REPORT PREPARATION
SAGUN Program

COVER PHOTO
Children of Phusremato CFUG, Dhading District Protecting themselves from the Sun rays and heat with *Nanglo (winnowing tray made from Bamboo)*
Users of Tharu CFUG, Bardia District Protecting Maize from Damage by Floods Hanging on Wooden Pole

PHOTOGRAPHS
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Climate Change Impacts on Livelihoods of Poor and Vulnerable Communities and Biodiversity Conservation :

A Case Study in Banke, Bardia, Dhading and Rasuwa Districts of Nepal

Conducted by SAGUN Program in
Collaboration with LIBIRD

Strengthened Actions for Governance in Utilization of Natural Resources (SAGUN) Program

Acknowledgements

We would like to express our sincere thank to USAID for its continued support to conduct the Case Study on 'Climate Change Impacts on Livelihoods of Poor and Vulnerable Communities and Biodiversity Conservation in Banke, Bardia, Dhading and Rasuwa District of Nepal' where the 'Strengthened Actions for Governance in Utilization of Natural Resources (SAGUN)' Program is currently in operation.

We would like to thank LI-BIRD for providing their consultancy service and its study team members: Mr. Bimal Raj Regmi, Dr. Pratap Shrestha, Mr. Apar Paudyal, Mr. Gandhiv Kafle, Ms. Rojee Suwal, Ms. Sandhya Karki, Ms. Rachana Devkota, Ms. Rajju Mall Dhakal, Mr. Tara L. Lama, Ms. Janita Gurung, Mr. Chandra Gurung, and Mr. Ganga Gurung for their high caliber professional inputs in conducting this study.

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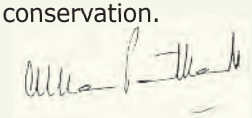
Finally, we are indebted to members of CFUGs, BZCFUGs and CBAPUs, and local and national level stakeholders for enriching our knowledge and providing us with valuable information. CARE Nepal is grateful to them.

We strongly believe that findings and recommendations made in this study report will be useful to all community based organizations to support and empower the communities to build their capacity for climate change adaptation and mitigate its negative impacts on their livelihoods and bio-diversity conservation.



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FOREWORD

The USAID supported 'Strengthened Actions for Governance in the Utilization of Natural Resources' (SAGUN) Program has been implemented by CARE Nepal in collaboration with WWF Nepal, RIMS Nepal and FECOFUN since November 2002, fostering grassroots democracy through the democratic and sustainable management of natural resources. Recently, as a part of research work on it's more than six years outstanding performance, the SAGUN Program has conducted a case study on linkages among climate change, livelihoods improvement and biodiversity conservation in its three ecological zones: Mid Western Terai (Banke and Bardiya Districts), Mid-hills (Dhading District) and High Mountains (Rasuwa District) in collaboration with LI-BIRD.

This study report has clearly shown that climate is changing in the study areas, like elsewhere in the world. The impact of climate change on biodiversity and livelihoods of communities in the study areas is very distinct and it has indicated that poor, marginalized women and *Dalit* were more vulnerable to climate change impacts. Meanwhile, coping strategies and adaptation mechanism applied by these local communities are not very effective to address climate change issues and threats.

In this context, this study report is very timely and most warranted. I believe that this study report will be very useful to all community based organizations and community forestry practitioners to support and empower the communities to build their capacity for climate change adaptation and mitigate its negative impacts on their livelihoods and bio-diversity conservation. I request the readers for their feedbacks that will help us to improve the next edition.

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ACRONYMS

ADB	Asian Development Bank
ANOVA	Analysis of Variance
BZCFUG	Buffer Zone Community Forest User Group
CBAPU	Community Based Anti Poaching Unit
CCN	Climate Change Network
CCNN	Climate Change Network Nepal
CDM	Clean Development Mechanism
CF	Community Forest
CFUG	Community Forest User Group
CO_2	Carbondioxide
CRiSTAL	Community based Risk Screening Tool- Adaptation and Livelihoods
CVCA	Climate Vulnerability and Capacity Assessment
DANIDA	Danish International Development Assistance
DFID	Department for International Development
DNA	Designated National Authority
EIA	Environment Impact Assessment
FECOFUN	Federation of Community Forestry Users, Nepal
FGD	Focus Group Discussion
GHG	Green House Gas
GoN	Government of Nepal
IISD	International Institute of Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Nature Conservation
LDCF	Least Developed Countries Fund
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
MoEST	Ministry of Environment, Science and Technology
NAPA	National Adaptation Program of Action
NTFP	Non Timber Forest Product
PGA	Participatory Governance Assessment
PPCR	Pilot Program on Climate Resilience
PWBR	Participatory Well Being Ranking
REDD	Reducing Emission from Deforestation and Degradation
RIMS	Resource Identification and Management Society
SAGUN	Strengthened Actions for Governance in Utilization of Natural Resources
SEI	Stockholm Environment Institute
SPSS	Statistical Package for the Social Science
USAID	United States Agency for International Development
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund
VDC	Village Development Committee
WTLCP	Western Terai Landscape Complex Project
WWF	World Wide Fund for Nature

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Executive Summary

A case study on linkages between climate change, livelihoods improvement and biodiversity conservation was conducted in three ecological zones where 'Strengthened Actions for Governance in Utilization of Natural Resources' (SAGUN) Program is implemented: Mid Western Terai (Banke and Bardia Districts), Mid-hills (Dhading District) and High Mountains (Rasuwa District). SAGUN Program is in operation in collaboration of CARE Nepal, WWF Nepal, RIMS Nepal and FECOFUN with financial support of USAID-Nepal. The sustainable livelihood framework was used to guide the study. Field-based methodologies and participatory tools (e.g. CVCA and CRiSTAL) were applied to collect information related to climate risks and hazards, impacts, vulnerability, and coping/adaptation strategies at local level. Meteorological data of the last 30 years from stations nearest to the study sites were also collected and analyzed to support the study findings. Target CFUGs were identified based on hazard mapping, participatory governance assessment, and well-being ranking. CFUGs prone to climate risks and hazards and with large numbers of poor households were selected and categorized based on their levels of activeness. Household surveys were conducted on both well-off and ultra-poor categories.

Data analysis indicated that temperature was increasing at all sites. Rainfall patterns were also recorded altered, delayed monsoon, erratic rainfall and shorter rainfall duration. Winter rainfall decreased in most of the areas, while both rainfall and snowfall were unpredictable. Temperature increase was higher in the high mountains (Rasuwa) than at other study sites with very hot summers and cool winters. This extreme climate variability indicates that climate change is occurring at the study sites, and supports national scenarios and projections on climate change. Major climate risks in the study sites include drought, landslides, floods and riverbank erosion. Other hazards include fire, and hailstone. There is clear indication that risk and hazards are different in mountain, mid-hills and Terai regions. Major risks in the high mountains include drought, fire and landslides. In the mid-hills, drought, soil erosion and landslides were observed. In the Terai, major problems were; floods; riverbank erosion; and drought. The study found a relationship between rainfall, temperature and changes in frequency, magnitude and impact of risks and hazards like drought, flooding and landslides. However, it also identified the need to conduct further in-depth studies to determine linkages between climatic parameters and outbreak of fire and hailstone.

The impact of climate change was severe on biodiversity and livelihoods of communities in the study areas. Drought and floods disrupted rural livelihoods by posing a threat to agriculture, biodiversity, health and infrastructure. Major impacts were observed in agriculture and natural resources like forests, wetlands and pastures. Frequent flooding washed away thousands of hectares of productive agricultural land, destroyed crop yields, damaged houses and infrastructure, took human and livestock lives, and contributed to outbreak of diseases. Similarly, drought resulted in decline in crop productivity, loss of local crop species, drying of water sources (wells, ponds, and springs), and outbreak of pests and diseases. Extreme climate events forced thousands of people to leave their homes, destroyed wildlife habitat and increased human pressure on forest resources due to reallocation and resettlement. Change in rainfall and temperature resulted in changes in plant behavior like early flowering, shift in vegetation line (i.e. expansion of habitat of crops and species), and loss of some valuable species and NTFPs. These changes indicate that unpredictable climate variability will be a major obstacle for subsistence-based livelihoods in rural areas of Nepal.

The study indicated that poor, marginalized; women and *Dalit* households were more vulnerable to climate change impacts. In particular, women bear a disproportionate burden of climate change impacts. Women play a dominant role in subsistence agricultural production. They are largely responsible for water collection and are thus more affected when quantity of and/or access to water changes. In most households, women were responsible for taking care of their family members especially because of male out-migration for employment. As primary care-givers, women's responsibilities will increase when family members become ill due to exposure to vector-borne diseases such as malaria, diarrhea, and cholera.

Climate change impacts on CFUGs were very high regardless of levels of activeness or categories of users. However, there was some difference in coping capacities among types of CFUGs and among well-off and poor categories. Ultra-poor households were severely affected by disasters compared to well-off households. The impact of drought and landslides on livelihood assets of poor households was higher than for well-off households. Less active households were also more affected by climate disasters than active households.

Coping strategies and adaptation mechanism applied by local communities were documented at the study sites. These strategies, based on local knowledge, practices and innovations, were limited at all study sites except in Balapur CFUG of Bardia District. Moreover, most adaptation strategies were limited to agriculture. Ethnic groups, such as the Tharu, have traditionally developed climate resilient systems like developing safety measures and finding alternatives to current livelihood practices. However, such initiatives do not fully address climate change issues and threats. The Government of Nepal does not have a climate change policy at present. Moreover, existing development and sectoral plans do not adequately address climate change impacts. The country also lacks adaptation strategies and action plan on climate change. National climate change processes are slow (NAPA, Second Communication Report, Policy) and have not been able to meet national international requirements. There is an urgency to support the Government in speeding the process to address climate change issues and to develop a clear roadmap for Nepal.

The SAGUN Program launched several important initiatives such as governance in natural resource management, on-farm and off-farm income generation, small material support for micro-enterprises, and livestock insurance schemes among others. Although these interventions were not designed to specifically address climate change, some practices strengthened community capacity to cope and adapt to climate change impacts; these include good governance within CFUGs, income generation activities, and pro-poor initiatives that enhanced livelihood assets. In the long term, this could contribute in reducing vulnerability to climate change.

The study also tested different methodologies to assess and map risks and vulnerability. It is recommended that a combination of various tools be applied to capture different climatic contexts and perspectives. These lessons could be used during the NAPA preparation process. There are several potentials within the SAGUN Program to reach out to the most vulnerable communities through improved governance, capacity building and pro-poor initiatives. The Program's future focus should be on building climate resilience, green jobs creation, and low carbon development. There is need for an integrated strategy (forest and livelihoods– agriculture, livestock, drinking water, health, and disaster risk reduction). Another important focus should be on action research, awareness, capacity building and policy advocacy. The study strongly recommends that SAGUN Program consider risk and vulnerability assessment, research and studies, access and benefit sharing issues, targeted and inclusive governance, climate change advocacy, and gender dimensions while designing new projects and programs.

1. Introduction

Nepal's temperature is increasing at a high rate. Warming seems to be consistent and continuous after the mid-1970s. Between 1977 and 1994, average warming in annual temperature was 0.06ºC per year (Shrestha *et al.,* 1999). Warming was much pronounced in the high altitude regions of Nepal such as the middle mountain and the high Himalaya, while warming was significantly lower in the Terai and Siwalik regions. Furthermore, warming in the winter was higher as compared to other seasons. According to a recent study, Nepal's temperature is rising by about 0.41ºC per decade (Dahal, 2005, Kansakar *et al*. 2004, Shrestha *et al*., 2000).

Weather-related extreme events such as excessive rainfall, longer drought periods, landslides and floods are increasing in terms of both magnitude, as well as frequency. Such events have negative impact on people's livelihoods. Floods and glacial lake outburst events will destroy irrigation and water supply systems, roads, bridges, settlements and productive land. Flood-related deaths will also increase. Land degradation will reduce crop productivity and place higher pressure on remaining fertile land. During the dry season, increased evaporation will lead to water scarcity. Soil moisture deficit, droughts, fire and possible pest outbreaks will decrease crop yields. Climate change impacts such as unpredictable weather patterns, loss of biodiversity, water scarcity, spread of tropical disease like malaria and dengue, decreased food productivity, and increased intensity and frequency of landslides and flooding were already visible in Nepal. These impacts threaten people's livelihoods, biodiversity conservation, safety, security and the national economy.

Poor people are highly vulnerable to climate change impact, but they have the lowest capacity to deal with them. Therefore, response mechanisms to climate change impacts should be integrated into development planning and policy (Huq and Ayers, 2008). There are two types of responses to address climate change impacts: mitigation and adaptation. Mitigation involves reducing emissions of greenhouse gases to slow or stop the process of climate change. Adaptation in other hand is adjusting to the natural or human system by learning to cope with temperature increases, floods, and other climatic risks and hazards associated with climate change (Reid and Huq, 2007). Since Nepal's contributions to global greenhouse gas emissions (0.025%) is relatively insignificant (SDAN, 2003), adaptation is more relevant. Moreover, a majority of the population is exposed to multiple stresses such as poverty and low adaptive capacity to climate change impacts. Therefore, adaptation options at the local level should be identified and prioritized to ensure development and livelihoods security.

The USAID-supported 'Strengthened Actions for Governance in the Utilization of Natural Resources' (SAGUN) Program is in operation since November 2002, fostering grassroots democracy through democratic and sustainable management of natural resources. CARE Nepal is implementing the SAGUN Program in collaboration with WWF Nepal, RIMS Nepal and FECOFUN. The synergy created by this team has ensured the program's success. SAGUN Program has instilled democratic, transparent, and participatory governance in more than 2,000 CFUGs, BZCFUGs, water users groups and hydro-power project affected communities, making them more responsive to the needs of women, poor, *Dalit*s and marginalized Janajatis. It has also supported formation of more than 850 new CFUGs and works with other agencies/organizations for sustainable and equitable natural resource management and biodiversity conservation through good governance, livelihoods improvement, and policy advocacy. This case study is part of a breakthrough study at SAGUN Program working sites to understand the situation of risks, hazards, and vulnerabilities associated with the impacts of climate change on livelihoods and biodiversity conservation in three ecological zones of Nepal.

2. Rationale of the Study

Climate Change is currently one of the greatest threats to environmental conservation and livelihood security. An increased emission of greenhouse gases into the atmosphere is further compounding these problems. Although Nepal's contribution to global greenhouse gas emissions is only 0.025%, it is among the most vulnerable countries to climate change impacts. Nepal's atmospheric temperature is increasing at an alarming rate (0.06ºC per year). Poor people, women, and marginalized communities are highly vulnerable to climate change impacts. Thus, in order to secure their livelihoods, it is imperative that climate change issues be addressed as a key development concern.

Given this background, a case study on linkages among climate change, livelihoods improvement and biodiversity conservation was conducted in three eco-regions of SAGUN Program. The study covered three ecological zones of Nepal: Mid-Western Terai (Banke and Bardia Districts), mid-hills (Dhading District) and high mountains (Rasuwa District).

3. Objectives of the Study

The broad objectives of the study were to assess climate change impacts on natural resource management and livelihoods of local people, and to identify adaptation measures for improving livelihoods of poor people while reducing their vulnerability to climate change.

Specific objectives of the study were:

- To collect and analyze overall climate change impacts on natural resource management, including biodiversity, and livelihoods of poor, vulnerable and marginalized groups in the three ecological zones.
- To assess coping mechanisms practiced by local communities for improving and securing their livelihoods and conserving biodiversity in the three ecological zones.
- To analyze existing policy gaps to address climate change issues from perspectives of livelihoods security and biodiversity conservation.
- To provide recommendations for addressing climate vulnerability and improving livelihoods of poor, vulnerable and marginalized groups and achieving biodiversity conservation in the three ecological zones of SAGUN Program areas.

4. Methodology

4.1 Tools and Methods

The study used the participatory tools and methods. Primary information were acquired through in-depth interviews with key stakeholders, and focus group discussions with members of CFUGs. Gender, age, social position and income of respondents were considered during the process. Focus group discussions were conducted which were guided by participatory tools. The participatory tools included matrix ranking (impact of risks and disasters vs. livelihood assets), timeline (historical scan for identifying major events), hazard mapping (identifying major risk and hazard prone areas), vulnerability mapping (identifying hotspots of vulnerable areas), mobility mapping (rescue and rehabilitation centers), and local knowledge documentation (documenting local knowledge, technology and practices related to coping and adaptation strategies). In addition, quantitative data were collected through household interviews.

Photo 1: Communities were involving in Preparing Risk and Hazard map.

Key informant interviews were conducted with selected community group members such as poor, women, and marginalized groups within CFUGs, CBAPUs and BZCFUGs groups involving livelihoods improvement and biodiversity conservation, NTFP Cooperative members, women groups, and *Dalit* groups. Interviews were also conducted with representatives of district line agencies, Buffer Zone Management Councils and User Committees, and National Park personnel. Field observation was

conducted to complement the information provided by respondents.

Table 1: List of Study Parameters and Tools

Assessment Parameters	Tools
Historical trend analysis of changes, risks and impacts	Time line (FGD, key persons), key informants interview, seasonal calendars
Climate Risk and Hazard	Risk and Hazard mapping (FGD), matrix ranking, literature review (review of hydrological and meteorological data)
Vulnerability Assessment	Mapping, FGD and group discussion, matrix ranking, use of social analysis tools including Social Domain
Comparative analysis of impacts across different groups	Household survey, key informants interview
Assessment of coping strategies and adaptation measures	FGD, household survey, local knowledge documentation
Policy analysis	Key informants interview, individual consultations

The study team consulted policy makers at the central level to acquire policy-level feedback. Objectives and accomplishments of the SAGUN Program were reviewed with reference to climate change. Similarly, information from secondary sources were reviewed and assessed in order to triangulate information collected from field observation, discussion and household surveys.

4.2 Sampling Process and Techniques

The Community Forest User Groups (CFUGs) in each eco-region were categorized as very active, medium active and less active based on Participatory Governance Assessment (PGA) ranking. Local resource person and staffs of SAGUN Program then identified at least five CFUGs that were highly vulnerable to climate risks and hazards (flooding, landslides, forest fire, riverbank erosion, and drought). These CFUGs were then ranked as very high, high, medium, low or very low in terms of their vulnerability to climate risks and hazards (see Figure 1). The poverty index (number of poor households) was calculated for each CFUG in order to determine CFUGs with higher numbers of poor households. Vulnerability levels and poverty index were then used to finally select two CFUGs under Very Active and Less Active categories. A total of six CFUGs were chosen for this case study. Within each CFUG, participatory well-being ranking (PWBR) was used for identifying each of the households. Among these, 12 well-off and 12 ultra-poor households were selected for group discussions from each of the six selected CFUGs (Annex 4).

In Rasuwa District, WWF Nepal implements the SAGUN Program as one component of its larger program. Thus, the study assessed the combined effects of SAGUN and WWF Nepal's programs in the district. Here, two VDCs exposed to high climate risks and hazards were identified in consultation with stakeholders who included BZUCs, BZCFUGs, Community-Based Anti Poaching Units (CBAPUs) and mother groups.

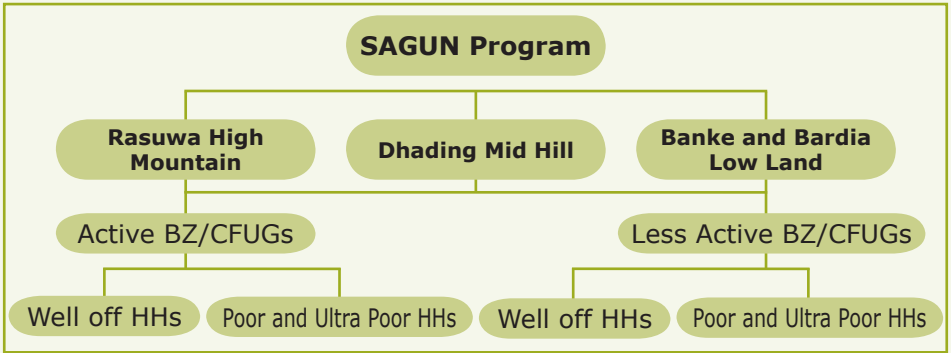

Figure 1: Sampling Framework

5. Data Analysis

Quantitative information was analyzed using Statistical Package for Social Sciences (SPSS) and simple Statiscal tools, while qualitative information collected through focus group discussions and key informant interviews was analyzed via matrices, descriptive information and case studies. Differences in CFUGs were evaluated using ANOVA and Spearmen Correlation Coefficient.

6. Framework for Assessment

The study used the Sustainable Livelihoods Framework to assess vulnerability context, types of livelihoods assets affected, total impacts, and total capacity available among target groups to cope with climate change impacts (Figure 2). The livelihoods framework analysis is a tool used in assessing the various livelihood assets of rural communities (Chambers and Conway, 1992). It offers opportunities to assess various assets of household, and how these are contributing towards vulnerability of communities. It further explains how various social, human, natural and economic factors affect livelihood strategies and outcomes. Users practice a range of livelihood strategies based on local knowledge, innovations and practices. Although not well studied and recognized, these locally grounded strategies might be effective in coping with climatic stresses.

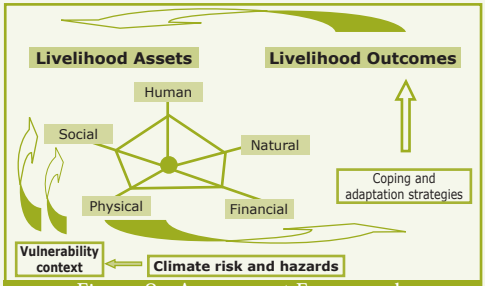

Figure 2 : Assessment Framework
Source : CARE USA.

Vulnerability[1] to climate change is more than the biophysical effects from a climate risk such as drought – it is also affected by factors such as access to resources and other socio-environmental circumstances shaped by political and economic processes. Some individuals and communities are more vulnerable than others, due to for example reliance on climate sensitive crops, lack of access to alternative livelihoods, remoteness to markets, inferior social services and weak social networks.

The study also used the Community-based Risk Screening Tool–Adaptation and Livelihoods (CRiSTAL) to further support the framework assessment. CRiSTAL, which was developed jointly by IUCN, SEI-US and IISD, draws on the Environmental Impact Assessment (EIA) model, as well as the Sustainable Livelihoods Framework. CRiSTAL aims to provide a logical user-friendly process to help users better understand the links between climate-related risks, livelihoods, and project activities (Hammill et al., 2009). Specifically, CRiSTAL is intended to help users systematically understand links between local livelihoods and climate; assess a project's impact on livelihood resources important to adaptation; and to devise adjustments that improve a project's impact on livelihood resources that are important for adaptation.

The Climate Vulnerability and Capacity Analysis (CVCA) Handbook, developed by CARE International (Dazé, 2009), was also used during the study. Recognizing that local actors must have the opportunity to drive their own future, CVCA places emphasis on local knowledge on climate risks and adaptation strategies during data collection and analysis. The assessment framework is presented in Figure 2.

7. Background of the Study Sites

7.1 Rasuwa District

Nadangche Anti Poaching Unit, established in 2008, is situated in Ward 3 of Thulo Syabru in Rasuwa District. Major activities of the unit are to control illegal wildlife poaching and illegal trade and harvest of medicinal plants. This anti-poaching unit is a community-based group and is in the initial stage of conservation and natural resource management work. Ramche Buffer Zone User Committee is the apex body of user groups in Ward 9 of

1 Vullnerability is the function of potential impacts (exposure, senstivity) and its adaptive capacity.

Ramche VDC in Rasuwa District. The geology of Ramche VDC is very fragile and prone to landslide and erosion.

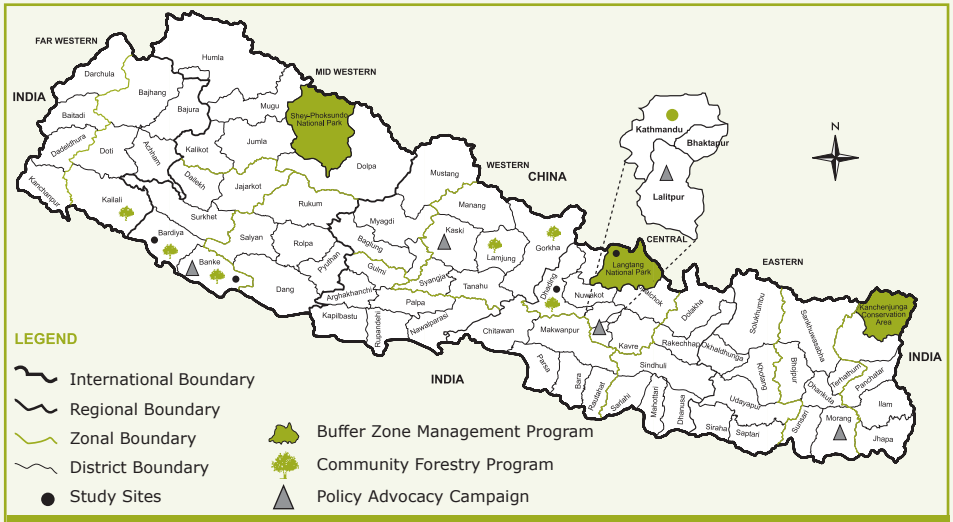

Figure 3 : Map Showing Study Area

7.2 Dhading District

Deupuje Community Forest User Group is located in Jivanpur-9, Dhading District. The community forest is situated on a southeast facing hill slope. The Mahesh River flows from east to west at the southern part of the community forest. The nearest market is Dharke along the Prithivi Highway.

Phusremato Community Forest User Group is located in Jivanpur-7 of the district. The Kolphu River flows from east to west at the base of the north-west facing slope.

7.3 Banke and Bardia Districts

Bansakti Community Forestry User Group is located in Rajpur village, Ward No. 9 of Kachanapur VDC in Banke District. It falls within the Dhakari Range Post and locates to the south of Mahendra Highway and 10 km east from Kohalpur. Households include indigenous Tharu communities and migrants from Salyan and nearby hills. Tharu Community Forestry User Group is located in Balapur village, ward No. 6 of Gulariya Municipality in Bardia District. It falls within the Khairapur Range Post and is located north of Gulariya town. Population pressure resulted in massive deforestation

between in 1980-1990. Communities realized the importance of forest conservation and management when there was no forest and their demands for forest resources increased.

Table 2 : Characteristics of Sutdy Area CFUGs/Groups

Name of CFUG/Group (Zone)**	Altitude (m)	Total HHs	Major Ethnic Groups	Vegetation Type	Year established
Nadangche APU, Rasuwa(H)	2,300	130	Tamang, Lama	Temperate (dominated by Pinus)	2008
Ramche BZUC, Rasuwa (H)	1,500	448	Tamang	Juniper and Pinus (dominated by Pinus roxburghii)	
Deupuje CFUG, Jivanpur-9, Dhadhing (M)	700-1,000	652	Brahmin, Newar, *Dalit*	Pinus, Schima, Castanopsis, Tilchaude, Shorea,	2001
Phusremato CFUG, Jivanpur-7, Dhadhing (M)	1,100-1,300	1132	Brahmin, Chettri, Tamang, Rai, *Dalit*	Schima, Castanopsis, Alnus, Engelhardtia (mauwa), Shorea, Syzygium Pieris (angeri), Grevillea (kangiyo)	2004
Bansakti CFUG, Rajpur, Banke (T)	100-200	170	Brahmin, Chettri, Tharu, *Dalit*, Magars	Sub-tropical mixed forest	1989
Tharu CFUG, Gulariya-6 (T)	100-200	115	Tharu	Sub-tropical mixed forest, mostly plantation forest	1998

** Ecological Zone : H=High Mountain, M=Mid-hills, T=Terai
Source : Field Survey, 2009

8. Results and Discussion

8.1 Climate Change Scenarios

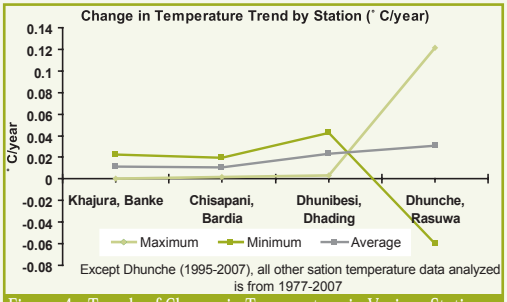

Figure 4 : Trends of Change in Temperature in Various Stations
Source : Department of Hydrology and Meterology

Analysis of temperature data indicates that average temperature is increasing at all study sites (Figure 4). Moreover, average temperature increase is higher with increasing elevation. Average increase in temperature is 0.01˚C in Banke and Bardia, 0.02˚C in Dhading, and 0.03˚C in Rasuwa. In the Terai and mid-hills, increase in average minimum and maximum temperatures is gradual. However, in the high mountain zone, abrupt changes in minimum and maximum temperatures have occurred with a short time period (13 years between 1995-2007).

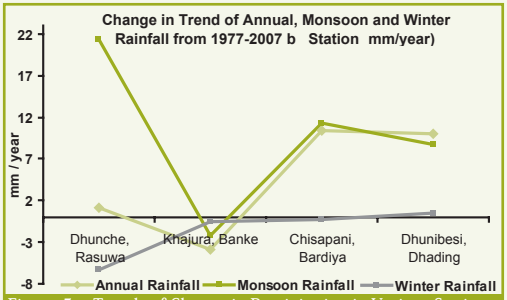

Figure 5 : Trends of Change in Precipitation in Various Stations
Source : Department of Hydrology and Meterology

Rainfall patterns and distribution have been erratic at the study sties. Average annual rainfall was found to be higher in Chisapani, Bardia, but low in Dhunibesi, Dhading (Figure 5). Precipitation trend analysis indicates a decrease in winter rainfall in Rasuwa by 6.3 mm/year and Terai sites by 0.4 mm/year. However, there was increase in monsoon rainfall in Rasuwa by 21 mm/year, Dhading by 9 mm/year and Chisapani by 11 mm/year. In Khajura, Banke, annual, monsoon and winter rainfalls are decreasing.

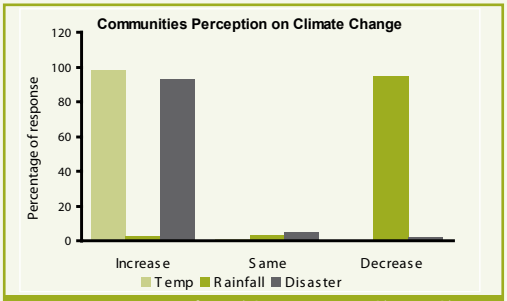

Figure 6 : Perception of Local Community on Climate Change
Source : Field Survey, 2009

Focus group discussions and key informant interviews indicate that communities experienced water stress and increased temperatures in recent years. Almost all respondents (more than 95%) revealed that local temperature had increased and rainfall had decreased compared to 15 years back (Figure 6). Users linked this situation to erratic monsoon and changes in rainfall intensity and patterns. Users also indicated a relationship between change in rainfall pattern and intensity with magnitude and impact of disasters such as flooding and riverbank erosion.

Change in climatic factors manifested in all study sites in the form of inter-annual variability of temperature and rainfall, as well as extreme events such as droughts, riverbank erosion, and heat/cold waves. Timeline assessment of climate risks suggests that the frequency of temperature, rainfall and disasters are correlated. These observations support the IPCC Fourth Assessment Report and the Initial National Communication (INC) report to UNFCCC.

8.2 Climate Risks and Hazards

Past and current climatic stresses are through subjective experiences of climate events, i.e. hazard mapping and time-line. These subjective perceptions can indicate how people are affected by climate stresses (Table 3). These experiences also assist in determination of adaptation strategies. The study found that climate risks and hazards are increasing at all study sites. According to respondents, the magnitude of impacts and frequency

of their occurrence have increased. Almost 95 percent of respondents perceived that risks and hazards in their locality have increased (Figure 7).

Table 3: Climate Risks and Hazards in Study Area

Climate Risks	Study Sites		
	Banke/Bardia	Dhading	Rasuwa
Floods	√	√	
Riverbank erosion	√	√	
Drought	√	√	√
Landslides		√	√
Drying of springs/rivers	√	√	√

Source : Field Survey, 2009

Villagers have substantial basis for linking changes in temperature and rainfall with frequency and magnitude of risks and hazards. They perceived that due to higher temperature and change in precipitation, the intensity of climate change impacts have increased, thus posing a threat to their survival. The time-line in all study sites indicated that key climate risks and hazards like flood, drought and landslides were frequent during the last 10 years, and their impacts were severe on poor households. Increased risks and hazards were also linked with decreased opportunities and employment at the rural level, hence compelling people into wage labor and out-migration for employment.

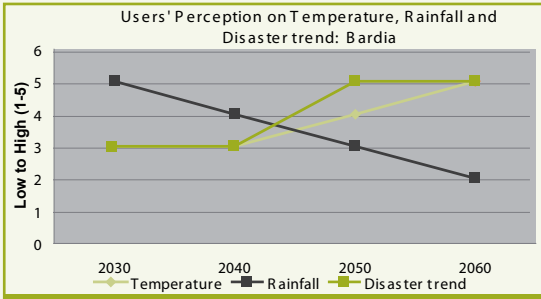

Figure 7 :User's Perception on Trend of Temperature, Rainfall and Disasters
Source :Field Survey, 2009

In the high mountains, communities identified landslides and drought as the major problem. Similarly, respondents of mid hills expressed their experiences as drought and landslides disrupted the social system and agriculture-dependent livelihoods. Where as in Terai floods emerged as major climate risk that persistently


Photo 2: Risk and Hazard Map Prepared by Communities in Rajpur, Banke District

and drought were causing huge losses in agriculture and threatening people's livelihoods. Drying of wells, rivers, springs, ponds and wetlands was also a major concern among Users and development workers. If this trend continues, many biological and human systems dependent on these ecosystems will face challenges in the future.

8.3 Climate Change Impacts on Biodiversity and Livelihoods

8.3.1 Impact on Biodiversity

Nepal is rich in biodiversity and regarded as a hotspot for some locally and globally significant plant and animal species. Forests constitute Nepal's largest natural resource covering 26% of the total land area (WRI 2000). However, climate change is likely to affect Nepal's forests. A recent study projected that doubling of atmospheric CO_2 concentration will reduce Nepal's forest types from 15 to 12, and habitats and ecosystems will be destroyed. Climate change will also affect productivity of natural ecosystems, particularly provision of environmental services such as clean air, water, food, and aesthetic values. Communities in various parts of Nepal have already experienced loss of native plants and species. Anecdotal evidences and communities' perceptions suggest that the vegetation line has gone up due to temperature increase in high mountain zones like Mustang and Manang (Dahal, 2005).

Key informants reported that forests, lakes, grasslands, wetlands and agricultural ecosystems in the study area were in critical condition, thus reducing opportunities for fisheries, NTFPs, and ecotourism. Grasslands had been converted to barren wasteland due to human interventions and prolonged drought. These losses add to community vulnerability to climate change.

8.3.1.1 Forest Resources

Most CFUG members in Banke and Bardia Districts reported the loss of forest species such as Malupaat (*Sonchu sasper*), Sal (*Shorea robusta*), Khaniyo (*Ficus*), Amala (*Emblica sp*.), Khair (*Acacia catechu*), Sissoo (*Dalbergia sissoo*), Simal (*Bombax ceiba*), Bhalayo (*Rhus wallichii*), Dumri (*Ficum glomerata*)), and Bhellar (*Trewia nudiflora*). They also mentioned that medicinal plants and NTFPs including Sarpaganda, Kurilo (*Asparagus*), Sikakai (*Acacia coccinia*), Pipla (*Pipe nigrum*), Gholtapre (*Centella asiatica*), Amriso (*Thysomolaena maxima*), Gurjo (*Tinosphora cardifolia*), Kaas (*Sacchrum sp*.), Harro Barro (*Terminalia sp*.), and Gurjo (*Tinosphora cardifolia*) were no longer found, particularly in Bardia. Communities repeatedly mentioned that Sarpaganda[2] and Kurilo, which need moisture for growth, were disappearing due to dry conditions.

2 *Rauwolfia serpentina* is one of Nepal's endangered medicinal plants restricted for harvest and trade by the Nepalese Government.

Box 1: Impact of Climatic Variations on Forest Resources

In 1986, Rajapur village was ruined by disasters including fire and flood. A devastating fire destroyed 10 houses, while heavy flooding destroyed three houses and damaged fertile agricultural land. Forestland was cleared to allocate space for victims and flood-prone households. 116 households were provided with 0.6 ha of forestland for resettlement. However, some rich households received 0.16 ha of forestland. The dense mixed forest in the area was destroyed resulting in loss of forest biodiversity. Tree species including Asna (*Terminalia tomentosa*), Dhauti, Karma, Sindhure (*Mallotus phillipensis*), Rohini (*Swietenia febrifuga*), Jamun (*Syzygium cumini*), Saal (*Shorea*), Khayer (*Acacia*), Bel (*Aegle mermelos*), Kusum (*Schleichera oleosa*), and Rajbrikshya (*Casia fistula*), and herbs including Amala (*Emblica*) and Kurilo (*Asparagus*) were lost. A total of 7.7 ha of forest was damaged. This had major implications in the loss of animal, bird and plant species, and in the ecosystem integrity.

Binod Gahatraj and members of Bansakti CFUG, Banke

Respondents in Dhading District mentioned that forest species like *Kaiayo* (*Wendlandia exserta*) had disappeared from their forests. Herb species including *Saccharum, Impereta* and *Fragaria indica* (*Bhuikaphal*) had also declined. Interestingly, communities mentioned that wetland species like *Kholejhar (*weed found along riverside*)* and *Gholtabre (Centella asiatica)* were no longer found. According to members of Deupuje CFUG, the flowering season of *Siplican (Crateava religiosa)* had shifted to late March/ April. Their pre-flowering young shoots are consumed as vegetables and/ or pickles. Villagers reported that *Siplican* used to produce many young shoots, however this year the species flowered directly foregoing the young shoot phase. There is a clear linkage between early flowering and long period of dry spell this year. Members of Phusremato CFUG were concerned about the decreasing population of forest species such as *Sal (Shorea robusta), Simali (Vitex negundo), Khote Sallo (Pinus roxburghii) and Tuni (Toona ciliata)*.

Mobility trend of communities in Banke and Bardia Districts indicated increasing human pressure on forest resources from refugees and landless communities. People whose lands were lost due to floods occupy nearby forest areas. This occurred in Bansakti CFUG where communities were resettled in forest areas (Box 1). There is growing interest among this CFUG to move inside the forest and to use wasted and river-washed land, they used to occupy before, for plantation. However, this will not compensate for either Users' initial assets, or forest biodiversity and ecosystem integrity. Compensation mechanisms are crucial to conserve forest areas while securing people's livelihoods. Encroachment in the Terai is increasing, and it was predicted that the rate and severity would increase in the coming years.

In Rasuwa District, communities have experienced shifts in vegetation patterns and reduction in production and supply of timber and NTFPs. Similar observations were made in parts of Mustang and Manang Districts of Nepal (see Dahal, 2006). Rangeland communities are likely to face higher burdens because they will need to cover greater distances for pastureland. Communities revealed that different plant species were flowering irregularly. Rhododendrons were flowering early from January/ February at lower elevations to April/May in higher elevations. Moreover, the number of rhododendron species is decreasing, and there is loss of *Sunpati* (*Rhododendron anthopogon*) above tree line. This study also supported scientific findings on changes in physiological characteristics of some plant species. In the Thulo Syabru area, communities indicated that *Rhododendron, Juniper and Lokta (Daphne bholua)* were appearing at higher altitudes than their normal range. These changes were based on communities' historical scan (data of past and present events) and their perception on the linkages to variability in rainfall and temperature. This provides us with opportunities to capitalize on local knowledge that can be used as a basis for conducting further scientific studies on ecological changes and future projections in the region.

Photo 3: Early Flowering of Rhododendron, 2009 April

Table 4: Summary of key Impacts of Climate Risk and Disasters on Forest Resources

Study Sites	Climate Change Impacts			
	Forest Resources	Wetlands	Ecological Services	Key Indicators
Rasuwa (Syabru and Ramche)	Shift in vegetation line/ succession. Loss of NTFPs and medicinal plants like Sunpati	Drying of streams, waterholes and springs.	Disruption of agro-ecosystems by landslides. Changes in high altitude ecosystem characteristics.	Shift in vegetation line. Emergence of new species and crops. Early flowering of species.
Dhading (Duepuje and Phusremato CF)	(Not so significant)	Drying of springs, rivers, wells and ponds.	Threat to agricultural production systems.	Early flowering, e.g. Siplican. Spread of invasive species. Pest outbreak.
Banke/ Bardia (Rajpur and Balpur village)	Loss of NTFP species like Sarpaganda and Kurilo	Drying of wetlands. Decrease in aquatic populations.	Disruption of low-lying riverine habitats and agro-ecosystems.	Spread of invasive species. Outbreak of pests and diseases.

Source : Field Survey, 2009

8.3.1.2 Impacts on Animals and Livestock

Climate change impacts were observed in agriculture, livestock and forest species. The *Chauri* (mountain cow) population is steadily decreasing in Thulo Syabru of Rasuwa District. Communities indicated that 80% of the population used to rear *Chauri* in the past, but now only 20% raises *Chauri*. Due to extreme drought, there is a direct impact on the growth of palatable grass species. Regeneration of fodder species, particularly herbaceous species, in pastures and forest floor is also decreasing. As a result, there is shortage in diversity and quantity of livestock fodder. This has affected livelihoods of local people through decreased production of milk and milk products. Livestock population in Ramche is also declining. Drought has also affected livestock by drying water sources and streams and decreasing availability of drinking water to livestock. Wind also affects livestock, particularly livestock infrastructure, by overturning roofs of livestock shelters. Besides biophysical factors, there are other reasons for the decline of livestock population including shortage of labor, declining rangelands, and opportunities for other kinds of work.

According to communities, wild animals such as tiger, monkey, blue bull (*nilgai*), swamp deer, jackal, wild boar, and wild rabbit have declined from Balapur area. Heavy deforestation and loss of forests from river cutting are some of the causes of decrease in wildlife population. Similarly, users have reported the loss of key bird species like crow, eagle, and sparrow from their areas. CFUGs from other sites also shared similar experiences. They mentioned that riverbank erosion, and destruction of forests during floods was contributing to shrinking habitats for wild animals.

There are other interesting anecdotal evidences on wildlife populations. Communities in Rasuwa are noticing early bird breeding and appearance of mosquitoes for the last 2-3 years. According to them, forest fires and forest cover reduction have significant effects on wildlife movement, particularly among birds and mammals. People reported frequent sightings of wild boar, Himalayan black bear, monkeys and porcupine (*Dumsi*) in agricultural lands and human settlements in search of food. Wild boar damaged wheat fields, and local people responded by using local tools to protect crops such as building human-like artificial structures and installing drums to produce loud noises that would chase away wild animals. Perception of local communities on human-wildlife conflict was not favorable towards conservation of these species, hence indicating the need for special incentive programs to address this issue. There was human-wildlife conflict in both Ramche and Thulo Syabru areas of Rasuwa district. The cause of this conflict was habitat degradation of wildlife fueled by climate hazards such as drought and fire. People reported that while musk deer occurrence in Thulo Syabru area was previously frequent in the last decade, they are now scant or absent. They suspect that musk deer is moving to upper belts

in search of better habitat. In Ramche area, people indicated that Himalayan black bears, which previously occurred frequently in agricultural fields and settlements, were no longer sighted. Communities also mentioned a decline in snow leopard population due to decreased snow in the mountains. One of the interesting observations shared by communities was that wild boar had migrated upwards from 3,500m to 4,000m msl.

Discussion with communities revealed that forest fire is the major factor affecting wildlife population in Langtang National Park. Fire has affected wildlife habitats in the Park including those of forest birds, musk deer, wild boar, monkeys, and Himalayan black bear, among others. In particular, fire has damaged bird nests in forest areas. Local people also indicated damage from fire to medicinal plants. Fire has also reduced regeneration of vegetation by destroying understory seeds and seedlings.

8.3.1.3 Spread of Invasive Species

There are concerns among the scientific community regarding the outbreak of invasive species due to increased temperature, as well as its negative impact on biodiversity. Changes in temperature and rainfall are creating favorable environments for pests, diseases and invasive species to emerge, spread and encroach on agriculture and forestlands. Although there are few studies on the spread of invasive species, local communities have already experienced the emergence of species they have never seen in their lives.

Invasive species like *Parthenium hysterophorus, Nilgandhe, Aalas (*Euphorbiaceae family*), Daldale (Portulaca oteracea), Hauda (Medicago denticulata), Gorakh pan (Spilanthes species), Sewali (Cuscuta reflexa), Pyaaje (*Liliaceae family*), Banmara (Lantana), Titepati, Jhiljhile, Lasur,* and *Karangi*[3] are evident in the study areas (see Annex 5). These weeds and species are new to both researchers and local communities. *Banmara lahara* (*Mikania micrantha*), an invasive plant species, has invaded large areas of Chitwan National Park and is spreading in other protected areas. This has slowly reduced available Pastureland[4].

Communities perceive that invasive species is spreading very fast and damaging both agriculture and forestlands. Users were worried that production of major crops had declined to some extent due to spread of invasive species. Communities link the emergence of these new invasive species with increased temperature and floods. However, this needs further verification through research. Within the last five years, both CFUGs in Dhading District observed that *Gandhe Jhar* (*Ageratum conyzoides*) and *Kande Jhar* (local weed) had invaded their farmlands. Interestingly, its color has also changed from white to purple.

3 These are local names of weeds and species.
4 Information shared by Mr Sunil Pant, Constituent Assembly member.

Photo 4: Spilanthes sp. (left) and Lantana Spp.(right)

Banmara (*Lantana* and *Eupatorium spp*.) is the major invasive species found throughout Langtang National Park. Local people have reported that this species has been widespread in Gosaikunda Lake (4,300m msl) area, as well. Another invasive species in the area is *Kande Jhar*, a spiny weed. Local people have observed these species since the past 7-8 years, and they relate it with decreasing snowfall. Invasion by these species has caused a decline in herbaceous forest species including medicinal plants and fodder. If not taken care, it can have immense impacts on biodiversity conservation, especially by threatening flora and livestock (yak) farming.

8.3.2 Impact on Livelihoods

8.3.2.1 Agriculture and Food Security

Nepal's agriculture will face many challenges in the coming decades as degrading soils and declining water resources place enormous strains on the productivity of the land and achieving food security for it growing population. The conditions may further be exacerbated due to climate change and its unwanted impacts. Warming of more than 2.5ºC could reduce global food supplies and contribute to higher food prices (IPCC, 2007). In Nepal, most irrigated terraces have been converted into rain-fed *bari* land, as a result the crop production is decreasing. Decline in food production will lead to increased malnutrition and severe consequences, particularly for children.

Studies were conducted on the impacts of climate change on some cereal crops of Nepal (MoEST, 2004). Vulnerability assessment of rice yield showed that a 4º C rise in temperature and 20% increase in precipitation could result in marginal yield increase from 0.09 to 7.5%. Beyond that, the yield would decline. In the case of wheat, the actual yield showed increased output in the western region of Nepal with rise in temperature, but a decline in other regions. Similarly, temperature rise showed a decrease in maize yield with increase in temperature. Though temperature rise had more negative effects on maize yield, the trend was almost similar to wheat. However, rice, wheat, and maize responded positively under double CO_2

concentrations. Wheat potential increased by a high of 60%, rice yield by 21% and maize yield by 12%.

More than 90 percent of the population at the study sites depend on agriculture for their livelihoods and follow traditional cultivation practices that rely on seasonal rainwater. Change in climatic conditions affecting rainfall patterns is having an adverse impact on livelihoods of most of these communities, thus increasing their risks to food insecurity. The impact of climate change on agriculture has affected economic well-being of the population. According to CFUGs, there have been changes in rainfall patterns: length of rainfall has decreased but its intensity has increased, i.e. more rainfall in short of time. According to Users of Banke/Bardia, rainfall days have decreased from 5 months to nearly 2.5 months within the last ten years, while intensity per rainfall period has increased. This contributed to heavy floods, riverbank erosion, and loss of both top soil and crops. Users stated that increased weather unpredictability and intensity of climate hazards had disrupted rainfed agricultural systems and caused loss of local landraces of crops. Similarly, Users in Dhading and Rasuwa Districts noticed sharp declines in production of agricultural crops due to lack of rainfall (Table 5).

Drought has multiple effects because it affects not only water resources, but also agriculture, and subsequently food security. Study sites at Dhading are now facing challenges of drought and water shortage. Users were forced to carry out mal-adaptation practices such as using machines to pump water from natural springs and ground water sources in order to fulfill their daily water requirements for household and farming activities.

Table 5: Impact of Climate Risks and Disasters on Agricultural Systems in Study Area

Categories	District		
	Banke/Bardia	Dhading	Rasuwa
Loss of local landraces	Anadi, Dhunmuniya, Masuli, Shyamjira, Tilki, Barma, Sungapankhi, Deruwa, Rudhani Tilki, Shyamjira, Sungapankhi, Barma, Kanakjiria, Basmati, Goguwa, Sauthiyari, Suhawat, Gopal, Latera, Rudhani	Krishnabeli, Chuinekath, Aanpjhutte, Chinia	Buckwheat and Naked Barley (Karu)
Loss of production of key crops	Rice, Wheat, Lentil, Chickpea, Mustard, Millet, Maize	Rice, Wheat, Maize, Pulses (Gahat), Sugarcane	Buckwheat, Barley
Change in cropping patterns due to extreme events	Only one crop per season	Only one crop per season; more attracted towards vegetable farming	Shift to vegetable farming
Pest and diseases	Increasing	Increasing	Increasing
Input of production	Increasing use of chemical fertilizers and pesticides	Intense use of chemical fertilizers, pesticides and underground water	Increasing
Emergence of new crops	Vegetables, Maize	Off-seasonal vegetables	Sugarcane, Vegetables

Floods and changes in rainfall pattern had drastically decreased yield and production of key crops such as rice, maize, wheat, lentil, and chickpea. Mustard cultivation was almost abandoned at the sites due to unfavorable growing conditions[5]. Many Users mentioned that due to decreased rainfall, the water table has been lowered resulting in water scarcity for irrigation and the area turning arid. Users also mentioned that floods had converted productive paddy fields into sandy beds and deserts. Several new pests had also appeared and were attacking local crop landraces. Insect pests and diseases attacked chickpea (Arhar) and mustard. Users also noticed that pear, guava, and mango were flowering earlier than in the past, and that the ripening and harvesting patterns of some crops had changed by 10-15 days. In parts of Ramche and Syabru in Rasuwa District, Users no longer grew buckwheat and naked barley (*Karu*) due to decreased rainfall. Most Users were found to be abandoning production of potato, which is one of the major crops in the areas.

Other studies also support the above findings. In a study conducted by Regmi *et al*. (2009) in Talbesi near Chaur village, it was found that there used to be large swamps and wetland areas. Users of Chaur village used to cultivate a local rice landrace, *Gauriya*, which grew well in these areas. However, frequent flooding of the Talbesi River and its tributaries deposited massive amounts of mud and soil, thereby turning this swampy area into dry agricultural land. As a result, *Gauriya* rice was no longer grown and was replaced by modern varieties such as *Radha* and *Mansuli*. Now, on the one hand, Users cannot find seeds of local landraces, and on the other hand, they are facing difficulties with production and expenses of growing modern varieties.

Another study by Bhandari (2008) in two agro-ecological zones, i.e. hills and Terai, revealed that more households (40%) in the Terai than hills (11.6%) reported decrease in crop production from 5-25% due to abnormal rainfall. Similarly, 11.1% respondents experienced food insecurity due to crop loss/failure in non-normal rainfall years. This clearly indicated that in the hills where landraces dominate, the effect on crop yield was low in comparison to the Terai where mostly modern varieties are grown. There is high risk of food insecurity during abnormal rainfall years in the Terai due to increased dependence on modern varieties.

The Western Terai Landscape Complex Project (WTLCP) in Nepal documented some interesting examples. Users in Shankerpur VDC of Kanchanpur District lost their local rice landraces because they prioritized high-yielding early-maturing non-local varieties. WTLCP worked to promote local varieties such as *Tilki* and *Shyamjeera* in the area. An unexpected and devastating flood in October of 2008 destroyed the early-maturing varieties, but the local rice landrace survived the flood. This has given some relief to the households who were suffered from the massive flooding.

5 Mustard cultivation is slowly being replaced by other crops due to lack of winter rain.

In Rasuwa District, some crops, which previously did not occur in the area, were now thriving in the current environment. Sugarcane is now grown above 2,000m, and a number of vegetables and fruits – oranges, guava, and persimmon – are being produced in high amounts. Communities were happy with the increased production of vegetables but were worried about incidents of diseases and pest attacks in agricultural crops.

In high altitudes, previously grown fruits and crops were suffering from climate change. Apple production in Ramche and Syabru was reported decreasing. Communities noticed a sharp decline in apple production due to early flowering and increased disease and pest incidents. Communities strongly felt that increased temperature was responsible for early flowering of apples. The decreased in apple production and yield in recent years was causing major economic loss to Users. Officials at the Rasuwa District Agricultural Office also validated this information. Furthermore, there is significant decline in the yield of winter crops as there is a decrease in snowfall. Users have also observed increased incidents of aphids in winter due to decreased snowfall that favors development of aphids.

Although some Users may benefit from temperature increase in the short term, most Users are worried about the changing climatic scenario. Delays in the monsoons in the past few years have changed cropping patterns and crop maturity periods. Planting and harvesting seasons have been pushed back by a month, and rotational cropping systems have been consequently affected. Thousands of hectares of farmland have become fallow, and production has declined due to lack of water and delayed rainfall. Users have experienced that the intensity of rainfall has decreased, and the rivers and springs have dried due to low levels of water. These negative trends are likely to continue in the future and will make poor Users more vulnerable to climate risks and hazards.

Box 2: Impact of Rainfall and Flooding on Local Livelihood

The impact of decreased rainfall and flooding is massive in our village. I lost around 1 hectare of my agriculture land, two dozens livestock and a house. My agricultural land was converted into desert land. Less rainfall led to loss of local landraces (*deruwa, syamjira, sunga pankhi, rudhani, dhanmuniya*), increased land erosion hence contributed in conflict between landowner and tenants. Climate-induced disasters decreased food security and now I can feed my family for only 6 months. It damaged 7 hectares of forestland and contributed to the loss of major species. The flood also damaged infrastructure (roads and buildings). Invasive species have now started to emerge (*banmara, kalo pati, kareli, gaja*).

Kariga Tharu, Rajpur-9, Kanchanpur VDC, Banke District

8.3.2.2 Loss of Land and Human Life

Communities indicated that climate risks and hazards had negative impacts on their resources and livelihoods. Intense rainfall induced riverbank erosion and flooding, and consequently contributed to loss of houses, farms, crops, livestock and infrastructure. Users in Banke District remembered a flood that damaged thousands of houses, killed 70% livestock, damaged thousands of hectares of land and rendered many people homeless. The entire village of Rajpur was evacuated and moved to a nearby forest area (see Box 2). Similarly, frequent flooding occurred in recent years in Balapur VDC of Bardia District created panic and damaged key community assets such as homes, land and infrastructure.

In Rasuwa, from 2003 to 2009, landslides affected over a hundred people in the study sites. Landslides killed more than 37 people, left 100 households homeless, and caused damages amounting to US$ 1 million. A total of 3.51 ha of land were lost within the last few years. The entire population of Ward 9 of Ramche, i.e. 68 households, was reallocated to another place due to landslide. Disasters, including floods and drought, severely disrupt livelihoods and community development. In fact, drought has affected an even greater number of people.

8.3.2.3 Drying of Hydrological Cycles-Wells, Springs and River Sources

Photo 5: Drying of Traditional Ponds

In Dhading District, natural springs, wells and water sources have dried since the last 7-8 years due to decreased amount of rainfall to recharge these sources. Communities from Deupuje CFUG reported that 11 of their natural wells had dried up in the last few years. Similarly, streams in Ramche area were completely dry during the dry season, but they triggered flash floods during the rainy season. In Gatlang of Rasuwa district, 8-10 water sources existed in the last decade, but now only 2-3 sources remained. Local people and tourist guides indicated that if snowfall continued to decline, glacial lakes would soon dry out and even disappear. This has caused tremendous losses to poor people. Similarly, drying of waters in rural areas is also causing problems for water mills and cultural monuments and heritage like "*Mane-peme*". In some areas of Dhading District, poor people have to walk a longer distance to fetch water, while in others people are now forced to use alternative sources such as improved tube wells. Drying of springs has in fact caused major problems to paddy cultivation that depends on rain-fed systems from the monsoons. In addition, drying of wells and springs decreased soil

moisture of agricultural lands, causing major problems in food security. Users complained that ponds, which used to be bathing pools for livestock, are now depleted due to water shortage. Traditional systems of livestock rearing have also decreased causing major implications to the number of livestock reared by households. However, we observed some mal-adaptation practices that were being followed due to water scarcity. People are exploiting underground water for irrigation purposes, which might be a major problem for increased water scarcity in future.

Box 3. Consequences of Mal- Adaptation Practices

Hira Bahadur Bhujel is a poor farmer from Deupuje CFUG, Jivanpur-9, Dhading District. He owns 0.3 ha of land, and leases the same amount for farming. His land is located nearby Mahesh River and is connected with Maheshtar irrigation facilities. A prolonged dry period that started from September 2008 has affected his farming. Inspired by his cousin brother, he recently bought a water-pumping machine to irrigate water in his land. He invested NRs 13,000 (US$ 175) on the machine and accessory pipes. Like Bhujel, other households (16%) near the riverside area own a pumping machine to irrigate their land. They dig a large hole where water will retain from the groundwater table. They plug in the machine and irrigated their farms. Others pump water from a natural spring, and they complain that the groundwater pumping is contributing to drying of spring and lowering the water table.

Stakeholders at the consultation meeting in Bardia District also shared similar experiences. People observed a decrease in flow and discharge of water particularly in Babai and Karnali Rivers[6]. According to them, the level of river water has subsequently gone below record, and canals and local irrigation channels have been drying up. These experiences were also occurring elsewhere as higher temperatures, increased evapo-transpiration, and decreased winter precipitation caused more droughts in Nepal. In addition, many rivers may face highly variable flows with climate change. Local residents shared that variation in river flow has severely affected irrigation, particularly in Banke, Bardia and Kailali Districts, and in central and eastern regions of Nepal.

Wetlands, including ponds, streams, temporary canals and rivers, are livelihood resources for ethnic *Majhi* and *Bote* communities in the Terai. Fishing communities who depend on these wetlands complain about the drying of these resources, as well as the decreasing fish numbers. This has posed serious challenges in sustaining the livelihoods of these poor ethnic communities. Fishing households in Bansakti and Balapur villages of Bardia district shared their bitter experiences on decreasing water levels in the river and shrinking fish populations.

6 Mr. Dayaram Khadka, ex-Mayor of Gulariya Municipality, mentioned that he has been observing such changes in the flow of water in Babai River since last few years.

8.3.2.4. Impact on Human Health

Climate change is expected to have many consequences for human health. Diseases such as malaria and Japanese encephalitis have spread to new areas. One area prone to increased diseases is the lowlands of Nepal, i.e. the Terai, which is warmer than mountain regions. The general trend of malaria cases increased during the period from 1963 to 1985, and then subsequently decreased due to adoption of mitigation measures. Temperature between 22-32ºC favor development of mosquito and completion of its life cycle, while those above 32-34ºC could reduce its survival rate substantially. Thus, the temperature range in Nepal is highly suitable for the malaria parasite to exist and develop. *Kala-azar* (Visceral leishmaniasis) cases have also shown an increasing trend in the last two decades. This trend is becoming more pronounced in recent years. *Kala-azar* reached epidemic form in eastern and central regions of Nepal, especially in the Terai Districts. The most vulnerable are poor people and rural cattle keepers. Similarly, Japanese encephalitis occurs mainly at average annual temperature range of 23-26º C, thus an increase in temperature will make the subtropical regions more vulnerable to this disease (Regmi *et al*., 2007).

The impact of climate disasters on human health is very high. Communities at all study sites have experienced intense heat since the last ten years that resulted in development of allergies and itching problems, particularly in women and children. The time-lines show that communities' perception of intense heat also coincides with the spread of mosquitoes and outbreak of diseases like Japanese encephalitis and malaria. Almost all respondents in Dhading mentioned the need for using mosquito nets and repellents during summer. They further reported that the size of mosquitoes had increased. Aftermath of flooding is often painful to villagers. According to information derived from focus group discussions, more than 60% of children and the elderly suffered from water-borne diseases like cholera, diarrhea, and skin infections. Similarly, communities reported that invasive species observed in their locality, like *Parthenium hysterophorus*, caused irritation and swelling of eyes[7]. In one of the discussions, CFUG members also indicated that they encountered new diseases during the monsoon season when risks and hazards were most expected.

8.4 Vulnerability Posed by Climate Risks and Hazards

Vulnerability is defined as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Climate induced risks and disasters[8]

7 Mr Tihar Bahadur Tharu, a resident of Balapur village, shared that invasive species is detrimental to the health of both humans, as well as animals. He himself felt the irritation and problem in eye due to exposure to *Parthenium weed.*

8 Climate risks and hazards are identified by communities based on changes in rainfall and temperature. It was distinguished with natural disasters based on the frequency, magnitude and impact of rainfall and temperature variability.

will contribute to pre-existing poverty, low economic development, and exclusion of communities making them more vulnerable and poor. Risks and disasters will also weaken livelihood assets and further increase their vulnerability. There are many causes besides biophysical, which pose threats to livelihoods. The assessment explores causes of vulnerability among communities. These causes demand further studies in order to explore factors contributing to negative impacts on livelihoods of communities.

8.4.1 Impact on Poor Ethnic Groups

Poor people are vulnerable to loss of physical capital (damage to shelter and infrastructure), human capital (malnutrition and diseases), social capital (displacement of communities), natural capital (loss of productivity in agriculture and fisheries) and financial capital (more disasters and lower income). Degradation of livelihoods by climate change will thus leave poor people with fewer of the assets they need to withstand shocks and stresses.

Group discussion with community members clearly indicated that poor, marginalized, women, children and the disabled are most vulnerable to climate change impacts as they have less capacity to cope up with such unvoigable situations. In Rajpur village of Kachanapur VDC in Banke District, flooding resulted in loss of homes, and many households had to settle in upstream forest areas. Each family was allocated 0.06 ha land for settlement, but due to large family sizes among Tharu ethnic group, they were forced to return to risk-prone areas in order to feed their families. There are around 35 households living along the river basin, most of them are Tharu households affected by flooding every year. They mentioned that they do not have any choice other than settling in these high-risk areas.

Communities in Dhading and Rasuwa Districts also shared similar stories. Due to drought, farm labor input is increasing and poor people[9] must input hard labor to produce enough to feed their family. Similarly, death toll from landslides, flooding and other disasters indicate that ethnic groups, *Dalit*s, women and children account for 70% of the total[10].

Loss of life and reallocation is making the life of poor people more painful and frustrating. In wards 1 and 9 of Ramche VDC, frequent landslides made all families homeless. There were 17 households in Ward 1 who live in caves as they lack money to build another house, while 68 households of Ward 9 have completely resettled in nearby areas. They have few options

9 In this context, poor means those people who are landless, depend entirely on nature and in particular natural resources, economically weak, isolated in terms of trade, have weak infrastructure, and lack access to technology and information and armed conflict. These factors have made it more difficult for such people to cope with agricultural consequences of climate change.

10 Household survey and focus group discussions at all study CFUGs.

for diversifying livelihoods and reducing vulnerability. Discussion with communities indicated that poor people do not have adequate assets to sustain their livelihoods after hazards because of low financial resources, poor health, lack of clean water and sanitation, weak physical infrastructure, and remoteness from government services. Lack of access and ability to use technology reduces their speed of recovery and options for livelihood strategies.

Focus group discussion and matrix ranking with communities suggest that the degree of vulnerability in terms of risks and hazards is different among social categories of users. Well-off users and ultra-poor users have various coping and adaptation strategies and capacity, which makes their vulnerability status different. Vulnerability also depends upon exposure and strength of livelihood assets. The findings suggest that in both Rajpur and Balapur villages, the impact of disaster in mostly economic, human and social assets are very high in terms of poor, and high in terms of well-off households. There is no significant difference between these two categories of users as communities mention that there are not many economic (income level) and social (living standard) differences among them in these two villages. There are examples where land and livestock of poor are totally lost during flooding, and due to lack of available cultivated land and livestock their lives became miserable. There are even landless communities in Rajpur village of bardia district who have to rely on wage labor for their survival due to loss of their limited parcel of land.

8.4.2 Impacts on Gender Role

Photo 6: Women waiting long for Water Collection

Gender dimension analysis in climate change impact is essential for developing countries like Nepal, where women, children and resource-poor are vulnerable and marginalized. Of the total households surveyed by questionnaire for climate change risks and hazards, 30% were female respondents. Majority of respondents were from Tamang ethnic group, followed by Tharu, Chhettri, and Janajati. Female representation during FGD on climate change perspective was satisfactory (30-75%). However, the level of participation during discussions varied among districts: there was active female participation in Dhading, medium level participation in Banke, and passive participation in Bardia.

Decreased Food Security: Study found that women have to bear a disproportionate burden of climate change consequences. Women play a

dominant role in subsistence agricultural production. The increasing trend of male migration for exploring employment opportunities creates pressure on women for subsistence production in addition to household chores. Moreover, climate change and its consequences increase the unpredictability and scarcity of food sources. Around 90% of female respondents reported that they were facing problems from climate change, particularly increased temperature and unpredictable rainfall that exposed them to loss of harvests, often their sole source of food and income. Invasive species, mostly weeds that proliferate due to climate change, has also decreased productivity, and women bear additional burden of weeding them out.

Increased Household Activities: Most respondents reported that climate change might exacerbate existing water shortage. Women are largely responsible for water collection and are thus more affected when the quantity of water and/or its accessibility is changed. Female participants reported that they invested more time (about 2-4 hours) collecting water for household activities when compared to the last five years, and this had affected their other household activities. Stresses and shocks had added to already aggravating problems and contributed to increasing vulnerability of communities in both Deupuje, as well as Phusremato CFUGs.

Increased Burden of Care Giving*:* In most households, women were responsible for caring their family members. As primary care-givers, women may see their responsibilities increase, particularly when family members fall ill due to exposure to vector-borne diseases such as malaria, diarrhea, and cholera.

Increased Burden Due to Infrastructure Damage*:* Climate hazards damage rural infrastructure like bridges, roads, and culverts, which further increase vulnerability among women. Because women were actively involved in water collection, marketing, forage and livestock fodder collection, they were affected when infrastructure was damaged. Women were responsible for managing with damage to infrastructure, as well as household property and livestock. In most rural areas, the male member is away from home and women must therefore take care of family members, as well as property. Women must make decisions in the aftermath of climate change disasters. In most cases, it was found that women, children and old people suffer directly from climate hazards, as women are unable to provide complete protection to other family members. In these situations, women are under stress to rescue their family members and to protect physical properties including grain and livestock. The study in Balapur and Rajpur villages found that mostly women, children and old people lost their lives due to climate hazards.

8.5 Vulnerability among CFUGs

The degree of vulnerability[11] varied across CFUGs, i.e. among active and less active CFUGs (Figure 8). Impact was high among all CFUGs, but capacity to cope differed between active and less active groups. Active CFUGs have greater capacity to cope than less active groups. This may be due to several reasons. CFUG members reported that one of the contributing factors to coping capacity was available funds, good governance, and investments.

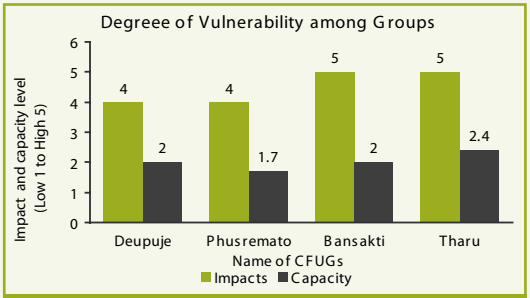

Figure 8 : Degree of Vulnerability among CFUGs.
Source : Field Survey, 2009

There were some differences in vulnerability between active and less active groups, i.e. between Tharu Mahila CFUG and Bansakti CFUG. The impact of climate risks and hazards for both CFUGs is very high due to its severity and frequency. During group discussion, members of both CFUGs mentioned that floods and riverbank erosion had major impacts on their livelihood assets. Similarly, CFUG members mentioned that in the last 10 years, floods and riverbank erosion were increasing in magnitude, impact and negative livelihood implications. Coping and adaptation capacities in terms of socio-economic conditions of users, technologies, human resources and financial resources were high in Tharu CFUG than Bansakti CFUG.

There were some differences in vulnerability among active and less active groups, i.e. between Deupuje CFUG and Phusremato CFUG. The impact of climate risks and hazards for both CFUGs was relatively high due to its severity and frequency. However, capacity to cope in Phusremato CFUG was low due to less exposure and access to adaptation technologies and lack of information. Discussion in both CFUGs mentioned other climate risks and hazards like landslides and floods, but it seemed that the drying of rivers, springs, lowering of water table and water scarcity are the major problems that affected people's livelihoods.

8.6 Causes of Vulnerability among Groups

One of the major objectives of the study was to explore groups and communities vulnerable to climate change impacts and to determine the reasons behind it. Vulnerability is not the outcome of a single factor; rather it is caused due to physical and biological losses (low biodiversity, sensitive ecosystem, and

11 The degree of vulnerability was determined by matrix ranking where communities ranked the impacts of major climate risks on their livelihood assets (physical, biological, financial, human and social) and their coping capacities (availability of resources to counter problems). The vulnerability is the difference between the impact and capacity to cope.

water stress), poverty, conflict, exclusion and lack of access to knowledge, information and technology. This section will present the main vulnerability factors identified in the selected project areas, reflecting the dynamic contexts in which poor people in the area experience adverse weather events. Also, in this case, there are several social, economic and environmental problems creating vulnerability to climatic risks exemplified above.

8.6.1 Socio Economic Condition of Users

Household income level is relatively low at all study sites. Most people depend upon subsistence agriculture that does not contribute significantly to household requirements needed to feed household members. Only a very few households were reported having monthly income more than NRs. 20,000 in 2008. Local people were found to be engaged in various on-farm and off-farm activities, including sale of agricultural and livestock products. Earnings were reported to spend on food, medicine, clothes and children's education. Rich households invested in purchasing land and houses in nearby cities. Community members also engaged in wage labor and migrated to India and abroad for employment.

Gender differences were noticed in the workload, with women working more than men do. Women were more involved in planting, sowing, processing and harvesting, whereas men were involved in marketing and social services, and migrated to India and Gulf countries for in search of jobs and employment. Children from poor families and elderly people were found engaging in heavy household and farm work as well as wage labor[12]. Since women, children and elderly people often faced disasters, they were more vulnerable.

Agriculture was the major source of income among more than 90% of households in the study sites. Livestock farming used to be the major livelihood source in Rasuwa, Dhading and Banke/Bardia Districts. However, users mentioned that the number of livestock was decreasing. Decrease in grazing land, lack of feed availability, and other demographic factors were causing the decline in livestock population. Communities are now exploring other options and opportunities like livelihood diversification to sustain their livelihood.

Education level in the area was also low in comparison to the national level due to that fact that more than 50% of users were illiterate and cannot read or write. However, users mentioned that there was increasing trend of sending children to schools nowadays. All sites have education facilities, i.e. up to high school level education. However, in high mountains it was often difficult to reach the schools due to difficult terrain and distance.

12 Pimkali BK of Rajpur village (Kanchanapur VDC-9) in Banke District mentioned that due to labor crisis in her home she had to request her children to drop out of school and support her in wage laboring and agriculture work.

Analysis showed that there was a significant difference in education and annual income among well-off and ultra-poor families. The poor have less education and income than the rich do. Rich households have more income than the poor do, and education levels among the rich and poor, and active and less active groups were significantly different (Table 6). This implies that income and education are determining factors for differentiating rich and poor households.

Table 6: Comparative Analysis of Differences within and among Groups

Categories	Income	Education	Food sufficiency
Well-off Vs. Ultra poor	0.001 (0.992)	0.111 (0.170)	Not significant
Active Vs. Less active	5.080 (0.026)	0.544 (0.466)	Not significant

Correlation is significant at the 0.05 level.
Figures in parentheses indicate the t-value or correlation value.

More than 90% of ultra-poor households were food-sufficient for less than six months from their land production. Food sufficiency was also a problem among well-off households, although it was not as severe as among poor households. However, the analysis does not show any correlation between these two categories and within the groups.

In Thulo Syabru of Rasuwa district, most of the people changed their livelihood strategy from agriculture to hotel management, so the impacts are less in Thulo Syabru than in Ramche. Also, people in Thulo Syabru are financially better off than in Ramche, Rasuwa district.

More than 70% of households at all sites have temporary houses made from mud, wood and bamboo. However, during disasters, rich households have some mechanism of protecting their key resources in comparison to the poor. In Balapur village of Bardia District, well-off families have permanent structures to protect themselves and their key assets like harvested grains, while the poor have temporary and fragile structures to protect only their lives. Majority of ultra-poor respondents (70%) mentioned that they were helpless during disasters. They also shared that they could only wait and pray for the least damage to occur[13].

8.6.2 Awareness and Knowledge

Awareness and knowledge on climate change at the study sites were very low (Figure 9). Communities did not understand climate change, but they have experienced changes in terms of temperature and rainfall. Many of the users related climate change with natural changes and changes in the ecosystem.

13 Mr. Hari Bahadur Tharu, a resident of Balapur-9 of Gulariya-Bardia, shared that he and his family spent three days and three nights on the roof of his temporary house during a flood without food and drink, waiting and praying for their survival.

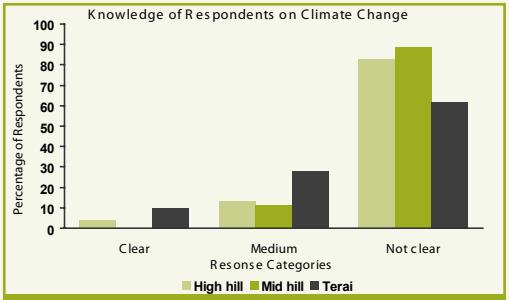

Figure 9 : Knowledge of Users on Climate Change
Source : Field Survey, 2009

Analysis done by using SPSS tools showed that there was a significant difference between poor and well-off and between active and less active groups on climate change awareness and knowledge (Table 7). Knowledge on coping strategies between well-off and ultra-poor users is different, but there is no difference between active and less active groups. Policy-level awareness was low among all categories of CFUGs because climate change has not been in the agenda of local education systems or in development.

Table 7: Comparative Analysis of Awareness and Knowledge within and among Groups

Categories	Awareness on Climate Change	Knowledge on Coping	Awareness on Policy
Well-off Vs. Poor	-0.072 (0.374)	-0.096 (0.235)	-.024 (0.763)
Active Vs. Less active	2.036 (0.156)	16.361 (0.000)	0.454 (0.502)

Correlation is significant at the 0.05 level.
Figures in parentheses indicate the t-value or correlation value.

8.6.3 Institutional Governance and Group Dynamics

Institutional governance and group dynamics play an important role in identifying options and opportunities for building resilience of communities. The study showed that the stronger the group, the stronger the initiatives and activities in terms of helping the poor and supporting their livelihoods. CFUG investments depend upon size of funds, leadership, user dynamics, and visionary levels of committee members. There were some differences between active and less active CFUGs, which are categorized based on fund flow, regularity of meetings, initiatives in resource management, governance, and participation. The study further supported this categorization. The study team observed that active CFUGs have managed their funds well, and invested wisely in forest management, community development and investment for the poor. For example, Tharu CFUG of Balapur village in Bardia provided a soft loan to poor users to send their family members to foreign countries. Similar examples were also found in Dhading and Rasuwa Districts.

8.6.4 Available Technologies and Knowledge

Existing local knowledge, practices and technology influence coping and adaptation strategies of communities. Although discussion with users at all study sites showed that available technologies and knowledge was limited except in Balapur village in Bardia, adoption of climate-resilient agricultural

practices was more common among well-off users in comparison to the ultra-poor. The analysis (Table 8) showed that rich households had adopted new agricultural technologies and diversified their livelihoods. It was observed that well-off users planted new crops and species and used recent technologies to counter problems of drought and landslides. This holds true with all users regardless of the type of CFUG (Table 8).

Table 8: Comparative Analysis of Adoption and Livelihood Practices within and among Groups

Categories	Adoption of Climate Resilient Agriculture Practices	Diversified Livelihood	Protection of Key Assets
Well-off Vs. Poor	0.035 (0.664)	-0.20 (0.804)	Not significant
Active Vs. Less active	Not significant	Not significant	Not significant

Correlation is significant at the 0.05 level.
Figures in parentheses indicate the t-value or correlation value.

8.6.5 External Support

External support and interventions during disaster and relief operation affected vulnerability of communities. These were further linked to exposure and access to information, knowledge, technology and resources to cope with climate risks and disasters. Among users in Banke and Bardia Districts, it was observed that active CFUGs had more external support than less active CFUGs. In Balapur village of Bardia, there were more than 20 organizations working on forestry, agriculture, disaster risk reduction, health, and infrastructure. A specific project was also being implemented on disaster preparedness. On the other hand, in Rajapur village of Banke, there were limited external interventions and no support during disasters. This was also true for CFUGs in Dhading and Rasuwa districts. The differences were mostly due to limited intervention and support from the external organizations. There is no significant difference in coping strategies and adaptation between active and less active groups. This indicates that both types of groups did not have much socio-economic differences and are equally vulnerable to the climate risk and disasters.

8.6.6 Coping and Adaptation Strategies at Community Level

Adaptation is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation (UNFCC, 2009). A fully conceived, integrated and functioning regime for adaptation to climate change impacts is yet to emerge (Reid & Huq, 2007). However, at the study sites, there are some local coping and adaptation strategies adopted by communities in response to potential/observed risks and hazards related to climatic and non-climatic factors.

From the perspective of poverty reduction, adaptation is already necessary as people's lives and livelihoods face an increasing burden of broader shocks and stresses. Communities have been using traditional methods of adaptation for generations based on local knowledge and innovations. These community level evidences and anecdotal information require further investigation. There is a need to investigate whether or not existing local knowledge and livelihood assets enable villages to cope with climate change. It further examines how local knowledge and innovations are important in designing research and development interventions targeted for vulnerable communities.

8.6.6.1 Technical Strategies

Balapur village of Bardia District had an effective information and communication system in place, including an early warning system. There was also provision for communicating with the military camp in Chepang based on water levels in the river. The information flow mechanism is as follows: if the river depth rose to 4m, the information would be relayed to downstream communities; if the river rose to 5m, communities would be alerted; and if it rose above 6m, then communities would have to evacuate. The community was trained for rescue preparation. In particular, women were trained since male household members were less likely to be available due to their high migration rates. Similarly, rescue materials were also provided by organizations and included boat, rope, life jacket, siren, and information board on preparedness.

Seasonal and off-seasonal vegetable cultivation was one recent practice among communities to cope with extreme weather events and losses of major crops and vegetables. People have started to produce off-seasonal vegetables during winter. Every household in Balapur now cultivates and sells vegetables in the market. They were earning relatively more money than before. However, this was not the practice in Rajapur village of Banke due to lack of market and external support from government and I/NGOs. These findings support the previous conclusion regarding the relatively weak coping capacity of communities of Rajapur compared to Balapur.

In Ramche of Rasuwa District, communities were using some local strategies to cope and adapt to climate change impacts. Users changed their cropping patterns, i.e. cultivation of potato and maize one month earlier than before. They also started to sow the entire potato tuber instead of cutting it into two pieces to avoid rotting due to drought. Recent focus was on vegetable farming instead of cereal crops. People have started rearing poultry and goat, as these require less water. Similarly, groups have used gabion walls to protect landslide-prone areas. They have also planted Stylo *(Stylosanthes guianensis), Uttis (Alnus nepalensis)* and *Amriso (Thysanolaena maxima)* in landslide areas. Communities managed a water

tank to store water. Local people had adopted local techniques to prevent overturning of their roofs during windstorms. They have applied stones, wooden logs and gabion wires to press and tie their roofs. However, some people had no capacity to cope with shortage of water for irrigation due to lack of funds and technology. To cope with the energy crisis, most local people in **Thulo Syabru** of Rasuwa district installed solar panels in their houses. To prevent further landslide, the local community constructed waterway drainage at the head of the landslide to drain excess water in Ramche area of Rasuwa district.

In Deupuje CFUG of Dhading District, pipes were used for water management. There were temporary wells from natural springs for irrigation. Water pumping from Maheshtar irrigation canal and Mahesh River using machines was a recent and common practice. Some were digging wells in moist places. Users also mentioned plant-based irrigation for wise use of water. There were also changes in cropping pattern by replacement with less water-requiring crops such as finger millet, lentil, mustard and tomato. RIMS Nepal and District Soil and Water Conservation Office supported with wire mesh protection and construction of embankment near the river erosion site. The project planted bamboo, *Amriso*, Fodder, and *Simali* to protect the area from landslides and erosion.

In Phusremato CFUG in Dhading, communities pumped water from Kolpu River in lower lands (rich households only). Three springs were refurbished through VDC support (NRs. 7,000 each). One spring was refurbished with support from RIMS Nepal and local school (NRs. 2,057). Two springs were refurbished with help from local communities, and one spring refurbished with help from Focus Nepal (NRs. 2,063). UNICEF supported 19 taps in the village. Plantation activities were conducted through RIMS Nepal in order to check soil erosion and to increase greenery in degraded and denuded lands. Leasehold Forestry Program, with support from District Forest Office and District Veterinary Office, has utilized degraded land for plantation of bamboo, *Uttis (Alder)*, and *Amriso (Broom grass)*.

8.6.6.2 Social and Institutional Strategies

Social and institutional preparation for coping with risks and hazards was relatively weak in Rajapur village (Bansakti CFUG) of Banke District due to lack of group cohesion and communal efforts. The village has relatively strong CFUGs and other groups formed by organizations like HEIFER International and SAGUN Program, which focus on income generation, empowerment and governance issues. These activities increased community awareness on resource use and benefit sharing issues but had little to do with risk and hazard reduction and coping and adaptation strategies. On the other hand, communities of Balapur village in Bardia District were more

Box 4: Social Inclusion and Equitable Benefit sharing Strategy in Balapur, Bardia District

Balapur village in Bardia District, dominated by Tharu community, lies in Gulariya Municipality. This village is accessible by a linked highway, but people are poor, vulnerable and marginalized. "Flooding and riverbank erosion are the main problems that have affected our livelihoods many times within the past 30 years," says Kali Prasad Chaudhary (President of Tharu CFUG, Balapur). Before community forestry, people were not organized for development action in the village, and they used to suffer from food security problems and poverty. Gradually many research and development organizations started to work in the village. The Tharu CFUG of Balapur is now becoming a role model in Bardia District among 28 CFUGs. While determining the key factors for success of the CFUG, the study found that social inclusion strategy played an important role. The group developed different strategies to reach and provide benefits to poor and socially excluded community members. They focus on pro-poor and social empowerment interventions specific to the needs and priorities of different categories. Analyzing the problems and situation in the village, executive members of the CFUG decided to invest group funds for securing employment in foreign countries like India, Malaysia and Japan. Besides income generating activities like vegetable farming, livestock and other off-forest activities, the community perceived that investing in foreign employment contributed to improving people's livelihoods. This good inclusion strategy worked well for poor and marginalized households. The group allocated about NRs. 75,000-150,000 each year for this purpose. To encourage the poor and marginalized, the group invests 100% of their total required cost, while rich and medium members receive 25-50% of the cost. The CFUG also waived two months interest for poor members, after which interest must be paid at a rate of 12%.

Mr Sobindra Chaudhary, CFUG Secretary, highlighted the importance of this inclusion strategy to reach poor and vulnerable members in the group. Most of the poor and vulnerable members are taking benefit of this investment. Almost 100% of the investment was mobilized efficiently and effectively. The concept was now institutionalized within the group. This social indirectly strategy indirectly plays an important role in increasing resilience of marginalized and vulnerable community members towards climate change hazards, particularly floods and riverbank erosion. Households vulnerable to climatic risk are now able to construct improved/modified structures (cement up to water disaster level, concrete roofing and safe structure). They are also able to purchase and store food for crisis and disaster periods.

The social inclusion strategy of Tharu CFUG not only directly supported in improving livelihoods of resource poor and vulnerable community members, but also indirectly increased resiliency of community to climatic stress.

advanced and prepared in establishing social and institutional mechanisms for developing coping and adaptation strategies to deal with impacts of flooding and riverbank erosion. Tharu CFUG allocated NRs. 25,000 for relief

operation of flood victims. There was also provision to provide free wood for construction of houses for victims. There were relief committees of two members from each tole. The CFUG invested thousands of rupees to send members of poor and hazard-victim households abroad for employment. They provided NRs. 70,000-80,000 for poor members, and 50% loan for well-off households. There was also provision of waiving interest for two months for the poor. These provisions have helped poor households regain their economic condition, and it was interesting to note that their well-being status has changed from ultra-poor to medium. The number of such households now ranges between 10-15. Communities also developed an inclusion strategy that has contributed in dealing with climate risks and hazards (see Box 4).

In Ramche of Rasuwa District, people have resettled in new areas to protect their families from landslides. They have also used wire and stones to tie and press roofs to prevent detachment during intense windstorm events. Some well-off and rich households have migrated to cities and foreign countries due to frequent landslides, whereas ultra-poor households have resettled to new but vulnerable areas due to lack of capacity to purchase or settle in a better place. Well-off families have changed their houses and built concrete and permanent structures and used other sources of irrigation for their crops.

Employment pattern have also changed due to climatic hazards. Decline in productivity in Dhunche area caused many local people to shift their occupation to tourism, hotel and other services. In Thulo Saybru, a mother group was formed that works on awareness activities among women on biodiversity conservation. Money was collected monthly from all group members and provided as loan to needy members. They also provided loan to victims of landslides and windstorms. This has helped poor households to cope with hazardous conditions.

In Ramche, people were involved in CFUGs that mainly focus on environment and biodiversity conservation. These types of activities helped members to increase their knowledge on these areas, but they made less contribution towards coping and adaptation.

In Deupuje CFUG, communities were active and had established norms and regulation to manage their forest resources. The CFUG was providing social, economic and resource support to users, particularly poor households. Besides the CFUG, other social network included Kalyankari Women Group, Bhuwanishwori Community Development Group, Youth Club, and small farm groups. Similarly, **Phusremato CFUG** was also mobilizing its resources for forest management and community-focus activities. Recently in 2008, in Phusremato CFUG, District Veterinary Office and District Forest Office jointly handed over Leasehold Forestry Program to user groups in Jivanpur-7. Around 10 ha (200 ropani) land was handed

over to poor users in this Program. The total number of user households was 68 and included members from other adjoining wards. There were 23 household members in three leasehold forestry groups who commonly shared membership with Phusremato CFUG. With this leasehold forestry program, socially marginalized user groups are receiving benefits as member households allocate land territory for management. This Program also has implications in mitigating effects of climate change in terms of land use management and supporting livelihoods. In addition, what was new about the Program was that there is livestock loan and insurance scheme where user groups collect funds and disburse among themselves. Their unique social network supports the social system and functions.

8.6.6.3 Local Strategies

Local strategies in Rajapur village of Banke District were not visible except for some immediate responses to risks and hazards like shifting valuable goods and items to elevated places during flooding. However, in Balapur village of Bardia District, there were many local strategies and traditional systems in place. These were community-based adaptation strategies in dealing with climate risks and hazards. People have constructed shelters within their homes: *thaati* for rich and *aati* for poor. Similarly, they take their livestock to elevated and safe places during the flooding season. Priority was made on evacuating women, children, old and disabled during disaster events, and young people, mostly young women, were involved in rescue and evacuation. Houses were traditionally elevated to avert medium scale flooding. Animal shed, grain storage, and hay storage were also now elevated to protect from flood damage. Communities constructed earthen vessels at elevated locations to protect their grains. Communities also prepare dry food (bread, snacks) to be used during flooding.

Communities in Balapur village have started to use riverbanks for vegetable cultivation (*bagare kheti*). This riverbank used to be cultivated land before. Due to riverbank erosion and change in river routes, the land was converted into sand fields. Communities have learned to cultivate this type of land to grow vegetables, mostly tomato, bitter gourd, watermelon, sweet potato, sponge gourd, bottle gourd, and pumpkin. Similarly, sandy and riverbank land belonging to community forests was used for communal farming of rice, pulses, and wheat. The CFUG distributed the land equally among 116 households who now cultivate paddy, wheat, chickpea and lentil. From their harvests, the CFUG collects 15-20 kg from each household. The collected funds were then deposited in the CFUG account and used for social purposes. This shows that communities are managing land resources in an equitable and sustainable manner.

Vegetable cultivation in sandy soil was very promising in Bardia, Banke, Kailali and eastern region of Nepal. People grow seasonal vegetables during the winter season in order to utilize fallow sandy land and earn income. In

Balapur village, a farmer earns around NRs. 20-30,000 in a season. Users also commercially grew these kinds of crops in winter season due to high market price. This practice has potential to be disseminated in Rajapur village in Banke and other areas where farmland is sandy, and even in public and government barren riverbank land. Users, particularly ethnic inhabitants like *Tharu* communities in Rajapur of Banke District, have rich cultural and technical knowledge and practices in dealing with climate extremes like rainfall. If rainfall does not occur in the month of *Ashad* (June-July), the women dress as men, take their tools, travel to other villages and sing songs while collecting additional similar-dressed women. Hill migrants sacrifice a goat to a goddess if it does not rain.

Photo 8: Cultivation in Riverbank Sandy Areas

The Tharu communities of Belapur village in Bardia District have cultural practice of calling the rain '*Maghalotne*'. People go to villages, make the children naked, and pour dirty water over them. There is also a practice of bringing a cow from a neighboring village, and playing *dohari* (duel song) in which the neighboring village must win to take their cow back. Villagers expressed that during the year of cultural presentation, heavy flooding occurred after 2-3 days. Villagers also believe that if there is intense flowering of mangoes, then a flood will occur.

8.7 Analysis of Existing Policies on Climate Change in Nepal

The effectiveness of policies and measures for climate change adaptation is strongly dependent on the ability to identify extent of impact, and therefore of the vulnerability to climate change, of economic and social systems, both in space and time. While research and development activities related to greenhouse gas inventory in Nepal have progressed satisfactorily, those that address vulnerability and adaptation have yet to proceed satisfactorily. Various constraints have beenidentified, most important of which is the lack of technical capability to apply the results of Global Climate Models to local areas and making projections on their impact in different sectors and areas (Regmi et al., 2009).

At national and international levels, the government has made several commitments and agreed for policy formulation related to climate change issues. Analysis of existing situation of policies on climate change shows some gaps that require urgent addressing in order to devise an all-inclusive policy that delivers strategic plan of action to adapt and mitigate climate change impacts.

8.7.1 Government Policies and Program on Climate Change

The Government of Nepal showed its commitment to address climate change by becoming party to the Framework Convention on Climate Change in 1994. Since then, some initiatives were conducted by Climate Change Network Nepal (CCNN), an informal network of international and bilateral agencies/ organizations to help the government ratify the Kyoto Protocol and prepare the first Initial Communication Report. Kyoto was ratified in 2005 and the government appointed MoEST as Designated National Authority (DNA) for looking at Clean Development Mechanism (CDM) projects. There were already some initiatives on CDM and adaptation carried out by I/NGOs in Nepal. The climate change policy preparation was initiated by MoEST with support from WWF Nepal and government-established CCN comprising of 23 members, mostly government and international organizations like CARE Nepal and WWF Nepal. Similarly, with the initiation of LI-BIRD, 20 civil society/NGOs formed NGO Group on Climate Change and showed their commitment to work on community-based adaptation and to support the government in preparing the National Adaptation Plan of Action (NAPA). A coordination committee of donors and other stakeholders was started in 2008 to foster collaboration and partnership in taking the climate change agenda forward. Although the proposal was submitted in 2006 for NAPA, it was delayed till November 2008 due to various reasons. Finally, on 14 November, 2008 an agreement was signed between UNDP and MoEST for NAPA. Similarly, other commitments were also expressed through NAPA^{+} (extended NAPA with support from DFID, DANIDA and UNDP), technical assistance from ADB and recently the Pilot Program on Climate Resilience (PPCR) proposed to government from World Bank and Asian Development Bank. All these initiatives are aimed at promoting climate resilience and low carbon development.

The progress of these initiatives is very slow and time demanding. Frequent transfer of staffs and lack of human resources and technical capacity of MoEST are major reasons for such delay. There are also delays from the agencies responsible for contracting and providing technical support to these processes due to their long and complex administrative processes in hiring consultants and formalizing the institutional structure.

8.7.2 NAPA Process and Beyond

Government of Nepal, with support from UNDP, has initiated NAPA with funding from the Least Developed Countries Fund (LDCF). Preparation of NAPA is the first official initiative for mainstreaming adaptation to national policies and actions for addressing adverse impacts of climate change and reducing vulnerability to climate stimuli including extreme events. Nepal has prepared the project document to initiate NAPA with participation from a multi-disciplinary team coordinated by MOPE (Alam and Regmi, 2004).

Recently in November 2008, the government signed a contract with UNDP to officially start formulation of NAPA. The Ministry has confirmed that the NAPA process will be completed within 18 months.

The Asian Development Bank has agreed on a technical assistance initiative with GoN on climate change which will look at institutional and capacity development aspects of climate change challenges for development planning. GoN has support from development partners DFID and DANIDA to implement an expanded NAPA process that will result in a strategic framework and a programmatic approach to climate adaptation planning and implementation. The inception workshop of NAPA was completed with a high level of participation from government, civil society, NGOs and INGOs. There is a need to now design mo*dalit*y and mechanism to ensure participation of all sectors and their ownership in the NAPA process and also to think to initiate Local Adaptation Plan for Action (LAPA) .

8.7.3 Draft Climate Change Policy

MoEST drafted a climate change policy with support from WWF Nepal. This policy aimed at addressing impacts of climate change through mitigation and adaptation. It has given emphasis to clean energy and technologies, knowledge center, need for research and development, disaster and risk reduction, information flow and empowerment. The draft document also lacks proper consultation with stakeholders including communities.

8.7.4 National Level Stakeholder Perception on Some Issues Related to Climate Change

There are various issues and concerns related to climate change policies and actions raised by national level stakeholder. The following are some of the issues raised by them:

- Climate change is not adequately integrated into relevant sectoral and development policies, but there is a need to raise awareness and build capacity of stakeholders involved at present to incorporate climate risk information in their development planning.
- Institution operation mechanism on climate change is not clear and there is evident lack of inter-departmental coordination.
- There is need to establish links between stakeholders in more collaborative, inclusive and constructive manner.
- Role of civil society involvement in environment and climate change was not realized and recognized.
- There are no advance early warning systems in place. There is a need to strengthen the mandate, capacity and reach of Department of Hydrology and Meteorology for developing climate projections.

- The present method of gathering climate data manually needs to be furnished with automated digital weather prediction systems to assist more accurate climate database storage, forecasting and modeling.
- It is essential that a system should be developed to acquire real time weather data and develop accurate short-term and medium-range forecasting system.
- At national policy level, climate change issue is gradually gaining ground, but policy makers should view climate change at different levels to accommodate local, national, trans-boundary and regional level perspectives.
- Some of the hazy elements in the drafted policy are: climate justice, climate refugee, polluter's pay mechanism, compensation scheme, planned migration mechanism for vulnerable communities, financial mechanism, and technology transfer, which need further clarification and focus. The draft policy was criticized for not being able to address concerns of poor and vulnerable communities.

8.8 SAGUN Contribution to Reduce Impact of Climate Change

The SAGUN Program was implemented by CARE Nepal, WWF Nepal, RIMS Nepal and FECOFUN. It was funded by USAID. It aimed to improve governance, improve livelihoods, and build capacity and skills for biodiversity conservation. Although the program was not designed with a climate change perspective, remarkable progress was made in terms of the following[14] (Source: SAGUN Program, CARE Nepal Annual Reports, 2003-2008):

- Number of CFUGs increased from 427 in 2002 to 1174 (8.4% of national figure) in 2008 due to facilitation of SAGUN Program. Area of community forest increased from 23,153 ha in 2002 to 190,566 ha (15.88% of national figure) in 2008.
- Representation of women, *Dalits* and poor in leadership position has increased from 37%, 5% and 14% in 2002 to 44%, 11% and 23% in 2008 respectively. Similarly, representation of marginalized *Janajatis* in leadership position increased from 43% in 2002 to 46% in 2008.
- Amount of biomass including timber, poles, fuel wood, thatch/fodder grass and non-timber forest products extracted by UGs on a sustained yield basis increased to 32,388 metric tons in 2008 from 14, 113 tons in 2002.
- The amount of UG's fund mobilization has increased. So far, UGs allocated a total of NRs. 1,568,650 or 49% of their total group fund and a total of 535 CFUGs have made mandatory provision of group fund mobilization for pro-poor activities.

14 This information is cited from the project report of SAGUN Program.

- Areas of Community Forest and Protected Area that have been managed to reduce threats for bio-diversity conservation increased from 181,028 ha in 2007 to 190,566.4 ha in 2008.
- A total of 316 advocacy campaigns were conducted at local level (309), regional level (5) and national level (2). As a result, the Ministry of Forest and Soil Conservation (MoFSC) withdrew their decision to not hand over CFs in Terai and Inner Terai, reopen CFUGs' bank account, and impose VAT on out-sale of timber from CFUGs. Further, MoFSC decided to increase selling price of resin from NRs. 3 to NRs. 6 per kg. In addition, in facilitation of SAGUN, the National Planning Commission managed to include 7,000 Forest Operational Plans for revision/preparation on Government of Nepal's Three Years Interim Plan when only 3,000 were proposed.

In the study sites, the project has contributed specifically in strengthening governance, capacity building, livelihoods improvement, development of community facilitators, forest management, and NTFP and biodiversity conservation. The Program included service delivery mechanism, inclusion, evacuation and relief operation during disasters (case Shiva Durga CFUG: NRs. 5,000 initial investment from CARE Nepal, with the community later raising Rs 65 lakhs). Biodiversity threat assessment was carried out, and based on this action plans were approved. In Banke and Bardia Districts, CARE Nepal supported relief and rehabilitation work for flood victims by distributing relief packages and supporting groups to recover. CFUGs in the areas were mobilized to provide support to help victims. Besides, several awareness-raising activities were carried out on climate change issues. In Dhading, the project focus mostly on governance coaching, livelihoods improvement, capacity building, management of forest resources, public hearing, and infrastructure development. The findings suggest that SAGUN Program has mostly contributed in biodiversity conservation, livelihoods enhancement of few poor household, institutional support through enhanced governance within CFUGs, and capacity building of users. The study found that there is indirect contribution of SAGUN Program activities to resilience that the users did not directly observe and experience.

WWF Nepal implements SAGUN Program in Rasuwa District. Major activities implemented were awareness raising, capacity building, afforestation, governance coaching, biodiversity conservation, and livelihoods enhancement of users. WWF Nepal was active in institutional development where many Mother Groups and Eco Clubs were established. Some of the activities were focus on raising awareness on climate change issues to link up with biodiversity conservation. In Ramche, they supported infrastructure such as roads and schools. Communities shared that WWF Nepal is mostly implementing activities related to environment conservation, biodiversity conservation and empowering people in various units thus contributing to livelihoods enhancement.

Since the activities of SAGUN Program were found mostly related to biodiversity conservation and awareness raising activities, it has helped people acquire knowledge on climate change and importance of biodiversity conservation. Although the activities of SAGUN Program is not designed with climate change perspectives, the activities are supporting user groups and poor households in particular to enhance their knowledge, skills, capacity on livelihood dynamics. Activities are partly contributing to build community resilience through improvement of livelihood assets.

9. Summary and Conclusion

Climate change is evident in the study areas. Communities are already experiencing unusual changes in temperature and rainfall patterns, which were supported by a number of indicators such as decreased rainfall over the last few years, increased rainfall intensity within short duration, invasion of weeds and species, and outbreak of pests and diseases. These outcomes were linked to increased risks and hazards, increased magnitude of impacts and their severity and vulnerability posed by such factors in the livelihoods of poor and marginalized communities residing in all the three ecological zones.

Current and future scenarios of climate change indicate that many of the study areas will face risks that include higher aridity, more variable water supply, melting of glaciers, erratic rainfall, and periods of water scarcity and drought. Drought may cause outbreak of fire, as well as pests and diseases. Melting of snow and glaciers will result in formation of glacier lakes and consequently outburst events, less water in rivers and streams and thus water scarcity. On the other hand, intense rainfall may trigger flooding and landslides in some areas.

Climatic stresses have made sectors such as agriculture, biodiversity, and human health more vulnerable and fragile. There have been huge losses in livelihood assets of communities, particularly among the poor, marginalized, and women. Stresses and shocks are aggravating problems and vulnerability of communities in Banke and Bardia Districts. Impacts were observed contributing to loss of species and local landraces, declining productivity and yield, outbreak of diseases and pests, rapid encroachment by invasive species, loss of forest land and biodiversity, and emergence of human diseases. The loss of productive agriculture land has forced many youth and active labor force to go to India and abroad in search of employment. This has created labor crisis in their communities and subjected women to increased labor in order to rescue and rehabilitate their families and livelihood assets.

Similarly, in Dhading District, changes in water balances have affected land, ecosystems, biodiversity, rural economies, food security, and human

health. Water users have become more vulnerable to water shortage, reduced land productivity, and non-violent conflict over water allocations. Mal-adaptation practices observed in Deupuje CFUG were clearly found to aggravate further vulnerability to water resources and inequitable resource use among villagers.

In Rasuwa District, landslides were devastating to human life, agriculture, biodiversity and infrastructure. Every year, people lost their lives and valuable assets, including homes and land, to landslides. One of the villages in the study site was evacuated and resettled at another location. Other hazards, such as fire and hailstorm, also resulted in the loss of biological resources and community assets.

The study shows that poor, marginalized; women and *Dalit* households are more vulnerable to the impacts of climate change. Besides climate related disasters, the vulnerability was also aggravated by low income, lack of access to technology and knowledge, low education, limited assets and weak infrastructure. Climate risks and hazards were very high in the communities visited regardless of their levels of activeness and categories of users. However, there is some difference in coping capacity among types of CFUGs, and among well-off and poor categories. Ultra-poor users were more affected by the aftermath of disasters compared to well-off users. This is supported by the analysis that people with higher income, education, knowledge, and adaptation options are less vulnerable than those who are deprived from them. Similarly, coping mechanisms, external interventions, traditional knowledge and innovations all play an important role in shaping vulnerability. Analyses also indicated that the impact of climate change was high at all sites and the capacity to deal with it was relatively low. This implies that communities were vulnerable across categories and ecological region.

Coping strategies and adaptation mechanism were limited at all study sites except Balapur CFUG of Bardia District. Local knowledge, practices and innovations are important elements for community-based coping and adaptation mechanisms. There were few examples of adaptation strategies mostly in agriculture such as change in cropping patterns, choice of crops, and improvement in the system. Other areas (forestry, livestock) had relatively less innovations and practices to deal with climate risks and hazards. It was observed that ethnic groups, such as the *Tharu*, have traditionally developed climate resilience systems like developing safety measures and finding alternatives. However, these initiatives were limited and scattered and do not fully address climate change issues and threats.

There was limited awareness, knowledge and capacity at local and district levels to understand climate change scenarios, address issues, and conduct long-term planning. Climate change was not a priority agenda for any of the district line agencies and NGOs because it was not understood and

internalized by stakeholders. However, some observations were made regarding changing climate and its indicators, and skepticism was expressed in terms of climate change impacts and magnitude. At the national level, there was lack of information, knowledge, and proper database regarding local and regional information, and government plans and strategies to deal with climate change impacts. The few existing initiatives are often scattered and isolated when mainstreaming development.

The SAGUN Program had a focus on strengthening governance and forest management activities within CFUGs. It has contributed positively in social inclusion, empowerment and institutional governance. There are activities in biodiversity conservation and livelihood support for the poor. These activities have contributed to building resilience of communities by strengthening their capacity to manage forest resources. Future challenges in biodiversity conservation and livelihoods include increased risk from invasive species; loss of local and native flora and fauna; impact of landslides, riverbank erosion, and GLOF on forests; and forest fire. Considering these scenarios, activities need to be redefined and restructured using an integrated approach that includes research and development to address knowledge gaps, development of a climate-resilient forestry sector, and generation of green jobs and employment for local communities.

Information derived from the study demands more in-depth sectoral studies and research that address impacts of climate change on ecosystems and biodiversity – wetlands, forests, land-use change, species composition, and important plants and wildlife. There is also a need to integrate communities' perception and knowledge with climate scenarios development and projections. Moreover, local community perceptions and concerns demand for immediate action on promoting climate-resilient development activities at CFUG level.

10. Recommendations

Nepal's forests now face two significant challenges: deforestation and climate change. Moreover, fragmented and small forest communities are more vulnerable to new stresses brought about by climate change. CARE Nepal and its partners have a dual responsibility of ensuring ecosystem resilience, as well as improving livelihoods of poor and vulnerable marginalized communities in Nepal. The following measures can be undertaken to address these challenges[15]:

10.1 Hazard and Risk Management

- Forest Fire Management: Activities must be designed to increase community awareness; develop village-level forest fire management

15 These are strategic recommendations that link grassroots and national level perspectives. SAGUN Program can use these recommendations to design a new Program to address climate change issues.

mechanisms; transfer skills, knowledge, and tools and technology in forest fire management; and strengthen information dissemination system.

- Risk Assessment and Mapping: Landslide and riverbank erosion is increasing. It is also posing a threat to forest resources. Thus, it is necessary to identify disaster- and risk-prone forest areas through vulnerability assessment and mapping. Activities need to be designed to address these risks.

10.2 Action Research

- More studies need to be conducted on both opportunities and constraints in biodiversity (forest resources) conservation in the changing context of risks and vulnerabilities posed by climate change.
- More in-depth study is needed to determine which species are lost and why, and what implication this has on livelihood strategies of local communities.
- Research is also required on conflict issues among users in terms of access to resources, benefit sharing mechanisms, and prospective carbon trading.

10.3 Building Ecosystem Resilience

- Implement integrated NRM mo*dalit*y such as integrated wetland and watershed management to improve fragmented resources, and ensure access and benefit sharing through Payment of Environmental Services.
- Expand protected area networks, including existing CFUG network, to prevent further habitat fragmentation that will otherwise hinder adaptive migration of species.

10.4 Planning and Monitoring Mechanism at Local Level

- CFUG operational plan and activities should include community climate risk and hazard elements and a threat analysis. It will be a monitoring mechanism at CFUG level. Frequent monitoring is needed on an annual basis or more.
- National systems for monitoring forest cover and related changes in carbon stocks need to be developed or further strengthened and complemented by sub-national monitoring efforts where necessary.

10.5 Adaptation

- Benefits derived from sustainable forest management could be invested in supporting alternative energy schemes to poor and marginalized households through mobilization of funds that will benefit the poor.

- Development and implementation of efficient management techniques are needed in reforestation and transplantation programs, e.g. agro forestry.
- Improve community forest management as a tool to lower carbon emissions while protecting key habitats and species, as well as providing income generation opportunities for local communities (should not offset communities' rights to use of resources). This could be a win-win mechanism for ensuring conservation and sustainable livelihoods of poor.
- Strengthen access and benefit sharing mechanism: Ensure equitable access and benefit sharing mechanism so that vulnerable groups will benefit.
- Mobilization of funds: Propose for mandatory mechanism of funds allocation by CFUGs to support those users who are victims of climate disasters.
- Relief and rehabilitation: Relief and rehabilitation for both people, as well as wildlife, should be a mainstream forestry development process. This should be integrated in CFUG plans. Some CFUGs are already at a vulnerable stage and require intervention.
- Document and promote existing coping and adaptation strategies.

10.6 Inclusive and Targeted Governance

- Raise awareness of present climate stress, interaction with other pressures and projected climate change and impacts, technologies and coping strategies in sectors like NRM and livelihoods.
- Build capacity of stakeholders and CFUG members in assessment of impacts, designing coping strategies and adaptation measures, and using economic potential of forest resources.
- Use inclusive and targeted governance approach to reach to the most vulnerable and_socially excluded groups.
- Continue with governance coaching and empowerment activities, which will develop capacity of poor and marginalized vulnerable communities to negotiate on access and benefit sharing mechanism.

10.7 Integration in National and Sectoral Plans

- Vulnerability assessment and mapping should be part of national and sectoral development in forestry. Identifying key niche risk and hazard prone forest resources and planning for its management will be advantageous.
- Support range posts and district-level planning: Climate change risk, mitigation and adaptation plans at range post and district level should be integrated in future.

- Support in policymaking process: Provide input in refining climate change policy, stimulating National Adaptation Plan of Action (NAPA). Sectoral policy, strategies and guidelines on climate change is necessary so that it will be an opportunity to support MoFSC to move in t

10.8 Specific recommendations on strengthening SAGUN Program in light to climate change[16]

- Strengthen the current innovative practices of rescue and rehabilitation done in Banke and Bardia by a number of CFUGs in terms of helping disaster-affected communities.
- Promote local carbon development and climate resilience, institutionalization of governance interventions in community forests is an important step that could be scaled up across Nepal.
- Support CFUGs to create green jobs through promotion of forest-based enterprises and income generation opportunities within CFUGs through funds mobilization.
- Capitalize on current CFUG strengths including equitable sharing of benefits, and piloting REDD mechanism and methodology to ensure community-based mechanism for financial flow.
- CFUGs could play an important role in addressing issues of climate justice, tenure and property right issues (who owns carbon), equity and inclusion (how the benefits could reach to the poorest of the poor) through piloting and developing mechanism and mo*dalit*y.
- Build awareness and capacity of staff and beneficiaries on climate change issues through training and exposure.
- Mainstream adaptation planning in ongoing SAGUN Program through integration into CFUG and district level plans and programs.
- Pilot programs such as innovative fund mechanism, mainstream planning within CFUGs, impact and vulnerability monitoring by group, forest based adaptation strategies, etc.

16 These recommendations are specific to SAGUN Program and should be used to strengthen the Program.

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Annexes

Annex 1: Terms of Reference

Term of References for Case Study on Climate Change Impacts on Livelihoods of Poor and Vulnerable Communities and Bio-diversity conservation in SAGUN Program Areas

Introduction

The Strengthened Actions for Governance in the Utilization of Natural Resources (SAGUN) Program is in operation since November 2002, fostering grassroots democracy through the democratic and sustainable management of natural resources. CARE Nepal is working on the SAGUN Program in collaboration with WWF Nepal, RIMS Nepal and FECOFUN. The synergy created by this team has gone a long way to ensure the success of the program. SAGUN Program has worked to instill democratic, transparent, and participatory governance in more than 2,000 FUGs, BZFUGs, water users groups and hydro-power project effected communities, making them more responsive to the needs of women, poor, *Dalits* and marginalized *Janajatis.* It has also supported the formation of more than 850 new FUGs and works with other agencies/ organizations for sustainable and equitable natural resource management and bio-diversity conservation through good governance, livelihoods improvement, and policy advocacy. Recently the SAGUN Program has been extended for another nine months starting from 01 October 2008 with the following five Specific Objectives.

1. Strengthening internal governance of target FUGs and other relevant stakeholders at the local level;
2. Improving livelihoods of FUG members with special focus on women, poor, *Dalits* and marginalized *Janajatis*;
3. Enhancing the knowledge and skill of FUGs in sustainable forest management and biodiversity conservation;
4. Enhancing the knowledge and skills of FUG members and their representatives to advocate for their rights in connection to sustainable forest management and biodiversity conservation, and
5. Documenting best practices and lessons learned.

Expected Results

The following are some expected results of the program:

- Livelihoods of women, poor, *Dalits* and marginalized *Janajati* groups will be improved through initiatives such as governance in NRM, off-farm income generation, small material support for micro-enterprises, livestock insurance schemes, among others, and address climate change vulnerability.
- This extension period will also help enable stakeholders, including those at grassroots level, to advocate themselves for their own right to sustainable forest management and biodiversity conservation.
- To further enhance long term sustainability of the SAGUN Program, this

extension period will see the dissemination of lessons learned, challenges overcome and best practices put in place through the dissemination of a video production and documentation showing the linkages between FUGs, and governance, livelihood improvements, policy advocacy and biodiversity conservation.

Rationale of the Study

The world has taken Climate Change as one of the greatest threats posed to environment conservation and livelihood initiatives. The situation is becoming worse with more release of greenhouse gases into the atmosphere. Even though Nepal's population is 0.4 % of world population and responsibility for emitting greenhouse is 0.025% to the global share, Nepal is one of the countries most vulnerable to climate change impacts. Its temperature is increasing in an alarming rate than the global trend (0.06 Degree Centigrade per annum). The impacts of increasing air temperature are already observable in the Himalayan ecosystem. Glacier Lake Outburst Floods (GLOF) caused by rapidly retreating glaciers and the hasty formation of Glacier Lakes is just one example of the risks of climate change in Nepal.

Other climate change possible impacts such as unpredictable weather patterns, loss of biodiversity, water scarcity, spreading of tropical disease like malaria and dengue, decreased food productivity and increased intensity and frequency of landslides and flooding are visible in Nepal. All of these impacts lead to a high threat to people's livelihoods, bio-diversity conservation, safety, security and the national economy. And as always the frontline to face these impacts are poor, women and marginalized people who are compelled to live at marginal lands for their livelihoods. Therefore, the issue of climate change is take-up as a key development concern. Without addressing climate change issues, it would be naive to ensure that the expected outputs of the program particularly livelihoods of the targeted groups will be improved, natural resources and bio-diversity are managed and conserved on sustainable and equitable basis.

In this background a case study on **linkages among climate change, livelihoods** improvement and bio-diversity conservation have been identified as one of the evolving window opportunities within the Specific Objective 5 of the program. The case study is proposed to cover three ecological zones of Nepal: Western Terai (Banke and Bardia districts), mid-hills (Dhading, Gorkha and Lamjung districts) and high mountains (Rasuwa district).

Study Objectives and Key Questions of the Final Evaluation

The broad objective of the study is to find out impacts of climate change on livelihoods of local people and bio-diversity conservation, and find out adaptation measures in order to improve livelihoods of poor people mitigating vulnerability and threat to their lives.

Specific Objectives of the Study

The following are the specific objectives:

1. To collect and analyze the overall climate change impacts on livelihoods of poor vulnerable and marginalized groups and bio-diversity conservation in the three ecological zones.
2. To assess the coping mechanisms practiced by the local communities to improve and secure their livelihoods and conserve bio-diversity in the three ecological zones.
3. To analyze the existing policy gaps to address climate change issues from livelihoods security and bio-diversity conservation perspectives.
4. To provide recommendations to address climate vulnerability and improve livelihoods of poor, vulnerable and marginalized groups and bio-diversity conservation in the three ecological zones of the program areas.

Key Questions

Key questions related to each specific objective are as follows:

1. To collect and analyze the overall climate change impacts on livelihoods of poor vulnerable and marginalized groups and bio-diversity conservation in the three ecological zones.

- Who are the most vulnerable communities for climate change impacts?
- How the local communities of the three eco-logical zones perceive climate change? On what areas of their livelihoods?
- What are the visible and invisible impacts of climate change on their livelihoods and bio-diversity conservation?
- What are the key indicators of the climate change impacts?

2. To assess the coping mechanisms practiced by the local communities to improve and secure their livelihoods and conserve bio-diversity in the three ecological zones.

- What are the coping mechanisms practiced by the local communities to improve and secure their livelihoods and conserve bio-diversity inside their forests?
- How successful the coping mechanisms to address the impacts due to climate change?
- Has the coping mechanisms been able to reach the intended beneficiaries and contributed to improve their livelihoods and bio-diversity conservation?
- What could be the possible contributions from the SAGUN Program to address climate change impacts and adaptation?

3. To analyze the existing policy gaps to address climate change issues from livelihoods improvement and bio-diversity conservation perspectives.

- What are the government's policies that have been formulated to address climate change impacts?
- Is there a need for any formulation of new policies and changes in current government policies to create an enabling environment for the design

and implementation of future livelihoods improvement and bio-diversity conservation from climate change perspectives?
- Is there any role for the program to influence any existing government's policy positively?

4. To provide recommendations to address climate vulnerability and improve livelihoods of poor, vulnerable and marginalized groups and bio-diversity conservation in the three ecological zones of the program areas.

- What could be recommendations to address climate vulnerability and improve livelihoods of poor, vulnerable and marginalized groups and bio-diversity conservation in the three ecological zones of the program?
- What could be the most possible strategies to implement the recommendations effectively and how?

Target Groups

In longer term, the target groups for this study will likely to be poor, women and children, vulnerable and marginalized groups of CFUGs abd BZCFUGs of three ecological zones of the program.

Methodology

The case study should strictly follow the principles of a participatory approach. The case study process will acquire information (both qualitative and quantitative) from a variety of sources including (a) program participants, (b) field observations, (c) other case studies, (d) program documents and other records, (e) counterparts and other local partners, (f) community evaluation and (g) staff evaluation. Other primary information essential for the evaluation process can be generated and collected from the following activities:

- Field observation and interaction with selected community group members such as poor, women, and marginalized groups within CFUG and BZCFUGs, groups involving livelihoods improvement and bio-diversity conservation, NTFP Cooperative members, women groups, *Dalit* groups, individuals such as district line agencies, Buffer Zone Management Councils, and User Committees, National Park personnel.
- Workshops at the field level and at the central level (if necessary).

Prior to the field study, the case study team is expected to prepare a detailed assessment plan and share it with the key personnel the program. The plan should identify methods for gathering information to address the key questions, and should include semi-structured interview guides and PRA[1] exercise to be used. Relevant photographs and 'stories' from different individuals/groups that highlight both climate change impacts and adaptation measures should be included.

Study Team Composition and Responsibilities

1 Participatory Rural Appraisal

The study will be conducted by an expert in climate change vulnerability assessment, with extensive experience on Livelihood improvement of poor, vulnerable and marginalized groups, and bio-diversity conservation. The expert must possess extensive experience in reviewing performance of integrated development projects, institutional strengthening, rights issues and policy advocacy. The SAGUN Program team (DPCs, PFOs, Rangers) in the districts will assist partly or whole as necessary in the field works.

CARE Nepal, the district based project team and staffs from local implementing partner will support the review team through local resource persons, and will participate in information collection and organizing workshops and meetings at district and national levels. The expert will be primarily responsible for overall review and revisit process ensuring that all issues of ToR and contract agreement are being addressed satisfactorily, and for the submission of final case study report.

More specifically the study Team (expert and the research assistant) will be responsible for the following major tasks:

- Review Term of Reference (TOR) and provide appropriate suggestions for addition and omission of the tasks
- Review all relevant documents available at SAGUN Program and Climate Change projects, other organizations or government institutions related to study purpose.
- Review all the documents and literature, reports related to climate change vulnerability and adaptation issues
- Consult MoFSc, MoEST, DFOs, NGOs, INGOs and other related organizations at national, regional or district levels and seek their inputs.
- Design a study plan and develop appropriate checklist for data collection, sampling size, share study plan and tools with CoP, TL, DPCs and NTFPO, and study collaborators.
- Conduct field visit and interact with/interview DFO, AFO, Rangers, DPCs, PFOs, Local Resource Persons, Women motivators, LRP, CFUG members (including women, poor and *Dalit*), FECOFUN luding final editing of the report to ensure that the final report is a coherent and readable product to fulfill the needs of the project, the donor and key stakeholders.

Outputs and Document Format

The expert will first produce a draft case study report followed by a central level wrap-up meeting to present the initial findings and to seek feedback. All valid comments generated during the meeting will be incorporated in the draft report. A final report will be produced and will be submitted to CARE for its approval by April 2009. The TOR, evaluation plan, questionnaire and checklist, workshop proceedings and other relevant reports, including photographs should be appended as annex. Except in exceptional circumstances, the report should not exceed 45 pages, including a summary of no more than 2 pages. The team leader will submit two hard copies of the report along with the electronic copies in CD.

Annex 2: Trend of Change in Temperature in various Stations (°C/yr)

Station	Year	Altitude	Average Temp (°C)		Temperature Trend (°C/yr)		
			Max	Min	Max	Min	Avg
Khajura, Banke	1978-2007	109	31	18.1	0.000623	0.022833	0.011728
Chisapani, Bardia	1977-2007	225	29.4	19.5	0.001573	0.019245	0.010409
Dhunibesi, Dhading	1977-2007	1085	26.5	15.9	0.003198	0.042719	0.022958
Dhunche, Rasuwa	1995-2007	1982	20.3	11	0.121384	-0.05985	0.030769

Source : Department of Hydrology and Meterology

Annex 3: Trend of Change in Annual, Monsoon and Winter Rainfall in various Stations

Station	Year	Average Annual (mm)	Change in Precipitation Trend		
			Annual	Monsoon	Winter
Dhunche, Rasuwa	1977-2007	1963.6	1.123806	21.29312	-6.3
Khajura, Banke	1977-2007	2244.5	-3.85167	-2.15021	-0.56515
Chisapani, Bardiya	1977-2007	2440	10.39945	11.27159	-0.30275
Dhunibesi, Dhading	1977-2007	1609.7	9.989274	8.705403	0.42871

Source : Department of Hydrology and Meterology

Annex 4: Matrix Ranking for Selecting CFUGs for the Study

CFUG	Poor	Total HH	Poverty percentage	Type of Group	Impact of Risk and Hazard	Type of Risk	Remarks
Dhading							
Duepuje	65	110	59.09	Active	Very high	Drought	Selected
Phusromato	130	198	65.66	Less Active	Very high	Drought/ Landslides	Selected
Torikhet	150	394	38.07	Medium	Very high	Drought	
Machindra	118	278	42.45	Less Active	High	Drought	
Banke and Bardiya							
Bansakti	80	170	47.058	Less Active	Very high	Flooding	Selected
Laljipur	53	108	49.074	Active	Very high	Flooding	
Gijara	169	267	63.295	Less Active	Very high	Flooding	
Tharu	94	152	61.84	Active	Very high	Flooding	Selected
Rasuwa							
Nadengche APU	NA	130	NA	Medium	Very high	Landslides/ forest fire	
Ramche BZUC	NA	448	NA	Less Active	Very high	Landslides	
Singa Devi BZFUG	NA	105	NA	Active	Very high	Landslides/ Drought	

Source : Field Survey, 2009

5a. Coping and Adaptation Matrix

	COPING AND ADAPTATION STRATEGIES
Technical	
Economic	
Social/institutional	
Local knowledge/practices/innovations	

Annex 5b: Vulnerability Assessment Tools

	Types of livelihoods assets affected				Total impacts	Types of Livelihoods Assets Available to Cope with Impacts			
Vulnerability context	Types of natural assets and level of affects (list each and assess the effects) Very severe-4, Severe-3, Moderate-2, Low to None-1	Types of physical / technological assets affected by climate change vulnerability context (list each and assess the level of each) Very Severe-4, Severe-3, Moderae-2, None-1	Severity (socio economic impacts) Very Severe-4, Severe-3, Moderae-2, None-1	Frequency of CC vulnerability context (less frequent-1, moderately-2, very frequent-3)	Level of CC impacts (multiply 5 and 6)	Availability of economic assets to cope with impacts (Very high-4, high-3 moderate-2, low to none 1	Availability of human capital to cope with impacts (very high-4, High-3, Moderate-2, Low to no-1)	Availability of social/ institutional capacity to cope with impacts (very high-4, High-3, Moderate-2, Low to no-1)	Level of capacity of the people to deal with impacts (average of column 8,9.10)

5c. Impact Matrix

Livelihood assets	Hazard 1	Hazard 2	Hazard 3	Hazard 4
Financial (income, resource, saving, land)				
Human (knowledge, labor)				
Physical (infrastructure, resources)				
Social (Cohesion, saving credit, Groups)				
Biological				
Agriculture				
Forestry				
Wetland				
ANGR				

5 = significant impact on the resource, 4= high impact on the resources, 3 = medium impact on the resource, 2 = low impact on the resource, 1 = no impact on the resource

Source : Adapted from CVCA Hand Book CAER International, 2009