CASE STUDY: 2

Government of Nepal
Ministry of Science, Technology and Environment
Pilot Program for Climate Resilience

Mainstreaming Climate Change Risk Management in Development

ADB TA 7984: Indigenous Research

INDIGENOUS AND LOCAL CLIMATE CHANGE ADAPTATION PRACTICES IN NEPAL

CASE STUDY CHAPTERS

ACRONYMS

ACAP	Annapurna Conservation Area Programme
ADB	Asian Development Bank
AGM	Annual General Assembly
AIPP	Asia Indigenous Peoples Pact
AIS	Argali Irrigation System
AMIS	Agency Managed Irrigation System
BLGIP	Bhairawa Lumbini Ground Water Irrigation Project
BLGWP	Bhairahawa Lumbini Ground Water Project
BTCB	Baglung Type Chain Bridges
BZMC	Buffer Zone Management Council
BZUG	Buffer Zone User Groups
CAPA	Community Adaptation Programme of Action
CBFM	Community Based Forest Management
CBNRM	Community Based Natural Resource Management
CBOs	Community Based Organisations
CBS	Central Bureau of Statistics
CC	Climate Change
CCA	Climate Change Adaptation
CDO	Chief District Officer
CF	Community Forestry/Forest
CFUGs	Community forest user groups
CMIS	Chhattis Mauja irrigation system
CSO	Civil Society Organisation
DDC	District Development Committee
DFO	District Forest Office
DHM	Department of Hydrology and Meteorology
DHQ	District Headquarter
DLCW	District Level Consultation Workshop
DLSO	District Livestock Office
DNPWC	Department of National Parks and Wildlife Conservation
DoLIDAR	Department of Local Infrastructure Development and Agricultural Roads
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DSCO	District Soil Conversation Office

DWS	Drinking Water System
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organisation
FECOFUN	Federation of Community Forest Users, Nepal
FES	Friedrich Ebert Stiftung
FGD	Focus Group Discussion
FMIS	Farmers Managed Irrigation System
FNCCI	Federation of Nepalese Chamber of Commerce and Industry
GCAP	Global Climate Adaptation Partnership
GDI	Gender Development Index
GGTDC	Galkot Ghumte Tourism Development Center
GHG	Green House Gas
GLOF	Glacier Lake Outburst Floods
GO	Government Organisations
GoN	Government of Nepal
GTZ	German Technical Cooperation
Ha	Hectare
HDI	Human Development Index
HELVETAS	Swiss Association for Technical Cooperation
HH	Household
HHI	Household Information
HHIC	Household Information Collection
HHs	Households
HPI	Human Poverty Index
HR	Human Resource
HRD	Human Resource Development
IPBES	International Platform for Biodiversity and Ecosystem Services
I/NGO	International/Non-Governmental Organisation
ICIMOD	International Centre for Integrated Mountain Development
IDS-N	Integrated Development Service, Nepal
IEE	Initial Environmental Examination
IGA	Income Generating Activities
IIED	International Institute of Environment and Development
IK	Indigenous Knowledge
ILK	Indigenous and Local Knowledge

ILKP	Indigenous and Local Knowledge and Practices
ILKS	Indigenous and Local Knowledge System
ILP	Indigenous and Local People
IPCC	Inter-governmental Panel on Climate Change
IPs	Indigenous Peoples
ISET-N	Institute for Social and Environmental Transition-Nepal
ITK	Indigenous and Traditional Knowledge
ITKP	Indigenous and Traditional Knowledge and Practices
ITKS	Indigenous and Traditional Knowledge Systems
ITSI	Indigenous traditional Social institutions
IUCN	International Union for Conservation of Nature
KI	Key Informant
KII	Key Informant Interview
KU	Kathmandu University
LAPA	Local Adaptation Plan of Action
LDO	Local Development Officer
LFP	Livelihoods and Forestry Programme
M&E	Monitoring and Evaluation
MAPs	Medicinal and Aromatic Plants
MCA	Multi-Criteria Assessment
MFSC	Ministry of Forests and Soil Conversation
MoENV	Ministry of Environment
MoSTE	Ministry of Science, Technology and Environment
MWDR	Mid western development region
NAPA	National Adaptation Programme of Action
NCCSP	Nepal Climate Change Support Programme
NCVST	Nepal Climate Vulnerability Study Team
NEFAS	Nepal Foundation for Advanced Studies
NEFIN	Nepal Federation of Indigenous Nationalities
NGO	Non-Governmental Organisation
NIIS	Nepal Irrigation Institutions and Systems Database
NPC	National Planning Commission
NPD	National Project Director
NPM	National Project Manager
NRM	Natural Resource Management

NRs	Nepalese Rupees
NSDRM	National Strategy for Disaster Risk Management
NTFP	Non-Timber Forest Products
NTNC	National Trust for Nature Conservation
O&M	Operation and Maintenance
PA	Protected Area
PAC	Practical Action Consulting
PES	Payment for Ecosystem Services
PPCR	Pilot Program for Climate Resilience
PRA	Participatory Rural Appraisal
RCC	Reinforced Cement Concrete
REDD	Reducing Emissions from Deforestation and Forest Degradation
SBT	Suspension Bridge and Trails
SCMIS	Sorah-Chhatis (16-36) Mauja irrigation system
SLD	Shared Learning Dialogue
SNP	Sagarmatha National Park
SNPBZ	Sagarmatha National Park Buffer Zone
SPCC	Sagarmatha Pollution Control Committee
SPCR	Strategic Program for Climate Resilience
SPSS	Statistical Package for Social System
TMI	The Mountain Institute
TSI	Traditional Social Institution
TU	Tribhuvan University
UMDWS	Users Managed Drinking Water Schemes
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Economic, Social and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
USAID	US Agency for International Development
VDC	Village Development Committee
VFCC	Village Forest Coordination Committee
WASH	Water Sanitation and Hygiene
WB	World Bank
WFP	World Food Programme
WRS	Water Resources Strategy

CASE STUDY I

INTRODUCTION, OBJECTIVES AND METHODOLOGY

FOREWORD

The main report on Indigenous and Local Climate Change Adaptation Practices in Nepal is supported by six additional chapters that introduce the case studies and provide details of each in separate five chapters. The five studied examples are: local water management practices; forest and pasture management; rural transport infrastructure; settlements and housing; and traditional social institutions. Chapter one, which is common to all the five chapters, presents research issues, objectives, methods, case study themes and the case study examples. Chapter two describes local water management practices covering farmers managed irrigation systems, community managed drinking water schemes and locally managed water mills. The third chapter describes forest and pasture management practices in Nepal. Chapter four is related with indigenously developed rural transport infrastructures that help in the mobility of rural population. Chapter five on housing and settlements examines the link between climatic risks and settlements in Nepal and how indigenous responses can minimize risks and enhance resilience. The last chapter on traditional social institutions describes their evolution as an integral component of indigenous knowledge, practices, rituals, and norms. The chapter suggests that local traditional institutions can play key role in making adaptive actions more effective.

The five case studies also demonstrate that indigenous communities and local communities collectively engage in utilizing indigenous, traditional and local knowledge to deal with both climatic and non-climatic stresses. These actions over the centuries have helped evolve different types of adaptation measures in response to climate change vulnerability and impacts. The results reveal that indigenous and local initiatives can help address the effects of climate change within a certain threshold and assist in enhancing resilience of community-based development plans and programs. As climate change exacerbates extreme weather events and thresholds are approached or exceeded, indigenous and local and indigenous knowledge practices on their own will not help overcome Nepal's adaptation deficit. Overcoming such deficits at local, sub-national and national levels requires integrating situation specific indigenous knowledge and practices with scientific knowledge system.

CONTENT

1.1. BACKGROUND

1 The indigenous local populations of Nepal possess rich and diverse traditional knowledge, technologies and practices that are increasingly being used to design CCA and DRR-related solutions (Dahal, 2013; UNFCCC, 2013). In fact, the role that ILKP can play in CCA mitigation and DRR is now globally recognized (IPCC, 2014; Nakashima, 2012; Odero, 2011; Nakashima & Roue, 2002). Indigenous communities, especially those in remote rural areas of Nepal, have been using ILKP to adapt to both climatic and non-climatic changes (Helvetas, 2011) for centuries. Indeed, marginalized communities in the most remote parts of the country depend on ILKP to survive the harsh climate and poverty they face.

2 ILKP helps in adaptation planning by a) enhancing people's understanding of the nature of risk; b) identifying gaps in the adaptive capacity of individuals and institutions; and c) reducing the cost of adaptation by using local knowledge and physical resources (Dahal, 2013). Peoples' knowledge about and skill in managing the environmental systems they live in and its relationships with social systems form an important element of their culture and identity as well as their capacity to adapt (Berkes et al., 2012). However, the use of ILKP in CCA in Nepal is not yet well documented (Shrees Magar, 2007). More information about ILKP will allow government and non-governmental agencies to better understand how to apply ILKP in development and climate change adaptation programs and plans. This report on study of five case studies documents and assesses a variety of practices from different parts of Nepal that are used to adapt to climate variability and change, reduce disaster risks and respond to non-climatic challenges.

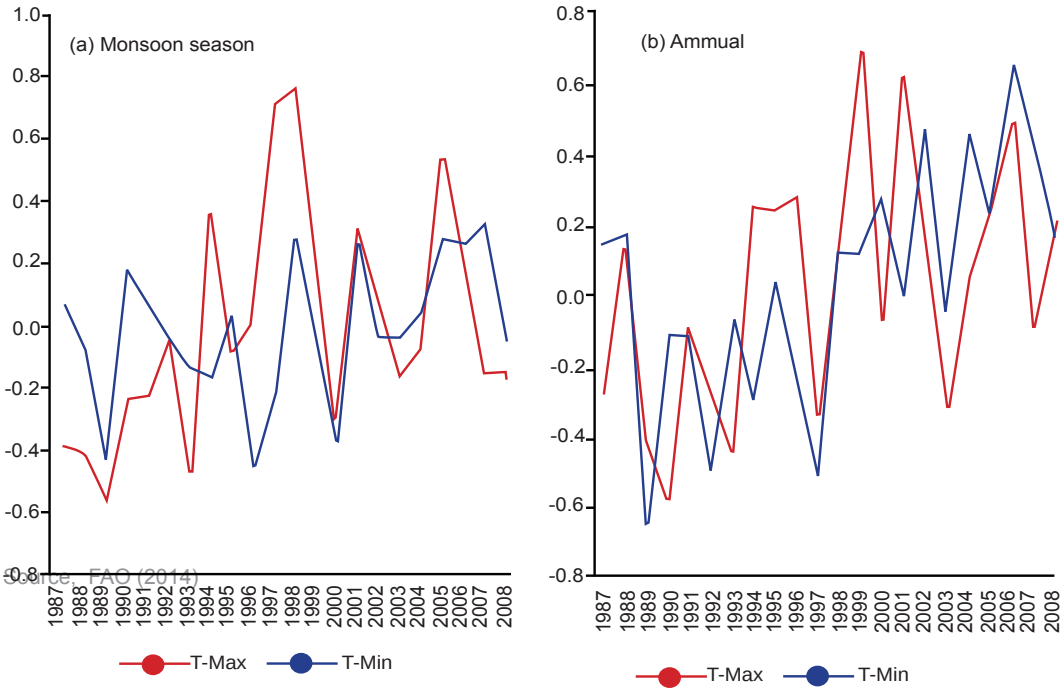
1.2 INTRODUCTION

3 Nepal was ranked the 4th most vulnerable countries in the world by Maplecroft – a British organization based on its growing vulnerability to climate change impacts (Maplecroft, 2011). Climate change has resulted in increase in temperature, erratic and extreme rainfall patterns, and the increased frequency of floods, landslides, and droughts that annually result in the massive loss of lives and properties (FAO, 2014; Karki et al, 2011; NAPA, 2010; Dixit et al., 2008). The increase in annual average temperature is around 0.06°C (Devkota, 2014; Gautam et al., 2013; NCVST, 2009; Kulkarni et al. , 2013). The increase in average annual temperature on the high Himalayan slopes is greater than in the Midhills and Tarai plains. This increase is also higher than the global averages (FAO, 2014; Devkota, 2014; Kulkarni et al, 2013). Rising temperatures cause Himalayan glaciers to melt and form lakes with a high probability of breaching and causing flash floods (Shrestha, 2012). The rate of -increase of average winter temperature is higher than that of summer (Figure 1) and is high enough to change ecosystem functions, plant production cycles and ecosystem services.

4 The pattern of monsoon rainfall– both in volume and season – is changing; the number of heavy rainfall events in western Nepal has increased while rainfall

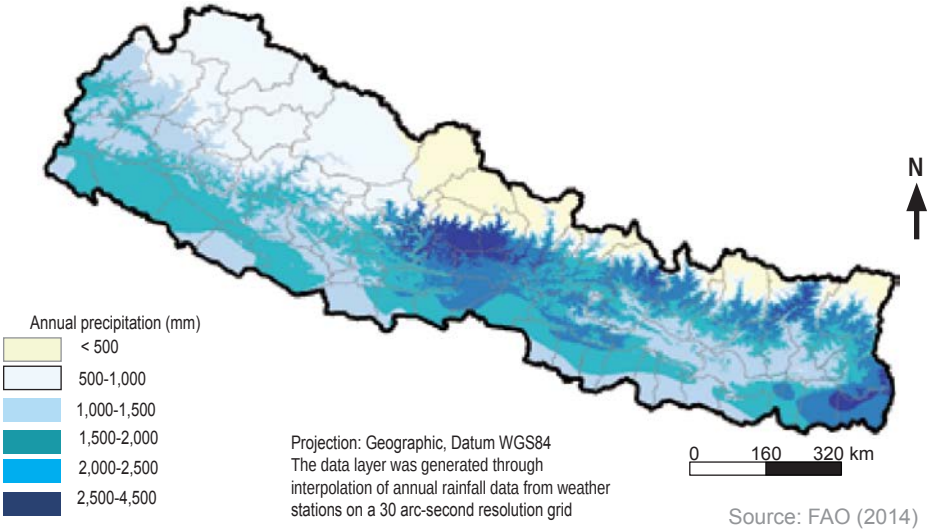
season in eastern Nepal has become more erratic. The number of winter showers is decreasing and summer rain is falling later than in the past. At the national level, the total annual precipitation volume has not significantly changed but there are pockets of substantial increases and decreases (Figure 2), indicating a high regional variation (Duke Univ./WWF, 2011). Extreme rainfall events and flash floods are likely to increase in Mid-Western Nepal while in Eastern Tarai droughts are likely to increase in future. The last few years have seen longer cycles of drought and heavy floods in different parts of Nepal.

Figure 1: Maximum and minimum temperature trend (1987-2008) in Nepal



Source: FAO (2014)

Figure 2: Precipitation trends in Nepal



Source: FAO (2014)

5 The future projection of climatic trends for Nepal is alarming. The number of days with heavy precipitation is likely to increase the number of damaging flood events in future (Devkota, 2014). Different projections made by national and international scientists using global and regional climate models (NCVST, 2009; Gautam et al, 2013; Kulkarani et al., 2014) estimate different changes in temperature and precipitation. According to NCVST (2009) on an average, temperature will rise 1.4°C by 2030; 2.8°C by 2060, and 4.7°C by 2090 (Table 1). Although precipitation is expected to increase only marginally, the number of both heavy rainfall events and droughts is expected to increase. Kulkarni et al. (2013) have compared the observed current summer temperature and rainfall data with the ensemble based data for four periods up to the end of century and found similar trend (Table 1a). Climate change is expected to increase climate-induced risks and exacerbate the vulnerability of Nepal and Nepalese people. To adapt to the emerging uncertainties and risks new knowledge and capacity are needed.

Table 1: Model projections of temperature and precipitation trends in Nepal

	Nepal country wide		
	2030	2060	2090
Change in mean temperature: annual (°C)	+1.4	+2.8	+4.7
Change in frequency of "hot days" per monsoon (%)	-	6-77%	29-93%
Change in monthly precipitation annual (%)	-34 to +22 with multi model mean of +0	-36 to +67% with multi model mean of + 4%	-43 to + 80% with multi model mean of 8%

Changes are relative to the mean 1970-1999, run using the A2 scenario, hot days taken as hottest 5% days in the period of 1970-1999, and heavy events means high rainfall within the short time. (Source, NCVST, 2009)

6 The Government of Nepal (GoN) has initiated a number of activities to enhance the technical and institutional capacity of social, economic, and institutional sectors in order to minimize the vulnerability and improve the resilience of the population. International development partners, including ADB, are assisting GoN through the Pilot Programme of Climate Resilience (SPCR) to meet these objectives. The GoN's Pilot Programme for Climate Resilience (PPCR) aims to identify ways to integrate climate risk and resilience into development planning. It intends to provide incentives for scaling up action and initiating transformational changes (ADB, 2011) to build resilience especially in infrastructure sector.

7 Component 3 of PPCR, Mainstreaming Climate Change Risk Management in Development (MCCRMD), Technical Assistance Project (TA) 7984, aims to develop knowledge-management tools suitable for CCA. Under Output 2, the TA specifically planned to "document traditional or indigenous adaptation practices in Nepal, including those of women and disadvantaged groups" (ADB, 2011). Accordingly, this study was designed to a) systematically document ILKP in development-relevant and climate-sensitive sectors and b) analyze and interpret the results from the perspective of CCA so that ILKP can be utilized by decision-makers to formulate policies and plan and manage adaptation and resilience-building activities in Nepal.

1.3 UNDERSTANDING OF INDIGENOUS PRACTICES AND CLIMATE CHANGE

Indigenous and local practices (ILP) are the result of the application of culture, context, and location-specific knowledge to solve local problems. These practices have evolved through the use of ILK generated over hundreds of years and are locally tailored, cost-effective and community-owned. The term “indigenous and local knowledge” is described under various names such as indigenous traditional knowledge (ITK), traditional ecological knowledge (TEK), or simply, traditional knowledge (TK). However, one element that is common to all the definitions is that indigenous or local knowledge is unique to a given culture, society, and location (Warren, 1992; World Bank, 1998).

According to Mukhopadhyay (2009) “indigenous knowledge is knowledge unique to a given culture or society, acquired through accumulation of years of experiences of local people passed on from generation to generation” and IPCC (2010) describes ITK as an “invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change”. Nakashima et al, (2012) defines

indigenous, traditional and local knowledge as “knowledge and know-how linked to a specific place, culture or society developed in several generations; these knowledge systems are dynamic in nature and exist among people who live as a part of natural ecosystems”. This report uses the term `indigenous and local knowledge and practices’ (ILKP) based on the definition used by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). Accordingly indigenous and local knowledge (ILK) is understood as “the multi-faceted arrays of knowledge, know-how, practices and representations that guide societies in their innumerable interactions with their natural surroundings”.

This generations long relationship “ 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). Indigenous and local knowledge have played an important role in solving problems, including those related to climate change and climate variability. Since indigenous and local people live close to natural resources, they observe changes around them quite soon after they occur and identify and adjust activities to adapt to these changes immediately (Tebtebba Foundation, 2013).

In the context of CCA, it is important to develop a common understanding of what ILKP means and which of their characteristics make them suitable for adaptation. Some of these properties are as follows.

- Knowledge found locally and specific to different situations and cultures;
- Tacit (unspoken or implicit) knowledge gathered through interaction among and observation process of community members, thus easily disseminated;
- Transmitted orally from generation to generation or self-learned, getting refined in the process of transference;

- Practical knowledge which is applied rather than theoretical
- Experiential learning and specific to locale; and
- Constantly changing as it is regularly improved upon (Warren et al., 1995; Berkes, 2012; Nakashima et al., 2012).

13 Although wide-ranging applications are found globally, regionally and nationally (UNFCCC, 2013; IUCN; 2008; Helvetas, 2011), the deliberate application of ILK to CCA in Nepal is relatively new and few examples of systematising or scaling-up ILK to address as yet exist. One of the hurdles is lack of technical and institutional support especially from the GoN. For ILK to be applied effectively to climate change adaptation over the long term requires more institutional supports such as:

a) A national institution dedicated to documenting and promoting ILK and ILKP;
b) Applying vulnerability assessment and adaptation planning methods that use ILK leading to adaptation plans that integrate ILK (as the NAPA calls for MoEnv, 2011);
d) National policies in support of ILK for development and adaptation;
e) Local-level (as opposed to national and international driven) initiatives to use and promote ILK;
f) Broad-based and scaled-up practices rather than just the localized and context-specific practices that predominate.

1.4 RESEARCH OBJECTIVES

14 According to the terms of reference (Annex 1), the general objective of the study is to identify, document, and analyze ILKP of different types of indigenous and local communities of Nepal relevant to CCA and resilience-building measures with special emphasis on gender inclusion.

The study's specific objectives are as follow:

- Analyze climate change issues and adaptation priorities from the perspective of diverse social, cultural and linguistic groups, particularly of the women within them.
- Identify, analyze, and document adaptation practices based on indigenous population's ways of recognizing climate change-related impacts in their environment and the measures they take to cope with or benefit from these changes.
- Recommend how indigenous adaptation practices can be integrated into programs or policies to strengthen the climate resilience of Nepal's development efforts, with particular reference to the MCCRMD project and other components of the PPCR.

15 The study aims to develop a comprehensive knowledge-base of local adaptation practices that can ensure the resilience of the nation's development plans and programs. The collection and documentation of ILKP are assessed for their possible integration, synergy, and complementarities with scientific knowledge to create and

utilize new knowledge in adaptation planning. The focus of the study is on climate-sensitive development sectors and vulnerable regions of Nepal. Detail description of research themes (covering development and livelihood sectors), locations (districts), and participants were selected based on national and district level stake holder consultation and extensive literature (including grey literature) review.

16 The study makes a distinction between autonomous adaptation—that spontaneously adopted by locals for whatever reason--and planned adaptation--calculated responses implemented as programs and projects by governments or communities to respond to, or in anticipation of, expected climate, and only climate, impacts (ISET, 2008). Given the uncertainties associated with localizing the consequences of global climate change at the ward, VDC, district, sub-watershed, or ecosystem level, strategies to build resilience and adaptive capacity need to link planned with autonomous adaptation through use of both social, institutional and physical infrastructure systems and the ILK to deal with stresses.

17 Though they are created and governed at the societal level, physical infrastructure systems and the institutions managing them, in tandem with IKL, enable or constrain the shifting of strategies by individuals, households and organizations. IKL can serve as the bridge between national strategies and the inherently local-level realities where responses to climate change will ultimately occur (ISET, 2008). Nepal's LAPA process is one effort to bridge that gap, and its effective implementation is central to building adaptation.

1.5 RESEARCH QUESTIONS

18 The following questions were formulated to guide the study and meet the requirements of research on indigenous ILK (UoM, 2013).

a. What are the key considerations for adopting ILKP for increasing adaptive capacity and resilience to climate change in Nepal?
b. What lessons do past researches on indigenous practices in Nepal provide?
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?

1.6 RESEARCH METHODOLOGY

19 Discussion of the methodology used in this study is divided into five sections: a) research framework, b) design concept, c) literature review, d) research approach and tools, e) case study methods

1.6.1 Conceptual framework

20 Researchers first developed a general research framework and structure to illustrate a logical sequencing of the major steps they would take (Figure 3). The framework helped define the social, cultural, and technical domains of IKLP and guided the design of the qualitative data collection and analytical tools, including focus group discussion and community perception analysis (Schensul et al., 2009). Quantitative data were collected using both key informant and household interviews with purposively selected participants. The qualitative information was complemented by case-study discussions with the practitioners, observations during transact walks, focus group discussions and shared learning discussions among concerned groups and individuals (Egeru, 2011). To capture gendered dimensions and the disaggregated views of men and women, the researchers used gender-sensitive checklists and questions and gender and social analysis techniques. The quantification of gender-disaggregated responses helped assess men's and women's different perceptions of vulnerability to climate change, perceptions which, in turn, indicate their learned behaviour and preferences (Lambrou & Piana, 2006).

1.6.2 Research design

21 The study was designed to achieve the objectives in an inclusive and holistic manner. The overall methodology design is based on the general principles of participatory action research (PAR) (Sillitoe, 2007; Sillitoe et al., 2002). The study was framed to accomplish the following objectives:

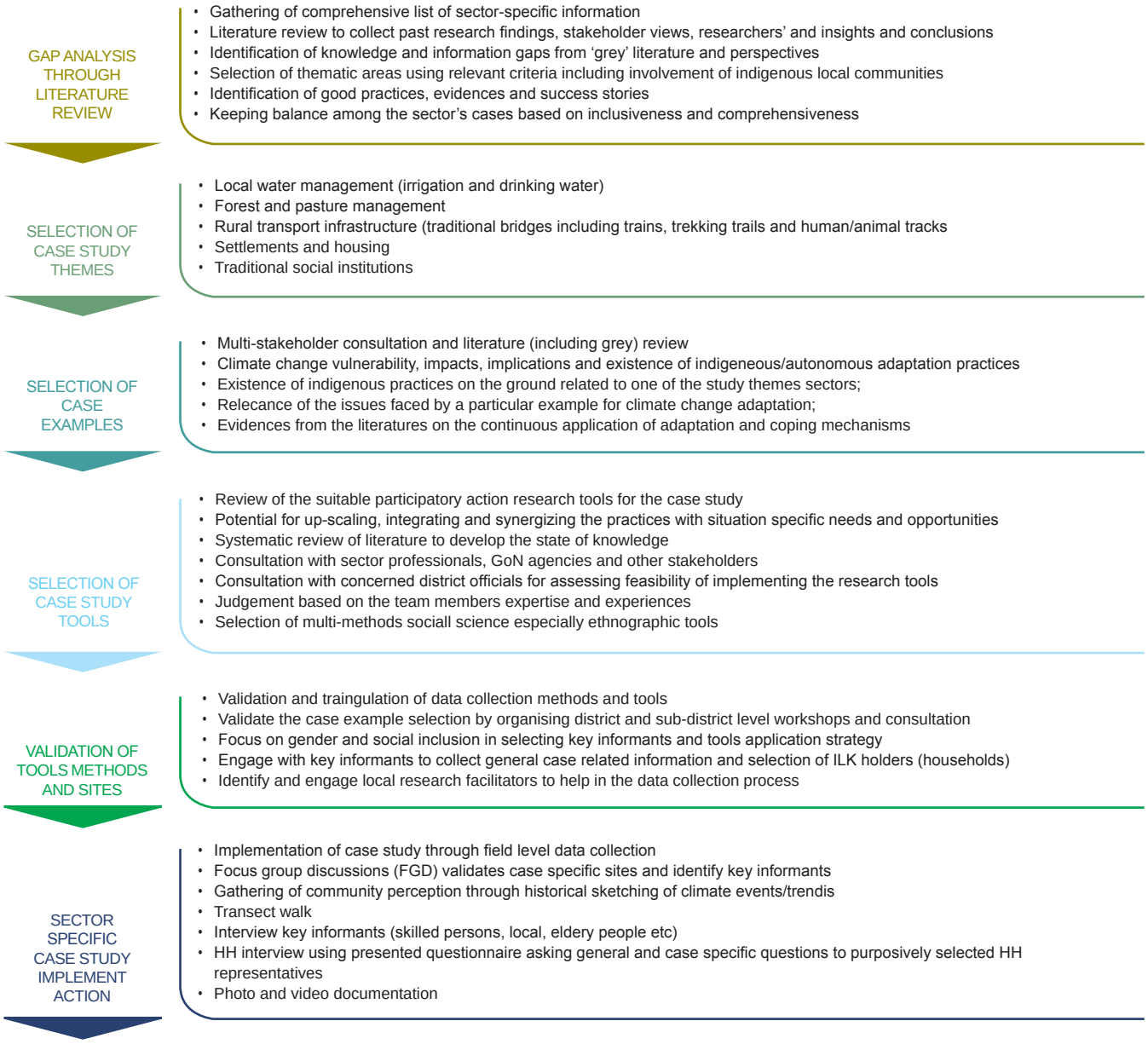
- Generate both quantitative and qualitative data;
- Utilize the purposive selection of, participatory consultation with, systematic inquiry among ILK holders, practitioners, and leaders from the district to household level,
- Collect information from both primary and secondary sources; and
- Validate the accuracy of the data by triangulating and crosschecking the results produced by a wide variety of tools and methods (Putt, 2013; Beach & Pedersen, 2013; Beltran, 2000).

1.6.3 Literature review on research methodology

22 A systematic review of literature helped us identify and document the wide variety of appropriate participatory action research methods and tools used by social science and ethnographic researchers in global, regional, and national contexts to study ILPs and CCA (Beltran, 2000; Gonzales, 2012; Beach & Pedersen, 2013) by engaging traditional societies and indigenous communities. Such methods must collect information at the grassroots level keeping in mind ethical issues in the solicitation of information from indigenous communities. Our review of the literature and of research conducted in Nepal (Shrees Magar, 2007) as well as our own knowledge and stakeholder consultations, we determined that the case study (Galloway McLean, 2010) was the most appropriate research method.

23 The review of recent case studies within and outside Nepal (Nakashima et al., 2012; UNFCCC, 2013) helped us analyze good practices and draw insights linking indigenous practices with CCA. Reports collected from Central Department of

Figure 3: Research framework and process



Environmental Science of Kathmandu and Tribhuvan universities, ICIMOD, WWF, Practical Action, ADB, the World Bank and other agencies (World Bank, 1998; ICIMOD, 2007; Sherpa et al., 2013) revealed state-of-the-art information on where indigenous research-based knowledge in Nepal stands. The five sectors were analyzed from the perspectives of a) relevance to development and livelihood; b) sensitivity to climate; and c) the strength of the involvement of indigenous and local communities.

The aim was to identify case-study themes for documenting good practices that could be recommended for planning and promoting situation-specific knowledge-based

adaptation solutions. To do so, we first had to build our knowledge base on the importance of indigenous practices as an effective tool for reducing risk from climate-related hazards. We examined a number of ILPs developed by communities across Nepal, South Asia, the Asia Pacific, and Africa. More particularly, we documented and assessed ILKP-based CCA in countries such as India, Kenya, Uganda, and Ghana (Midgley, 2011; DA/CDKN, 2011; Ajani et al, 2013; Mukhopadhyaya, 2009). The review provided an overview of the types of ILK that exists in the context of CCA, disaster preparedness and early warning. It also provided some understanding of how ILK can be integrated with scientific practices to achieve better adaptation and resilience-building outcomes (Nakashima et al, 2012).

25 Researchers also stress the need to win the trust of indigenous local communities through the demonstration of reciprocity and empowerment, that is, by researchers sharing their knowledge, insights, and observations and not simply collecting those of local people. By sharing their insights from research on ILK along with scientific approaches researchers can establish meaningful partnerships that help them better understand ILPs (Thornton & Scheer, 2012). This sort of shared learning process is one of the key methodological approaches that ISET-Nepal and it partners use in their CCA research.

26 At the same time, arranging for capacity-building and training in the use of scientific techniques can enable ILK holders to deal with modern knowledge systems so that they can synthesize it with ILK for use in successful adaptation efforts. In this endeavour TSIs have a crucial role: they represent communities they enact and enforce the rules of the social contract that relate to dealing with the inflow of external information. TSI can help in generating shared understanding.

1.6.4 Research approach

27 Case study methodology was selected as a key research method for this research since it is a commonly used methods universally (Yin, 2003a; Yin, 2003b; Brown, 2008), It is also acceptable by both traditional and modern scientific communities. It is a qualitative method based on a clear rationale so that the validity and reliability of the evidence collected, which is itself testimony to the accuracy of research results, can be demonstrated clearly and convincingly (Brown, 2008). The method followed involved the systematic investigation of IKL and ILP and the systems underlying both and covered multiple aspects of local context. The framework shown in Figure 4 is followed by a brief description of the activities undertaken.

28 The study focused on five thematic sectors- water, trail bridges, community forestry, settlements and traditional social institutions, the study team needed a method that would provide it with flexibility in gathering data using both group discussions and individual experts. Flexibility was necessary for drawing inferences beyond the individual cases studied. Detailed information on individual cases, both qualitative and quantitative, was collected through intensive community-level interaction.

1.7 EXECUTION OF CASE STUDY METHODS AND TOOLS

29

The study selected five development, livelihood and infrastructure-related case-study themes based on five factors: a) justification in the literature; b) relevance to CCA; c) participation of indigenous local communities; d) scope for scaling up practices and e) potential for developing complementarities and integrating with modern approaches. The selection was also based on evidence from research in Nepal, the researchers' knowledge, and a consultation with national stakeholders. The infrastructure-related themes ultimately arrived at were: i) local water management, ii) forest and pasture management; iii) rural transport infrastructure; iv) settlements and housing, and (v) TSIs.

1.7.1. Long list of potential case study themes

30

Considering the information gathered from the assessment of literature on ILK in Nepal and the study's objectives the researchers prepared a long list of possible case studies which included both strong and weak examples of the application of indigenous practices to CCA in Nepal organized according to sector.

1.7.2. Short list of case study themes

31

This list was evaluated in three ways. First, the climate change-related implications for each sector were analysed. Second, sector-specific stakeholders, including professionals, representatives of concerned ministries and departments, academicians, and development practitioners were consulted. Finally, at least two to four case studies for each thematic sector were selected for study in 18 of the nation's 75 districts. In total, 31 case studies spread across Nepal's three ecological and five development regions of the country were selected.

1.7.3. Local stakeholders' consultation for method validation

32

Local stakeholders included district-level government officials, ILK practitioners (men and women from different ethnic groups), teachers, and representatives of NGOs, CBOs and TSIs. These stakeholders were engaged at two stages. First, district-level consultative workshops were organized in each case-study district in order to validate the selection of case studies and to solicit input on research questions, methods and tools. With the input received from local stakeholders, as well as from professionals, the research questions, tools and methods revised. The purpose of the consultation was to validate the long and short listing and selection of case study themes and examples.

1.7.4. Final selection of case study themes, examples and districts

33

In the second stage, the community representatives selected in the first stage were consulted about the current status of the case studies, the types of ILPs used, and specific examples being used for climate change adaptation options and strategies by the local communities. During this second round of interaction, particular attention was paid as to how such ILKP meets the adaptation objectives of the concerned communities.

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[1] The TA-suggested eight case study districts: Mugu, Achham, Kailali, Banke, Myagdi, Kathmandu, Sunsari and Panchthar.

1.8 SELECTION OF CASE-STUDY DISTRICTS AND CASE EXAMPLES

34 The terms of the reference of the study (Annex 1) stipulated that the study districts were to be selected to provide an appropriate profile of adaptation practices by the country's indigenous population and marginalized groups. To meet this stipulation, the study team followed a logical process to select themes, districts, and case studies which would cover Nepal's three ecological zones and five development regions. For this purpose, the study team selected 18 districts of Nepal including some of the eight districts selected by the MCCRMDP. Additional districts were selected to include the maximum number of ethnic and caste groups representing different ecological and development regions of Nepal. The selection of the districts was also based on the availability of suitable case study examples. It also considered the information gathered from the assessment of literature on ILKP in Nepal. This helped us to narrow down to prepare an inventory of tentative list of adaptive indigenous practices relevant for CCA in Nepal.

35 This list was evaluated in three ways. First, the climate change-related implications for each sector were analysed. Second, the views of sector-specific stakeholders, including professionals, representatives of concerned ministries and departments, academicians, and development practitioners were considered. Finally, at least four to five case study examples were insured to be available for each case study themes. This led to the identification of 31 case examples spread across Nepal's three ecological and five development regions that were selected. The aim was to maintain a proper balance between different social, ethnic, ecological and physical factors and systems - a balance that was important to meet the objectives of the study (Figure 4).

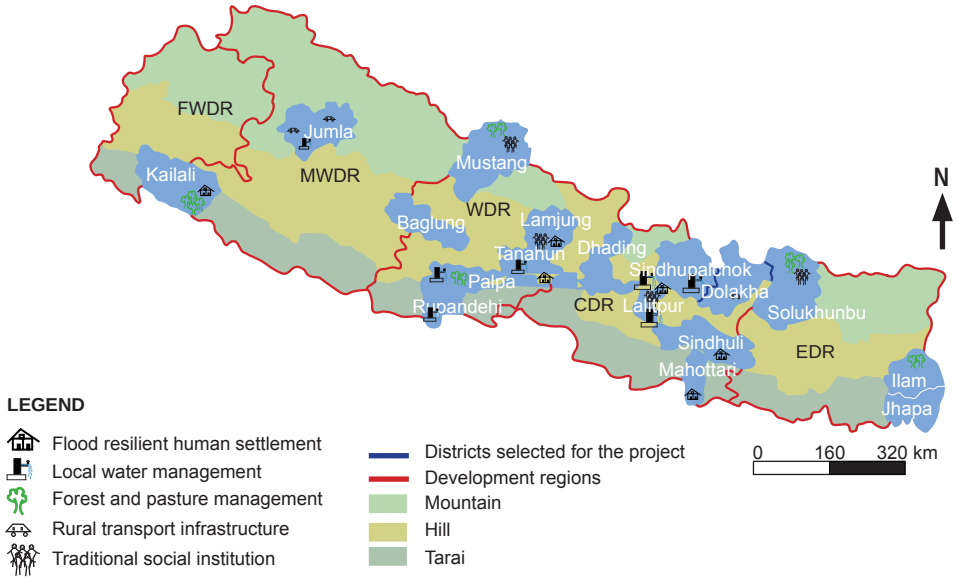
36 The study team identifies ILKPs with clear links to local adaptation and development efforts to make community level infrastructure and institutions more resilient. The team collaborated with 18 DDCs of the districts in which the case studies fell and invited their representatives to be involved in research activities. Some case studies were selected based on the researchers' own knowledge of and communications with key informants, a strategy complementing findings from the literature and input from the stakeholders; workshop. National- and district-level workshops were organized to validate the selection of the districts and case studies.

1.9. RESEARCH STEPS

37 The steps the researches took in carrying out the 31 case studies are summarized below (Univ. of Melbourne, 2010).

STEP 1: Establish broad case to investigate;
STEP 2: Establish research questions;
STEP 3: Select tentative case(s) to be studied;
STEP 4: Determine case-study research design and data-gathering and analysis techniques;

Figure 4: Districts, case study sites and examples



STEP 5: Prepare for fieldwork and collect data;
STEP 6: Collect information using the tools planned but remain flexible enough those other suitable tools can also be used;
STEP 7: Compile, tabulate and analyze the data and information using both qualitative and quantitative techniques; and
STEP 8: Prepare and share a report

One of the many methodological tools and triangulation techniques the team used was shared learning dialogue (SLD). At both national- and district-level consultations, SLD enabled the team to interact with multiple stakeholders to share sector- and group-specific knowledge and experience. We initiated two-way communication between local practitioners and external experts to generate new understandings that would help improve the quality and effectiveness of decision-making at local and national level (ISET, 2010). The tools used in the study are listed in Table 2. The study team pre-tested the methods and tools in Makawanpur District to ensure that they were both accurate efficient and made necessary revisions.

38

1.10 LITERATURE REVIEW ON THE FIVE CASE STUDY THEMES

39

The review of available literature in the areas of ILKP was carried out first by identifying literature including grey literature in Nepal followed by the region and the globe. The method followed was systematic mixed-methods literature review developed and employed by Ford et al., (2011) and recently used by Parkas (2013). The main objective of the literature review was to identify ILKP that were used to respond to climate change effects in the case study sectors identified for this study. The other aim was to find out the methods used, research gaps identified, and

Table 2: Summary of different research tools used in ILK documentation

Activities	Tools	Participants/Purpose
District Consultation	Audio visuals, presentation, interaction	DDC officials and line agencies, local leaders, decision makers and university teachers discussed on district level issues of climate change, adaptation and ILKP
Focus Group Discussion (FGD)	Checklists, recorder and maps	VDC secretaries, user group officials, women's groups, saving and credits groups, teachers, lead farmers, ethnic communities discussed on case examples in context of CC and ILKP
Key Informant Interview (KII)	Checklists, semi-structured questions, photographs audio video	ILK holders, skilled persons, local leaders (ethnic and marginal communities – men and women), tradesmen/women, community infrastructure maintenance workers, local traditional leaders, elderly persons interviewed for detail information on case example or other related issues
Household Interview (HHI)	Closed and open-ended questionnaires, photographs audio video, observation	Socio-economic, ethno-cultural, livelihoods, ILKP, community infrastructure, CC perceptions, adaptation practices, gender and sector specific questions administered in about 10 households in each case example area
Participant/Case observation (PO/CO)	Maps, GPS, recorder and video	Observed community participation and social dynamics while taking transect walk of case example. Informal conversation and narratives of local people used.

conclusion reached regarding the effectiveness and scale of the identified practices. The researchers looked for most recent and updated state of knowledge on the indigenous or traditional science that was being applied to reduce climate change induced vulnerability, risks, and enhances resilience of local people and traditional institutions.

40 The review was primarily guided by the research questions set for each case study themes and key words preselected by the research team to give priority to ILKP that existed in Nepal and other developing countries. The review included various published and unpublished sources on ILKP and climate change, books and manuscripts in local languages as well as English, research papers and other written materials. Also referred were oral history, ethnographic reports, observation of rituals, events, and conversation with the ILK holders and practitioners.

41 The literature review was critical to assess both the state of knowledge in the areas of indigenous, traditional, and local knowledge and practices but also to identify the research gaps and issues. This helped the researchers to aim for incremental knowledge and climate change adaptation relevant practices. The team reviewed the literature keeping in mind ILKP and the climate change challenges that the five identified thematic sectors were likely to face. The aim of the review was to assess the state of knowledge, research gaps, and opportunities related to sector-based issues.

Though ILK is on the international agenda (World Bank, 1998), substantial challenges to its use remain, and this gap needs to be better understood. The review was guided by three objectives besides fulfilling the larger goals of the research: a) to encourage the GoN to formulate and implement strategies for integrating ILK; b) to enhance the capacity of national and regional ILK networks; c) to promote the use of ILK by local communities and agencies. A synopsis of the literature review pertinent to the five sectors follows.

1.10.1. Local water management

The traditional knowledge base regarding, skills in and capacity for managing water for different uses have a long history among the communities of Nepal. Two specific sectors in which ILK have evolved are irrigation and drinking water systems. With roots in cultural and religious domains such practices have helped communities benefit from the traditional systems and in some cases, also minimise impacts of water-induced hazards. Farmers in Nepal have built traditional irrigation systems established and arrangements for allocating water (Shivakoti and Shrestha, 2004) and the institutions created have undergone changes adjusting to the social, economical and other stresses. One typical institutional example is a devise cut from tree trunk called sancho installed in an irrigation canal for distributing water to smaller canal that serve farming plots. Farmers also used bushes, wood, mud and stones as sancho. In recent times, cement concrete sancho have replaced the local types while rules of water allcoation remain.

The institutional arrangement of irrigation system management are maintained though the social context has has undergone changes. The Panchakanya Irrigation System in Chitwan District and Sorah-Chhatis Mauja Irrigation System in Rupandehi District reflect such elements. Indigenous Tharu communities originally built both systems about 200 years ago.These systems followed specifc arrangement to maintain headworks and upper canals *(Sidhabandi)* and management responbilities was entrusted totraditional community leader *(Badhghar)*. At present command areas served by both systems and the committees that manage the systems has mixed ethnic/caste composition thus some of indigenious practices are discontinued while other are still followed as major practices (Ojha et al., 2008). In the process the knowledge system embodied within the traditional systems have been internalized in formal system (Sharma, 2004) in developing new irrigation systems or in improving performance of system already built by government agencies (Dixit, 2000).

The promotion of local and indigenous water management knowledge, technologies and practices offers scopes of using them in strategies aimed at responding to climate change impacts, particularly in making irrigation systems resilient to support local livelihoods and food security in the face of increased climate change stress. The other local water management examples are *Dhunge dharas* and *Paani Pandheros* that tap natural springs (Joshi, 2008) for meeting drinking needs. *Dhunge-dharas* (stone spouts) some of which date back *Licchavi* era (500 CE) met drinking water needs of resident of Kathmandu, Patan and Bhaktapur though with increasing urbanization and changing village life, particularly with the introduction of piped tap water supply systems, the traditional types have lost significance. Many stone spouts

in Kathmandu Valley have become dysfunctional due to the pressure of haphazard urbanization. Yet the architecture and function of stone spouts do carry knowledge that can be drawn to devise operation and maintenance of drinking water supply systems (Tiwari, 2014).

1.10.2. Forest and pasture management

46 Climate change is expected to increase the rate of degradation of forest and pasture land and lead to losses of biodiversity as well as of ecosystems and the services they produce. Increasing temperatures and changing moisture regimes threaten the availability of both the resource stocks and ecosystem services that support the livelihoods of poor and indigenous communities. Climate change also puts the agriculture sector at great risks due to the consequent decrease in nutrient cycling (Karki et al., 2011; Tiwari et al., 2012). When communities apply ILKP, they manage their resources in a socially and culturally sound manner to the extent that management of these resources is in their control.

47 Indeed, ILKP promotes living in harmony with nature and encourages the protection of natural resources (Sherpa et al., 2013). Nepal has a set of community-based forest management practices (Gill, 1993), (including community, collaborative, and leasehold forestry (Carter et al., 2011)) that is based on ILKP as well as more recent scientific and development research. As such community-based forestry opens space for collaboration among ILK holders, development practitioners and scientists to improve our understanding of the impact of climate change on ecosystem goods and services. This collaboration creates conditions that could lead to the adoption of better adaptive strategies in Nepal (GoN, 2014). ILK should be documented, further researched and tested scientifically (Roy et al. 2004) for its ability to provide benefits to society.

1.10.3. Rural transport infrastructure

48 Villagers use ILKP to construct and maintain rural trail bridges and trekking routes in Nepal (Joshi & Chitrakar, 1989). Traditional knowledge and skills have also been used to construct goreto and *ghoreto* (trails for people and animals respectively) in rural areas and to maintain slope stability through a calculated width and height of steps. Traditionally built trail bridges and *tuin* (a sort of ropeway over deep, fast-flowing rivers), despite the risk they pose, are exemplary evidence of how indigenous technology evolved to enable people to cross rivers. The challenge for the rural transport development managers at the community level is to find ways to integrate ILKP with scientific knowledge to deal with climate change challenges. The issues each system of knowledge raises are so interwoven and interdependent that it is difficult to find a solution working in isolation or using just one knowledge system.

1.10.3. Settlements and housing

49 As a rule, the number of ILKPs found in the settlement and housing sector is great (Dhaka, 2012; van Wyk, 2013) and Nepal is no exception. Nepali villagers grow shrubs and grasses in and around their hill settlements to shore up the soil and protect their homes and community properties from the flash floods and landslides heavy rainfall often triggers. They rarely plant large trees close to their homes for fear of their falling and damaging homes (ISDR/KU/EU, 2008; Helvetas, 2011). In

the Chure region farmers plant amriso (bouquet grass) and babiyo *(Eulaliopis sp.)*, species with strong soil-stabilizing properties, to protect settlements from landslides.

Local communities plant bamboo, a species whose spreading root system helps conserve soils in gullies and shady areas to regulate runoff (Paudel and Das, 2002). Communities also build drywall and biological fences to minimize the effects of floods, landslides, erosion, side-cutting, and slope failure and thereby protect settlements. This knowledge base and these practices can build the capacity of communities to withstand new stresses and adapt to the disaster impacts (Kayastha and Shrestha, 2005) that climate change may exacerbate. Such approaches will be useful in making human settlements throughout Nepal more resilient to climate change. Because the majority of indigenous and poor communities exposed to such hazards do not possess the capacity to increase their resilience (ICLEI-Africa, 2013), it is imperative that such capacity be built if adaptation strategies are to be effective.

1.10.5. Traditional social institutions

Communities transfer ILK to the new generation using practical demonstrations and oral traditions. Such transfers are stronger in homogenous communities than heterogeneous ones as the former are characterised by more cohesion, solidarity and good governance (Agrawal, 2008). Traditional systems of sharing and transmitting knowledge are different from modern scientific approaches (Warren et al., 1995). The transfer of traditional knowledge is mediated through institutions based on membership, gender, and possession of capacity and knowledge (Turner, 2014). ILK, especially about drinking water, flood disaster, natural resource management, and rural transport, highlights a number of gender-based vulnerabilities. Gender relation is crosscutting issue of general importance that influences processes of CCA through their impact on productive uses of assets, rural economic development and livelihood diversification. TSIs should assume responsibility for forecasting and early warning as well as relief and rehabilitation efforts that address gender inequity during the preparation for and rebuilding after a disaster (Ngenwi et al., 2011).

CASE STUDY II

UNDERSTANDING INDIGENOUS AND LOCAL PRACTICES IN WATER MANAGEMENT FOR CLIMATE CHANGE ADAPTATION IN NEPAL

CONTENT

ABSTRACT

1

People in Nepal have used indigenous and local knowledge (ILK) in developing different types of local water management systems and practices that are considered adaptive and tailored to the local situation. Studies have found that these systems are community-developed, community-owned, collectively managed, and improved upon through continuous generation of knowledge and innovative practices. Although, climate changes is already posing challenges to local peoples' adaptive capacities and practices, a number of farmer-managed irrigation and local drinking water systems are adapting better than capital and technology intensive government-built systems. Documenting these local practices is important to promote and protect valuable knowledge and practices for ensuring water, food, and energy security of the local people in the face of growing climate change impacts which are projected to escalate in the future. This case study documents different local water management practices prevailing in Nepal in the context of growing vulnerability to climate change impacts.

2

Data, information, and knowledge generated through multi-stakeholder consultations, focus group discussions, key informant interviews, case observations and household interviews were analyzed to examine the current status, impacts of climate change, adaptation strategies, issues and challenges. The main question the case study answers is how these indigenous and local knowledge and practices (ILKP) evolve, undergo innovations, gain adaptive characteristics and get transferred to succeeding generations. A deeper understanding of indigenous irrigation and drinking water systems can help to reinforce the resiliency of these systems to future climate and socio-economic changes. It can also assist in transferring knowledge of these practices for integration into modern systems. The study results fill in the knowledge gap that exists in Nepal by documenting, reflecting and recommending the use of successful indigenous, traditional and local skills and practices in water management.

3

Among the findings, indigenously developed and managed practices of water management in seven districts of Nepal indicate that farmers managed irrigation systems (FMIS), community managed drinking water schemes, and traditional water mills are constantly monitoring the changes in local climate, adjusting their practices accordingly, and meeting the changing needs of local water users. A number of case examples show that the local water managers are successfully integrating their knowledge with scientific knowledge to improve climate change adaptation. The findings show that ILKP are transferred from one generation to the next through learning-by-doing culture of the local water users. Culturally ingrained skills and knowledge have helped people to adapt to change based on different drivers. While some communities are adapting to the changes in traditional ways, others are already opting for a more synergistic system wherein both indigenous and scientific practices are integrated. The casy studies feature irrigation systems that are technically and institutionally adaptive to local climate, topography and hydrology. Similarly, the case studies document community managed drinking water systems that exhibit distribution and management arrangements that have adapted to the stress across both time and space. The cases also show that certain systems, which were not adaptive to the changes, and so are dysfunctional today.

4 These otherwise adaptive and resilient systems are facing a number of constraints. Increasing extreme events of landslides, floods and droughts, exacerbated by climate change, are directly impacting irrigation canals, water distribution lines, and water mills. Higher siltation, source depletion, water leakage, decreasing groundwater recharge, deforestation, and sand mining are additional challenges. It is clear that climate change will pose significant threat to the locally successful water management systems and institutions featured in this research. While planning adaptation and water management initiatives and systems, concerned agencies and development partners should build on the knowledge and experiences of Nepal's indigenous and local communities who have been effectively and efficiently managing water for centuries.

2.1. INTRODUCTION

5 Historically, people from the rural hills and Tarai plains of Nepal have adapted to seasonal weather patterns that result in too much or too little water at certain points in the year. In that regard, they have used local and indigenous knowledge and skills. Some of the traditional and cultural practices demonstrate a long history of water resource management. Many of the irrigation systems built prior to 1950 are still working at local level with minimum or no intervention from the outside stakeholders (Poudel & Sharma, 2012). These systems highlight the significance of locally evolved institutions in resource management (Ostrom, 1990) with traits of shared relationships, norms, knowledge and understanding as key factors that help govern and manage common-pool resources (CPR). These factors, indeed, sustain productivity of natural and social capital in the long run (Ostrom, 1994). Further, Ostrom (1994) has argued that common property institutions are not the artefact of the past but knowledge resource base that should be part of the future policy making for governance and management of CPR (Ostrom, 2000; Ostrom, 1994). Common property institutions that manage water in the country embody knowledge and skills that have been continuously tested and tried over the years to adapt to changing contexts.

Study rationale and current status:

6 Given the geographical and ethnic diversities, Nepal has rich local indigenous knowledge and skills (Sharma et al., 2009). For example, historical water management systems have been designed, planned, developed and maintained throughout the country with local ownership. The system uses indigenous knowledge that is passed down through succeeding generations. Today, many of the farmer-managed irrigation systems and Raj Kulos (royal canals) stand as examples of this knowledge pool. One such system, for example, the Argali irrigation system demonstrates sophisticated design including tunneling through rocky terrains, intricate canal for water distribution, and pani sanchoes (wooden weirs) to allocate water equitably. Simultaneously, local farmers maintain common property institutions such as Kulara (collective canal maintenance) developed over the generations to maintain the system and obtain benefits. Such knowledge pool handed over generations is extensive in terms of social and technical skills it holds, though the pool itself is minimally explored, poorly archived and underutilised as far as adaptation strategies are concerned. This pool of knowledge can provide a sound

basis to design and implement climate change adaptation initiatives in water resource management at local level.

Local water management system involving irrigation, drinking water and water mills in Nepal exhibit many practices of indigenous and local knowledge. Some of the CPR management practices have been sustained for generations adapting to changes, while others have failed to do so. This study takes a few cases of irrigation, drinking water and water mill systems to understand the impacts of climate change on them and explore, analyse and link traditional, local and indigenous knowledge systems to the uncertainty that climate change entails. In doing so, the study aims to contribute to more effective policies for building adaptive capacity and resilience of local communities.

2.2 CASE STUDY OBJECTIVES AND RESEARCH QUESTIONS

The study aims to increase the understanding of the roles indigenous and local knowledge and practices (ILKP) play in local water management in context of climate change adaptation and to contribute in developing climate friendly plans and programs. The specific objectives of the study are:

- to understand the impacts of climate change in local water management system and their vulnerabilities
- to identify and document the role ILKP have played to adapt local water management over generations
- to identify and analyse how such ILKP can contribute in climate change adaptation efforts to build climate resilient water systems.

Research questions:
The study sought to answer some of the following research questions:

- What are the indigenous and local knowledge and practices in local water management system?
- What are the key challenges/gaps to sustain ILKP in local water management practices?
- What are deemed to be good examples of best practices in local water management and which may have practical application today?
- How can ILKP support local communities in climate adaptation and help build resilient water systems?
- How ILK from good practices can be integrated in climate change adaptation policies and programs reflecting community, gender and social inclusion issues?

Methodology:
The study adopted a broad social science research approach using case study and participant observations, focus group discussions (FGDs), key informant interviews (KIIs), household interviews, district level consultations, and literature review as key methodologies. Detailed observation of irrigation canals, water source, drinking

water system and water mills were carried out through transects walk along canals and existing water systems. FGDs with water user groups were conducted to take stock of ILKP used in water systems to understand the perceptions and impacts of climate change and identify adaptation practices. Likewise, key informants of irrigation, drinking water systems and water mills were interviewed to understand the current status of management of the water systems and resources. The data generated from the fieldwork, literature review, and insights are synthesized and presented below. The process documentation, the research design and methodology are described in the earlier chapter.

2.3 CASE BACKGROUND

10 Irrigated agriculture in Nepal is known for its strong tradition of farmer managed irrigation system (FMIS) both in the hills and Tarai plains. Many of these systems are technically and institutionally adaptive to local climate, topography, and hydrology (Lam 1996; Martin & Yoder 1987; Pradhan et al. 2000; Shivakoti & Ostrom 2002; Parajuli 2013; Pradhan, P. 1989; Pradhan, U. 1988; Yoder & Upadhyaya, 1987; Yoder et al. 1987 cited in Roth & Vincent, 2013). Farmer managed irrigation system (FMIS) evolved over time mainly through local initiatives to meet local needs. The context of landscape and condition of water flow has shaped the system design including choice of technology. Similarly, locals' understanding of extant societal context and agro-ecological conditions has made such irrigation systems simple, flexible and sustainable (Parajuli, 2013). The Nepal Irrigation Institutions and Systems (NIIS) database suggests that there were 33 irrigation systems including Raj kulo of Argali in operation before 1800 AD (Poudel & Sharma, 2012). Traditional irrigation systems have created a rich base of knowledge over time on technology, institutions and organizational structure that suit the changes brought about by different drivers including climate change. In the process, the knowledge has helped in functioning of irrigation systems and management of local water resources.

11 The construction of traditional drinking water system such as hitis or dhunge-dhara (stone spouts) in Kathmandu Valley dates back to Licchavi period (500-800 AD) and some of them exists even today. These systems-hitis and the Raj kulos were further developed in the Malla era (1420–1768 AD) (Becker-Ritterspach, 1995; Joshi, 2008). These dhunge dharas of Kathmandu valley consist of intricate underground network of conduits and water supply system. This represents the affluent urban culture grown over time supported by fertile farmlands (Tiwari, 2002). However, outside the valley, drinking water scenario was different. There were no such examples of drinking water systems in the hills besides tapping of spring sources and locally built stone taps. These sources of water for domestic use varied from kuwa (surface well) and inar (dug well) for drinking water, nadi (river), khola (stream) and kunda (pond) for religious water need and pokhari (pond), khahare (seasonal stream) and kulo (canal) for other household water purpose (Sharma, 2004). While construction of irrigation canals expanded over time due to its direct implication on revenue generation for the state, building drinking water systems was limited to meet community's needs.

This case study elaborates on the local water management systems, mainly farmer managed irrigation system (FMIS), and community based drinking water systems in seven districts of Nepal representing different geographic and socio-cultural settings (Table 1). In Jumla, Palpa, Rupandehi and Bhaktapur districts, the case studies were focussed on local irrigation systems; while in Tanahu and Lalitpur districts, drinking water systems were studied. Similarly, in Sindhupalchowk district, issues and opportunities related to water mills were examined. The FMIS studied varied from small-scale system in Jumla district managed by the community to large-scale systems that serve 20,000 households in Rupandehi district. The four studies on irrigation include: (i) Sorah-Chhattis irrigation system in Rupandehi district, (ii) Argali irrigation system in Palpa, (iii) Giri Khola irrigation system in Jumla and (iv) Raj Kulo irrigation in Bhaktapur. Similarly, under community managed drinking water systems, stone spouts in Patan of Lalitpur district, Godavari community water supply system in peri-urban Lalitpur, and Bandipur community water systems in Tanahu district were studied. Information on traditional water mills in Sindhupalchok district was gathered through observation and interviews (Figure 1).

Table 1: The selected cases, districts, and purpose of selection

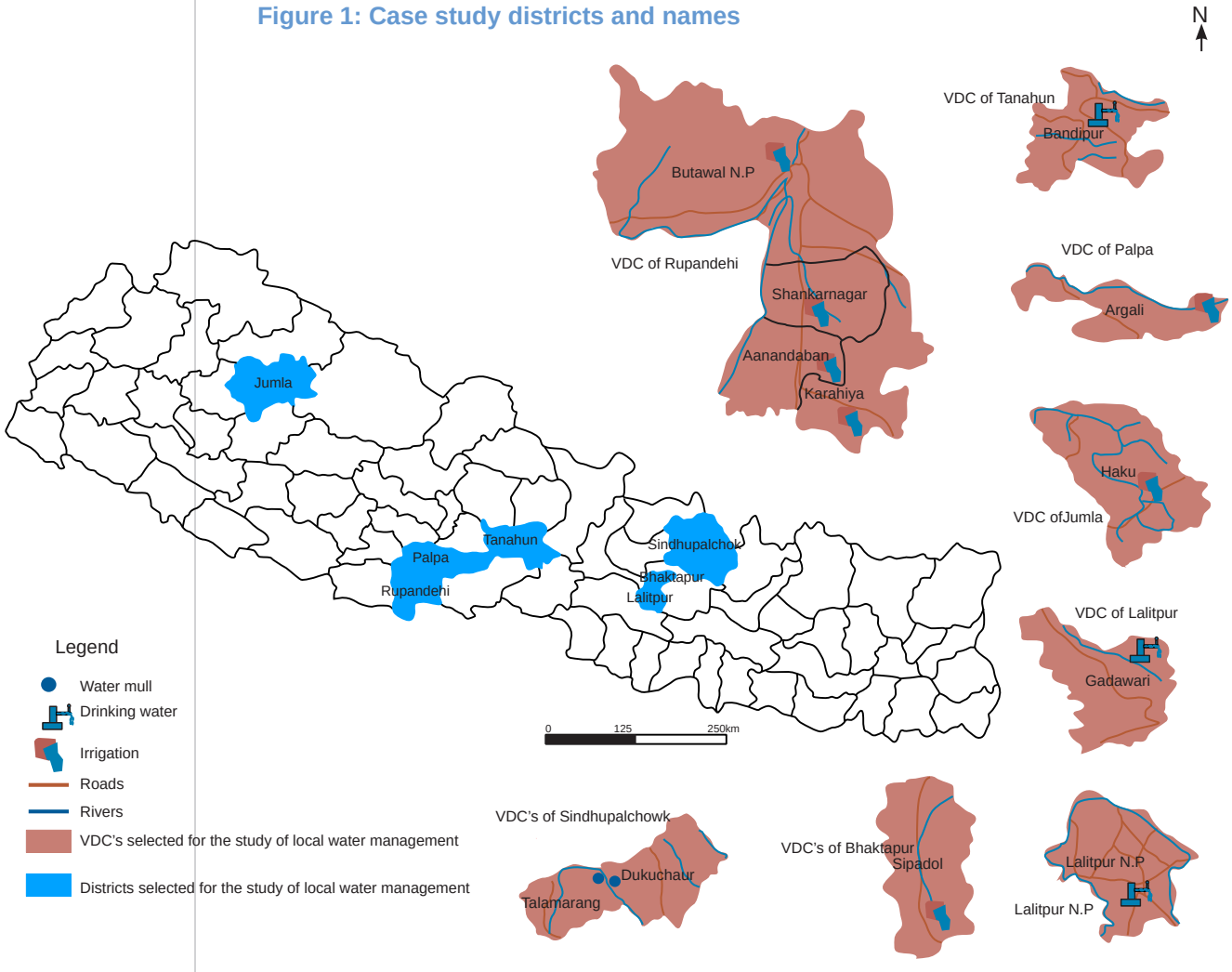
Cases	District/Region	Purpose of selection
Sorah-Chhattis (16-36) Mauja irrigation system	Rupandehi district/ Western Development region	Constructed by indigenous Tharu community 170 years ago, systematic irrigation management, large command area (3500 ha), indigenous and local knowledge and practices with strong local ownership
Argali irrigation	Palpa district/ Western Development Region	Constructed nearly 500 years ago, exemplary locally managed irrigation system, ILKP transferred through generations, local ownership
Giri Khola irrigation	Jumla district/ Mid-Western Development Region	Community initiated irrigation system along bank of river, in high elevation, managed and maintained by local community, small command area, local and indigenous knowledge used, long history, DDC workshop feedback
Raj Kulo irrigation	Bhaktapur district/ Central Development region	Constructed nearly 400 years ago during Malla kings' rule, multipurpose irrigation system with design to help ground water recharge, indigenous technical design
Stone spouts of Patan	Lalitpur district/ Central Development Region	Constructed in 500-800AD, intricate underground network of conduits and water supply, indigenous skills used for recharging local aquifers
Community managed Godavari drinking water	Lalitpur district/ Central Development Region	Community started initiative to manage local water supply, rural urban comparison in Lalitpur district
Bandipur drinking water management	Tanahun district/ Western Development Region	Ancient civilization with well established water supply system, nature of water demand change with expansion in trade/business in the past and tourism in the recent time, local adaptation effort
Traditional water mills	Sindhupalchowk district, Central Development Region	Water mills very common in VDCs, water mills owners association in the district, Melamchi project water diversion impact local water mills

13

2.3.1 District case scenarios and climate information

Rupandehi: This district lies in Tarai within sub-tropical to tropical climatic region with hot summers and cold winters. The recorded data for 30 years show decreasing trend of mean annual rainfall (not statistically significant), while temperature depicts pronounced increasing trend. Mahendra Highway and Siddhartha Highway, Nepal's two major highways, pass through the district and most of the villages are connected by motorable roads. The district is famous for Chhattis Mauja irrigation system (CMIS) constructed by indigenous Tharu community. Most of the Tarai section of the district has high potential for groundwater irrigation. Bhairahawa Lumbini Ground Water Irrigation Project (BLGIP), developed few years ago, irrigates sections of the

Figure 1: Case study districts and names



command areas served by CMIS. Other irrigation systems are Siyari irrigation, which irrigates land from water conserved through rainwater; and Gajedi irrigation system, where a lake supplies water. Marchawar irrigation system in the south of the district pumps out underground water using six pumps from Danav River (Table 2 & 3).

Palpa: The district lies within the tropical to sub-tropical climatic regions. Usually, summers are hot with warm temperature in the valleys. The mean annual rainfall does not show any significant change, however, temperature shows distinct warming trend (Table 2 & 3). The Argali irrigation system was constructed around 17th century by the first Sen king of Palpa district. In 1925, locals built canals to tap water from a local stream and initiated Cherlung irrigation system.

Jumla: The district lies in temperate to Trans-himalayan region of Nepal and is one of the highest rice-growing areas of the world, where 'red'-rice, a unique variety, is grown. The two villages where this variety is grown are Haatsinja (3,000 masl) and Chhumchour (3,000 masl). Jumli Marshi, a Japonica variety of indigenous rice which has a cold tolerant gene, is probably being cultivated on the bank of the Tila River since 700 AD. The 30 year DHM data of rainfall shows that mean annual rainfall of the district is decreasing and the mean temperature is increasing, both of which are statistically significant. In the western part of the district lies Sinja Valley where the Khas Nepali language evolved. Bandiraj Kulo of Kanka Sundari and Jachali Kulo of Birat in Haatsinja are two other large irrigation systems in the district (Table 2 & 3).

Bhaktapur: Bhaktapur district lies in a sub-tropical to temperate climatic region. The mean annual rainfall does not show any significant change, however temperature records for 30 years show an increasing trend (statistically significant) (Table 2). The indigenous Newar community lives in this district. Agriculture is the mainstay of the economy of the community. The district still has functioning Raj kulos which are Bidol, Sudar, Taleju Bhawani, Bageswori and Katunje (Khaniya, 2005) (Table 2 & 3).

Tanahu: The district experiences tropical to sub-tropical climate. The rainfall and temperature trend analysis of the last 30 years suggests an increasing mean annual rainfall, which, however, is not statistically significant. The mean annual temperature is also increasing and it is statistically significant. The drinking water systems in Bandipur are Jaal Devi, Haree Danda and Taam Khola (Table 2 & 3).

Lalitpur: Lalitpur District has tropical, sub-tropical and temperate climate. The mean annual rainfall does not show any significant change. The changes in mean annual temperature records for 30 years show increasing trend (statistically significant). Patan, which is the main city of this district, has many stone waterspouts (Table 2 & 3). According to a UN-Habitat report 2008, 400 traditional stone spouts were recorded in Kathmandu Valley, out of which 58 stone spouts were in Patan and its periphery. Of these 58 spouts, four are dry while seven do not function anymore.

Sindhupalchowk: The climate of Sindhupalchok district ranges from tropical to temperate. The mean annual rainfall for 30 years in the district shows increasing trend and is statistically significant (Table 2 & 3). Temperature data availability, however, is incomplete and analysis was not feasible. Traditional water mills or Paani Ghatta are common in the district. These mills have been is use in Nepal for a long time. Though historical data doesn't show how long they have been in use, according to an oral history, this technology came to Nepal from Tibet about 300 years ago during Malla era. These water mills are used for grinding cereal grains (maize, millet, wheat, rice, etc) and can grind 10-20 kg per hour.

(Annex I details socio-economic information on all case districts).

Table 2: District information

District	Ecological Zone/ Region	Area (km^2)	Population	Cultivated Land (Ha)	Drinking Water (%)	Sanitation coverage (%)
Jumla	Mid-West Mountain	2,531	108,921	25,231	87.95	37.21
Palpa	Western Mid-hill	1,373	269,372	47,380	82.2	52.68
Tanahu	Western Mid-hill	1,546	330,581	48,223	82.44	56.63
Rupandehi	Western Tarai	1,360	880,196	82,893	91.81	48.74
Sindhupalchowk	Central Mountain	981	2,89,455	59,151	80.93	33.85
Bhaktapur	Central Mid-hill	119	304,651	8,612	91.66	87.12,
Lalitpur	Central Mid-hill	385	468,132	14,437	89.33	83.69

Source: CBS, 2011

Table 3: District climate and vulnerability information

Districts	Climatic regions	Temperature mean max - min (^{0}C)	Annual precipitation (mm)	NAPA combined vulnerability index	Mean annual rainfall trend (30 years)	Mean annual temperature trend (30 years)
Rupandehi	Tropical to subtropical	30.8 - 19.0	1935	0.000 (Very low)	Decreasing (not significant, p-value = 0.827)	Increasing (significant, P-value=0.000)
Palpa	Tropical to subtropical	27 – 15.1	1571	0.003 (Very low)	No significant changes (p-value = 0.891)	Increasing (significant, P-value=0.001)
Jumla	Temperate to Trans-himalayan	21.6 – 5.4	832	0.562 (Moderate)	Decreasing (significant, p-value = 0.005)	Increasing (significant, p-value = 0.001)
Bhaktapur	Subtropical to temperate	18.8 – 10.4	2000	0.886 (Very high)	No significant changes (p-value = 0.589)	Increasing (significant, p-value = 0.031)
Lalitpur	Subtropical to temperate	22.7 – 11.7	1933	0.193 (Low)	No significant changes (p-value = 0.340)	Increasing (not signification, p-value = 0.130)
Tanahu	Tropical to subtropical	29.7 - 17.7	2151	0.503 (Moderate)	Increasing trend (not significant, p-value = 0.452)	Increasing (significant, p-value = 0.045)
Sindhupalchowk	Sub-tropical to alpine	NA	NA	0.403 (Moderate)	Increasing (significant, p-value = 0.006)	NA

Source: DHM, NAPA, 2010, Climate data analysis, ISET-N

Types of participation: Different methodological tools were used in the study in which 323 participants from 7 districts participated in consultations, focus group discussions, and key informant interviews and household level information. About 20 per cent of the participants were female. The details are given in table 4.

General characteristics of case study households: Regarding irrigation and drinking water system case studies in six districts, a total of 59 household respondents were interviewed for collecting information related to indigenous and local knowledge and climate change. Among these respondents, 39 were male and 20 were female with a mean age of 51.12 years. About 50 per cent of the respondents were Chhettri/Brahmins on overall, while more Janajati respondents took part in Rupandehi, Bhaktapur and Lalitpur districts. Majority of the respondents (90%) were Hindus. The occupation of the households interviewed is agriculture (61%) followed by services (14%) and business/trade (13%). About 40 per cent households have food sufficiency of three to six months with their own cultivation, but this characteristic varies by district. 36 per cent of the respondents were literate but had no formal education, while 20 per cent had completed secondary school education (Figure 2, 3, 4 & 5). Annex II details SPSS data tabulations.

Table 4: Types of participation

Sector: Local water management					
Total number of participants (District level workshops, FGD and KIIs): 323					
Category type	Percent (%)				Total per cent
Gender	Male 77.4		Female 22.6		100
Caste/Ethnicity	Brahmin/Chhetri 59.8	Janajati 35	Dalit 4.6	Muslim 0.6	100
Methodology/Tools	District workshop 37.8	FGD 34.1	KII 9.9	HHI 18.3	100

2.4 CASE EXAMPLES FINDINGS

2.4.1 Case example: Sorah-Chhattis (16-36) Mauja irrigation system of Tarai plain

Evolution and socio-economic context: Sorah-Chhattis Mauja irrigation system was built with land grants provided more than 170 years ago during the time of the Prime Minister Jung Bahadur Rana (1846-63). Indigenous Tharu people of Tarai originally constructed the irrigation system by diverting Tinau River to serve Chhattis Maujas (land grant areas or farm villages of command area). There is no official record of when the water of the Tinau River was diverted for irrigation but locals refer to the practice that stem back to Lord Buddha's time (around 400 BC). At that time, Kapailvastu (where Buddha was born) was a prosperous area with large settlements that must have created a demand of irrigation system for agriculture. During the Rana period

Figure 2: Cast/ethnicity of respondents

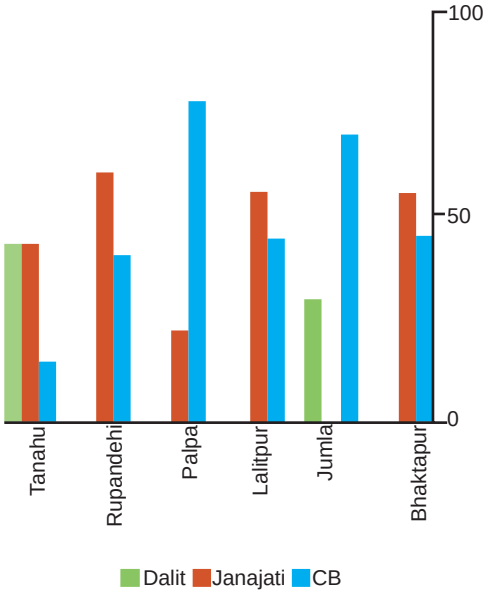


Figure 3: Education level of the respondents

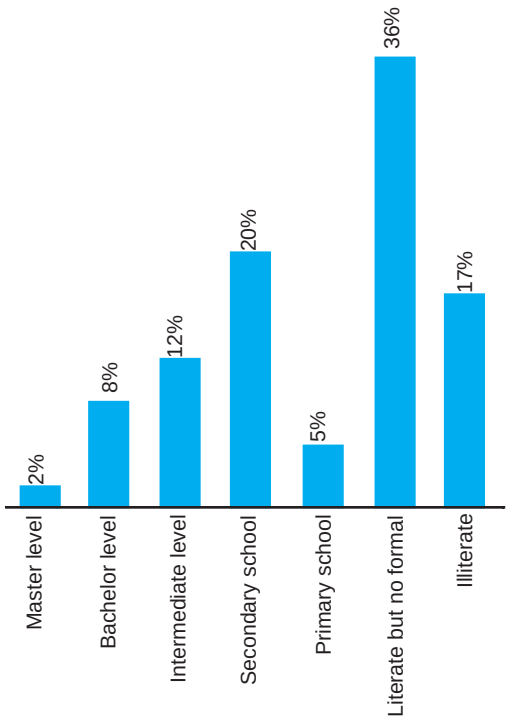


Figure 4: Major occupation of HHs

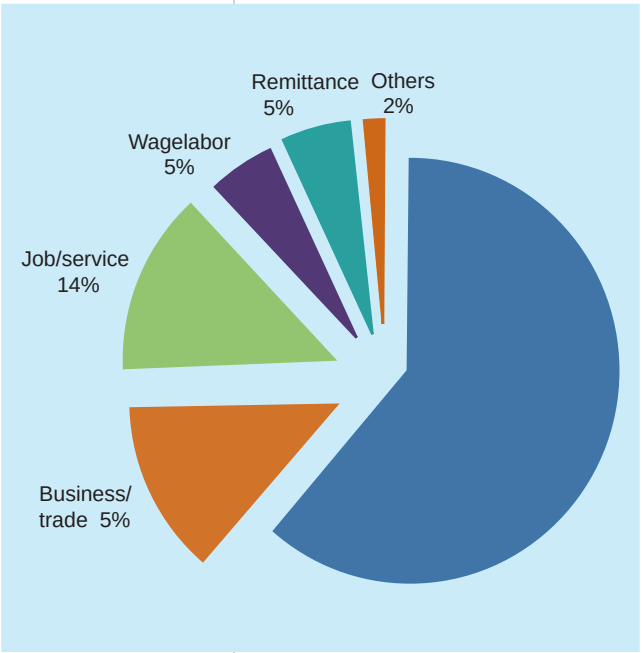
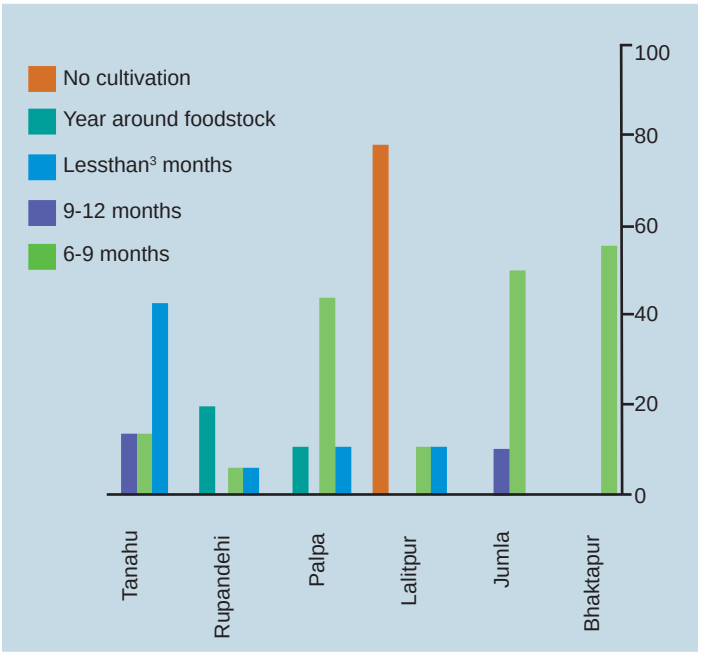


Figure 5: HH food sufficiency from own cultivation



(1846-1951AD), the management system evolved and became more systematic after 1959-61 AD. From the 1940s, migration and encroachment of land began to increase as new settlers acquired water through one time payment to Tharu leaders so that outlet was opened to their settlements. In the past 100 years, people migrating from the surrounding hill areas began to exercise influence over the management and by 1958, they completely took over and managed the irrigation system (Zwatreveen, 2006).

23

With rapid influx of hill people, mainly upper caste groups – Brahmins and Chhetri in the command area after malaria eradication (1950), the command area expanded horizontally creating two irrigation systems since 1960-1970 to Sorah Mauja (16 farm villages) and Chhattis Mauja (36 farm villages). The irrigation systems get water from the Tinau River upstream of Butwal and irrigates about 59 farm villages and 2500 households. Earlier, it was named as 16-36 *Mauja*[1] as it used to irrigate 16 and 36 *Mauja*[1], now the irrigation system has expanded to 34 *Mauja* and 59 *Mauja* respectively. The average irrigated land holding size is 1.0 ha in the head reach and 1.6 ha around tail end reaches. The system irrigates 3,500 ha of land in Shankarnagar, Anandaban and Karahiya VDCs, and wards 10, 11, 12 and 13 of Butwal municipality in Rupandehi.

Major features of the Sorah-Chhattis Mauja:

24

The main canal of the irrigation system is diverted at Kanyadhunga and again at a place called Itabondh. At Tara Prasad Bondh water is divided into canals. Here a permanent proprotioning divider allocates 60 per cent of water to Chhattis Mauja and 40 per cent to Sorah Mauja. Chhattis Mauja canal is 14 km from the diversion intake of Tinau River to tail end of the command areas. The intake area has weak geology and is affected by a large boulder where a side intake has been constructed for channelling water to the main canal (FGD, 2013).

25

While Chhattis Mauja irrigates the western section of the command area, Sorah Mauja irrigates the area east of the main road (Pokhara-Sunauli Highway). This system is demand driven, popular among users group, and is operated and maintained by a user committee. A joint committee comprising of 11 members, six from Chhattis Mauja and five from Sorah Mauja functions to coordinate among users, regularise operation and maintenance, and mobilise labor and other resources. Election is held once every two years for the committee. The management board have 16 (in Chhattis) and 11(in Sorah) members respectively and the general assembly has 576 members. The users committee has maintained the intake and lining of the canal. The crossovers are also well maintained and the credit goes to both management committees and the farmers. One reason for its success is that the rules enacted by the committee are strictly implemented.

26

Climate change perception and impacts: Locals of Sorah-Chhattis Mauja command area shared their experience regarding change in climate. Some of the major changes they noted are extreme heat in summer and colder winter, increased winter fog, and decrease in rainfall which is also becoming more erratic.

[1] One *Mauja* ranges from 11.35 *Katthas* (3.85 hectare) to 24.73 *Katthas* (8.38 hectare). One *Kattha* = 0.339 hectare (Uprety, 2008)

Permanent divider being consturcted at Tara Prasad Bondh

16-36 division at Tara Prasad Bondh

28 They reported that water for irrigation in the monsoon used to be adequate for rice planting but with changing rainfall pattern it is not enough and disputes in distribution arise (FGD, 2013; KII informants, Shankarnagar # 1). Decreasing water flow in the Tinau is another major challenge faced by locals of Sorah-Chhattis Mauja. The bed of Tinau River has gone down up to 10 meters in some places due to extraction of sand and boulders. In addition, some sections of the canal leak. It is estimated that water has decreased in the river by 25-30 per cent and the canal conveys 5.5 cusec instead of 8.5 cusec that it conveyed in the past (FGD, 2013). The downstream users are negatively impacted by upstream interventions such as sand mining and water diversion. Farmers in the downstream get less water, and sometimes in winter, no water at all. When this condition prevails, the crops do not get water from February onwards. In addition, siltation is high in the Tinau which has resulted in changed course of the river in the past. A flood in 1962 caused the river to bypass the barrage, and in 2038 (1979), Tinau River again changed its course during a flood.

29 **Indigenous and local knowledge and practices used:** The Sorah-Chhattis Mauja irrigation system necessitates intensive contribution from the local users. This has been possible through traditional *kulara* system (voluntary labor contribution; one *kulara*=one person labor). In the early days, the irrigation system was maintained and operated with rules and laws that the Tharu community developed. *Badhghar* or *Jamindar* (Tharu community leader) used to be responsible for management of irrigation and was assisted by *Chaukidar* (water guard). All the farmers used to abide by the rules set by the *Jamindars* and even paid *Khara* (fine in cash or kind) in case they could not provide labor contribution. Cultural practice such as *Sidhabandi* or maintenance headwork and upper part of the canal (FGD December 2013; Uprety, 2008) used to be practiced. While some of the traditional practices such as *kulara* or *khara* payment still continue, they have either been improvised or are not practiced anymore.

30 The joint committee follows the same traditional management practice through electing executive committee members and selecting *Meth Muktiyar* (main head) and *Muktiyar* (head for *Maujas*) to maintain the system. Traditional distribution system allocates water based on farmers' landholding and their participation in

maintenance. Proportioning weirs called *sanchoes* were constructed using locally available materials such as bushes, wood, sand, soil and stones. This has been replaced by concrete structures. They divert water into the fields using *tingode* (wooden tri legs to block/control water). This is known as *jhalpara* (preparing of brushwood for dam). Farmers still make *syauli bandh* (temporary dam) or brushwood dam using bamboo, brushwood and clay. These irrigation systems are well adapted to the changing water availability and the nature of river flow.

Since *kulara* system or canal cleaning work required labor contribution from each household, transfer of knowledge from one generation to next was through participatory activities. Though Brahmin and Chettri castes have replaced Tharus in Sorah-Chhattis Mauja command area, the knowledge and system for managing irrigation have been transferred to the hill migrants and continues to be practiced even today.

Key issues, challenges and climate change adaptation: There are many challenges for the Sorah-Chhtais Mauja irrigation systems. They are lowering of riverbed due to over extraction of sand and boulders, leakage of water from canal and siltation. Other challenges are land encroachment and pollution. The demands for irrigation water is changing with land fragmentation, urbanization and decrease in irrigation area due to plotting of land for housing development. These dynamics are constraining smooth and effective functioning of the irrigation system. Similarly, deep boring in the command area is leading to drought like condition for areas served by shallow tube wells. Sorah Mauja irrigation system is exposed to land fragmentation where households are reluctant to contribute voluntary labor for maintenance. Climate change induced dynamics will aggravate water stress in the command area. Similarly, impacts of floods and siltation are high in the command area. The indigenous *kulara* system holds norms and knowledge to continue such works as building temporary *syauli bandh* (brushwood dam) to divert water to the canal from Tinau River. The *syauli* dam gets washed away every year during the

Sauli bandh (brushwood dam) in the Tinau River

Canals in 36 Mauja command area

BOX 1

Anarjit Tharu is a 60 year old is a native of Sorah-Chhattis Mauja command area. He remembers his ancestors' contribution in the irrigation system's sustainability. The irrigation system was not systematic in the early days. According to his forefathers, the dense forest area was gradually cleared for settlement and agriculture. Later on, in order to irrigate the lands, people started to work collectively to dig canals for water distribution. He participated in irrigation work such as *Naj laune* (digging), *kulai garne* (canal cleaning/labor), constructing dam by making tingodi (wooded three legs to block the flow of river), and *Jhala laune* (grass bundle/brush wood dam) etc. He mentions Shankar Prasad Chaudhary as one active person during the Rana Regime who used to manage everything including canal digging and distributing system. *Mukhiya* (leader) system is a traditional practice and this system is continuing till now with one *Mukhiya* and one *Meth Mukhiya* as the head in each of the 16 *Maujas*. Tharu says drying of Tinau River and increasing water shortage for irrigation are two major challenges for them. According to him, there used to be *hatiyako jhakari* (continuous small rain for 6-7 days in monsoon), which is more erratic now. Some of the new development efforts, such as Bhairawa Lumbini Groundwater Irrigation Project (BLGIP) has directly affected the level of ground water and excavation of stones and sand from the Tinau River to meet the need of rapid urbanization, have detrimental impacts to CMIS. However, he adds that following old tradition and system completely is not possible now. New technologies and equipment have to be used to adapt to the changed environment.

(Source: KII, member of users committee, - Sorah Mauja irrigation project, Tikuligad, Shankharnagar VDC, Rupandehi)

floods. The communities need support to build their adaptive capacity to deal with these challenges.

2.4.2 Case example: Argali irrigation system in rural mid hill

33

Case evolution and socio-economic context: Argali irrigation system is an exemplary locally managed irrigation system. Built about 400-500 years ago during the era of King Mani Mukunda Sen, Argali system carries in its essence: traditional knowledge, skills and practices; historical importance; and a practice of collective action. According to the local oral history, this Raj Kulo, known as Jethi Kulo (first canal), was dug in 1558 AD[2] to grow rice needed for pilgrims and local priests to perform religious ceremony (puja) in the Rishikesh temple located 5 km northwest of Argali. In 1630, 1647 and 1668 (1573, 1590 and 1611 AD respectively), locals constructed three more canals; making the number of canals four. These four canals are *Jethi* (first) Raj Kulo), *Maili* (second), *Saili* (third) and *Kanchi* Kulo (youngest canal). The intake of all four canals is Kurung River which is located in Deurali VDC. While Kurung River is the source for later three canals, the source of Jethi kulo lies in Bhairavsthan VDC, south of Argali VDC. The Jethi Kulo, which is 8 km in total length, is tunnelled through rocky hills for one third of its length. The length of the main canals of *Maili, Kaili* and *Kanchi* Kulo ranges from 1.5 to 2 km.

[2] People in Argali still hold some documents dating back to 1787 AD mentioning canals of Argali during the Sen period (Pradhan, 1990).

Argali is one of the 65 VDCs of Palpa district. This VDC has a total of 831 households, of which, about 75 per cent benefit from the system that irrigates 215 ha of land. The VDC has a total population of 4,628 comprising of Brahmin, Magar, Dalit and Newar caste/ethnic communities. The population practices Hindu religion and almost 98 per cent of them speak Nepali as their mother tongue. About 82 per cent of the households receive electricity from the national grid, and about 90 per cent of household use firewood for cooking. Literacy rate is 86 per cent and agriculture is the main source of livelihood. Few household members hold jobs, engage in business/local trade while others migrate seeking other livelihood options. People cultivate rice, maize and wheat. In many part of the command areas fruits, potato and vegetables are also common.

BOX 2

Religious belief among the people suggests that there was a time when water didn't flow from one particular part of Jethi kulo (canal) so the king had a Dhami/Jhakri (traditional healer) inquired to figure out the problem. The king was told by the Jhakri that the Goddess wanted a sacrifice of a queen over the place where the water had dried up. Because of this need, queen Madhumati, second among the three queens of the king, was ready to sacrifice herself. While she was being readied for the sacrifice, Goddess Durga appeared and salvaged her life. Today, there exists a temple in that place in honour of the queen. People of Argali strongly believe in this divine power and perform a sacred puja (worshipping) in the temple every 3 years during the months of June and September. Till today women sing folklore which recites this story while planting rice.

Madhumati temple in Jethi Kulo

(Source: FGD at Argali VDC)

Major features of the Jethi Kulo: This canal distributes water in a unique way. Jethi Kulo has 50 *bhai* (50 brothers) management system for distribution of water. The main canal first allocates water to two *bhai* or two distributing canals, then to four Bhai or four distributing canals and finally, allocates water in two canals each of 22 Bhai or 22 distributing canals thus making a total of 50 Bhais. The water is distributed according to the rule *jati khet tyeti pani* (water as per landholding) demonstrating collective management practice. All beneficiaries work in the canal under an arrangement when jhara (announcement) is announced for kulara (canal cleaning work). The announcement does not apply to Mukhiya (head of the canal committee) and Baidar (helper) who manage cleaning work. The households that do not attend kulara have to pay a fine to the committee. Rules are strict and everyone has to abide by them. The local calls this practice 'democracy in water distribution, dictatorship in water management'.

36 In monsoon, water is distributed according to land holding; and in the winter, the committee decides on the allocation and management of water distribution. If problems emerge, maha jhara (major announcement) is announced. Likewise, there is a dispute mediation process called Aata. However, locals claim that disputes among users have never arisen, and Aata has never been implemented. For local people, participation in canal cleaning gives someone prestige (FGD, 2013). Distribution of water depends on their participation in the maintenance of the system.

37 **Climate change perception and impacts:** Locals of Argali claimed that rainfall pattern has changed in the recent times. They mentioned that rainfall, which used to start around late May, now begins towards the end of June. The intensity of the rain has also changed with high precipitation in brief periods. In the past, it rained for many days continually. In addition, the decrease in winter rain has been perceived. They also suggested that temperature in the summer months has increased. Another indicator of change in temperature is the increasing presence of mosquitoes and drying of spring sources. One of the main concerns of the communities is the potential impact of climate change on water and its availability (FGD, December 2013). The local people mentioned that increasing temperature and changes in rainfall pattern have impacted availability of water in the sources and consequently in the canals. In Argali, the four canals of the irrigation system are fed by other springs besides the main sources: Kurung River of Deurali VDC and Bhaja Mul (source) of Bhairavsthan VDC. As a result, decrease in water level has directly affected the irrigation system. In monsoon, when there is ample rain, equitable water distribution is possible. However, it is unlikely in winter when the river flow is reduced. Another major challenge of Argali is the conservation of the source catchment of Jethi Kulo. The catchment lies in (Bhairavsthan) whose conservation is crucial if the canals are to keep supplying water. Deforestation of the catchment or diversion of water to other places will have implications on the irrigation system in the winter when supply is limited. The possibility of this threat is higher because both the water source and the forest lie in another VDC.

38 **Indigenous and local knowledge and practices used:** Many of the indigenous and traditional knowledge, skills and practices that continue in Argali irrigation system has been passed on down through the generations. The *kulara* arrangement includes working under *Mukhiya* (chief/head) and *Baidar* (assistant) under strict rules of *khara* (fine payment), *jhara* (announcement for work), *maha jhara* (major announcement for work), and *aata* (conflict mediation). *Pani sanchoes* (wooden weirs) are used for allocating water and earthen canals for distribution. Canals used to be lined with *'surki'* (paste of limestone, brick dust and black lentil) to prevent leakage but is being replaced by cement lining nowadays.

39 Collective actions for management, water distribution, and cleaning of canal are guided by traditional knowledge that has survived for centuries. The four canals of Argali are aligned in such a way that water distribution is not affected. Tunnels are dug through rocks and they are large enough to allow people to move in to perform regular cleaning and maintenance. The tunnel was dug by specialists called Agri and their knowledge was transferred to other locals while participating in the construction activity. Locally trained technicians, *Agri*, functioned like modern day engineers.

Key issues, challenges and climate change adaptation: Climate change has induced changes in water availability in canals and sources of Argali irrigation system. Taking the example of decreasing discharge in Argali, locals claimed that if new ideas and innovations in agriculture are not developed, the situation will become serious (FGD, 2013). They claim that change in rainfall has already impacted agriculture in the district. With 76 per cent of pakho (non-irrigated) land in Palpa district, farmers

Water distribution in Argali farmland

Mud weir for water distribution in the canal

have used sprinkler or plastic ponds for irrigation in other VDCs, however, these systems depend on adequate rainfall (District level workshop, 2013). In Argali, though all canals demonstrate sophisticated design, including tunnels through rocky terrain and intricate water distribution system, the climate change variability is directly impacting irrigation. In the last few years, the canals have been renovated and reconstructed using cement concrete lining in some sections to prevent leakage and increase water yield. These interventions show that the local community do co-opt modern technologies to adapt to new stresses and changing context while maintaining practices of good governance, equity and justice.

2.4.3 Case example: Giri Khola Irrigation system in mountain district

Case evolution and socio-economic context: During the reign of King Baliraj of the Kalyan Dynasty (1400 AD), farmers received support to build canals in the far western part of Jumla at an elevation of about 2,500 meters. Local communities took the initiative for constructing canals to bring water for cultivating paddy on the banks of Tila and Sinja rivers. These canals still maintain irrigation systems of the areas mentioned. Giri Khola irrigation system in Hanku VDC is one such system. People have been living here for many generations and some believed they have been here for 20-25 generations (over 2000 years). They mentioned that the irrigation canal was built immediately after the settlements began in the region to provide water for the crops. Giri Khola, one of the tributaries of Tila River, originates from a small lake (also known as Giri Lake).

44 Giripandey *Gaun* (village) in Hanku VDC is a small settlement of Giri and Pandey Brahmins and other castes such as Chhetri, Thakuri and Dalits. Hinduism is the dominant religion and Khas Nepali is the language spoken. Agriculture is the major occupation of people and rice, wheat, barley are the major crops. The main source of energy for cooking is firewood, and few households use electricity and solar panel for lightening. Out migration is rare in this area and in the district as well because the region has productive land with high soil fertility and other natural resources. Local people term Jumla as *kanchho* Dang (Younger Dang district, a fertile valley in inner Tarai, MWDR).

45 **Major feature of the Giri Khola Kulo:** Giri Khola Kulo, managed by locals of Hanku VDC, irrigates 150 ha in 7 wards of the VDC. A 9.2 km canal was maintained annually through the assembly of the farmers. Locals used to follow traditional system of operation and maintenance such as keeping Katuwal (local informant for communication) who was paid for the labor. This practice discontinued when the Maoist insurgency began in 1996[3]. At present, 11 member users' committee (3 women and 2 Dalits), registered in the District Irrigation Office, oversees operation and maintenance of the Giri Khola kulo system. Women also participate in the cleaning and repairing of the canal. A fine system exists for those households not taking part in the collective action. When needed, members from each household (excluding children, senior and differently abled persons) come together for maintaining the canal. The users' committee settles disputes. After a repair in 2013, the flow has been regular and distribution of the water more efficient. Normally, every year in April/May, locals participate in cleaning and repairing of the canal. There is head-end/tail-end dichotomy (users at the head of the canal get more water than the people at the tail end), but there is no dispute regarding water distribution from the canal. The canal, constructed using earth (no bricks, cements and rods used), is stable and its slope is considered appropriate for smooth flow of water.

46 **Climate change perception and impacts:** Locals stated that rainfall in Jumla in the last two decades has decreased overall, but the intensity has increased. It affects the traditional munda (mud) roofed houses adversely. They reported that amount of snowfall has also decreased. They said that the trend of *Saune Jhari* (continuous

BOX 3

According to a legend, in the ancient time, the then king of Jumla organised Aswameg Yagya (a religious function), and Brahmins were called upon to recite the Vedas (ancient Hindu scripts). Then one migrant from India, who was an ancesrtor of the present community people, prayed to the deity for power to recite Vedas. After his prayer, a lamp was lit automatically in panas (a small pot to light the lamp in Hindu culture), and he started uttering the Veda spontaneously. After his successful recitation of the Veda, he was honoured and also provided with birta (land grant) by the king. Since then, they (the community people of Hanku VDC) became priests at the Kartikswami temple near Giri Khola (River) and at the same time, started cultivating the birta land.

Source: FGD, Hanku VDC , 2014

[3] Some of the practices such as keeping Kuthe (water guard who helps in water distribution) is still continued in some of the irrigation systems of Jumla, such as Tikhune canal irrigation in Kudari VDC (Observation and interview in Tikhune canal, 2014).

rain for a week or more) during monsoon has changed. Rainfall is scattered and it is not uncommon to get high rainfall in one area while the adjoining sub-watershed is dry. The hailstones have also become denser. These changes lower performance of the irrigation system and subsequently, agriculture. Locals also suggested changes in flowering and fruiting behaviour of the plants. "*Guchhi*" mushroom, which has high medicinal value, was common ten years ago, but is hardly seen these days (a kg of dry mushroom fetches 16-20 thousand NRs). Locals have experienced shift in the timing of flood peaks from June/July to September/October. Though there has been no major climatic disaster in the area for many years, in the beginning of the monsoon

Fertile land in Tila valley

Earthen canal of Giri Khola irrigation

Guchhi mushroom

season (June/July) of 2013, a major hailstorm killed about 500 horses/mules and 2,500-3,000 goats and sheep. This event also led to death of three individuals. The other impacts that have been felt by the local people are soil erosion and mudslides (FGD, 2014, Hanku VDC).

47

Indigenous and local knowledge and practices used: In Jumla, canal irrigation system practices similar kind of management as in Sorah-Chhattis and Argali irrigation systems. One *khetala* (labor) from each house participates in canal maintenance and erection of *syauli* dam using *juhari* (wooden holder like *tingode*). Giri Khola irrigation system in particular is managed by small groups of farmers who live in the area. They use local knowledge while digging the canal, maintaining width and depth that suited the local topography. They also aligned the canal without destroying the roots of big trees. This approach in terms of design, slope grading and soil quality is similar to other FMIS of Jumla- Bandiraj Kulo of Kanka Sundari VDC and Jachali Kulo of Haat Sinjha in Birat VDC which, among other, results in minimum siltation.

48

Key issues, challenges and climate change adaptation: In recent years, water scarcity, floods, landslides and siltation are affecting irrigation systems in Jumla.

Monsoon flood frequently damages the canal of Giri Khola irrigation. The farmers mentioned that they need technical and financial support for stabilising the canal and divert the flow. The users do not see other major issues in the canal operation except cleaning of vegetation and debris deposited during rainy season that block the flow. Deforestation, open grazing and increasing population with haphazard settlements are other challenges threatening the irrigation system. Locals have planted trees such as baish (Salix Babylonica) around cultivated area near Tila River and other rivers, and have built and positioned gabion wire frames to protect farms from soil erosion and landslide.

2.4.4 CASE EXAMPLE: Raj Kulo (royal canal) irrigation of mid hill (focus area Sipadol VDC, Bhaktapur)

Brushwood dam in Tikhune irrigation, Jumla

Indigenous water division practice in Jumla

Case evolution and socio-economic context: The Malla period of the 17th and 18th centuries was important in terms of the spread of drinking water spouts and *raj kulos* (irrigation canal). In 1678-79 AD, King Jitamira Malla constructed the Raj Kulo, the canal that brought water from the Mahadev River to Bhaktapur and its surrounding areas. This was a multi-purpose irrigation system as it helped recharging ground water and increased the water table level and maintained a continuous flow in the stone spouts and wells (Pradhan, 2012). Raj Kulo of Bhaktapur fed water to Dhunge dharas (stone spouts) as their source or as the canal to bring water from Mahadev River, Nagarkot (Khaniya, 2005). Water from different sources around Mahadev Khola used to be collected into Mahadev Pokhari and was fed into 15 km canal

Salix Babylonica plantation around cultivated land, Tila valley

constructed by the local Newars to bring the water to different dharas of Bhaktapur city (FGD, 2014; Khaniya, 2005). This supply considerably resolved the water crisis of the city by catering to the multiple needs of the people. Similarly, adequate provision of drainage was also introduced around the dhara to ensure the disposal of waste water and avoid water logging. Different religious and cultural rituals also started during the Malla rule that ensured the cleaning of water canals and spouts (Pradhan, 2012). A Guthi (religious social institution) was established for maintenance of the system.

Bhaktapur district has 16 VDCs and two municipalities. Bhaktapur is famous for its rich cultural heritage augmented by its local craftsmanship, religious functions, local indigenous agricultural techniques and tourism. Indigenous Newar community have practiced agriculture for countless generations, and it is said that the rice produced in the district was sufficient to feed the entire population of Kathmandu valley in the past (Khaniya, 2005). Sipadole VDC has Newar community as the dominant ethnic group who live in 2,278 households. 50

Major features of the Raj Kulo: This Raj Kulo was constructed with a religious priority and for drinking water more than the need for irrigation (Pradhan, 2012; Khaniya, 2005). The Raj Kulo fed the Sundhara (golden spout) inside the palace and the water was used for performing religious rituals ascribed goddess Taleju. Although it holds historical and religious significance, the Raj Kulo does not function at the present. The basic infrastructure and the canal were damaged in the 1934 earthquake. The ensuing private piped water systems implemnetd by Bhaktapur Development Project substituted stone spouts as the source of drinking water in the 1980s (FGD, 2014; Pradhan, 2012). These proceses gradually led to shrinking the role of Raj Kulo which is totally non-functional today. Few Raj Kulos in Bhaktapur are partly functioning as in Tahali VDC. The water thus supplied meets the irrigation needs of few households. 51

Climate change perception and impacts: Like elsewhere, the locals felt that they have experienced less rain and increased warming in the past decades. There were other changes too. The water source of Raj Kulo was gradually declining and was inadequate to fulfil the needs of all the users. The households residing further away from the canal did not get services from the existing Raj Kulo and their participation in maintaining the canals declined. To meet the needs of irrigation, farmers have started digging wells in their private property. They also began pumping water from nearby rivers. Besides, they have switched to vegetable farming that requires less water. Individual farming is more common than community-managed system. The locals mention that with climate change, water availability for irrigation will be strained in the coming years. 52

Kalimati Kulo Tathali VDC, Bhaktapur

53 **Indigenous and local knowledge and practices used:** Through different rituals and traditional practices passed down from older generations, the Newar community engages in conservation of cultural norms, values, and practices. They also promote ecotourism and build environmentally friendly infrastructures. However, today there is absence of indigenous and traditional knowledge due to the non-functional condition of the Raj Kulo at Bhaktapur. Having mentioned thus, one function, which is still practiced by locals of Bhaktapur, is Sithi Nakha, which requires cleaning of all water sources and conduits every year before the monsoon. This practice, these days, is confined to in-house cleansing and as a religious celebration.

54 **Key issues, challenges and climate change adaptation:** Raj Kulos and other water systems of Bhaktapur do not function as the way they did in the past. This is because of rapid urbanization, increasing water demand, and source depletion. When the supply of water from the Raj Kulo decreased, the user community sought government assistance and built concrete irrigation canal from a water source in the vicinity. This venture served few farmlands only. Groundwater recharge system has also been affected because large numbers of brick factories have been built: a demand generated by rapid urbanization of Kathmandu Valley. The brick factories divert high volume of water for producing bricks creating competition for water use.

Dysfunctional traditional stone spout in Bhaktapur

Siddapokhari (Traditional pond), Bhaktapur

2.4.5 CASE EXAMPLE: Nagbahal Hiti (stone spout) of urban Lalitpur

55 Case evolution and socio-economic context: There are 61 hitis or water spouts in Lalitpur Municipality[4] at various states of functionality (Table 6) (Culture and Archaelogy Unit, Lalitpur Sub-Metropollitan City, 2007). Such water systems are found in almost all of the Newar settlements in the valley. The system consists of five components: the intake, the conveyance system – surface or sub-surface flow channels, water storing and recharging structures called *Pukhus* (ponds), water conduits or hitis (stone spouts) and *tuns* (wells), and the drainage system. Mainly, two types of structures are used as sources of water by the Newars: *hiti*, or water

Table 5: Characteristics of Farmer Managed Irrigation Systems in case examples

Case Examples	Location	Date of origin(AD)	Source	Length of irrigation system	Command Area in hectare	Population benefitted
Sorah-Chhattis Mauja Irrigation	Butwal, Rupandehi	1846-63	Tinau River	-	3500	20000
Argali Irrigation (Jethi Kulo)	Argali VDC, Palpa	1558	Bhaja *Mul* source in Bhairavsthan VDC and Kurung River	8km	215	3500
Giri Khola Irrigation	Hanku VDC, Jumla	Not sure, Very old	Giri River from Giri Lake	9.2km	150	1700
RajKulo	Sipadole, Bhaktapur	1678-79	Mahadev River, Nagarkot	-	-	

Source: Field study 2013-14

spout located in the manmade depressions and tun, or the dug wells. Network of canals, ponds and water conduits were constructed to serve water throughout a year to the city people (Becker-Ritterspach, 1995). Nagbahal hiti is considered as one of the ancient hitis dating back to Licchavi period[5].

Lalitpur has 41 VDCs and one sub-metropolitan city. Nagbahal is one of the biggest residential courtyards in Lalitpur. It was originally a Buddhist monastery but its original structure no longer exists, albeit the bahal still retains its religious and cultural importance[6]. Nagbahal Hiti benefits 100 to 120 households of ward 16. This is a dominant Newar community settlement that practices Buddhism. The locals living in the area are economically well off. The locality is mostly famous for hastakala (handicraft). The locals are mostly business owners trading gold, brass and metal idols.

56

Nagbahal Hiti, Patan

Major features of the Nagbahal Hiti: Nagbahal Hiti is Located at Nagbahal and the source of the water is Khwayebahi aquifer southeast of the hiti and is linked to Raj Kulo from Lele/Chapagaun. Nagbahal hiti consists of three individual stone taps with a large stone image of the Buddha. Though its construction date is unknown, some inscription on the Buddha's statue

57

[4] Patan is Lalitpur sub-metropolitan city and also one of the major cities of Kathmandu valley.
[5] *Manga hiti* is considered to be the oldest monument of such kind in Patan as the inscription on stone slab suggests a date around 570 AD. Other famous hities are Alkwo hiti, Chysal hiti, and Illanani hiti which were also observed during the study.

suggests construction date at around eighth century (Joshi, 2008). The hiti had been dry for a decade and its renovation was contemplated. The community tried to revive the spout but the source could be traced only as far as 500-600 meters and became impractical as it passed through dense housing area. Although the renovation could not be completed, the supply of water in the hiti has improved after the restoration work and clearance of the blockage. The water is available only during the monsoon season. The inlet channel of this hiti, 9 to12 feet from the ground level, is made of brick. The conduit is 6 to 7 inches deep and about 4 inches wide. The channel has stone and brick collection bowls filled with pebbles to facilitate filtration (KII, 2014).

Table 6: Status of Hitis in Patan

Types of stone spouts	Numbers
Naturally operated	47
Pipelines connected	0
Non-operational	7
Extinct/disappeared	7
Total	61

Source: Lalitpur Sub-Metropolitan

58 **Climate change perception and impacts:** In urban Patan, the water conduits have lost their significance in the recent days due to various reasons like drying of water sources, increasing urbanization, and changing life style. Locals pointed out that drying of the *raj kulos* (canals) from the intake and damaging of the canals that recharged the ponds have led to drying of the spouts. The community of Nagbahal opined that though many of the spouts get water supply during the monsoon, decreasing and variable monsoon rain and increase in temperature have impacted the water supply. Inspite of all the difficulties, people have restored few hitis and established management committees to operate and maintain them.

59 **Indigenous and local knowledge and practices used:** Traditional water conveyance and management systems throughout the Newar settlements are significant evidence of indigenous skills developed in the past. Early Kirat settlements used ponds and springs in tar (elevated land which has to rely on rainfall for farming) lands and hill slopes which later *Lichchhavi* kings linked to spouts to discharge water from stone spouts (Tiwari, 2002). These *hitis* were recharged through local aquifers. The Newars also mastered the skills of recharging local aquifers through conveyance canals from ponds popularly known as *deidha* or *raj kulo*. In brief, the spouts are located within the rectilinear pits on the ground; water is supplied through *raj kulos* or other independent sub surfaces; the water passes through series of gravel filters consisting coarse to fine granules with the filters connecting to clay pipe system that directs water to the spout. This is an example of water management knowledge that existed around 570 AD and was passed down through generations (KII, 2014; FGD, 2014; Shakya, 1993; Becker-Ritterspach, 1995).

60 The function and architecture of the water conduits display and transmit knowledge from indigenous communities of Kathmandu valley (Becker-Ritterspach, 1995). The

[6] The Dipankara yatra, a religious excursion around Kathmandu Valley that occurs once in about 18 years when all the 5 auspicious elements align and celebrated by both Hindus and Buddhists, originates from this site. Nagbahal is also the site where the five-yearly Patan Samyak, the assembly of all the Dipankara Buddha images from Patan and its surrounding areas, take place (Joshi, 2008).

Newari communities of Patan also celebrate Siti Nakha as a one of the main festivals where families from all households clean water conduits for four days and gather around to feast. This is strictly followed in some of the hitis such as Nagbahal hiti which have strong religious and communal ties among the households (FGD and KII, 2014).

61

Key issues, challenges and climate change adaptation: Variability in climate, together with rapid urbanization, has directly led to increased water stress in urban Patan. The Raj Kulo from Lele VDC that used to feed the city's stone spouts is heavily damaged and its complete revival is less likely now due to urbanization of Patan. Inhabitants of Patan have started different systems for collection and distribution of water among themselves. For example, to meet water demand in the dry season, some communities buy water from tanker each day and distribute it among the households; while others collect water from stone spouts for 24 hours in plastic tanks for distribution. Community management is still practiced to make water supply accessible. Community of Nagbahal Hiti and other hitis rely on water from these traditional stone spouts. According to the FGD, some activities were initiated with external support to reconstruct the water system and allow water to flow to Patan; however, the initiatives could not materialise because of the differences in interest regarding water sharing among different administrative units that the Raj Kulo passed from Lele VDC till it reached Patan.

2.4.6 CASE EXAMPLE: Community managed Godavari Drinking water of Lalitpur District

62

Case evolution and socio-economic context: Godavari VDC lies in the lap of Phulchoki mountain known for it fresh drinking water source. There are mainly two sources of water: Naudhara (nine stone spouts) and Godavari kunda (a religious pond) with Panch dhara (five stone spouts). Naudhara is used for general drinking water purpose while panch dhara source is mainly used for religious purpose[7] (people take bath during festival). The source of Naudhara is also used for irrigation and it is believed that a person called Dashrath Khatri built the spouts about 150 years ago.

Intake of Raj kulo at Lele River,Tika Bhairab

Collection of water for reservoir from Alok Hiti, Patan

Godavari VDC is about 10 km from urban Patan. The VDC has 1,825 households with a total population of 7,558. The locals have lived here for many generations. About 10 percent of the people are migrants. Tamang people, who used to work in the farmland but were landless, now live in squatter settlements. The majority of the population speak Nepali. Other local dialects such as Tamang and Newari are also popular. In this area, almost everyone follows Hinduism. As in other parts of the country, many youths from this VDC seek foreign employment. It is interesting to note that although the VDC is not far from the capital, it has a low literacy rate. Selling drinking water from the streams and other sources was practised here but is stopped now because of the source disputes. Another source of income in this area is through hotel and tourism.

63 **Major features of the community managed Godavari drinking water:** Nine water conduits and a temple was constructed by a Silwal-family[8] during 1799-1816 AD as indicated in the inscription. Recent repair work was done on the spouts in 1988 (KII, Godavari, 2014). Prior to 1965-66 AD, people of this VDC depended on surface well and stone spouts for water. There are still six to seven surface wells and about 25 stone spouts in existence.

64 At present, locals of Godavari access drinking water from the source that feeds the Naudhara spouts. The water users' committee was established in 1993. Presently, it has 13 members in the committee including two women and two Janajati. It is a locally managed drinking water distribution system with 1,200 taps. There is one tap


Naudhara in Godavari


Godavari Kunda, Panchdhara

[7] There is temple of Goddess Durga at Naudhara stone spouts. The stone spouts resemble the feet of the Goddess. Likewise, there is also a temple at the top of Phulchoki hill which is revered as the head of the Goddess. Godavari kunda was established by Bahadur Puri Swami (a saint). It is believed that his religious tools such as Trishul and Kamandalu were found here. Every 12 years, there is a mass pilgrimage called Godavari mela to this pond to take holy bath). It is believed that in the ancient time, a queen conserved the forest of Godavari in order to protect the water resource for cattle.

in each house, while community taps have been provided in squatter settlements. All flow of water is metered and monthly water tariff is collected. The tariff ranges from NRs 10 to 10,000 per month depending on the amount of water used (10,000 litre = NRs 10). The supply is available 24 hours a day which is unusual for Nepal where supply of water is heavily curtailed to a couple of hours per week. The water is free of suspension matter and is distributed without treatment.

65

Climate change perception and impacts: Locals of Godavari shared their experience regarding the changing pattern of rainfall, decreased winter rain, and more occurrence of erratic rain in monsoon. They have also experienced many of the surface wells becoming dry even though the forest is dense. They do not mention any experience of increase in temperature. Deforestation in the catchment area had created water stress, and at present, the VDC has four community forests (Naudhara forest users' committee is one of them), which help conserve the respective forest under their jurisdiction. The forest cover has substantially increased in recent years, and overall, it contributes to the protection and preservation of wildlife in the area.

66

Indigenous and local knowledge and practices used: In Godavari, the drinking water system is totally different than water spouts system found in Patan, however, community water management system incorporates collective strength to maintain a very effective water distribution system. The communities have used local indigenous knowledge, skills and practices in conserving forests and preserving water sources, or following religious and cultural festivals like in Patan. The management and distribution system is more than 20 years old and is regarded as a successful practice. The ownership of water rests with the committee and the District Drinking Water Office has no role in this scheme. There are five water sources registered under this committee and three are currently in use. The committee undertakes maintenance of the system and a technician is appointed to perform the task. The technician works in consultation with the committee and the local needs.

67

Key issues, challenges and climate change adaptation: Godavari drinking water committee has been facing problems in water sharing with the neighbouring VDCs. The pressure on both the forests and the water sources has increased due to encroachment and claims by adjoining VDCs. Locals mentioned that promotion and conservation of existing forest is and will be a greater challenge as urbanization continues. Issues regarding sharing water or other resources are of key concern for the community and they fear that in a federal structure the problems will escalate as each province would claim right over its water and exacerbate disputes. They felt that indigenous, local knowledge and practices may be useful in managing traditionally built drinking water systems. The members of the community suggested that climate change will have adverse implication on water sources hence appropriate management system needs to be in place to adapt to the situation of water stress that may emerge.

[8] Silwal is a Chhetri caste group and is responsible for maintenance of Naudhara and temple there.

2.4.7 CASE EXAMPLE: Drinking water management in Bandipur village of mid hill

68 **Case evolution and socio-economic context:** Bandipur has traditional water sources like Satnale, Tapnali, Bangepani, and Tindhara. These springs are the traditional sources of drinking water for the village. As the water stress increased with increase in population, Jaldevi Khanapani, with its source in Jhargauan, was initiated under the instruction of late King Mahendra, and constructed through a water users and sanitation committee. Completed in 1962, it provides service to around 350 households and the system was enlisted under district water supply office in 1974. Today, Bandipur has changed from a small trade junction to a bustling tourist destination and the nature of water demand has also changed. Another Small Town Water supply system is currently being built. All the sources, including Tamu water supply system, are merged together for effective management.

69 Bandipur is an old town on a hilltop in the mid hills of Nepal. This town of 3,750 households is surrounded by Magar settlements of Silthok, Baralthok, and Ranthok; and is inhabited by Newars, Gurungs, Brahmins, Chhetris, Magars, Tamangs, and Dalits (Damai, Kami, Sarki). The religious and cultural practices of the town revolve around Khagdadevi temple. All castes and ethnic people have a specified role in the annual puja (worship) and Jatra (festival) during Dashain festival. Newar traders from Bhaktapur established Bandipur as a trade post after Prithvi Narayan Shah conquered it in 1768 AD.

70 Major features of Bandipur drinking water supply: The existing water system was expanded from 1962 to 1974 and two other drinking water systems were merged. The current Bandipur Water Supply and Sanitation Committee comprise of 9 members and there are 660 households as users from ward 2, 3, 4, 5, 6, 7 and 9 of the VDC. The office has employed five staff members to operate and maintain the system, supplying water uninterruptedly through 660 taps. The committee, which has tenure of four years, is responsible for operating and maintaining the system. The users contribute in cash and kind for all the systems (Bandipur, Small Town and Tamu water supply) and also pay service charge. The community is divided into six categories based on the economic status of the households. Cash contribution ranges from NRs. 2,000 to NRs. 10,000 and the monthly service charge payment ranges depending on use: from NRs. 10 per unit for the first 10 units, and additional NRs. 10 for each 10 unit blocks up to 30 units, and NRs 40 for each 10 unit block above that. The committee used to allocate two types of taps, private and community, till 1962, with only 7 private taps. Today, all taps are private. After 2009, there are different installation charges for inhabitants in old and new settlements.

71 **Climate change perception and impacts:** The local inhabitants of Bandipur expressed that they have experienced an overall increase in temperature. They also reported of increase in mosquito infestation, pests and diseases. In addition, some of the water sources have dried up. The locals also mentioned that the rainfall does not follow the previous pattern these days. High volume of rainfall in a short period, and less rainfall overall has become common. Other changes perceived are the drying

of spring sources and frequent landslides; both of which have had major impacts on the local water system. To adapt to local water stress, community of Bandipur has built tanks to harvest rain. The locals have also taken the initiative of tree plantation and implementing bioengineering measures.

72

Indigenous and local knowledge and practices used: The Bandipur water system used traditional skills to construct a tunnel 50 meters long and few meters deep to lay down the pipelines. For constructing the tunnel, skilled persons *(Agris)* were brought from Baglung. All the materials and skilled labor were local, except the pipes, which was brought from India. A spring that emerged from the crack between two big rocks was used as the source by constructing an intake chamber. Sometime later the intake chamber sunk for about 3-5 inches and as a result water started to leak form the cracks significantly reducing the yield. To overcome the shortage, the tunnel was deepened to 8 meters and smooth flow from the intake to the reservoir ensured.

Tunnel for water supply pipelines

73

Key issues, challenges and climate change adaptation: The demand for water has substantially increased in Bandipur because of the increase in population and the change in the modus operandi of the business with more focus on tourism. The springs are drying and they introduce new challenge to maintain regular supply to the town. Also, frequent landslides disrupt the system. To meet such shortcomings, the communities have taken initiatives like cleaning, maintaining and preserving traditional stone spouts. They have merged supply systems built at different times to generate more water. They have also established a better management system, harvest rainwater and conserve forest around the source to maintain its integrity.

2.4.8 Case example: Traditional water mills in Sindhupalchowk District

74

Case evolution and socio-economic context: Traditional water mills in Nepal are commonly called Paani Ghattas. Though historical data on use of pani ghatta doesn't exist, they have been in use for long time. Oral history claims that ghatta technology came to Nepal from Tibet more than 300 years ago. The components of the water mill include wooden water wheels with flat paddles, wooden hub that includes a metal vertical shaft, an open wooden chute of varying cross-section and runner mounted on a wooden frame. Water mills are used for grinding cereal grains (maize, millet, wheat, rice, etc.) and can grind 10-20 kg of grain per hour. Ghattas

are common in Sindhupalchowk district and symbolises technological innovation that suited the local context. A Ghatta Owners Association, which works as a service centre, has been established in Chautara, the district headquarter. The income from traditional water mill is low, the local people are shifting towards improved water mills.

75 **Major features of watermill:** Most of the water mills in the district are privately owned. The construction, operation and maintenance are carried out by mill owners, or hired operators. The mill has to be registered in the VDC office before it can be established and operated. A certain amount of tariff is paid to VDC office annually. All water mills are locally manufactured using local materials.

76 **Technology:** The grinder consists of a pair of circular stone slabs locally known as janto. The flow of the water moves the turbine, which has a vertical shaft holding up to turn the upper stone. The other part of the mill has a funnel shaped grain holder suspended above the grinders. These holders are made of woven basket or tin. The holders feed grain in a hole in the upper stone, and the cereal is grinded between the stones. The feeding rate of grains can be controlled using simple nub (managed by small handle) fitted at the surface of the funnel. Depending on the nature of the grains and the speed of the wheel and the grains falling down can be increased or decreased. Preference for smooth grinding to coarse grinding can be changed with nub which manages to uplift or down lift the upper stone wheel while rotating to manage the fineness of the flour. The grinded flour gets collected in the wooden box that surrounds the grinding stones. Water flow for spinning the turbine is regulated through a gate at the top from where it is channelled.

77 **Climate change perception and impacts:** Discharge in the stream is continuously decreasing in the last decade, which is more severe in the dry seasons of March, April and May. Incidentally, mill operators also need water for irrigation during these months, thus water has to be diverted to their fields. During these months, it is difficult to run the water mill (KIIs, 2014). During the monsoon rains, floods damage canals that bring water to the mills. Sedimentation also damages the canals and needs regular maintenance.

Corn flour grinding in water mill

Dundh, traditional open wooden pipe

78

Indigenous and local knowledge and practices used: ILKPs of local skilled workers are used in construction, operation and maintenance of water mills. Mill owner or operator undertakes minor repair that does not need services of a skilled person. A pair of grinding stones can last for five years and wooden turbine lasts for five to six years. The stone costs about nine thousand Nepali rupees (approximately $90) and is available locally. A metal blade turbine has life of nine to 10 years. It takes one and half-hours to grind about five pathi[9] (about 20kg) of corn. The mill charges half mana[10] (about one fourth kg) of flour as mill charge for every pathi of cereal grinded. The stone wheels (pair) are to be replaced in three to four year time. The wooden dundh (traditional open wooden pipe) channels water into the turbine. They are normally replaced in five to six years. The pora or madani (turbine) is strong and durable and does not normally require short-term replacement. Local blacksmiths make chute that takes water from the canal to the turbine.

79

Key issues, challenges and climate change adaptation: Traditional mills face various challenges and one of the issues pointed out by the KI is decreasing water flow in the river. People interviewed also suggested that rain used to be widespread earlier and floods washed away the water mills. The last one they can recall was ten years back. The production of the village has decreased in the recent years due to untimely and lower rainfall adding to the lower income of the mill owners. Another major challenge for all water mills in the district is the competition that they receive from more efficient machines. Since the mills are located close to the rivers, they are often washed away and the burden falls on the local people including women who have to walk longer to grind the grains. Thus, these days they opt for nearby machine operated mills. Even then, people use water mills because machine grinded flour does not have the same taste as flour from water mills. On a different note, development projects can also bring changes. The water mills dependent on Melamchi River will be non-operational and displaced, as the Melamchi Water Supply Project will divert the water in the near future. Livelihood of many local mill owners could be saved if these water mills were to be left operational. As an indication of changing times, many water mill users have replaced dundh (traditional open wooden pipes) by polythene pipes for achieving higher efficiency.

2.5 CASE FINDINGS

80

The household (59 households) interviews during the study focussed on questions that aimed to understand local perception of climate change and disaster risks; their past experience regarding impacts of climate change; if ILKP has helped in adapting to such impacts; their perception of vulnerability; and gender issues in climate change. Among the respondents, 95 per cent said that they have observed changes in temperature and rainfall in their village. About 94 per cent of respondents

[9] One pathi equals to about 4 kg.
[10] One mana equals to about half kg.

reported increase in temperature in the past 20 to 40 years, while 51 per cent of them said rainfall is decreasing in the same period. Likewise, 83 per cent of the respondents reported changes in snowfall, fog, hailstone, lightning, thunderstorm, frost and fog (Figure 6, 7, 8 & 9).

81 In all case study sites except Jumla, respondents have reported increase in mosquitoes, pests and diseases in plants. Respondents mentioned that the events have affected crops impacting food production which has affected their livelihoods (Table 7).

82 **ILKP, gender and climate change adaptation:** When asked if indigenous and local knowledge have helped respondents and their households in climate change

Figure 6: Local perception of climate change

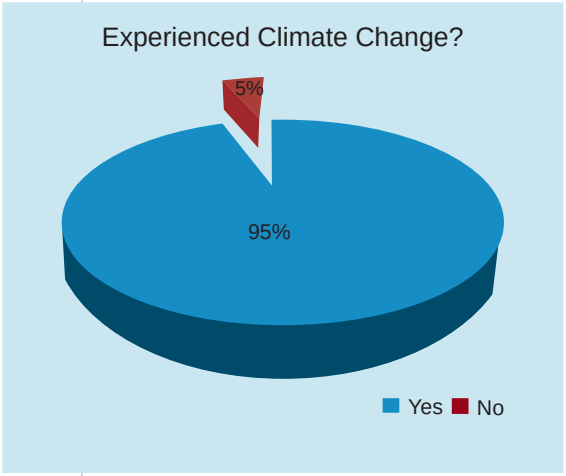


Figure 7: Local perception of temperature

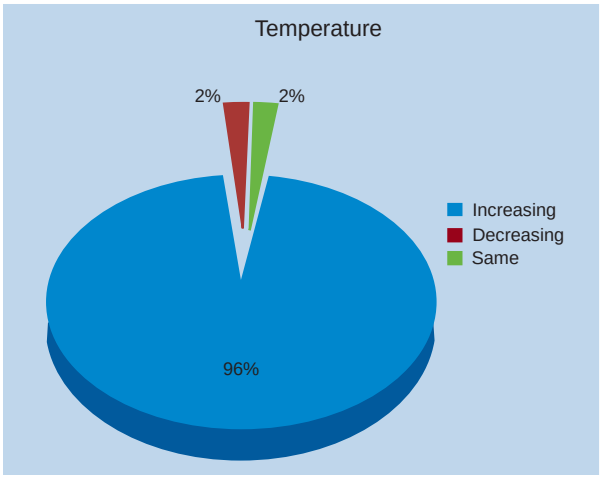


Figure 8: Local perception of rainfall

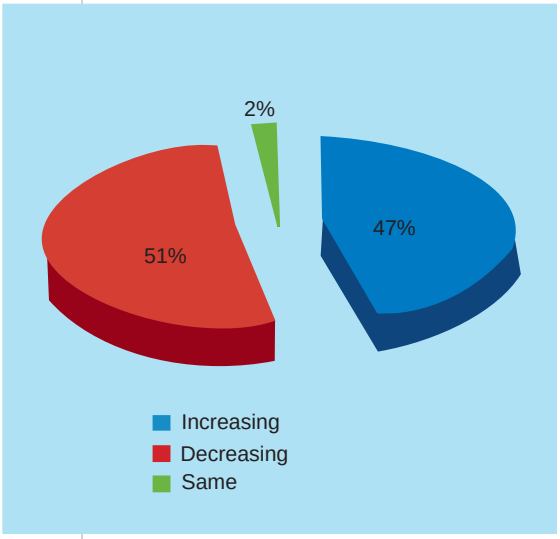
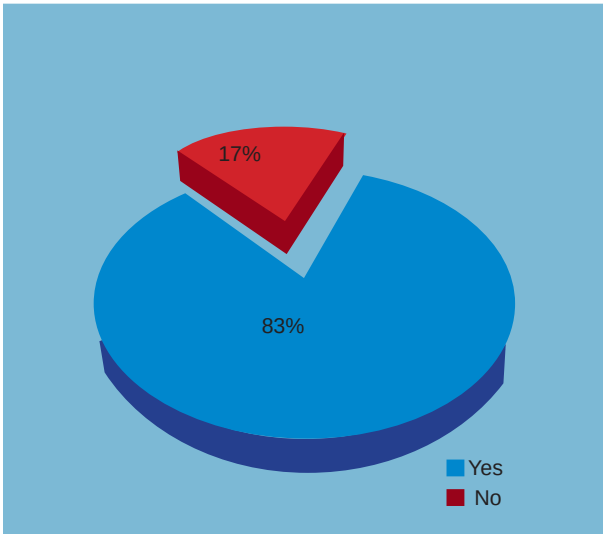


Figure 9: Change felt in other climate events/ indicatiors



adaptation, about 68 per cent said yes (base number 59). They mentioned that ILKP in irrigation management; pond, well and spout construction; forest management; water collection and management; and selection and plantation of trees according to climatic zone have helped in enhancing adaptation. They mentioned that the collective actions

Table 7: Local perception and experience of Climate Change

District	Temperature	Rainfall	Climate related events/indicators
Rupandehi	Increased	Delayed, untimely and decreased rainfall with spatial variation	Increased fog/mist and cold in winter; decreased wind and storm; increase in frequency of lightning strike; mosquitoes seen in winter months (December–January), drying of water sources
Palpa	Increased	Erratic rain with spatial variation	Increase in frequency of lightning strike, more fog in winter, decreased hailstones, increased mosquitoes both in summer and winter, drying of water sources
Jumla	Increased	Decreased and erratic	Decrease in snow; increase in frequency of lightning, thunderstorm, forest fire, hailstorm, floods and landslides; decrease in river volume
Bhaktapur	Increased	Decreased	Significant decrease in winter frost and fog; decreased hailstones, more mosquitoes; frequent occurrence of pest and diseases in plants
Lalitpur	Increased	Delayed and decreased	Decrease in snowfall in surrounding hills (Phulchoki); decrease in winter frost and fog (in urban Lalitpur); winter days are less cold; more mosquitoes; frequent occurrence of pest and diseases in plants; drying of deep dug wells
Tanahun	Increased	Decreased and erratic	Drying of water sources; decreased thunderstorm and lightning; increased pest and diseases; frequent landslides.

Source: Household questionnaire interviews, ISET-N/IDS, 2013-14

in irrigation and drinking water depend on indigenous and traditional management systems. Similarly, when asked if their households are likely to suffer more from climate change impacts than other households, 46 per cent perceived that they are more vulnerable than other households in their village (Figure 10 & 11).

The reasons, however, varied. Many respondents mentioned that because they live close to the river and/or the forest, there are more chances of floods, landslides and forest fire. Others mentioned that they have limited access to water, road and other development infrastructure. When asked if events caused by climate change affected women differently than men, 61 per cent of the respondents replied affirmatively.

Figure 10: ILKP has helped climate change adaptation

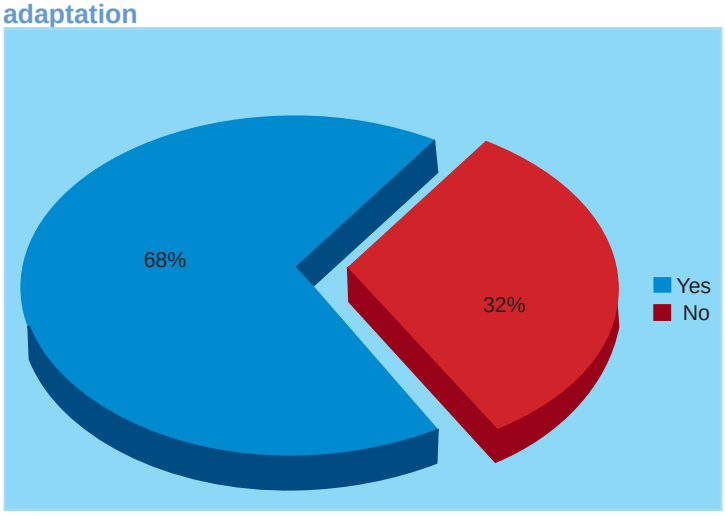
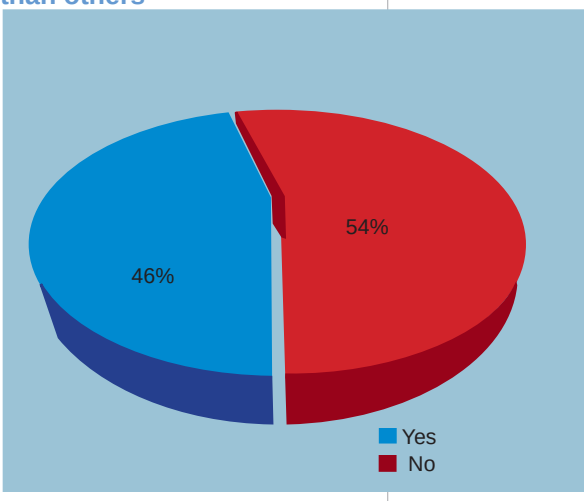


Figure 11: HH more likely to suffer from CC impact than others



While responses were disaggregated by gender, it showed that 64 per cent of the males and 55 per cent of the females believed that events caused by climate change will affect women differently than men (Figure 12).

84 Likewise, 46 per cent of the respondents mentioned that men and women could play different roles in climate change adaptation (Figure 13). They reasoned that women and men play different roles and can use their knowledge and different experiences in adaptation process. For example, in villages, it is usually women who go to the forest to collect fodder and firewood, and they suggest that women can play an important role in adaptation by protecting plants. Similarly, women are the ones who generally use water for household chores. This places them in a unique position for water management. In the irrigation sector, men can use their knowledge and skills while taking adaptation initiatives because of their longer experiences in canal constructing, cleaning and maintaining works.

85 **Irrigation cases:** The irrigation systems that were studied in various districts used technological consideration for water diversion, canal construction and distribution of the flow. Among the 43 households interviewed, all of them owned farmlands; and among them, 97 per cent had access to irrigation. 60 per cent of the households

Figure 12: CC affect women differently than men Gender Crosstabulation

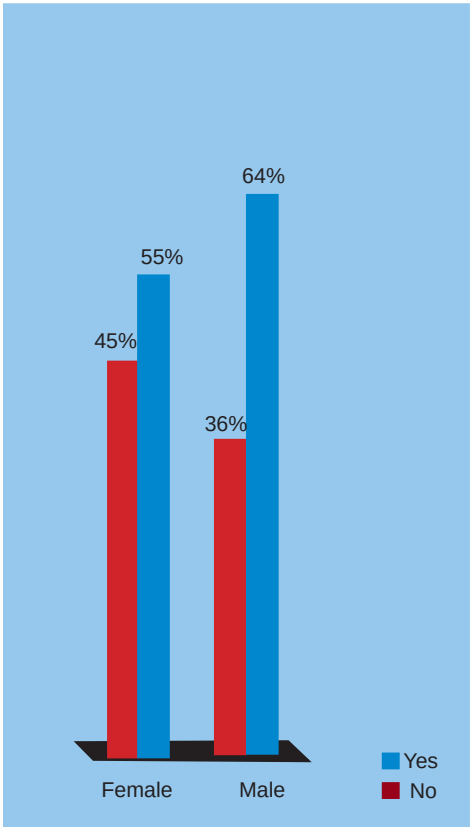
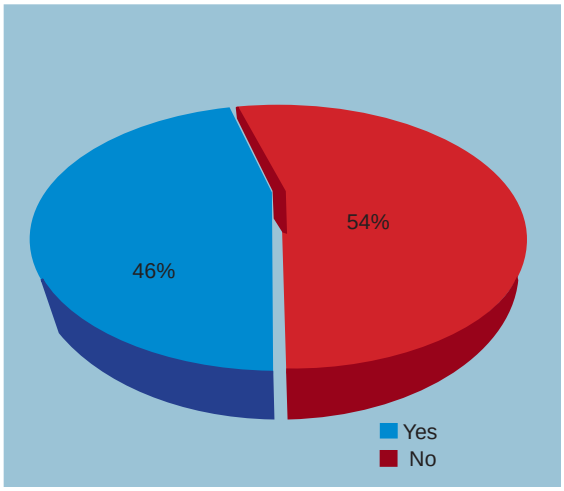


Figure 13: Men and women can play different roles in climate change adaptation



had up to 0.5 hectare of land with irrigation access (Figure 14). About 95 per cent households used canal for irrigation, while 5 per cent used tube wells or wells. The households informed that the operation and maintenance of the irrigation systems was carried out through collective community action since the irrigation system was established, and the same still continues with some modifications. Households contribute in the operation and maintenance of the irrigation systems by providing labor, economic support, or technical assistance (Figure 15 & 16).

According to the respondents, operation and maintenance of the irrigation systems is still highly dependent on collective community actions (Figure 17).

86

Figure 14: Total land benefitted by irrigation

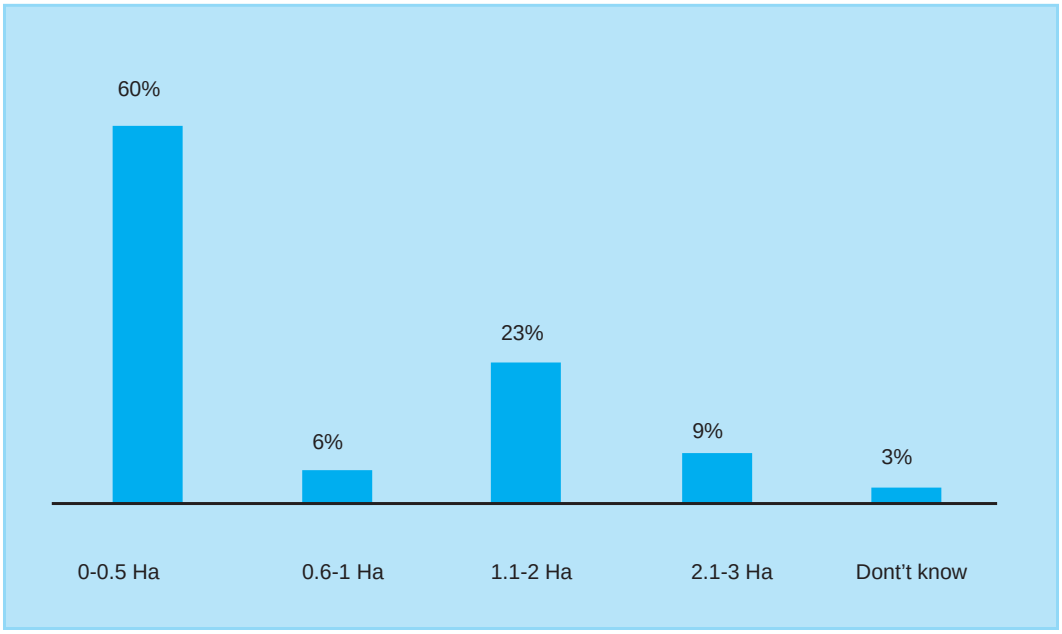


Figure 15: O&M since construction began

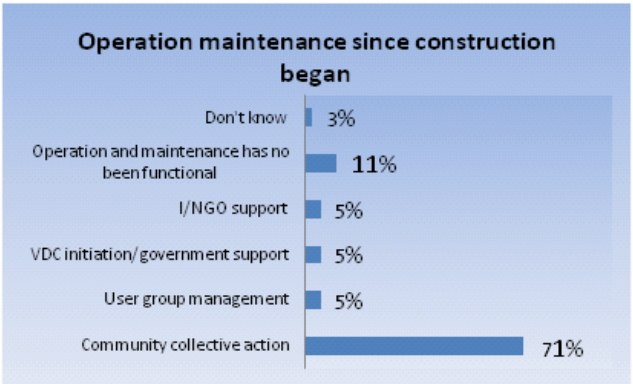
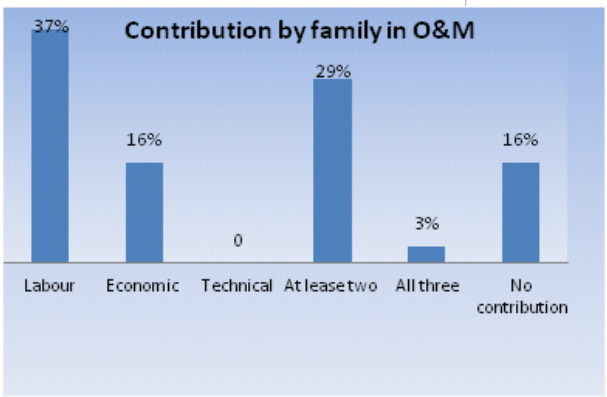
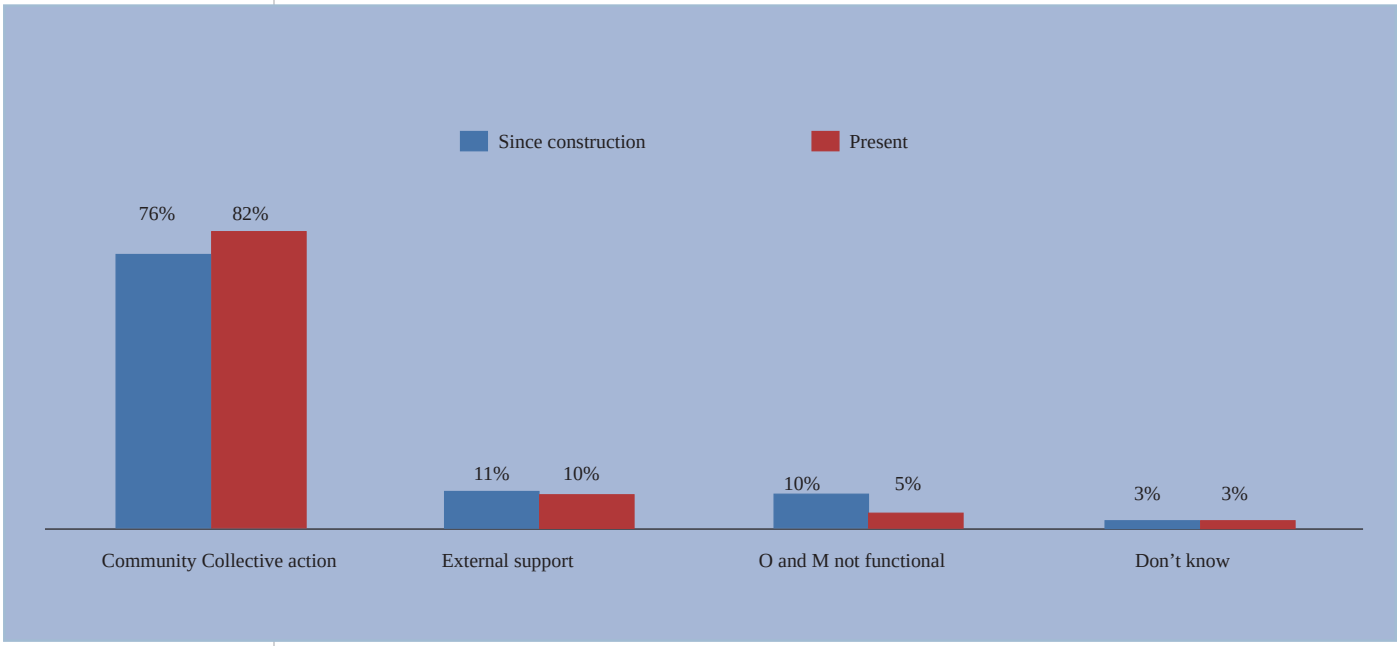


Figure 16: Contribution in O&M



87 Drinking water system (DWS) cases: Among 16 households interviewed, 62 per cent of the households had substituted their main source of drinking water supply from what they used in the past. At present about 56 per cent of the households

Figure 17: O&M of irrigation system



88 used private water taps, while 31 per cent used community water taps (supplied by pipelines by both government managed and community managed DWSs), and 12.5 per cent of households used other types of sources like ponds, wells and stone spouts. In the past, about 12 per cent of the interviewed households used private taps, another 19 per cent used community taps, and remaining 69 percent of the households used other sources of drinking water as their major source (Figure 18 & 19). 94 per cent of households mentioned that the current water supply system they are using is operating well. The respondents mentioned that the operation of the current DWS is smooth because the supply from the source is good, the cooperation among users' committee members is high, and it is community managed distribution system. About 94 per cent of the respondents reported that they have contributed in modification or repair work in their DWS due to in the effects of climate change or other changes. They had participated in the DWS maintenance either by providing labor contribution (31%), economic contribution (12%), or technical knowledge contribution (20%). Current operation, maintenance and management of DWS are either done by formal water users groups, households/communities, or both (Annex II).

Figure 18: Change in main source of drinking water

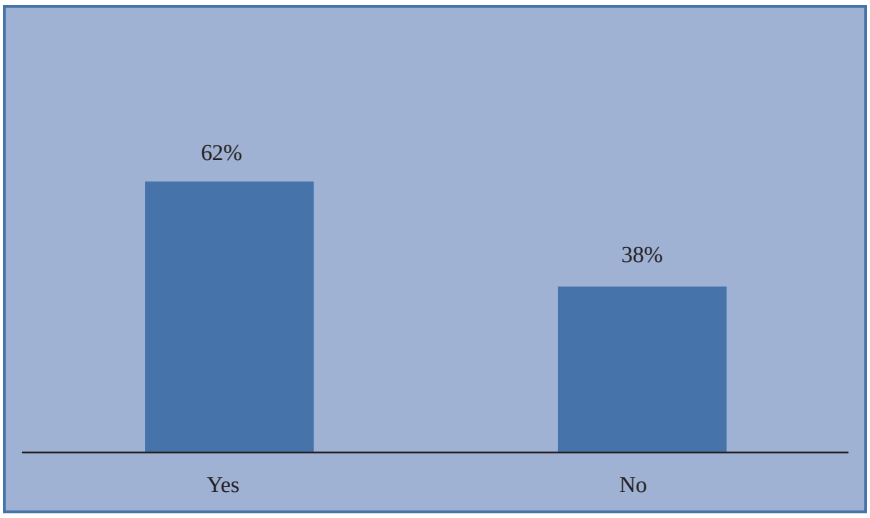
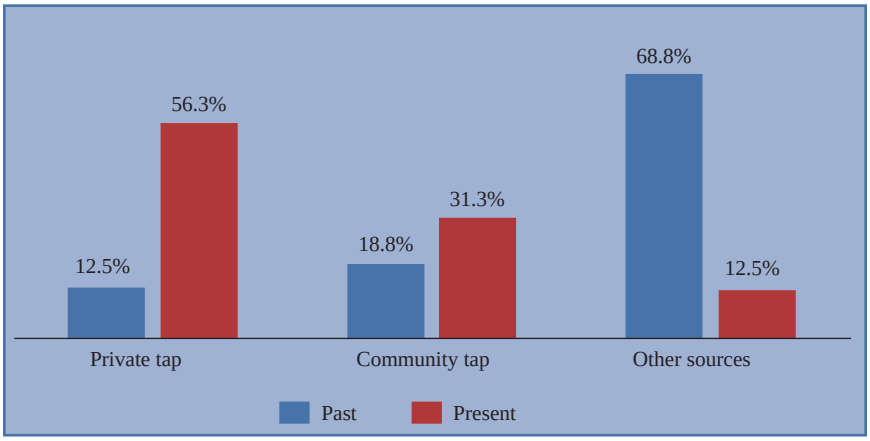


Figure 19: Main source of drinking water



2.6 DISCUSSION AND ANALYSIS

Drawing upon the findings from consultations and discussions and findings from case examples of FMIS, community managed drinking water systems and water mills, it can be argued that the indigenous and local knowledge of water management tranferred from generation to generation is comprehensive in the following ways: (i) in terms of their speciality in structure and design that suit local conditions, (ii) in framework of allocation and distribution that reflects good water governance and promotes equity in water distribution based on contributing labor for maintenance, and (iii) in management system which ensures continuity of operation with minimum disputes. These case examples highlight why some of the local water management systems are sustainable while others are not. The case study examples in seven districts clearly show that local people experience multiple drivers of change including climate change which affect traditional water management practices. Some are adapting to these changes using traditional methods, while others have developed practices that use both local and modern methods to sustain the systems. Such lessons can be helpful in building climate adaptive and resilient systems.

90 The case examples also demonstrate how hydrological, technical and socio-economic conditions have been considered while constructing the irrigation canals and underground network of conduits; and operating and maintaining them over the years. Argali irrigation system in Palpa, Sorah Chhattis Mauja irrigation system in Rupandehi, Raj kulos of Bhaktapur and stone spouts of Lalitpur were constructed through initiatives of local rulers or rich and influential farmers. In these endeavors, skilled personnel such as Argis (miners) were employed to dig canals that were elaborate and complex. Building such systems needed major investment in terms of labor and money thus, it was only possible in societies that had some element of affluence and surplus resources. For example, the command area of Argali is away from the main water source, and the canals are long with networks of distribution and diversion arrangements. Other irrigation systems of Jumla were smaller in scale and initiated by local farmers with simpler structures. The canals of Giri Khola irrigation and Tikhune irrigation in Jumla are short, the command area is close to the water source and water is diverted using a temporary diversion weir.

91 One of the ILKP deployed during canal construction was using extreme heat and pouring of cold water to break the rocks. The same effect was also achieved with gahat (lentil) or barud (gun powder). This technology was used in the water systems of Palpa and Jumla where the canals passed through rocky terrain in the hills. Sorah Chhattis Mauja system is relatively large with substantial amount of water discharge. The source river Tinau experiences frequent flash floods in monsoon that wash away the diversion. The farmers understood the nature of the river, and developed and maintained an indigenous practice of *kulara* to mobilize labor resources to build temporary *syauli bandh* (brushwood dam) and divert water to the canals from Tinau River. Use of *syauli bandh* with *tinghode* or *juhari* (wooden holder with three legs) is also common in irrigation systems of Jumla. Local and indigenous knowledge, skills and techniques have enabled communities to adapt to the changing condition of water flow, the availability of water, and changing agro-ecological conditions. Operational and technical management of *kulara* system including *khara* (fine) payment is similar in the management of both Argali and Chhattis Mauja irrigation systems. Indigenous Tharu knowledge is prevalent in practices like *pankat* or water control during flood and *kulara*.

92 Likewise, the institution of *pani sanchoes* (wooden weirs), which are simple control structures that divide water in the main canal to distribution canals, is a practice commonly used. As weirs are built in the river, the width of the weir corresponds to the water allocated for the branch canals. The width is set according to land holding size of the farmers. *Dundh* (traditional open wooden pipe), which is used to maintain flow of water, is common in irrigation systems and water mills of Jumla and Sindhupalchowk. Sticks were used to measure and dig out soil while constructing canals. Traditional agricultural tools such as *kuto, kodalo, aasi, damlo*, wooden shovel, *gal, bausa, jato* (stone grinder) are made locally by skilled persons. These tools help introduce efficiency in construction of canals and similar water systems.

93 While ILKP used in local water management are diverse, not all these knowledge and practices suit the present circumstances; and thus, ILKP faces multiple challenges. Raj kulo of Bhaktapur and stone spouts of Patan can be taken as examples of this

case. They help to further explain how some indigenous and local technologies, despite excellent designs, could not be sustained. The multiple water use approach used by Raj Kulos was not adaptive in the changing socio-economic contexts of the country. Most of the Raj Kulos do not function anymore.

94 Some significant examples realised from the case studies are the technical arrangement that reflect social context and the organisational aspect of water management. The distribution structures supply water to beneficiaries based on their requirements without affecting the needs of the others. However, this arrangement depends on water availability and the season. Similarly, the organizational strength of local water management is even more significant. The local water management institutions follow traditionally established customs and enforce rules set by those who initially developed the systems. This practice, on one hand, has enhanced local ownership and sense of collective responsibility; and on the other, has built institutions that have survived centuries. These inbuilt mechanisms and norms can help build adaptive capacity of the users and integrate it with analytical rigor of scientific knowledge and bring about resilience as Nepal faces the impacts of climate change.

95 Another noteworthy example observed during the study was the gradual change in the practices that discriminated against women and other occupational caste groups. This shows the flexibility within the institution allowing the norms to be changed. Indeed, the hierarchic arrangement that evolved within historical context had embedded gender differentials. Social construction regarding gender still limits women's decision-making roles in irrigation and water management process; however, their participation has increased significantly as compared to the past. In the past women's roles were more confined to works such as collecting/carrying of wood, brushwood, and stones in preparation of temporary dams or preparing of food for male workers and were not allowed to be near canal and water taps during menstruation. Likewise, occupational caste groups (Dalits) were not allowed to participate in religious ceremony during canal work and were many times assigned to use different water taps than other caste groups. This has progressively changed now.

96 Women and Dalits actively participate in different activities of the irrigation process; including religious ceremonies and in the works related to canal operation and maintenance. As members of user group committees, women bring their knowledge and experience of conserving water and its management. Activities such as erection of syauli diversion needs intensive labor and are dominated by male workers; but because of the current situation, where many male members of the family have migrated for work, women have increased their roles in such activities that were strictly within the domain of males in the past. While the changing social condition has created space for women's empowerment, it has also added to their drudgery, as women bear multiple workloads.

97 **Implication for adaptation and climate resilience in local water management:** The study shows that the climate change induced variability will have major impacts on the existing water systems. Increasing temperature and change in rainfall has

affected water availability and existing systems are unable to meet the increasing needs of water. Similarly, incidences of landslides and floods exacerbated by climate change have directly impacted irrigation canals, water distribution lines, and water mills. The implications that climate change may have on local water management and how they may be dealt with can be drawn from the case studies.

98 Many local technologies like irrigation, drinking water systems and water mills were constructed using locally available materials. Sustaining this practice has become a challenge for two reasons. First, locally skilled persons and their skills are disappearing due to lack of livelihood opportunities in continuing the traditional work. The common phenomenon of migration across the country has created demographic shift in villages with implications for sustaining institutions such as kulara. Secondly, though many of the practices evolved over time are adaptive and sustained till today, they are not resilient enough to face the impacts of climate change and other changes. This lesson has already been learnt as seen in the case studies. In Argali and Sorah Chhattis Mauja irrigation systems, farmers have replaced surki lining of earthen canal by cement lining to prevent leakage and maintain water delivery efficiency and strengthening the diversions to deal with the monsoon flood. In Patan, Godavari and Bandipur, communities have dealt with increasing pressure on water resource by using pipes and tanks for storing water. Polythene conduits have replaced wooden ones in many of the observed water mills. ILKP in local water management needs to be integrated with newer technologies to make the existing systems and practices more resilient.

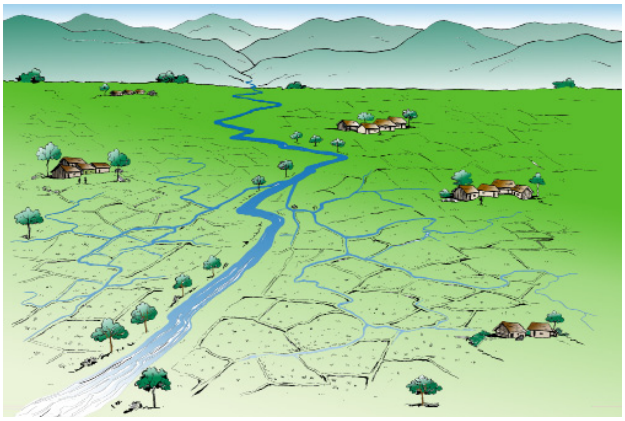
2.7 CONCLUSION AND RECOMMENDATIONS

99 The study shows that it is difficult to differentiate change impacts resulting from climate change, and those resulting from other change drivers. Having mentioned thus, rising temperature and erratic rainfall are commonly experienced phenomena whose implication ripples through existing systems in varieties of ways. The local communities have used indigenous and local knowledge and skills to adapt to these changes and manage water. These practices consider hydrological, technical and socio-economic conditions at the local level while implementing adaptation plans. This practice has continued for years in the case study sites. New initiatives in water management need to recognize this knowledge as an asset for enhancing resilience.

100 The case examples show that collective actions are needed to institutionalize practical ways to sustain local water systems in the changing climate scenario. Many of the ILKP that had sustained local water management practices have gradually disappeared over time as intervention of modern technology has led to its neglect. Emerging water scarcity that climate change and rapid urbanization will bring needs creative approaches to manage the water demand. This can be augmented by bringing in the strength of ILKP and synthesizing it with the scientific method to enhance adaptive capacity and resilience.

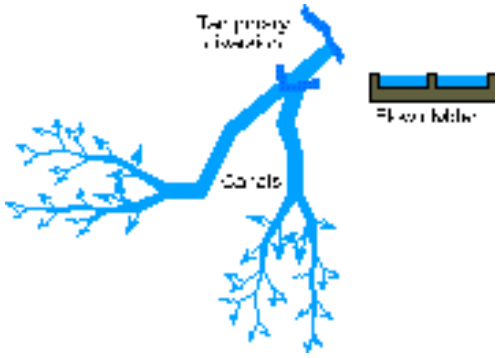
101 ILKP practices regarding local water management are unique because the framework within which people network and participate fosters collective ideas to be generated and builds its own capacity to enhance resilience as the social, economic and political

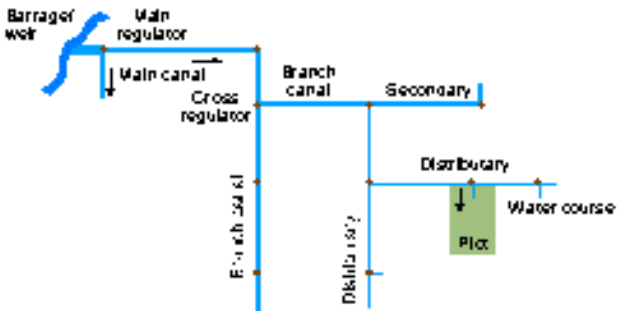
Schematic of farmer and agency managed irrigation systems



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)

contexts change. Reliance on local technology is strengthened by the collective support to innovate new ideas. These systems have evolved with their own set of rules and regulations; changing when needed, in time of crisis, to adapt to new contexts. This process has continued over the centuries and it suggests that local ownership is central if local impacts of climate change are to be dealt with. This is a key lesson to be learnt as societies attempt to deal with climate change. While more interventions and investments are required for climate change adaptation at the local level, building on local and indigenous knowledge on water management will help enhance resilience. The following recommendations are made based on the study findings:

- Case studies of water management systems in Nepal show how locals have diverted water for irrigation, to run water mills, and to generate hydro-electricity among others. This practice needs to be explored in terms of management, benefit sharing, resource sustainability, and conflict resolution.
- Water management system needs to be enhanced using alternatives techniques over those existing in ILKP like rain water harvesting, ponds/wells construction, and multiple use of water to adapt to increasing impacts of climate change.
- Steps towards awareness building should be taken to ensure that not every impact is attributed to climate change, especially if there are no evidences for such an attribution. Also, such knowledge will be important for the local community to understand the implications of climate change.
- Rapid urbanization is a major driver that poses challenges to local water management, which the local government alone is unable to address. Policies and legislation on land use and urban water management need to protect arable land and water rights. Irrigation canals, large farmlands and water sources have faced damage because of lack of clarity of land use. New policy needs to recognize the local level practices in the changing context in farming.
- Local water is a common pool resource, and may overlap across more than one administrative boundary. Such a context requires national/ local level policies and regulations that would mediate allocation of resources equitably to meet increasing needs. Criteria based on the historical use of the water resource, demand and supply balance, and good management practices will contribute to such an endeavor.
- Indigenous and local practices and systems need to be recognized and integrated while introducing new water management system and technology to provide local ownership and ensure sustainability. Thus, new practices need to follow bottom-up approach to promote effective aspects of ILKP.

ANNEXES
Annex I: District profiles

PALPA DISTRICT
Total Population: 261,180
Population Density: 190.23
Ethnic composition: Newars, Magars
Agro-ecological Zone: Western Mid-Hill
Total VDCs: 65
Total Municipalities: 1
Total Household: 59,291
Total literacy rate: 76.2
Female Literacy: 56.4
NAPA vulnerability: 0.003 (Very Low)
Mean Maximum temperature: 27°
Mean Minimum temperature: 15.1°
Annual Precipitation: 1571mm

TANAHU DISTRICT
Total Population: 323,288
Population Density: 209.11
Ethnic composition: Newar, Magar, Gurung, Brahmin, Chhetri, Damai, Sarki
Agro-ecological Zone: Western Mid-Hills
Total VDCs: 46
Total Municipalities: 1
Total Household: 78,309
Total literacy rate: 74.8
Female Literacy: 56.2
NAPA vulnerability: 0.503 (Moderate)
Mean Maximum temperature: 29.7°
Mean Minimum temperature: 17.7°
Annual Precipitation: 2000 mm

SINDHUPALCHOWK DISTRICT
Total Population: 287,798
Population Density: 113.22
Ethnic composition: Tamang
Agro-ecological Zone: Central Mountain
Total VDCs: 79
Total Municipalities: 0
Total Household: 66,688
Total literacy rate: 59.6
Female Literacy: 51.9
NAPA vulnerability: 0.403 (Moderate)
Mean Maximum temperature: N/A
Mean Minimum temperature: N/A
Annual Precipitation: N/A

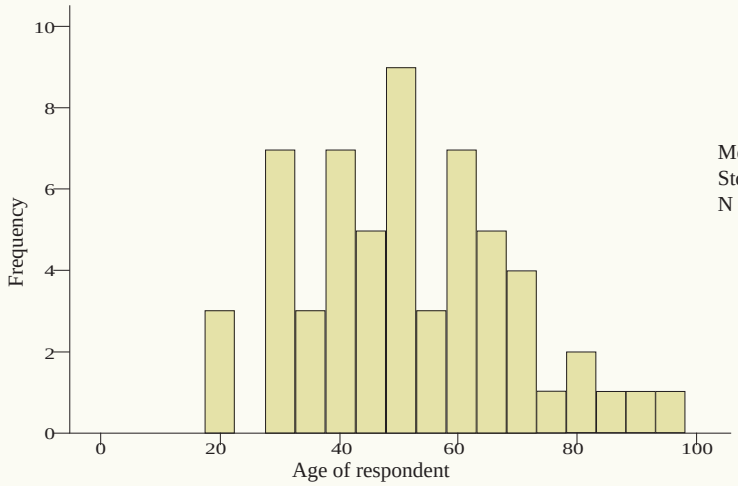
BHAKTAPUR DISTRICT
Total Population: 304,651
Population Density: 2560.1
Ethnic composition: Newar, Chhetri, Brahmin, Tamang
Agro-ecological Zone: Central Mid-Hill
Total VDCs: 16
Total Municipalities: 2
Total Household: 68,636
Total literacy rate: 81.7
Female Literacy: 72.7
NAPA vulnerability: 0.886 (Very High)
Mean Maximum temperature: 18.8°
Mean Minimum temperature: 10.4°
Annual Precipitation: 2000 mm

RUPANDEHI DISTRICT
Total Population: 880,196
Population Density: 647.2
Ethnic composition: Brahmin, Magar, Tharu, Musalman, Yadav, Chhetri, Chamar/Harijan/Ram, Kami, Lodh, Kewat
Agro-ecological Zone: Western Terai
Total VDCs: 69
Total Municipalities: 2
Total Household: 163,916
Total literacy rate: 70.0
Female Literacy: 60.8
NAPA vulnerability: 0.000 (Very Low)
Mean Maximum temperature: 30.8°
Mean Minimum temperature: 19.0°
Annual Precipitation: 1935 mm

LALITPUR DISTRICT
Total Population: 468,132
Population Density: 1215.9
Ethnic composition: Chhetri/Brahmin, Tamang, Newar
Agro-ecological Zone: Central Mid-Hill
Total VDCs: 41
Total Municipalities: 1
Total Household: 109,797
Total literacy rate: 82.5
Female Literacy: 74.4
NAPA vulnerability: 0.193 (Low)
Mean Maximum temperature: 22.7°
Mean Minimum temperature: 11.7°
Annual Precipitation: 1933 mm

JUMLA DISTRICT
Total Population: 108,921
Population Density: 43.03
Ethnic composition: Chhetri, Brahmin, Thakuri, Kami, Sarki, Damai
Agro-ecological Zone: Mid-West Mountain
Total VDCs: 30
Total Municipalities: 0
Total Household: 19,303
Total literacy rate: 54.7
Female Literacy: 40.8
NAPA vulnerability: 0.562 (Moderate)
Mean Maximum temperature: 21.6°
Mean Minimum temperature: 5.4°
Annual Precipitation: 832 mm

Annex II: SPSS data tabulation



	Irrigation	Drinking Water	Total
Bhaktapur	9	0	9
Jumla	10	0	10
Lalitpur	0	9	9
Palpa	9	0	9
Rupandehi	15	0	15
Tanahu	0	7	7
Total	**43**	**16**	**59**

	Male	Female
Bhaktapur	5	4
Jumla	7	3
Lalitpur	6	3
Palpa	7	2
Rupandehi	11	4
Tanahu	3	4
Total	**39**	**20**

Sectors * Name of district Crosstabulation

		Name of districts						Total
		Bhaktapur	Jumla	Lalitpur	Palpa	Rupandehi	Tanahu	
Sectors	Irrigation	9	10	0	9	15	0	43
	Drinking water	0	0	9	0	0	7	16
Total		9	10	9	9	15	7	59

Name of district * Gender Crosstabulation

		Gender		Total
		Male	Female	
Name of district	Bhaktapur	5	4	9
	Jumla	7	3	10
	Lalitpur	6	3	9
	Palpa	7	2	9
	Rupandehi	11	4	15
	Tanahu	3	4	7
Total		39	20	59

Name of district * Caste categories Crosstabulation

		Caste catagories			Total
		Chhetri/Brahamin	Janajati	Dalit	
Name of district	Bhaktapur	4	5	0	9
	Jumla	7	0	3	10
	Lalitpur	4	5	0	9
	Palpa	7	2	0	9
	Rupandehi	6	9	0	15
	Tanahu	1	3	3	7
Total		29	24	6	59

Name of district * Religion Crosstabulation

		Religion			Total
		Hindu	Buddhist	Christian	
Name of district	Bhaktapur	9	0	0	9
	Jumla	10	0	0	10
	Lalitpur	5	3	1	9
	Palpa	9	0	0	9
	Rupandehi	13	2	0	15
	Tanahu	7	0	0	7
Total		53	5	1	59

Name of district * Major occupation Crosstabulation

		Major occupation						Total
		Agricul-ture	Business/ trade	Job/ service	Wage labor	Remit-tance	Others, specific	
Name of district	Bhaktapur	9	0	0	0	0	0	9
	Jumla	5	0	2	3	0	0	10
	Lalitpur	0	4	4	0	0	1	9
	Palpa	7	2	0	0	0	0	9
	Rupandehi	11	1	1	0	2	0	15
	Tanahu	4	1	1	0	1	0	7
Total		36	8	8	3	3	1	59

Religion	Frequency	Percent	Valid Percent	Cumulative Percent
Hindu	53	89.8	89.8	89.8
Buddhist	5	8.5	8.5	98.3
Christian	1	1.7	1.7	100.0
Total	59	100.0	100.0	

Major occupation	Frequency	Percent	Valid Percent	Cumulative Percent
Agriculture	36	61.0	61.0	61.0
Business/trade	8	13.6	13.6	74.6
Job/service	8	13.6	13.6	88.1
Wage labor	3	5.1	5.1	93.2
Remittance	3	5.1	5.1	98.3
Others, specific	1	1.7	1.7	100.0
Total	59	100.0	100.0	

Food sufficiency		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 3 months	6	10.2	10.2	10.2
	3 - 6 months	23	39.0	39.0	49.2
	6 - 9 months	17	28.8	28.8	78.0
	9 - 12 months	2	3.4	3.4	81.4
	Year around food stock	4	6.8	6.8	88.1
	No cultivation	7	11.9	11.9	100.0
	Total	59	100.0	100.0	

Education of household head		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Illiterate	10	16.9	16.9	16.9
	Literate but no formal education	21	35.6	35.6	52.5
	Primary school	3	5.1	5.1	57.6
	Secondary school	12	20.3	20.3	78.0
	Intermediate level	7	11.9	11.9	89.8
	Bachelor level	5	8.5	8.5	98.3
	Master level	1	1.7	1.7	100.0
	Total	59	100.0	100.0	

Food sufficiency		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 3 months	6	10.2	10.2	10.2
	3 - 6 months	23	39.0	39.0	49.2
	6 - 9 months	17	28.8	28.8	78.0
	9 - 12 months	2	3.4	3.4	81.4
	Year around food stock	4	6.8	6.8	88.1
	No cultivation	7	11.9	11.9	100.0
	Total	59	100.0	100.0	

Operational and maintenance support to maintain drinking water system		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Labor contribution	5	31.3	31.3	31.3
	Economic contribution	2	12.5	12.5	43.8
	Technical knowledge	3	18.8	18.8	62.5
	At least two of above	3	18.8	18.8	81.3
	All three	1	6.3	6.3	87.5
	No contribution	2	12.5	12.5	100.0
	Total	16	100.0	100.0	

CASE STUDY III

UNDERSTANDING INDIGENOUS AND LOCAL PRACTICES IN FOREST AND PASTURE MANAGEMENT FOR CLIMATE CHANGE ADAPTATION IN NEPAL

CONTENT

ABSTRACT

Forest and pasture resources provide critical livelihood support to the majority of indigenous and local communities (ILC) of Nepal. Local users have developed a strong tradition of using these resources balancing demand and supply. Rich and diverse types of indigenous, traditional and local forest and pasture management practices are found throughout Nepal according to different cultures, locations, and socio-economic situations. Most of these practices are adaptive, flexible, scalable and low cost. A large number of these community-based natural resources management (CBNRM) practices conserve soil, water, and biodiversity as well as protect vital livelihood and development infrastructures building resiliency and adaptive capacity of ecosystems.

Climate change, as the newest driver of deforestation and degradation, has been impacting forest ecosystem by fragmenting habitats, altering species composition, changing growing season, lowering biomass productivity, and increasing risks of fires and floods. Forest dependent communities are coping with the changes by using their indigenous knowledge, skills, and practices (ILKP) and applying these to make forest management more adaptive and resilient. They have accumulated an array of indigenous knowledge and practices that are globally recognized as inclusive and adaptive solutions. However, these practices need systematic documentation, understanding, and promotion. This case study reports on the documentation and assessment of different community based practices drawn from five case examples in five districts of Nepal covering aspects including evolution, innovations, and adaptation. Using field-based shared learning approaches, it explores the challenges and opportunities of integrating, synergizing, and complementing indigenous practices with modern scientific knowledge and technologies.

Among the major findings, a diverse type of community-based adaptive, sustainable and resilient building practices, tools and techniques are found to be widely used. Location and situation specific community based protection, development, conservation, and sustainable utilization practices are commonly prevalent and largely successful. Promotion of non-timber forest products (NTFPs) and eco-tourism for saving trees and wild animals, using biological flood control measures to reduce flood and landslide risks, social fencing for effective forest protection and rotational grazing management are some of the major indigenous practices. The communities are diversifying forest products giving more emphasis to non-timber, marketable, short-duration products and services. Forest management plans are being mainstreamed with climate change in the form of community adaptation plan of actions or CAPA. Indigenous adaptive capacity is being improved through tailored training and capacity building. Forest and pasture users are well organized institutionally and increasingly found integrating, synergizing, and complementing their indigenous and local practices with the government management systems and rules.

4 Effectively addressing climate change impacts on forest and pasture lands needs new and synthesised forest management knowledge, experience, and skills and continuous policy support. Although indigenous peoples and local communities are successfully demonstrating the use of their traditional knowledge, innovation, and collective efforts to achieve multiple benefits from forests in an equitable and sustainable manner, they need support to adapt to increasingly complex and unpredictable phenomenon of climate change. The Government of Nepal has recognized the critical role played by these knowledge and practices and community / collective forest and pasture management systems are in place in many localities in Nepal in particular in remote mountain areas. The Government needs to further expand and protect these examples from the risks and hazards posed by climate change. This can form a good basis to plan and implement sustainable forest management activities that support the country to adapt to climate change impacts.

3.1 INTRODUCTION

5 One of the major challenges of Nepal's forestry sector is how to meet the growing demand for forest products - both timber and non-timber - while providing ecosystem services such as watershed protection for saving lives and properties from extreme weather events. Well managed forests, especially in mountain landscapes, are known to be more climate resilient. Good forest management practices reduce flood and landslide vulnerability as well as generate ecosystem goods and services such as clean water, air, food, fuel wood, timber, fodder, and eco-tourism (FAO/SDC, 2011). This case study documents and assesses various types of indigenous and local forest and pasture management systems that are community managed and adaptive. It reports on the different types of indigenous and local forestry and pasture management practices prevailing in different parts of Nepal by employing a case study approach. In-depth study of five case examples demonstrate how community-based forest management (CBFM) practices are being used as the principle means to plan climate change adaptation and build community resilience.

6 Nepal's indigenous and local communities were managing their forest and pasture resources well through different types of community systems till late 1950s when suddenly the government nationalized all forest lands in 1957. This swift action turned what used to be a communal system of protected forests into open-access resources with all the traits of `tragedy of commons' syndrome (Hardin, 1978). Previously, the forests used to be managed by local communities using their indigenous and local knowledge and practices (ILKP) (Gilmour, 1989; Fisher, 1989, and 1991; Baral and Lamsal, 1992). But the nationalization of forest resources disenfranchised and disempowered them resulted in massive deforestation, forest degradation, and land conversion (Wallace, 1981; Eckholm, 1976). The Government, realizing its mistake, initiated a series of policy and legislative steps toward decentralized and devolved community-based forest management (CBFM) by enacting and amending policies,

acts and regulations starting in 1975. Ultimately in 1993 Community Forestry Act was passed and in 1995 detailed regulations were issued (Baral, 1992). Most of the credit for such a policy change goes to Nepal's diverse and rich indigenous forest management practices (Gilmour, 1989; Baral & Lamsal, 1991).

A number of authors have documented the role of indigenous local knowledge in forestry (Berkes, 2009). Most agree that such practices have helped make the community-based forest management (CBFM) or community forestry (CF) practices more adaptive and attuned to different types of changes including climate change (Karki et al., 1994; Chhetry and Pandey, 1993; Carter et al., 2011; Van Bodegom et al, 2009). Most authors agree that such collective actions-based indigenous system of managing forest have halted deforestation and restored greenery, especially in the Middle Hills of Nepal. However, in recent years, rapid climate change and climate variability combined with socio-economic changes have created multiple risks and hazards to the CBFM practices (MoFSC, 2013). Forest area and density, biodiversity and potential for sustainably harvesting products are decreasing. Incidence of pests and diseases, fire, and invasive species has increased. While productivity in low land forests is declining, in highland tree line is moving up. Climate change has created a number of problems and some opportunities forestry sector. Therefore, mainstreaming these new risks and possibilities into forest and pasture management (FPM) strategies has become necessary to protect watersheds, biodiversity and local community's livelihoods (MoFSC, 2011; MoFSC, 2013).

Adaptation and mitigation are two major approaches that can be adopted to manage these changes impacting Nepal's forests (Pokharel and Byrne, 2009; FAO, 2011; RECOFTC, 2012). Among these alternatives, adaptation is more urgent and of immediate priority for Nepal since adaptation is necessarily local and most of the CBFM practices are also local. Given the high dependence of the indigenous and underprivileged locals on forest-based goods and services, there is a need for documenting and sharing local adaptation practices. Synthesized and systematically assessed indigenous local knowledge systems (ILKS) have potentials to scale up forestry adaptation practices. At present, ILKS is more important than scientific knowledge on forest and climate change (CC) since later: a) exists mostly at global or regional level, b) generally is not applicable, accessible and affordable by local forest users to solve local forestry problems, and c) at the national level there is knowledge and capacity gap to provide situation specific forestry-based adaptation advice (MoFSC, 2013).

In Nepal, indigenous and local knowledge have evolved along in the context of particular culture, rituals, livelihood strategies, location of indigenous and local communities (ILC) over generations. From hunting-gathering stage to shifting cultivation, forest lands have always been managed for food, fodder, fuel wood and other basic needs by ILCs. Nepali hill farmers have developed farming systems using their indigenous knowledge wherein forestry and agriculture systems are intricately linked (Karki, 1982). Animals – both domestic and wild, are important

component of the integrated forestry-farming system of Nepal as animals contribute to nutrient cycling between forests and farms (Hardwood, 1978). Managing trees and associated vegetation has been the expertise of indigenous local communities for generations since it's the most common resource to which they have access to.

10 However, in recent years, forest users have been increasingly facing the negative impacts of climate induced stress and vulnerability both on forest landscape and community managing them. These communities are doing their best to cope with the changes but it is clear they require new knowledge to address this new challenge, which, unfortunately, the forestry agencies are not in a position to supply. Indigenous local knowledge and practices in forestry comprises a combination of forest, pasture, and terrestrial biodiversity management typologies that are categorised by various authors (Gilmour, 1989; Baral & Lamsal, 1991; and Roy et al., 2004; Shrees Magar, 2007; Aryal, 2013) as: a) indigenous, b) community, c) communal, d) collaborative, e) government, and f) protection/conservation systems of management. The five case examples meet the above described case study selection criteria and demonstrate diversity, richness, and quality in terms of indigenous local knowledge and practices.

11 Therefore, the people of Nepal have been using diverse types of indigenous and local knowledge systems (ILKS) in dealing with these changes (Sherpa, M, 1993; Roy et al., 2004; Shrees Magar, 2007; Sherpa PD et al., 2013). In the past, indigenous local knowledge systems (ILKS) had helped them cope with urgent and immediate challenges. These measures are no longer proving to be adequate to deal with both rapid changes such as temperature rise and shifting of rainfall timing and volume as well as extreme events. Most of the vulnerable communities are barely able to cope with the changes to address immediate threats. However, adaptation need medium to long term resilience building and systematic changes for which using their indigenous local knowledge and practices is likely to face a varying degree of success. This issue needs to be explored and this is the rationale for this case study.

3.2 CASE STUDY OBJECTIVES AND RESEARCH QUESTIONS

3.2.1 General Objectives

12 The general objective of the FPM case study is to contribute to the understanding of the role of indigenous, traditional, and local knowledge and practices (ILKP) in building resilience and improving adaptation of the forest and pasture management systems in the context of regional and local climate variability and change in Nepal. The specific objectives are:

3.2.2 Specific Objectives

a. Identify and analyse climate change issues and adaptation priorities of the local forest and pasture management from the perspectives of diverse social, cultural and linguistic groups in different ecological zones of Nepal,
b. Identify, analyze and document adaptation practices in forestry sector based on indigenous local population's ways of recognizing climate change related impacts in their social and natural environments, and
c. Recommend how indigenous local adaptation practices in forestry and pasture systems can be integrated into the local development plans and programmes thereby mainstreaming climate change risk management in overall development projects.

3.2.3 Research Questions

Common research questions applicable to all the five case themes were pre-set based on the literature review and are described in Chapter 1. Forestry specific questions were set and refined during the field research process. The questions are also customized to the sub-themes of forests and pasture/range management.

The case study has developed research questions from the perspectives of the climate change adaptation planners, policy decision makers and ILK holders and practitioners that the researcher have used in analysing and discussing the findings of the case study. They are:

a) What have been the findings and directions of the past studies on indigenous forest and pasture management systems in Nepal?
b) What constitutes good indigenous and local knowledge and practices (ILKPs) in the forest and pasture management sector at local and national contexts?
c) What attributes of the practices can be characterized as adaptive, flexible, and cost effective and what are some of the examples identified by this case study?
d) Can the practices documented be considered climate resilient, gender sensitive, and inclusive?
e) What are some of the programme and policy related implications of these case study findings in Nepal? and
f) What are some of the key methodological challenges, assumptions and limitations of the study?

3.2.4 Case Specific Methodology

The general methodology applicable to all the five Case Study themes is described in Chapter 1 of this report which provides a broad frame work. The forestry and pasture management specific methods employed for this case study is based on the concepts and tools of participatory action research (PAR), multi-methods and triangulation approaches, and shared learning tools. Household (HH) interview questionnaires

were used to collect data from purposively selected HH representative. National and district level consultations, focus group discussion (FGD), and key informant interview (KII) were used as the shared learning tools to collect stakeholders' feedback. Besides, comprehensive literature on community-based forest and pasture management (CBFM) was reviewed and individual experts were consulted to finalize the checklists and questionnaires.

3.3 CASE BACKGROUND

3.3.1 Case Introduction

16 This Case study describes the indigenous and community-based forest and pasture resources management systems in five different socio-cultural locations and settings in Nepal. It focuses on the context of climate change induced vulnerability and impacts. These study locations are defined as Case examples that have been selected purposively to capture the diversity of the indigenous local practices prevailing among indigenous and community based forest and pasture management systems throughout Nepal.

17 Generally, the examples selected are based on ethnicity (culture, language, and social norms), agro-ecology, and indigenous local knowledge systems. The specific

FIGURE 1: Major causes of loss of resiliency in forest ecosystem

criteria for the selection of the case examples are: 1) application of indigenous and local practices over a long period of time; b) involvement of at least one major indigenous community; c) represents at least one of the three agro-ecological zones as well as development regions of Nepal; and d) features indigenous community-based management of forest and/or pasture lands. The examples selected had to demonstrate either full engagement by indigenous local community (ILC) or implementation managed by local community organizations or the cases are mainly benefiting the ILC. The other criteria used were that an indigenous practice had to be climate change adaptation oriented and enhance the resilience of CBFM practices and improve both conservation and livelihoods in the face of increasing climate variability and stress on the forest ecosystems. The practices chosen had to be also in use by local people – men and women of all ethnicity and castes - and environmentally and socio-culturally sound. The five case examples selected are listed below and shown in Table 1 and Map 1.

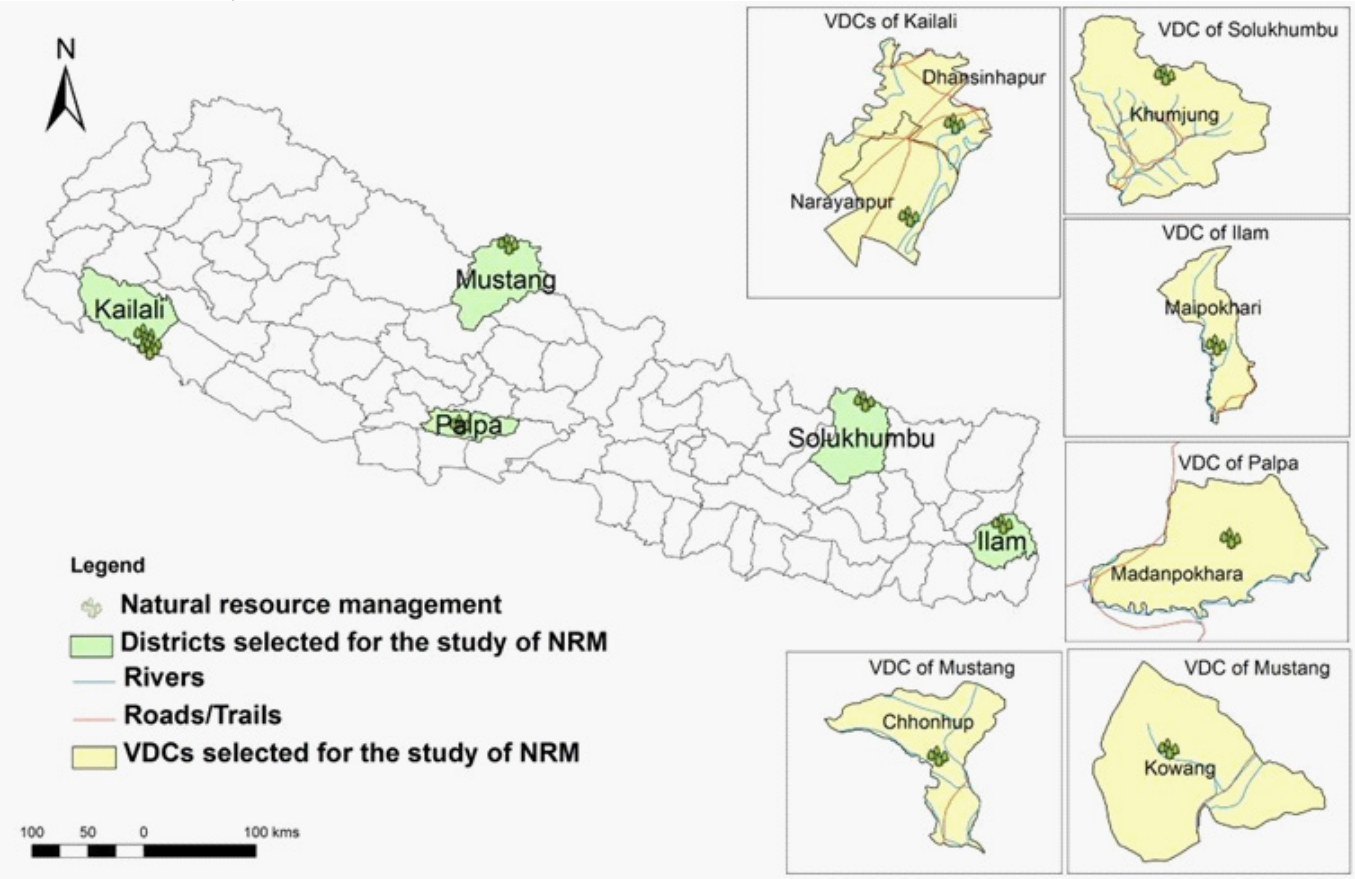
Besides, documenting indigenous and local knowledge (ILK) and practices of the forest and pasture users, the case study also gathers the perceptions, experiences, successes, and failures of these practitioners while adapting to and managing the changes. The focus is on the knowledge and practices that are directly meeting their livelihood and adaptation needs and indirectly supporting sustainable management of the forest ecosystem goods and services.

Table 1. Salient features of the case examples selected

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

Source: ISET/IDS Study Team, 2014; GON (2014)

MAP 1: Maps showing the location of the 5 case examples



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This case study documents the major indigenous and local practices (ILP), and highlights key issues and challenges encountered by the selected communities in integrating climate change risks and hazards in local FPM practices. The report also gathers lessons learned from different communities covering the experiences gained during the course of last several years when climate change impacts have become important stressors for forestry system in most part of Nepal. The information gathered has been disaggregated at specific ethnic and local user group level and analyzed. In addition, different perspectives and practices adopted by the users as part of their holistic management of resources were identified and documented. Various sections below introduce the case study objectives, research questions, and describe the socio-economic characteristics and climate change perceptions of five case examples. Key findings based on the analysis of the data collected are presented and a number of lessons learned and team reflections are shared. Discussion on good indigenous practices, key challenges, opportunities and recommendations are also presented towards the end.

3.3.2 Participation of Respondents:

The Case study organized four district level workshops, six focus group discussions, and 29 key informant surveys as shown in the Tables 3 and 4 which shows that the percentage of women among the respondents was 33% and janjati population was 54% (Table 2).

TABLE 2: Gender and ethnicity composition of the consultation respondents

S.No.	Data collection tool	Total	Male	Female
1	District level consultation	74	64	10
2	Focused Group Discussion	59	30	29
3	Key Informant Survey	29	15	14
	Total	**162**	**109**	**53**

S. No.	Data collection tool	Total	Bahun/ Chhetri	Janjati	Dalit
1	District level consultation	73	51	19	3
2	Focused Group Discussion	59	27	32	0
3	Key Informant Survey	29	9	19	1
	Total	**161**	**87**	**70**	**4**

3.4 CASE STUDY GENERAL FINDINGS

3.4.1 Introduction: The findings are divided into two parts

Common findings: These apply to all the five case examples. These include findings on socio-economic characteristics and social and gender response to climate change impacts by the research subjects and community's perception on climate change and climate variability in comparison to the trend established from the recorded scientific data from the Department of Hydrology and Meteorology (DHM), and

Case example specific findings: This section on the findings forms the main findings of the Case Study focusing on indigenous and local approaches, methods, and skills of coping with, building resilience against and adapting to the climate and other changes in their extant forest and pasture management practices. The two types of findings are described below:

3.4.2. Common Findings

Socio-economic characteristics of the indigenous forestry practitioners

The socio-economic data and information on the case study districts and VDCs were collected both from primary and secondary sources to understand the general socio-economic characteristics, ethnicity and gender division among the HH respondents. Brief accounts of the baseline information on the five case examples are described in this section.

25 As per the common case study methodology described in Chapter 1, the study team collected primary data through focus group discussions (FGDs), key informant interviews (KIIs), and Household interviews (HHIs). The tabulated data regarding the socio-economic characteristics of the district as well as environmental features are described in Tables 2-4 and Charts 1 and 2 which display some of the key attributes of the households (HH) covered by the study. Further details are provided in Annex 3.2 Tables 1-9.

26 Table 3 shows that the majority (31 out of 44 households) of the forest users selected for the household interview belonged to either indigenous (Janjati) or disadvantaged (Dalit) community. Agriculture is the main occupation of the majority (32 out of 44 households) of the respondents (Table 4), followed by small business (9 out of 44 households). Annex 3.2, Table 1 indicates that 54% of the respondents are native to their current geographical location. In terms of mother tongue spoken, 36% of the respondents are from Nepali language community followed by Gurung and Sherpa languages (Annex 3.2, Tables 1-2).

27 Regarding food self-sufficiency, only 25% respondents stated that their own produce was enough to meet their family needs for the whole year (Figure 3). Close to 50% (21 out of 44) responded that their own produce barely met the needs for 3-6

TABLE 3: Composition of caste/ethnicity of the HH respondents

Name of the districts	Caste categories			Total
	Chhetri/ Brahmin	Janjati	Dalit	
Ilam	1	6	0	7
Kailali	8	2	1	11
Mustang	0	10	0	10
Palpa	4	2	1	7
Solukhumbu	0	9	0	9
Total	13	29	2	44

TABLE 4: Major occupation of the household respondents

Name of the districts	Major occupation				Total
	Agriculture	Business/ Trade	Job/service	Wage labour	
Ilam	4	3	0	0	7
Kailali	9	2	0	0	11
Mustang	10	0	0	0	10
Palpa	5	1	1	0	7
Solukhumbu	4	3	0	2	9
Total	32	9	1	2	44

months (Figure 3 and Annex 2, Table 3). This portrays a poor status when it comes to food-sufficiency among the participants.

As shown in Table 5 below 17 out of 44 (39%) respondents – mostly household heads – are either illiterate or barely literate able to write his/her name. Close to 14% have intermediate or college level education degrees. Therefore close to 50% respondents are either high school pass or drop outs. Indigenous and local practices are closely associated with traditional social institutions. Annex 3.2, Tables 4 and

TABLE 5: Education of household heads or the representative respondents

Districts	Education of household head						Total
	Illiterate	Literate but no formal education	Primary school	Secondary school	Intermediate level	Bachelor level	
Ilam	0	1	3	3	0	0	7
Kailali	0	3	2	2	1	3	11
Mustang	5	2	1	1	1	0	10
Palpa	1	1	4	1	0	0	7
Solukhumbu	3	1	1	3	1	0	9
Total	9	8	11	10	3	3	44

FIGURE 2: Distribution of caste and ethnicity of HH respondents

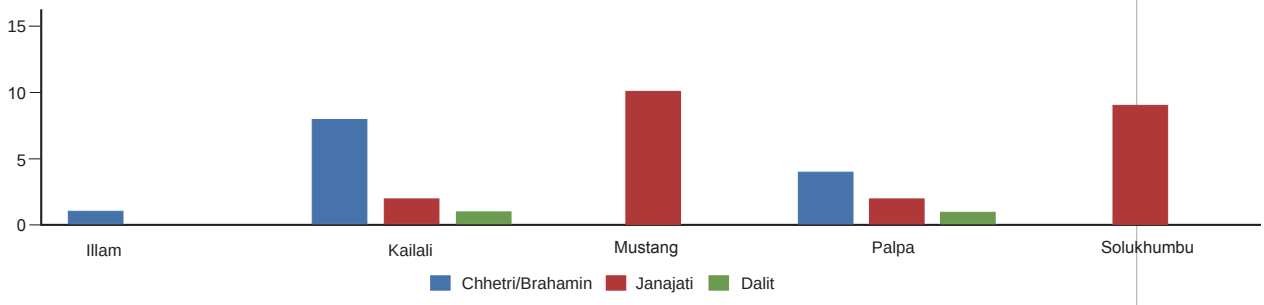
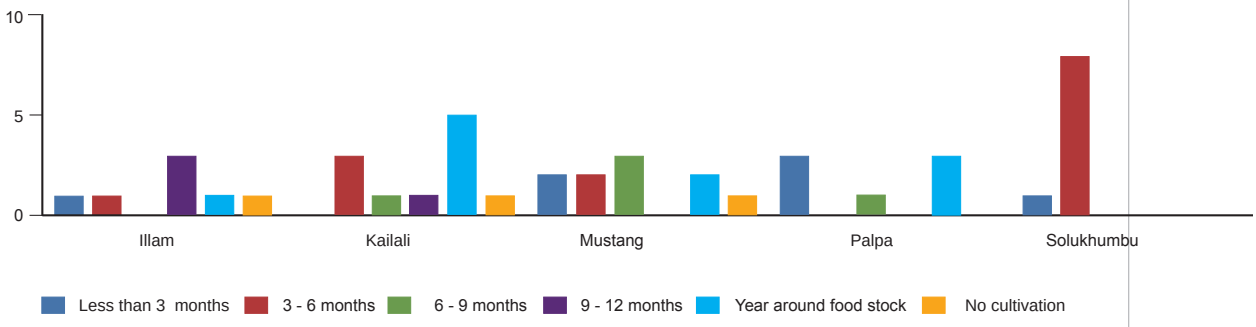


FIGURE 3: Food sufficiency among the case example HH respondents



5, indicate that 82% of the respondents are members of one or more traditional or social institutions and 75% feel that their membership is helping them enjoy some kind of livelihood benefits.

Community Perception of Climate Change

29 Climate data from the period between 1961 and 2012 - depending on the availability, were collected from the Department of Hydrology and Meteorology (DHM). The data were analyses to develop historical temperature and rainfall variability trends. The results indicate both significant and non-significant increases in annual temperature data. The analysis shows that annual mean temperature has been increasing in all case districts with higher increase showing in higher altitudes. Higher average increase is also found in winter temperature as compared to summer temperature. While increased number of hot days and less number of cool nights are being experienced in the hilly and mountainous districts, Tarai districts show more cold days and cold nights.

30 Regarding the precipitation trend, the station recorded data (DHM, 2012) analysis shows no particular trend from the data of the study districts. While Palpa and Mustang districts indicate increasing rainfall trend; Ilam, Dolakha and Kailali show decreasing amount of rainfall. However, only Mustang district trend is statistically significant (Annex 3.2, Figures 3 and 4).

31 The recorded data trends were compared with the data collected based on the community perception. As the table below (Table 6) the respondent's perception with regards to rise

TABLE 6. Historical and current climate change and climate vulnerability data

Districts	mean max - min (°C)	Annual precipitation (mm)	Mean annual rainfall trend (30 years)	Mean annual temperature trend (30 years)	NAPA vulnerability index
Palpa	27 – 15.1	1571	Non-significant changes (p-value = 0.891)	significant increase (, p-value=0.001)	0.003 (Very low)
Kailali	30.4 – 17.5	2602	Non-significant changes (p-value = 0.191)	significant decrease (p-value = 0.003)	0.192 (very low)
Ilam	19.8 – 11.9	2152	Decreasing but non-significant change (p-value = 0.619)	positive but non-significant change (p-value = 0.864)	0.140 (Very low)
Solukhumbu	N/A	1833.9	Non-significant change (p-value = 0.399)	Positive but non-significant change (p-value = 0.021)	0.725 (High)
Mustang	17.7 – 6.0 312	Significant increasing trend (p-value = 0.249)	Positive but non-significant change (p-value = 0.087)	0.559 (Moderate)	

TABLE 7: Community perception on the climate change impacts and indicators in the Case districts

Name of the districts	Perception on increase in temperature			Perception on change in rainfall patterns (seasons)		
	Yes	No	Total	Yes	Not Sure	Total
Ilam	7	0	7	7	0	7
Kailali	11	0	11	11	0	11
Mustang	10	0	10	10	0	10
Palpa	4	3	7	4	3	7
Solukhumbu	8	1	9	8	1	9
Total	40	4	44	40	4	44

in temperature matches well with the trend established based on the DHM collected data. The community perception on temperature increase and change in rainfall season both are found consistent with the scientific data (Table 7).

An overwhelming 40 out of 44 HH representatives confirmed their perception of increase in temperature and change in rainfall season. Regarding the rainfall patterns, except in Mustang, almost all the respondents felt that rainfall season has changed and both the number of rainy days and volume were decreasing. In their view, there were fewer days of rainfall than in the past although intensity of the event was higher. In Mustang, the respondent opined that both the rainfall amount and intensity have increased. In Palpa and Solukhumbu some respondents were not so sure. The community perception more or less confirms the recorded data trends which indicate no significant increase or decrease in rainfall except in Mustang where the recorded data shown a significant increasing trend (Annex 3.1, Figures 1-4).

32

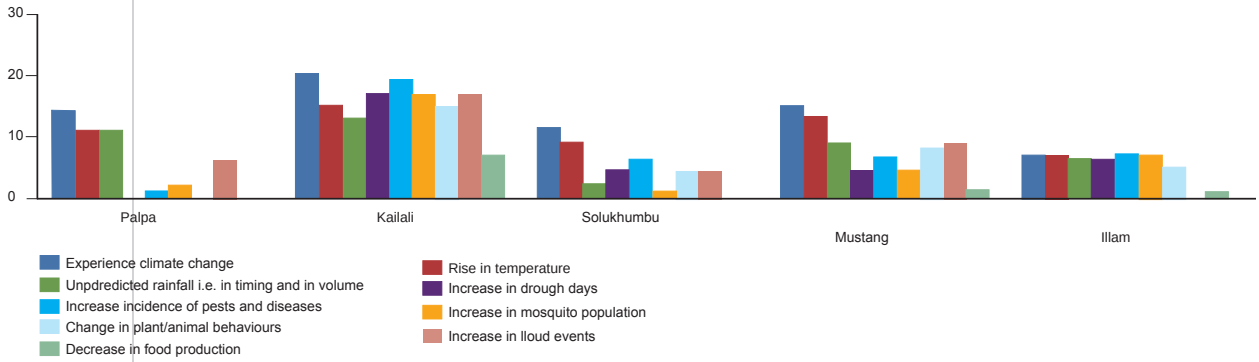
Regarding case location specific climate change impacts observed by the ILK household representatives, the participants provided varying response. Participants of the district level consultation provided a long list of perceived changes in climate conditions and events observed and/or reported from different parts of districts. For example, in Upper Mustang region it was reported that three villages of Samzong, Dhey and Yara were on the verge of moving out of their ancestral places due to drying up of traditional water sources, shortage of grazing land, and risk of flash floods. They also cited unprecedented 2012 flood in Tiri village, Kagbeni VDC which killed one person, swept away dozens of animals, destroyed recently completed drinking water system and destroyed houses, crops and farm lands.

33

At the community level, participants clearly expressed their experience of different types of climate change impacts such as fog and cold wave, droughts, and flood inundation in the Tarai districts; and flash floods, drying up of water sources, increase in pests and diseases in the Hills and Mountains (Figure 4)

34

FIGURE 4: Types of Climate Change Impacts Experienced by the Participants



35 As described above, the prime indicators of climate change in the study areas are temperature rise and higher variability in precipitation timings and amount during the past 30 years (Annex 3.2). The study investigated the threat perception of the household respondents to this indisputable climate change variability. More than 66% of the respondents felt that they and their communities were more likely to suffer from the negative impact of CC. They also mentioned that they have observed impacts in their own or nearby localities such as unprecedented flood events such as the unprecedented floods in Kailali district in 2008, 2010, and 2012. Dhangadi town was repeatedly getting inundated since 2008.

3.5 CASE EXAMPLE SPECIFIC FINDINGS

3.5.1. Case example No. 1: Community Managed Forests of Madan Pokhara

Case Evolution:

36 The forested areas in the Madan Pokhara VDC, Palpa were fast deteriorating and food production was declining after the nationalization of the forests by the Government in 1960s and early 70s. Today, thanks to the sustained efforts by the indigenous and local forest users, there are 13 well functioning community forest user groups (CUFG) managed forests in this VDC. The users comprise of mixed ethnicity: Brahmin, Chhetri, Magar, and Kumal. They have used their indigenous local knowledge to develop one of the most successful networks of community based forest management practices. Moreover, their strategies are found to be socially inclusive, gender sensitive, and climate resilient. Based on the data and information collected through two FGDs, five KIIs and seven HHIs, the people of this VDC were found to be well educated, knowledgeable, environmental friendly, enterprising and innovative.

BOX 1

Mr. Ghanta Prasad Aryal is a pioneer in applying and innovating indigenous and local knowledge in protecting, restoring, and managing community owned forests in Madan Pokhara through popular participation. His efforts in Palpa started in 1966 and similar initiative, interestingly, was formalised by the GoN27 years later in 1993. The forests of Madan Pokhara serve as the globally successful model of community forestry in Nepal. He was perhaps the first community forest manager who charged Rs. 100 entry fee to all outsiders to visit his forest – an indigenous idea of sustainability. He says, "Today, we treat our forest as gardens that provide us clean water, air, biodiversity, and enjoyment; we no longer need them for fuel wood, fodder and timber".

The older generation of these villages migrated from higher altitudes before 1950s when Malaria eradication programme started. Prior to this, people resided on the hill tops and commuted to the valleys to work in the farms and forests during the day. Every evening, they would return home fearing malaria infection. Once Malaria was eradicated in 1950s, people started settling down in Madan Pokhara valley permanently resulting in deforestation and degradation of the locality. Agriculture was, and still is the dominant occupation of majority of the respondents. But lately, they claim to have experienced the impacts of climate change and it is the indigenous knowledge and practices that are helping them to adapt to such changes.

37

Major Features of Madanpokhara CFUG

Observing the degradation of their forests during the 1960s, the village elders started discussing the situation. The root causes were identified as lack of awareness, lack of community oriented feeling, and more importantly, lack of leadership to bring about changes. They decided to work under the leadership of the senior elder Mr. Ghant Prasad Aryal (see Text Box1) who lead the initiative to protect the local forests. The collective action to protect and manage local forests using their indigenous and local knowledge took the form of a movement that started in 1966, much before the formal system of Community Forestry was launched in the country in 1988. Under this community movement, forest protection committees were formed by the villagers who were assigned the authority to: a) mobilize one person from each house to guard the forest on a rotational basis, b) to collect fines based on the nature of offense. They were also responsible for increasing need-based and user group-specific awareness among the users and sharing their knowledge. The lead for this collective and bold initiative was taken by the Mulgaira village forest community where people were banned from entering forests even to collect leaf litter (Karki et al., 1994).

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Within a short span of time, the forest started regenerating and was protected through the participatory protection mechanisms. The result was a green environment, and

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more importantly, water springs resurfaced. There was also a reduction on the damage to farm lands due to flood, landslide, and siltation. During the 1986 to 1990 period, a forest management plan, jointly prepared by the local community with the support from forest department rangers was drafted. The rules and regulations would govern the removal of forest products, especially fuel wood, fodder, and leaf litter. Harvesting was banned and strictly enforced until the forest cover stabilized. The implementation of the management plan improved the quality of the forests and other villages within the VDC started using the Mulgaira forest and its leader Mr. Aryal as their role model. Each village started a forest protection initiative in the form of a campaign. They were assisted technically by the German aided Tinau Watershed Project (TWP) which provided tree seedlings, grass seeds, and advice on forest and watershed management. In 1988, GoN issued the Community Forestry (CF) policy and in 1993, CF Act was released. The Madan Pokhara community managed forests were transformed into CF immediately. Today, these community managed forests have become national and global platform of learning and are regularly visited by knowledge seekers ranging from policy makers to forest users from both Nepal and abroad.

FIGURE 5: Indigenous Practices of Palpa and Kailali districts

Indigenous Practices Used

40 Madan Pokhara (MP) VDC is one of the most prosperous and green VDCs in Palpa and much of the credit goes to pioneering initiatives of indigenous forestry practices initiated by the village elders 50 years ago. Besides conserving forest biodiversity, the indigenous system of forest management is also generating income for the community. In addition, there are lot of innovative practices going on there. Some of the CFs have grafted pears with Mayal (Pyrus pasia) plant (see accompanying picture) and others are growing number of NTFPs such as Tej Paat (Cinamomum tamale), Kapok (Camphor sp.), and broom grass. One CFUG has initiated vulture conservation. While unplanned village roads construction and use of excavators are major concerns for the VDC, impact of climate change on the forests is also becoming a perceivable and significant issue. Nonetheless, the communities are adopting a number of adaptive practices as described below:

41 For physical protection of the forests, Somali (thorny vines) plants were used for bio-fencing in the past but this practice is gradually decreasing since the forests are already well established and social fencing is working well. The indigenous forestry and land management knowledge and practices of Madan Pokhara are well recognized and appreciated due to their innovative practices, flexibility, and good governance. In fact, the VDC is a leading example for the district in all human, social and economic development indices. In addition, it is also operating the first community radio registered in the district. It has all weather roads, 24-hour drinking water supply, dependable irrigation systems, a large number of educational institutions, and organic agriculture enterprises. But most prominent of all, MP has a well-managed network of 13 community forest user group (CFUG) forests.

Key Issues and Challenges

42 The twin slogans propounded by the village elders here are: a) `internalize or embrace the change', b) `develop your own village to become self-reliant' which clearly demonstrates how the people of Madan Pokhara are adapting to the changes including climate change. The local leaders and indigenous knowledge holders feel that the success of Madan Pokhara (MP) can be attributed to these factors: a) enlightened, knowledgeable and capable leadership; b) raising right kind of awareness among the people who were acting out of ignorance; c) the principle of creating a balance between demand and supply of forest products; d) innovating new resources through composting, mulching, pond rehabilitation, and water management to support indigenous forestry; e) starting bio-gas energy production to give alternative fuel source for cooking; and f) peer learning and sharing culture practiced by the local community forest users from 13 forest user groups, demonstrating successful application of indigenous and local knowledge.

Adaptation Opportunities

43 The indigenous and local forest managers and practitioners suggested the following points for consideration: a) indigenous practices in MP are grounded on the

traditionally built culture of conservation and collective actions that are much more stable now than in the past and are helping reduce poverty. For example, forest users feel that the value of forests has been changing for them – from basic goods supplier to a landscape service giver (rest and recreation, fresh air, and a natural capital are what they are enjoying now; and b) revitalizing ITK requires indigenous leadership and local success stories so that there is active peer learning through "seeing is believing" learning process. Such a proactive approach can help promote indigenous practices;

44 Success stories of Madanpokhara (MP) can be attributed to the existence of visionary, dedicated and able leadership. The early realization on the part of the community that rampant deforestation and land degradation would deplete natural water sources and affect agriculture can be attributed to the `right kind' of awareness building these leaders could achieve. This can be argued the strength of indigenous knowledge to tackle multiple stressors which are relevant for indigenous climate change adaptation practices. This experiential learning can be used as a strong evidence for both climate change and community based forestry related policy influencing at local and national levels. Two implications of this success stories can be presented: a) Climate change adaptation (CCA) requires resilient ecosystems that are less sensitive and have natural buffering capacity which the indigenously managed forest is aiming to achieve; and b) CCA needs resilient communities and capacitated institutions which the 13 networks of CFUGs in MP VDC are trying to demonstrate. Therefore, well managed community managed forests can help build resilient human and ecological systems ensuring better adaptation.

3.5.2 Indigenous Community Based Managed Forest Management, Kailali

Case Evolution:

45 The two case examples studied were: a) Sati Karnali community forest (258 ha) located in Narayanpur and Dhansingpur VDCs and b) Bhageshwor community forest (26 ha) located within the Dhangarhi municipality. Both these community managed forests were officially handed over to the local users after the initiation of Nepal's CF policy and Act in 1990s. However, local leadership, local knowledge, and indigenous practices of both native and settled communities have played a major role in shaping their current status of good community participatory forest management.

46 Based on the information collected from the two community forestry user groups (CFUGs) and the observation of their indigenous forest conservation and management practices, the team learned the following: a) the community have utilized their indigenous knowledge of managing the undergrowth (Non-timber products) and protecting the overgrowth (trees) and improved the traditional and local practices in conserving the forests; but the benefits accrued from the forests are not equitably distributed; b) climate change related events, especially annual floods and fires, have

impacted the forests damaging forest lands, caused change in species composition, and loss of biodiversity. So far, only plans are being made to redress this issue– there is a need for action; c) there is greater need for technical training to improve the high income diversification potentials of the forest; and d) income generation and livelihood improvement related activities need to be developed based on non-timber forest products such as Rattan, Asparagus, medicinal plants, and fruit crops to better conserve the forests through adaptation and mitigation.

47

One of the major highlights of the two case study examples in Kailali was very high participation of women, indigenous communities and dalits (a disadvantaged community of Nepal). Both forests are fairly well-protected, but not necessarily well-managed. The larger size forest in Sati Karnali example that is rich in commercial Rattan products demonstrated high commercial and socio-economic potential indicating the importance of quality and commercial potential in successful management. The protection and management of forests in both communities was initiated by indigenous leaders (Tharu and Magar respectively) which shows the leadership quality of indigenous community in developing inclusive and participatory forestry. The users also indicated their interest in integrating scientific management of Rattan and other NTFPs in both the forests since they felt that their indigenous local knowledge needed higher quality technical inputs in improving the management. The study confirmed the existence of technical deficiencies such as poor stand management of Rattan in Sati Karnali, and lack of NTFP cultivation in Bhageswor although user committee members express these as their management objectives.

48

There are some of the issues and challenges faces by CFUGs: a) serious impacts of both climate change (more obvious in Sati Karnali) and socio-economic changes (more pronounced in Bhageshwor); b) the current policies and legislations are inadequate and are discouraging both in their objectives and implementation (for example: forest department has a policy to remove forest land encroachers but the livestock department implements forage and fodder development programme in the same encroached land); c) the regulation of charging royalty on the basis of green weight of non-timber forest products, especially Rattan or Cane, is very discouraging since their sale is based on dry weight which is one fifth of the green weight. This puts the forest community in a position of loss in terms of revenue; d) lack of technical inputs from the district forest staff in improving the management of the forest is challenging crops such as Rattan; e) low priority is given to investment in forest resources development and management, especially NTFP development, that generate income to deprived people; e) there is a lack of programme for promoting indigenous and local adaptation knowledge and practices in the community; and f) external funds meant for emancipation of the poor are spent on conducting meetings and developing plans. For example, Community Adaptation Plan of Action (CAPA) was prepared by the WWF and FECOFUN for both the forests but there are no funds allocated for income generation activities or implementation of the CAPA.

Indigenous Practices Used

49 The findings cover key issues, adaptation practices, interpretation of the data collected, and discussion. The major issues identified by the two user groups are: a) the communities have utilized their indigenous knowledge and improved the traditional practices to conserve the forests, but the benefits from the forests are not adequate to meet the minimum needs of all the users, especially the poor and the marginalized households; b) climate change has impacted the forests seriously through damage from flood and fire (more in Sati Karnali), and change in species composition (more pronounced in Bhageshwor); c) there is a greater need for raising awareness and developing skills of the users to improve the productivity of the forests to meet the growing cash and product needs of the users; d) more income generating and livelihood improving activities are needed to generate economic incentives to protect and conserve the forests; and e) a significant amount of income from the forests is being spent on higher secondary and college level education which does not benefit the poor users directly (true for Sati Karnali). A common positive highlight observed in both the groups was the active participation of female members which has contributed in improving the protection of forests in both the CFUGs.

BOX 2

The Bhageswor forest was encroached in 2004. I took lead in protecting it for 6 years. I initiated cultivation of Asparagus and Goat farming for providing some income to landless people some of who had encroached upon the forests. The committee under me decided to sell 600 cu. ft. of timber to set up a revolving fund which is providing low interest loan to landless members and from the interest earned a Forest Guard is maintained. Thus “an island of greenery within a growing town has been saved” says Mr. Magar.

50 The rich growth of Rattan vines used in furniture industry in Nepal and India makes Sati Karnali a highly lucrative forest. The CFUG has been operating under an operational/management plan that is largely based on indigenous and local knowledge. The forest exists as part of Karnali River ecosystem and its location in the flood plain is highly suitable for natural growth of rattan crops. But this very fact makes the forest prone to destruction by flood (18 ha lost in last 5 years). However, the community is yet to realize the full potential of the forest based on the sustained yield management principles, and protect it from climate change induced rising flood waters. Sustainable harvesting of rattan vines is a technical subject that needs both indigenous and modern knowledge for ensuring higher productivity. A protection strategy from flood also needs a combination of engineering, biological, and social dimensions. Therefore, although Sati forest is considered a successful locally managed forest, it needs more intensive management system to yield sustained income to the users. Also, the annually increasing flood water has been cutting the river bank of the forest area which is the biggest concern of the forest users and needs immediate adaptation and flood risk reduction measures.

Both the forests are facing challenges in improving equity and transparency in benefit sharing, forest revenue management, and enhancing income generation. Currently large portion of the revenues generated by Sati Karnali forest - estimated at Rs.5-6 million per year - is being spent on education in meeting expenses of higher secondary and a college. While spending on education is a good social investment but it may not equitably benefit poor households that have higher school dropout rate and lower college enrolment. The other concern of the community is the increasing damage caused by annual floods (18 ha of prime forest have already been destroyed till date) to their forest. The community has approached different government agencies for constructing flood embankments, but so far, the support has been inadequate and poorly coordinated. The community has been trying indigenous protection methods as an alternate by growing native trees and grasses. But the magnitude of the problem needs a combination of indigenous and scientific measures. Therefore, the CFUG has to develop a short as well as long-term adaptation plan to save this valuable and unique forest (perhaps the only commercial quality Rattan growing CFUG in the country).

Similarly, Bhageshwor CFUG forest, although much smaller in size, has rich Sal (Shorea robusta) and other commercial timber species. Due to its location within the Dhangarhi city limits, it is not only vulnerable to CC but also to social, economic, and political pressures from the expanding settlements encircling the forest. Besides, a large number of landless user households also expect to draw their livelihoods from the forests. However, due to the inclusive practice established by a pioneer leader (Text Box 2) of the Forest users committee, the forest is found well managed. It has included the landless households in the user group and provided them the equal share of the benefits in terms of the forest products without any discrimination. This has contributed to forest protection as well as participation of the members in forest management by preventing illegal extraction and harvesting of the forest products.

Key Issues and Challenges

It is clear that both these CFs are facing more exogenous pressures and risks than endogenous problems and challenges. The ILKs and ILPs are found effective in managing the internal changes and challenges. However, they are found wanting in managing the external drivers of change such as climate change and socioeconomic changes. For example, the increasing demographic pressure on the forest due to heavy in-migration seems to be beyond the capacity of ILKs. It was observed that holistic management of underlying causes of deforestation such as politically driven encroachment of the forests needs to be managed jointly with the Forest Department which is lacking. Both the external factors such as climate change induced river bank cutting (in Sati Karnali forest) and socio-economic-demographic changes (in Bhageshwor forest) needs to be managed through community based sustainable forest management (SFM) and integrated DRR and adaptation plans.

54 For example, the Sati CF can develop integrated adaptation and flood risk reducing activities by revising their forest operation plan (OP) by mainstreaming climate change integrated manner focusing on flood risk reduction and livelihood improvement through diversification of livelihoods through improved management of the high value Rattan crops and ploughing back some of the revenue in constructing embankments. Similarly, the Bhageshwor forest, according to the residents, has the potential to develop as urban forestry/biodiversity park. Some users also spoke of managing forests for carbon by developing REDD+ project through which they expect to get more benefit than harvesting timber.

Adaptation Opportunities

55 The growing population dependent on limited forest resources is a challenge faced by both the forests. Climate change has is playing the role of additional stressor affecting the productivity of forest products. The communities have been managing these changes using tools such as livelihood forestry wherein landless households are involved in income generating activities centred on non-timber forest products such as growing Asparagus, Lemon grasses, and other commercial herbs. Another strategy is using social fencing and participatory protection of forest resources through regular awareness raising and social mobilization. The users also expressed the need to develop alternate energy sources to reduce dependence on fuel wood. Similarly, in order to provide supplementary income to landless users, the community is planning to grow NTFPs such as Asparagus, lemon grass, and some other medicinal and aromatic plants. This is helping to save the valuable timber species. In addition, both communities are improving their skills through trainings on forest management, good resource governance and sustainable livelihoods which are helping to reduce vulnerability and build resilience.

3.5.3 Community Managed Forests of Bhedi Chok VDC, Ilam

Case Evolution

56 The Bhedichok Community User Group Forest (CFUG) covers an area of 200 ha. The locals trace the history of forest management to the old Kipat system of land management which had recognized the usufruct rights of Limbu community to the forest. This system was also applied for the management of personal estate of Limbu kings. Located near the popular Mai Bokhara wetland – a Ramsar site, the forest is one of the oldest Kipat systems linked forests in Ilam before government abolished Kipat system in 1964. The name Bhedichok signifies a grazing and resting place for transhumance animals, especially sheep.

[2] *Kipat* is a system of land management under which the state recognized the land owned by the *Limbus* people of eastern Nepal; under this system, the right to use the land was given to a member of a *Kipat*-owning ethnic group; the state had no authority on the *Kipat* land; the system was abolished after the Land Reforms Act was promulgated in 1964.

The forest including the wetland was managed well until1964 when Kipat system was abolished. The feeling of loss of ownership on the land led to rampant deforestation and degradation. After 10 years, the forest was reduced almost to shrub land which made some conscious people of the village initiate reforestation work. They plant fast growing trees such as Champ (Michelia champaca), Dhupi (Cryptomeria species), and Patle (Castanopsis hystrix) seedlings in the deforested area. In the year of 1978, Panchayat (community) protected forest systems were introduced by the government. About 50 ha of degraded land were afforested in Maipokhari VDC. In 1986, the local community formed a forest committee of seven members in order to protect the forest resources. However, after the devastating earthquake of 1988, once again timber cutting started and destroyed all the revived efforts.

The consequence has been that the original primary growth forests that had complex ecosystem due to its rich biodiversity was replaced by secondary growth vegetation comprising of low value exotic tree and shrub species such as Japanese Salla (Cryptomeria japonica), Khote Salla (Pinus wallichiana), or Gobre Salla (Pinus roxburghii).Cardamom plantations were introduced under the Uttis (Alnus nepalensis) forests. The reforestation process was successful due to three factors: (i) outside knowledge including guidance obtained from forestry professionals and practice observed in neighbouring Darjeeling district, India, ii) lesson learned from the impact of forest degradation and effective community mobilization to reverse it, and (iii) effective control of open grazing plantation management. It is obvious that the local knowledge did play a role in successfully reforesting the forest land. In 1991, as per the new Community Forestry (CF) Act, the indigenous local community (ILC) collectively decided to form an inclusive community forest user group (CFUG) under the leadership of an indigenous Gurung community leader. The CFUG today has around 160 households as members of the Assembly and an operational plan has been approved to regulate the extraction of forest products. Out of the total 200 ha forest area, 90ha has wetland. A wetland management and conservation action plan has been prepared jointly with the district forest department.

Indigenous Practices Used

Bhedichok community forest users have reinvented and applied the indigenous and local knowledge and practice including the old Kipat system of land management to the current community based forest management system. More importantly, the current management combines the modern knowledge with traditional wisdom to sustainably managing the forest. The committee feels that by combining the indigenous practices of Limbu and Gurung communities have been adopted to manage the forest land following an integrated watershed management model.

[3] According to the District Forest, Ilam, Japanese pine was first introduced in Mai Pokhari area from Darjeeling, India by a hermit Narayan Dil in 1965; During the last 50 years, the species has spread over large areas covering more than 60% forest coverage (DFO Ilam, 2012) which has severely affected indigenous broad-leaved vegetation of oaks, laurels and magnolias.

This is to address the problem of water shortage due to sudden disappearance of traditional water sources. The major cause for the disappearance of the natural water source according to the locals is the massive plantation of exotic pines (Japanese pine and other Pinus species) during 60s and 70s and continuing deforestation and degradation of forests in neighbouring villages in the upper catchments. The reason for drying of water sources and declining biodiversity is attributed to external factors especially climate change which the local community does not understand well but is responding to the impacts. Locals blame the pine plantation for the problem that might be true since Japanese pine is a large tree with both deep and side roots consuming lot of water.

60

The community, especially youths, being aware of the problems have started long-term planning and management of local forest resources highlighting the role of biodiversity conservation in the wetland. With increasing domestic and international tourists visiting the nearby Mai Pokhari wetland - a Ramsar sit, the community has already developed a strategy to implement a sustainable eco-tourism plan. However, the community feels that they should learn first-hand from other well managed touristic lakes such as Phewa in Pokhara, Nepal. The successful management of the forest in an equitable and sustainable manner is attributed to three local practices: a) learning from the indigenous practices of Kipat system of Limbu community; b) forming an inclusive management committee; and c) transparency and equity in benefit sharing.

FIGURE 6: Indigenous Practice of Forest Management, Bhedichok, Ilam District

Other indigenously managed forests such as the neighbouring Bhalu Kateri community managed forest where the learning from the Kipat system is not used has only patches of forest left. This signifies that the learning of the communal system of land management from the Kipat system helps to make the practice more effective. The strengths of the indigenous communal land management practice that are based on the basic tenets of the Kipat system are: a) the right to use the land was given to local ethnic and caste groups which gave the CFUG security of tenure; b) local community had full ownership on land as well as all its resources thus providing them adequate incentives to invest in raising and managing forests; c), the forest cover are maintained all the time to conserve water. But Bhalu Kateri community forest does not seem to have used the learning as effectively since their forest has not been successful in achieving participatory protection and management.

Key Issues and Challenges

The Bhedichok community forest is following a climate adaptive system of management. The users have considered climate variability while revising their management plans. However, the communities now being a mix of indigenous and local ethnicity and caste groups, have to innovate synergised practices building on the indigenous practices such as promoting ecotourism with technical support from the forestry professionals in the district. Innovation is necessary on develop and implement management strategies to utilize the vast wetland which is not well utilized. Since the major problems of water shortage and forest quality degradation are associated with climate change, the local community's plan to improve their technical knowledge, strengthen their forest management system, and enhance collaboration with the DFO have to take major resilient building measures.

Adaptation Opportunities

Given the strong commitment on the part of community users to make the Bhedichok forest more sustainably managed, mainstreaming climate change risk in the approved management plan is critical. Here, the identified indigenous and local knowledge can be integrated with scientific knowledge and practices for robust results. For example, forest users can reduce their dependence on fuel wood by developing alternate energy and eco-tourism based livelihood sources so that the forest can be conserved for environmental services. Rain water harvesting and soil and water conservation activities are necessary for the restoration of wetlands which the local people are keen to practice.

Open grazing should be banned, and community based forest fire management system should be developed in addition to identification of means of clean energy which can enhance the biodiversity and recharge the wetland. Development and implementation

[4] Sherpa community call the Khumbu region as Beyul (sacred landscape) region under which a number of place-based spiritual perspectives and taboos are used to promote sustainable practices of resources use (Spoon and Sherpa, 2008)

of sustainable eco-tourism plans integrating climate change adaptation and resilience building measures can not only enhance forest conservation and reduce pollution of wetlands but also promote bio-cultural heritage laden with indigenous knowledge and practices by improving the local livelihoods and community resiliency. This would be possible through the indigenous culture of collective work, volunteerism, and attaching religious values to the resources especially the culture of respecting the sanctity of the lake. This study found that the communities are eager in enhancing and using climate friendly forest ecosystem.

3.5.4 Integrated Buffer Zone Management and Shingi Nawa System of Forest and Pasture Management in Khumjung

Case Evolution

65 The Khumbu region is one of the major hotspots of climate change (CC) in Nepal. Local people are facing heavy snow fall and avalanches, windstorms, landslides, glacial lake outburst floods (GLOFs), and forest fire that are fully or partially associated with climate change. The warming climate is changing the forest species composition and productivity of forest and pasture ecosystems. Predominantly Sherpa communities of Khumjung have been managing their forests and pasture resources through their traditional institution called 'Nawa ' (Sherpa PD et al., 2013; Spoon & Sherpa, 2008; Stevens, 1993; and Sherpa M, 1993). The main function of the 'Nawa' system is to manage the use of agricultural lands, forests, and pasture lands by balancing demand and supply of forest products and grazing resources (Stevens, 1997; Bhatta, 2013) which are always in short supply in the harsh climate of high Himalayan mountains.

66 The Nawas are assigned the job of preventing unsustainable use of forest, pasture, and water resources by users and maintain equitable access to resources for use by all the community members now and in future. Traditionally, two types of Nawa systems prevail: a) Osho or Lotok Nawa that deals with agriculture, water and animal husbandry related issues; and b) Shingi Nawa that manages forest and grazing lands related matters (Sherpa et al., 2013; Hardie et al., 1987). The Shingi Nawas are responsible for protecting the village forests and Osho or Lotok Nawas supervise the enforcement of the laws regarding cattle and agricultural production (Hardie et al., 1987). This case example is based on the Shingi Nawa system in Khumjung VDC.

67 The Khumjung VDC is one of the two core VDCs under the jurisdiction of the Sagarmatha National Park (SNP) and its Buffer Zone Management Committee (BZMC). The predominantly Sherpa village of Khumjung has around 800 people from 275 households (HH). Local people speak both Sherpa and Nepali languages

[5] A traditional institution of the Sherpa community that controls the use of village land and forest for the purpose of agriculture and cattle raising (Sherpa, PD et al, 2013)

and practice Buddhism. Lhoshar and Dumje are the two main festivals of the local people - the latter is celebrated to mark the beginning of the planting season. The indigenous practices, traditional way of living and even languages spoken have all undergone tremendous changes in Khumbu region during the last 50 years.

68

Major changes started after the declaration of SNP in 1976. In 2002, the BZMC was established by the SNP in Khumjung and Namche VDCs with the aim of incorporating the traditional Shingi Nawa system in managing the community lands around these VDCs (Bhatta, 2013; Bhattarai and Upadhayay, 2013). The physiographic features of the SNP are described by Bhuju et al. (2007). Khumjung Buffer Zone Committee has several Nawas working in close collaboration with the SNP to manage the forest and pasture of the VDC. The indigenous forest and pasture land management practices have gone through changes after the establishment of the Buffer zone management committee (BZMC). Under the SNP rules, community or private holding of forests is banned. People have started to shift from agriculture and livestock sector to tourism. Due to rapid development of trekking and adventure tourism, traditional livelihoods were gradually replaced by tourism. Agriculture has become limited with more market oriented farming aimed at meeting the demand created by tourism.

Indigenous Practices Used

69

The main finding centres on the revitalization of the indigenous Shingi Nawa (community forest guards) practice which is well integrated within the operational system of the SNP's Buffer Zone Management Committee (BZMC). After 25 years of its establishment, the SNP had decided to recognize and co-opt the Nawa system as a part of the Park management system through the BZMC for better protection and management of forest and pasture resources based on the concept of participatory conservation. The Nawas are provided monthly allowances for their service by the BZMC which has revitalized this indigenous practice. The key findings on how the system is working are described below:

Selection of Nawa

70

Nawas are selected through a lottery or rotational system. A Nawa household (HH) is nominated after lottery is drawn in his/her HH's name. Former Nawas do not have a right to give his/her name for the candidacy. Nawas can be both male and female since in the Sherpa committee women enjoys full gender equality – many homes are female headed. The tenure of each Nawa is one year. Depending upon the size of forest and population, each ward has one or more Nawa depending upon the size of the population and the area of the forest.

Working Mechanism

71

Nawas in Khumjung manage agriculture, forest and livestock sectors using traditional rules that are aligned by the SNP rules. The Nawas specifically regulate the use of tress for timber, fuel wood, fodder, and grazing. The research participants felt that women Nawas are more active than men since they do most of the agriculture

and livestock related work. After the forest is closed for cutting trees and collecting fodders, no one is allowed to enter into the forest. Nawas have their own rules to conserve forest. Once the rules are agreed by the village assembly, anyone breaking is fined Rs.500.

72 Nawas manages the grazing system on rotation basis. During summer, the entire village livestock herds are taken to the high mountain pastures for free grazing. People are not allowed to bring their cattle to their homes. In Dingboche village, Nawas have made a rule that all the adult villagers must leave the village during June 15-August 15 period for collecting fodder, fuel wood, and construction materials for use in winter. Forest fires are also strictly managed by imposing heavy fines and controlling it through community mobilization.

73 The Nawas are adapting to the high climate variability observed and impacts experienced in their social and natural systems with their indigenous and local knowledge and practices. They are using their weather forecasting knowledge and experience to change the operational rules of forest and pasture management practices. For example, earlier people were allowed to collect animal litter or Sottar (dried surface grass) from the forests anytime of the year, but now it has been restricted to a few months to prevent landslides, soil erosion, and pasture production decline. In one season, the forest is normally opened for 10 days for grazing. For fodder collection it is opened twice a year. People are also allowed

FIGURE 7: Indigenous Buffer Zone Management Practice of Solukhumbu District

to use the forests of neighbouring villages through the decision of the Buffer Zone (BZ) or Nawa Council of the villages concerned. For example, Khumjung people use the forest of Tyangbochhe.

Key Issues and Challenges

The Khumjung communities are concerned about their future especially because of the changes brought about by high climate variability and impacts. Although the forest resources are conserved through collaborative efforts between the SNP and the local communities, they are constantly worried about the risks of GLOFs, gale-wind storms, landslides, and decline in forest and pasture production. The indigenous resources management through the Nawa practices so far has been working well and but it's continuation is uncertain due to two principle factors: a) the younger generation is more interested in tourism related business, trade, and foreign employment; and b) rapid urban and commercial orientation of the local economy.

In Namche VDC, which is a commercial centre, the indigenous Nawa practice is already in decline because of the shift of the population from agriculture to service sector. People in Khumjung strongly favour to continue Nawa system by improving it to tackle future problems. With the support from the SNP supported BZC, the local clubs and other community institutions are planning to develop Khumjung as a Green Valley of this region by developing a long term adaptation and development plan. Given the strong desire of the local communities to preserve Khumjung's rich bio-cultural heritage, the continuation of Nawa system will be possible. This will need integration of indigenous and local practices with outside knowledge and practices. One of the priority areas of the Khumjung community is to reduce risk of flash floods and landslides using their knowledge and practices along with scientific knowledge.

Adaptation Opportunities

The use value of the forests, pastures and natural landscape needs to be diversified and enhanced so that the younger generation do not lose interest to continue practicing Shingi Nawa and other indigenous practices; Concretely, the adaptation and development planners should gradually shift the forest and pasture management goal from agriculture to eco-tourism, water management and NTFP-based enterprises;

The collaboration between the traditional institutions and the Park Management should be expanded beyond Buffer Zone Management. Specifically, the perception of GLOF risk among the Khumbu inhabitants and the role of forest management to reduce and mange the risk need to be better highlighted to attract and sustain local participation in a holistic forest and pasture management.

3.5.5 Indigenous Management of Pastureland in Chungjung and Sauru Khanti

78 This case example documents and analyses the indigenous and local practice of managing range and pasture resources in two VDCs of Mustang district with a specific focus on how local communities are adapting to climatic hazards and risks in particular and socio-economic changes in general. Agriculture especially livestock husbandry is the mainstay of Mustang' economy. But the district is facing an unprecedented natural onslaught affecting their current practice of pasture management.

79 The main issues faced by the pasture users are: rapid climate change induced disasters such as flash floods, landscape degradation, and acute water shortages. In fact, three villages in upper Mustang – Samzong, Dhey, and Yara – are on the verge of displacement due to drying up of their traditional water sources (KFS/SUPSI/LMF (2012) which is impacting their cattle farming. The communities are also facing other changes such as increasing human-wildlife conflict due to declining pasture productivity, degradation of pasture land, and dust storms. Traditionally, animal husbandry has been the main occupation in the district with around 45,000 goats, 4,000 yaks and 8,000 cows. Yaks are more popular in Upper Mustang (UM) and cattle in Lower Mustang (LM) and goats are common throughout the district.

Case Evolution

80 Two villages - Chungjung village in Chhonhup VDC in UM and Khanti village in Kowang VDC in LM, are the focus of this case example. Two major indigenous communities - Lho-ba (means southern people in Tibetan language) in UM and Thakali in Lower Mustang are respectively involved in these examples. The indigenous and local practice studied is their traditional Mukhiya system. According to the participants, following are the major problems the pasture land is facing: a) drying up of traditional water sources in the pasture land due to decrease in snowfall, b) lack of access to pasture land due to damaged trails caused by heavy rains and floods, d) increasing wild animals affecting the grazing capacity of their pastureland. The communities are also facing issues such as: a) lack of nutritious grasses; b) snow leopards preying on the domestic animals; c) increasing number of invasive species affecting the quality of pasture; and d) lack of coordination between ACAP activities and those adopted through indigenous Mukhiya system's practices.

Chungjung village, Chhonhup VDC

81 The Chungjung village has a population of 225 distributed in 44 households. The villagers maintain horses, yaks, and sheep that are moved to different pastures according to seasons. Animals are left free grazing and attendants visit them only once a month to provide them salt and water during all three seasons. Although traditionally every village had well defined jurisdiction of their pastures, now there are boundary disputes between the people of Chungjung and neighbouring Tshossar VDCs. Chungjung faces the problem of overgrazing of their pasture due to the

FIGURE 8: Indigenous Practice of Pastureland Management, Mustang

encroachment by animals from neighbouring villages in violation of traditional rules enforced by village appointed pasture controller, locally called Dhongba, who has to grant permission for such matters in consultation with his/her counterparts in other village.

Chungjung is predominantly a pastoralist village. It is a settlement of nomadic community who use their indigenous nomadic knowledge in cultivation and grazing land management. They manage their natural agriculture and pasture under the Dhongbaor Ghempa (also known as Mukhiya or village Chief of Headman) system. The main responsibility of Dhongba is to implement the indigenous system of pasture land management as per the rules framed by their community. The Dhongba is selected based on his/her knowledge of the village affairs and normally serves for a year. S/he has the authority in fixing monthly or annual grazing fees for local as well as outsiders based on the types of animals and their number. A Dhongba can hire an assistant called 'Chhimeas' as per the need to manage the pasture.

82

The villagers follow grazing rules strictly since animal husbandry is the main source of their livelihoods and pasture is limited. The villagers take their animals to high altitude pasture during summer months to prevent damage to crops. However, the traditional grazing rules and regulations are weakening due to growing scarcity of winter pastures.

83

FIGURE 9: Indigenous Practice of Land Management, Lower Mustang

84 The reasons assigned to such diminishing pasture land are: a) indiscriminate removal of the main vegetation cover of the area (Caragana and Lonicera shrubs) for fuel; and 2) overgrazing of the highland pastures.

Sauru Khanti village, Kowang VDC

85 Kowang VDC is part of traditional settlement of Thakali peoples known as Thak Khola. The region has rich indigenous practices developed by Thakali community to manage community's forest and pasture resources that includes high altitude alpine pastures. Their indigenous system is known as Mukhiya system that still prevails although this VDC falls within the protected area managed by the Annapurna Conservation Area Programme (ACAP) of the GoN.

86 Climate change is affecting pasture lands in a significant manner. Both the temperature and rainfall are increasing, numbers of cold days have decreased and so has snow fall amount, and cropping seasons and patterns have changed. The Kali Gandaki river bed has been constantly rising and flood water is entering areas that were considered safe 15-20 years ago. Apple crop of the area, that used to be considered of very high quality, has changed its fruiting habits with deteriorating size and quality. The problem has manifested to such an extent that the orchard owners have started uprooting and replacing them by vegetable plantation and other crops. Although the population is

increasing, the villagers are facing acute labour shortage because of heavy youth out migration which has affected the agriculture, horticulture, and livestock operations resulting in increased fallow lands.

The role of the forest and pasture land is critical here since majority of the people draw their livelihoods from raising livestock or through agriculture. Although the ACAP has been promoting conservation of biodiversity, it is giving more emphasis on wild animal protection resulting in feed shortage for livestock and increased people-wildlife conflicts.

Indigenous Practices Used

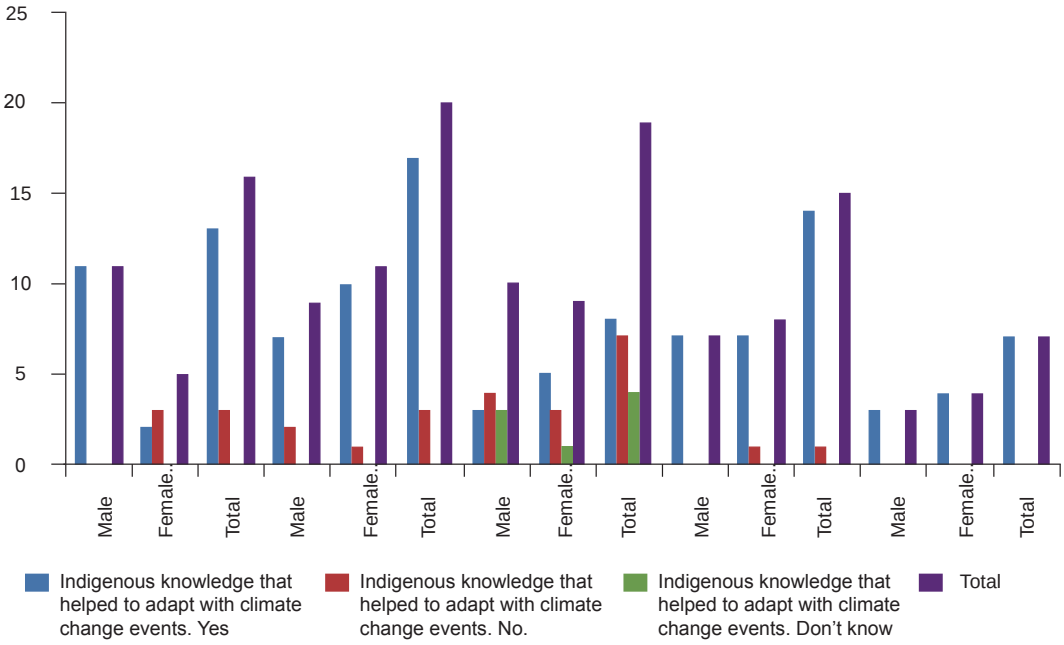
With the support from the ACAP, the local pastoralist communities have formed Saurukhanti Pasture User Committee (accompanying picture). The local community prefer to use their indigenous Mukhiya system although they also participate in the ACAP formed institutions such as Forest Protection Committee and Conservation Area Councils. There are 13 Mukhiya systems (13 ghare) in Thak Khola (LM) area that govern not only the natural resources management but also social affairs (see Chapter 6 in this volume) district in the past by serving the local people. Mukhiya system is culture and location specific which means that although the practice has common name, its practice in throughout Mustang varies from place to place.

The Mukhiyas are paid in the form of one goat and a sheep for their service in a year by each herder. The current village Mukhiya committee has 7 members out of which 2 are female. They serve a village of 50-60 households. The operational system of Kharka (pasture) management followed by the Mukhiya system is as follows: a) the three main pastures of the community are managed on a rotational basis. The Mukhiya with the help of his assistants called Kundals allocate timing and duration for grazing the animals in each pasture according to the season. The pasture situated at the highest altitude is open during summer; the mid-altitude pasture during spring; and the lowest altitude pasture during winter. The priority for grazing is based on the traditionally recognized user rights that were defined by the 13 village Mukhiya Council and in consultation with the communities concerned. However, on the discretion of the Mukhiya Council, they may also allow herds from outside the district such as Myagdi, including transhumant animals by charging them double the number of goats and sheep as compared to those belonging to those of natives.

Adaptation Opportunities

In terms of the adaptation priority and plan of the local people, following findings are listed: a) assess and monitor the status of pasture land in view of high climate variability and its impact; b) document traditional ecological and native pasture related knowledge; c) build all- weather access trail to the highland pastures, c) build water hole in the pasture land to ensure water for animals and uniform use of the pastures; and d) develop more winter pasture area to address the fodder deficit situation. To address the larger problems of shortage of animal feeds due to changing weather

FIGURE 10. Role of indigenous knowledge and practices in climate change adaptation



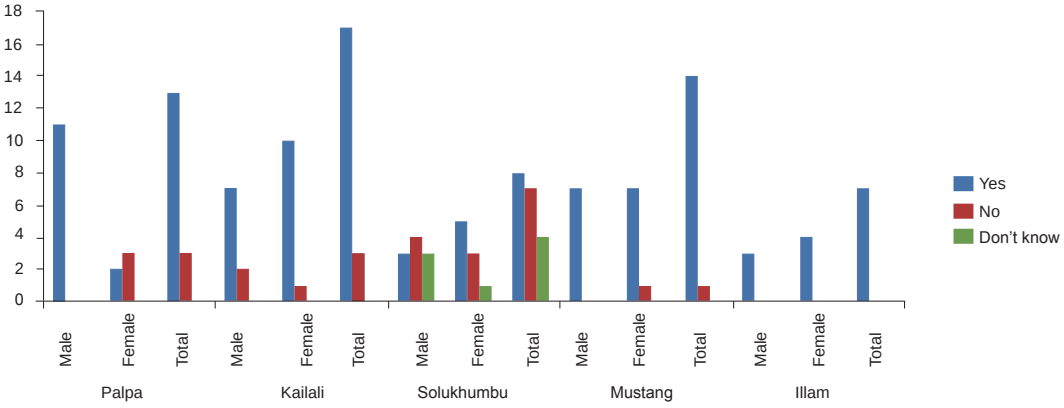
and increased probability of damage due to frequent floods and droughts, a detailed vulnerability impact assessment and adaptation plan covering the entire district is necessary.

3.6 ANALYSIS OF CASE STUDY FINDINGS

Analysis of results:

The five case examples demonstrate that there are a number of similarities and differences among the indigenous and local practices of the communities in managing the forest and pasture resources. The findings show a diverse range of indigenous and local practices prevalent that are trying to maintain a balance between the demand

FIG. 11. Gendered response on whether indigenous knowledge helped to adapt



and supply of forest goods and services. An analytical discussion covering similarities and difference among these practices, common adaptation challenges faced, gender dimension and local innovations being made, and policy implications in and among the above five FPM practices are discussed below under separate headings:

Role of Indigenous Practices in CCA

The above findings indicate an overwhelming agreement that indigenous knowledge and practice works in adapting to CC at local level. Further exploration specifically on their role in improving forest and pasture productivity gave an understanding that while they work well on softer issues such as mobilization of communities for protection, afforestation and reforestation as well as carrying out silvicultural operations. However, for addressing newer and more forest biological issues such as spread of invasive species (Palpa), shift of species (Kowang), river bank cutting (Kailali), and sudden disappearance of water (Ilam, Mustang), the ILKP is found inadequate. This is perhaps the reason that some of the participants responded negatively or were not sure regarding the efficacy of the ILKP in adaptive to CC.

92

Gender Differentiation

Since the socio-economic baseline information indicate that women and men feel differentially impacted by climate change (CC) their adaptation strategies also have gender dimension. The study enquired the respondent whether women were impacted more than men and that whether women needed gender specific adaptation. More than 66% (29 out of 44) respondents positively specifically mentioning that more women in their villages have died of floods and landslides than men. Regarding the role of men and women in CC adaptation, more men answered in affirmative than women which means they are speaking from their experience which is true especially in forestry related adaptation work which are more demanding physically and technically. However in Ilam and Solukhumbu the response was that both men and women as shown in Figure 4 (Annex 3.2 Table6 provides the data).

93

Diversity of Indigenous Practices: The findings based on the information collected from the HH representatives and the key informants (KI) provide useful insights into different types of ILPs that prevail among the five cases explored. They indicate varying types and level of indigenous and local knowledge systems, awareness levels, perceptions, practices, and skills among the users. Around 64% of the respondents felt that the quality of their forests was better than in the past due to collective actions and good resource governance practices followed across five examples. Only in Mustang district, majority of the respondents deemed their situation of pasture and forest management is not working due mainly to rapid climate change and government interventions (Table 7).

93

Majority of the respondents indicated that their indigenous local knowledge and practices were predominantly related to agriculture, forestry, water management,

94

animal husbandry and pasture management. Knowledge related to animal husbandry, agriculture and water management were the ones most widely identified (Table 7 & 8).

TABLE 7. Type of indigenous and local knowledge used in Forest and Pasture Management

Name of the districts	Type of indigenous and local knowledge used in FPM			Total
	Pasture Management and Animal husbandry	Forest Products and NTFPs Management	General types (agriculture, Water management etc.)	
Ilam	1	6	0	7
Kailali	0	9	2	11
Mustang	7	3	0	10
Palpa	0	6	1	7
Solukhumbu	5	4	0	9
Total	13	28	3	44

The practices found in Mountain districts (Mustang and Solukhumbu) were of more mixed and integrated types in comparison to Tarai districts where the practices were more related to flood management, housing and forestry. In terms of their coping strategy and adaptation strategies in forestry and pasture management, most of the respondents (89%) agreed that their indigenous and local knowledge is helping them reduce the vulnerability and build resilience. They described how they are using their intuitive and experienced knowledge and innovative practices to prevent flood and landslide damage to forests and pastures by banning grazing and felling altogether.

TABLE 8: Types of indigenous and local forest and pasture management practices prevailing in different cases

Districts	Type of indigenous and local practices in FPMs			Total
	Communal management or Customary Laws and Rules-based	Community Forestry User Group-based	Co-management based	
Ilam	1	6	0	7
Kailali	2	9	0	11
Mustang	8	0	2	10
Palpa	0	7	0	7
Solukhumbu	4	0	5	9
Total	15	22	7	44

[6] Different types of community based pasture management especially within the protected area (e.g., group tenure over a large pasture land or institutional arrangement at local level with CBFPM approach).
[7] The Shingi Nawa deals with the husbanding of the wood and timber resources in the community.
[8] Mukhiya system is a Chief system established by the state to collect revenue from the people and pay to the government; they were authorised to regulate economic, social and justice system in the designated area.

Figure 10 provides the response of the HH heads on the role of indigenous and local knowledge in making the forests and pastures more resilient:

Human-Ecosystem Specific Practices:
96 The respondents in all the five locations also indicated that women did most of the collection and harvesting of forest products. In Tarai and Midhills, most of the products were collected during winter and spring seasons, whereas, it was carried out during spring and summer seasons in the Mountains (Annex 3.2, Tables 13 and 14). Most of the forest products were collected to meet domestic needs. Only in Kailali and Palpa forest products were marketed (rattan and pears respectively) (Annex 3.2, Tables 7 and 8).

97 Analysing different types of forest and pasture management systems documented above, it can be argued that although most of the practices are adaptive, depending on the culture, location, and purpose of the practitioners, the evolution, typology, and innovation process and quality of the practices are different, diverse, and contextual. The study found that most of the practices documented can be analyzed under the broader community based forest or pasture management (CBFM/CBPM) concepts and practices that are dynamic and adaptive. However, given the nationwide prevalence of CBFM system of forest management, community forestry user group (CFUG) forestry dominates the practices documented. CBFM is identified closer to the indigenous practices than formal sustainable forest management (SFM) system. Around 65% of the respondents felt that they were practicing CFUG forest. One third felt that they were practicing a more restricted community forestry systems specifically buffer zone management (BZM) in Solukhumbu and conservation oriented pasture management in Mustang. The main difference between the two is that former has full usufruct or use rights, the later has restricted access and regulated use rights.

98 However, in all examples, the role of indigenous and local knowledge and practices is found to be substantial. Where there were failures, either proper synergy and integration between indigenous local knowledge and practices was missing or meaningful information sharing and partnerships between the two systems. The communities in Khumbu and lower Mustang regions were found to be using what can be called a co-management system of forest and pasture management (Table 6). While the findings from Solukhumbu indicate a good integration of indigenous or informal and formal institutional arrangements, Mustang findings indicate that both informal (Mukhiya) and formal (ACAP) systems are operating in parallel.

99 While the SNP management has recognized the Shingi Nawa system of Sherpa community and included the Nawas as an integral part of their Buffer Zone Committee staff, the ACAP has not recognized the Mukhiya system of the Thakali and Lho-ba community. The ACAP has been running a parallel structure of CACs and CAMCs and Forest Protection Committees (FPCs) which besides alienating the indigenous

peoples has also resulted in duplication of efforts and less than satisfactory conservation achievements. Table 9 below supports this argument.

TABLE 9: User perception of forest and pastures in the Case examples

Name of districts	Status of forest			Total
	Good	Bad	No change	
Ilam	5	2	0	7
Kailali	8	3	0	11
Mustang	2	7	1	10
Palpa	7	0	0	7
Solukhumbu	6	1	2	9
Total	28	13	3	44

3. 7. DISCUSSIONS, LIMITATIONS AND IMPLICATIONS

Discussion

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All the five case examples have identified and scrutinized prevailing indigenous and local FPM practices which lead to the argument that the ILKPs widely vary in quality and adaptive characteristics. The findings show that effective community practices can reduce the vulnerability created by climate change. As an illustration, the local community managed forests in Palpa stands out as climate resilient and adaptive practice since the practices are based on effective local and indigenous knowledge, practices and experiential learning. Also, the Buffer Zone Management practice in SNP have demonstrated scalability and cost effectiveness. Madanpokhara CBFM practices have reduced dependency on the forests by switching to alternate energy sources such as solar and micro hydro projects. In a clear shift from agriculture to service sectors, the demand for conventional forest based products such as fuel wood, fodder, and leafy biomass is decreasing and marketing of ecosystem services such as clean water, watershed services, and eco-tourism is increasing.

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Similarly, the Sati Karnali forest users in Kailali have not utilized all available technical and management expertise for sustainably harvesting and managing rattan or cane plants. In the mountain region, the pastoral communities in Mustang and Solukhumbu are facing a number of climate change related challenges. Comparatively, communities in Khumjung within the SNP area are adapting better than Mustang community by integrating available outside knowledge and practice systems with its own Nawa system indicating tremendous scope for cross community exchanges and learning. Established organisations like ACAP can learn from the SNPBZMC on how ILKPs can be integrated with PA management systems for better conservation and poverty reduction outcomes. This also points out the opportunity for cross case example or peer learning and knowledge exchange.

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Although the five case examples have demonstrated a diverse types of forest and pasture management systems, (e.g., subsistence, conservation and market oriented) they all indicate a common set of issues and gaps which includes: a) the need to increase forest and pasture productivity since increasing temperature and uncertain rainfalls are adversely impacting productivity and quality, b) the need to improve technical skills and capacity of the indigenous forest users since climatic hazards such as river bank erosion requires technical measures such as gabion rings, cemented spurs, and embankments, c) the need to integrate, synergize and compliment indigenous and local practices with the practices promoted by the Government and development partners; and d) the need to use the existing indigenous forestry practices in preparing local adaptation plan of actions (LAPA) and community adaptation plan of action (CAPA).

103

The in-depth analysis and observation of the information of these five case examples spread around in five distinct socio-economic and ecological locations of Nepal provides possible conceptual framework for building climate resilience in Nepal's forestry sector. For example, as per the GON policy, LAPA and CAPAs have to be prepared to access CC funds for adaptation by the forestry sector. The activities suggested in this case study could help in preparation of CAPA. Given the strong role played by the `right kind of awareness raising' and the message of `self-help and self-reliance' as was adopted in Madan Pokhara, Palpa, one can argue that there is need for practical knowledge in order to build climate sensitive resilient communities. It is also evident that raising awareness about the relevance of ILKs and their availability within the community is fundamental to sustainable and adaptive CBFM.

104

The case examples from Palpa and Ilam districts strongly show that inclusive participation of indigenous and local community members, including women, dalits, and landless households is not only necessary, but also critical to build resilience within the FPM systems. Participation of all stakeholders, including those who indulge in encroachment and illegal harvesting of forest products, is essential in achieving participation of all stakeholders as was observed in Bhageshwor, Kailali. Indigenous and local knowledge systems reflect cultural values as well as technical knowledge held by forest users, farmers, and traditional healers. For any adaptation and resilience-building activity to succeed, it is necessary to customize the plans to the local ecosystems and/or watersheds contextualizing the whole process to a particular culture, location, and social value system.

105

The case study findings also indicate that indigenous forestry practices in Nepal have been continuously transforming during the last 50 years. The indigenous and traditional practices were forced to cease or integrate with formal system of forest management after a series of policies and acts were introduced by the Govt. of Nepal. The Forest Nationalization Act 1957, Land Reform Act, 1964, and Land (Survey and Measurement Act), 1963 created disincentives to maintain private, communal, and religious forests and added incentives to convert forest land into agricultural

land. Along with the different types of locally and indigenously managed forests, the associated traditional institutions also vanished. Indigenous practices cannot function without indigenous institutions and thus indigenous practices after few years of struggle were reinvigorated under different types of CBFM institutions. Thus we can argue that indigenous FPM practices have been both adaptive and resilient since they are functioning under different types of institutions for the last 50 years.

106 The current CBFM and CBPM are dynamic systems undergoing necessary modifications and adjustments in their according to the changing cultures, peoples' needs and aspirations. The autonomous adaptation strategies seems to be progressive in the Forest Users Committee in Palpa; the Mukhiya system in Lower Mustang; and Shingi Nawa system in Solukhumbu. In Ilam, Kailali and Upper Mustang examples, it seems that community's extensive agriculture and grazing systems were unable to survive.

107 The case study indicates that indigenous and local practices can be integrated and synergized with scientific or formal practices. The integration of the Nawa system into a formal system of protected area management in the SNP is a good example of a synergy between indigenous and modern practices. This reinforces the earlier conclusion on this good practice (Stevens, 1993 and Bhatta, 2013).107.The discussion above indicate that the local users have used indigenously developed and innovated community based forest management (CBFM) practices (observed in Palpa, Ilam, and Solukhumbu) successfully in meeting their needs while effectively conserving the biodiversity and ecosystem services. In contrast, CBFM practices observed in Kailali and Mustang are found less effective due sudden and larger climate induced changes. The poor success in adapting to CC may also be due to poor application of indigenous and local knowledge and practices. In successful districts, the ILKPs are well integrated or synergized with outside knowledge, especially from sources such as SNP, and government's management guidelines. For example, in Mustang, ACAP has developed its own grassroots institutions whose reluctance to integrate the indigenous Mukhiya system has resulted in overall inefficiency, duplication of resource use, and most importantly, ineffective conservation efforts.

Case Study Limitations

108 Among the methodological challenges faced during the research, the selection of representative case examples that could capture the large diversity of indigenous and local practices found in Nepal proved to be of considerable difficulty. Literature review indicates that indigenous forestry practices are linked to ethnicity, castes, cultures, languages, festivals and local ecosystem characteristics. This makes indigenous forest and pasture management system generally localized and situation specific. It was, therefore, decided to take a mix of agro-ecological and ethnographical criteria in picking up five case examples covering Tarai, Mid-hills and Mountain ecosystems on one side and indigenous as well as local community practices on the other. Thus, while the study managed to cover the indigenous practices of major ethnic and caste groups of Nepal, it still has missed some important practices. The assumption is that

the study has captured adequate diversity of research subjects to achieve a good representation of the typologies of the ILKPs that exist in Nepal's forestry sector.

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Therefore, the study has limitations such as: a) non-inclusion of the indigenous practices of Rai community in Khotang and Bhojpur, women-led CBFM, and Dalit led CBFM that are also found in different parts of Nepal ; and b) limited household respondents (238)while analysing the climate change related vulnerability issues representing Nepal. In addition, the study is also limited in covering both the current and future aspects facing the indigenous and local forest users, such as, impacts of species and change in habitat on production and productivity of forests and pastures. The study also has not covered the resource access rights and tenure issues which the indigenous people consider important.

Implications

110

The case study findings have a number of implications for building resilience to Nepal's successful community based forest, pasture, and biodiversity management. These can be listed as below:

a) Addition of new knowledge and perspective in the ongoing discourse on how to make indigenous forestry knowledge and practices more climate adaptive; the five case examples have demonstrated that different indigenous forestry practices of Nepal have different degree of efficacy toward resiliency building and adaptation for climate change and climate variability. For example, highly exposed and sensitive trans-Himalayan pasture systems are not resilient and need a major change in management strategy;

b) The findings also has identified the indicators and practical examples of adaptive forestry practices; As argued by several authors (Bk, 2010; Carter and Pokharel, 2011) the CBFM examples of this case study shows a number of good practices and mechanisms to plan adaptation including eco-system based management and NTFP management. This reinforces the argument that the indigenous forestry knowledge should be the very basis to plan adaptation activities in forest and pasture management in Nepal to reduce growing climate induced vulnerability and ecosystem degradation.

c) The study also highlights often neglected aspect of the indigenous forestry practices as to how they have been dynamic adjusting activities according to the change in weather and climate; this case study demonstrates their robustness to reduce climate change hazards, risks, and vulnerability using either their natural buffering capacity or through human planned resilient building activities such as thinning of dense stands and plantation of agro-forestry crops.

d) This study also indicates that the indigenous forestry practices are found to be of varying quality and efficacy; while they flexible, cost effective, and gender sensitive they still need to improve social inclusion and biodiversity conservation. The implication is that CBFM has to remain open to synergizing and/or integrating with scientific knowledge so as to create more robust and cost effective forest-based adaptation solutions.

e) In the context of CCA, an adaptive and resilient indigenous forestry practice should not increase green house gas (GHG) emission. For example, uncontrolled burning of forests to increase production of food grains and fodder grasses as a part of traditional Shifting Cultivation cannot be considered an effective and efficient indigenous practice. Instead multiple use forest management can yield forest ecosystem goods and services, including non-timber forest products such as medicinal herbs, clean water, and carbon sequestration that can generate adaptation, mitigation and poverty reduction outcomes. Such practices should be promoted to build climate change resilience and to assist forest managers to better managing risks in overall adaptation and development planning.

3.8 CONCLUSION AND RECOMMENDATIONS

111

This study provides policy insights of high importance on the relevance and potentials of indigenous local knowledge and practices in forest and pasture management for climate change adaptation in Nepal. The examples of adaptive and resilient practices documented under this case study are compelling enough to start using indigenous local practices in forest ecosystem based adaptation planning, multi-stakeholder forestry programme development and community-based project management. The relevance of practices and evidence of the effectiveness of ILKP presented in this report stresses the key role of context-specific indigenous local knowledge in climate change adaptation. Some of the main interventions that can help in making ILKP in forestry more effective for climate change adaptation are the following:

a) Recognisation of the ILKP as a valid source of knowledge and basis for adaptation planning and decision making by the ministries of Forest and Soil Conservation, Agriculture Development and NGOs;
b) Facilitated development of enabling policies, legislations, and institutional framework involving all relevant stakeholders to promote integration of indigenous forestry knowledge and practices in decision making; this task could be done by forestry, agriculture and livestock management related NGOs, CBOs, and service providers;.
c) Valuing the relevance and appropriateness of ILKs in forest ecosystem based adaptation; there is a need to harness the power of indigenous science through innovative CBFMs; this may be the starting point for planning situation based climate change adaptation by district forest, soil conservation, agriculture, and livestock development offices;
d) All local level agencies should recognize that the indigenous practices have evolved with particular reference to a particular ethnicity, culture, and location; they should promote ILKP in local and community adaptation plan of actions (LAPAs and NAPAs) by enhancing community empowerment, capacity building and technical skill development;

e) Given the importance of reducing deforestation and forest degradation for a sustainable CCA, involving all the stakeholders, including those who are not native to a village and/or members of the forest/pasture user committees will be necessary; this will build resilience and adaptiveness in existing forest/pasture management practices; this task could be performed by field level governmental and non-governmental agencies;
f) Timely launching of innovative income generating activities by planting commercially potential non-timber forest products (NTFPs) can make vulnerable communities – landless, dalits and marginalized members of the society, more resilient; and
g) Reinvesting part of the income generated through community based forest and pasture management practices into poverty reduction and climate change adaptation activities can promote indigenous knowledge and practices; this could be done both the CFUGs and the district and national forestry and livestock agencies.

To sum up, developing resilient and adaptive community based forest management is critical to mainstream climate change risks management in Nepal's development plans since Nepal's agrarian rural economy is highly dependent on the forest ecosystem goods and services. Forest ecosystems including forested watersheds are natural infrastructure of Nepal that can be protected and managed to build climate resiliency so that the biophysical vulnerability can be reduced for managing growing risks to the country's development infrastructure such as hydro power plants, roads, and irrigation facilities in fragile hilly terrains.

112

Such a nature-based strategy can ensure sustainable adaptation and development at a much lower cost. Community-participated forest and pasture management strategies are no-regret and low-regret adaptation strategies which, as the case study shows, generally do not fail in delivering both conservation and development objectives at local level, especially in hilly and mountain ecosystems. Therefore, a sound and sustainable community-based forest resources management would be an important component of mainstreaming climate change risk management in Nepal's development plans and programmes. This is the concluding message of this case study.

113

Annex 3.1: Brief profile and climate change status of case study districts

114

Palpa: Palpa has sub-tropical to temperate climate and has been placed under `very low' vulnerable category by the National Adaptation Programme of Action (NAPA) report (MoEnv, 2010). The district has dominant population of Magars Brahmins and Chhetri communities. It has one of the highest literacy rates in the country (Box 1). Palpa has good quality forest land and watersheds. But it was not so 50-60 years before. Degradation of the local forest resources started in 1958 after the GoN nationalized all forest lands in the country. By the year 1965, the condition of almost all the forests that had been under indigenous and local community management before the government takeover, became alarmingly deteriorated (Baral, 1993). Soil erosion, landslides, and flash floods became common problems along with silting farms, drying up of drinking water sources, and clogging irrigation canals. The situation has changed and no serious impacts of climate change are observed in the district at the present.

PALPA DISTRICT

Total Population: 261,180
Population Density: 190.23
Ethnic composition: Newars, Magars
Agro-ecological Zone: Western Mid-Hill
Total VDCs: 65
Total Municipalities: 1
Total Household: 59,291
Total literacy rate: 76.2
Female Literacy: 56.4
NAPA vulnerability: 0.003 (Very Low)
Mean Maximum temperature: 27^{O}
Mean Minimum temperature: 15.1^{O}
Annual Precipitation: 1571mm

115

Kailali: Kailali district has been placed under `low' category of vulnerability by the NAPA report (MoEnv, 2010). The district has sub-tropical climate. During the last five years, it has been experiencing more frequent and devastating floods, river cutting and inundation problems. The district's geographical location (bordering with India), fast changing demography (population growth ~ 3.5%), rampant deforestation and forest degradation make the district increasingly more vulnerable. The district level stakeholder consultation indicated that the government regulatory mechanisms to regulate land use, human settlements, infrastructure development, and water and disaster management are largely non-existent,

KAILALI DISTRICT

Total Population: 775,709
Population Density: 239.79
Ethnic composition: Tharu, Brahmins, Chhetris, and Dalits
Agro-ecological Zone: Far-Western Tarai
Total VDCs: 42
Total Municipalities: 2
Total Household: 142,480
Total literacy rate: 66.3
Female Literacy: 44.4
NAPA vulnerability: 0.192 (Very Low)
Mean Maximum temperature: 30.4^{O}
Mean Minimum temperature: 17.5^{O}
Annual Precipitation: 2602mm

ineffective, and uncoordinated. The rich indigenous local knowledge is vanishing and local practices are either getting integrated with or replaced by outside knowledge. There is a heavy in-migration of people from the Hills and other parts of the country which has both influenced the status of the ILK systems and affected the forest situation in the district.

116 **Ilam:** Ilam district located in the eastern border region of Nepal is a hilly district. The NAPA process of the MoSTE has categorized it under `very low' vulnerable category (MoEnv, 2010). The district has sub-tropical to warm temperate climate. In the historical times, most of the original settlements of the district were indigenous peoples consisting of the Rai, Limbu, Sunuwar, Sherpa, Gurung, Tamang and Magar communities. Today, the population is mixed. Indigenous peoples and Brahmin and Chhetri, along with dalits and occupational casts, live in the district (Box 2). The climate is characterized by fragile sub-tropical and temperate bioclimatic ecosystems as part of the broader Eastern Himalaya eco-regions. . Diverse types of vegetation are found in these mountain ranges since the climate is hot and humid during the summer season and cold and frigid during the winter.

ILAM DISTRICT

Total Population: 290,254
Population Density: 170.44
Ethnic composition: Limbu, Magar, Brahmin, Rai, Chhetri, Gurung, Sherpa
Agro-ecological Zone: Eastern Mid-Hill
Total VDCs: 48
Total Municipalities: 1
Total Household: 64,502
Total literacy rate: 77.9
Female Literacy: 52.9
NAPA vulnerability: 0.140 (Very Low)
Mean Maximum temperature: 19.8^{O}
Mean Minimum temperature: 11.9^{O}
Annual Precipitation: 2152mm

117 **Solukhumbu:** Solukhumbu district is ranked by the NAPA study (MoEnv, 2010) under the `high' vulnerability category. The district has temperate to wet alpine climate and the dominant population consists of indigenous peoples (Box 4). Khumbu region in particular, is considered to be one of the most climate vulnerable regions of Nepal due to rapid melting of glaciers and formation of melt water lakes. The Imja glacier located in the region has been classified as the 2nd most dangerous lakes with GLOF potential (ICIMOD, 2010). The average annual temperature is estimated to be increasing more than 0.090 C. Both the glacier volume and area have decreased significantly (23-25%) during the last

SOLUKHUMBU DISTRICT

Total Population: 105,886
Population Density: 31.97
Ethnic composition: Rai, Sherpa, Chhetri, Tamang, Kalong, Kama, Magar
Agro-ecological Zone: Eastern Mountain
Total VDCs: 34
Total Municipalities: 0
Total Household: 23,785
Total literacy rate: 64.2
Female Literacy: 55.7
NAPA vulnerability: 0.725 (High)
Mean Maximum temperature: N/A
Mean Minimum temperature: N/A
Annual Precipitation: N/A

few decades and almost all glaciers have receded forming several glacial lakes with high risk of triggering flash floods. The snowfall – a critical source of water is also decreasing and due to the increasing temperature, the permafrost is melting and avalanches have become common, threatening the lucrative mountaineering expedition business of the people in the area. People blame the accelerated rise in temperature for the avalanches in 2014 along the Everest expedition route where 16 Sherpas lost their lives.

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Mustang: Mustang district is known as the dry alpine desert of Nepal. It has harsh but an enchanting landscape, rich and diverse bio-cultural heritage, well known Himalayan Mountains and the deepest gorge in the world along the Kali Gandaki River. The district is situated in the Trans-Himalayan rain shadow area and receives less than 200 mm rainfall annually, although in recent years it has been increasing. The NAPA report (MoEnv, 2010) has categorized Mustang as a `moderately' vulnerable district. However, the current indicators show that the district is experiencing severe impacts of climate change which points toward a higher vulnerability in future. The district is populated by two dominant ethnic groups: Lho-ba or Gurung in the North and Thakali in the South (Box 5). Traditionally, Mustang was divided along the ethnic lines as 5 Gaunle (culturally distinct village cluster), 12 Gaunle, and 16 Gaunle located along the Kali Gandaki River from south to north. Now it is divided into two: Lower Mustang (LM) and Upper Mustang (UM). A recent study by Swiss experts (KFS/SUPSI/LMF (2012) has projected that the Upper Mustang area will experience between 50 to 100C temperature rise by the turn of this century. Most of the snow will fall in the form of rain progressively increasing the precipitation patterns and flash flood risks. Already, Mustang is perhaps the first place on earth to produce climate refugees. Three villages – Dheye, Yara, and Samzong, are facing combined impacts of water sources drying up and flash floods, and are on the verge of migrating to other places (SUPSI, 2012).

MUSTANG DISTRICT

Total Population: 13,452
Population Density: 3.76
Ethnic composition: Tsahalis, Gerung's, Lho-bas, Tibetans(pls check this)
Agro-ecological Zone: Western Mountain
Total VDCs: 16
Total Municipalities: 0
Total Household: 3,354
Total literacy rate: 66.2
Female Literacy: 46.9
NAPA vulnerability: 0.559 (Moderate)
Mean Maximum temperature: 17.7^{O}
Mean Minimum temperature: 6^{O}
Annual Precipitation: 312 mm

Historical Climate Variability

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Regarding the historical variability of climate change in the Case study districts, we accessed the temperature and rainfall data of the past 30 years (DHM, 2010) and analysed the trend. The data indicate that while in the hilly and mountainous districts (Palpa, Ilam, Solukhumbu, and Mustang) average annual temperature is significantly increasing, the Tarai districts of Kailali and Mahottari are showing a decreasing trend (Graph 1 and 2).

Regarding the precipitation trend, the historical 30 years data indicate that while average annual rainfall is showing an increasing trend in Mustang, there is decreasing trend in Dolakha, Palpa and Ilam. In Dolakha, the decrease is statistically significant as shown by Graph 3. In Mustang, there is an increasing trend in average rainfall (Graph 4). In Solukhumbu, Mahottari, Rupandehi and Kailali, there is no clear trend indicating that the rainfall quantity is more or less constant, but rainfall patterns have changed with more rain falling in shorter duration. It may also be noted that both decreasing and increasing trends in precipitation are not statistically significant.

FIGURE 1: Temperature increase trend in Palpa district

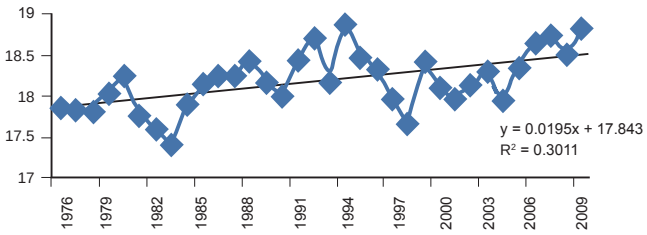


FIGURE 2: Temperature decrease trend in Kailali district

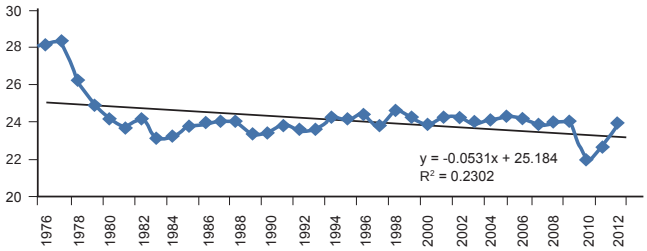


FIGURE 3: Decreasing rainfall trend in Dolakha

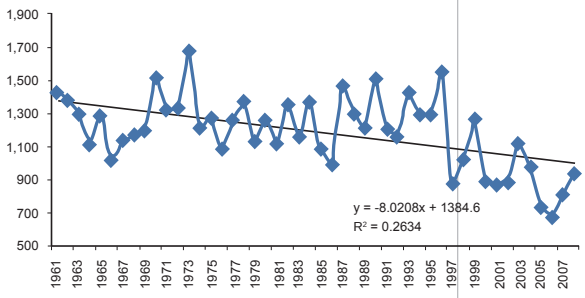
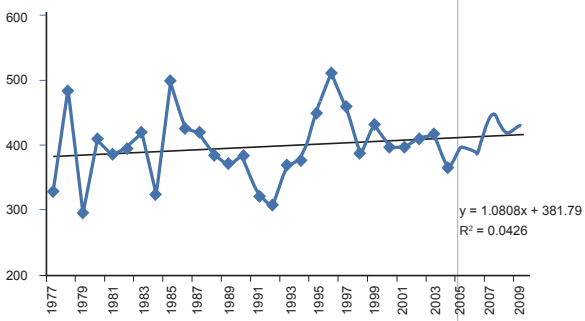


FIGURE 4: Increasing rainfall trend in Mustang



ANNEX 3.2, TABLES 1-9

TABLE 1: Birth place of household respondents

Name of the districts	Birth place of household head			Total
	Same village	Elsewhere in the district	Elsewhere in the country	
Illam	6	1	0	7
Kailali	2	0	9	11
Mustang	7	3	0	10
Palpa	1	5	1	7
Solukhumbu	8	1	0	9
Total	24	10	10	44

TABLE 2: Mother tongue of the household (HH) respondent

Name of the districts	Mother tongue										Total
	Gurung	Kumal	Magar	Maithali	Nepali	Sherpa	Thakali	Tharu	Loba	Other	
Ilam	4	0	0	0	3	0	0	0	0	0	7
Kailali	0	0	1	1	8	0	0	3	0	0	11
Mustang	4	0	0	0	0	0	2	0	2	0	10
Palpa	0	1	1	0	5	0	0	0	0	0	7
Solukhumbu	0	0	0	0	0	9	0	0	0	0	9
Total	8	1	2	1	16	9	2	3	2	0	44

TABLE 3: Food self sufficiency of the household respondents

Name of the districts	Food sufficiency						Total
	Less than 3 months	3 - 6 months	6 - 9 months	9 - 12 months	Year around food stock	No cultivation	
Illam	1	1	0	3	1	1	7
Kailali	0	3	1	1	5	1	11
Mustang	2	2	3	0	2	1	10
Palpa	3	0	1	0	3	0	7
Solukhumbu	1	8	0	0	0	0	9
Total	7	14	5	4	11	3	44

TABLE 4: Membership of HH respondents in traditional social organizations

Name of the districts	Membership in any of social organization at present		Total
	Yes	No	
Ilam	6	1	7
Kailali	11	0	11
Mustang	8	2	10
Palpa	5	2	7
Solukhumbu	6	3	9
Total	36	8	44

TABLE 5: Membership benefits in social organization for improving livelihoods

Name of the districts	Membership supports livelihood improvement		Total
	Yes	No	
Ilam	6	1	7
Kailali	11	0	11
Mustang	4	6	10
Palpa	7	0	7
Solukhumbu	5	4	9
Total	33	11	44

TABLE 6: Response on whether men and women play different role in climate change adaptation activities

Name of the districts	Men and women play different roles in climate related adaptation activities				Total
	Yes	No	Any two (men or women)	Everyone (men, women and children)	
Ilam	2	5	7	0	7
Kailali	7	4	11	1	11
Mustang	6	4	10	0	10
Palpa	5	2	7	0	7
Solukhumbu	2	7	9	2	9
Total	22	22	44	3	44

TABLE 7: Time of harvesting timber products in the Case Study areas

Name of the districts	Time of harvesting timber products (logs, fuel wood, and poles)								Total
	Summer	Autumn	Winter	Spring	Summer & Spring	All year round	Once a year	Item not collected	
Illam	0	1	5	0	1	0	0	0	7
Kailali	2	0	8	0	1	0	0	0	11
Mustang	0	0	0	5	0	0	0	5	10
Palpa	0	0	2	0	5	0	0	0	7
Solukhumbu	0	0	0	1	6	0	0	2	9
Total	2	1	15	6	13	0	0	7	44

TABLE 8: Marketing of Non timber forest products (NTFPs)

Name of district	Purpose of NTFPs Collection			Total
	Household use	Market	Not collected	
Ilam	6	1	0	7
Kailali	4	5	2	11
Mustang	2	2	6	10
Palpa	2	3	2	7
Solukhumbu	0	0	9	9
Total	14	11	19	44

TABLE 9: Household members involved in harvesting NTFPs

Name of the districts	Household members involved in harvesting and using forest and pasture products				Total
	Women	Men	Any two (men or women)	Everyone (men, women and children)	
Illam	4	3	0	0	7
Kailali	6	4	0	1	11
Mustang	8	1	1	0	10
Palpa	4	3	0	0	7
Solukhumbu	3	4	0	2	9
Total	25	15	1	3	44

CASE STUDY IV

UNDERSTANDING INDIGENOUS AND LOCAL PRACTICES IN RURAL TRANSPORT INFRASTRUCTURE FOR CLIMATE CHANGE ADAPTATION IN NEPAL

CONTENT

ABSTRACT

Climate change influenced extreme events such as floods and landslides seriously impact Nepal's rural transport infrastructures affecting the movement of goods and people. Nepal's indigenous and local communities (ILC) have developed a range of practices in building trails, bridges, and road tracks to maintain mobility in all seasons since time immemorial. A wide range of indigenous and local knowledge and practices (ILKP) in transport infrastructure are climate resilient and adaptive. These practices could be further developed in enhancing adaptive capacity of the local community against climate change induced stresses. While used for infrastructure plans at the district level, these ILKP have not been systematically documented, assessed and scaled up.

This report provides an account of ILKP documented from the study of seven different case examples indigenously developed and used in five districts. Using literature review, national and district level stakeholder consultations, focus group discussions, key informant and household interviews, the report documents, analyzes, and recommends ILKP related to infrastructure suitable for climate change adaptation (CCA) in Nepal. Specifically, the study has covered traditional bridges, tuins, hilly trails and tracks.

Among the key findings, Baglung's iron chain and Jumla's wooden bridges that date back hundreds of years stand out as classical indigenous technologies. The Baglung Type Chain Bridges (BTCB) was developed by the local blacksmiths mining locally available iron ore in the early 20th century. This knowledge has been recognized and integrated by the modern suspension bridge technology promoted by Swiss development agency in Nepal. Similarly, the Jumla type bridge developed by indigenous communities using wooden logs without any cement, iron rods or nails is another unique construction related ILKP. These rural trail bridge construction practices and the technologies used are now included in the district development polices and plans. The other ILKP documented are human and animal trails, tracks and river crossing Tuins or `Wire Bridges' which are still the primary means of rural transport facilities in areas devoid of modern roads and suspension bridges. These ILKP play critical role in disaster risk management by maintaining communication links and also getting local products to markets.

The indigenous local bridge and trail practitioners lack capacity, complementary technology, and access to skill improvement opportunities. Without sufficient recognition, the skills will be less and less used and such types of infrastructure will become unavailable despite their appropriateness and clear advantage for climate resilient small-scale infrastructure. These practices are found useful and rather critical while planning adaptation since they help make infrastructure cost effective, socio-culturally more acceptable, and environmentally sound by using local technicians, local materials, and peoples' participation, all of which are vital for operation and maintenance of the infrastructures. The ILKP documented are also being blended with modern engineering knowledge. If these ILKP are promoted with suitable modifications and retrofitting, they can help vulnerable communities

further develop their adaptive capacities in the face of extreme events and reduce risks. However, the role of ILKP in rural transport sector is diminishing. Supportive policies and programmes are needed to sustain these innovative rural practices and technologies.

4.1 INTRODUCTION

4.1.1 Overview:

5 Nepal has rich indigenous and local knowledge and skills in rural transport infrastructure sector out of which, some are beneficial and climate friendly. These indigenous and local practices also relate to coping with natural disaster through preparedness. That is why the demand for such practice grows, especially while developing and maintaining rural infrastructure. Literature from around the world attests to the value of ILKP in rural transport infrastructure. For instance, in Sub Saharan Africa, farmers' experiences on early warning system (Ajani et al, 2013) are useful lessons for pursuing planned adaptation measures. This chapter analyzes indigenous practices prevalent in Nepal's small-scale rural transport infrastructure such as bridges, tuins and trails rather than major infrastructures in which such practices are less often applied. Tuins can be considered as a primitive stage of river crossing device (bridge) using cable car or ropeways.This study tries to analyse on farm and off farm transport infrastructure system that the rural communities are using for their livelihoods and argues that such infrastructures are more frequently damaged by increasing climatic hazards.

6 Indigenous and local knowledge has not been widely used in new project designs for small-scale rural infrastructure in government or bi-lateral and multi-lateral financed projects in Nepal despite the options available and their appropriateness to local conditions. Mercer et. al., (2009) states that the use of indigenous knowledge alongside scientific knowledge is increasingly advocated but as of yet, no framework exists that demonstrates how the two may be integrated with the objectives to reduce community vulnerability to hazards. The challenge for planners working on rural transport is to find better ways to learn from indigenous institutions and practices to adapt modern rural transport techniques (Chakwizara & Nhemachena, 2012).

7 Very few frameworks are available that demonstrate how traditional or indigenous knowledge in rural transport has evolved and been used to minimise community vulnerability to climate hazards. Better understanding of local skills and knowledge in rural transport can add value to develop rural infrastructure. Such understanding can provide improved techniques for the transport sector, including designing systems that are more resilient to climate change impacts. Indigenous and local knowledge systems (ILK) provide cost effective and simple solutions in the context of limited resources in the transport sector (Chakwizira and Nhemachena, 2012). Non-formal knowledge related to rural transport (in contrast to formal knowledge) is handed over orally from generation to generation using hands on experiential approach. Kilkenny (1998), World Bank (2008) and Mashiri et al, (2008) suggest that locating

and situating in rural transport add value to rural development. This is so in Nepal where the existing ILKP in rural transport sector can support for climate change adaptation practices. The case studies in this chapter substantiate this viewpoint.

4.1.2 Rural transport and gender issues:

Many rural transport projects often concentrate on building larger infrastructure rather than on improvement, maintenance and upgrading of the smaller roads and tracks/ feeders. Many rural women and small farmers use them for local transportation to meet their daily livelihood needs. One possible reason for this disregard is that women in general as well as communities that are more marginalized are less included in the planning and management of rural transport system. Women in rural households undertake different transport tasks, and often carry a heavier burden in terms of time and efforts in transporting materials (Blackden & Wodon, 2006). Rural transport, for example, is related to the task of fetching water, agricultural inputs, and fuel-wood collection the types of roles undertaken by women. Climate change risks and hazards threaten these vital lifelines.

4.1.3 Rural Bridges and trails in Nepal:

Earlier rural bridges (or fadke in local dialect) were constructed of vines and wooden planks using traditional or indigenous knowledge. These were made of wood, bamboo, babiyo, or choya (local dialects for describing plants that are used to make ropes). Wooden bridge in Jumla and Sangle Bridge (bridge made of iron chains) in Baglung are typical examples of this kind. As per the Department of Local Infrastructure Development and Agricultural Roads (DoLIDAR), the span, height, tightness/sagging, capacity, weight, diameter of rope, and materials used were ethno-engineering techniques. Traditional experiences and knowledge that considered extreme climate events assisted in forecasting flood magnitude and high flood water level. The modern suspension bridges built in Nepal follow similar practices. This approach thus bring the traditional practice and modern scientific (engineering) knowledge together.

According to DDC Baglung (KII with Planning Officer, 2013) early suspended bridges were simple engineering system which used indigenous knowledge. The design and material used had limitation but did meet commuting needs. For centuries, communities in Nepal built bridges across rivers using such technologies which can be observed in temporary bridge designs or other river crossing devices such as tuins or iron chain bridges. At the beginning of the 20th century, the government became involved in constructing bridges at key locations. It was not until 1964–65 that systematic and planned construction started with Swiss support to build trail bridges and later evolved as one example of successful development partnership. These bridges are built and maintained by the community themselves with greater ownership, accountability, responsibility and transparency in bridge building process. According to DoLIDAR official (KII with Senior Divisional Engineer in Kathmandu, 2014), Nepal has more than 5,000 trail bridges (2012 on record) that use modified (based on engineering design) local knowledge and experiences.

11 Rural roads like Goreto (trails or path for walking) and Ghoreto (trails or path where horses, donkeys and mules can commute) are/were built and maintained by local people, mostly through voluntary contribution of labour. In these infrastructures, indigenous skill or experience can be observed in the width, span, and height of stairs: elements to suit the needs of the elderly and the children. Building of resting places (chautari in local dialect) was taken into consideration while goreto and ghoreto were laid. Repair activities included cleaning, maintaining and upgrading-activities that are generally carried out after monsoon and before Dashain and Tihar festivals. These months are chosen because the weather conditions are favourable and people are free from farm activities enabling them to contribute voluntary labour. People usually judged the slope stability by observing the presence or absence of paharo (local term used for exposed or unexposed base rock). A slope was considered stable if a paharo is present; lack of paharo indicated instability. This criterion was also used when houses and settlements were established. Today, even the road surveyors consult the local and elderly people to get better sense of the topography including fragility of a particular area.

4.1.4 Study rationale and current status:

12 A large section of the rural population who rely on rural transport infrastructure is also impacted by climate change as their daily livelihood is affected. These infrastructures (rural bridges, tuins and trails) adhere to good practices of ILK useful in climate change adaptation efforts as they can be cost effective and environment-friendly. By incorporating ILKP one also ensures that the traditional systems would be promoted and preserved. Such efforts would help add knowledge of these systems of which limited numbers of research exists.

4.2 CASE STUDY OBJECTIVES AND RESEARCH QUESTIONS

4.2.1 Case study objective:

13 The objective of the rural transport case study is to examine the potential impact of climate change on rural bridges, tuins and trails, and ascertain if local and indigenous knowledge and practices are being used in their development. The findings will be useful for supporting livelihood strategies and to take ameliorative action against climatic hazards. The findings will also be useful for programs and policies at both local and national levels.

4.2.2 Research questions:

14 The research questions of this study are determined to suit objectives. The questions are,

- What local and indigenous knowledge are being practiced in rural transport infrastructure?
- How well are these practices documented?
- How climate friendly are these practices and how do they support local communities to adapt to climate change?
- What are the gaps and methodological challenges in understanding such

practices?
- How are community, gender and social inclusion issues reflected in these practices?
- How can one promote such knowledge and practice so that the government includes them in its policy and programs at national level?

4.2.3 Methodology

The methodologies and tools used to collect information were workshops at the respective districts, focus group discussions, key informant and household interviews, and observation. The research team interacted with the occupational caste people (blacksmiths) in Baglung who were involved in making chain bridges and have followed it as a family vocation. In Jumla, the team interviewed key informants who were involved in operation and maintenance of the wooden bridges. In Dhading, the team crossed a river on a tuin and received a firsthand experience on the difficulties and the technicalities of tuin operation. The team also walked along some of the trails, and interacted with local people. Both structured and semi structured questionnaire were used during such interactions. Prior to the field survey, literatures focusing on rural transport infrastructure and indigenous knowledge and climate change adaptation practices were reviewed.

4.3 CASE BACKGROUND

4.3.1 Case introduction:

The cases examined local context, evolution of cultural knowledge and practices, location and ethnicity. For instance, the wooden bridges of Jumla represent the traditional local technology of a Mid-Western Development Region (MWDR). The local people constructed these bridges using local materials and technology. Locally available logs were used and the bridges were built with the support of the community without the use of imported materials. The people of Jumla began using these bridges about 100 years ago which proved to be climate friendly and adapted to natural variability. Although the bridges are maintained regularly using the old methods, no new bridge has been built using this technology for over three decades. Likewise, in the iron chain bridges of Baglung (Western Development Region) constructed by the local blacksmiths' applied local and indigenous knowledge. Ethno-engineering technology (cultural context that did not involve imported techniques) based on the topography and geology of the river-reaches is used for constructing them. In many places, including Dhading, in Central Development Region (CDR), tuins, a purely local innovation, is still in use to cross the rivers.

The trails in Jumla, Baglung, Dolakha and Solukhumbu districts used local people's knowledge, skills and practices for constructing and maintaining them. The lessons learnt from these case studies will be useful as they may enhance resilience of rural infrastructure which is threatened by climate change impacts.

4.3.2 Study districts, selected cases, and purpose of selection:

Based on the literature review and stakeholders' consultation, the team selected 7 case studies in 5 districts (See Map) to document ILK practices in rural transport (Table 1).

4.3.3 District scenario and climate change variability:

19

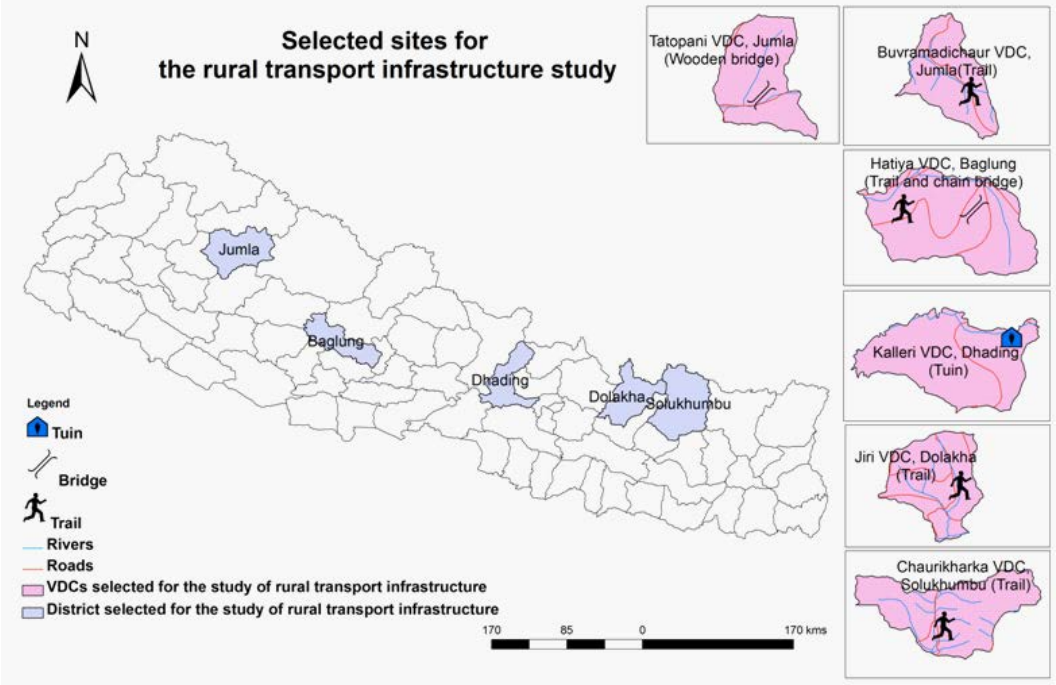
Jumla: Jumla was the cradle of an ancient civilisation and is thus, rich in terms of archaeology and history. It is located in Karnali zone in the western Nepal with its district headquarter in Khalanga. Sinja valley on the western part of the district is where the Khas Nepali language originated, and is considered to be the original home of the Khas ethnic group. Majority (98%) of people in Jumla are Hindu with other religious groups forming a minor faction (CBS, 2011). The majority of the population are from Chhetri ethnic community, followed by Dalits, Brahmins and Janajaties.

Table 1: The selected cases, their districts, and purpose of selection

Cases	District/Region	Purpose of selection
Wooden bridges	Jumla District/Mid-Western Development Region	Local and indigenous technology; traditional design and constructed with locally available wood with community participation
Iron chain bridges	Baglung District/ Western Development Region	Made by Indigenous (blacksmiths) people using local technology, partly local materials (iron chairs and wooden planks), and community participation
Tuins	Dhading District/ Central Development Region	Made using partly local materials used and local technology; traditional river crossing devise at a more primitive stage of bridge building
Jumla - Rara / Gamgadi trail	Jumla-Mugu districts/ Mid-Western Development Region	Environment friendly and maintained with the participation of the community members; construction carried out with locally available materials
Galkot - Ghumte trail	Baglung District/ Western Development Region	Environment friendly and maintained with the participation of the community members; construction carried out with locally available materials
Jiri - Lukla trail	Dolakha - Solukhumbu districts/Central and Eastern Development Region	Environment friendly and maintained with the participation of the community members; construction carried out with locally available materials
Lukla - Namche trail	Solukhumbu District/ Eastern Development Region	Environment friendly and maintained with the participation of the community members; construction carried out with locally available materials

20

Jumla is famous for its wooden bridges. There are about 14 suspension and 293 wooden bridges in the district. One of the wooden cantilever bridges is built across the Sinja khola (river) on the trail from Sinja to Jaljala Chaur. Another speciality of Jumla is it has numerous trails. Out of these, some of the popular ones are trails from Jumla to Rara or Gamgadi (Mugu), and from Jumla to upper Dolpo-Jomsom. The later one is one of the most extreme adventure circuits, which has been recently opened to introduce the remote Nepali country life and habitat of the mountainous people. Within the district, mules, sheep and humans also provide transportation. The climate of Jumla district varies from temperate to alpine.



Baglung: Baglung district is a part of Dhawalagiri zone and Baglung Bazaar is the district headquarter. It is a hilly district and most of the settlements are along the river banks. The headquarter Baglung Bazaar is situated at the bank of Kaligandaki River. The district has diverse religion and ethnicity where Hinduism and Buddhism are the major religions. Magar, Chhetri, Brahmin, Newar, Gurung, Chhantyal and Thakali ethnic groups live in Baglung. The district has many rivers and streams, and suspension bridges have been built for crossing them. Due to the large number of bridges Baglung is also known as the district of suspension bridges. Nepal's longest suspension bridge connects Kushma, the DHQ of Parbat district, and settlements of Baglung district. The district also has many trails in use since the ancient times. Baglung district has a varied topography and enjoys warm summers and mild winters. It has tropical, subtropical and temperate types of climate.

21

Dhading: Dhading district is part of Bagmati zone in CDR, and Dhading Besi is the district headquarter. Though close to the capital, the district has relatively poor basic services and infrastructure. The ethnic composition consists of Chhetries, Brahmins, Dalits and indigenous Chepang community. Prithvi Highway that connects Kathmandu with Pokhara passes through this district, but many parts of the districts are away from the road. Many snow-fed rivers flow through the district including Trishuli and Budi Gandaki. Crossing these rivers during monsoon is a challenge as the numbers of suspension bridges are limited. As a result the local people have developed tuins to cross rivers in many parts of the district. Dhading has sub tropical monsoon climate along the river valley and cold climate in upper regions.

22

23 **Dolakha:** Dolakha district is part of Janakpur zone. The district headquarter is Charikot. Majority of the people here are Chhetris, followed by Tamangs, Brahmins, Newars, Thamis and Sherpas. The Jirel and Thamis are the indigenous tribes of the district. Dolakha is a delightful place with people having strong religious affiliations. It is popularly known for Dolakha Bhimsen temple in Charikot. Another popular destination in Dolakha is Jiri. As the closest road head, it is the trailhead of 4-5 days trek into the Everest region. The trail passes through numerous settlements inhabited by different ethnic groups including Jirel, Chhetri, Newar, Rai, Tamang and Sherpa. The main attraction of this trek is Junbesi village (2,650 masl), the oldest Sherpa settlement in Solukhumbu. As trekkers walk along this, they experience traditional aspects of the culture. The climate of Dolakha district varies from tropical to temperate and alpine.

24 **Solukhumbu:** Solukhumbu district in Sagarmatha Zone, has Salleri as its headquarter. The district consists of the two sub-regions, Solu and Khumbu. Mount Everest is located in the in the Khumbu region in northern part of the district within the Sagarmatha National Park (SNP). Indigenous ethnic Rai and Chhetri are the main groups living in the mid-hills of the district, while the Sherpas live in the high mountains. The district is famous for the trekking trails and expeditions, of which trail from Lukla to Namche or up to Everest base camp is a popular trail for trekkers and mountaineers. The climate of Solukhumbu district varies from temperate to alpine.

Table 2: Temperature and precipitation data of the districts studied with the vulnerability ranking

Districts	Temperature* mean max - min (0C)	Annual precipitation* (mm)	NAPA combined vulnerability index**	Mean annual rainfall trend*** (30 years)	Mean annual temperature trend*** (30 years)
Jumla	21.6 – 5.4	832	0.562 (Moderate)	Decreasing annual trend, statistically significant with p-value of 0.004	Increasing annual trend, statistically significant with p-value of 0.001
Baglung	27.1-15.4	2744	0.574 moderate	Slightly increasing annual trend, does not reveal any statistical significance with p-value of 0.372	Increasing trend, not significant change with p-value of 0.194
Dhading	N.A.	2158.81	0.758 high	Decreasing annual trend, statistically not significant with p-value of 0.013	Increasing annual trend, statistically significant with p-value of 0.004
Dolakha	21.2-8.5	1188.125	0.855 very high	decreasing trend, statistically significant with p-value of 0.000	Increasing annual trend, but not significant with p-value of 0.411
Solu-khumbu	N.A.	1833.9	0.725 high	Slightly increasing annual trend, does not show any significant change with p value 0.399	Increasing trend, not significant with p-value of 0.439

Source: *DHM (MoSTE), 2012, **NAPA (MoSTE) 2010, DHM data analysis /ISET-N

The socio-economic information of all the districts studied for rural transport infrastructure is presented in annex (a).

Table 2 shows climate data, variability and vulnerability index of the districts studied for rural transport infrastructure.

4.3.4 Types of participation:

As discussed above, different methodologies were used to get the information during the data collection process. In rural transport infrastructure two hundred fortyone participants participated in the discussion (through the means of workshops, FGDs KIIs, household interview), of which, about 29.9%% were female. Their composition in terms of caste and ethnicity were 65.6% Brahmin/Chhetri, followed by Janajati (32.0%) and small percentage of Dalit (1.7%) and Muslims (0.83%). This composition signified fairly inclusive participation reflecting composition of the population within

Table 3: Level of participation by gender, caste and methods/tools

Total number of participants(district level workshops, FGD, KII and HHI): 241						
Category type						Total
Gender	Male		Female			100%
	70.1%		29.9%			
Caste	Brahmin/Chhetri	Janajati	Dalit	Muslim		100%
(Social inclusion)	65.6%	32.0%	1.7%	0.83%		
Methods/Tools	District workshop	FGD		KII	HHI	100%
	34.0%	39.8%		5.3%	21.2&	

Source: ISET-Nepal field Survey 2013/14

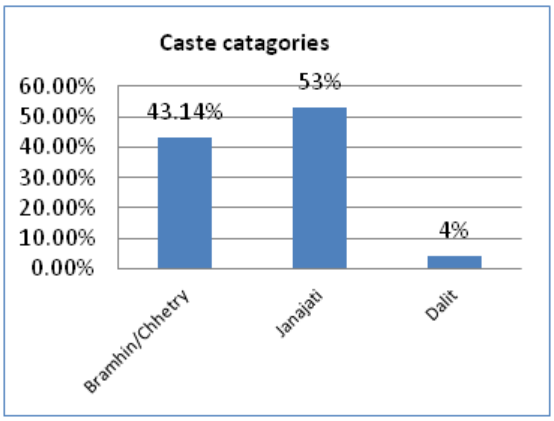
study. In regard to the methods used, about 34% belonged to district workshops, about 39.8% to FGDs, 5.0% to KIIand the rest (21.2%) to HHI (Table 3).

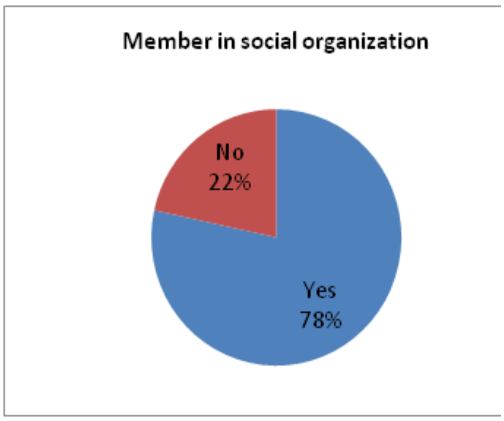
4.3.5 Socio-economic situation:

Socio economic information and climate perceptions were collected from the bridge, tuin and trails (rural transport) user households from the selected districts (Jumla, Baglung, Dolakha and Solukhumbu). A total of 51 HHs (21 bridge and tuin users, and 30 trail users) were interviewed for this purpose.

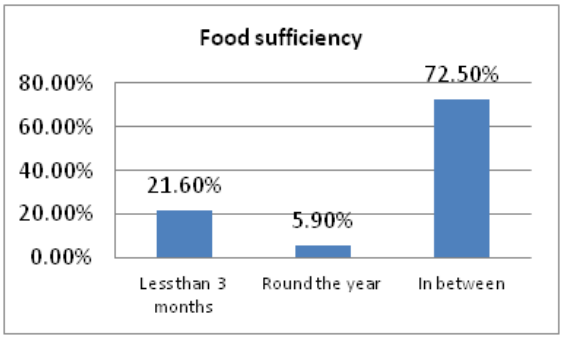
Out of 51 HHs interviewed for rural transport study, 78.4% HHs reported that they are associated with some kind of social organisations. These organisations include CBOs, NGOs, youth clubs, cooperatives etc. They receive services from these organisations in some form, and are supposedly less vulnerable as compared to those who are not members of such organisations (See Figure).

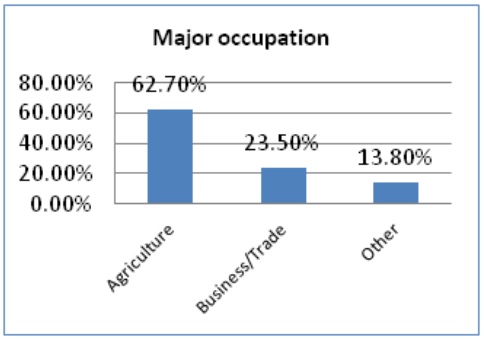
Of the total respondent HHs, 62.7% stated agriculture as their major occupation followed by business/trade (23.5%) and others (13.8%). Some of them reported multiple occupations as well. HHs having more than one occupation are again supposed to be less vulnerable to climate stress. Likewise, only about 6% HHs have food stock (availability of food grains from own production) round the year. About





Source: ISET Nepal field survey, 2013/14





Source: ISET Nepal field survey, 2013/14

22% HHs have food stock for less than 3 months (see bar graphs below); and 92.2% have their own house (regardless the type) whereas, only 9.8% were living on rent.

31 Further information on migration, climate change and adaptation programmes is presented in annex (b), (c) and (d) respectively.

4.4 CASE EXAMPLE FINDINGS

4.4.1 Wooden bridges of Jumla

4.4.1.1 Case evolution:

32 As mentioned earlier, Jumla is famous for its indigenous wooden bridges, known as Jumla Type Bridge. These wooden bridges were built long time ago by the local people using indigenous knowledge, skill and practices. Before modern engineering or before foreign materials (rod, cement) were introduced in the district, local informants say that such technology was in use for more than 200-300 years. The team visited few wooden bridges constructed over Tila River in Tatopani VDC. There were 10 bridges in the VDC, and made detail study of the Bridge at Ranka.

To that end the team held focused group discussion (FGD) with the local people at Ranka (Tatopani VDC) to collect detailed information from the village leaders and key informants. Prior to that, a district level workshop was organized at Khalanga, the district headquarter of Jumla, to solicit the stakeholders' views. The field level information (including information from the households) gathered in Jumla are summarized below.

4.4.1.2 Case study site description:

33 Ranka village includes wards one and two of Tatopani VDC, with about 257 households and a population of 1,152. During FGD the participants suggested that, the village has 60 per cent Chhetris and 40 per cent Dalits; most of whom follow Hindu religion. Ranka village is half an hour drive from the district headquarter towards south west along the Karnali highway. Khas Nepali is the village's spoken language. Literacy rate of the village is below national average 65% (CBS, 2011). People have been living here for many generations and they have no knowledge of where their ancestors came from. Most of the people follow traditional farming for their livelihood, and seasonal migration to India is common.

4.4.1.3 Bridge for local livelihoods:

34 Locals suggest that about 1,000 people use the bridge each day, including those from other VDCs, as it provides access to the roads that connects with Jajarkot District. Women respondents suggested that the bridge has made their daily commuting easier. Local people in Ranka village use this bridge to cross the Tila River and get their daily needs. They also use the bridge to take their cattle for grazing, to go to the forest for fodder and firewood collection, and to work in farms/pasturelands. The major fuel source for cooking is firewood, and women of each household carry loads (about 40-50 kg) of firewood across the bridge every day.

4.4.1.4 Climate change perception and impacts:

35 In recent years, local people experience increase in temperature and decrease in the amount of rainfall and snowfall. They complain that water sources are drying and discharge of Tila River is decreasing. The production of rice has been affected by warmer temperature. They suggest that in recent years flowering time is earlier, while pests and diseases are more common. Rise in temperature and erratic rainfall are also affecting apple farming. In addition, they are experiencing early fruiting of chilly plants, and with increasing temperature, the necessity of early harvesting of barley. However, none of these changes directly affect the wooden bridge.

4.4.1.5 Indigenous and local knowledge and practices in bridge construction:

36 The Ranka Bridge is locally known as Kote sangu (wooden bridge) and the locals believe that it is 150 to 200 years old. They suggest that it is one of the strongest bridges in the region. Wooden nails have been used in the pillars and not a single iron nail or any kind of imported material has been used for the constructing of the bridge.

37 Such wooden bridges are made up of wood from deodar trees (Himalayan Cedar or Cedrus deodara growing at 1,500 to 3,200 masl). The tree is suitable for

constructing bridges because its height reaches 40-50 m and trunks are of about 3 meter in diameter. This size enables making of longer and wider pillars. Usually, local people repair existing bridges when they become rickety, and locals term for repaired bridges as 'new bridges'. Kote sangu (Ranka Bridge) has been repaired four times in the past 60 years (1947, 1971, 1986 and 2006). It takes about three years to complete construction of a new bridge. The steps include: selecting the trees, cutting it, seasoning the wood, carrying logs from the forests, and construction (which takes only 3-4 months). The local community regards bridge construction as a festival. At least 400 people are involved in constructing the bridge. Men and women above 10 years of age from each household participate in the construction process. Men undertake the building tasks. Women are responsible for carrying loads of materials required; women also bring food and water for all the workers. In addition, women perform worship before the construction begins. Menstruating women are not allowed to cross the bridge while it is being constructed. Participation in construction depends on who uses the bridge. For example, Kote snagu, is constructed by Ranka villagers as they are the ones who mainly use it to get to their agricultural land across the river. Whereas, other bridges in longer trail routes such as Kudari VDC gets volunteers from farther VDCs in Sinja Valley as people from these areas use the bridge to travel to different parts of the district and beyond.

38 Constructing the bridge requires both skill and knowledge. Since the bridge is made of wood, skilled locals determine the size and shape of slabs, pillars, wooden nails and wood crafts. They also decorated the bridge by carving models of aeroplanes, horses, elephants, humans, birds and gods.

39 The constructors of such bridges require knowledge about measurement, designing, carving and other works. For making bridges, the two pillars on the sides are first set, and then slabs are put from both sides till the middle is reached. It is difficult to put pillars on the two sides and it takes a longer time. Another important indigenous knowledge found in bridge construction is the use of Bhojpatra (Himalayan birch – Betula utilis) bark, and stone walls constructed with ground whipped black lentils as the mortar. The bark of Bhojpatra has been used for centuries as paper to write

Kote Sangu, Ranka

Roadway to Tamti VDC settlement in Ranka village

Sanskrit scriptures and texts. Because Bhojpatra preserves wood from decaying, wooden parts are wrapped in the barks before they are fixed on the stone walls with black lentils which works like the modern day cement.

DETAILS OF KOTE SANGU

Total length of the bridge: 51 m. (above water and land) i.e. total walking length
Length of the bridge above water: 22.1 m.
Length of the bridge above ground: 27.88m (92 ft) (in one side only, the other side is rock)
Bridge width (above land): 2.6 to 1.25 m.
Bridge width (above water): 1 m.
Bridge height from water level (at centre): 8.18m (27 ft.)
Height of the side walls (supporting walls on the both side of the bridge): 1.5 m. to 1 m.
Tallest pillar: 12 m. (approx.)
Pillar circumference: varies from 1.7 m to 2 m.
Source: ISET-N field survey, April, 2013/14

4.4.1.6 Learning and transfer of indigenous and local knowledge practices:

The indigenous technology and skills have been transferred down the generations through hands-on experience as people participate in the construction. Locally skilled personnel performing the role of engineers do the planning, designing, budgeting, implementation, supervision and monitoring of the bridge construction. They guide the construction in site selection, layout design, selection of local construction materials, fixation of foundation depth of wooden piles, and selection of wood for the bridge. In the last few years, no new bridges have been constructed due to lack of appropriate sized Deodar trees; though entire wooden components have been changed during repair. The locals take collective ownership for reconstruction of a bridge every time it is repaired, and contribute both labour and cash. A noteworthy part of the bridge repair process is the formation of users' committee. Villagers discuss and nominate users' committee members based on consensus and the committee remains active till the construction is completed. While the construction progresses, the villagers have to contribute either financially or physically or both. Absentees have to pay a penalty.

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4.4.1.7 Key issues and challenges:

This indigenous knowledge and skill of wooden bridge construction is dying for various reasons. Locals complain that they do not find suitable Deodar trees and

41

Stone walls fixed with black lentils and Bhojpatra

Indigenous modern bridge and modern suspension bridge

BOX 1: THE RANKA BRIDGE

Mr. Hari Bahadur Kathayat (59) is a local resident of Tatopani VDC and former vice chairman of the VDC. He took leadership in maintenance of the bridge in 1986 and claimed that his ancestors built the Ranka bridge some 150-200 years ago during Rana regime. This bridge is regarded as one of the largest and strongest bridges of its kind in Jumla. About 50-60 mules can easily cross the bridge with load at one time. He clarified that there is no fixed interval or date for undertaking repair or maintenance of the bridge; it is done as per the need. All the male members from a family participate in repair and maintenance and more than 200 people are involved. During maintenance, old decayed wood, slabs and pillars are replaced. In addition, other structural adjustments are also made during this renovation process. Normally, the same design and the structural systems are maintained. Advantage of such a bridge is that it does not swing while crossing as opposed to modern suspension bridges, and it is straight in design (no curvature as seen in modern suspension bridges).

Bhojpatra due to deforestation and limited re-plantation efforts. The process of wood selecting, collecting, seasoning, furnishing and building takes time that affects their other livelihood pursuits. The young generation is not interested in wooden bridges and skilled personnel are decreasing. Additionally, lack of support from government and other agencies in promoting and preserving such local knowledge, skills and practices further aggravates the decline.

4.4.2 Baglung type chain bridges (BTCB)

4.4.2.1 Case evolution:

42 With more than 500 suspension bridges in the district, Baglung is known as the district of suspension bridges. The district is also well known for locally made indigenous iron chain bridge called the Baglung-type bridge. Local community built bridges to make their mobility easier. Many chain bridges still exist in Galkot area and around Tarakhola VDC of the district. In the past, Baglung District had many iron and copper mines. Iron extracted from the mines was used to make chains for bridges and to other tools. It was carried out by 'Kamis', the occupational blacksmiths. Later on, extraction of iron and copper was stopped because of high tax imposed by the government. The people who constructed trail bridges were more skilful than university graduate engineers because of their experience. Mr. Omkar Prasad Gauchan (a former minister) initiated expansion of the Baglung Bridge technology to other districts of Nepal.

43 These trail bridges in Baglung are of two types: 'suspension' and 'suspended'. The walkway of a suspension bridge is supported by vertical cables hung from the main iron cable stretched between lattice towers built on opposite banks of a river. One each bank the cable is anchored to a rocky wall or to a masonry block. The walkway is generally cambered upwards. To design and construct a suspension bridge requires higher degree of expertise and costs more than a chain bridge. On the other hand, suspended type of trail bridge is built without towers. The walkway of the bridge is held by cables attached to the main cables. The suspended bridge is cheaper, safer and better quality than suspension type (Dixit, 2006). The chain bridges in Baglung are all suspended bridges. Many of these suspended bridges are constructed with Sangla (iron chain) made by the local blacksmith. Anybody can see the indigenous knowledge, skill and practices of local people used in developing the bridges. It is said that in the ancient times, a local tribe called 'Chantyal' were

intuitive enough to identify iron deposits by smelling. While the 'Magars' (another tribe) extracted iron ores using their physical strength. Then the local blacksmiths used to cast the iron using their indigenous skill to make chains for bridges. The 'Thakali' were the marketers for the materials produced by the blacksmiths. A social practice was in place but almost gone today.

The team assessed the ILK and practices regarding BTCB at Hatiya village located in Galkot region based on the feedback at the district level consultation that was presided by the Chief District Engineer of the district. In a FGD held at Hatiya, key informants and traditional bridge makers were consulted, while user HHs were interviewed. These processes yielded the following findings.

4.4.2.2 Case study site description:

Galkot area is in the middle of the district which comprises 16 VDCs, and Hatiya is one of them. The road passing through Hatiya falls under Madya Pahadi Rajmarga (Mid Hill Highway under construction). Galkot region faces high youth migration due to lack of employment opportunities, and low agriculture production.

Agriculture is the main occupation for most of them living here, followed by income from remittance. Majority of the people are Brahmins and Chhetris, followed by Dalits and Janajatis (Magars, Chantyals). Most of them follow Hindu religion. Nepali is the main language spoken here. The literacy rate almost coincides with the national average (65%). Most of the participants were natives to the places who have been living there for at least 5-6 generations. Very few households in Galkot are female headed. The progress of construction of these bridges and trails started after the visit by the then king Mahendra in the 1960s.

4.4.2.3 Bridges for local livelihoods:

The team visited two BTCB in Galkot region – one in Hatiya bazaar and another along the Baglung-Hatiya road. These bridges were roughly 15 metres in length and at least 20 years old. The bridges were built over streams and not over major rivers as the BTCB do not support the technology for bigger bridges. Small settlements and markets are located around the bridges. The stakeholders mentioned that these bridges have helped local people in maintaining mobility such as visiting markets, schools, service centres, and visiting relatives or friends. It was observed that the local people's dependency on these bridges is very high.

4.4.2.4 Climate change perception and impacts:

The local people expressed that drying up of springs, changing behaviour of plants (such as early or late flowering/fruiting) and animals (breeding or conceiving time of cows and buffalos), and increased climate hazards (landslides, flood, drought etc.) as main indicators. Torrential rains few years ago damaged the bridges and destroyed crops but the impact was manageable and could be repaired. They opined that it is the preference for black topped road and cement concrete bridges rather than the issue of climate change that are affecting indigenous trails and bridges that have displaced traditional blacksmiths and other skilled human resource. Landslides and floods affected the infrastructure.

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4.4.2.5 Indigenous and local knowledge and practices in trail bridge construction:
Traditionally, materials for BTCB were made with local tools and techniques. The blacksmiths used to make the iron chains for trail bridges. The iron ore (to make the chain) was available from local iron mines. The tools for construction of the bridge were locally made. Local leaders used to take initiation to carry out such undertakings. Traditional engineering (ethno-engineering) was applied for planning, designing, construction, supervision and monitoring the quality of construction works. Iron chains were used as cable to suspend walking planks. The wooden deck slabs were locally made using ILK, which hardly exist nowadays. Now, these have been replaced by steel deck and imported steel cable. Out of many iron chain trail bridges built, only a few are in existence and help in local commuting.

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4.4.2.6 Transfer of indigenous and local knowledge:
The local blacksmiths who used to cast iron and make chains for trail bridges are now only a few in numbers as younger generation is not interested in the traditional vocation. It is mainly due to five reasons: a) mining of iron and copper has been stopped due to government imposed tax and other restrictions on mining b) Imported steel cables became cheaper than the locally produced chains, c) Wooden deck slabs were replaced by steel deck because of low maintenance cost and durability in addition to minimising deforestation d) imported wire ropes and deck slabs are found to be stronger, durable and did not rust. e) ILK was not transferred from generation to generation because it was difficult to maintain their livelihood just by doing ironwork. A local blacksmith who did say that their forefather used to make chains for the bridge construction but they know little about such skills and they practices pottery now. They are not in favour of motivating their children to be engaged the same job.

BOX 2: LIVELIHOOD UNDER STRESS

Mr. Krishna Bahadur Biswakarma (42) is a native of Hatiya and blacksmith by profession. He runs a small workshop along with his brothers for making iron tools and pots. He has a larger responsibility to support his extended family. He has a small agricultural land and the production hardly supports for 3 months, and for the rest of the year, he is surviving because of his business. Earlier, his family was involved in making chains by casting iron. His father had the knowledge of making iron chains. Nowadays, he and his brothers have stopped making chains. Lack of raw iron and the decision of the government to use imported steel cable instead of the iron chains have made the professional continuity even more difficult.

He feels that it is hard for him to make a living using his traditional profession. People are not interested in this job. The government policy does not support this type of traditional professional skill and knowledge. Not only the chains or cables are imported, all other iron tools like bulldog grips, saddle plate, anchoring parts, and steel parts are also imported in huge quantities rather than them being producing locally. It was also learnt that producing tools and steel parts locally is not cost effective; hence it is imported. These factors have threatened his livelihood. He emphasized that education should be provided to all so that the individuals can make choice of his/her profession.

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4.4.2.7 Indigenous and local knowledge and practices used:
In the beginning, the practices used in chain bridges were widely applied to construct other suspended trail bridges in the district. After import of materials from India started, local practices could not be continued as local product became more costly. In place of chain bridges, modern suspension bridges were built. These modern bridges could be built faster; they were bigger, and more durable. Though the materials are imported, still ethno-engineering techniques of the local blacksmiths are applied on the new bridges. These suspension bridges are also being replicated in other districts in Nepal. Recognizing the success of the BTCB, the technology is also practiced in other developing countries of Asia and Africa (DDC sources).

4.4.2.8 Key issues and challenges:

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Due to deforestation, wood and timber are less available. So the planks that were used as pedestrian deck in the chain bridges are replaced by steel deck. Local people having indigenous and local knowledge are no more transferring their skills and knowledge to their children and therefore ILK is a dying wisdom. The bridges are now in poor condition but still functioning in many places. There are some skilled masons who have developed skills in the use of new technology as well as having indigenous knowledge. The challenge is to preserve their knowledge and skill.

Table 4: Comparing Baglung and Jumla type bridges

Bridge type	Materials used	ILK in	Commonalities in both	Differences	Special features
Jumla type	Log of woods only	Bridge planning, design, construction, supervision, wood collection, Use of Bhojpatra to wrap wooden beams, Use of black lentil as an adhesive	Traditional, labour intensive, locally made, suitable in hilly areas, no modern technologies and materials, Not designed as per engineering requirement, all built on local knowledge and assumption, technology disappearing	Totally local materials used	The bridge does not swing while crossing, Made of 100% natural materials
Baglung type	Iron chains, rods, wooden slabs,	Iron extraction, Making iron chains, making wooden deck slabs, design and construction of the bridge		Partly local materials, partly imported materials used	The bridge does not swing much; it is stable and durable as iron chains do not decay.

Source: ISET Nepal field survey 2013/14

4.4.2.9 Comparing Baglung and Jumla type bridges:

53

Both the Jumla and Baglung type bridges are different in nature and design and their comparison is useful to know the ILKP used in different circumstances and locations, and some of these indigenous practices could help to reduce the impacts resulted by climate change stresses (Table 4).

4.4.3 Tuins of Dhading

4.4.3.1 Case evolution:

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Use of traditional or indigenous knowledge in making tuins (also called as targhat or ghirling in some places) can be a good example of its kind. It is not a new technology, and it has been in use in Nepal for a long time. Tuins reflect on the status of the local technology, its use by people, its socio-economy, and the opportunities it has created for people living in villages separated by major rivers and their tributaries (Dixit & Upadhya, 2004). In due course of time, these river-crossing devices have improved with the use of steel cables and pulleys. This is purely a local novelty. A common example of tuins can be seen in the section between Baireni (Dhading) and

The chain bridges at Hatiya (Picture 1 and 4); The iron chain bearing the load of the bridge (Picture 3); The iron chain hooked into the ground (Picture 2)

55 Mugling along the Prithvi Highway and in other parts of Nepal. This local technology has been in use in many parts of Nepal for a long time and still continues to serve many villagers. Where river flow was swift, Kathe Sanghu (bridges of wooden logs) were used in the winter, whereas tuins were used during the monsoon. Tuins are still in use in many isolated parts of western Nepal.

4.4.3.2 Case study site description:

56 The case study village (Baireni, Kalleri VDC-3, Dhading) consists of 50 HHs who are directly dependent on the tuin. About 90 households in the surrounding villages also use this tuin. The village comprises of 50% Rai, 45% Magars and the rest are Brahmins and Dalits who all speak Nepali as their mother tongue. All the HHs are extensively involved in vegetable farming and the tuin is the only viable

means to transport the vegetables. Although there is a bridge around two kilometres ahead, the tuin is used for daily transportation, including heavy load transfer which saves time and money. The settlement is about 25 years and it was established after malaria eradication and when the prospect of vegetable farming increased after the Highway was constructed. Currently, there are only 12 operational tuins on Trisuli river corridor but they are gradually being phased out and replaced with suspension bridges. The daily users of this tuin are students, farmers, women and children, elderly and the sick people.

4.4.3.3 Climate change perception and impacts:

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The villagers have felt increases in temperature and decreases in rainfall which affects vegetable farming. The community does not think climate change is affecting their means of transport such as tuins. But they are concerned that they may not be able to replace the suspension wire of the tuin in case the current tuin is damaged by floods. A major floods in 1993 brought massive devastation. According to the local informants, a tuin was constructed in1980s was swept away in 1993 and a new tuin was installed in 1998. Now the tuin is functioning well.

4.4.3.4 Indigenous and local knowledge and practices:

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A tuin located 100 m east of Adamghat is 225 meters long and is used for crossing Trishuli River. It has two wires with a suspended basket (Kokro) big enough to carry 3-4 persons. Before the tuin was established here, the villagers crossed the river in boats. They installed the first tuin using iron wire from old Malekhu Bridge and using their local knowledge and material. The basket was made from wood and the bearings were brought from Kathmandu. In 2012 the Practical Action (then ITDG) improved the current structure. Before that some other organisations had also provided support to improve it. The local people contributed 28 days labour during the repair work and were paid wage labour for additional 22 days. Now cash contribution is made to pay for maintenance. The current structure is suspended on two cement poles and platforms. Everyday around 10 tons of vegetables and 200 people cross the river using this tuin. The people have been seeking support to upgrade and maintain the tuin and also want to replace the wooden basket by a metal one.

4.4.3.5 Operation and maintenance:

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The members of the local community who live in nearby villages take responsibility for the operation and maintenance of the tuin by forming an ad hoc committee. Whenever problems occur, local people (especially the regular tuin users) donate

some money and labour for its repair. Additionally, they charge the users other than locals who use the tuin and collect fund. Tuins are considered community assets and the users repair any damage. There is no formal body for its operation and maintenance.

4.4.4 Case example: trails of Jumla, Baglung, Dolakha and Solukhumbu

4.4.4.1 Case evolution:

60 All the 4 trails are located in mountainous districts (covering both eastern and western parts of the country). Local people thought that they were constructed during the Rana regime. They couldn't recollect when they were first constructed. Trails in Nepal had narrow width when they were first built which made walking difficult. They were not paved with stone either. It was very dangerous in many places as they encountered slippery slopes in rocks and threat from wild animals was high. Later, the trails were widened when flow of tourists started to increase. The Jumla-Rara (lake) trail became popular following king Mahendra's visit to the lake in 1962. It was widened and upgraded then. The Jiri to Lukla and Lukla to Solu trail became popular after Sir Edmund Hilary and Tenzing Sherpa used this route to get to the base of Mt. Everest in 1953. Following their successful summit, the Government repaired and upgraded the Lukla-Namche trail. Similarly, after Ghumte peak in Baglung became popular as pilgrimage site, the trail was repaired. The trails for this study were selected based on the suggestions given during the workshops organised at the district headquarters or towns. These workshops also provided feedbacks on local adaptation practices as follows.

Table 5: Case study site description of the trail user HHs

Site	Socio-economic features						
	HH No. (approx.)	Major religion	Major caste / Ethnicity	Literacy status	Language spoken	Livelihood	Distance from DHQ
Neurigad, Jumla (Between Jumla and Rara)	22	Hindu	Kathayat, Budha	Very few literate, Many can only write their names	Khas Nepali	Agriculture, Hotel business for trekkers	8 hours walk
Hatiya, Baglung (Starting point to travel to Ghumte peak)	200	Hindu	Brahman, Chhetri, Dalit, Magar	About 50%	Nepali	Agriculture, Remittance	4 hour drive
Jiri, Dolakha (Starting point to Lukla)	1200	Buddhist, Hindu	Jirel, Sherpa, Bramhan, Chettri, Dalit	About 76%	Jirel, Sherpa, Nepali	Agriculture, Service, Business	2 hour drive
Phakding, Solukhumbu (Between Lukla and Namche)	250	Buddhist		About 60%	Sherpa, Rai	Hotel business for trekkers, Agriculture	3 days walk , 1 day from Lukla

Source: ISET-Nepal field survey 2013/14

4.4.4.2 Case study sites description:
The case study sites for rural trails were of different in their location and settlements. Some sites were highly populated while others were not. The sites not only differ in terms of caste/ethnicity, literacy status or language spoken of the people living in the area but also on their distance from the district headquarters, livelihood dependency, and the religion the communities follow (Table 5).

4.4.4.3 Trails for local livelihoods:
Trails support local livelihoods in two ways. First, the local people use the trail for fetching water, collecting fodder and firewood, taking animals for grazing, and visiting markets and service centres. Second, those who run hotel business and work as porters use the trail to maintain their livelihood by providing service to the trekkers. Trails thus function as the backbone for the local communities. The shorter trails like Ghumte peak- Baglung specifically caters to the pilgrims and trekkers (both domestic and foreign) who visit the temple and the peak (4,000 masl plus) for enjoying the panoramic view of the Central Himalaya. Although the number of foreign trekkers to Ghumte is small, domestic tourism is growing. People expect that it will grow further once the Mid-hill Highway becomes operational. The trail is heavily used when there is festival or an auspicious day.


Galkot-Ghumte trail (managing rubbish)


Jumla-Rara trail

4.4.4.4 The features of the trails
Jumla- Mugu trail connecting Jumla DHQ and Mugu DHQ or Rara lake in Mugu, passes through small markets like Chere, Danfe lek, Khali, Neurigad, Kabra, and Bhulbhule where simple lodging facility and food are available. The 60 km long trail passes through crests and valleys of the hills and through steep slopes. The enchanting landscape attracts moderate flow of trekkers.

64 Ghumte Dhuri (peak) is the highest mountain of Baglung district (3,150 masl), and more than 16 Himalayan peaks can be seen from there. The spot is famous as a Hindu shrine. The road is about 5 km long and requires 4 hour uphill hike from Hatiya bazaar. The trail was built in ancient times and has well-laid stone steps in many segments.

65 The Jiri-Lukla trail is about 180 Km long and takes about 6 days to reach Lukla (up to the airport) without load. The trail passes through many settlements. It is regarded as one of the most beautiful trails in Nepal. Local people don't know when the trail was first constructed. The flow of trekkers has decreased when the airport in Lukla began to operate.

66 Lukla-Namche trail is about 18 km long and is wide enough for comfortable walk. The width varies and in some specific points narrows. Starting from Lukla (2,800 masl) it gradually goes downhill up to Phakding (about 2,600 masl). Then from Jorsalle the trail takes sharp uphill turn up to Namche (3400 masl.), which is about 3 hours walk. The flow of trekkers is high in this trail.

4.4.4.5 Climate change perception and impacts:

67 Along with the temperature rise and erratic rainfall, people have expressed that flood, landslide and droughts are increasing. Such events add to the existing risks along the trails. People suggest that, water sources (springs) are drying making it inadequate to meet the demands. In Solukhumbu, people have experienced rise of temperature every year. In Baglung, they have experienced drying of springs. The residents of Dolakha are worried about the future of Khimti and Tamakoshi hydroelectric plants because of decreasing river discharge. They attribute these changes to climate change.

68 People expressed a mixed opinion regarding precipitation. In Jumla, local people experienced that precipitation is decreasing, but in other 3 districts people say rainfall has become more erratic. In Baglung, they have experienced unprecedented

Lukla-Namche trail (planned maintenance) (Picture: 1); Rubbish Management (Picture: 2); Trekkers enjoying the trek (Picture: 3)

intense rainfall. In Dolakha, people suggested that rainfall is untimely and decreasing. People everywhere are experiencing less snowfall (in the mountains) as compared to the past. Cherdung Mountain in the north of Jiri valley used to get snowfall in all seasons but now this has become history. The Sherpas in Solukhumbu shared the similar and suggest that the snowline has shifted up. The declining trend of winter fog has also been noticed. In Jumla, the fog is gradually decreasing, whereas, in Dolakha, local people expressed that they have not seen morning fog for years.

Impact on trails: When asked to recount the impact of climate change on the trails, people agreed that as compared to agriculture, water, and health, the impact was less evident. In all case study districts local people suggest that days are hotter than in the past and rainfall more erratic. The damages were more pronounced due to flash flood and intense rains. Recalling a big landslide of 2010 in Khumbu region (Ghat) which killed 6 people and damaged the trail heavily, people in Solukhumbu were worried about the changing climate. Further, the landslide destroyed a bridge at Thado Koshi and section of the trail.

The Jumla-Rara trail has faced several effects of flood events, especially in 1978 and in recent times. Landslides affect the trail every year but damage is not as significant as it was in 1978. In Baglung, people attribute increased landslide events that damage the trails to deforestation. The respondents agreed that instances of both drought and flash floods have increased and the floods damage trails. Climate change could further exacerbate extreme events. They felt that the winds were becoming stronger, and heavy storms and frost damage the trails. Rocks used as steps break more easily as summer temperature has increased. Not only humans but even domestic animals feel difficulty treading on the trails.

The impacts of climate change issue are complex and need to be analyzed both at micro and macro level. Climate change has directly impacted sectors such as agriculture and water (lowering production, drying up of sources and shifting cultivation). Regular monitoring is necessary. The events are likely to damage trails and increase cost of repair and maintenance. Cessation of mobility in some of the trails also adds to the costs.

4.4.4.6 Indigenous and local knowledge and practices in trail construction:
The evidence of the use of ILKs in trails and bridges were limited though the ones that existed were noteworthy. The trails were constructed or built using community participation and using traditional tools. In Jumla, shovels came later and the indigenous instruments (such as Daabia to throw or dig out soil and stones) made of wood were used for widening the trail. They made ropes by using grass (Babiyo or Nigalo) to pull logs and stones for construction. Hammers were used to break stones apart as no explosives were available. To break stones, they used to heat it and pour cold water on top.

In Baglung, earlier people used wood, grass, and bamboos for digging trails which is not used anymore. Trail to Tara khola (another trail in Baglung) was constructed by breaking big rocks, and using wooden logs. Locals in Dolakha excavated trails using local understanding of geological structure to build steps and pavements with timber

FGD at Neurigad

BOX 3: HISTORICAL LOCAL CONTEXT

Mr. Jhanka Bahadur Basnet (51) is a chairman of the Galkot Ghumte Tourism Development Centre (GGTDC). A native to this place, he has contributed comprehensively to improve the trail for the trekkers and to promote tourism in the area to create jobs and also save environment. A small pedestrian trail was built in the historical time to reach Ghumte peak but remained neglected over the years. The local people, under his leadership, reconstructed it and opened as a new trekking route in 2011. The task was to widen the trail and improve greenery to attract trekkers.

Jhanka Bahadur says that the trail is unique for its religious, environmental and social values. It was constructed using indigenous and local knowledge, skill and practices that need to be protected. In rocky section, log of wood (crafted) is used as steps. In other places, wooden nails are used to support wooden beam (sapat). Local Chhapani (typical stone to pave the trail) was used in the trail. Both materials and technicians (Magars and Chhetris) were all local.

and stones. The trail in Solukhumbu was designed and built with the help of surveyors and engineers who consulted the local people during construction.

74 Local people say that there is a direct relationship between indigenous people and soil or land (including water and forest) that makes them knowledgeable on development of infrastructure such as bridges, trails, irrigation canals and water mills. They are worried that their knowledge might be perceived as being primitive. The use of local materials and indigenous knowledge/practices in climate change adaptation and disaster reduction may be able to save both time and money as they can perform such tasks through community mobilization.

4.4.4.7 Transfer and learning of indigenous and local knowledge practices:

75 Local people's knowledge on type of soil, geology of the construction area, and presence and nature of rocks are important aspects of ILK in trails development. Considering the transfer of ILK in trail construction, the older instruments hardly work as the sector has been modernized. Yet local knowledge and skills can be useful and add value while carrying out local infrastructure works such as filling the approach with earth, and constructing retaining structures in rural roads. Some of these knowledge and skills are being transferred from generation to generation and their use in construction, operation and maintenance of trails continues. One of the local concerns is that the ILKs in trails are in decline as no new trails are being developed. Instead, motorable roads are being built to connect all district headquarters. Younger generation is not interested in constructing and maintaining trails, and there is lack of proper documentation of traditional practices to transfer the knowledge and practices to them. The voluntary participation in community work is declining too, and people show interest in cash incentives. Nevertheless, trails remain important in the rural hills even when motorable roads are being constructed as the later can become non-functional due to floods and landslides. Not every village can be reached by motorable road. In Lukla-Namche stretch, villagers are in favour of trails rather than motorable roads because they fear that road will reduce

trekking tourism. They are motivated to preserve and transfer indigenous skills and practices.

4.4.4.8 Key issues and challenges:

76 Except the Lukla-Namche trail, the 3 trails face several challenges. The most important challenge is that existing trails are being widened to function as motorable road. For instance, motorable road has been completed half way along Jumla Rara and Hatiya-Ghumte trail. Similarly, parallel road is being constructed along Jiri- Solu trail. As a result, number of trekkers using these trails has decreased. Another example is the Annapurna circuit where the number of tourists decreased tremendously following construction of the motorable roads that connects Beni with Jomsom. Clearly, trekkers do not like the dust and noise of the motor vehicles as they long for respite from drudgery when trekking.

77 ILK that are being used to maintain these trails have either become redundant or majority of the local people are not interested in trails. They demand roads. The people in Lukla-Namche trail are an exception as the trail there generates local business (including hotel and restaurant business) and their livelihood is dependent on the trail.

78 Most of the popular trekking trails in Nepal are located in remote areas (including the 4 trails studied). In all the areas construction of motorable roads is the first choice and so is government's preference. Identification of alternative routes to reach specific destination is another challenge. For instance, opening of Lukla airport affected Jiri-Solu trail, and opening of Mugu airport and the motorable road up to Mugu reduced dependence in Jumla-

Jiri bazaar was initially first established through Swiss intervention

BOX 4: COMMUNITY AS BUILDERS

Mr. Ranuman Jirel

Mr. Ranuman Jirel (78) is a native of Jiri. He has walked the trail from Jiri to Everest base-camp more than 30 times. He is a retired government civil servant and remembers that the local communities built the trail in segments. The easier section was constructed first, and later on, the difficult parts like rocky outcrop and high slopes were constructed later. He informed that the trail was not built under government plan, and the community managed it all. As the number of trekkers declined, the livelihood of the local people was seriously impacted. Hotels, which depended upon trekkers, are now closed.

Mr. Jirel and his friends used to have good income when they worked as porters. These days, opportunities as a porter are limited. Women, rather than men, have benefitted more from the trail lately due to their regular dependency on the trails for collecting fuel, fodder and water.

Rara trail.

4.4.4.9 Comparison of four trails:
It is useful to compare the all four trails regarding their type, purpose, present condition, and the economic activities (Table 6). The table mentions the level of climate change impact on these trails at different ecological belts and the type of ILK used by the local communities for adaptation.

Table 6: Comparison of the trails by type, purpose and present condition

Trail name	Type of trail and length	Purpose of Trail	Present trail condition	ILK used	Climate change impact	Road (motor) intervention
Jumla-Rara/ Gamgadi (Jumla)	Mountainous, ups and downs, Medium trail	Trekking, Tourism, Service	Moderate	Simple	Moderate	Partly
Haitiya-Ghumte trail (Baglung)	Mountainous, uphill, Short trail	Trekking, Tourism, Religious,	Moderate	Simple	High	Partly
Jiri-Lukla trail (Dolakha)	Mountainous, ups and downs, Long trail	Trekking, Tourism	Moderate	Simple	Moderate	Partly
Lukla-Namche trail (Solukhumbu)	Mountainous, Ups and downs, Medium trail	Trekking, Tourism, Expedition	Good	Simple, with modern intervention	Moderate	None

Source: ISET-Nepal field survey 2013/14

Deserted Jiri-Solu trail

BOX 5: PREFERENCE FOR TRAILS

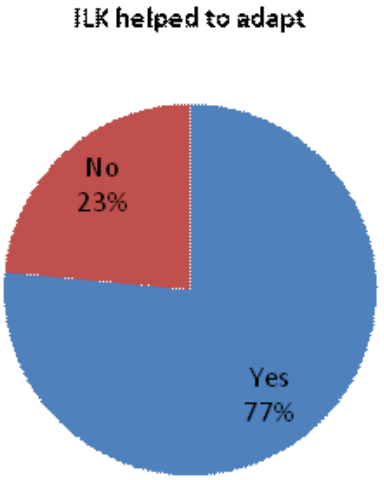
Mrs. Pasang Lamu Sherpa

Mrs. Pasang Lamu Sherpa (68) is a native of Solukhumbu District. She runs a hotel in Phakding. She remembers that part of the trail was across the Dudhkoshi River. When a landslide damaged the trail, it was shifted to the side in Phakding where she lives now. In 1953, Edmund Hillary and Tenzing Sherpa took shelter in her house during their expedition. She worked many times as a porter with expedition teams and has reached up to the Everest base camp. She had participated in the trail construction on many occasions when she was young. Because of the trail and the trekkers' inflow she is able to run the hotel although the competition is more intense now. She links improvement in her livelihood to the existence of the trail. She added that if motor vehicles run on this trail, she and many others from her community will lose their livelihoods. She is against the idea of building a motorable road like in other districts. She pointed out that ILK was used in trail construction in ancient times by digging, grading, widening, and paving stones. She remembers using Gahat (horse gram) to crack the rocks while quarrying and considers this as local knowledge.

4.5 ANALYSIS OF CASE FINDINGS

4.5.1 Climate change observation, household vulnerability, ILK and gender issues:

80 A total of 51 HHs were interviewed in rural transport infrastructure sector (bridge, tuin and trail users). About 90 % households felt that they do observe the climate change in their village (rise in temperature, less snowfall and erratic precipitation). In addition, 84.3% felt that there are other climate change related issues such as less fog and increasing cases of disasters. When asked whether his or her house is more vulnerable as compared to others, more than 50 % HHs treat theirs as more vulnerable (Table 7). This response also depended on the type of house they owned: kachha, pakka or semi-pakka; or on whether the house is situated in an exposed area or not. On the ILK related question, 76.5 % HHs expressed that the ILK used in bridges and trails (that they are currently using) has helped them become more adaptive (Pie chart).



Source: ISET-Nepal field survey 2013/14

81 Regarding gender and climate related issues, 66.7 % HHs thought that climate change affects women differently than men because of the nature of the job and biological factor; whereas, 33.3 % didn't consider this as a fact. When asked whether men and women can play different roles on climate change adaptation (based on

their experience gained through different roles and responsibilities in the society), about 55 % didn't consider this statement to hold true (Table 8).

Table 7: HHs responses to climate change issues and ILK

82

CC observation in the village (temperature, precipitation)		Changing pattern in other climate related issues (snowfall, fog, hailstone, lightening strike, thunderstorm, mist etc.) in past 20/30/40 years		Households more vulnerable than others to climate change	
Yes	No	Yes	No	Yes	No
Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
90.2	9.8	84.3	15.7	53.0	47.0

Source: ISET-Nepal field survey 2013/14

Table 8: Number of HHs responding climate change and gender issues

Sector: Rural Transport (Bridge, tuins and trails) Total HHs interviewed:51			
CC affects differently to women than men		Men and women can play different role to climate change adaptation	
Yes	No	Yes	No
66.7%	33.3%	45.1%	54.9%

Source: ISET-Nepal field survey 2013/14

83

Stakeholders were aware about the climate change issues at national and global scale, but not so much at local level. They believed that climate change challenges cannot be left to local communities alone. The government needs to address these issues as part of overall development strategy.

4.5.2 Status of infrastructure and their modification:

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The households who were using bridges, trails and tuins recognised changing pattern of climate in their villages. All 51HHs reported that the climate change has impacted the rural transport infrastructure. They also recognised that other factors such as maintenance also affected these infrastructures. About 57 % believed that these infrastructures are not functioning well; whereas, about 43 % expressed that they are functioning well. In order to make these infrastructures resilient or adaptive to climate change impacts, about 73 % said that local participation will be necessary in their modification incorporating ILKP as well (Table 9).

Table 9: Status of infrastructure and its modification (rural bridge, trail and tuins)

Particulars	Yes	No	Total
Rural transport infrastructure functioning well	22 (43.14%)	29 (56.86%)	51 (100%)
Family members' involved in modification of infrastructures due to climate change impacts	37 (72.55%)	14 (27.45%)	51 (100%)

Source: ISET-Nepal field survey 2013/14

4.5.3 Type of management and contribution in O&M:

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The approach of operation and maintenance of such bridges, trails and tuins varied. In all cases 'community collective action' was prominent (47.1 %) followed by 'committee formed as per need'. VDCs, local clubs, NGOs were also involved (about 20 %) in operation and maintenance. Some of the local people initiated operation and maintenance of these infrastructures themselves without any support. Response also suggests that autonomous responses are common. In terms of the type of contributions made, the households were supported by either labour contribution (25.5 %) or economic cash (13.7 %) or both (39.2 %). About 22 % of the households didn't contribute anything (Table 10).

Table 10: Types of management and contribution in O&M of rural infrastructure (bridge, trail and tuins)

Type of management in operation and maintenance (O&M)				
Community collective action	Self initiation for community welfare	Committee formed as per need	Other (VDC, Club, NGO etc.)	Total
24 (47.1%)	3 (5.9%)	14 (27.5%)	10 (19.6%)	51 (100%)
Type of contribution in operation and maintenance (O&M)				
Labour contribution	Economic contribution	Both	No contribution	Total
13 (25.5%)	7 (13.7%)	20 (39.2%)	11 (21.6%)	51 (100%)

Source: ISET-Nepal field survey 2013/14

4.6 DISCUSSION AND ANALYSIS

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The above sections described interpretation and insights of rural transport infrastructure. It is clear from the analysis that local people of the case study sites are familiar with the climate change issues, the changing pattern of it and their vulnerability associated with such changes, and this has been found more prominient in transport sector. It is the local people's argument that their ILKP is useful to make them adaptive. Thus integrating such ILKP in rural transport infrastructure implementation program will make people climate resilient. This makes O & M cost effective. Specific insights are as follows.

4.6.1 Bridges:

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Local people were in favor of conserving and preserving the indigenous knowledge and practices used in constructing wooden bridges and chain bridges. For instance in Jumla, locals inform that high level of deforestation has sharply decreased Deodar trees and simultaneously climate change impacts are more visible. Thus this has impacted constructing new bridges and operation and maintenance of the wooden bridges. Hence this has adversely afftected the mobility of the locals. This holds true in other rural transport infrastructures as well. This has further impacted on community collective action or self initiation for

doing such works at local level. Similarly, there are several reasons for gradual vanishing of Baglung Type Chain Bridges. First, national policies do not promote them, their demise even though some policies to preserve these traditional bridges have been adopted at the district level along with the construction of modern suspension bridges. Another reason is the labor intensive nature of construction and imported cheaper iron and steel cables make local products less competitive.

88 In many places 'disregard to local wisdom' has displaced traditional vocations and led to wastage of resources. For example, iron and copper mines in Baglung could not be sustained because of the increased competition and lack of government support. The knowledge, skills and practices of indigenous communities such as Magar, Kami (local blacksmiths) and Chhantyals were displaced as new technology replaced the traditional ones.Thus local knowledge, skills and practices need to be preserved and promoted.

89 In Jumla, planting local variety of tree species called 'Bainsh' (Salix sp.) and Deodar trees over large areas in deforested area would be a strategy to maintain supply of wood and to reduce landslides. Planting and preserving of Bhojpatra trees was another suggestion to promote ILK as such plants can be used as local materials while constructing wooden bridges. Local people are familiar with local circumstances, they carry ILK from generations; thus they know more about specific conditions while designing and constructing infrastructure such as bridges. It is important that external knowledge and technology should be used and blended with indigenous practices.Consulting local people and making use of the rich indigenous and local knowledge while making modern bridges can support climate change adaptation practices.

90 In order to make the process beneficial, the local government and the ministry should introduce a policy to preserve and promote indigenous knowledge, skill and technologies, to help generate local employment. Use of locally available materials has less adverse effects on the environment too. The argument is that such practices can be maintained or sustained if ILKP is integrated into policy system of the government.

4.6.2 Tuins:

91 A tuin is not a safe means of crossing. Further, risks of cutting one's finger between the cable and the pulley falling into the river are high. Yet they continue to be used in many locations. Tuins benefit local people and reduce the distance between the producers and the market. For many villagers, the benefits outweigh risks, especially in the absence of alternative crossing systems. However, the state has paid little attention to improve this technology (Dixit, A., Upadhya, M., 2004).

92 Two aspects should receive priority. The first is that safety measures of existing tuins must be significantly improved. Secondly existing tuins must be replaced by

suspension bridges and more suspension bridges should be built at appropriate locations to ease mobility. These initiatives must build on ILKP while integrating climate change adaptation efforts.

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4.6.3 Trails:

Climate change is affecting rural trails in Nepal. Frequent landslides, soil erosion, floods have shown major impacts in trails. In order to systematize rural trails, different issues that are affecting these trails need to be understood for making them sustainable. For this, good practices of ILK needs to be recognized and used. Many of the measures identified during the study of trails can support in sustaining climate friendly trails. 93

During the course of this study, the trail users suggested that the subsidiary trails should be maintained along with the main that connect the villages and other communities away from the main trail. This would enable proper utilization of the main trails as evident in Jumla-Rara trail. One of the suggestions received was that emphasis should be given to minimize open grazing which is one of the causes of damage to the trails and the nearby vegetation. 94

The growing preference for motorable roads were discussed and the participants suggested the concerned authorities should build such roads away from the trails without disturbing them. This would ensure that the aesthetic they promote is maintained. Such strategy should be pursued in Jumla, Baglung and Dolakha. The local people of Solukhumbu suggested that no motor road was necessary near Lukla–Namche trail. A motorable road will not only ruin trekking business but will also impact the environment and the local people's livelihoods. Motorable road up to Surke (foothills of Lukla) is already included in the government plan. The local people do not prefer its extension. Uses of dozers and excavators while constructing motorable roads are affecting forests and water resources in addition to the rural trails (considering occurrence of frequent landslides). 95

Bio-engineering can help stabilize landslide affected area, land slide prone area, and barren lands in deserted area close to the trails in all 4 cases. Local level stakeholders in Baglung suggested planting rhododendrons, amriso (broom grass), tuni (in dry areas), and napier along the trekking route in Ghumte. Such types of plantation are used by local people successfully as landslide and flood control measures in other districts. They also suggested that the trails should be upgraded and new standards like stone pitching in difficult places and slopes, construction of retaining walls at landslide affected and landslide prone zones, expanding the width of the trail (Jumla, Baglung), smoothening of sharp curves (Jumla, Baglung), constructing resting places in regular intervals along with provision of tea and snacks facilities (Jumla, Baglung) would make the trails more traveller-friendly. 96

The trail users in Jumla and Dolakha suggested a restriction on plastic use along the trails (plastic, paper, glass, cans and other wastes). An effective outcome can be replicated from Lukla-Namche trail which has implemented this convention 97

successfully. Another idea is to segregate garbage into degradable and non-degradable (Harichaur VDC in Baglung has taken this initiative and other trail regions in Jumla and Dolakha can follow too). The people suggested that local materials (stone, sand, wood, soil) rather than imported ones (steel bars and cement) should be used wherever possible while constructing trails.

98 Investment in trails can support tourism promotion with a high return. Such investment can be sources of alternative employment opportunity, help in alleviating poverty (Tyler et al, 2014) as new livelihoods are created. More choices will be available in their response to stress that climate change may bring (Moench and Dixit, 2004). People are in favour of penalty system to be imposed for those who damage or pollute the trails. Animals carrying loads (mules, horses, and yaks) defecate on the trail and the smell can be a detracting factor for travellers on the trails (Lukla-Namche trail). There should be a provision of not dumping animal waste on the trail. On top of that, drainage is a problem (Lukla-Namche) and should be addressed.

99 The issue of security is another problem along the route. Some of the trekkers who went missing in Lukla-Namche and Namche–Everest Base camp trail have not yet been found. The communication, coordination and security mechanism should be revised for trekkers. The people also suggested establishing pharmacies, paramedics and health posts along the trail.

100 Some other issues were noteworthy. The trekkers may be interested to buy the local products. For instance, apples, wall nuts and woollen carpets of Jumla; iron pots of Baglung; and Cheese from Jiri (Dolakha) are worth mentioning here. It is better to adopt local market promotion strategy along the trail routes; as such a strategy will be of mutual benefit to both the local traders and the trekkers. Furthermore, construction of ponds in hills tops will support the water recharge rate and also increase the trail beauty. The trails can be shortened to save time and avoid dangerous sections as suggested by the villagers in Neurigad (Jumla).

101 There are no users' committees in the trail area. Most of time committee for operation and maintenance of the trail are ad hoc according to needs. In some trails, this arrangement is partly working but not in others. The management of the trail in Solukhumbu is under the jurisdiction of Sagarmatha National Park (SNP) and this mechanism provides a point of entry for repairing when and if climatic hazards such as extreme rainfall damage trails.

4.6.4 Implication for adaptation and climate resilience in rural transport infrastructure:

102 Climate change impact has affected many sectors and its impact on rural infrastructures is both direct and indirect. During climatic events local people take initiatives for maintaining and repairing them and without external support, plant trees along the route and on both sides of the bridge and also construct retention walls. Likewise, local people engage in regular maintenance and repair work

even when there are no such events. Local communities have been involved in these endevors as autonomous adaptive measures. District level agencies provide some support but they are not adequate. Jumla DDC has started focus on environmental issues such as EIA, IEE and pursues bioengineering measures in construction of new infrastructure. Some VDC budget is also being allocated in addressing landslides and damage to bridges and trails. Suspension bridges gradually replacing wooden bridges, chain bridges and tuins (as per the policy of the DDCs).

103 In Jumla, some of the efforts made on climate adaptation include undertaking bio-engineering measures in landslide prone areas by the District Forest Office (DFO). In the district level workshop, it was suggested that forestry sector needs to work with the road sector if transport infrastructure is to be resilient. Such partnerships are necessary in other districts too. Some section of Jumla-Rara trail (before Rara Lake is reached) is within the National Park and foreigners who visit these regions must pay entrance fee. But this resource is not allocated to upgrade or repair trails outside National Park. These sections are being managed by communities through the mobilisation of local labour.

104 Sagarmatha Pollution Control Committee (SPCC) and Sagarmatha National Park (SNP) have initiated program for construction, upgrading and maintenance of Lukla-Namche trail. The Government has designated surveyors and engineers to maintain and renovate the trail. In the process with support from donors, the trail was widened, graded and paved. Permanent trail bridges were built wherever necessary. In addition, greenery is maintained along the route and the trial is free from garbage. Small structures have been constructed for disposing plastic, paper, glass and cans. Government generates revenue from trekkers. Part of the revenue is allocated for trail maintenance. The National park (core and buffer zone) supervise this tasks with the help of Nepal Army. Local community undertake small-scale construction, upgrading and maintenance. A number of trekkers in Jiri-Solu trail (Dolakha) has been reduced, no planned activities for trail maintenance and upgrade take place. Although there are small-scale maintenance activities at community level, major repairs are not done.

105 The major issue related to rural transport infrastructure (in relation to climate change adaptation and inclusion of indigenous practices) in Nepal is lack of deeper study and lack of macro-economic policy analysis particularly on mechanisation. Rural transportation issues cannot be separated from energy, water and agriculture policies; and the national policies should be seen in an integrated framework (Biggs, S. and Scott, J. 2011). An indication of effectiveness of policy within this arena would be to motivate poor and the marginalized into action and bring about effective and beneficial transformations in rural transport infrastructure.

4.7 CONCLUSION, KEY MESSAGE AND RECOMMENDATIONS

4.7.1 Conclusion

106 National, district and local stakeholders are in favor of sector-wise policies to be formulated as climate change issues are mainstreamed. In this process, integration of indigenous practices is deemed mandatory. Not all ILKP are resilient to climate change, and it is important to explore and identify the climate friendly practices in rural transport infrastructure. Government should formulate policies to conserve traditional skills that are useful in climate change adaptation and integrate it with modern technologies.

107 Bridges: Although Jumla type bridge is completely made of wood and free from external materials (cement, iron rod, pipes, polythene etc.), it is not totally environment friendly since a large number of trees need to be cut each time (about 300 trees for one average size bridge, and these trees take 40-50 years to fully mature). When imported materials were not available or were costly; and trees were abundant, its use was acceptable but not anymore. Since government does not have enough resource to build suspension bridges, repair and maintenance of these existing bridges is important for commuting. But it is still imperative to conserve these bridges by regular operation and maintenance as mobility of local people completely depend on these bridges and until other reliable alternatives are available for them. Local people claim that if Deodar trees are available by massive reforestation they can build such bridges even today.

108 Although physical replication of chain bridges (Baglung type) is not possible, the skill and knowledge of the local blacksmiths should be preserved in order to transfer the skill and practices for local livelihoods.

109 Reproduction of the traditional knowledge, skills and practices of bridge construction does not require much cost. In addition, IK in rural transport should be tested for functionality to evaluate how well it works, and what the effectiveness and ease of transferability is. Besides, interventions should aim at reducing the time spent by women on domestic chores. For this, integration of women's needs into mainstream infrastructure projects is necessary; and programs should aim at delivering time- and energy-saving technologies directly to women. The absence of state support to facilitate such transformation means that a majority of rural population particularly women continue their existence in deprivation.

110 Tuins: Local community demand for suspension bridges where tuins have been built. Many tuins in Nepal have already been replaced (or are being replaced) by suspension bridges. For instance, during the last 4 years, Dhading DDC has not received any new demand for tuins from the local people although it has received request for their maintenance. The demand for suspension bridges to replace the tuins however is high. If ILKP are to survive, it has to incorporate changing

social aspirations. The question is, should the tuins be replaced completely by suspension bridges? Climate change hazards like risk of floods while crossing rivers is increasing but will there be enough funds to build required number of suspension bridges? Considering these facts, the remaining tuins should be operated and maintained until good alternatives are available.

Trails: The study suggest that certain policies on trails are needed such as favouring a policy for plantation of trees along the trails that will promote eco-tourism. The number and types of trees to be planted can be determined at local level for each trail. Another policy could be classifying of trails/roads under the government plan, to enable maintenance which needs revision in the current contractual practice. Government however has not paid enough attention for the promotion of trails with exclusive focus on motorable roads. 111

4.7.2 Key message

. Rural transport infrastructure do contain rich and diverse local knowledge and practices offering insights into useful community-based measures that can help in creating resilient local infrastructure to facilitate adaptation to climate change impacts. There is need to understand location-specific vulnerabilities, capacity gaps, and local needs. Adopting new rural transport technologies without considering indigenous and local technology is a major reason for loss of indigenous knowledge/skill, and is leading to livelihood loss of marginalized population. Introduction of new technology should consider cognizance of local and indigenous knowledge. 112

The ministry and local governments are constructing motorable roads in place of existing trails (even to popular ones) using heavy machines such as excavators. Poor planning, implementation and maintenance of motorable roads have negative effects on indigenous practices. Such practice damage forests and water resources whose impact ripples into local communities and their knowledge practices. Roads, trails, and bridges need to be made more climate resilient which requires synthesis of climate change science and local knowledge which can produce cost effective, culturally acceptable, and environment friendly innovations. 113

4.7.3 Recommendations

- Develop and maintain the trails and bridges through government facilitation, but the community should take ownership so that ILKP go in hand.
- ILK based rural transport interventions should be implemented in an integrated approach along with water supply, irrigation, and access to service centres.
- The state should pay attention to the existing tuins to improve the technology by making it efficient and safer as the tuins are still important part of rural transport.
- Government should introduce policies to preserve and promote indigenous skill, knowledge and technologies and transfer these skills to the future generations with the objective of building adaptive climate change resilient systems. .

- Promote home-stay tourism, and help develop hotel/restaurant facilities along the trail route. Such strategy will enrich local tourism and diversify livelihood options for the local population.
- Pay attention to the conservation of local biodiversity while planting trees and implementing any activities related to infrastructure.
- Focus on multiple drivers of change while designing development interventions in the districts including development and maintenance of local infrastructure that benefit the locals.
- Enhance use of bio-engineering measures to develop eco-tourism along the trails.

ANNEX

Annex (a) Brief socio-economic description of the case study districts for rural transport case studies

Particulars	Jumla	Baglung	Dhading	Dolakha	Solukhumbu
Total area	2,531 sq. km	1,784 sq. km	1926 sq. km.	2,191 sq. km.	3,312 sq. km.
Total population	108,921	268,613	336,067	186,557	105,886
Population density	43.03	150.57	174.49	85.15	31.97
Major ethnic composition	Chhetri, Brahmin, Thakuri, Kami, Sarki, Damai	Magar, Brahmin, Chhetri, Kami, Sarki, Damai, Chhantyal, Thakuri	Brahmin, Chhetri, Tamang	Chettri, Jirel, Thami, Sherpa	Rai, Sherpa, Chettri, Tamang, Kulung, Kami, Magar
Agro-ecological zone	Mid-West Mountain	Western Mid-Hill	Central Mid-Hill	Eastern Mountain	Eastern Mountain
Total VDCs	30	59	50	51	34
Total Municipalities	0	1	0	1	o
Total Household	19,303	61,522	73,851	45,688	23,785
Total literacy rate	54.7	72.9	62.9	62.8	64.2
Female Literacy: 40.8	40.8	65.3	53.5	53.7	55.7

Source: Central Bureau of Statistics (CBS), 2011

Annex (b) Reasons for migration (multiple responses)

Sector- Rural transport infrastructure										
Reasons for migration-multiple responses (HH count)										
Name of districts	Don't know	Migration due to food insufficiency	Lack of agricultural land	Lack of schooling	Relatives' migration	Livelihood prospects here	Family division	Other reason	Flood/land slide	Total
Baglung	0	0	2	0	0	3	1	1	0	5
Dhading	2	0	1	0	0	1	0	1	1	5
Jumla	12	0	1	1	3	2	0	1	0	18
Solukhumbu	1	0	0	1	0	4	0	0	0	6
Dolakha	3	1	0	2	1	3	0	1	0	7
Total	18	1	4	4	4	13	1	4	1	41
Total %	43.9	2.4	9.8	9.8	9.8	31.7	2.4	9.8	2.4	100.0

Source: ISET Nepal field Survey 2013/14

Annex (c) Effects of climate change (multiple responses)

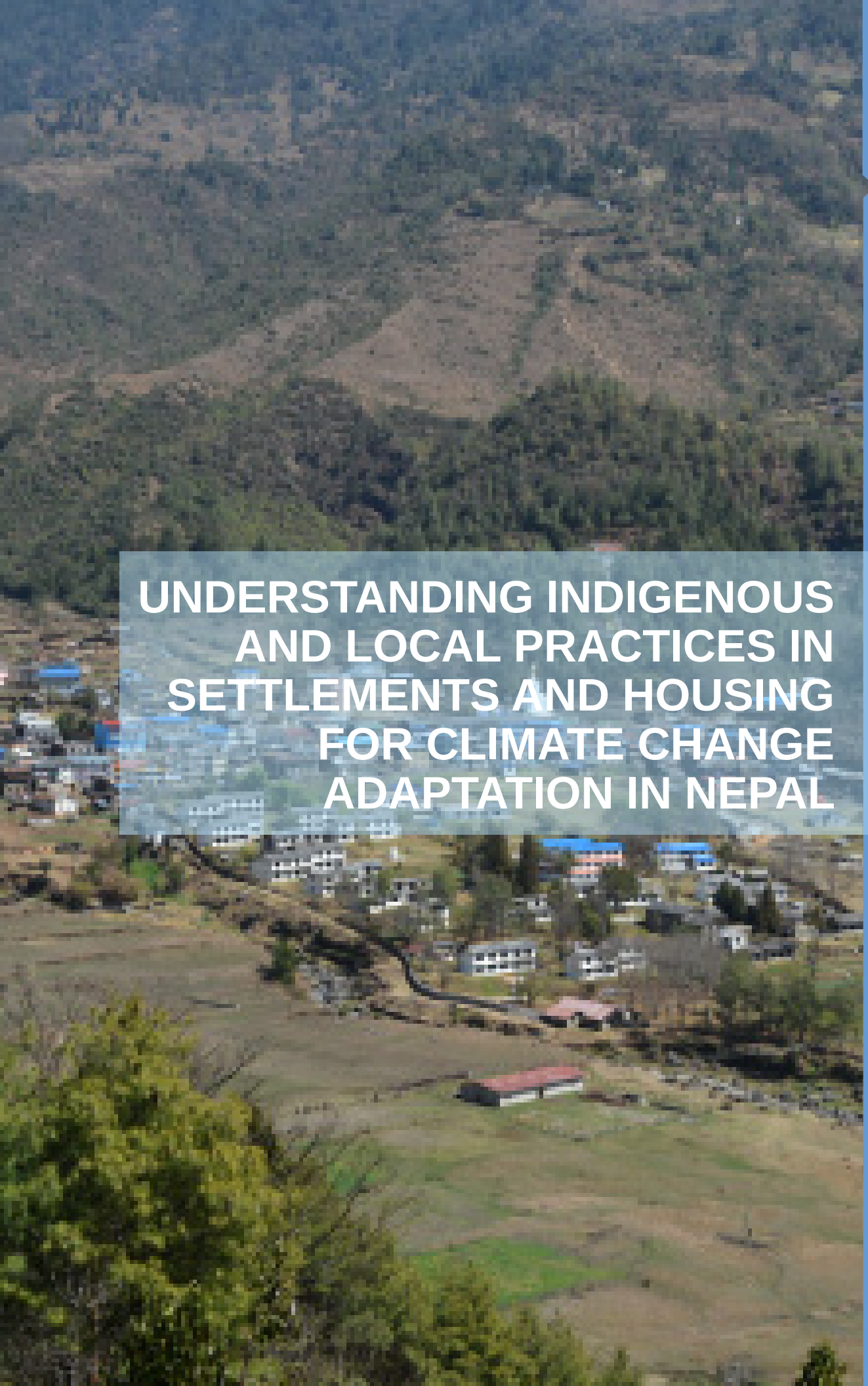
Sector- Rural transport infrastructure										
Effects of climate change-multiple responses (HH count)										
Name of districts	Rise in temperature	Erratic rainfall	Decrease in food production	Increase in drought days	Increase in flood events	Increased incidence of pests and diseases	Increase in mosquito infestation	Change in plant/ animal behaviour	Others	Total
Baglung	5	3	0	1	0	2	2	1	5	5
Dhading	4	3	4	6	4	6	5	0	0	6
Jumla	20	8	2	19	9	19	13	15	0	20
Solukhumbu	3	2	0	3	4	5	0	3	0	5
Dolakha	7	6	5	5	0	7	8	5	0	10
Total	39	22	11	34	17	39	28	24	5	46
Total %	84.8	47.8	23.9	73.9	37.0	84.8	60.9	52.2	10.9	100.0

Source: ISET Nepal field Survey 2013/14

Annex (d) Community adaptation programmes to fight against climate change impacts (multiple responses)

Sector- Rural transport infrastructure										
Community adaptation plans to fight against climate change impacts-multiple responses (HH count)										
Name of districts	Community forestry manage-ment	Grass cultivation in farm lands	Improvement in irrigation system	Pond construction for water storage	Prevention of forest fires	Soil and water con-servation	Tree plan-tation	Cultivation of NTFPs	Others	Total
Dhading	5	0	2	1	5	2	1	1	0	5
Jumla	17	16	14	9	17	16	14	8	1	18
Solukhumbu	4	2	1	0	5	2	4	1	0	5
Dolakha	4	5	0	0	3	2	5	1	1	7
Total	30	23	17	10	30	22	24	11	2	35
Total %	85.7	65.7	48.6	28.6	85.7	62.9	68.6	31.4	5.7	100.0

Source: ISET Nepal field Survey 2013/14



CASE STUDY V

UNDERSTANDING INDIGENOUS AND LOCAL PRACTICES IN SETTLEMENTS AND HOUSING FOR CLIMATE CHANGE ADAPTATION IN NEPAL

CONTENT

ABSTRACT

Nepal is a country of hills, mountains, flood prone flatlands, and rivers which makes thousands of villages and towns naturally vulnerable. Increasing number of extreme weather events and climate change induced hazards and risks have exacerbated the vulnerability of these human settlements and associated livelihood and development infrastructure. Reducing the vulnerability of these overly exposed human settlements by developing resilient societies and systems is a key priority for Nepal.

Studies have shown that integrating, synergizing, and complementing indigenous local knowledge and practices with modern knowledge and tools to carry out hazard mapping, vulnerability assessment, and adaptation planning of settlement sites helps vulnerable communities to reduce disaster risks. This also helps build resiliency in human habitats in the short run and adaptation strategies in the long run.. These integrated approaches are found cost effective, socially acceptable and environment friendly.

This case study carefully selected case examples from seven different districts of Nepal representing both ecological and ethnographic diversity documented indigenous, traditional, and local knowledge and practices that are being used for building resilient houses, settlements, and tourism related infrastructure. This report gives an account of these documented, analysed, and interpreted traditional practices and forwards some useful learning, reflections and recommendations.

The study found that the major factors that have defined the patterns, design, construction, risk management and adaptation planning features of traditional settlement patterns and housing designs in Nepal have considered local climate, culture, hazards, water availability, livelihood opportunity, social support, and ethnicity. Generally, two types of housing and settlement adaptation features are found - planned and autonomous. Settlements such as in Bhaktapur, Lamjung, and Tanahu case examples were organized based on the blue-print approach of the local king and/or village/clan head. The mixed settlements in Tarai and inner Tarai were initially based on ethnicity but later on migration, livelihood diversification and socio-economic changes played a major role in adapting them to mixed design based on local culture and practices.

Human settlement and environment management are crucial for effective disaster risk reduction. Long term adaptation requires assessment of local geology, settlement and historical disaster trend, indigenous and local practices of older generations, and local technology and materials. These factors seemed to have worked in the past to make Nepalese settlements adaptive and reasonably resilient. Given the reality that climate change creates unprecedented shocks and catastrophes, integrated disaster risk reduction and climate change adaptation planning and risk reducing design and construction measures such as raising the plinth level of house in Tarai, should be planned based on community perception, experience, knowledge and practices.

5.1. INTRODUCTION

5.1.1 Overview

6 This case study explores how the vulnerable indigenous and local communities (ILC) of Nepal have been building individual and community resiliency i.e., capacity to cope and adapt, to climatic hazards, risks, and disasters by employing their indigenous local knowledge systems (ILKS). This report presents the documentation of these practices focusing on the Climate Resilient Human Settlements (CRHS) sector that have been developed and used by ILCs in different parts of Nepal. Based on the data and information collected from seven case examples and insights gathered, this study discusses the potential of utilizing ILKS in making the traditional design and construction of housing, settlements, and livelihood infrastructure more climate adaptive. It also suggests different strategies to improve the resilience of human settlements including community assets such as traditional tourism infrastructure to deal with growing impacts of climate change both in short and long run; the emphasis is on using local knowledge to reduce multi-dimensional vulnerability to climate change.

7 The case study documents, understands, and reports different types of indigenous local knowledge and practices (ILKPs) that are used to plan safe human habitats and resilient livelihood assets. These are done through measures including proper vulnerability analysis, adaptation planning, early warning systems, flood risk reduction, and individual and institutional capacity building. The main focus is on the proper identification and use of ILKP in enhancing resilience in the existing human settlements and basic service facilities and mainstream climate change risks in local adaptation plans and programmes. It documents existing knowledge, practices, and different skills based on the researchers' interactions with ILK holders, practitioners, and stakeholders.

5.1.2 Context

8 Landslides, droughts, and floods, especially flash floods, have been devastating human settlements and destroying lives and properties of people and community in different parts of Nepal annually (ICIMOD, 2013; MOHA, 2010). Increasingly destructive phenomenon of flash floods, riverine floods, naturally or artificially formed dam burst floods caused by extreme rainfall events, landslides, mud slides, rock slides, slope failures, and glacier lake outburst floods (GLOF) are the biggest sources of vulnerability to the human settlements – both urban and rural - in Nepal (Fig. 1).

9 Nepal has a fragile topography especially in the hilly and mountainous regions. Population growth and the expansion of tourism has created pressures on settlements and transportation requirements that have resulted in poor land-use and construction planning, including construction of roads on fragile terrain, more hydro power stations, increased rock and sand-mining and use of heavy machinery.

Figure 1: Recent pictures of flooding in different parts of Nepal

These factors combined have increased the vulnerability of human settlements and heritage structures in recent years. The problem has affected the indigenous local and marginalized communities of Nepal since they are have the least capacity to cope and suffer the most once the hazards turn into disasters.. While the safety of the population from the growing risks of climatic disasters is a priority, the protection of vital tourism and development infrastructure of the country is equally important to sustain livelihoods and supply basic services to the citizens.

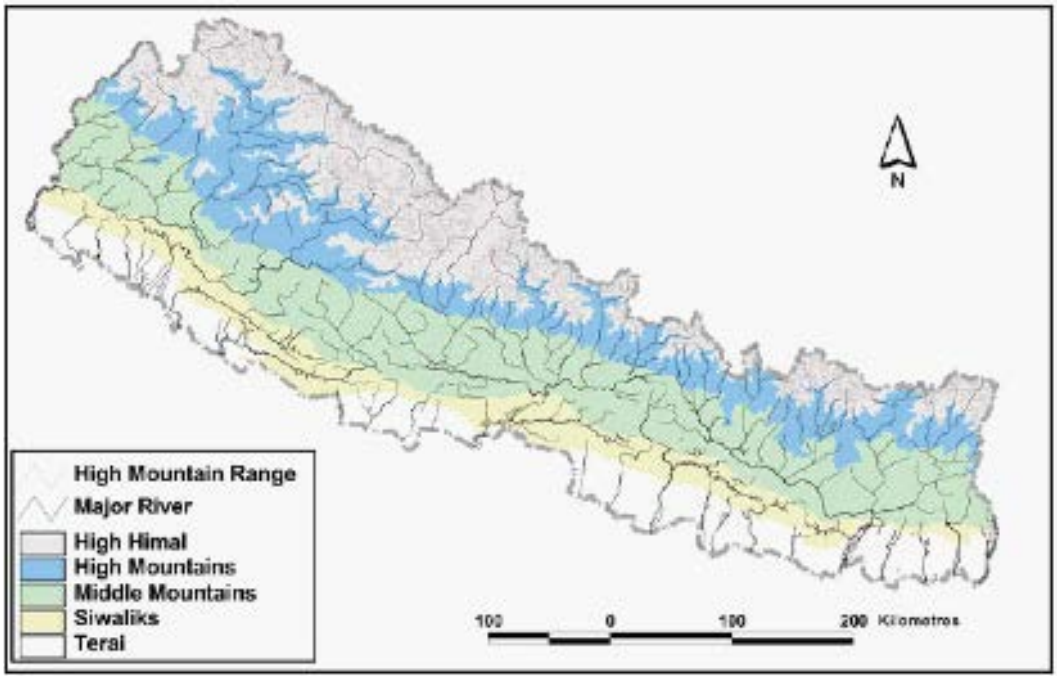
Nepal faces natural hazards of both geologic and climatic origin. Erratic and increasingly intense monsoon rainfall events and/or minor seismic disturbances serve as triggers for floods, landslides, debris flow and other secondary hazards. Earthquake, Wild fires and drought cause massive losses during the dry season although these topics are not covered under this Case study. 10

Land/mud/rock slides and associated flash floods remain the most common and frequently experienced natural disasters, especially in the Middle Hills and Shiwalik (Churia) regions. Riverine floods during the monsoon cause havoc in the densely-populated and agriculturally rich Tarai region destroying valuable farmlands and community infrastructures such as houses, schools and drinking water facilities. In recent years, there has been growing concern about the increasing risk of glacier lake outburst floods (GLOFs) due to glacial retreat and expansion of glacial lakes in high Himalayan areas. 11

12 Nepal has more than 6,000 rivers and streams. They belong to three broad categories based on source and discharge of water. The major perennial rivers, such as the Koshi, Gandaki, Karnali and Mahakali river systems, originate in the Himalayan Mountains and carry snow and ice melt water with significant discharge even in the dry season. Others originate in Mid-hills region that are fed with precipitation and ground and spring related flows. These have large seasonal variation in their discharge. They include the Mechi, Kankai, Kamala, Bagmati, West Rapti and Babai, and Mohana rivers. The third category of river systems, which originate in the Churia region and flow through the Tarai, are seasonal, with little or no discharge during dry season, and are characterized by a high rate of sedimentation and river bank scouring and cutting (Fig. 2).

13 Due to its varied topography, fragile geography, monsoon weather and vast networks of rivers and streams (Fig 2), most parts of Nepal are extremely prone to flood and landslide disaster, particularly during the monsoon season (MoHA, 2009; Chalise and Khanal, 2002). While the perennial rivers cause widespread flooding and inundation in Tarai region, the seasonal rivers, which drain the smaller catchment cause devastating flash floods. These floods are estimated to cause most of the fatalities and damage of settlements and agricultural lands in the inner Tarai and Tarai regions during the monsoon of June-September. Flash floods are triggered by intense rainfall, cloudburst, glacier lake outbursts (GLOF), slope failure, breakdown of infrastructure, and faulty human actions and inactions

Figure 2. River drainage network and physiographic zones of Nepal



(source: Khanal et. al, 2007)

14

Flash floods are severe flood events that occur with little or no warning. They are triggered by intense rainfall and the outburst of dammed lakes of a natural artificial nature. The Increasing frequency of flash floods in Nepal poses a severe threat to lives, livelihoods, and infrastructure since the flood water carry with them much higher amounts of debris than normal monsoon flows. And as a result, flash floods cause more damage to hydropower stations, roads, bridges, buildings, and other infrastructure (ICIMOD, 2013). The full impacts of geological and hydro-meteorological floods have been demonstrated by the latest cloudburst and landslide generated floods in different parts of Nepal that has killed 300 people, destroyed entire villages, and threatened settlements downstream beyond Nepalese border into India. Experts term these events as some of the deadliest in the country's recent history and should be treated as warning for better early warning system and disaster preparedness and management. According to Nepal Red Cross Society (NRCS), during the past decade, landslides killed over 1,300 people and destroyed 10,000 houses. The Asia Disaster Preparedness Centre calls Nepal one of the most disaster-prone countries in the world. http://www.irinnews.org/report/100451/

15

According to the Nepal Risk Reduction Consortium (NRRC, 2011) - a coalition of humanitarian, development, financial, and government bodies - floods and landslides are the main causes for around 300 deaths per year and economic damage exceeding US$10 million in Nepal.

16

Floods and landslides are the most devastating natural disasters overall in terms of number of deaths and damage caused. Of all deaths due to natural disasters in 2010, 29% and 25% were due to floods and landslides, respectively, while 71% of all families affected by disasters in 2010 were affected by floods (DWIDP, 2011). Between 2001-08, floods and landslides: killed nearly 1,700 people; and over 33,000 livestock; affected over 220,000 families; destroyed over 52,000 houses and washed away or destroyed over 22,000 hectare (ha) of land. Table 1 shows the dominant share of floods in Nepal's disaster statistics and growing number of fatalities. The monetary value of damages due to floods and landslides for 2001-2008 was estimated as US$130 million (about 0.1% of GDP) (MoHA, 2012).

Table 1: Loss of Lives by Flood & Landslide in Nepal

Types of Disasters	1983-2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Flood and Landslide	5829	196	441	232	131	141	114	216	134	135	240	252	120	8181

(Source: Ministry of Home Affair, MoHA, 2012)

17 Therefore, the growing role of climate change in creating multi-dimensional vulnerability to human settlements in Nepal cannot be overstated. The flood and landslide events are the biggest killer of human beings as well as animals in Nepal in which the poor and marginalized communities suffer disproportionately. These events have pointed toward more likelihood of such disasters happening in future as climate change risk multiplies in Nepal.

18 It is generally recognized (UNCRD, 2008) that the indigenous communities have been using their indigenous local knowledge systems (ILKS) to plan their settlements in safe and secure locations. They generally construct their houses closer to roads, trails, water sources, forests, and essential service facilities such as schools, hospitals, and security agencies. Once settlements have been created they learn to adapt with the local human-environmental systems by minimizing their bio-physical and socio-economic vulnerabilities. The communities learn to cope with extreme events such as hydrological disasters by using their indigenous, traditional, and local practices and extensive social networks (Oxfam, 2008, Shrestha et al., 2008). These practices are widely believed to exist in Nepal (MoSTE, 2011) but to date no systematic and comprehensive documentation and stock taking of them have been done especially regarding its application in climate change adaptation and resilience building work in Nepal. This issue has drawn attention of the Government of Nepal and the ADB that has resulted into this case study to find out the existence of the indigenous local knowledge practices (ILKPs) in the sector of flood resilient human habitats.

5.2. BACKGROUND OF THE CASE STUDY

19 Human settlement is generally understood as a human locality or populated place which houses human habitats or provides shelter for a permanent or temporary community in which people live or have lived, without being specific as to size, population or importance (Dutta et al, 2010). There are generally two types of settlements in developing countries: urban and rural settlements. In Nepal, generally, the rural areas have low density of population and agrarian nature of activities, especially in Tarai and inner Tarai regions. Urban and semi urban areas have high concentration of populations and are generally engaged in secondary and tertiary nature of service related activities (UNISDR, 2011).

Resilience in the context of human settlement is “the capacity and ability of a community to withstand stress, survive, adapt, bounce back from a crisis or disaster and rapidly move on” (ICLEI-AFRICA 2013). Alternatively resilience is “the ability of a system, community or a society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions” (ICLEI-AFRICA 2013).

Any human settlement can demonstrate climate resilience by weathering climate induced shocks such as floods and droughts using its in-built strengths and capacity to revert back to the pre-flood disaster state. Disturbance of sufficient magnitude or duration such as landslide blocked lake formation can affect habitats and may require a different land use planning and adaptation action (Folke et al 2004). This phenomenon was witnessed in recent Sunkoshi landslide blocked lake related disaster in Nepal.

Indigenous and local communities in Nepal live either in mixed and ethnically homogenous settlements ranging from clustered large size village to scattered hamlets or ethnically mixed villages, towns and cities. Most of the poor, dalit, and poor indigenous people live in marginal lands that are generally ecologically fragile. These settlements are particularly sensitive to human disturbances such as use of heavy machines and intensive sloping land agriculture. Rural houses are often built using traditional techniques and local materials that are usually well adapted to local weather conditions, but may be less prepared for extreme climatic hazards. In urban areas, houses of marginal people - usually found in slums along the rivers or on the marginal lands - are often of very poor quality such as plastic or tin roofed and bamboo mat partitioned exposing the inhabitants to floods and other hazards as seen in Kathmandu and Pokhara.

The Department of Survey, Government of Nepal has classified the design and construction of houses in Nepal into four categories on the basis of the types of construction materials used in walls and roof of the residential houses. These are a) permanent (*pakki*), b) Semi permanent (*ardha pakki*), c) temporary (*kachchi*) and d) mixed types (*kachhi/pakki*) (Kayastha and Shrestha, 2005). The permanent type of houses refers to those that have both their walls and roof made of permanent construction material like cement, bonded brick, concrete, stone, slate, tile, galvanized sheet, etc. ii) Semi Permanent house belongs to the category where either the wall or the roof is constructed with permanent materials and the other is constructed with temporary materials. iii) Temporary (*kachchi*) house, non-durable materials like wooden flakes, bamboo poles and mats, straw/thatch, mud, unbaked bricks, etc. are mainly used in both walls and roof and iv) Mixed category of house includes a variety of houses ranging from very temporary type of residential unit that is made with non-durable materials to such as plastic sheet, bamboo, straw/thatch, etc to half pucca and half kachi such as reinforced cement concrete (RCC)

built plinth and bamboo mat walls and roofs. For example, hut/tent or community relief centres are included in this category of houses. Settlements with kachi and semi-pucca houses are considered more vulnerable and need to build resiliency to the growing impacts of climate change (Kayastha and Shrestha, 2005)).

24 In hilly and mountain regions of Nepal, tourism (cultural, eco-tourism, and adventure types) provide local livelihood means, especially to indigenous communities such as Gurungs, Sherpas, and Thakalis. The rich natural and bio-cultural heritage of the country provides fundamental resources for the tourism industry's development. The indigenous tourism management is an integrated natural and eco-tourism resources management that has been led by local communities. However, these critical sources of livelihoods are in danger of losing their values due to the combined forces of climate change and globalization (Nepal, 2011).

25 Climate change induced weather extremes are seriously affecting the growth and health of Nepal's tourism development causing frequent cycle of floods and droughts resulting in flash floods, landslides and riverine floods. Among the major challenges, the tourism sector face especially in the mountain districts are: i) unplanned and haphazard road construction that spoils pristine natural landscape, ii) disturbed or destroyed infrastructure such as bridges and trails, and iii) glacial melting and danger of flash floods putting lives of the tourists at greater risk.

26 Most of the human settlements in Nepal are exposed to growing climate variability and disaster. While in the Mid-hills and Mountains, the settlements are exposed to landslides, flash floods, forest fires and snow storms; in Tarai and inner Tarai the population is exposed to monsoon flood inundations, heat and cold waves, drought and settlement fires. The recent trend is also the growing impact of short-lived climate pollutants such as Black Carbon (BC), methane and other aerosols. There are a number of small to medium size towns such as Jaleshwor and Dhangarhi in Tarai that are becoming more exposed to climate change induced flood risks due to large population, unplanned settlements and inadequate public services such as drainage which is a relatively new hazards to these cities. Nepalese settlements also face human-made hazards and risks due to unplanned infrastructure development and their poor maintenance.

5.3 OBJECTIVES AND RESEARCH QUESTIONS

5.3.1 General objective

27 This case study aims to contribute to the understanding of the role of indigenous, traditional, and local knowledge and practices in either enhancing resilience or reducing vulnerability of rural and urban settlements and community infrastructures considering the specific vulnerability, impacts and adaptation needs of indigenous, poor, and disadvantaged communities of Nepal.

5.3.2 Specific objectives

28

The following specific objectives were formulated to decide on the scope of the case study:

a) to document the indigenous local knowledge and practices followed by different indigenous and local populations in developing climate resilient human habitats and community infrastructures;
b) to document the social, religious and cultural contexts that help evolve indigenous and local knowledge and practices in making the climate sensitive human settlements and assets adaptive to unanticipated changes; and
c) to identify locally and indigenously developed adaptation practices practiced by the communities to live with floods and landslides by adapting to the risks through different mitigating measures.

5.3.3 Research Questions

29

The Case study aimed at exploring a number of research questions. Literature review on indigenous local knowledge and practices helped us to frame general questions as described in Chapter 1. However, specific questions relating to resilient human settlements were defined separately. These were further refined and revised during the fieldwork without losing the general purpose and focus of overall questions. Seven questions were used to study this case study as described below:

- How do the findings of the case study differ from past studies specifically in applying indigenous local knowledge in building climatic adaptive human settlements in Nepal?
- How can the community resilience practices documented be considered climate resilient, gender sensitive, and socially inclusive?
- Are the indigenous communities living in marginal lands with poor tenure and access rights generally more vulnerable than others?
- Do indigenous communities have disaster response preparedness and anticipatory adaptation planning for mitigating and adapting to climate change risks?
- Can strengthened institutions, accessible information, early warning related communication and awareness raising enhance local community's climate change adaptation capacity?
- What are implications of this case study findings in the disaster management and climate change resiliency building policies of Nepal?; and
- What are some of the key methodological challenges, assumptions and limitations of this study?

5.3.4 Case Specific Methodology

30

The case study follows the overall methodology described in Chapter 1 of this report above. However, since the literature review findings, especially from Nepal, indicate

marked patterns of settlements, housing designs and structures, and community resiliency building measures adopted by the indigenous and local communities based on different culture, climate, location, and ethnicity (Gounga, 2013; Shrestha et al., 2008), some specific methods were used to document the practices such as participatory case observations apart from focused group discussions (FGD) and key informant interview (KII). The method used included participatory consultation and observation of patterns in design and construction of homes and habitats according to the micro climate of a particular location. The study contextualized the methods according to the geographical and ecological features of Nepal and accordingly, the case study contexts and methods were customised to the two categories of case examples separately: a) Tarai/Inner Tarai region: Jhapa, Sindhuli, Mahottari and Kailali districts were more focused on flood related hazards, and b) Hills and Mountain region: Bhaktapur, Tanahu and Lamjung districts were focused on general climate change induced hazards, risks and stressors. The case examples were selected ensuring the coverage of settlements and tourism-based livelihood infrastructures of major indigenous communities especially Madheshis (Mahottari); Gurung (Lamjung); Magar (Tanahu); Tharu (Kailali), Newar (Bhaktapur), and mixed castes (Jhapa, and Sindhuli).

5.3.5 Case description

31 The Case Study was conducted in seven sites called case examples selected from different districts of Nepal. The major criteria set for selecting the case examples were: a) proper representation of eco-physiographic and ethnographic diversity of Nepal; b) severity of exposure to flood and landslide risks and past climate induced events, c) prevalence of indigenous/traditional and local knowledge and practices (ILKP). Regarding the relevance to climate change adaptation, practices considered had to be mainly in response to climate induced hazards and disasters. The selection of districts was also based on literature review and the feedback collected from concerned Govt. of Nepal lines agencies, especially the Ministry of Science, technology and Environment (MoSTE) and literature review.

32 The rivers assessed as representatives of the source of flood and land slide risks to settlements are: Bairini in Jhapa, Kamala and Khahare khola in Sindhuli, Ratu in Mohattari, and Karnali and Mohana in Kailali. These are known to cause considerable damage to agriculture land and crops as well as settlements. Riverine floods from the major perennial rivers such as Koshi and Karnali generally rise slowly once they enter Tarai plains and cause major damage from inundation of settlements and farms. Inundations of large areas due to breach of river banks or embankments such as the Koshi floods of 2008 are also attributed to human negligence.

33 Flash floods are devastating floods that occur with little or no pre-event indicators. These are most serious hazards to Nepalese settlements because of the suddenness and speed with which they can damage lives and properties in hilly and mountainous

terrains of Nepal. They are triggered by torrential rainfall such as cloud bursts, glacial lake or landslide blocked lake burst, or the failure of manmade dams causing deaths and destruction in downstream areas.

The case examples are divided into two categories based on Nepal's physical, climatological, socio-economic and cultural diversity since these four factors largely distinguish the types and sources of vulnerability. These factors also define the patterns and types of traditional human settlements found in different parts of Nepal. They are: a) Tarai and Inner Tarai case examples for which the districts selected are Jhapa, Mahottari, Sindhuli, and Kailali with a focus on flood disaster management; and b) Hills and Mountain examples for which the case study sites were selected in Bhaktapur, Lamjung and Tanahu districts (Map 1) with a focus on developing community resilience and disaster preparedness. Table 2 below provides a summary of the characteristics of the seven case examples including the main ethnic/caste groups involved, eco-physiological zone the practice represents, and the selected district's flood/landslide vulnerability indices. Annex 5.1 provides detail demographic and socioeconomic features of these seven districts in detail.

The location of the districts and the case study VDCs are shown in Map 1. Information on vulnerability features of the district is provided in Annex 5.3.Tables 1-3 provides a

Table 2. Location and ethnic descriptions of the case examples studied (Map 1)

District	Case Example Name	Major ethnic groups	Agro ecological Zone	Flood Vulnerability Index [1]	Landslide vulnerability Index
Jhapa,	Eastern Tarai Community-Based Flood Control	Rajbanshi and mixed community	Tarai (sub-tropical foothills)	Moderate	Low
Mahottari,	Central Tarai Urban/Peri-Urban Flood Inundation	Mixed Madheshi community	Tarai (sub-tropical plain)	Very High	Low
Kailali	Western Tarai Community-based Flood Risk Reduction	Tharu and mixed hill community	Tarai (sub-tropical plain)	Moderate	Low
Sindhuli [2]	Inner Tarai, Chure/mahabharat; Flood Degraded Land Management	Majhi and mixed hill community	Inner Tarai (Shiwalik foot hills and Valley)	Moderate	Moderate
Bhaktapur	Adaptive traditional houses and tourism infrastructure, Bhaktapur	Newar	Midhills (mountain valley)	Low	Moderate
Lamjung	Building Resilient Traditional Settlements and Village Tourism Infrastructure	Ghale gurung	Midhills (hills and mountains)	Low	Very high
Tanahu	Disaster Risk Reduction through Redesigning of traditional houses	Magar and Newar	Midhills (hills and mountains)	Low	Medium

[1] Source: NAPA report, Government of Nepal, 2010; Khadka & Khatiwada (2013)
[2] One of the three most multi-hazard prone districts in Nepal (UNISDR)

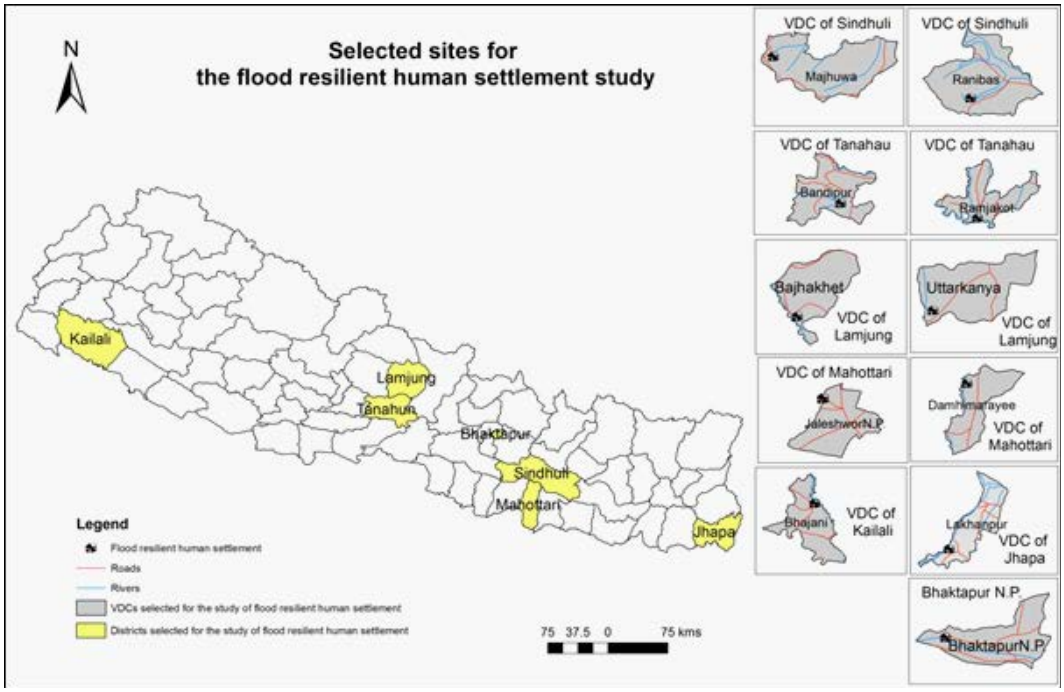
summary of the demographic, socio-economic, forest coverage, meteorological data of the districts covered under this Case study. As can be noted, overall the female population outnumber male in all the case districts except in Bhaktapur.

5.3.6 Nature and level of participation of research:

36

As stated above, the research has followed a participatory and an inclusive methodology to interact with indigenous and local practitioners while doing this case study. The involvement of the stakeholders was ensured from national to household levels through instruments including national and district level stakeholder consultations (NSC and DSC), focused group discussions (FGD), key informant interview (KII), and household interview (HHI). Table 4 indicates the level of their participation.

Map 1: Map showing the location of the case study examples



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As shown in Table 4 above, the research participants interacted mostly belonged to the upper caste (72%) followed by indigenous peoples (26%). Dalits and Muslims were negligible in their presence showing the caste composition data of Tarai. It can be noted that the largest percentage (88%) of upper caste presence in the district level consultations can be attributed to the participation of the Govt. officials and representatives from NGOs and media persons who generally belong to upper castes. In the FGD and KII, the distribution is more balanced as shown in Table 5.

Table 3: Socio-economic information of flood risk management; housing and settlements of studied districts

District	Area (Ha) *	Total Pop *	Male Pop*	Female Pop*	Forest Area (Ha)*	Total Length of Roads (Km)*	Total # of PSTN (tel.) *	Mean Annual Tem-perature Trend °C	Annual Rainfall Trend mm
Tanahu	154600	323288	143410	179878	71949	161.49	4903	23.8	2328.8
Lamjung	169200	167724	75913	91811	87552	72.04	1360	22.4	3364.5
Jhapa	160600	812650	385096	427554	13239	196.6	21251	24.9	2903.6
Bhaktapur	11900	304651	154884	149767	583	111.59	22249	15.1	1715
Kailali	323500	775709	378417	397292	169708	66.3	10960	24.5	1792.5
Sindhuli	249100	296192	142123	154069	136302	322.8	1108	-	2827.2
Mahottari	100200	627580	311016	316564	24086	185.29	1985	-	-

Source: * District & VDC Profile of Nepal, 2013 (Intensive Study and Research Centre, Kathmandu);
** Human Development Report 2014 GoN, NPC;
** UNDP-NP-Nepal Reading in Human development Report 1995-2001 (UNDP, 2002)

Table 4. Participation of stakeholders in data & information collection (DSC, FGD and KII)

Flood Resilient Human Settlements		Caste category of the participants				Total
		Chhetri/ Brahamin	Janajati	Dalit	Muslim	
Program in which participants present	District level consultation (DLS)	72	9	1	0	82
	Case study site workshop (FGD)	58	35	1	1	95
	Key Informant interview (KII)	6	6	0	0	12
Total		136	50	2	1	189

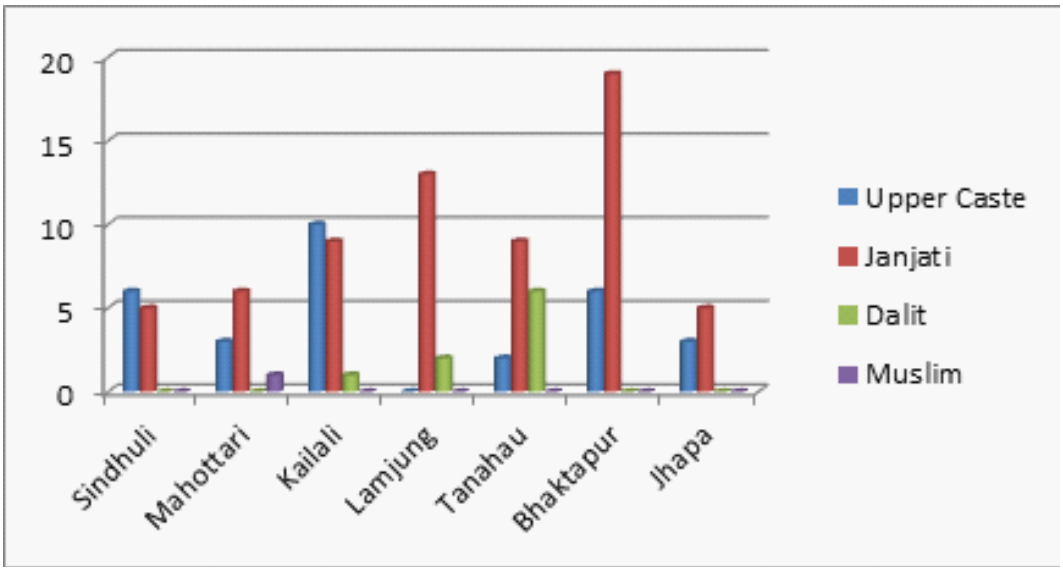
Table 5. Participation of stakeholders in data & information collection (DSC, FGD and KII)

Flood Resilient Human Settlements	Caste category of the participants				Total
	Chhetri/ Brahamin	Janajati	Dalit	Muslim	
District stakeholder consultation (DSC)	87.80%	11.00%	1.20%	-	100.00%
Case study site workshop (FGD)	61.10%	36.80%	1.10%	1.10%	100.00%
Key Informant interview (KII)	50.00%	50.00%	-	-	100.00%
	72.00%	26.50%	1.10%	0.50%	100.00%

38

Overall there was more than 46% participation of women in all the research interaction activities. The minimum percentage was at the district level consultation (9%) due to most of the participants being the government staff members. The FGD received a majority of women participants (close to 63%) and the KII engaged 20% women out of the 15 participants. Among the different castes and ethnic groups involved, the participation of the indigenous peoples (IP) or Janjati community was more than 50 % with higher percentage of IPs taking part in FGD (51%) and the KII (81%). (Table 5). The participation of women in the household level interview was 45%. The participation of different castes and ethnicity in the HH interview is shown in Figure 3. Regarding the socio-economic information on the household respondents see Annex 5.2, Tables 4-8.

Figure 3. Ethnicity and Caste Composition of HH respondents



5.4. CASE STUDY FINDINGS

5.4.1. General Findings

39

Most settlements in the study area consist of loosely clustered houses surrounded by agricultural and forest land. Houses in the hills are usually loosely grouped on a hilltop or hillside or by the side of a river or spring. In the hilly and Tarai regions, they are connected by footpaths that often converge around a large pipal (Ficus bengalensis) or banyan tree, which is surrounded by a stone platform or wooden

seating structure (*chautara*) that serves as a resting place for travellers and a meeting place for informal or formal community gatherings. These places also serve for different types of social gatherings and shelter from heat or rain. Most villages also have schools and community buildings for organizing large gatherings. These community places also double up for emergency shelter during the time of flood and other disasters.

Most traditional or old hamlets are clan or ethnicity based. Each hamlet has a concentration of houses of a particular clan, ethnicity or caste group of a particular community (e.g., Newar, Magar, Gurung, and Tamang). In each settlement most often one or more households of artisan castes (e.g., priest, black smiths, tailors, and traditional healers) are found to provide the traditional services such as rituals, metal works, and festival organization which are also important medium of knowledge sharing and transfer. 40

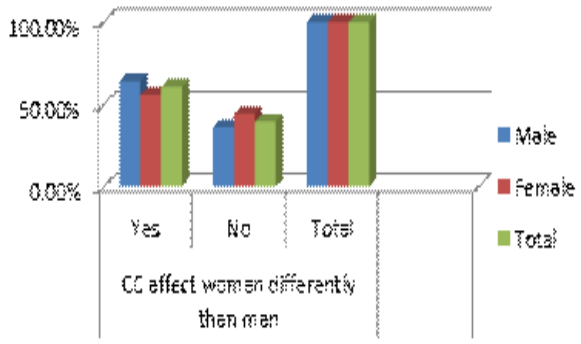
Climate change perceptions of the case study community

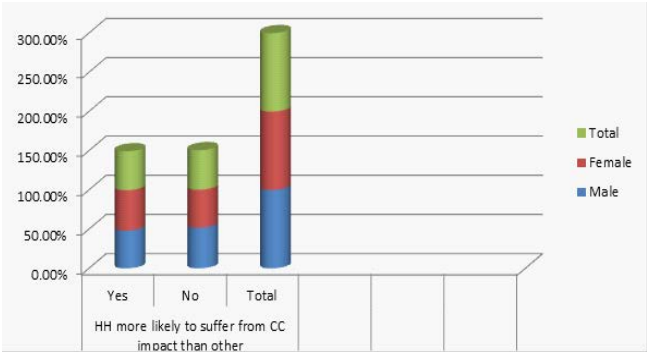
Concerning the changes in weather and climate of the case study districts, the study compared the community perceived recall data with recorded temperature and rainfall data of the last 30 years (DHM, 2012). As shown in the graphs below, based on the DHM recorded data all the seven case districts show increasing trend in annual average temperature figures. The increase is higher in winter average temperature than the summer average. The annual precipitation data indicated no particular trend with some districts such as Sindhuli showing decreasing and Mahottari showing increasing trend (Annex 5.1, A&B). 41

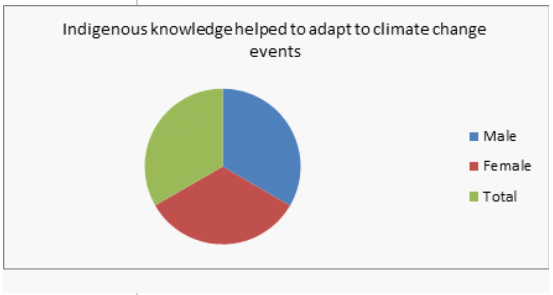
The trend shown by the record temperature data is more or less confirmed by the community perception response on increasing trend as shown in Annex 5.3, Table 9 and 10). The study found variation in the two district's precipitation data with community perception indication decrease in most of the districts which does not match with the recorded data (Annex 5.1A). The DHM data indicate that while average annual rainfall is showing increasing trend in Tanahu, Lamjung and Mahottari districts, there is no significant change in precipitation or decreasing trend in Kailali, Jhapa, Sindhuli and Bhaktapur. 42

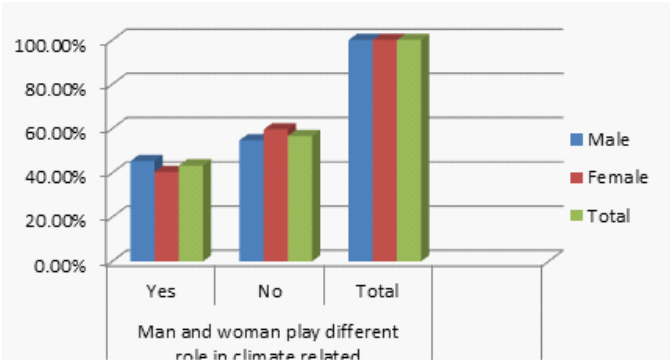
Regarding local perception on climate change impacts on flood risk and hazards, the respondents in category I districts; Jhapa, Kailali, Mahottari and Sindhuli opined that they are experiencing more flood and landslide events damaging their settlements and house hold properties in recent years than in the past (10-20 years before). Both men and women are impacted almost equally and when asked whether his/her household is more likely to suffer from climatic disaster than others more women felt positively than male member of the household did (Fig. 4) (detailed data provided in Annex 5.3, Tables 9 to 11). 43

Figure 4: Climate change perception and indigenous knowledge in CCA









44 However they were not confident on pinpointing the specific climate change induced events such as year the temperature increased the most, monthly rainfall trends and its intensity and patterns. The category II i.e., hill and mountain districts were found to be unanimous on their views that temperature was rising; rainfall amount was declining out-of-season short duration intense rainfall events causing flash floods are increasing.

45 The respondents in all the seven districts responded positively when asked whether or not the application of indigenous/local knowledge and practices in coping with the changes supported them to survive the weather anomalies. However, they were not sure about their coping capacity for adapting to extreme events. Regarding who plays bigger role in climate change adaptation, while more male respondents felt that women played bigger role, the female respondents felt that both played equal roles as shown by figures below (also see Annex 5.3, Table 12 and 13)

5.4.2. Specific Findings

Case Example 1: Eastern Tarai Community-Based Flood Management, Jhapa

Case evolution:

Lakhanpur VDC is a mixed ethnic case society. The VDC has 3479 HHs comprising of mixed ethnicity and castes of Brahmins, Chhetris, Magars, Tharus, Tamangs, Newars and others. The area was originally inhabited by Santhals, Mushars, Tajpuriya and Sattars indigenous peoples before 1928. After hill migrants started settling in the area after eradication of malaria in 1969-70, the original inhabitants moved out. Most of the Santhals are reported to have migrated to India due to better facilities for tribal peoples and kith and kin connections. 46

The VDC is situated in shallow and fragile Bhabar region which is highly hazard prone. It is regularly inundated and flooded by Ratuwa and Geuriya River water causing significant loss of lives and properties. The floods started in 1976 displacing 38 households. Local residents believe that the flooding was triggered by conversion of forest lands into human settlements and agriculture land which started as early as 1975 in upstream areas. The entire village is now affected by the sediment laden flood water from the rivers that cut and overflow the river banks. The construction of 1200 meter river training wall few years ago was effective initially to divert the river flow from the settlements but in 2011 the river broke the embankment and destroyed farm land and standing crops of around 25 ha. 47

Regarding the observed climate change indicators, the respondents reported of experiencing mosquito year round (3 years before no mosquito was found during winter). Rainfall is getting more irregular and unpredictable with each passing year. Tree crops such as sisau (Dalbergia sisau) are dying due to increased incidence of pests and disease. The fruit trees like mango and litchi are also less productive due to increasing incidence of pests and diseases and decreased fruiting. 48

Indigenous Practices Used:

The practices identified include structure, construction materials, interior design and risk minimizing – both anticipatory and reactive – efforts of the indigenous communities. The houses across the case study examples are found built with elevated plinth level, ceilings are provided hooks to hang clothes and valuables during inundation, and construction materials used are either flood proof (applies to rich HH) or affordable to replace (applies to poor). The settlements are protected by earthen embankments or trenches, walls, and bamboo and wood reinforced dams. . All these structures have ample use local knowledge in terms of site selection, selection of construction materials, and local participation. 49

50 Strengthened river banks are found to reduce flood risks and gabion wires filled with stones, cement mortar stone walls, and cement concrete slabs are used to block flood water entering houses and settlements. However, realizing that not all flood disasters can be prevented, the VDCs have allocated land to resettle the displaced people.

51 The communities are also found mobilizing the support and services of development partners including Red Cross, village clubs, local NGOs and community based organizations (CBOs). The Government provides support only for rescue and relief work but the costly rehabilitation work remains partially supported. The flood and drought risks have been steadily increasing during the past five to 10 years depending upon the region. While eastern Nepal districts are experiencing longer droughts and monsoon floods, western districts are getting both flash floods and inundation of new areas for the first time in their memories. The villagers blame bad settlement planning, deforestation, unsustainable road building, and improper land management work that has aggravated the problem.

Figure 5: Indigenous practices of living with floods in Jhapa

52 In Jhapa and Sindhuli, the VDCs and local elders have decided to establish fund for disaster management and ensure timely rehabilitation. The settlements located in flood prone areas has changed some agricultural and forestry practices to adapt to the erratic weather and bio-physical vulnerability. The houses are built with elevated plinth (up to1 meter higher) above the ground. People use local materials of bamboo and mud or cement for making walls, wooden frames are being replaced by bamboo frames, and thatch roofs by galvanized iron (GI) sheet – all cheaper and less hazardous materials. The traditional building of earthen dams using dry boulder materials and sand sacks are being reinforced by planting grasses such as Imperata cylindrica & Andropogon sp. along the vulnerable banks of rivers threatening the settlements. The community has identified safe locations for emergency shelter and made the people aware of the warning signals and sheltering places that have been put in place. The local youths have learned to weave gabion mess wire and bamboo woven baskets for quick flood protection in the event of flash flood as shown in Figure 5.

53 There is some mal-adaptation practices reported also. The community had built irrigation canal diverting the river water from under the bridge. But they had to quickly close the canal since flood water entered through the canal and they did not have technical means to construct the flood protection gate. The community is now facing problem in irrigating their farm land although they have prevented floods. Trees are not planted on the river control structures such as embankments since they perceive that it would weaken the wall due to spreading root system. However, they are planting bushy shrubs and grasses which would strengthen the wall since they believe that shallow roots are soil binding.

Transfer of knowledge:

54 Indigenous local knowledge (ILK) of flood management are transferred to the younger generation by involving them in most of the local practices such as embankment construction, river bank stabilisation, gabion filling, making protective walls around community buildings, constructing house walls and roofs and doing plantation through collective action. In the traditional house construction generally the collection and preparation of raw materials (logs and bamboo's) are done by male whereas both male and female weave the bamboo partition walls, baskets, and gabions. The mud lining of walls is mostly done by girls and women.

Issues and Challenges:

55 The respondents felt that although they are currently using locally evolved adaptive measures, they are having less and less belief in their indigenous knowledge and skills to address the frequently occurring hazardous flood and other unprecedented changes. The VDC is located next to a fast growing town of Damak. This is also increasing the vulnerability of the village community as the municipality has constructed spurs all along the city side of the river bank to protect its population diverting river toward the village settlement. There is no coordination and joint

settlement adaptation and disaster risk reduction practices between the two entities. More resources are needed to construct spurs and wall along the bank of the river to prevent the river from eroding the weaker side of the riverbank on the side of the village. The community is now investing individual finance to install water bore wells for developing irrigation facilities. However, construction of river training walls and river water management for irrigation are technologically and financially challenging ventures that indigenous and local knowledge systems are not able to address fully.

Case Example 2: Flood Disaster Risk Reduction and Management, Mahottari

Case Evolution:

56 This case example involves study of how local communities are adapting to or living with annual flooding and inundation problem in central Tarai. The district headquarter town of Jaleshwor and surrounding villages suffer from chronic flood problems due to overflowing seasonal rivers and streams. These rivers originate in Chure or Siwalik Hills and flows South through the district. About two-thirds of the River basin is under cultivation. Forests occupy 23% of the total catchment area mainly in the North. Hamlets and houses are generally scattered on the alluvial fan and in the river valleys dominated by agricultural land. Ratu (red mud) khola fills up its narrow river bed and shifts its course regularly overflowing its banks and inundating Jaleshwor town and surrounding villages in the lower basin. The water speed is rather slow but due to heavy siltation destructive power is high.

57 The main reason for the flood is continuous deforestation and degradation in fragile nature of Chure hills in the North and construction of embankment by India along the Border in South. The geology of the Chure is conglomerate of sand, grabbles, sedimentary rocks and landscape is very dry. When intense rainfall occurs, these exposed aggregates quickly move eroding farms rapidly as they pack destructive strength in flowing water. The unregulated excavation of stone and sand aggregates in the Chure hills and upper basin to supply construction industries both in Nepal and India hugely adds to the natural flood vulnerability by facilitating the spreading of destructive flood water and damaging of roads and bridges . Due to high level of siltation, the river bed of Ratu khola is increasing its level every year to overflow during the flooding season. As a result flood water enters in most of the old houses in Jaleshwor and surrounding areas damaging properties every year.

58 The flood affects the poor, the marginalized and lower-caste people the most. These people are dependent on their richer neighbours for their survival because of their lack of access to livelihood assets, especially farm land. Important differences exist in social vulnerabilities among different castes, age groups, and socioeconomic

[3] Recently the bridge over the Ratu river along the East West highway collapsed due to its pillars giving way.
[4] Maithali is an Indo-Aryan language spoken in South-eastern Nepal and North Bihar of India by 46 million people as of 2000, of which 3 million were in Nepal.

levels within each village and households. Gender specific vulnerability clearly exists since women in the Maithili and Muslim cultures - who are predominant in the area - women mainly stay and work at home. Due to increased youth migration, however, more women are found doing farming and household jobs previously done by men.

59

The case study data collection was done at two locations: a) semi-urban settlement of Jaleshwor municipality and rural settlement of Dami Marayee VDC. While Jaleshwor has mixed type of ethnic/caste settlement patterns, Dami VDC has cluster of Muslim and Brahmin, and other communities. Rich households in semi-urban Jaleshwor are increasingly building *pakka* (concrete) types of houses. The villagers own mostly kacha or kachi type of houses. The villagers mostly practice subsistence farming and the town people work either in government or service sectors – most of them as foreign migrant labourers.

Indigenous Local Practices:

60

Floods and droughts are occurring almost in alternate years. Most of the people living in kacha houses do not want to build *pakka* (concrete) houses for fear of losing them to floods. Instead they are adapting their houses to `live with floods'. They do not own or keep any valuables in their homes to reduce their financial risks. The communities have developed knowledge and practice to adapt to the almost annual flood inundation problem. Due to the unemployment situation and massive poverty, labour migration has been found a recent local adaptation strategy. From the district, 40,532 people were working abroad in the year 2011 (CBS 2011).

61

Indigenous peoples use bamboo, wild grasses, rice straw and clay to build their houses to minimize their losses. People are practicing number of coping strategies: a) moving to safer places mostly either on the high grounds or in neighbour's house or in community identified shelters, and b) transferring their animals to higher ground. When community leaders observe that water level is rising with muddy water, they inform villagers and pass on warning messages through village attendants. It is the most commonly practiced early warning system followed in the study area. This practice is common since many households have repetitively lost everything to floods (ICIMOD, 2007a).

62

Poor people sell their fixed asset for survival when they are left with nothing. The current local strategies for adaptation/coping can be summarised as follow (Figure 3):

a) Labour migration to foreign country which is becoming one of the most popular coping/adaptation strategies
b) Building new houses with high plinth level and placing *bhakari* (food storage bins) on raised platform to preserve seeds and grains.
c) Participating in peoples' embankment building initiatives and planting trees and grasses on the slopes of the embankments to strengthen them;
d) Distributing torch lights and raincoats to each vulnerable households to participate in rescue work;

Figure 6: Indigenous practices of living with flood in Mahottari

63 The respondents felt that given the scale and frequency of flood problem, there is a need to use modern scientific knowledge and good practices by integrating both the knowledge and practices. One such successful integrated practice cited was the participatory construction of embankment along the eastern bank of Ratu River that has prevented flood water entering some flood affected areas of Jaleshwor town in recent years. But the embankment has brought up some new issues. It has blocked natural drainage affecting the indigenous irrigation system. Also, water logging problem in farm lands along the embankment has affected the crop production.

64 Another good adaptation practice found is construction of cemented house altogether or partial replacement of thatch roofed traditional houses by reinforced cemented concrete (RCC) structures raising the plinth level above the high flood level. Also, people are planting adaptive short season crops such water melons and vegetables in silted farms to earn cash income to buy foods. Bamboo plantation has been carried out in some places of highly flood prone areas. Temporary bridges using bamboo

poles are constructed to maintain temporary movement of people and light goods during flood season. The excavation for aggregates in Chure hills has been legally stopped but illegal small scale excavation is still continues.

Challenges and Issues for Adaptation:

65 The communities are although using their indigenous knowledge and practices such as construction of bio-engineering flood mitigation measures, flood warning and disaster preventing notice boards, and changing their forest and agriculture land management practices, they realize that indigenous practices and technologies alone cannot prevent and manage extreme weather related loss and damage. It is in this context while they appreciate engineering measure such as GoN supported river bank embankments in Tarai districts (*janata ko tatbandh*), they express that these are top-down measures that have either underutilized or not utilized at all indigenous knowledge and practices that could make them more effective and prevent mal-adaptation..

66 The current process followed is generally contractor-based. People feel that better integration of IKLP could have made these costly structures serve multiple objectives including provision of irrigation facilities, prevention of water logging, improving animal feed and fuel wood supply. This, according to them, demonstrates the negative perception and attitude of government agencies toward local knowledge and practices. The researchers feel that the current procedure of construction activities is not very transparent as it does not encourage the involvement of user's committee. If the local knowledge and experience was considered, the construction of embankment could have channelled the excess irrigation water either to village ponds or back to the river thus preventing both the drought like situation on one side of the embankment and water logging on the other side.

67 In Mahottari, the bad design and construction management has forced farmers abandon their traditional cultivation of rice and switch to drought or water logging tolerant crops.The stakeholders were found to be in agreement that the perennial flood inundation problem cannot be solved on a long-term basis without conserving the forests of upstream Chure Hills. They strongly felt that just doing preventive flood control in downstream areas alone will not bring permanent solution. They suggested that more attention was needed in the upstream part of Ratu Khola rather than downstream which has been the case so far. Downsreream people have realised that the cause of flood in their area is due to heavy deforestation and land degradation activities in the foothills of Chure hills upstream. So the initiation should be taken from upstream side first, the case study participants felt. Locals also highlighted larger societal problem of poverty and ignorance, which can be, only be dealt with increased education, awareness programme and cultural and behavioral change.

68 The participants also highlighted the impacts of floods on women in the area. Especially women participants felt that due to the *ghumto* or *parda* (head cover)

practice necessary for married women in public places they face difficulty to carry out work outside the households that has been necessitated with male migration. Similarly, such practice limits their mobility during the time of flood risking their lives. Also Muslim women due to different social restriction are forced to cut plants and grasses only in nearby places which has become a major problem in the success of tree plantation in and around embankment areas.

69 The inundation problem is caused largely due to the construction of embankments and highways by the Govt. of India along the Border blocking the rivers and floodwater from Nepal. Nepal should discuss the issues with the Indian government and find a long-term solution.

Case Example 3: Indigenous Flood Protection and Management, Sindhuli

Case Evolution

70 This case example focuses on study of indigenous and local knowledge and practice of building resiliency in housing and settlements by reducing flood and land slide disaster risks prevailing in the Ranibas and Dandi Guranse VDCs in Sindhuli district. These settlements located on the northern slopes of fragile Chure hills are frequently devastated by flash floods of Kamala, Marin and a number of Khahare khola (rivers) that flow down from the Chure hills bringing flash floods during monsoon season.

71 The two VDCs have mixed population of indigenous as well as migrant higher caste groups comprising of Majhi, Tamang, Magars, Brahmins and Chhetris. Houses are built with extensive use of wood with khar or tile roofs mostly using traditional designs and patterns. Population of the area increased after migrants from hill started settling down in the areas after1950. Majhi tribe in Ranibas and Tamang in Dandi Guranse VDCs are the native people living there for several generations. After the hill settlers moved in, massive deforestation occurred and flood problem started. The communities recall the devastating flood events that occurred in 1973, 1984, and 1993, and 2012 which destroyed a large area of fertile agriculture lands, damaged or swept away close to 50 houses, and killed several people. In 2012 flash flood event in Ranibas, two school children and seven pilgrims lost their lives.

72 Numerous khahare kholas exist in both the VDCs and incessant rains cause flash flood every year since there are few trees, vegetation, and natural barriers left to hold the water during rainy season. During some years the floods are manageable by using their local knowledge and practices but the communities are finding it difficult to cope with more destructive floods especially during peak monsoon months. Traditionally people used to cultivate rice and maize which is declining due to a)

[5] Khahare khola is a seasonal flash flood prone river that rises suddenly during monsoon and remains active for a short period but causes massive damage and destruction of lives and livelihoods.

rice production has declined due to flood damage of their fields and availability of less water during planting season, and b) popularity of maize and wheat crops which do not need as much water and there is lower flood risk. The community experience of the flood damage reporting in the study area is summarised in Table 6:

Table 6: The flood events, damages and the impacts in Beltar

Major flood event year	Perceived cause	Scale of the damage	Impacts
1973 & 1984	Deforestation and heavy rainfall	Medium	Some HHs severely affected in Beltar along with destruction of prime agriculture (rice farms) land
1993	Cloudburst	Biggest ever[6]	Prime agriculture land, settlements, people, livestock damaged in a massive scale
2003	Extreme rainfall	Big	25-30 HHs damaged along with large paddy fields
2012	Deforestation	Small (every year)	Remaining agriculture land is being effected and settlements threatened every monsoon

Water springs including a popular natural spring, have dried up. Women are facing problems of fetching water. They have to walk about an hour to bring water increasing their work load. If water sources are dried up permanently, the community will have no option but to move since there are no alternate sources around. The local people are curious to know why such wells and water springs are drying despite forest protection and tree plantation. In recent years, a new problem of landslides has been threatening the community. “Previously soils, sands, and pebbles used to flow in flood water now whole mountain come crashing down” lamented a participant. 73

Indigenous Adaptation Practices:

The local community has banned open grazing even though it is not a popular decision since it affects the feed supply for animals. But gradually, the communities have realized the importance of zero grazing which has reduced flood damage. The women now practice `cut-carry-feed’ system of stall feeding of their animals using the community rehabilitated and managed forests which actually has proven to be a win-win situation as the forests are both protecting the settlements and supplying adequate quantity of animal feed. Tree plantation program has been initiated through community forest and private forest programmes. 74

People have constructed check dams, trash dams, bamboo and log reinforced flood barriers and gabion walls to control flood and protect agriculture land. They have approached government agencies; especially the President’s Chure Conservation 75

[6] 482 mm rainfall was recorded in Upper catchment of Marin Khola in Sindhuli district in the morning of July 20 (UN Habitat, 2002)

Programme for assistance and has received some gabion wires. The villagers in general are coping with the annual disasters using their own knowledge and local resources to adapt to the changes and disasters. In the process they have developed a number of innovative practices. As shown in the Figure 7 during flooding season, they dig series of holes and put tree logs in them along the river banks in order to protect the farm land from large boulders and to slow down the sediment laden flood water. This is an effective practice followed by their ancestors which is being improved with modern technologies such as cement and stone mason walls.

76

Women in the villages are doing some income generating activities through Poverty Alleviation Fund (PAF) which is supporting the flood affected families to adapt to the wherein their traditional source livelihoods such as farming and animal husbandry has been affected. They are also utilizing some positive aspect of flood by irrigating their rice farms with flood water if it just brings silts of fertile soils.

Figure 7: Indigenous flood protection practice of Sindhuli district

Adaptive housing:

77

Each type of housing structure has particular characteristics for climate adaptation. Ghumaune ghar (Figure 8) used to be more common in the older days in Sindhuli when it used to rain longer (long monsoon rain) as these houses had roofs with slope in all four sides, and rain did not get into the rooms and windows. This kind of design helped in keeping hailstones and rainfall sideways. Also these kinds of houses used to have shorter height and kept the rooms warm. However, now it is more common to find Pankhe ghar (photo 2) in the Ranibas settlement area. Pankhe ghar have slopes only on two sides, so if it rains longer there is a chance for water to get in the house. But this kind of house have higher roof with more height making room more airy. The KI mentioned that it has become hotter these days so people prefer to have houses with tall roofs. Another change that can be found in the houses these days are the size of windows, now people keep bigger windows in the house because of hotter days. Also windows are designed to open outside now days as earlier windows opened from inside.

78

The local communities studied are using their knowledge and practices to fight against the flood and environmental problems. They have demonstrated that their local practices are effective in developing preventive measures against normal size of flash flood problem. However, they also express the inadequacy of indigenous practices during extreme rainfall events such as cloud burst events citing the flood of 1993. They have collectively identified the issues and are implementing the followings measure for reducing disaster risks and building resiliency in their community:

- Adaptation to water and animal fodder supply shortage is necessary to reduce vulnerability of women (especially the drinking water issue was mentioned),
- Continuation of tree and grass plantations (bamboo, amriso or broom grass, and fodder grasses are preferred) that recharge water, make soil strong, and also supply fodder to animals,
- Planting suitable cash crop such as medicinal plants and broom grass in the forest o generate extra income from the forest to benefit vulnerable population.
- Villagers are advised not to do cultivation on sloping lands; if cultivation is unavoidable terraces should be made inward sloping and proper drainage made; Only rain fed agro-forestry has been suggested
- Inclusion of climate change issues in the school syllabus and conducting awareness programmes for the communities involving schools would prepare the community better to adapt.
- Conducting community-based forest fire prevention and control is necessary
- Reducing local livestock population by replacing the local breeds with improved ones will be more remunerative and this will reduce the demand for grazing and animal feeds;
- Improving women's leadership in environment conservation is necessary since most of the youth migrate either to cities or foreign countries (The example of Laxmi Baral is cited).

Challenges and Issues:

There are certain activities which the communities have identified but fell that they need outside or government's help in undertaking them:

- Construction of permanent bridge across big river such as the Marinkhola river to make the movements of people uninterrupted as traditional fadke (temporary bridge during lean season) is not useful during winter months; for this they have sought government's help.
- Construction of check dams in the upper catchment areas to protect both the Ranibas and the Beltar villages,

Ms. Laxmi Baral, aged 33 has Bachelor of Education (B Ed) degree and is a teacher by profession. She lives in Ranibas VDC, Sindhuli district. Her extended family includes 11 members. She lives in wooden house with tile roof and mud floor (kachha type). The house was constructed 12-15 years before. Ms. Baral feels wooden houses are common because they suit the changing weather and also require less work to clean and maintain thus reducing women's workload. This type of housing design was introduced by Hill settlers which are now also followed by indigenous Majhi peoples.. Here, as a preventive measure, her family planted trees and bamboos around the house. After the devastating flood of 1993, the villagers have decided to protect the forests along the *khahare* river to provide more effective flood protection. Laxmi and all the women members are actively engaged in the reforestation and protection of forests preventing people and animals to damage the plants. She played a crucial role in convincing villagers to enforce the community decision of `zero grazing' in forest and community land in the village. The decision was particularly unpopular among women as they used to do let the animals do free grazing thus reducing their workload of fodder collection.

Figure 8: Climate adaptive houses and settlements in Sindhuli district

5.4.4 Case Example 4: Community Based Flood Risk Reduction Practices, Kailali

Case Evolution

The case involves study of community-based flood control and adaptation work done by the community in one of highly flood vulnerable VDC in Kailali district. The study covered three wards inhabited by around 700 HHs of Tharu (50%), upper castes Brahmin and chhetris (45%) and Dalits, Muslims and others. The villagers used to face inundation, water logging and flash flood mostly during monsoon in the past. In recent years, they are facing unpredictable flash floods and riverine floods before and beyond monsoon season. The rainfall is getting more and more erratic. The people also reported that previously rainfall used to occur only after days of cloud formation but now mostly rainfalls occur after short duration of cloud formation and floods move very fast. Previously, flood used to occur within the river banks (which used to be deep) and boulders earthen walls, forest vegetation used to prevent it from gaining ferocity but now flood water fan out everywhere.

Partly they blame human activities such as deforestation in Chure hills in the upstream areas and indiscriminate mining of sand and boulders, forest clearance along the river bank, and heavy siltation due to land degradation and road building activities in upstream areas. As a result the debris filled flood water spread out very fast, providing very little time for saving lives and properties. One key informant said: “Flood used to gradually increase but now it increases immediately leaving no time to escape and save”.

The Bhajani VDC is flooded by the combined flows of four rivers: Kandra, Mohana, Patharaiya, and Kada which destroy farm land (*kataan*), inundation (*duban*) and deposit of sand and debris. Although the most devastating incidences of flood occurred in1994 and 2008 after considerable interval in the past, but now flood occurs every year. The people have felt decreasing intensity rainfall but the loss of human lives and properties is higher due to increase in population and rise in riverbed overflowing the surrounding lands.

Indigenous Practices Used:

One of the prominent local practices found is adaptation in housing and settlement design and patterns. Most of the traditional houses are built single story Kucha type made of mud and straw walls to adapt to floods. For safety reason, the roofs are made from light materials such as tiles (50%), CGI sheet (45%) and 5% thatch grass (straw). Some houses have wooden beams and poles. The availability of traditional roofing materials (bamboo and grass (*khar*) has decreased due to loss of forest areas and therefore most of the families are opting for tin roofs. The practice is to keep the houses cheaply built so that even if they are washed away, the loss will be minimal. The practice is also to use simple construction methodology and local materials so that they can afford increasing frequency of replacement (mostly each year or in two years) and availability of other options.

84 Many of the newly constructed houses have elevated plinth level of few feet above ground. The people are raising the floor level, increasing the building height, adding more windows and doors, and using bamboos or wooden poles as a part of their adaptation strategies. To adapt to frequent floods the plinth level of not only the houses but animal sheds and toilets too have been raised (Figure 9). The traditional one story mud houses of Tharu settlements are being converted into wooden two story houses using timber logs. They have constructed mud check dams around the houses, raised height of walking trails and farm bunds.

85 Among the collective actions of the community to protect villagers and their properties from annual floods comprise of protecting riverbanks with gabion walls and doing plantation along the river banks. They now have acquired boats to rescue people and installed early warning system as a part of disaster preparation.

86 During floods, the families put all the valuables on the bed, tie ropes in the four legs of their *khatiya* (cot) and pull it up to the ceiling beam of the roof for protection. The people of the area move temporarily to the highlands in the previously identified spots. The families also adopt differentiated practice of protecting individual items. Women tend to first protect the kids, food and utensils while men go for important documents, household assets such as electrical and agricultural equipment.

Transfer of ILKPs

87 The house construction knowledge, skills and practices are transferred within the family either through learning-by-doing or tutoring. The Tharu communities also have some occupational castes doing masonry, carpentry, and water works that transfer their skills and knowledge mostly to their own kith and kins. There is also gendered learning. Most of the raw materials for making walls are collected and prepared by

BOX 1

Mr. Budha, a resident of Theki ward no 5 Bhajani, migrated from Lauhadhungra Bajura after losing all his assets in landslide 43 years ago. With the governments permit (as support for rehabilitation option) to migrate to kailali, clearing forest area first settled in Pahiyaprasar for 13 years but was displaced by flood. He resettled in lalbhuji VDC clearing forest area but was again displaced in B.S 2041. The third resettlement is in Theki again clearing forest since last 20 years. The piece of land lying in a very flood prone area has been transferred in his name compelling him to live in the same place. He has enacted some simple measures like making his house two stories, making the main door in the opposite direction of river, his sons have joined the local club and they store food and fuel on the second floor before monsoon each year. The grains are grinded and packed for three months, a soil dam is build around the house as precautionary measures.

Mangal B. Budha - a lifelong victim and learner of flood and landslide disaster

males whereas the actual weaving and tying are done by both male and female. The mud plastering and painting work on the walls and floor are done entirely by women. All boys and girls help in the work of the parents, learning the skills from their parents and elders. The newer buildings utilize specific flood protection skills (of masons, carpenters and electricians) which are found among trained personnel. The village youth assist in most of the flood preventive activities learning from the elders (one example of ILK holder is Mr. Mangal Budha, see text Box 1)

The flood predictions knowledge and innovated practise are very location specific and based on long experience and interest. The knowledge is acquired mostly observing the formation, direction and colour of clouds and direction of winds. The village club members are getting more interested in doing flood prediction for conducting flood drills, using and reacting to early warning systems and participate in flood rescue operations provided by different development partners.

Figure 9: Climate adaptive houses and settlements in Kailali district

Issues and Challenges:

89 Most of the study participants expressed their vulnerability not only to climatic factors which of course is increasing. They also face socio-economic deprivation, and security challenges. While the indigenous Tharu peoples are finding their farmland shrinking or degrading due to their socioeconomic vulnerability, the settled community feel that if they lose the current patch of land which they acquired with great difficulty, they have nowhere to go. The community leaving along the Indo-Nepal border face triple source of vulnerability: robbery from across the border, inundation caused by embankment raised by India, and annual flood water destroying their lives and properties. Every year floods from between one to four rivers impact the community that lasts for months together.

90 The participants felt that indigenous or local knowledge and practices are not adequate and not well known to the wider public. To address the flood issue, technical knowledge of river training, construction of embankment on major river banks, and preparation of community disaster management plan for better flood control and disaster management are necessary. They also suggested building check dams, enforcing guidelines for constructing flood resilient houses, and conservation and protection of remaining forest resources.

Case Example 5: Building Resilience in Traditional Settlements and Community Infrastructure, Bhaktapur

Case Evolution

91 Bhaktapur city is composed of 8 settlement established in 8 different directions from the centre where a famous temple of Taleju bhawani is located. Figure 10 shows the settlement pattern of Bhaktapur central city, where the core is the temple, surrounded by the palaces of the former kings. The second tier is the priest family (Rajopadhaya) houses who are needed for performing all religious functions. Similarly, the third circle is build-up of the houses of Joshi and Karmacharya clans who are involved more on providing management support. In the fourth circle are the settlements of entrepreneurs and business people who supply necessary goods and services. The fifth circle is for skilled castes for doing tailoring, masonry, carpentry, goldsmith work. The sixth circle is for private house, followed by security/ shielding measures (walls, fortress), and the seventh tier is for the residence of security personnel. The eighth and ninth tiers are for service providers like shoemakers, sanitation workers, and carcass managers.

92 This functionally layered settlement patterns of old era can be considered relevant for adapting to climate change since all the skills required to predict, prevent, and manage disasters are found in a well structured settlement so that people can call on help easily to rescue, provide relief and rehabilitate once disaster strikes. Actually indigenous knowledge and practices of Newar community is preserved, promoted and

transferred through the different types of designs of the houses and organization of events, rituals and festivals. The case example was selected since Newar community is considered more adaptive and resilient community compared to many other ethnic groups in Nepal. Bhaktapur city was selected since a) it has dominant population of indigenous Newar peoples who have rich traditional knowledge and practices, b) NAPA (MoENv, 2010) has categorised Bhkatapur as the most vulnerable district because of high number of people exposed to climate change.

Indigenous Practices Used:

The Newar community members religiously protect and promote their traditional cultural and religious values, norms, systems, practices, and collective actions that also include their traditional architecture and heritage settlements. In Bhaktapur, they have constructed infrastructures such as walk ways, community halls, stone water spouts, and temples and stupas demonstrating rich traditional architectural

Figure 10: Climate resilience building of houses and cultural infrastructure in Bhaktapur district

knowledge and design and construction practices. The inhabitants still maintain the system of Chowk or a community meeting place that were constructed in ancient times using traditional technologies (Fig 10). The communities are strengthening the capacity of social and religious institutions for operating and managing cultural heritage and indigenous practices in drinking water management and sanitation ponds.

94 These practices are found adaptive and resilient since the indigenous institutions are adaptive and constantly strengthened. All constructions and retrofitting of old houses are done using old design, architecture, and local materials as much as possible. The local people's skill of construction exhibits how they construct domes of the temple without using cement and iron materials which are climate friendly. The stone slabs are placed in circular and are balanced using Surkhi the mix of black pulse (phaseolus mungo) and raw sugar. This knowledge has been used in all dome shaped structures (mostly temples) built during that period.

95 Some of their most indigenous practices found in Bhaktapur are:

a) Strong community feeling and a culture of helping each other during the time of crisis which explains why there is relatively very few poor people among Newari families;
b) Well organized and capacitate traditional institutions which are functioning and sustained due to strong cultural belief inculcated in younger generations about their need;
c) Fairly strong culture of voluntarism to do social work to maintain public buildings and temples which act as shelters during the time of natural disaster;
d) High value given for educating children and a culture of investing in maintaining social institutions such as Guthis.

Issue and Challenges:

96 The Bhaktapur town is densely populated settlements. In urban climate change context, the city is vulnerable since a large percentage of people are exposed to a phenomenon called `urban heat island'. The city is also suffering from water shortages with its old `stone spouts' drying and water infrastructure becoming obsolete. Another issue is also younger generation gradually losing interest to maintain traditional rituals and festivals that are considered important medium of knowledge and skill transfer. Growing as cosmopolitan town modernity has also influenced every aspect of traditional culture and indigenous practices. So the challenge Bhaktapur community face is how to integrate or maintain synergy between two or more knowledge systems.

Case Example 6: Community- Based Rural Human Settlements in Ghalegaon, Lamjung

Case Evolution

97

The case example explores the resilience building knowledge, skills and practices of the Gurung community to adapt to changes including climate variability. The name Ghalegaon (village of Ghale Gurung ethnic community) refers to an ancient domain of the Ghale kings established in 19th century (Dhakal, 2012; Adhikari, 2009). The indigenous community till date follow the traditional cultural habits and social norms established by their ancestors. One of their cultural values is to live in harmony with nature upon which they are using to build community adaptation strategy and climate resilience.

98

In the year 2001, some locals initiated the concept of home stay tourism in order to harness and promote the unique and rich traditional cultural wealth and architectural landscape of Ghalegaon. The village produces handmade woollen blankets (*radi-kaamlaa*) and waist coats (*bakhu*) as well as bamboo and wooden carved items such as Theki, Pung, and Pache which are popular tourist products of Ghalegaon. The woollen products are mostly prepared by women. Thus the village has a rich variety of indigenous, traditional knowledge and practices which are linked to the unique settlement patterns and living styles of Gurung community. Besides, the village surroundings also have rich biodiversity and natural landscape. These all combine well to promote as a cultural and eco-tourism package.

Climate Change Issues:

99

The community representatives stated that the changes in rainfall patterns, increasing temperature and unprecedented droughts are the clearest sign of climate change. They feel that since 1995 rainfall intensity has increased but frequency (number of rainy days) has decreased. The community is experiencing less snowfall during the winter season affecting ground water recharge. During summer season the area is experiencing more hails and lightening which destroy crops and affect productivity and make cultivation difficult leaving a large patch of rain fed farms fallow. These changes in weather patterns have affected drinking and irrigation water supply. Most of the households stated that they need to buy more food grains from market to survive as compared to 10 years before. Youth migration is another problem making less number of people available for community work.

Indigenous practices used:

100

Adaptive nature of traditional human settlements is visible in Ghalegaon through the structures and designs of the housing and use of local construction materials in constructing community as well as private houses and public infrastructures (Fig 8). Previously the major construction materials used were grasses for roofing; woods for windows, doors, and beam; and rock/stone slabs for flooring and pavements with stones and mud as the plastering materials. These days, the trend is using modern construction materials such as bricks, cement, iron and galvanized tins for walls and roofs. Local materials such as stones are still used for constructing pavements and

walkways. The community leaders attribute the reasons for the changes observed to climatic and socio-economic changes as the community feels they need robust design and strong construction to withstand harsher weather.

101 Ghalegaon used to be known for its famous *golo ghars* (round houses) designed for keeping the occupants warm inside it (Fig 11). These houses have two layers of compartments for better protection from extreme wind blow and snowfall. However, during the last 10 years as the local climate has been warming, people are changing their housing structures and designs to rectangular types that provide more air circulation, privacy and space for family members. These houses are also two storied and often have balconies so that they are suitable both to hot summer months and cool winter months. The *golo ghars* are being redesigned and modelled as tourist attraction.

102 The local communities have used the inevitable changes to their advantage by remodelling the heritage building for tourism that has been providing increased income to the local people besides preserving their indigenous cultural knowledge

Figure 11: Climate resilient tourism infrastructure of the Ghalegaon, Lamjung district

and practices. This indigenous innovation shows that the traditional housing and settlement practices are dynamic and able to embrace the changes to improve the community resilience.

Challenges and opportunities:
Although the indigenous community has introduced adaptive strategies to deal with the climate change induced risks and streses, there is a need to develop an integrated village tourism and livelihood strategies. The challenge faced by the local communites are many. Demand for mororable roads, uninterrupted electricity supply, and market oriented livelihood strategies will require a long term adaptation and resilience building plan for all sectors of the village economy. The community-based tourism promoted by ACAP needs to develop a more holisitc plan wherein besides mainstreaming climate change issues, social issues such as unequitable access and benefit sharing needs to be addressed.

103

Case Example 7: Housing and Settlements, Keshavtar VDC, Ramjakot-8, Tanahu

Case Evolution
This case example of examines the settlement patterns and climate change adaptation activities of the Magar community of Ramjakot village in Tanahu district. The locals believe that their settlement started around 400 years ago. The settlement pattern is clusters of individual houses located on top or along the foot path of the hilly terrain. Traditional houses are mostly of kacha type made of stone, mud, wood and straw. In recent years, corrugated iron sheets or slate roof are being used. Traditional houses are gradually vanishing. Only two Golo ghars or round houses are remaining. The rest were replaced by modern square shaped houses (Fig. 12). The traditional Magar clans have their own building norms and construction guidelines. The roofs of the same clan should all be facing the same direction and it's unacceptable to build a roof facing roads and human walkways. The reasons given are related to privacy, identity, and belief that it provides better safety.

104

The construction materials and skills used are all indigenous except the iron sheets, rods and cement. This change is due to declining supply of local materials and commonly perceived risks and potential loss if they stick to former types. Traditional single story houses are being gradually replaced by double story houses for better adaptation to changes.

108

House construction work is gender sensitive. There exists a clear distinction of role for men and women. Women are involved in water collection, mixing soil for wall construction, smoothing the mud floors and walls. Men do the masonry work and loading unloading of heavy logs and stones. The gendered role in household management is changing due to growing awareness, increasing economic contribution of women, breaking down of joint family system, women's empowerment, and above all youth migration.

106

Indigenous Practices Used:

The indigenous practices of Magar peoples are closely linked to their religious and cultural practices. Although their original religion or belief was based on Shamanism and Tengrism (Bista, 1996), today they practice both Hinduism and Buddhism. The community also believe in traditional Dhami (the faith healer or a kind of shaman) is called Dangar and their jhankri (another kind of faith healer or shaman) is called Rama. Bhusal was the traditional spiritual and social leader of the Magars (Bista, 1996) who performs religious activities, organizes social and agriculture-related festivities, brings about reforms in traditions and customs, strengthens social and production system, manages resources, settles cases and disputes and systematizes activities for recreation and social solidarity (Dhakal, 1996). These are all part of creating and maintaining a harmonious society.

Figure 12: Climate adaptive houses and settlements in Tanahu district

Most of families worship their clan god called Kuldeuta annually to keep the habitat safe from disasters and other elements such as evil spirits. They also practice Guthi (trust) for different cultural rituals and social needs. If a household member falls sick or in case of death in the family, the Guthiyars or trustees support the household financially and socially. This social event bonds the villagers together and prepares them to deal with natural calamities. The houses are gradually changing their design and construction patterns and technologies (Figure 12) reflecting Magar community's adaptive characteristics.

Issues and Challenges:

The community leaders felt that the traditional houses and settlements of Magar community are changing as the weather is warming. However, most of the adaptation decisions are made on an ad hoc basis without doing a detail vulnerability impact assessment and community consultation lacking holistic or comprehensive approach. For example, individual family decides to remodel its low ceiling houses located on hill tops and convert into two story house which poses risk to others. Given the increasing frequency of landslides and slope failures in Nepal's Midhills region, the Magar community needs to plan resilience building of their settlements by integrating disaster risk reduction and adaptation planning knowledge. This will need integration of indigenous local practices and scientific knowledge. However, for this the community felt that capacity building, funding, and joint planning between the DDC, NGO and VDCs is necessary.

5.6 DISCUSSION ON CASE STUDY FINDINGS

The findings of the seven case examples indicate that human settlements and associated livelihood infrastructure are facing multidimensional vulnerability in Nepal. The exposed communities are coping with the new hazards and risks - mostly created by climatic forces - through the application of a diverse range of indigenous and local practices. They are developing and implementing different types of autonomous adaptation practices. In several case examples, the communities have been successful in adapting to the changes. The case of Mahottari community learning to live with annual flooding and inundation problem by developing flood resilient settlements, Jhapa community constructing structure to minimize flash floods damage, and Kailali community using vegetative measures to reduce river bank erosion demonstrate the efficacy of ILKPs.

Similarly, the Sindhuli communities are addressing their constant flood problems through indigenous risk reduction measures that are providing both short and medium term results. These measures, while are found effective in normal flood years, they are not effective during extreme weather events. For example, in Kailali, the communities are facing three climatic and non-climatic hazards and risks

simultaneously – river bank cutting by Karnali river, inundation by Mohana and other rivers, and prolonged inundation of settlements due to the dam constructed by India blocking the natural flow of rivers. These problems are becoming common throughout the Tarai districts. Therefore, the local adaptation planners (mainly DDC) as well as the communities have to gradually switch to adaptation interventions that can meet the disaster reduction and adaptation goals in a more medium to long term basis. In the case study districts, the ILKPs seem to be falling short especially when extreme weather related disaster strikes. By planning local adaptation measures through LAPA and CAPA in conjunction of the effective autonomous adaptation measures adopted by the indigenous and local communities, the GoN agencies could prevent measure disasters in future as well as make adaptation more sustainable.

112 The case examples also show the effectiveness of community-driven and bottom-up approaches followed by indigenous and local practitioners in Sindhuli, and Lamjung case examples. However, long-term effectiveness of managing climate change risks and other underlying sources of vulnerabilities in fragile ecosystems of Chure and Mid-hill regions will require integrated approaches. Cost effective provision of reliable weather data, early warning system, and capacity building of local institutions is possible if outside support is built on local practices and institutions such as in Kailali where technical inputs are needed. While the community perception and knowledge of past climate change trend is useful, this will not be enough to forecast the future weather especially the flood and drought events. This calls for partnership building between the two knowledge systems.

113 Resource conservation, especially soil, water, forests, biodiversity, ecosystems and watershed, is pivotal to promote sustainable adaptation and resilience (FAO, 2014). The communities in Lamjung and Sindhuli have adopted such measures. However, it is clear that they are facing number of issues, gaps and challenges mainly related to robustness of technology, appropriateness of the use of the knowledge and adequacy of the efforts. First, they lack early warning information on the elevated risks of landslides and slope failures in the Middle hills of Nepal due to more incidence of heavy rainfall including cloud burst events mainly due to climate change. Second, the increased probability of flash floods both in Tarai and Middle Hills due both climatic and non-climatic forces is also a new nature of hazards for which local knowledge and practices are found wanting. One of the key informants in Lamjung said: “they do not have much information on Climate Change vulnerable areas of the village; they lack capacity, resources, and skills in setting up early warning systems and disaster preparedness planning”. This confirms the research findings that there is lack of coordination and collaboration between planned adaptation activities being undertaken by mainly NGOs under various donor funded programmes and schemes.

114 For example, under the programs sponsored by Appropriate Energy Promotion Programme (AEPC) and Department of Water Induced Disaster Prevention

(DWIDP), some awareness and capacity building as well as river bank stabilization programmes are found underway in Kailali. However, these activities are not utilizing ILKP since the policy and mechanism to practice such integration do not exist. Similar situation was found in Sindhuli where the President's Chure Conservation Programme distributes gabion mesh wires to construct flood diversion structures. This demonstrates that capacity building and training activities of district level stakeholders are being conducted without assessing the training gaps and needs as well as the traditional knowledge base that could make the adaptation measures more robust.

115

Similarly, there exist poor linkages between scientific knowledge generation and disaster risk management needs of Nepal. In all case studies, lack of district wide research and broader scientific knowledge generation on the impacts of rising temperature and extreme rainfall events on infrastructures especially tourism assets is lacking. The increasing gap in generation of synthesised and situation demanded knowledge is acting as a barrier to effectively integrate ILK in making community level infrastructure such as cultural and home-stay tourism assets climate resilient. For example, the Bhaktapur and Lamjung communities are applying their accumulated and intuitive local knowledge to redesign and strengthen their traditional infrastructure to address perceived risks. However, mainstreaming risk management in infrastructure development planning needs robust future climate information and technical know-how that the communities lack.

116

There is ample opportunity to bring the two knowledge systems – modern and indigenous – together to make Nepal's CCA and DRR efforts more effective and resilient. This requires both national and local level interventions. First, there is a need to change the mindset on the part of the government agencies toward the value and utility of ILKP. While there is generally appreciation of the importance of documenting ILKP, the researchers found that there are not many examples of the concrete examples where ILKP have been supported proactively and meaningfully. As an example, without doing proper capacity and skill gap analysis as well as knowing the community perception, government planned local adaptation activities cannot become effective. Training of local volunteers on early warning to rehabilitation work is required which will need knowledge management that should include indigenous and local good adaptation practices on settlements and housing.

117

The major challenges faced by settlement and housing sector in building community resilience and adaptive capacity are filling in knowledge and skill gaps, and collaboration between formal and informal institutions. This requires improved recognition and utilization of local knowledge in flood and landslide risk management efforts by the concerned government and non-governmental agencies. Community resiliency development efforts have to be, based on the learning form the ground such as what these case examples have shown. There is a growing gap between demand and supply of knowledge and skills in the housing and settlement sector

since climate change induced disasters cause heaviest loss of lives and properties in this area. The gap is more of technical nature needing skill up gradation and scientific information supply. These can be addressed through proper integration of ILK and modern knowledge in a situation specific manner. Disaster risk reduction (DRR) and holistic natural and socio-cultural resources management can address climate change impacts in this sector in a more sustainable manner.

118 For example, the indigenous and local communities of Ghalegaon are using their knowledge, capacity, and experience in practicing autonomous adaptation activities. They have strengthened traditional institutions such as Aama Samuha (mothers' groups) and Dhukuti (informal micro-credit fund in rural areas). But they do not have much capacity in terms of disaster management since they lack reliable data on impacts of rising temperature and extreme rainfall on tourism assets. Capacity-building of different stakeholders in different skill area is needed to set up and run early warning system. Once major disaster is prevented, perhaps rehabilitation can be done through indigenous adaptation practices. Some of the challenges faced by the local knowledge holders and practitioners are:

118 Based on the findings of FGD, there is a perception among the indigenous knowledge holders and practitioners that most of the government officials do not treat the indigenous local knowledge and practices at the same level as they do with scientific knowledge. This perception was the basis for understanding and recommending an action that indigenous/ local knowledge and practices in disaster risk reduction should be respected and utilized by the government agencies while planning community based disaster management activities at village level. Proper assessment, identification, validation, use and replication of ILKP are complex and difficult tasks. Joint testing and piloting of vulnerability assessment and disaster risk reduction planning by the indigenous and modern knowledge holders and practitioners might be a good practice to utilize the available knowledge. The case example in Mahottari exemplifies this practice. Some key points of the understanding and insights that can be discerned are listed below:

- The current system of constructing embankments in Tarai regions is ignoring local knowledge, practices and institutions; it lacks social and gender inclusiveness and measures to mitigate unintended impacts such as water logging of farmlands,
- Due to rapid nature of climatic changes, local knowledge and practices are becoming inadequate especially to deal with extreme events; River bank cutting in Kailali, prolonged inundation both in Kailali and Mahottari, flash floods by seasonal streams in Sindhuli cannot be mitigated through ILKPs alone;
- Indigenous and local knowledge lacks acceptability within the communities themselves especially among the younger generations especially in human settlement sector;

- There are strong gender issues in the application of ILKP in adaptation of housing and human settlement sector; some of the cultural practices as observed in Mahottari case example are not gender balanced and gender sensitive (UNCRD, 2008).

5.7. CONCLUSION AND RECOMMENDATIONS

Disaster risk reduction, maintaining social well being and environment management have been the three major elements of Nepal's traditional human settlement sector. Nepalese indigenous communities, especially those living in rural areas have been using indigenous local knowledge (ILK) to manage these factors by adapting to both the climatic and non-climatic changes. The marginalized and disadvantaged communities are solely dependent on indigenous local knowledge and practices (ILKP) to survive the harsh climate as well as chronic deprivation.

A number of innovative and practical adaptation measures are found being adopted by the indigenous and marginalized people in villages where the development and service agencies often do not reach. Building resilient human settlements entails a complex integration and holistic management of available indigenous, traditional, and local knowledge in managing local resources judiciously and drawing lessons from the experiences, observations and peer learning. This process is found to be practical and cost effective way of responding to both the slow and fast on-set climate change impacts that are observed in the above described case examples.

The indigenous knowledge and practices in housing and settlement sectors are found to have good generational transfer system especially in Newar community. However, this trend is also weakening. It can be concluded that as long as they met livelihood objectives of the people and are open to embrace outside knowledge systems, the transfer continues. However, rapid climate variability has brought sudden and unprecedented changes and unfamiliar impacts and consequences that are becoming difficult to manage with indigenous knowledge and practices alone. This has forced local communities to integrate indigenous and scientific knowledge and create a kind `fusion' knowledge system to improve their adaptation and disaster risk reduction options, especially in human settlement area.

This Case study has provided a useful understanding of the use of indigenous local practices in building resilient settlements. The study findings provide key indication of the important role such practices can play in developing local people's coping strategies. However, their continuous relevance and potential in future adaptation plans hinges on their effectives, reliability, and scalability.

The global and national literature and good practices on local knowledge in disaster management is considerable and highly useful, but climate change impacts largely being local, their use in local adaptation planning and resilience building of human habitats has to be context-specific and tailored to local community's perception and priorities.

This study documented the use of ILKPs in community's coping strategies and adaptation actions to reduce or manage disasters caused by floods, landslides, debris flow, heat waves, cold waves, and droughts. Some of the practices identified that can help in making indigenous local knowledge more effective for climate change adaptation are straightforward but require participation and commitment of all local stakeholders since disaster does not recognize political, social, and natural boundaries.

Therefore, in terms of recommendations, the following points are highlighted:

- The concerned government agencies, non-governmental and civil society organizations, and development partners have to identify major policy and capacity constraints in addressing the challenges of integration of indigenous and modern knowledge systems in DRR and climate change adaptation (CCA).
- As the seven examples above have shown, Nepal's indigenous and local communities are already practicing successful autonomous adaptation practices which point to the fact that indigenous and local knowledge holders are valuable knowledge and good practices that can help build resilient communities. Therefore, adaptation and disaster management authorities including the DDCs should develop mechanisms to consider effective indigenous knowledge and practices while planning CCA and DRR measures in the district.
- The government agencies such as MoSTE could make it mandatory to consider and use indigenous local knowledge while planning local disaster management plans and programmes; this will also require strengthening the traditional local institutions since ILKP exist and continue if the associated institutions also continue and provide support (e.g., Guthi system of Bhaktapur and Aama Samuh of Lamjung).
- The DDCs need to take lead by practicing ILKP mainstreaming policy in all infrastructure related projects in the districts. Since, at present, the use of ILKP in infrastructure planning is negligible, one approach could be to start integrating locally relevant knowledge and experience in planning and implementing climate change resilient measures in a limited number of pilots wherein both formal and informal institutions participate and co-develop new knowledge and learning; if found successful in the pilot phase, VDCs and municipalities could mainstream the integrated planning practices. For this, suitable district planning norms and policy guidelines are needed. The evidences collected under this case study can be used as one of the inputs.

ANNEX 5.1: DESCRIPTION OF THE CASE EXAMPLE DISTRICTS

Case Study Districts Overview

Jhapa: The main climatic hazards are flood and landslides caused mostly by perennial and seasonal rivers - Mechi, Kankai, Biring, Ratuwa and Nanda - that criss-cross the district. Erratic and heavy rainfall and rising temperature are the major climate change indicators. Mechi river causes major damage in the eastern and southern parts and Ratuwa and Geuriya rivers threaten the commercially important town of Damak and Lakhanpur VDCs nearby. Although NAPA report (MoEnv, 2010) has placed Jhapa district under `low vulnerabile' category, the district suffers from increasingly damaging flood havocs regularly. The fast growing town of Damak and surrounding VDCs - Lakhanpur, Kohabara and Khajurganchi are considered most vulnerable as they regularly get devastated by both flash and monsoon floods. Lakhanpur VDC is the case example used for the study. River control, degraded land rehabilitation and flood risk mitigation are the focused issue of the Case example. The district is heavily populated by both the indigenous and migrant populations comprising of Rajbansi, Sattars, Gurung, Brahmis and Chhetris.

JHAPA DISTRICT

Total Population: 812,650
Population Density: 508.01
Ethnic composition: Limbu, Rai, Dhimal, Dhangad, Koche, Rajbanshi, Satar, Meche, Tamang
Agro-ecological Zone: Eastern Terai
Total VDCs: 47
Total Municipalities: 3
Total Household: 184,552
Total literacy rate: 75.1
Female Literacy: 47.7
NAPA vulnerability: 0.125 (Very Low)
Mean Maximum temperature: 31.3°
Mean Minimum temperature: 17.6°
Annual Precipitation: 2495mm

Sindhuli: The district is a historically important place of Nepal . Although the past rainfall data indicate decreasing trend in precipitation (Annex Graph 2), Sindhuli has suffered devastating floods in 1954, 1972, 1993, and 2010 due to heavy events including cloud burst in 1993. Lack of proper rehabilitation of past flood damages and continuous threat of future floods as a result of unplanned development work, especially road and settlements, combined with lack of awareness,

SINDHULI DISTRICT

Total Population: 296,192
Population Density: 118.9
Ethnic composition: Tamang
Agro-ecological Zone: Central Mid-Hill
Total VDCs: 53
Total Municipalities: 1
Total Household: 57,581
Total literacy rate: 61.0
Female Literacy: 52.1
NAPA vulnerability: 0.567 (Moderate)
Mean Maximum temperature: 29.38°
Mean Minimum temperature: 15.46°
Annual Precipitation: 1120 mm

are the major concerns of the local people. Although categorised as a `moderately vulnerable' district by the NAPA process, it is one of the three most hazard prone districts in Nepal (due to its fragile geology with both Mahabharat and Chure hills being parts of its geography). Climate change indicators and impacts include unpredictable and heavy rainfall events, ravaging flood waters from all the three major rivers –Sun Koshi, Roshi, and Kamala, and decreasing agriculture production. Flood risk reduction and degraded land rehabilitation for enhancing livelihoods is the topic of this Case examples studied at two locations – Ranibaas, and Beltar VDC.

Mahottari: The district, one of the most densely populated districts in Nepal, is categorized as a `high vulnerable' district by the NAPA report (MoEnv, 2010). The district has been experiencing climate change impacts especially in the form of annual inundation of the entire southern belt. Yadav, Muslims, dalit, and upper cast Tarai Brahmin people dominate the district population. The rainfall pattern has changed in recent years with more torrential events falling in shorter duration as compared to the past. People have not seen winter rain for the last 2 years. The summer days are hotter as compared to past. Due the cold waves (seet lahars) in winter children and elderly people are having number of health problems including some deaths. The district is also facing landslides and flash floods in the North and inundation, riverbank cutting, and droughts in the South. Flood risk reduction and degraded land rehabilitation for enhancing livelihoods is the topic of the Case examples studied in the district headquarter of Jaleswor and nearby VDC of Damahimarayee (Figure 5).

MAHOTTARI DISTRICT

Total Population: 627,580
Population Density: 626.33
Ethnic composition: Yadav, Musalman, Dhanuk, Koiri/Kushwaha, Brahmin (Terai), Teli
Agro-ecological Zone: Central Terai
Total VDCs: 76
Total Municipalities: 1
Total Household: 111,316
Total literacy rate: 46.4
Female Literacy: 36.6
NAPA vulnerability: 0.785 (High)
Mean Maximum temperature: 29.9°
Mean Minimum temperature: 19.4°
Annual Precipitation: 817.5 mm (Jaleshwor only)

Bhaktapur: Bhaktapur is one of the top five `highly vulnerabile' districts in Nepal (MoEnv, 2010). It has rich cultural heritage including a number of World heritage sites. It also represents a unique Newari civilization of Kathmandu valley. Bhaktapur has been acknowledged as a global tourism destination which has become a significant economic activity of the people as well as a big revenue earner for the country.

BHAKTAPUR DISTRICT

Total Population: 304,651
Population Density: 2560.1
Ethnic composition: Newar, Chhetri, Brahmin, Tamang
Agro-ecological Zone: Central Mid-Hill
Total VDCs: 16
Total Municipalities: 2
Total Household: 68,636
Total literacy rate: 81.7
Female Literacy: 72.7
NAPA vulnerability: 0.886 (Very High)
Mean Maximum temperature: 18.8°
Mean Minimum temperature: 10.4°
Annual Precipitation: 2000 mm

Therefore, keeping the traditionally built tourism infrastructure resilient to changing climate is one of the key priorities of the district. The typical and traditional housing design and structures represent unique characteristics of the urban settlement but are vulnerable to `urban heat island' and unplanned settlement patterns. The traditional design and construction of numerous heritage buildings, temples and monuments need climate proofing. Preserving the traditional architecture and design and making these valuable tourism assets more climate resilient is the focus of the Case study in the district predominantly populated by Newar ethnic community.

Lamjung: The district is `highly vulnerable' district of Nepal (MoEnv, 2010). The district is well known destination for global tourists being a part of the famous trekking route of the Annapurna circuit. Every year thousands of international tourists visit the district. In recent years, home-stay tourism to culturally rich Ghale Gaon and Chosar villages has diversified the tourism business. These predominantly Gurung villages fall under the Annapurna Conservation Area Program (ACAP). While the Ghalegaun presents cultural heritage, surrounding Himalayan peaks of Mansulu, Lamjung Himal and Annapurna II provide adventure and trekking tourism opportunities. Climate change is impacting these tourism resources needing adaptation and resilient building measures urgently. The ACAP managed under the National Trust for Nature conservation (NTNC) is promoting ecotourism and cultural visits to the district but the growing climate change impacts are posing a number of constraints and challenges principal among them being landslides and flash floods aggravated by unplanned development. Ghalegaon was selected for the Case study research.

LAMJUNG DISTRICT

Total Population: 167,724
Population Density: 99.13
Ethnic composition: Gurung, Chhetri, Brahmin, Kami, Tamang
Agro-ecological Zone: Western Mid-Hill
Total VDCs: 61
Total Municipalities: 0
Total Household: 42,079
Total literacy rate: 71.1
Female Literacy: 63.3
NAPA vulnerability: 0.948 (Very High)
Mean Maximum temperature: 26.9°
Mean Minimum temperature: 15.8°
Annual Precipitation: 3372 mm

Tanahu: The district is predominantly an agriculture and forest rich district of the Midhills region. It is classified as a `moderately vulnerable' district by the NAPA report (MoEnv, 2010). Tanahu has more than 25 different ethnic groups of people dominated by ethnic Magar peoples with their rich culture and traditions. Bandipur,

TANAHU DISTRICT

Total Population: 323,288
Population Density: 209.11
Ethnic composition: Newar, Magar, Gurung, Brahmin, Chhetri, Damai, Sarki
Agro-ecological Zone: Western Mid-Hills
Total VDCs: 46
Total Municipalities: 1
Total Household: 78,309
Total literacy rate: 74.8
Female Literacy: 56.2
NAPA vulnerability: 0.503 (Moderate)
Mean Maximum temperature: 29.7°
Mean Minimum temperature: 17.7°
Annual Precipitation: 2151mm

a famous old commercial town and the former district headquarter is a tourist town. Around 80% of the people in Tanahu reside in rural areas. Several hydro power rich perennial rivers including Kali Gandaki, Marsyangdi, Madi-Seti and Trishuli pass through the district increasing its climatic vulnerability. Several traditional settlements of Magar and Newar communities including Bandipur, Ramjakot, Dholbarahi, and Mirlung are being developed as cultural tourism destination which needs to be made climate resilient. Ramjakot, an old Magar village, is selected for the Case study.

Kailali: The district is classified as a `low vulnerable' district by NAPA report but it in recent years, it has been facing devastating flood disasters. Dhangadhi, a regional commercial hub of the entire far western development region and growing urban centre is facing unprecedented flood inundation problem threatening critical development infrastructures at risk. Karnali and Mohana River and their tributaries have been regularly causing inundation f farm lands, forests and settlement areas heavily eroding river banks and overflowing out of their course. During the last five years three major floods have killed people and livestock and damaged settlements, houses, crops and standing rice crops. Poor and marginalized people are especially affected by flood disaster due to their settlements being located along the river banks or other unstable parcels of land. The embankments built by India along the Border, shifting nature Karnali river course and heavy encroachment of districts' forest by new settlers are causing more and more serious floods in the district. The district is inhabited by ethnic Rana Tharu, Magars, Dalits, and upper case Brahmins, Chhetris most of who have migrated from the western Hills. Bhajani VDC, a high vulnerability VDC, was chosen for doing the case study.

KAILALI DISTRICT

Total Population: 775,709
Population Density: 239.79
Ethnic composition: Rana Tharus, Magars, Dalits, Brahmins, Chhetris,
Agro-ecological Zone: Far-Western Terai
Total VDCs: 42
Total Municipalities: 2
Total Household: 142,480
Total literacy rate: 66.3
Female Literacy: 44.4
NAPA vulnerability: 0.192 (Very Low)
Mean Maximum temperature: 30.4°
Mean Minimum temperature: 17.5°
Annual Precipitation: 2602mm

ANNEX 5. 2.

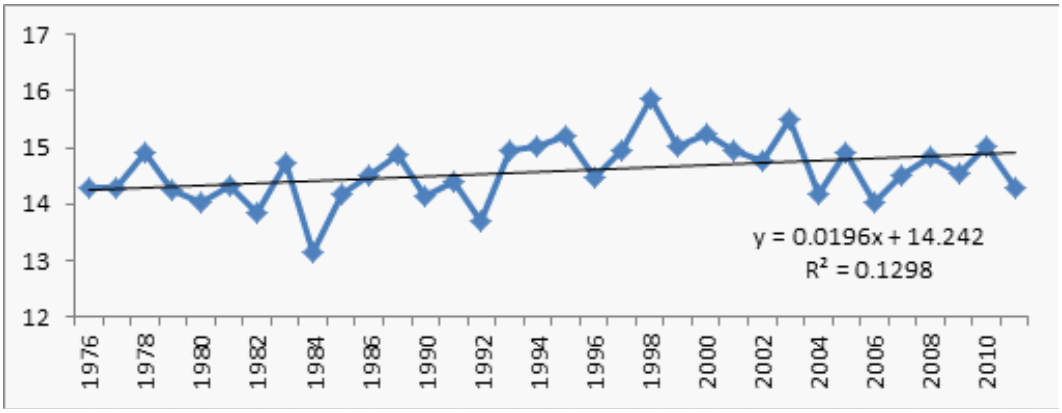
HISTORICAL TEMPERATURE AND PRECIPITATION TREND ANALYSIS OF SELECTED CASE DISTRICTS

A. Temperature Trend:

Bhaktapur

The trend analysis depicted that the warning trend has been increasing with mean annual temperature showing increasing trend with p-value of 0.031.

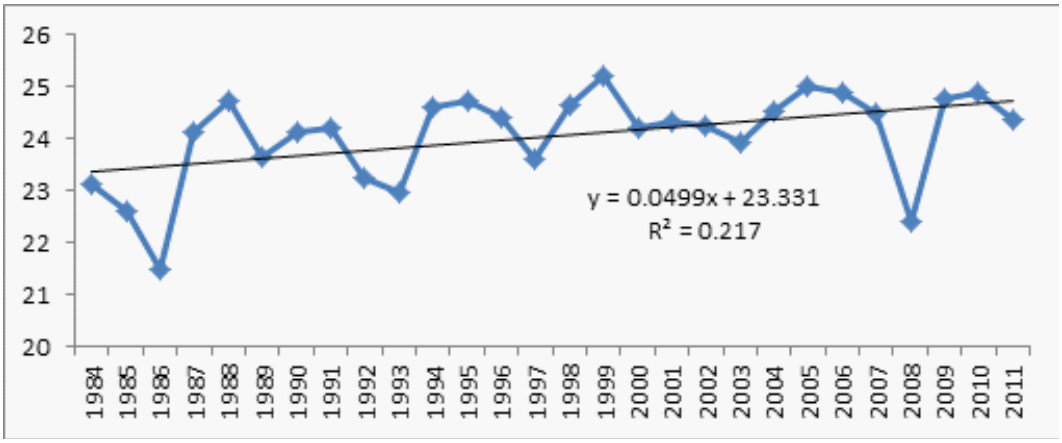
Mean annual temperature



Jhapa

The trend analysis reveal increasing trend with moderate statistically significant warming trend with p-value of 0.012.

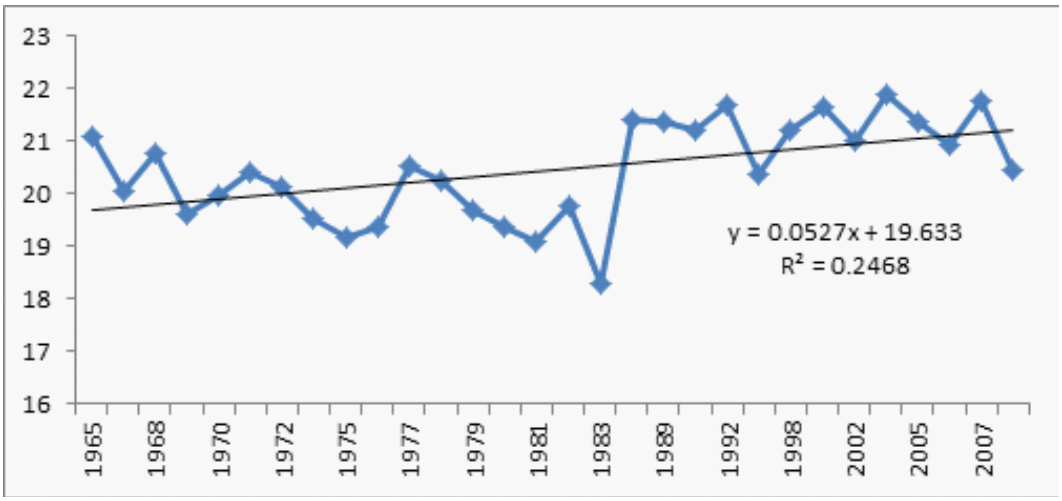
Mean annual temperature



Lamjung:

The trend analysis shows the increasing trend which is statistically significant with p-value of 0.001. The analysis shows pronounced warming trend.

Mean Annual Temperature

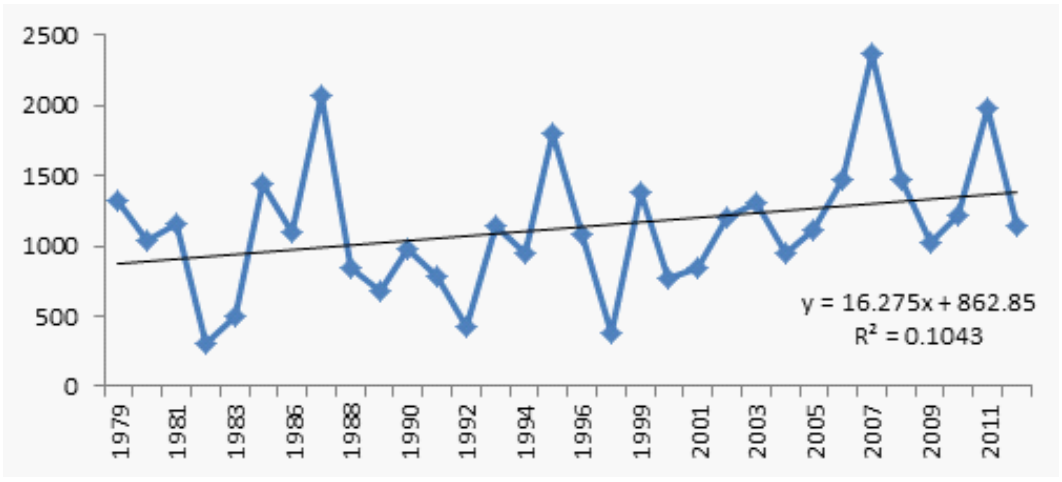


B. Precipitation Trend (only description and data for sample districts are provided)

Mahottari

Tropical, sub-tropical and lower-temperate climate is found in Mahottari district. The mean annual rainfall of the district is 1131.39 mm. Trend analysis depicts increasing trend which is not statistically significant with p-value of 0.076.

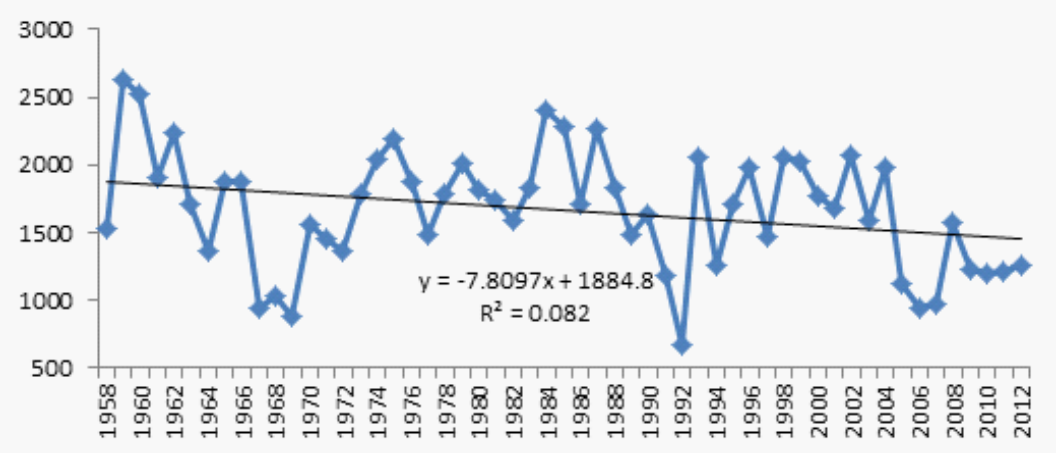
Mean annual rainfall



Sindhuli

The climate of Sindhuli district varies from lower tropical to temperate. The mean annual rainfall of the district is 1666.15 mm. Trend analysis depicts decreasing trend in precipitation over the period of time with p-value of 0.034.

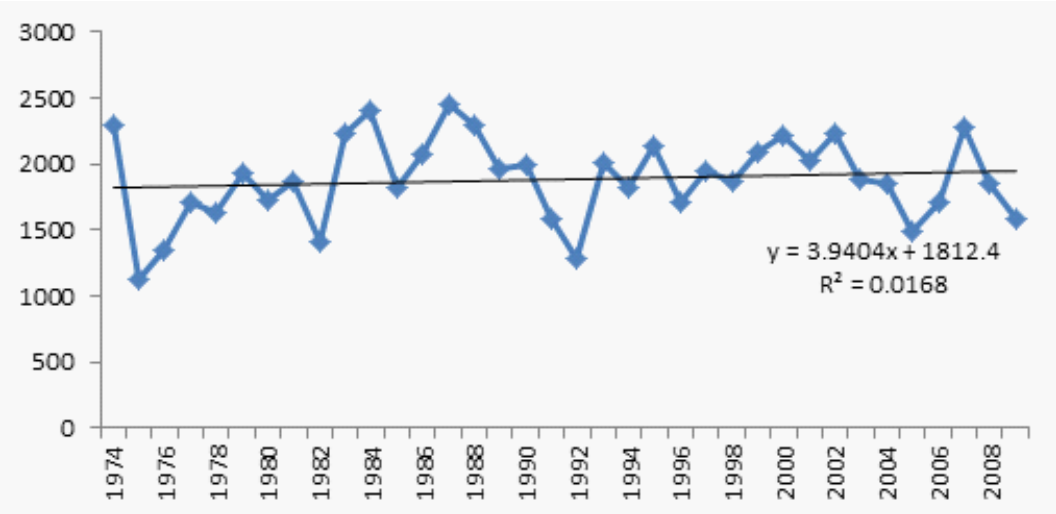
Mean annual rainfall



Tanahu

Tanahu district lies within sub-tropical to tropical climatic region. The mean annual rainfall of the district is 1885.24 mm. The trend analysis shows slight increase in increasing trend in rainfall but not statistical significant change with p-value of 0.452.

Mean annual rainfall



ANNEX 3 TABLES

Additional Baseline Socio-economic and Environmental Information

Table1: Birth place of household respondents

Sectors			Birth place of household head				Total
			Same village	Elsewhere in district	Elsewhere in the country	Abroad, specific	
Housing/ Flood management	Name of district	Sindhuli	5	3	3	0	11
		Mahottari	9	0	1	0	10
		Kailali	4	4	1	0	9
		Lamjung	10	0	0	0	10
		Tanahau	7	2	0	1	10
		Bhaktapur	8	2	1	0	11
		Jhapa	3	4	1	0	8
	Total		46	15	7	1	69

Table 2: Caste categories household respondents

Sectors			Caste categories				Total
			Chhetri/ Brahamin	Janajati	Dalit	Muslim	
Housing/ Flood management	Name of district	Sindhuli	6	5	0	0	11
		Mahottari	3	6	0	1	10
		Kailali	2	7	0	0	9
		Lamjung	0	8	2	0	10
		Tanahau	1	6	3	0	10
		Bhaktapur	2	9	0	0	11
		Jhapa	3	5	0	0	8
	Total		17	46	5	1	69

Table 3: Education level of household respondents

Sectors			Education of household head							
			Illiterate	Literate but no formal education	Pri-mary school	Sec-ondary school	Inter-mediate level	Bach-elor level	Master level	Other
Housing/ Flood manage-ment	Name of district	Sindhuli	1	4	1	4	1	0	0	0
		Mahottari	4	2	0	1	1	2	0	0
		Kailali	7	1	0	1	0	0	0	0
		Lamjung	1	6	2	0	1	0	0	0
		Tanahau	5	4	1	0	0	0	0	0
		Bhaktapur	2	2	0	2	3	0	1	1
		Jhapa	3	2	2	1	0	0	0	0
	Total		23	21	6	9	6	2	1	1

Table 4: Religion of the household respondents

Sectors			Religion				Total
			Hindu	Buddhist	Muslim	Christian	
Housing/ Flood management	Name of district	Sindhuli	9	2	0	0	11
		Mahottari	9	0	1	0	10
		Kailali	7	0	2	0	9
		Lamjung	10	0	0	0	10
		Tanahau	10	0	0	0	10
		Bhaktapur	11	0	0	0	11
		Jhapa	7	0	0	1	8
	Total		63	2	3	1	69

Table 5: Membership in social organisations of the household respondents

Sectors			Member in any of social organisation in present		Total
			Yes	No	
Housing/ Flood management	Name of district	Sindhuli	11	0	11
		Mahottari	5	5	10
		Kailali	9	0	9
		Lamjung	10	0	10
		Tanahau	7	3	10
		Bhaktapur	10	1	11
		Jhapa	3	5	8
	Total		55	14	69

Table 6:Support availability for livelihood improvement from membership in social organizations

Sectors			Membership support livelihood improvement		Total
			Yes	No	
Housing/ Flood management	Name of district	Sindhuli	9	2	11
		Mahottari	3	7	10
		Kailali	9	0	9
		Lamjung	10	0	10
		Tanahau	6	4	10
		Bhaktapur	10	1	11
		Jhapa	5	3	8
	Total		52	17	69

Total
11
10
9
10
10
11
8
69

Table 7: Major occupation of the Household Respondents

Sectors			Major occupation							Total
			Agri-culture	Business/ trade	Job/ service	Wage labor	Pension	Remit-tance	Other	
Housing/ Flood manage-ment	Name of district	Sindhuli	9	2	0	0	0	0	0	11
		Mahottari	4	0	2	1	0	1	2	10
		Kailali	8	0	0	0	1	0	0	9
		Lamjung	9	0	0	0	1	0	0	10
		Tanahau	6	1	1	0	0	2	0	10
		Bhaktapur	6	3	0	1	0	0	1	11
		Jhapa	3	0	1	2	0	2	0	8
	Total		45	6	4	4	2	5	3	69

Table 8: Food sufficiency of household respondents

Sectors			Food sufficiency						Total
			Less than 3 months	3 - 6 months	6 - 9 months	9 - 12 months	Year around food stock	No culti-vation	
Housing/ Flood manage-ment	Name of district	Sindhuli	0	4	3	3	1	0	11
		Mahottari	3	3	0	0	2	2	10
		Kailali	0	3	2	1	3	0	9
		Lamjung	0	3	2	5	0	0	10
		Tanahau	2	4	2	2	0	0	10
		Bhaktapur	2	4	2	0	1	2	11
		Jhapa	2	1	0	1	0	4	8
	Total		9	22	11	12	7	8	69

Table 9: Climate change perception of household respondents

Sectors			Experience climate change in your village		Total
			Yes	No	
Housing/ Flood management	Name of district	Sindhuli	10	1	11
		Mahottari	10	0	10
		Kailali	9	0	9
		Lamjung	8	2	10
		Tanahau	10	0	10
		Bhaktapur	11	0	11
		Jhapa	8	0	8
	Total		66	3	69

Table 10: Change pattern felt by the household respondents in weather/ climate related events

Sectors			Change pattern felt in weather/ climate related matters (snowfall, fog, hailstone, lightening strike, thunderstorm, mist etc) in past(20/30/40)		Total
			Yes	No	
Housing/ Flood management	Name of district	Sindhuli	9	2	11
		Mahottari	10	0	10
		Kailali	9	0	9
		Lamjung	6	4	10
		Tanahau	8	2	10
		Bhaktapur	10	1	11
		Jhapa	8	0	8
	Total		60	9	69

Table 11: Household respondents' perception on likelihood to suffer from climate change impact

Sectors			HH more likely to suffer from CC impact than other		Total
			Yes	No	
Housing/Flood management	Name of district	Sindhuli	5	6	11
		Mahottari	6	4	10
		Kailali	8	1	9
		Lamjung	1	9	10
		Tanahau	3	7	10
		Bhaktapur	5	6	11
		Jhapa	4	4	8
	Total		32	37	69

Table 12: Perception on the impact of climate change on woman and men

Sectors			CC affect woman differently than man		Total
			Yes	No	
Housing/Flood management	Name of district	Sindhuli	11	0	11
		Mahottari	10	0	10
		Kailali	9	0	9
		Lamjung	2	8	10
		Tanahau	7	3	10
		Bhaktapur	2	9	11
		Jhapa	1	7	8
	Total		42	27	69

Table 13: Perception on the role of man and woman in climate related adaptation activities

Sectors			Man and woman play different role in climate related adaptation/coping activities		Total
			Yes	No	
Housing/Flood management	Name of district	Sindhuli	7	4	11
		Mahottari	8	2	10
		Kailali	0	9	9
		Lamjung	3	7	10
		Tanahau	5	5	10
		Bhaktapur	5	6	11
		Jhapa	2	6	8
	Total		30	39	69

CASE STUDY VI

UNDERSTANDING INDIGENOUS AND TRADITIONAL SOCIAL INSTITUTIONS FOR CLIMATE CHANGE ADAPTATION IN NEPAL

CONTENT

ABSTRACT

Indigenous people face increased risk from climate change due to their high reliance on natural resource-based livelihoods. Their increased vulnerability demands strategic and contextual responses, tailored from the fusion of scientific and local knowledge. Indigenous knowledge, traditional practices and governance systems are directly linked to people's socio-economic life, their identity and existence, so assessment of these practices, revitalization, documentation and promotion are very essential. Proper understanding and use of such indigenous and local knowledge and good practices possess capacity to enhance the resilience of the ecosystems as well as to the stresses posed by climate change.

The most vulnerable peoples' responses to environmental challenges are shaped by governance systems managed by traditional institutions influencing their collective responses, access to, and use of resources. This study, through six unique and diverse Indigenous Traditional Social Institutions case examples of Nepal examines local management systems influencing social groups' access and use of resources in the context of climate related vulnerabilities and adaptation practices.

The case study used participatory tools such as stakeholders' consultation at district and case level, key informant interviews, household interviews, and observation for generating empirical information. The information thus collected was substantiated by extensive literature review. The analysis demonstrated impacts and depends on interlinkages among various elements of governance and management and that they need to be understood better for developing effective strategies for climate change adaptation.

There are several forms of traditional institutions in Nepal that could aid in the building of adaptive capacity. The institutional development, capacity enhancement, and collective unity for social mobilization of the Guthi system should be strengthened and replicated for climate change adaptation. The Dhikur system generates capital and often operates as an informal banking system in rural parts of Nepal. Mukhiyas leading a holistic governance system is self-sufficient to control and manage forest and rangeland, whereas, Singhi Nawa System of Solukhumbu is an example of controlled and sustainable forest management fusing traditional practices. The Amchi medicine system is being increasingly recognized and formalized, the Aama samuha is an example of utilization of women's knowledge and equity, which also empowers them.

The study shows that traditional social institutions can play a central role in facilitating actions to increase access, use of resources and assets. They play an important role in preserving the cultural and natural environment. Both are instrumental for adaptation to multiple changes. Indigenous Traditional Social Institutions (ITSIs) possess replicable adaptive characteristics useful for policy making. Such existing institutions can influence collective actions to build climate resilience in development sectors if scientific knowledge is integrated into their management practices. Their credibility in community enables them to popularize new knowledge, practices and innovations.

6 However, ITSI face various challenges; lack of recognition and promotion, low capacity, scarcity of raw materials, reluctance of young generation in participating, duplication of initaitives, and informal nature of ITSIs. Immediate attentions are needed to address these limitations.

6.1 INTRODUCTION

6.1.1 Overview

7 Climate change poses a direct threat to most indigenous communities due to their dependence on natural resource-based livelihoods that use services from local ecosystems, biological resources and cultural landscapes. These are sources of sustenance and wellbeing. Multiple drivers interact with each of the above elements making community-specific groups vulnerable. Historically individuals, households and communities have been adapting to natural variability. Overtime, these practices have been established as traditional knowledge (Macchi et al., 2008).

8 Local institutions create rooted social networks that can be used as a foundation for using indigenous knowledge and developing strategies to build adaptive capacity. Uncertainties that climate change introduces mean that both traditional and modern scientific forms of knowledge on their own will not offer solutions to emerging vulnerabilities. Approaches that assimilate and synthesize different forms of knowledge including indigenous and scientific forms through a shared learning will be necessary.

9 As climate change threatens most vulnerable and marginalized groups (IPCC 2007) shared knowledge will help social institutions play a mediating role in local level planning and implementation of local adaptation actions (Agrawal, 2008). Adaptation plans that support and use existing social institutions have higher chances of supporting a group's access to and use of assets and natural resources. In addition, traditional practices and governance systems of indigenous people are directly linked to their socio-economic context and identity. Thus, assessment, documentation, promotion and revitalization of these practices are important to improve their wellbeing (Dolma et al, 2013). Yet, few studies examine the interrelationship among governance practices of indigenous traditional organizations, vulnerability, risks and adaptation. This case study examines the nexus between the governance of indigenous traditional institution, vulnerability and adaptation as a step towards filling this gap.

6.1.2 Major traditional social institutions of Nepal

10 Nepal currently has 126 castes and ethnic indigenous groups; 123 languages spoken as mother tongue; and 9 religions (CBS, 2011) each with distinct cultures and unique ways of life. Traditionally, communities have relied heavily on voluntary local governance for conducting most affairs of daily life. Each ITSI is specific to different caste and ethnic groups, locations as well as specific to different purposes (See

Table 1a). Empirical research has shown that ITK are common in the management of four resources in Nepal: forest, water, land and herbal medicines.

Table 1a : Types of ITSI in respective sectors in Nepal

Sectors	ITSI
Forest and Land Management	*Bheja, Kipat, Raikar, Mirchang, Posang, Singhi Nawa*
Financial Management	*Dhikur, Subba, Jimmwal, Pagari, Thari, Guthi*
Labour Relations	Parma, Nogiyar/parima, Baure, Nogar, Jajmani/Bista, Addhiya/ Kut, Haliya/Kamiya, Shramadhan/Begar/Ansari, kamara, khel
Social and Culture Management	Guthi, Mukhiya, choho,Tthi, Rodi, Aama Samuha
Religious sectors	Monks, Aani (Female Monk), Priest
Health/Medicinal	Amchi, Baidhya, Dhami, Jhankri

Many of these traditional management systems have been forgotten or disappeared, and not recognized by external actors (Berkes et. al, 2000). Yet, some practices of different ethnic groups have been sustained despite the change in political, social and environmental contexts. Such practices have preserved cultural values and the natural environment and can be used to support initiatives that aim to build adaptive capacity and resilience to climate change induced vulnerabilities. Improved understanding and use of ILKP can enhance the resilience of the ecosystems, and help decrease vulnerabilities. 11

ITSIs either in their original or contemporary forms exist in all of the case study locations, actively perform different roles and responsibilities: Guthis (religious, social, and agricultural works), Kulharis (maintaining irrigation system), Dhikur (credit management), Mukhiyas for local governance, Amchi (health management). Their contemporary forms exist in community users groups like the community forest users groups, Aama Samuha (Mothers' group: women's welfare). The groups are involved in activities like maintenance of bridges and trails, management of forests and water, providing credit to members. Some of the groups also organize entertainment activities while farmer co-operatives support them get easy access to agriculture inputs and veterinary services. The functioning of traditional institutions is necessary to maintain indigenous and local practices for the operation, management and maintenance of such system. For example, in all the case locations, user groups of forest, water, and other services were active and produced positive results. The works by community forestry user groups (CFUG), water users association, credit cooperatives, and Amchi is globally recognized. In some cases, most credit goes to indigenous system of local resources and service management established in Nepal. 12

6.1.3 Study rationale

All the ITSIs evolved from local and contextual necessities. They are at the center of decision-making that govern access to and use of natural resources on which community's livelihood depends. The community has mandated them to govern, decide, determine and shape their livelihood and help in responding to risks and 13

vulnerabilities that the communities face. Examination of ITSIs can provide lessons about how historically communities have responded to various kinds of stress through collective efforts. Such lessons can provide key insights into the functioning of the local institutions, unpack the inherent barriers so that interventions designed enhance adaptation to climate change.

6.2 CASE STUDY OBJECTIVES AND RESEARCH QUESTIONS

14 ITSI case examples help track the role and capacity of local management systems to deal with various changes. The main objective is to examine how local management systems influence a group's access to and use of natural resources. The specific objectives are: a) identify issues and priorities of ITSI on climate vulnerability from local perspectives; b) document and analyze practices of ITSI in responding to impacts in priority sectors, and c) recommend learning of indigenous governance practices for integrating them into proposed adaptation plans and programs.

Research Questions:

15 As a part of the study this case study aimed to seek answers to the following questions

i. What lessons do past studies on traditional social institutions management system in Nepal provide?
ii. What constitutes good governance practices that will increase access to resources for climate change adaptation through local institutions?
iii. What major leanings can be replicated to meet above objectives in local governance?
iv. What issues on gender sensitivity and equity in the governance system of ITSI have implications on policy?
v. What are key challenges that ITSI face for supporting climate change adaptation?

16 The case examples were selected from a long list of traditional institutions identified from the literature review. ITSI's originate and thrive in homogenous communities than heterogeneous ones as the former are characterized by cohesion and solidarity. ITSI's in Nepal originated among specific indigenous group/groups and their practices are common in their locality. To seek answers to the above questions the prominent indigenous groups[1] who maintained ITSI were identified. The basis for

[1]The National Foundation of Indigenous Nationalities (NFIN) has declared 59groups as ethnic nationalities and has classified these groups into five categories based on their population size and other socio-economic variables such as literacy, housing, land holdings, occupation, language, and area of residence. According to this classification there are 10 'endangered groups- Bankariya, Kusunda, Kushbadia, Raute, Surel, Hayu, Raji, Kisan, Lepcha,Meche;', 12 'highly marginalized groups-' Santhal, Jhangad, Chepang, Thami, Majhi, Bote, Dhanuk (Rajbansi), Lhomi (Singsawa), Thudamba, Siyar (Chumba), Baramu, Danuwar;, 20 'marginalized group- Sunuwar, Tharu, Tamang, Bhujel, Kumal, Rajbansi (Koch), Gangai, Dhimal,Bhote, Darai, Tajpuria, Pahari, Dhokpya (Topkegola), Dolpo, Free, Magal, Larke (Nupriba), Lhopa, Dura, Walung', 15 'disadvantaged groups'- Jirel, Tangbe (Tangbetani), Hyolmo, Limbu, Yakkha, Rai, Chhantyal, Magar, Chhairotan, Tingaunle Thakali, Bahragaunle, Byansi, Gurung, Marphali,Thakali, Sherpa., and 2 'advanced groups'- Newar, Thakali. Considering the diverse cultures, races, languages and customs, the Constitution of Nepal, 1990, has recognized the existence of'tribes and indigenous people' in the country.

selection was: a) originating, thriving and sustained within specific indigenous social groups b) influencing community access to resources, and c) facilitating use of ITK in selected themes. Thus local water management, rural transport infrastructure, forest and pasture management, and settlements were selected as case examples (see Chapter one). Each of the sector pursued specific governance mechanism.

Subsequently district level workshops held to validate the selection. In the next stage, for each case, interactions with focus groups were conducted and key informants and beneficiary households were interviewed. The objective of the interview was to understand perceptions of the respondent about how they benefited from ITSIs. Checklist, structured and semi-structured questionnaires were used for collecting information. Historical trend analysis, and recall method were used to assess how the ITSIs evolved and institutionalized their operation. The factors that determined their performance were also assessed. Social diversity and gender balance was considered throughout the information collection process. The study also attempted to get an insight in to governance mechanism of the ITSIs, and examine the role ITSI's could play in addressing climate change adaptation. Attempts were made to draw lessons from their use of local knowledge and practices to deal with other changes.

17

6.3 CASE BACKGROUND

6.3.1 Case Introduction

The case examples are summarized in table 1b and shown in Figure 1. The sections describe the ITSI relevant context in each of the selected districts.

18

Figure 1: Location map of ITSI case studied

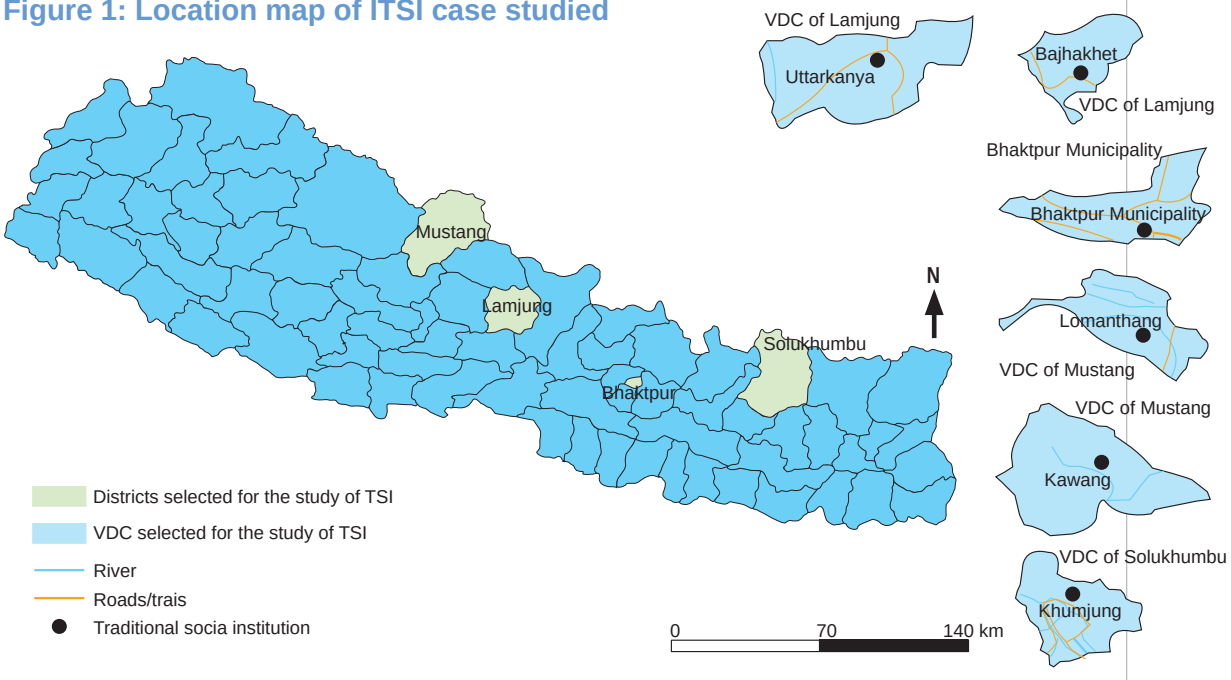


Table 1b: Selected Case Examples

ITSI	Purpose	Caste	Settlement	District
Guthi	Religious and socio-cultural playing a prominent role in enriching social capital, and in strengthening management of local infrastructure	Newar	Bhaktapur city and its surrounding areas in Bhaktapur district	Bhaktapur
Dhikur	Access to financial resources	Thakali, Sherpa, Gurung	Ghalegaun, Khosur Lomanthang, Kobang	Lamjung Mustang
Mukhiya System	Governance of natural resources and management of social capital	Thakali	Lomanthang, Kobang	Mustang
Aama Samuha (Mothers' Group)	Increase social capital and equity	Gurung	Ghalegaun, Khosur	Lamjung
Singhi Nawa	Forest management	Sherpas	Khumjung	Solukhumbu
Amchi	Health care in rural mountains	Thakali, Gurung Loba	Lomanthang and Kobang	Mustang

19 **Bhaktapur:** This smallest district of Kathmandu Valley covers an area of 119 square kilometers.Bhaktapur city is the headquarter of the district and lies within sub-tropical to temperate climatic region. Literally referred as the "The City of Devotees" the city is an ancient Newar town. Home to traditional art and architecture, historical monuments, craft works, rich local customs, culture, religion, and festivals, it's also called "Khwopa" (the masks of gods and goddesses) or "Ancient Newari Town". The major caste in the district is Newar (45.58%), followed by Chhetri (20.06%), Brahmin (14.23%) Tamang (8.94%) and others.Newars, known for their rich cultural practices, are traditional merchant and trading group. The group maintains a complex social structure that reflects four Hindu Varna categories, and practice two religions: Hinduism and Buddhism. Guthi is their prominent traditional social institution and agriculture, the mainstay of their livelihood.

20 **Mustang:** It is known as the desert of Nepal. The district encompasses an arid windy valley with dry, strong winds and intense sunlight. More than 40 percent of its area is rangeland and pasture lying at altitudes between 3,000 to 5,000 m, and covered by snow for 4-5 months (November to March). Located in the rain shadow of the Annapurna and the Dhaulagiri mountain range the district receives low rainfall: its southern part receives more rains than the northern areas. The social composition of the district is comprised of Gurung (45.2%); Thakali (16.5%); Magar (6.7%); Bahun/Chhetri (11.3%) and the rest (20.3%); mostly following Bon religion and Buddhism (CBS 2011).Gurungs and Thakalis are known for their hospitality, good salesmanship, and cleanliness; and Lo-bhas of Tibetan origin have strong traditional practice of water management. Mustang is culturally rich and has many environment friendly practices that include the institution of Mukhiya (village headman) system,

Dhikur system, Amchi (traditional medical professional) system, Monk, Aani, and Siju (religious) systems. They respectively manage the society, natural, economic resources, provide health care service, and maintain religious rituals.

Lamjung: With Besisahar as its headquarters, the climate of the district varies from upper tropical to Trans-Himalayan. The district houses Gurung (31.25%), Chhetri (15.99%), Brahmin (12.75%), Kami (8.63%), and Tamang (7.23%) population (CBS 2011). The indigenous group Gurungs, who are famous for their culture, are animists (or followers of the Bon religion). In Gurung society, the main responsibility for managing the village administration rests with leader of the village, Chima, who, among other things, settles local disputes in the village. Rodhi, Aama samuha, and dhikur are among the major social management systems of Gurungs.

Solukhumbu: The district lies in mountains of Eastern Development Region with Salleri as the district headquarter. It has two regions: Solu, which comprises the southern part inhabited by Rai (19.6%), and Chhetri (16.0%) communities; and Khumbu, the northern part, consisting Sagarmatha National Park (SNP) and Mount Everest, inhabited by Sherpas (16.7%) (CBS 2011). Traditionally the economy was based on agriculture and animal husbandry and has been superseded by tourism. This shift has brought benefits but also increased risks of forest degradation and generation of wastes. In addition, the rise in temperature has led to melting of glaciers and increase in the volume of glacier lakes.

Table 2: Brief socio-economic status of case example districts

Particulars	Mustang	Lamjung	Bhaktapur	Solukhumbu
Total area (sq km)	3,573	1,692	119	3,312
Total population	13,452	167,724	304,651	105,886
Population density	3.76	99.13	2560.1	31.97
Ethnic composition	Thakalis, Gurungs, Lobas, Tibetans	Gurung, Chhetri, Brahmin, Kami, Tamang	Newar, Chhetri, Brahmin, Tamang	Rai, Sherpa, Chettri, Tamang, Kulung, Kami, Magar
Agro-ecological zone	Western Mountain	Western Mid-Hill	Central Mid Hill	Eastern Mountain
Total VDCs	16	61	16	34
Total Municipalities	0	0	2	0
Total Household	3,354	42,079	68,636	23,785
Total literacy rate	66.2	71.1	81.7	64.2
Female Literacy	46.9	63.3	72.7	55.7
Human Development Index-HDI*	0.508	0.507	0.573	0.502
Human Poverty Index-HPI*	31.2	27	19.4	32.5
Gender Development Index-GDI*	0.368	0.344	0.377	0.396

Source: Central Bureau of Statistics (CBS), 2011, * HDR 2014

23 Data collected by DHM/GoN shows increasing trend of average annual temperature in Bhaktapur and Lamjung. The annual average rainfall trend in Bhaktapur, Solukhumbu and Lamjung does not show any significant change but shows increasing trend in Mustang though statistically not significant.(See Table 3).

Table 3: Climate data, variability and vulnerability of the case study districts

Districts	Temperature mean max - min (0C)*	Annual precipitation (mm)*	NAPA vulnerability index**	Mean annual rainfall trend (30 years)***	Mean annual temperature trend (30 years)***
Bhaktapur	18.8 – 10.4	2000	0.886 (Very high)	No significant changes (p-value = 0.589)	Increasing (significant, p-value = 0.031)
Mustang	17.7 – 6.0	312	0.559 (Moderate)	Slightly increasing (p-value = 0.249)	No significant changes (p-value = 0.087)
Solukhumbu	N/A	N/A	0.725 (High)	No significant changes (p-value = 0.399)	No significant changes (p-value = 0.439
Lamjung	26.9 – 15.8	3372	0.948 (Very high)	No significant changes (p-value = 0.034)	Increasing (significant, p-value = 0.001)

Source: *DHM (MoSTE), 2012, **NAPA (MoSTE) 2010, DHM data analysis /ISET-N/IDS-N

3.2 SOCIO-ECONOMY AND CLIMATE PERCEPTIONS OF RESPONDENTS

24 For generating qualitative information Focus Group Discussions (FGDs), Key Informant Interviews(KIIs), and observation tools were used; and for quantitative data, semi-structured questionnaires for housheolds interview were used. Field information on socio-economy and climate change perception was collected through four district level workshops, six VDC level FGDs, 22 KIIs and survey of 24 households. The analysis is presented as follows.

25 Among 124 people consulted, 93 per cent were from Janajati (indigenous) communities. Among the total case respondents, 90 per cent were native to the study area and 10 per cent were migrants. Most of the household had agriculture as primary means of livelihood while few depended on service and trade/business (Figure 2 & 3). Vulnerability perceived within the community setting was assessed to visualize the exposure of households to extreme events.Only few respondents felt that they were at more risk due to climate change impact than their neighbors, indicating that each community perceived collective risks and vulnerability (Figure 5).

26

27

Most of the respondents did not feel that climate change had differential impacts on men and women. Few felt that women were affected more adversely than men. Responses from FGDs and KII illustrated the gendered roles and responsibilities both in the governance system of ITSI as well as in access to benefits. Consideration of insecurity included higher work hours, less access to food and nutrition and disconnection from social network.

Figure 2: Diversity of respondents

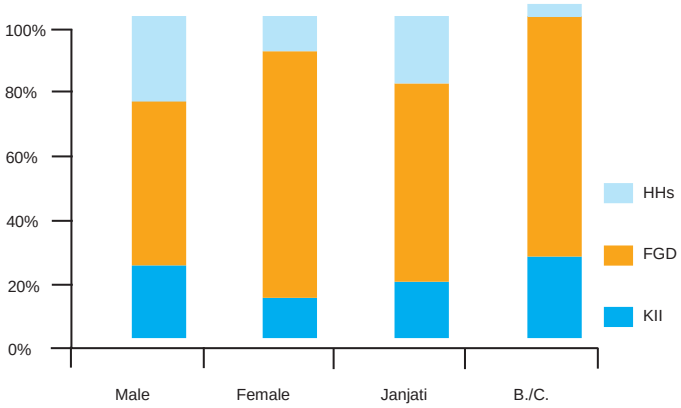


Figure 3: Occupation of respondent HHs

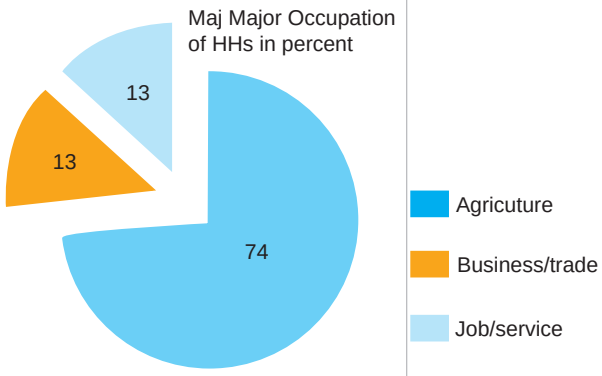


Figure 4: Food sufficiency of respondent HHs

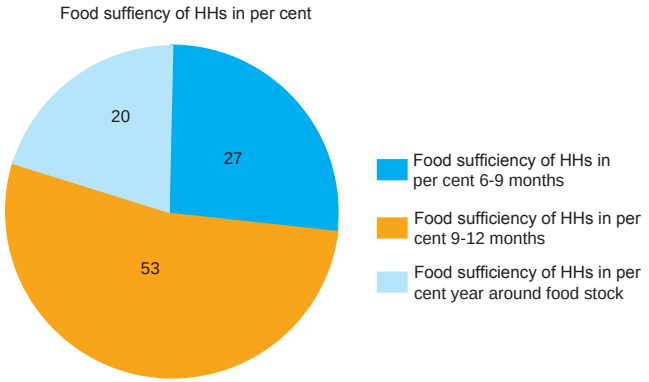
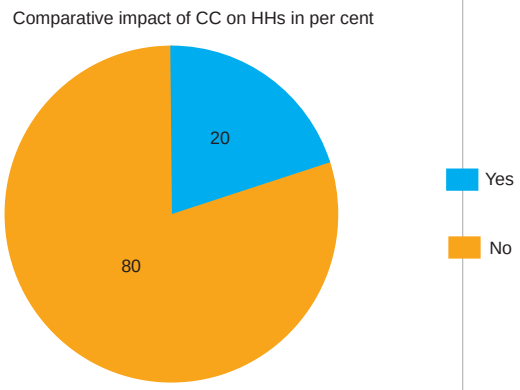


Figure 5: Comparative impact of CC on HHs



6.4 CASE EXAMPLES

6.4.1 Case Example 1: Guthi system of Newar Community

28

Newars, a prominent resident group of Kathmandu Valley, are urban indigenous people. The Guthi (derived from 'Gosti of Sanskrit meaning meeting or consultation), which occupies a prominent place in Newar society, is a loose association for social network with hereditary or voluntary membership (called Guthiyars in local dialect). The membership of Guthi is open to its clan/caste members only. The origination of Guthi system is not known. The respondents in this study presumed that the some

form of Guthi in the 5th century. The respondents presumed that origin of the Guthi was Shi Guthi to make participation of family and friends to perform last rituals of deceased family/clan member obligatory.The Shi Guthi started when settlement began in Kathmandu.

29 Guthi system has jurisdictional, social and festive functions and been associated with a kind of land tenure system, religious and philanthropic endowments, foundations, trusts and oil-processing cooperatives (Messerschmidt, 1981). Different types of Guthis exist depending upon the purpose, mostly to perform rituals or part of rituals of some deity: Sanah/Shiguthi is related to death rituals, Jatraguthi (conducting cultural celebrations), Dhal halne Guthi (construction and maintenance of sewerage), Lingo Dhalne Guthi (felling the culturally erected wooden pole for specific rituals), Dewali Guthi (worship of the clan deity), Nasa Guthi (music) and so on. Every Newar household voluntarily becomes Guthiyars (based on clan, lineage or territory) of one or the other Guthis, often of multiple Guthis, each headed by headman (Thakali in local dialect). Once a family starts its own kitchen, it is entitled for the membership as per the set criteria for membership (within the kinship of Guthiyars, take membership, accept and obey set criteria of Guthi, Give *bhoj* (or feast) in the first year and when one's turn comes, be active in Guthi's activities, do the Guthi work in one's term) and after depositing fees. If members violate Guthi's norms and values they would be denied of services, forgo participation rights and sometimes even face social boycott as an extreme punishment. Large and important Guthis hold considerable amount of land. In Bhaktapur different Guthis managed irrigation canals, water supply system, community buildings and temples.

6.4.1.1 Evolution of Prajapati Guthi System

30 The information collected through one FGD, six KII and five interviews reveal that the Prajapati community (Clay potters-Kumhale in local dialect) is a homogeneous clan. Their main occupation is agriculture, pottery making and local trade. They maintain strong communal ties and are well off. The Prajapati Guthi bound to Prajapati caste is believed to have originated with Taleju Bhawani Temple, as Shi Guthi though documented record put the date as Nepal Sambat 747.Prajapati Guthi's main function is to provide clay for casting Nawa Durga (9 goddess) during worships, clay pots and utensils to the goddess Taleju Bhawani during Dashain, Bisket Jatra, other worships and rituals of Bhaktapur.

The pottery square exhibiting ITK and skills of Prajapati Caste

Naike (elected through seniority) takes all decisions of work distribution and management, allocating assignments, membership and change of turn of the Guthi.One "Mukhute" (for handling the store), and two to three helpers assist the Naike. Thakuli (manager) assigns responsibilities of the Guthi function to each member family in rotation. Financial resources generated from membership fee, Guthi land and

savings are managed by member/team. Members contribute additional resources if needed. Women are neither allowed to perform rituals, nor take any responsible positions in the Guthi. They are invited only to take part in feasts. This practice is reflection of the presence of gender differential in the community.

As the clan expanded, assets like land and cash were donated to the Prajapati Guthi for performing rituals, thus, increasing its resource base. Rapid expansion of Guthiyars resulted in five sub-Guthis each with 50-112 Guthiyars for improving management of the Guthi. In 1993 an effort began to integrate the Guthis and materialized in 2003. That year Mulguthi or integrated Guthi named Hakujhya Prajapati Guthi was established a management committee with 11 members (10 selected members represent 5 Prajapati Guthis), The Guthi is responsible for managing assets and maintaining the norms and values of the Prajapati clan.

6.4.1.2 Community perceptions on Climate Change Vulnerability and Impacts

The respondents perceive changes in both environment as well as climate. They felt that temperature has increased and rainfall has become more irregular than in the past. They cite that Maghejhari (winter rainfall) as one example. The winter rains, they suggested has become irregular and brings less amount of water and snow. They suggested that fishes in the local rivers have vanished; snakes are non-existent; and yield of soya bean, chilly, and cucumber reduced decreased.

6.4.1.3 Indigenous and Local Knowledge Practices in Guthi Systems

Traditionally Prajapati people were involved in making clay pottery as source of their livelihood. Most of them live in Talako Tol (referred as Kumal Tol/Pottery Square) and earn their livelihood by making clay utensils using local clay, pottery wheel, coloring and polishing chemicals made from environment friendly local materials. Most of the works were performed manually but with availability of electricity, improvements been made and electricity operates the wheels. This innovation has eased the task of making pottery and also attracts tourists visiting Bhaktapur.

The Guthi guards, conserves and updates traditional rituals and cultures, such as organizing regular *bhajans* (carols), maintains the patis (resting sheds) within its jurisdiction in Surya Binayak temple, Jyatha Ganesh temple, and Guthi ghar once a year or as the need arises. The Guthi thus uses traditional knowledge that is continuously updated over time to govern itself.

The structure of its governance fosters a sense of community ownership, puts decisions in the hands of an experienced person to maintain credibility of the institution. The Guthi has been instrumental in discussing and leading ways for sustaining social capital, as social, economic and environmental systems experience changes. It facilitates collective effort to build community relationship. The Guthi also provides support for constructing and maintaining local infrastructures. The credibility and trust of the local community on Guthi can be harnessed creatively to meet local adaptation needs. One such measure is promoting the use of climate friendly clay potteries. They can be promoted as climate friendly pots in roof top gardens in Kathmandu that is becoming popular among urban dwellers.

6.4.1.4 CC Adaptation Issues and Challenges

37 The members of Prajapati community face many challenges including that due to climate change though Guthi is not directly affected by climate change. The way the Guthi has responded to other challenges provides lessons that can be useful in designing climate adaptation solutions.

38 One challenge the community faced was crunch of wood from suitable trees for erecting lingo, chariots and for performing rituals and renovating old monuments. The forests that grow suitable trees were handed over to local communities for management and access is limited. The Guthi responded to this constraint by planting specific tree species (Pinus Rusvergai) in a community forest area in Makawanpur District to ensure regular supply.

39 The other challenge the Guthi faces was in obtaining suitable clay for making pottery, as the availability of clay field in Sipadol in the neighborhood was becoming scarce due to urbanization. Not only lack of clay is a problem so is consumers preference for cheaper, less fragile but less environment friendly plastic pots. Though the Guthi's leadership in designing varieties of potteries to cater to market needs much deeper efforts needs to be made to promote clay potteries for gardening and decoration needs.

40 Rising cost of living has also demanded changes in traditional practices. Respondents shared that in the past they celebrated annual rituals for 30 days spread over a year. For the members the cost of maintaining this practice was becoming a burden and so was the cost of maintenance of infrastructure. Income from fixed asset and other source of the Guthis were not enough and guthiyars were less motivated to participate in Guthis activities. Faced with these challenge the management committee, which has the responsibility for introducing changes, consulted all the Guthiyars to find ways to deal with the issue of rising cost. A decision was taken to shorten the celebration to 10 days. This decision has relieved guthiyars from eating into their savings to meet cost of conducting rituals.

41 The three examples demonstrate how the Guthi's decision making capacity to frame clan specific norms helped them adapt to new challenges. Such capacity can be creatively used to design climate adaptation solutions.

6.4.2 Case Example 2: Economic Management through Dhikur of Thakalis, Lobas and Gurungs

42 The Thakalis, Lobas and Gurungs (also called Tamu) live in the in the mountain region of west Nepal. The information generated from 2 FGDs, 7 KIIs and 5 households in upper and lower Mustang had mostly janjatis (Gurungs, Thakali and Loba) participants. They speak Thakali, Loba and Nepali languages and follow Buddhism as their religion. The respondents were mostly agriculturists (87%) with few pursuing business and trade (13%).

43 They enjoyed some political autonomy and maintained a unique culture and traditional practices that shaped a self-sufficient lifestyle. The forefathers of Thakalis and Lobas were traders who earned their livelihood from trade across desert like

mountain landscape and along the ancient salt route between China and India. The forefathers of Gurungs practiced trans-Himalayan trade but gradually they began joining the British and Indian armies. These groups established Dhikur or Dhukuti (literally meaning a storage box for valuables or food grain) as a financial self-help strategy akin to an informal banking system.

6.4.2.1 Evolution of Dhikur System

Dhikur (in Thakali language) or Dhukuti/Dhikuti (in Nepali language) is a voluntary rotating credit arrangement that has sustained for centuries. Even today the practice continues to expand and used. Working as an informal banking system, the arrangement provides capital for merchants and farmers increasing their accessibility to financial resources. The practice started with the collection of food grains during the bartering period (when cash transactions were limited) to support the weakest member of the clan for subsistence in the aftermath of shocks or stress on livelihood. In recent times it is enacted to generate capital for those in need.

6.4.2.2 Indigenous and Local Knowledge Practices in Dhikur Systems

This practice began as a mechanism for dealing with financial difficulties that some members of the clan faced. Traditionally, relative of an individual who desperately need capital for specific activity becomes the Ghopa (coordinator) and seeks interested relatives, other community members to raise capital. A *jamani* (Guarantor) functions as collateral to initiate the system. Ghopa is responsible for all management tasks (inviting members, calling meetings, keeping records, collecting installments, distributing the fund, collecting fines and settling disputes) and for making Dhikur a success.

The group meets at specified interval for collecting each volunteer's shareand the total amount is allocated to members, in rotation starting with most in need (organizer-Ghopa). The order of individual who receive support is decided through lottery, open bidding, or closed bidding. The persons getting funds pay interest (shikuin local dialect) but interest rate is low compared to profit made after its investment. After the turn is completed, the Dhikur group automatically ends. Size and amount of a particular Dhikur are fixed, but varies between different Dhikurs.New constellations of Dhikurs with new members are created continuously and the system repeats itself.

Nowadays Dhikur is used for other purposes and may include large amount of cash for investment in trade and business. It is estimated that the volume of transaction through the informal Dhikurs comparable with credit card system exceeds that through regular banking system. While the Dhikur system is informal and based on trust, the credit system is formal and based on high-tech system (Bhattachan, 2002). The Dhikur still serves as a means to overcome social stress and shocks; and in the particluar rural communities, it is a source of credit that can be adopted to respond to stress imposed by climate change.

6.4.2.3 CC Adaptation Issues and Challenges

Dhikur was and is initiated for subsistence support for the weaker clan members. It started during barter era to support the economically weakest of the clan. Initially, it was carried out with available economic products, i.e. grains and sometimes

livestock. As all of the original three clans mentioned are business people, this system was slowly used for resource mobilization. Although huge transactions are made through this system nowadays, it is still used to support those in dire need. A criterion for being recipient of the support is that the person should beaffected by extreme events. In Ghalegaun, Lomanthang, for example, respondents who had lost homes or land in landslide said they used funds collected through Dhikur to build their houses and buy new land. It is enacted only to meet someone's need and can be accessed even in remote area. The shift from use of grains to cash transaction reflects evolution of Dhikur as an informal financial institution but new knowledge and legal governance would be necessary to make it a more formal entity. The Dhikur system is losing its main goal to help the needy for the recipient's subsistence, support to overcome financial and environmental stresses and turning into an informal and risky finance mobilization mechanism for meeting trading needs. The social welfare and equity consideration is being diluted.

6.4.3 Case Example 3: Governance in Mukhiya system of Thakali and Lo-bha Community

49 Mustang is the former kingdom of Lo, which followed Tibetan culture; and Thak khola which followed a fusion of Nepalese and Tibetan culture. Both communities are involved in trade, tourism and animal husbandry. Mustang is rich in culture and tradition, and apart from Dhikur, Amchi (person practicing traditional medical) system, Mukhiya (village headman,Dhongba/Ghempa in local language) system for governing community, Monk, Aani for religious purposes are unique native practices of the area.

6.4.3.1 Evolution of Mukhiya System

50 The Mukhiya system is in practice since historic times (1750 to 1760 A.D) (AIPP, 2007) in upper, mid and lower Mustang. Local differences based on geography and castes do exist in these systems. This traditional local governance system during Rana regime was adapted to collect tax for the king and the Mukhiyas acted as the judiciary unit for resolving local conflicts.After the end of Rana regime the system resumed its historic role of local governance and is operational today in 91 villages.

6.4.3.2 Indigenous and Local Knowledge Practices in Mukhiya Systems

51 In the three villages (Tiri, Kobang and Lomanthang), Mukhiyas are selected rotationally among the *samaj* (community) for a specified time. Their responsibility includes well-being of the village, maintaining cultural norms and values, maintaining law and order, administering punishment and reward, performing rituals, coordinating with external agencies, maintaining and regulating agricultural practices, governing use of pastureland and greenery, and managing other stresses as needed. In Tiri village, the Mukhiya is selected for one year (only 1 male is allowed) butin Lomangthang only Bistas are allowed to be Mukhiyas (1 male or female).The Lomanthang Mukhiya is assisted by two Mitis chosen among the wise and the witty; one as a legal advisor and the other chosen by the king (though dethroned by the government, people still give him the respect and some authority in all informal institutions) and 6 "Chhimeas" are selected from the Gurung clan for a one year period. The Mukhiya makes his/her decisions based on discussions and

consultations with the community and advisors. Unsolved issues in Lomanthang are presented to the king who suggests resolution.

52

The thirteen villages of Thak khola area (divided into 11,8 and 6 regions for effective and efficient administrative work) has a council of Mukhiyas (the thirteen villages each have 1–man or woman Mukhiya and the tenure is not defined) lead by Mir Mukhiya (selected from consensus among the 13 Mukhiyas), and supported by Upamir-Mukhiya,Tabil-Mukhiya (secretary who records all trials), and 10 members Mukhiyas. Kobang Mukhiya, being central to the Thakali communities plays the secretariat role, and keeps the records (one key each with Mir and UpamirMukhiya). The Mukhiyas are supported by Kundals (two or more selected in turn among all households of the village as messengers). Each Mukhiya, individually or collectively uses power to regulate economic, social and justice system in the region. A compliant passes through several stages: appealing in the written form to the village Mukhiya who resolves the issue. If the plaintiff is dissatisfied with the decision, an appeal is made to Mir-Mukhiya. If it does not reach resolution even then, the Dharmashava (holy assembly) organized to resolve the dispute. This justice system is still accepted and obeyed by all (none of the indigenous Thakalis has approached the government legal system in this area till date)(AIPP, 2007).

Indigenous traditional household products from upper Mustang

6.4.3.3 CC Adaptation Issues and Challenges

53

This governance system is adaptive to ongoing changes. The Thak khola Mukhiya committee abolished some impractical cultural norms like compulsion for the middle son or daughter to be a monk, aani or juma. This was brought into effect in 1956 A.D respecting the right of an individual to take decisions. Another community demand was met by deciding to decrease the mourning period from 59 days to 13 days and then further to 7 days in 2000 AD as time constraint and high economic cost. These decisions increase social and financial capital of the households leading to reduced vulnerability and increased capacity to deal with stresses. The committee also discusses extreme events, coordinate for fund raising and enact preventive measures for preventing bank erosion by Kali Gandaki River. The Tiri Mukhiyas were most active actors in the rescue work, coordinating rehabilitation process, approach and channelize external resources during flash floods last year. This step suggest that people rely on this institution for information and establishing linkage with external actors

54

Pastureland, forests and the protection of the local environment falls under the jurisdiction of the Mukhiyas and one of their major responsibilities is land management in their territory. They set up norms and seasonal calendar for the opening, closing

and shifting of pastureland and access to forest resources. Herders from within and outside the community have to pay tax in the form of “Shefal” (a goat or a sheep for community members, two for outsiders for using the pastureland) to the Mukhiya or the village council. The Mukhiya/council decides which pastureland would be open when and who can have access to the land. They can set fine the herder for not moving the herd in the right time to the right pastureland. It is an independent and self-sufficient system to regulate and manage forest and biodiversity. This system can play constructive role in reducing forest and pasture land in degradation of ecosystem and biodiversity. Such efforts can increase greenery reduce deforestation and minimize water source depletion. This ITSI uses ITKP for regulated access to resources and ecosystem services that support the livelihoods of poor and indigenous communities. In addition, it creates space for use of pastureland so that that sufficient green grass is maintained and ponds dug to maintain balance between demand and supply of water.

55 The power exercised by the Mukhiya in the community is more or less same as the local government system though the formal government system does not recognize, accept and accord role to the traditional arrangement. The effectiveness of adaptive action can be increased if Mukhiyas are made aware and mobilized for local adaptation activities. Infact they are already involved in activities like river training, source protection, establishing law and order for biodiversity management, and other development works. They need scientific knowledge to plan their work and manage local resources in a sustainable manner.

6.4.4 Case Example 4: Amchi System of Upper Mustang

56 Mustang is also known as the district of Amchi and Gumbas. Amchi is the name for a doctor practicing Tibetan medicine. This practice is also identified by the name Sowarigpa, which means “science of healing” in classical Tibetan. This system of healing is still respected and trusted in Mustang and other communities influenced by Tibetan culture.

6.4.4.1 Evolution of Amchi System

57 A spiritual practice of Amchi (practitioners of the Sowaripa medicinal tradition) system of medicine has been flourishing since historic time (some Amchis track its origin before Buddha: circa, 500 BC). More realistically, it is presumed to have started in between 7th to 12th century A.D.This system of medicine is based on spiritual practice evoking the fundamental medical treatise, the Gyushi or four Tantras (Lama et al. 2001) using local herbs for medicines and combining science, art, philosophy and religion; each element is closely dependent on others.

6.4.4.2 Community perceptions on CC Vulnerability and Impacts in case settlements

58 The respondents of all three villages felt that in the last 4 to 5 year things have changed: flash floods are frequent, frequency and intensity of rainfall has increased, while fruit and crop productivity decreased. The people of this semi-arid climatic area lived in cold and dry weather and shaped their living conditions accordingly.These changes mentioned above have led to new impacts on their lifestyle and livelihood.

The local inhabitants, for example are forced to change their house structure. Higher intensity rainfall is damaging traditional mud roof which also kept the room warm. Now people use CGI sheet, concrete or stones as roof materials. Likewise, apple orchards have replaced maize and walnut fields. It is however, not easy to attribute these practices to climate change: other factors such as improved mobility with road connection, commercialization of agriculture and so on also play a role.

In other areas, drying up of water sources has led to drinking water scarcity. Most respondents thought that it is not only increasing drudgery but also forcing entire community in Dhea, Samzong and Yara to move (Bernet et al., 2012). Flood events, previously unheard in villages like in Tiri (2013) and Kagbeni, are affecting many households in recent times. Increase in temperature has resulted in decrease in snowfall. Shorter period of snowfall and deposit on slopes has decreased availability of water. This process in turn has lowered productivity of crops like buckwheat.

Similarly, the flora and fauna have witnessed changes. The southern regions of Mustang such as Lete and Marpha, were famous for apple orchard but now fields there are being turned into walnut and maize farms, while apple orchard are moving to higher elevations, indicating rise in temperature. Similarly, production of crops and vegetables has shifted towards higher altitudes. Due to over harvesting, lack of awareness and change in temperature, medicinal herbs are either more scarce or are only found further in the wilderness. Some herbs like Upal, Parbata, and Khurmang have almost become extinct. Depletion in grassland due to overgrazing and uprooting of bushes (Caragana and Lonicera) for firewood are impacts of unsustainable resource management practices leading to dust storm and landslides.

6.4.4.3 Indigenous and Local Knowledge Practices in Amchi Systems

This traditional medicinal practice is well known in the areas influenced by the Tibetan culture including upper Mustang. This ITK is currently being fused with scientific knowledge and developed into formal educational course. This ITK is gaining popularity along with nationally and international acceptance and recognition.

This knowledge is transmitted from father to son and from teacher to pupil. The education of Amchi begins in his/her early teens when the student learns to identify medicinal plants: highlands in summer and lowlands in the winter. They start treating the patients only after 4-5 years of study. In recent times this knowledge is being formalized as a course within the formal government system through Lo Kunphin School for Amchi Education (established 13 years ago). The school provides education to students in Sambhuta Script up to 8th class. Further 3 years course is necessary to qualify as Community Amchi, and additional 3-year course for Durappa (assistant Amchi doctor).Three more years of study would make the aspirant Kapchupa (Amchi doctor) but this level of education is not available in Mustang District. With recognition and acceptance, Amchi knowledge is learned and researched by increasing number of students since 2010. Currently 56 students (both men and women) are studying in this school, 34 of them are in Lomanthang and the rest in higher Amchi School in Pokhara. Previously very few women used to venture into this profession, but majority of students in Lo Kunphin School are girls. If the monk is an Amchi, the medical knowledge is also taught in Monasteries.

64 This model of health system reflects holistic approach to treatment in which the sick is treated physically, emotionally and spiritually. The payback is in the form of contribution in cash, kind or only thanks. No fixed amount is charged. The system plays a crucial role not only in curative but in preventive medicine, which is evident from the emphasis given to water cleanliness, good diet, and healthy practices.

6.4.4.4 CC Adaptation Issues and Challenges

65 The respondents shared that they have to travel farther to collect medicinal herbs due to over harvesting and change in climatological conditions. They felt that some herbs are getting extinct. Climate change, they felt adds new stresses. They provide examples of how climate change is affecting *Amchi* practice. Some of the impacts are change in ecosystemsthat produce medicinal herbs, emergence of new diseases and disturbance in the relationship between human physiology and physical environment. On the brighter side, communicable diseases like diarrhea have decreased and hygienic practices of the population of Mustang District have improved. Yet tradition did and continues to play a major role in wellbeing of the community as well as in the preservation of local flora and fauna. The Sowarigpa's holistic approach to healing and understanding of total health as a relationship between mind, body, sprit and the physical environment recognizes their direct relationship with the environment. The Amchis are active in making people aware regarding sustainable harvesting of the medicinal plants. They lobby with the government agencies for their commercial production as well as conservation not only for securing the raw materials, but also maintaining one of the basic elements of their practice: the physical environment.

66 Changing social, economic, and cultural circumstances, and dearth of traditional institutes of learning of Tibetan medicine have contributed to the decline of Amchi. Lack of interest of the younger generation towards sustaining this practice further contributes to the decline.

6.4.5 Case Example 5: Women Empowerment in Aama Samuha of Gurung Community

67 The Gurungs, known for bravery and tradition of music and culture, are also well known for their rich food recipe, hospitality and institutions such as the Rodhi. Ghalegaun (Uttar Kanya VDC) and Khasur (*Banja Khet*) are two prominent traditional Gurung villages located in the Northern part of Lamjung District. These two villages are changing from agriculture-based livelihood to hospitality and tourismbased livelihood, and are popular for home stay programs and traditional lifestyle experience for the tourists. Aama Samuha (mothers' group), a unique cultural ITSI managed by married Gurung women has sustained in Gurung society of Lamjung District.

6.4.5.1 Evolution of Amma Samuha

68 The *Aama Samuha* emerged to meet needs of social welfare management, socializing, entertaining and organizing cultural activities. Since last two centuries majority (80%) of Gurung men of this part of Nepal join either British Army, or the Indian Army. The status of women in Gurung society is higher and lead to womens

empowerment and their leadership is accepted.This institution is believed to have evolved from the necessity to face the hardships of natural resource based livelihood.

6.4.5.2 Community perceptions on CC Vulnerability and Impacts

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The respondents of Ghalegaun have experienced climate change in terms of decreasing snowfall (few years ago snow would be 2-3 feet thick) and increasing hails and winds. They believed that occurrence of hail and wind will be less when snowfall is on time. They reported that seasonal calendar of crop plantation has been shifted forward by about two weeks.The villagers have fewer livestock due to labor crunch. The economic benefit from the livestock is lesser and in manure is low. This later context affects agriculture productivity. They also face depletion of water source. These changes have affected agro-based livelihood. Additionally migration of men has propelled them to explore other means of livelihood. With support from programs such as Annapurna Concervation Area Project (ACAP), and through Amma samuha most of the community are changing their livelihood to hospitality and tourism.

6.4.5.3 Indigenous and Local Knowledge Practices in Aama Samuha

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The Gurung community of Khasur and Ghalegaun plays a key role in preserving cultural norms and values as well as in maintaining ethnic bonding for building social, natural, human, financial and physical capitals to sustain their livelihoods. The community is known for their traditional lifestyle and typical roundhouse (only three remaining) in Ghalegaun and one in depleted condition in Khasur. Mostly Ghales, Gurungs and some Dalits inhabit the settlements. Around 80% of the villagers receive pension as most male are retired Lahures (employees in British or Indian armies) but hospitality and agriculture has fair share in local economy. The Aama Samuha enables married female to form small groups and plan, enjoy and earn. They also perform community-based works like parma (labor exchange), and cultural rituals. Income generated from the group is spend on buying goat for Loshar festival, institutional development and helping the needy (Gumba construction and financial support for flood affected people). The group maintains village streets, lead in cleaning and managing solid wastes. Regular meeting, registration in government

system, bank transaction and consensus-based decision-making are other tasks performed by the samuha.

71 Younger unmarried girls go to Rodhi for socializing and once they are married they join Aama Samuha. Women's access to financial transactions, assets and decision-making is high. They have been instrumental for the transition of agriculture based livelihood to hospitality and tourism based livelihood. Most of the houses (26 houses) in village have been turned into home stay places that are run by women.

72 Their main task is to welcome guests and returnee Lahures by organizing singing and dancing programs. The members earn their livelihood by hosting guests.The money thus collected is used to build trails, temples, etc. Accepted as one of the most universalized traditional voluntary organizations in Nepal, many INGOs and NGOs have promoted Aama Samuha across the country to meet different developmental issues and women empowerment needs.

73 This women only institution has been replicated in many development works like Drinking Water Supply Mothers Group, and Saving Credit Mothers' Group. These groups facilitate and support project implementation. They promote women empowerment. The community work is instrumental to address loneliness of living without husbands, support for livelihood and enriching social network.Women are not only considered as beneficiaries, but also lead many local initiatives. The traditional knowledge regarding women empowerment, promoting their leadership as well as singing and dancing is passed from mother-in-law to daughter-in-law. Every new member joining the group from outside the village brings in new knowledge while songs and dances add to knowledge diversity.

6.4.5.4 CC Adaptation Issues and Challenges

74 The changes in climate affect agriculture, which is the mainstay of local economy, decreasing productivity. In the studied cases, the village women suggested that they would prefer less labor-intensive income generating and livelihoods that uses their skills. This institution, initiated by local women to help them adapt to their need and is now playing an important role in development and maintaining the hospitality and tourism initiative. Both villages are promoting these options in partnership with ACAP and Government of Nepal. Thus developmental initiatives and collective working practices are being brought together. The shift has contributed to incremental resilience by decreasing their dependence on agriculture but entails new risks. This group, along with the community, have utilized their indigenous knowledge and improved traditional practices to conserve the ethnic culture (traditional lifestyle, cuisine, local products like radhi/pakhi), promote green and clean village, extend hospitality and enforce proper management and utilization of forest resources for improving livelihood.

75 Each year, the community decides to provide cash support to three persons in difficulties. The amount is decided through village council. Aama Samuha contributes cash and kind through the village council. This practice is called "Nogare"(labor group exchange), and for the first time support provided is NRs. 1,200, second time NRs.

2,400 and the third time NRs. 4,200. Attempts are made to cover all the cost the person would need. In 2013, Nogare of Ghalegaun provided support to a villager whose house had been swept away by landslide. The institution is also mobilized for disaster relief activities thus utilizing the traditional practice as a strategy.

6.4.6 Case Example 6: Forest Management through Nawa System of Sherpa Community

In the northern mountains of Solukhumbu District lies Khumjung Valley (275 households with 800 people). The valley had indigenous Rai communities who were replaced by Sherpas from Tibet migrating in search of better livelihood. The inhabitants are Buddhists who speak Sherpa and Nepali languages. Agriculture is the mainstay of this community and local products such as potatoes and buckwheat are sufficient round the year to meet local demands. Likewise, cauliflower and cabbage are also grown. All surrounding forests fall under SNP and Buffer zone arrangement. The Nawa institution is initiated and is being practiced here.

6.4.6.1 Evolution of Nawa System

Sherpas initiated the “Nawa System”, as a social institution to allocate and distribut, resources through controlled use of village land (pasture and agriculture) and forest for the purpose of agriculture and keeping of cattle. The traditional practice is sustained for more than 150 years to manage rangeland.

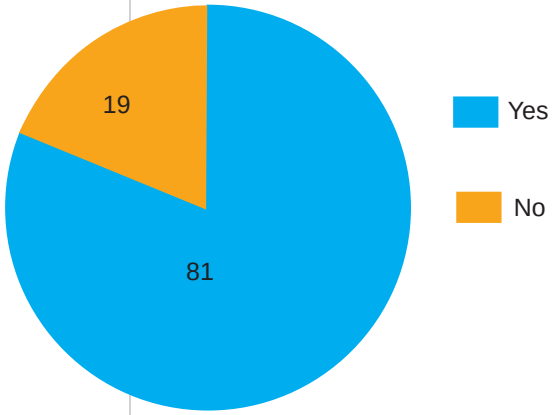
6.4.6.2 Community perceptions on CC Vulnerability and Impacts

The respondents reported rise in annual temperature and decrease in snowfall and increasing climate uncertainty. The increasing temperature lead to greater snow melt which they say is the result of climate change and results in more snowmelt. The instances of avalanche have increased. The recent avalanch in Everest region in 2014 (16 Sherpas lost their life) is one such example. They suggest that winds and storms instead of snowfall have increased but hailstones are few.The flowering and fruiting time of potatoes and buck wheat (phapar) has changed though the production is not yet decreased (rather increased). They attribute this change to decreased in fog. In one instance, landslide affected Khumle village and many houses and agricultural fields were destroyed. The ponds have dried up. Despite bring protected by SNP degradation continues and areas under forest decreased.

6.4.6.3 Indigenous and Local Knowledge Practices in Nawa System

Indigenous local people, contextualizing and adapting with the changes manage the Nawa system.The function of Nawa is to hold a balance between the needs of the Sherpas’ traditional economy and prevent carelessness of individuals that can damage the interests of other members of the community (Haimendorf, 1964) in resource allocation and distribution. Their governance system is democratic and inclusive. The Nawas are selected by a lottery system (only once) for one year. There is no gender bias and evey ward can participate. The former Nawa has no right to offer candidacy. So each member households get turn in each rotation. These are of two types; Osho Nawa and Shingi Nawa (Shingi is for timber or wood and Nawa stands for people who look after forest). Osho Nawa’s responsibility

Figure 6: Membership in social organization



is to coordinate the villagers' agricultural activities and to prevent damage to crops. Shingi Nawas are responsible for NRM but also look after agriculture and livestock management.

80 With villager's consensus the ITSI decide on norms, timings and sequence of rangeland for grazing and forest use. It can be used to take measures to preserve grazing land or other natural resource that minimize erosion and increase resilience. The Nawa's in consultation with community enforcestrict rules of management. The rules include no entry to forest except in the 10 days allowed, no livestock in village during summer and spring. They provide tools such as rotational grazing, sequencing and coordinating the grazing time and seasonal calendar depending on social and climate condition, fining and punishing the violators. The rotation depends on altitude and season, the highest during summer, mid altitude during springs and lowest in winter. This practice provides each rangeland with sufficient time to regenerate. The financial resources generated from instituting fines are used in community development activities such as the repair of trails and tracks, and the construction of community structures (Sherpa, 1993).

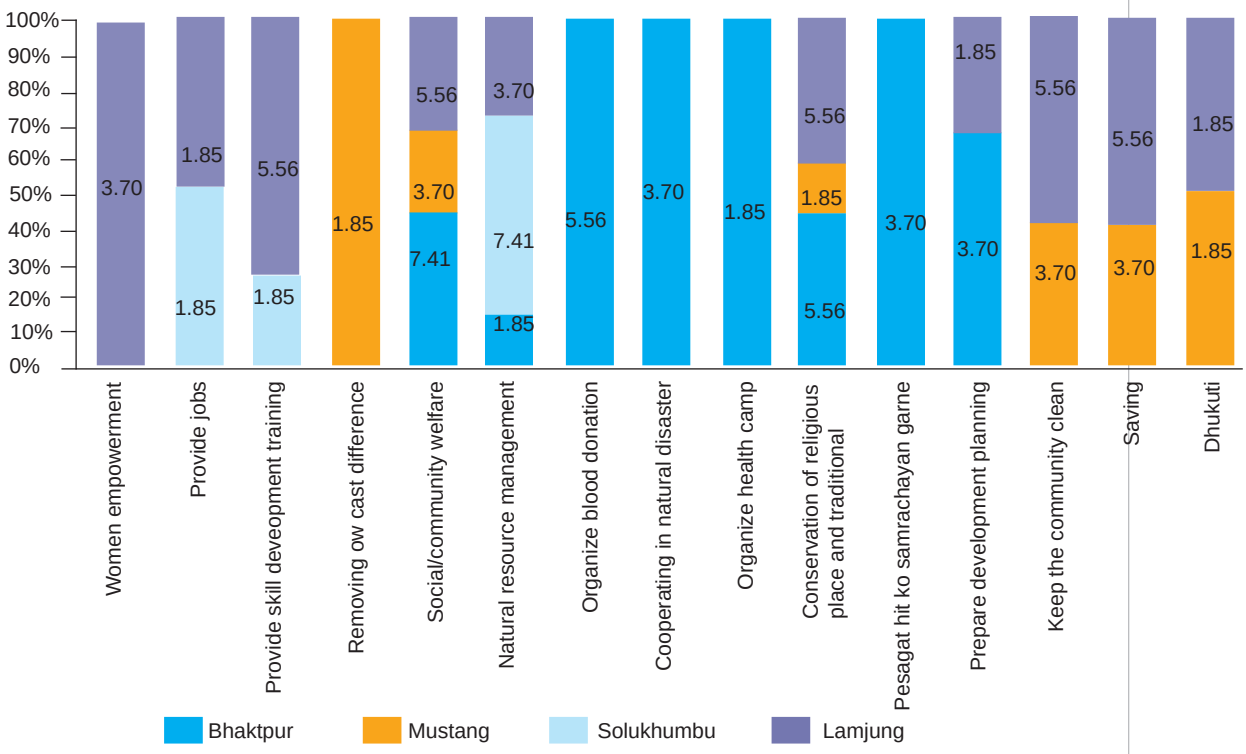
81 In line with their high status in community, Sherpa women are also selected as Nawa and are active in their roles. The coordination and cooperation between newly introduced initiatives and ITSI system for better forest and rangeland management is a good example of ILKP used for adaptation. SNP hires Nawa to help protect the forestland where Nawa gets remunerated for performing his/ her social responsibility. Thus SNP project outputs are delivered with the help of a local, experienced and knowledgeable ITSI. A mutually beneficial partnership between SNP and Nawa system produces win win outcomes.

6.4.6.4 CC Adaptation Issues and Challenges

82 Respondents reported shortage of drinking water and hay during severe winters. Despite the traditional management and SNP's facilitation the rangelands are being over exploited. Furthermore, uprooting of shrubs of caragana and other firewood has triggered degradation. Windstorm brings discomfort and is an issue that demands immediate action. Flash floods, avalanches (the 2014 base camp avalanche), landslides and GLOF are other threats. The community needs relevant scientific information to plan, prepare and adapt to these threats.The depleted forest and water source is under high pressure as tourism places heavy pressure on them. The Sighi Nawa has enacted stricter rules for use of forest product for year round fuel wood and animal litter collection. As context become more stressed due to climate change, strategies need to support such practices so that people can build on existing local instutions to deal with stresses successfully.

Figure 7: Activities of Social Organizations

Major roles and responsibilities of traditional social institutions



6.5 ANALYSIS OF CASE STUDY FINDINGS

6.5.1 Community perceptions

Information from interviewed HHs found that most rely on multiple social institutions for different aspects of their livelihood of all the 238 respondents majority are members of multiple institutions but few have not built any affiliations. The affiliated social institutions ranges from traditional organizations like Guthi, Dhikur, Mukhiya, Amchi, Gumba, Aama samuha systems to contemporary institutions like CFUGs, cooperatives, Nari Samuha users groups, Farmers Management Committee (FMC), School Management Committee (SMC),youth clubs, Social Service committee, community library, and so on traditional or contemporary social organizations have become an integral part of their lives. Most of the contemporary institutions are legal and formal entities registered under the government system as Community Based Organisations (CBOs) with organizational statute, finance and management procedure. They are enacted for implementation of development initiatives supported by GoN, development partners or by the civil society and private sector.

83

The socio-economic context of the community varies. In Lamjung, apart from Aama Samuha, membership in Gumba, Guthi, Dhikur and School Management Committee are higher. Bhaktapur respondents were more affiliated to cooperatives and social service committees in addition to Guthi. Similarly, in Mustang, the

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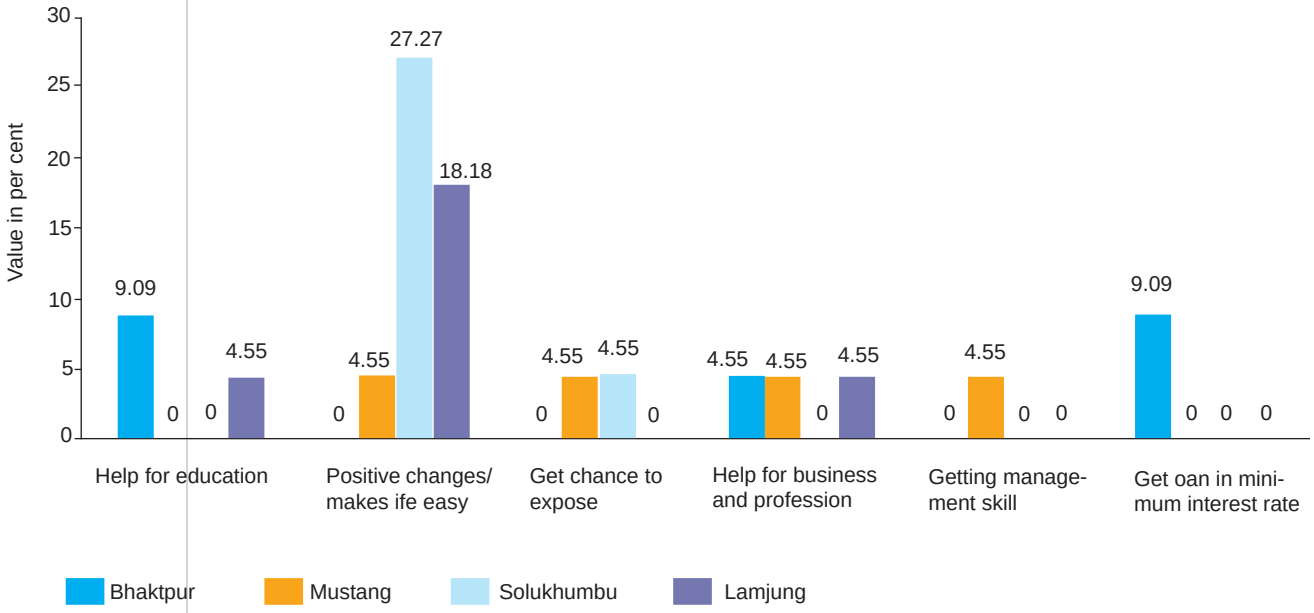
Figure 8: Perceived impact of ITSI on livelihood



respondents governed by the Mukhiya system were affiliated to multiple institutions; Aama Samuha, Gumba, SMC, FMC, ACAP, community library, and youth club. In Solukhumbu, SMC, and youth club prevailed followed by FMC and Nawa.

85

The study attempted to verifies qualitative findings of roles and responsibilities of studied ITSIs from executed activities; Aama Samuha's major activity were women empowerment, skill development training, community welfare (support in school building and disaster relief), conservation of religious places and traditional culture, keeping the village clean, and promoting the culture of saving. The Guthis aremostly engaged in social/community welfare, organized blood donation programmes, conservation of religious place/tradition/culture, prepare and implement development plan of their Guthi, and operation and maintenance of temples and community shed. The Khumjung respondents managed their forest, provided jobs and skill development trainings. The respondents from Mustang were more involved in social/community welfare, awareness raising on inequality between castes, keeping the village clean, and saving through Dhukuti. The overall responses show that social/community welfare is the major task, followed by natural resource management, conservation of religious places, tradition and culture, hygiene, saving and providing skill-based trainings. The respondents perceive that the role of social organization varies widely from organizing health/blood donation camp to conservation/preservation of religion, tradition and culture (Figure 6 & .7). Many development works are executed, operated and maintained through or partnering with contemporary social institutions (users groups). It is more obvious in NRM as seen in forestry, irrigation, and drinking water systems (all community forests are operated and maintained through users' groups-CFUGs as in Madanpokhara, Bhedichock etc.; irrigation as in Argali, Sorah/Chhatis Mauja, Jaldevi Drinking water supply and sanitation committee systems of Bandipur).

The respondents had varied perceptions about impacts of climate change but all felt that the climate is changing. Most immediately concluded that days are getting hotter and rainfall pattern has become erratic with intense rainfall in short. Respondents from Mustang District shared that Jomsom is experiencing increased rainfall since last few years compelling them towards changing their roof from traditional mud roof (Munda) to CGI or cement. In Sollukhumbu District, people suggested that decrease in the duration of snowfall and less snow covers led to flash flood that lashed Tiri village and adjoining areas.

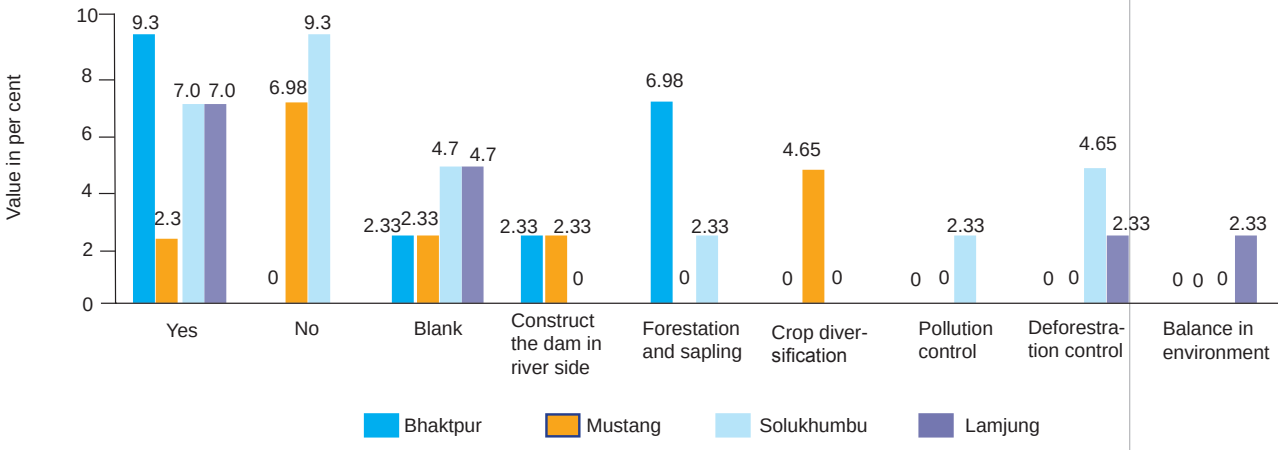
The respondents accepted that traditional knowledge is useful to adapt to climate change events, supporting their daily life, and enabling them to tackle changes around them. Support from ITSI ranges from increased access to low interest loan, help in agriculture/forest /farming (20%), cooperation in rituals and functions (17.1%), personal development, savings made easier, help in education (11.43%), and support in shocks and stress (5.7%). Similarly, respondents felt that the local institutions support has been useful. Most Guthiyars were facilitated for education and increasing access to financial resource for business promotion. For Sherpas and Gurungs life has been easier with TSI involvement whereas Thakalis and Lobas are getting increased access to finance, and personal capacity building through exposure and hands on experience. It is clear that ITSI have been instrumental in increasing peoples access to resources (financial, social, institutional, natural, and physical) facilitating them adapt to improve livelihood, decreasing vulnerability and built their builtcapacity. The knowledge and practices they have enacted for doing so has been generated and fine-tuned within the community.

6.5.2 TSI activities on local adaptation

The study further explored how people understood the relation between TSI activities and adaptation to climate change. Around 87% of the respondents were confident that IKP helped them to adapt to climate change events.

In response to pinpointing the CCA activities of ITSI the respondents shared that the social institutions have been helping them since earlier time to adapt with the

Figure 9: TSI support in CC Adaptation

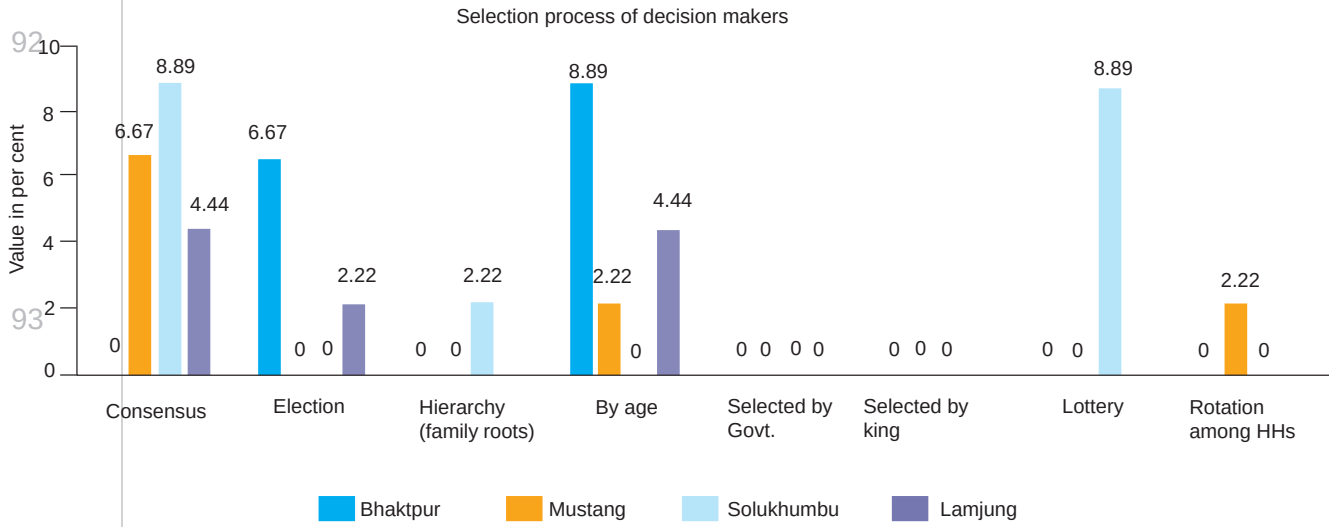


changes be it in social structure, cohesion and coordination, cultural and ritual traditions, managing the natural resources, social welfare activities, or recovering from extreme events. It was difficult for the to attribute the impacts to climate change, and they were not confident in saying how ITSI would help in climate change related challenge.Less than half respondents (45%) visualized ITSI helping role in adaptation, few could not visualize any relationship (29%) further 25% were confused to say either yes or no.

90 The respondents have experienced traditional institutions supporting the community in activities like river training, plantation, using climate resilient crop varieties (flood resistant, drought resistant), plantation on bare hills, conservation of forest and water sources, and support forrehabilitation in the aftermath of extreme events. Mukhiyas helped construct river training and diversify crops; Nawas helped in forestation, plantation and controlling deforestation; Aama samuha facilitated preserving forests and balancing the environment by conserving traditional lifestyle; and Guthi helped in forest regeneration and plantation.

91 The selection process of key positions was through three households criteria; clan/caste member, heredity or age and male. The Mukhiyas(male/female) in Lomanthang are selected from eligible households in rotation basis but only from Bista clan(the caste of former king of Lomanthang). Likewise, in Guthi system, the eldest is the Naike but the Guthiyar should be from the clan and they should be male.In Nawa system, the names of those who didn't have a chance earlier goes in the lottery box for being selected. The decision makers selected through consensus (Mukhiya system of Kobang) was 20%, by age (Guthi Naike) 15.6%, rotation wise among all households (Mukhiya in Lomanthang), hereditary (most Amchi are from lineage), through election, and by lottery (9% each). Findings suggest that traditional social institutions embody democratic principles and are manifested in power sharing and co-responsibility among its decision makers and members. Gender equity is not practiced in all cases, however.

Figure 10: Selection process for key posts by case example



The members of the committee (Mukhute in Guthi and Nawas) were selected by the following processes: around 32% from consensus, 26% by age, 21% by lottery and 11 % by election from people following the criteria mentioned. Selection of members of traditional institution or council takes different forms, but is always guided by the criteria of who is considered to be a good and a wise leader. The trend shows that governance is enacted either by mature, and experienced person whom the communities trust or rotation. Both of the modalities increase the ownership and credibility of the institution making it more dynamic.Furthermore, the decision makers always took after consultation with the community members. The findings show that ITSI are found in traditional or in contemporary form in all case districts and most respondents have experienced its influence in shaping their decisions.The practices are useful starting points for planning adaptation solution to climate change.

6.6 DISCUSSIONS AND IMPLICATIONS

The case study brings new information on scarce literature on ITK, ITSI and climate change nexus in Nepal (Bhattachan 2002, Agrawal, 2008; Sharma et. al 2009). It documents diversity of and influence of ITKPs that can contribute to enhance community's adaptation capacity. The study also documents diversified indigenous/traditional knowledge and practices streaming from social, geographical and ecological regions of Nepal. Many are instrumental in facilitating communities' adaptation efforts.

The long institutional development and capacity enhancement process of the Hakujya Prajapati Guthi, for example is noteworthy and suitable for replicating and utilizing local mechanisms for implementing new initiatives, specifically for adaptation. It's ability to learn, utilize the new learning for improved governance and transparency practices could be used for complimenting scientific knowledge with local experiences to develop adaptation strategies. The decisions are collective responses for community welfare and such practices can be harnessed to meet goals of building adaptation strategies to climate change.

Ownership demonstrated by members through kind and cash contribution is the additional silent feature for community mobilization. The clay potteries, which are climate friendly, need to find new niche to changing demand that roof top garden, in cities like Kathmandu.The awareness on caste and ethnic values has also prompted the people to conserve their traditions. To overcome the scarcity of tall trees for lingo, the community is engaged in planation of pinus species in Makawanpur with local CFUG helping reforestation and sustained use of natural resource.

Existence and use of Dhikur's informal self help finance system/banking system (in some remote village this is the only system available) has been going on since historic period to respond to various stresses. The system can be utilized as a tool in any local adaptation strategy. In Mustang, small farmers are using Dhikur for replacing house roofs and rehabilitating infrastructure after flash floods, thus helping to build local capacity to overcome shocks. Access to financial resources helps increase overall family resilience.

99 The Mukhiya system runs parallel to the VDC formal system of the government, legal system and forest management arrangement. It is effective in local resource mobilization especially in the pastoral community of Mustang. This mechanism needs to be recognized as a key mechanism in any management of natural resources proposed in the area. How well a community can adapt to external stress such as climate change depends on the quality of natural resources base and the service they generate. Sustainable management of natural resources is key to maintain quality is such services, which help in both adaptation and mitigation. Thus immediate action should be taken to conserve the local ecosystems and maintain interrelationship through provision of resources including financial and other support. Every village has it own 'Kharka" (pastureland) managed by the Mukhiya by mobilizing villagers according to season and altitude. The arrangement ensures sustained supply of local resources for their herds as well as earning sufficient sefal, a prerequisite for every village to perform yearly worship (sacrificing and feasting) for the clan deity.

100 Amchi knowledge is drawing international attention and funding, turning it into an attractive profession. In far-flung areas lacking accessibility to modern medical system, Amchi has been successfully catering to health needs. With its fusion with modern scientific knowledge, its scope to compliment has become higher. The healing approach of Amchi relies on interrelationship of mind, body, spirit and physical environment all four elements must be proper state, balance and harmony. It ensures the physical wellbeing of communities who rely on their surrounding environment and mental peace, Such qualities can help increase resilience to climate change impacts through better health care, stress free mind and healthier physical environment . The adequacy for raw materials of medicinal herbs which are difficult and expensive to acquire and often necessary to import needs government support for promotion.

101 Aama Samuha is a successful model of women empowerment through its tie with tourism. This shift in livelihood was adopted as an to agro-based livelihood that is sensitive to changes in climate, generates lower economic returns, is labour intensive and needs skills not available with community women. The new means of livelihood based on women's skill, less labour intensive, less sensitive to climatological changes and generates more income. These all contribute to decreased vulnerability and increased resilience of the female-headed households.Local conservation initiatives like ACAP and other development partners have used samuha as a support tool. The members of the samuha display extensive knowledge about traditional lifestyle and play a critical role in maintaining it. With the out-migration of males, women role has increased. While this may create new opportunity to get them greater role in local development, utmost care is needed to ensure that gender stereotypes are avoided and no additional labour burden on women is added.

102 The traditional indigenous practice of the Sherpa community has now been revived after being ineffective for several years. The practice was lost due to mismatch between of development interventions and local capacity. The establishment of SNP in 1976 continued thisdisjunction. The change in approach in 1981 provided space for complimentary etween traditional institutions and development initiatives. This

led to successful forest regeneration and revival of the local resource governing system. It created room for re-introduction of the forest guards system utilizing the Nawa practice accepted by Sherpa community. The fusion of these two systems is a noticeable example of successful approach to resources management. The lessons for adaptations are fundamental.

6.6.1 Gender equity, equality, and governance in ITSI

The findings of this study show that women's involvement in physically demanding activities such as irrigation canal building and maintenance (in Soraha Chatis Mauja and Argeli irrigation systems), suspension bridge construction, and trail and track improvement, mandatory labour contribution in Thak Khola Mukhiya system has been either completely restricted or constrained to mere materials hauling and support in providing refreshment. They are still excluded from religiously linked management activities like Guthi governance, due to misconceptions that women are weaker and inferior. In recent years, however, the government policy has mandated 33% women in all management committees and women have started raising their voice and participating in these activities as well but only to some extent. The examples are reflection prevailing gender inequality and will aggravate vulnerability to climate change their access to resources, mobility, culture, economic and social rights are restricted limiting their capacity to adapt. Excluding them from the decision making roles also deprives them of benefits that they could derive from their knowledge of local ecosystem and how such systems could be conserved. Overall gender inequity will prevent women from participating in NRM related decisions, as their views, skills and learning will be absent in resilience building strategies.

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Sometimes there are conflicting roles of women in ITSI. For instance, Mukhiya system in Kobang and Lomanthang utilizes women's vast knowledge in governance structure (women Mukhiya are normal) but prefer only male members during Jara. If a woman comes for Jara when the male is home, she will not be allowed to work in canal cleaning and in addition will be fined too. Women do participate in mandatory voluntary work when male members are absent or they are not able to pay the penalty. Women are discriminated against due to the characterization that they are impure during menstruation period or other reasons and so are not made part of the rituals.

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Women are an integral part of many ITSI. The Sherpa women's knowledge and skills shaped the growth of Nawa system. Nawa system does not discriminate based on gender and women Nawa are found to be more actively participating and taking effective decisions. This learning can be replicated in Mukhiya system and other NRM management initiatives for building resilience. The Gurung women take decisions not only to adapt by changing their livelihood option but successfully sustain and strengthen their Amma Samuha by choosing livelihoods that are less exposed to economic and climatic stresses. The model has been replicated in development of local infrastructure making it viable for CCA initiatives. In many cases women are less able to access the finances after shocks, making women headed households vulnerable to disasters. The Dhikur system enables men and women to share equal benefits. Without prescribed gender roles, women are also experimenting with

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Dhikur for their specific needs, for example a group of 20 women used Dhikur for purchasing gold rings, each adding their personal assets.

6.7 CONCLUSION, IMPLICATIONS AND RECOMMENDATIONS

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It is well established that social institutions articulate access to assets and resources to the local communities, which influence risks and vulnerabilities of the most disadvantaged. The role of social institutions as mediator for individual and community needs places them in a central position for effective adaptation to climate change.Their knowledge on how local communities responded to the environmental challenges in the past is a learning that can be assimilated with scientific knowledge to understand stresses imposed by climate change. The study provides the following key lessons:

a. Social institutions have been operating and governing their communities but they face new challenges. In all the social institutions, the problems regarding partial payment system based on voluntary donations needs to be addressed. They need to offer better incentives for people to encourage them to be involved. For example, a professional Amchi is paid voluntarily which is not an attractive livelihood option. Many of the institutions do not yet take advantage of all group members and are depending on the clan's eldest male. The young generation is losing faith in the ITS and no interest in traditional knowledge, social institutions and indigenous livelihoods. Due to the current economic lifestyle and male migration, labour shortage for voluntary contributions is increasing. The younger generation's attraction towards more scientific knowledge, modernization and modern means of livelihood has made wider social mobilization difficult than in the past. The decline in Amchi numbers from 30 to 7 in Mustang is due to a shift towards a more cash based economy, migration, and attraction of development programmes that undervalue ITK.
b. The availability, abundance and distribution of raw materials (like clay for Prajapati, water in Ghalegaun, medicinal herbs for Amchi, and Lingo for Guthi) have begun to diminish. Localized information of current and future risks is not available for improving the social welfare plans.
c. Advocacy and marketing of best aspects of knowledge is far and few. The practices are poorly understood, documented and used. The lack of recognition from the government has hindered not only the conservation and transfer of medical knowledge system but also rational and sustained use of herbs, which is basis for this practice.
d. In some cases, such systems have learned new ways to upgrade their practices as environmental shocks have stressed them. They discuss emerging constraints and propose way to deal with them, in turn develop the capacity of the beneficiary communities to respond to those constraints. The traditional Hakujya Prajapati Guthi has attempted to upgrade itself to keep pace with modern times. The Dhikur's life span is normally based on a person's credit need and its cessation, but now it is also used to manage larger funds. Aama Samosas have enacted

more users group/credit group norms but this is still informal. Amchi system is being upgraded into more legal entity by linking it with schools and accredited courses.

e. The ITIS are informal and their capacities are eroding. In addition, they receive low acknowledgement and recognition from ongoing development practices. Yet they offer potential for adoption if creatively pursued in current development and adaptation efforts. In all six cases, there is some transfer of knowledge to the next generation of kinships, volunteers and social workers. Such transfer is getting broader and more organized, legalized and linked with modern practices. In Prajapati Guthi both the governance, knowledge and livelihood skills have been transferred within members. The coordination and joint work of SNP through Nawa system is a successful example of working within existing setup, creating positive outcomes by bringing both traditional system and modern system together.
f. The findings indicate that the impact of climate change is already felt: days are hotter, summers are drier, winter milder, and precipitation more unpredictable. These changes translate into increase in the intensity and frequency of extreme events, scarcity of freshwater, decreasing agriculture production, increase in infectious diseases, degrading local livelihoods, and diminished wellbeing.
g. Some initiatives have been undertaken in the study district to adapt to such changes; some directly support efforts at enhancing resilience. Some aspects of the practices are likely to be contextualized for addressing climate change vulnerabilities and foster adaptation.The time tested Dhikur practices are familiar in the local community as a strategy during shocks. The system's relevance will be more pronounced with the predictions that extreme events will be more intense and frequent. In case of floods, 1-in-10year event could happen every few years under changed climate, and a 1 in 100 year event could occur every few decades in the future (IDS, PAC, GCAP; 2014). ISTI need to be formalized and brought under some regulating measures for effective adaptation and resilience.

6.7.1 Recommendations

There is a need for identifying location specific vulnerabilities, capacity gaps, and local needs along with cooperation with institutions, government partners and the community to build on local knowledge. A coordinated, local mechanism that utilizes past experiences needs to be pursued, its capacity enhanced by additional scientific knowledge of climate change impacts. The capacity of ITSIs could be strengthened to meet the above objectives by pursuing the following activities:

a. Capacity enhancement: Capacity of ITSI should be build so that they recognize and understand climate change impacts. Complimenting and creating synergy between ITLK and scientific knowledge is necessary to develop strategies, mechanisms to address climate related vulnerabilities and suggest adaptation practices. Local products like clay utensils, radi and pakhi (local hand woven wool blankets and clothing), hem cloths, and herbs should be updated, refined and promoted as climate friendly products.Research should be carried out

and documentation made to use the knowledge and proven practices of ITSI, specifically in fostering adaptation activities and improving policy for increased resilience.

b. Increased role for all: Women have to be included and be given a greater role in governance and decision making of all institutions. In Nawa system women are effective rangeland managers and they have been governing Amma samuha. This is a successful example of benefit between a new and old system for achieving a goal for sustainable natural resource management through ITSI. Inclusion of women enables their participation in local decisions where they bring perspective, skills and learnings that strengthen resilience. While designing policies, women must be provided space so that inequality aggregated by climate change is reduced.
c. Exploring linkages and strengths: Improving synergy between the community and the ITSI is of significance as its practitioners are disheartened by the lack of formal recognition and support. Traditional institutions have to be accepted and included as major stakeholders in adaptation activities as they not only effectively articulate access to assets and resources to the local communities, mediate with external resources which influences risks and vulnerabilities of the most disadvantaged and vulnerable groups but are also part of social mosaic and accepted by community as thus. Disaster risk reduction strategies should acknowledge and plan keeping local ITSI at their core for improving awareness, planning and social mobilization. The role of local institutions should be further clarified in policies related to adaptation and in developing local capacity.
d. Recognizing and promoting: Traditional institutions should be accepted and supported by the local government system for effective implementation of their programs. Local stakeholders need to play a key role in the developing local adaptation strategies and have greater say in the selection of appropriate institutions for partnership and implementation. The government has already started to build on this knowledge by creating roles for community users groups in water supply, irrigation, forestry and other sectors. It is clear that climate change adaptation is inherently local and if adaptation strategy is to be effective, it must take advantage of credibility of established actors at the local level. The studied institutions have gained such as status by involving themselves in conservation and management of natural resources. Existing institutions can more effectively influence collective actions to build climate resilience in all development sectors if scientific knowledge is better integrated into their management practices. Their credibility among the community members enables them to introduce and popularize new knowledge, practices and innovations
e. The study has found increased role for ITSI, along with ITK in order to build strategies for increasing adaptive capacity of the communities vulnerable to climate change. ITSI can help develop strategies to overcome local consequences of climate change impacts, associated risks and vulnerability by contextualizing mechanism and strategies.

ANNEX: LIST OF TABLES

Table No. 1 Involvement in Social Institution

Name of District	Involvement in Social Institution		Total
	Yes	No	
Bhaktapur	5	0	5
Mustang	4	1	5
Solukhumbu	8	1	9
Lamjung	5	1	5
Total	**22**	**2**	**24**

Table No. 2 Prevailing Traditional Institutions

Name of District	Prevailing Traditional Institutions									Total
	Buffer Zone	Nawa	Police post	Health Post	Post Office	Forest MC	School MC	Gumba	Guthi	
Bhaktapur	0	0	0	0	0	0	0	0	5	5
Mustang	0	0	1	1	1	1	1	1	0	6
Solukhumbu	2	2	0	1	0	1	5	4	1	16
Lamjung	0	0	0	0	0	1	0	0	0	1
Total	**2**	**2**	**1**	**2**	**1**	**3**	**6**	**5**	**6**	**28**
Name Of District	ACAP	Com-munity Library	Amma/ Nari Samuha	Mukhiya System	Dhikur	Cooperative	Youth Club	Udyog Banijya Mahasang	Social Service Committee	Total
Bhaktapur	0	0	1	0	0	5	1	1	2	10
Mustang	1	1	5	5	0	0	1	0	1	14
Solukhumbu	0	0	2	0	0	0	6	0	0	8
Lamjung	0	0	5	0	0	0	0	0	0	5
Total	**1**	**1**	**13**	**5**	**0**	**5**	**8**	**1**	**3**	**37**

Table No. 3 Major Roles and Responsibilities of Traditional Social Institutions

Name of District	Major Roles and Responsibility of Traditional Social Institution								Total
	Women Empow-erment	Provide jobs	Provide Skill development Training	Removing low Cast difference	Social / Community Welfare	Natural Resource Management	Organize blood donation	Cooperating in Natural Disaster	
Bhaktapur	0	0	0	0	4	1	3	2	10
Mustang	0	0	0	1	2	0	0	0	3
Solukhumbu	0	1	1	0	0	4	0	0	6
Lamjung	2	1	3	0	3	2	0	0	11
Total	**2**	**2**	**4**	**1**	**9**	**7**	**3**	**2**	**30**

Name of District	Organise Health Camp	Conservation of Religious Place and Traditional Culture	Pesagat Hit Ko Samrachayan Garne	Prepare Devlopment Planning	Keep the Community Clean	Saving	Dhukuti	Total
Bhaktapur	1	3	1	2	0	0	0	7
Mustang	0	1	0	0	2	2	1	6
Solukhumbu	0	0	0	0	0	0	0	0
Lamjung	0	3	0	1	3	3	1	11
Total	**1**	**7**	**1**	**3**	**5**	**5**	**2**	**24**

Table No. 4 Selection process of Decision Makers

Name of District	Selection process of decision Makers								Total
	Consensus	Election	Hierarchy (family roots)	By age	Selected by Govt.	Selected by king	lottery	Rotation among HHs	
Bhaktapur	0	3	0	4	0	0	0	0	7
Mustang	3	0	0	1	0	0	0	1	5
Solukhumbu	4	0	1	0	0	0	4	0	9
Lamjung	2	1	0	2	0	0	0	0	5
Total	**9**	**4**	**1**	**7**	**0**	**0**	**4**	**1**	**26**

Table No. 5 Selection process of members

Name of District	Selection process of members								Total
	Consensus	Election	Hierarchy (family roots)	By age	Selected by Govt.	Selected by king	lottery	Rotation among HHs	
Bhaktapur	0	2	0	4	0	0	0	0	6
Mustang	3	0	0	1	0	0	0	1	5
Solukhumbu	3	0	1	0	0	0	4	0	8
Lamjung	2	1	0	2	0	0	0	0	5
Total	**8**	**3**	**1**	**7**	**0**	**0**	**4**	**1**	**24**

Table No.6 Type of support received by respondent HHs from TSI

Name of District	Type of benefits received by respondent HHs								Total
	Personal Develop-ment	get loan in Minimum interest rate	Easy for Saving	Help in Bad Period	Help in Agriculture/ forestry/ farming	Cooperation in ritual function	Support Medical Expenses	help for educa-tion	
Bhaktapur	0	2	1	2		0	0	1	6
Mustang	1	2	0	0		3	0	0	6
Solukhumbu	0	0	1	0	7	0	0	1	9
Lamjung	3	3	2	0	0	3	1	2	14
Total	**4**	**7**	**4**	**2**	**7**	**6**	**1**	**4**	**35**

Table No. 7 Perceived impact on life and livelihood of TSI

Name of District	Perceived impact of TSI's benefit on life and livelihood						Total
	help for education	Positive Changes / Makes life easy	Get Chance to expose	Help for business and profession	Getting Management Skill	get loan in Minimum interest rate	
Bhaktapur	2	0	0	1	0	2	5
Mustang	0	1	1	1	1	0	4
Solukhumbu	0	6	1	0	0	0	7
Lamjung	1	4	0	1	0	0	6
Total	**3**	**11**	**2**	**3**	**1**	**2**	**22**

Table No. 8 Change in benefits from TSI in last 20 yrs.

Name of District	Change in benefits in from TSI in last 20 yrs.									Total
	YES	NO	Saving	Yes Easy to get loan	Yes Working for Develop-ment	Income Generation	Established home stay concept	Yes Send Doctors and Engineers	Yes Positive Changes	
Bhaktapur	5	0	0	1	0	0	0	1	2	9
Mustang	3	2	1	0	1	0	0	0	1	8
Solukhumbu	2	7	0	0	0	0	0	0	0	9
Lamjung	3	2	1	0	1	2	2	0	1	12
Total	**13**	**11**	**2**	**1**	**2**	**2**	**2**	**1**	**4**	**38**

Table No. 9 Cause for taking decision of change in support

Name of District	Cause for taking decision of change in support				Total
	Blank	Due to Behavioral change	To Help	To maintain the discipline in society	
Bhaktapur	1	2	1	1	5
Mustang	3	0	2	0	5
Solukhumbu	8	0	1	0	9
Lamjung	0	1	2	2	5
Total	**12**	**3**	**6**	**3**	**24**

Table No. 10 Process for taking decisions

Name of District	Process for taking decisions		Total
	Written	blank	
Bhaktapur	1	4	5
Mustang	2	3	5
Solukhumbu	2	7	9
Lamjung	4	1	5

Table No. 11: Institutional support in adaptation with climate change from identified impact of CC

Name of District	Institutional support in adaptation with climate change from identified impact of CC									Total
	Yes	No	Blank	Construct the dam in River side	Forestation and Sapling	Crop Diver-sification	Pollution Control	Deforestation Control	Balance in Environment	
Bhaktapur	4	0	1	1	3	0	0	0	0	9
Mustang	1	3	1	1	0	2	0	0	0	8
Solukhumbu	3	4	2	0	1	0	1	2	0	13
Lamjung	3	0	2	0	0	0	0	1	1	7
Total	11	7	6	2	4	2	1	3	1	37

Table No 12 : Detail of extreme events

District	2057				2058				2059			
	Occur-rence	Death	Injured	Property loss	Occur-rence	Death	Injured	Property loss	Occur-rence	Death	Injured	Property loss
Bhaktapur	37	3	0	5175000	0	0	0	0	18	0	0	0
Mustang	0	0	0	0	1	1	0	0	2	4	0	1535000
Solukhumbu	30	4	0	9850270	9	3	0	7655000	12	4	1	784200
Lamjung	20	13	0	5170900	18	5	0	439500	12	0	0	21258500

Table No. 13 : Gender wise Experience of climate change Cross-tabulation

Gender	Experience climate change in your village		Total
	Yes	No	
Male	134	5	139
Female	92	7	99
Total	226	12	238

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