer zone of SNP in the Khumbu region. Both formal and informal *Nawa* institutions were active in designing and implementing the management arrangements of the park. Although this strategy was not related to climate change it does, however, offer important lessons for designing region- and sector-specific activities to build resilience.

Monitoring and evaluation
Most of the adaptation plans currently in Nepal are in the design and implementation stages. However, monitoring and periodic assessment of these plans will be necessary to achieve the desired outcomes at different levels. The lessons from knowledge exchange, peer learning and participatory review and decision-making processes that brings ILK holders together can be used to develop results-based monitoring and participatory evaluation methods.

6.2 INTEGRATION OF INDIGENOUS AND MODERN PRACTICES

In order to remain adaptive and resilient, ILKP must be open to scientific knowledge. Integrating ILK with scientific approaches in planning, designing and implementation can increase the effectiveness of adaptation programs. The irrigation and forestry sectors analyze and integrate these types of practices, but no systematic guidelines have been produced yet.

Developing and adopting a synthesized knowledge system from ILK and modern knowledge will have to reconcile the different world views that each system espouses and maintains (Thaman, 2013; Berkes, 2012). Their different perceptions, views of nature and understanding of climate change challenges produce means that each will choose and apply different adaptation solutions. In the case study sectors covered in this study, the two knowledge systems have different ways of innovating (Sherpa, et al., 2013; and Shrees Magar, 2007). Despite this, it is necessary to foster partnerships between them, as demonstrated by this study (Table 11) through regular exchange, dialogue and joint piloting work. Some characteristics of successful integration processes in different parts of South Asian region applicable to Nepal (Srinivasan, 2005; McCallum, 2012; Alexander, 2010) are:

- Equitable participatory approach;
- Knowledge exchange;
- Collaborative processes;
- Mutually rewarding learning experiences;
- Problem-focused, demand-driven and project- or pilot-based approach;
- Capacity-building of stakeholders;
- Public awareness;

Table11: Contribution of indigenous local knowledge and practices to adaptation and resilience building

S.N.	Working strategy	Action	Partners
1	Integration of modern and traditional technology	Building concrete foundation to replace traditional trash dam to divert river water and attempt other innovations, Lining of canals to minimize loss and making cemented weirs to divide water into lower order canal with equity as guiding principle, Replacing wooden funnel by metallic one and using plastic pipes in place of open channel to improve flow in water mills, Planting local species of medicinal plants, grasses and fast growing trees for increasing income and benefits from forests, Grafting pear branches (scion) on Mayal (*Pyrus pasia*.) root stocks plants, Using metal wires in place of chains to construct traditional suspended bridges, Using engineering alignment and construction techniques in rehabilitating trails and treks, Combining micro-credit support with *aama samuha* to form Women's co-operatives'	DoLIDAR DoI NGOs DoF & DoLS DoA DDC DWCWO
2	Synergy	Improving *amchi* system of Tibetan traditional medicine by using scientific method of testing quality and processing of drugs to improve of treatments, Accredited training course in Tibetan medicine approved for practice in the *Amchi* system	Dept. of Ayurveda NGOs
3	Complimentarity	Replacing *tuins* and chain and wooden bridges by modern suspension bridge, Establishing improved water mills and machine run mills side-by-side traditional water mills, Use Shingi *nawa* system to operate by SNP authorities as a part of buffer zone management system	DDC Helvetas NGO/DDC DNPWC/SNP
4	Adaptive / Retrofitting	Using brick, cement, timber and tins and other construction technology in reconstructing ground floor of traditional mud and tile house to make flood adaptive shelters Wooden bridge/chain bridge strengthened with modern suspension bridge technologies Installing water storage tanks to supply water through traditional stone water spouts in Lalitpur *Tuins* strengthened by using strong wires and brevity rope way technologies in Dhading	Private sector, government, community
5	Others	Knowledge exchange and partnerships, facilitating national and regional networks of the ILK practitioners (e.g., *amchies* from Mustang and Ladakh regularly share their knowledge) *Aama samuha* (Mothers' group) – a gender sensitive practice	*Amchi* associations Co-operatives

- Culture of continuity and sustainability;
- Periodic participatory assessment of targets and how well they have been achieved; and
- Outreach strategies, knowledge exchange and technology adaptation

Recent research on building the resilience of urban food systems and ecosystem based adaptation accomplished by ISET-Nepal emphasizes the importance of transferring and integrating a range of information using shared learning dialogue (SLD) and including ILK and modern techniques into the local social, political and cultural context (Dixit & Khadka, 2013; Dixit et al., 2014). Shared learning brings together stakeholders[7] with different perspectives, information, knowledge and power on a common platform for conversation and uses of participatory problem-solving approaches. 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.

The SLD process should create effective communication between ILK holders such as CFUG committee members, *Mukhiyas* (village head person) *Ghempas*, *Nawas* and scientific communities. It should also increase the speed of dissemination and utilization of integrated knowledge that supports different CCA and DRR options. While ILK can buttress participatory development approaches, scientific methods can systematically document the value pathways associated with each of them. This creates opportunity to integrate the two knowledge systems. Integration can be improved by pursuing these processes (Prakash, 2013; Rayan, 2008):

a) Building awareness of the two practices;
b) Sharing individual perceptions;
c) Encouraging participation by targeting specific adaptation issues;
d) Pursuing collective visioning for a common adaptation solution to reduce vulnerability or risk;
e) Initiating joint experimentation at the pilot level;
f) Validating different knowledge systems;
g) Assessing jointly developed strategies;
h) Applying the most suitable approaches; and
i) Disseminating results and expanding outreach.

In the study areas, one or more of these steps and procedures were executed by both the traditional and contemporary social institutions and recognized and respected local knowledge leaders and practitioners.

[7] Comprises of local leaders, indigenous and local knowledge holders, village level planners and representatives of development partners engaged in planning local adaptation programs.

6.3. CONSTRAINTS, CHALLENGES AND LIMITATIONS

When using ILKP to plan and implement local adaptation programs, the following areas need to be addressed:

a) Consolidating: The value, use and needs of ILK as a valid knowledge system lacks policy and deeper administrative recognition even though the climate change policy of Nepal (GoN, 2011) has recognized them and suggested policy measures for their wider application. The recommended policy provisions have not been well implemented because there is no regulation that provides a mandate to the government and non-government agencies to study and document ILKP and integrate them in their regular activities.

b) Levelling the playing field: ILKP lacks the financial and institutional support that the modern knowledge system otherwise receives for innovation, testing and promotion. There has been little research into how local knowledge can be modified for use in adaptation and resilience-building efforts.

c) Winning the trust and confidence of ILK holders: ILK holders have different worldviews and cultures from those of the scientific and development communities. If the two communities are to work together effectively, they must build mutual trust and confidence. In cases where intellectual property rights are involved, ILK holders may be reluctant to share their information and knowledge.

d) Integrating: ILKP communities need to become more open to learning from, integrating into and developing synergy with modern knowledge partners. In order to do this, they need to be made aware of the approaches to, and mechanisms and forums for, engaging in dialogue. More importantly, both ILK and scientific communities need to be motivated to work together.

e) Capacity-building and networking: Indigenous communities are unaware of local, national and global climate change issues and future trends. They lack the capacity to avoid mal-adaptation and make their actions more resilient. They need to extend their network of users and 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 ILK communities.

Limitations of indigenous practices

There are several limitations to the application of ILKP. Since most ILKP 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 other areas. Most local communities began experiencing the impacts of climate change about 20 years ago and international agencies and government organizations only started assessing these impacts 5-10 years ago (UNFCCC, 2013). Compared to ILKP climate change is a relatively recent phenomenon and this knowledge system is yet to be validated for relevance to addressing the impacts of climate change. As a result, indigenous communities have little experience in integrating ILK into

modern climate change adaptation processes and GOs, INGOs, NGOs and CBOs lack the knowledge base and capacity to evaluate their efficacy. For this reason, agencies and governments are reluctant to acknowledge that ILKP can have key contributions in CCA.

Although the case studies illustrate a number of adaptive and resilient indigenous practices, these practices are only applicable to the current climate variability and may not be effective in addressing the future impacts of climate change, particularly the likely increases in extreme events. It is important to understand that much of ILKP correspond to the existing state of stresses and the needs emerging from there.

ILKP cannot solve all the problems and challenges that climate change causes. ILK reflects the cultural values and knowledge of the local people in a specific geographical space. It is site-specific which means that no practice can be easily scaled up and replicated without being tested for replication and tailored to different locations. ILKP are also more effective as preventive measures than as tools to repair extreme damage. Therefore, ILKP could be used as a starting point in CCA and DRR.

6.4 CONCLUSION

This report describes the results of a study of indigenous and local CCA practices used in 18 districts of Nepal. The overall aim of the study has been to add to and further the knowledge base pertinent to ILKP and their relevance in climate change adaptation that can be integrated intoon going initiatives of the ADB supported MCCRMDP and the GoN's PPCR.

The report reviewed and analyzed climate change issues, challenges and adaptation priorities from the perspective of indigenous, poor and marginalized groups. It also examined the sources, types and nature of climatic and non-climatic vulnerability that the local communities face. The perceptions of local communities about climate change were compared with observed climate trends and appropriate inferences drawn. 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 within a certain threshold. A multi-faceted approach would be more effective in dealing with vulnerability than an approach that only focuses on a single hazard 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) ILKP so they are equipped to deal with the challenges of building resilience.

Indigenous knowledge is not formally recognized as a source of knowledge for designing and planning local adaptation measures. This gap can be viewed as both a limitation and also an opportunity. The GoN's climate change policy stipulates that 80% of the budget for CCA be allocated to local-level activities. Mainstreaming ILK would create avenues to meet this target so long as the government recognizes and

promotes it. Sometimes government agencies and the scientific community view local knowledge as inadequate or incompetent for dealing with the complex challenges emerging from climate change that Nepali societies and communities face. The NAPA document, for example, makes only passing reference to ILKP (MoEnv, 2010) and overcoming these established attitudes presents a real challenge overcoming the set perspectives itself may present a major challenge. The fact that ILK is site-specific means they would be most useful in local adaptation and there may be limitations to the wider application of specific ILK.

ILKP must be recognized as a basis for implementing and revising LAPAs. The application of this knowledge to CCA is relatively new and therefore its promotion and utilization should begin with the removal of policy barriers and the provision of financial support for building the capacities of TSIs. The GoN and development agencies should support ILKP so that it can be more effectively integrated with scientific knowledge.

6.5 RECOMMENDATIONS

Chapter 4 has provided a list of recommendations specific to each case study theme or sector. The following sections provide action oriented recommendations directed specifically to government and non-government agencies and decision makers and actors at different levels:

A. Government ministries, development partners and policy level decision makers: Indigenous and local knowledge and practices should be integrated into local level adaptation plans and the design and implementation of adaptation activities. As a valid, relevant and practical knowledge system, ILKP has the potential to address climate change vulnerabilities and should be viewed as an invaluable knowledge resource for all agencies working in the areas of climate change adaptation and resilience building in Nepal. Some of the specific actions suggested for the integration of ILK are as follows:

- Bring indigenous knowledge holders, researchers and practitioners together by forming a common platform and networks at the national and district levels with the objective of exchanging, sharing and learning from each other's knowledge and practices.
- Organize national, regional and district workshops and interaction programs to discuss value pathways of different climate adaptive and resilient practices.
- Form a national task force comprising representatives of both the indigenous and modern knowledge systems to validate ILKP.

Ministries and line agencies of the GoN (Table 12) should begin streamlining relevant sectoral policies and programs, to make them responsive to climate change and create a supportive environment to integrate IKLP. Not all ILKPs are robust enough to deal with climate change risks and adaptation, but those that have proven merit in the local context need to be identified and promoted.

In the study areas, women have played a key role in knowledge and awareness building and promoting capacity building programs. Their contribution has led to empowerment of local community and promoting community-based approaches of management of resources and benefit-sharing with the focus on equity. Therefore, women and their groups should be provided with targeted technical, financial and institutional support so that they can play a proactive role in adaptation and resilience-building efforts and integration of potential ILKP.

Concerned GoN agencies and development partners need to significantly increase investment in the production and dissemination of both indigenous and modern knowledge systems. The investment should be focused on educating young professionals with interdisciplinary skills to respond to the multiple and emerging needs of Nepali society, including for climate change adaptation. The approach must recognize that having a broad knowledge base will help develop effective approaches to minimize climate change vulnerabilities and help communities to pursue adaptive practices.

B. Implementing agencies, development partners and general practitioners

Adaptation is essentially and inevitably a local agenda (Agrawal, 2008) and ILKP must play a crucial role in all adaptation-related decision-making processes and actions. Without building on the traditional wisdom and practices of indigenous and local communities, Nepal's local-level adaptation plans, such as LAPAs or CAPAs, will not be successful. For any adaptation or resilience-building activity to succeed, it must be contextualized to a specific culture, location and society. Adaptation plans must be customized to the local socio-ecological systems and institutional framework. The understanding of and insights into existing ILKP should be considered as a prerequisite for designing any local adaptation program. Specific actions suggested are:

- Mobilize ILK holders and facilitate their interaction with the proponents and/or users of modern knowledge and tools to build synergies between ILK and modern knowledge communities;
- Consider gender-specific indigenous and local knowledge practices to analyze their value in promoting gender specific adaptation and resilience building activities.

It is clear that improving effectiveness of adaptation and resilience building efforts require suitable governance arrangements at the national, sub-national and local levels and cooperation among public, private, community, civil society organizations and traditional institutions. This will promote co-production of knowledge among different agencies ultimately creating opportunities to blend ILKP with contemporary knowledge and practices and general promotion of ILKP.

For diverse social groups in Nepal adaptation is a complex but immediate imperative due to the country's development deficit and impending climate change risks. Nepali people still have to be provided with safe and reliable drinking water, sanitation, primary health care, education, energy security and secured livelihoods. Climate change vulnerabilities have added an additional layer of stress to the existing low

institutional capacity. Technical and institutional capacity building of ILK holders, practitioners and their institutions should be given high priority prior to planning and implementing local adaptation plans, such as LAPAs and CAPAs.
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C. Community level

Indigenous, traditional and local communities and their institutions with relevant indigenous knowledge and practices should value, promote and share their knowledge. Some of the actions they can undertake are:

- Identify and document local and indigenous knowledge and practices to prevent them from getting eroded or lost;
- Actively seek help from modern technicians and expert groups to improve ILKP and use them effectively in the strategies for building adaptive capacities;
- Organize peer interaction sessions among people of different social groups to share experiences relating to ILKP. Peer exchange will promote ILKP and help evaluate its value and/or limitations in promoting climate change adaptation in different contexts.

GLOSSARY

Aama Samuha	A traditional institution initiated by Gurung women of western Nepal as mother's group for social welfare management and promotion of indigenous culture; this traditional institutional is an exclusive mothers' club for doing collective actions and social engagement.
Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation:
Adaptive Capacity	The ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
Anticipatory Adaptation	Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
Argi	Tunnel digging specialist
Autonomous Adaptation	Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
Autonomous planning	Possessing a large degree of self-government of a community
Biological diversity	The theme concerns the conservation and management of biological diversity at the ecosystem (landscape), species and genetic levels. Such conservation, including to protect areas with fragile ecosystems, ensures that diversity of life is maintained, and provides opportunities to develop new products, for example medicines, in the future. Genetic improvement is also a means to improve forest productivity, for example to ensure a high wood production in intensively managed forests.
Biological Diversity (Source, WIPO)	Article 2 of the Convention on Biological Diversity (1992) defines the term "biological diversity", often shortened to "biodiversity", as meaning the "variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."
Climate Change	Refers to any change in climate over time, whether due to natural variability or as a result of human activity.
Climate Variability	Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events; Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).
Community based forest management	Different types of forest management modalities that involve local people in planning, implementation and benefit sharing (including community forest management, pro-poor leasehold forest management, collaborative forest management, buffer zone management, public land management and urban forestry)
Community forest	Forest managed by Community Forest User Groups as defined by the Forest Act (1993) and Forest Regulations (1995)
Community Forestry	Participatory management of community forests

Coping Capacity	The means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. (In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and human-induced hazards.)
Cultural Diversity (Source, WIPO)	According to Article 4(1) of the UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions (2005), cultural diversity refers to the manifold ways in which the cultures of groups and societies find expression. These expressions are passed on within and among groups and societies. Monuments: architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science; Groups of buildings: groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science; Sites: works of man or the combined works of nature and of man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological points of view.
Customary Law and Practices (Source, WIPO)	Black's Law Dictionary defines "customary law" as law "consisting of customs that are accepted as legal requirements or obligatory rules of conduct; practices and beliefs that are so vital and intrinsic a part of a social and economic system that they are treated as if they were laws."
Dalit (Minor Caste Group)	*Dalits* are commonly known as untouchables belonging to occupational and artisan group in traditional Nepalese society. *Dalit* Commission has defined *dalit* as, "the community discriminated on the basis of caste and marginalized in terms of social, economic, educational, political and religious sectors." *Dalit* are further divided into different groups in accordance to socially prescribed occupations.
Deforestation	Transfer of forest to other land uses i.e. loss of forest
Degraded forest	Defined as forest with < 20% canopy cover
Dhikur	*Dhikur* are credit associations enacted by ethnical Thakalis, Gurungs and Bhotes groups for raising capital for investment in trade and business. It has sustained for centuries and continues to expand.
Disadvantaged (DAG) Groups	The Interim Constitution of Nepal, 1990 consider women, *dalit*, indigenous/ ethnic groups, Madhesi, deprived groups, poor farmer and labour and other vulnerable groups as Socially and Economically Disadvantaged Groups, and provisions protection to them.
Disaster	Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.
Dundh	Open wooden pipe
Ecosystem impacts	Marked change in the physical, biological, and socio-economic status of a system due to a combination of exposure and sensitivity to climate change; at ecosystem level it can be mitigated by micro-habitats and topographic buffering.

Ecosystem services	The benefits that arise from healthily functioning ecosystems such as soil conservation, water conservation, biodiversity, carbon sequestration, flood control, climate amelioration, aesthetic beauty and others
Ethno-engineering	Cultural or sustainable context that does not necessarily involve western style
Exposure	The nature and degree to which a System is exposed to significant climatic variations.
Extreme weather event	An event that is rare within its statistical reference distribution at a particular place. Definitions of "rare" vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile; Alternatively, an "extreme climate event" is an average of a number of weather events over a certain period of time, an average which is itself extreme (e.g., rainfall over a season).
Fadke	A temporary bridge to cross a river in hilly areas in winter when there is no flood
Forest	A type of terrestrial ecosystem characterized by a more or less dense and extensive tree cover. It often consists of stands of trees varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, stream, fish and wildlife.
Forest degradation	A reduction in the capacity of forest to produce goods and services
Forest management	Forest management legal arrangements which determine how a particular forest is governed
Forest products	The physical products that can be yielded and used from forests such as timber, fuel-wood, NTFPs/MAPs, fodder and food and others
Globalization	The process of international integration arising from the interchange of world views, products, ideas and other things
Guthi	This is religious cum social management institution practiced by Newars and is associated with a kind of land tenure system, religious and philanthropic endowments, foundations, trusts, oil-processing cooperatives etc.
Indigenous and Local Communities (Source, WIPO)	The Convention on Biological Diversity (1992) uses the term "indigenous and local communities" in recognition of communities that have a long association with the lands and waters that they have traditionally live on or used. (UNEP/CBD/WS-CB/LAC/1/INF/5.)
Indigenous Knowledge (Source, WIPO)	Indigenous knowledge is knowledge held and used by communities, peoples and nations that are 'indigenous'. In this sense, "indigenous knowledge" would be the traditional knowledge of indigenous peoples. Indigenous knowledge is, therefore, a part of the traditional knowledge category, but traditional knowledge is not necessarily indigenous. Yet the term is also used to refer to knowledge that is itself "indigenous". In this sense, the terms "traditional knowledge" and "indigenous knowledge" may be interchangeable. The term "indigenous peoples" has been the subject of considerable discussion and study and there is no universal, standard definition thereof. The United Nations Declaration on the Rights of Indigenous Peoples (2007) acknowledges the equal human rights of indigenous peoples against cultural discrimination and seeks to promote mutual respect and harmonious relations between the indigenous peoples and States. However, it does not provide a definition of "indigenous peoples."
Integrated watershed management	A multi-resource management planning process that seeks to balance healthy ecological, economic, and cultural/social conditions within a watershed.

Jamindar or *badhghar*	Tharu community leader
Janajati (Ethnic/ Indigenous People)	The Asian Development Bank (ADB) has defined indigenous people based on two significant characteristics they display (i) descendent from population groups present in a given area, most often before modern states or territories were created and before modern borders were defined, and (ii) maintenance of cultural and social identities, and social, economic, cultural and political institutions separate from mainstream or dominant societies and cultures.
Jhalpara	Preparing of brushwood dam
Jhara	Work call announcement
Juhari	Wooden holder with tri legs just like *tingode*
Khara	Fine in cash or kind
Khetala	Farm labour
Kulara	Collective canal maintenance
Landscape	A land-area mosaic of interacting ecosystems, land uses and social and economic groupings.
Mal-adaptation	Any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability but increases it instead.
Mauja	Area that extends from 3.85 hectare to 8.38 hectare
Meth muktiyar	Main head for Maujas
Muktiyar	Head for maujas
National adaptation programs of action (NAPAs)	Documents prepared by least developed countries (LDCs) identifying urgent and immediate activities useful for coping with climate change.
Nawa	Locally appointed individuals responsible for enforcing forest and crop protection through regulations, principally by controlling livestock movement in the Park and Buffer Zone.
Pani ghatta	Water mill
Pani sanchoes	Wooden weir
Planned Adaptation	Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.
Resilience	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.
Resilience building	The ability to recover quickly from setbacks
Rural transport	Infrastructure such as rural bridges, trails and *tuins*
Sangle bridge	Bridge having iron chains instead of imported cables
Sensitivity	The degree to which a System is affected, either adversely or beneficially, by climate-related stimuli; the effect may be direct or indirect.
Shingi nawa	Locally selected forest guardians who enforce the ban on harvesting live wood in locally protected forests in the Park and Buffer Zone.
Sidhabandi	Cultural practice for maintenance and cleaning
Surki	Paste of limestone, brick dust and black lentil
Syauli bandh	Temporary brushwood dam
Tingode	Wooden tri legs to control water

Traditional Knowledge (Source, WIPO)	There is as yet no accepted definition of traditional knowledge (TK) at the international level. "Traditional knowledge," as a broad description of subject matter, generally includes the intellectual and intangible cultural heritage, practices and knowledge systems of traditional communities, including indigenous and local communities (traditional knowledge in a general sense or lato sensu). In other words, traditional knowledge in a general sense embraces the content of knowledge itself as well as traditional cultural expressions, including distinctive signs and symbols associated with traditional knowledge.
Tuin	A primitive river crossing device using cable car or ropeways
Users Committee	The governing body for execution of work selected among the users group.
Users Groups	This institution is developed for ensuring community ownership, mobilization and partnering in most development works; Community forest user groups(CFUGs), Water and Sanitation Users Group,
Village Development Committee (VDC)s	The lowest political/development unit in Nepal. There are 4,000 VDCs in Nepal.
Vulnerability	Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC).
Vulnerability Reduction	Decrease in exposure and sensitivity and increase in resilience achieved either due to enhancement of the adaptive capacity of the species or ecosytem, which is also a function of the ecology, physiology, and genetic diversity.
Vulnerable Groups	The Interim Constitution of Nepal considers disadvantaged groups (women, *dalit*, indigenous/ethnic groups, madhesi, deprived groups, poor farmers and laborers) also as vulnerable. In addition, various government plans and policies as well as some of the ADB guidelines also consider aged family member headed households, women headed households, family with disabled members and families having significant resettlement affect to be vulnerable.

ANNEXES

Annex A-1: Distribution of participants by gender and sector in research activities

Sectors			Gender of the participants		Total	Total per cent
			Male	Female		
Local water management	Research activities	District level workshop (DLW)	97	25	122	37.77
		Case study site workshop (FGD)	88	22	110	34.06
		Key informant interview (KII)	26	6	32	9.91
		Household information collection (HHIC)	39	20	59	18.27
	Total		**250**	**73**	**323**	
	Per cent		**77.4**	**22.6**		
Forest and pasture management	Research activities	District level workshop (DLW)	64	10	74	35.92
		Case study site workshop (FGD)	30	29	59	28.64
		Key informant interview (KII)	15	14	29	14.08
		Household information collection (HHIC)	24	20	44	21.36
	Total		**133**	**73**	**206**	
	Per cent		**64.6**	**35.4**		
Rural transport infrastructure	Research activities	District level workshop (DLW)	67	15	82	34.02
		Case study site workshop (FGD)	66	30	96	39.83
		Key informant interview (KII)	7	5	12	4.98
		Household information collection (HHIC)	29	22	51	21.16
	Total		**169**	**72**	**241**	
	Per cent		**70.1**	**29.9**		
Settlement and housing	Research activities	District level workshop (DLW)	22	2	24	10.30
		Case study site workshop (FGD)	75	47	122	52.36
		Key informant interview (KII)	15	3	18	7.73
		Household information collection (HHIC)	38	31	69	29.61
	Total		**150**	**83**	**233**	
	Per cent		**64.4**	**35.6**		

Traditional social institution	Research activities	District level workshop (DLW)	9	2	11	16.42
		Case study site workshop (FGD)	9	10	19	28.36
		Key informant interview (KII)	15	7	22	32.84
		Household information collection (HHIC)	9	6	15	22.39
	sub-total		**42**	**25**	**67**	
	per cent		**62.7**	**37.3**		
Grand Total 326 (30.5)				**Male: 744 (69.5)**		**Female:**

Annex A-2: Food sufficiency situation of the HH respondents (per cent)

	Food sufficiency						
Districts	**Less than 3 months**	**3 - 6 months**	**6 - 9 months**	**9 - 12 months**	**Year around food stock**	**No cultivation**	**Total**
Baglung	1	1	1	0	2	0	5
Palpa	4	3	5	0	4	0	16
Rupendehi	1	10	1	0	3	0	15
Sindhuli	0	4	3	3	1	0	11
Mahottari	3	3	0	0	2	2	10
Kailali	0	6	3	2	8	1	20
Lamjung	0	3	4	8	0	0	15
Tanahau	5	6	3	3	0	0	17
Dhading	0	1	4	0	1	0	6
Bhaktapur	2	8	9	1	3	2	25
Lalitpur	1	0	1	0	0	7	9
Jumla	7	11	11	1	0	0	30
Solukhumbu	1	10	1	2	0	5	19
Mustang	2	2	3	4	3	1	15
Illam	1	1	0	3	1	1	7
Jhapa	2	1	0	1	0	4	8
Dolakha	3	2	1	0	0	4	10
Total	**33**	**72**	**50**	**28**	**28**	**27**	**238**
Per cent	**13.87**	**30.25**	**21.01**	**11.76**	**11.76**	**11.34**	

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	Total		**169**	**72**	**241**	
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Grand Total 326 (30.5)				**Male: 744 (69.5)**		**Female:**

Annex A-2: Food sufficiency situation of the HH respondents (per cent)

Districts	Food sufficiency						
	Less than 3 months	3 - 6 months	6 - 9 months	9 - 12 months	Year around food stock	No cultivation	Total
Baglung	1	1	1	0	2	0	5
Palpa	4	3	5	0	4	0	16
Rupendehi	1	10	1	0	3	0	15
Sindhuli	0	4	3	3	1	0	11
Mahottari	3	3	0	0	2	2	10
Kailali	0	6	3	2	8	1	20
Lamjung	0	3	4	8	0	0	15
Tanahau	5	6	3	3	0	0	17
Dhading	0	1	4	0	1	0	6
Bhaktapur	2	8	9	1	3	2	25
Lalitpur	1	0	1	0	0	7	9
Jumla	7	11	11	1	0	0	30
Solukhumbu	1	10	1	2	0	5	19
Mustang	2	2	3	4	3	1	15
Illam	1	1	0	3	1	1	7
Jhapa	2	1	0	1	0	4	8
Dolakha	3	2	1	0	0	4	10
Total	**33**	**72**	**50**	**28**	**28**	**27**	**238**
Per cent	**13.87**	**30.25**	**21.01**	**11.76**	**11.76**	**11.34**	

Annex A-3: Gender distribution of the HH interview

Name of district	Respondents (per cent)	
	Male	Female
Baglung	100.00	
Palpa	68.80	31.30
Rupendehi	73.30	26.70
Sindhuli	54.50	45.50
Mahottari	90.00	10.00
Kailali	45.00	55.00
Lamjung	40.00	60.00
Tanahau	35.30	64.70
Dhading	50.00	50.00
Bhaktapur	68.00	32.00
Lalitpur	66.70	33.30
Jumla	73.30	26.70
Solukhumbu	52.60	47.40
Mustang	46.70	53.30
Illam	42.90	57.10
Jhapa	50.00	50.00
Dolakha	40.00	60.00
Total	**58.40**	**41.60**

Annex A-4: Sectors wise experience of multiple climate change indicators

Sectors	Change pattern felt in weather/ climate related matters (snowfall, fog, hailstone, lightening strike, thunderstorm and mist) in past (20/30/40)		
	Yes	No	Total
Local water management	49	10	59
Forest and pasture management	40	4	44
Rural transport infrastructure	43	8	51
Human settlement and housing	60	9	69
Traditional social institution	15	0	15
Total	**207**	**31**	**238**

Annex A-5: Gender wise response regarding the HH perception on likelihood to suffer from CC impacts

Gender of respondent	HH more likely to suffer from CC impacts than other		
	Yes	No	Total
Male	67	72	139
Female	51	48	99
Total	**118**	**120**	**238**

Annex A-6: Source of drinking water of the households interviewed

HHs by sectors	Source of drinking water (per cent)							
	River	Self owed tap	Spring water	Pond/ well	Tube well	Public tap	Others, specific	Total
Local water management	5.10	45.80		1.70	6.80	39.00	1.70	100
Forest and Pasture management		34.10	2.30		18.20	45.50		100
Rural transport infrastructure	2.00	49.00		3.90		41.20	3.90	100
Settlement and housing		47.80		2.90	30.40	18.80		100
Traditional social institutions		66.70		13.30		20.00		100
Total	**1.70**	**46.20**	**0.40**	**2.90**	**13.90**	**33.60**	**1.30**	**100**

Annex A-7: Land ownership situation of the HH respondents

Sector	Household having their own land		
	Yes	No	Total
Local water mangement	55	4	59
Forest and Pasture management	42	2	44
Rural transport infrastructure	45	6	51
Settlement and housing	62	7	69
Traditional social institutions	15	0	15
Total	**219**	**19**	**238**

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