



**USAID**  
FROM THE AMERICAN PEOPLE

TECHNICAL REPORT

# KHUMBU, NEPAL: LOCAL ADAPTATION PLAN OF ACTION (LAPA)

SAGARMATHA NATIONAL PARK

SOLU KHUMBU DISTRICT



This publication is made possible by the support of the American people through the United States Agency for International Development (USAID). It was prepared by Engility Corporation and The Mountain Institute.

This report has been prepared for the United States Agency for International Development (USAID), under the Climate Change Resilient Development Task Order No. AID-OAA-TO-11-00040, under The Integrated Water and Coastal Resources Management Indefinite Quantity Contract (WATER IQC II) Contract No. AID-EPP-I-00-04-00024.

Engility Corporation Contact:

Glen Anderson, Chief of Party, [Glen.Anderson@EngilityCorp.com](mailto:Glen.Anderson@EngilityCorp.com)  
Engility Corporation  
1320 Braddock Place  
Alexandria, VA 22314

# KHUMBU LOCAL ADAPTATION PLAN OF ACTION (LAPA)

SAGARMATHA NATIONAL PARK

SOLU KHUMBU DISTRICT

Prepared for:

United States Agency for International Development

Global Climate Change Office, Climate Change Resilient Development project

Washington, DC

High Mountains Adaptation Partnership

Prepared by:

Alton C. Byers

The Mountain Institute

Washington, DC

*and*

Shailendra Thakali

The Mountain Institute

Kathmandu, Nepal

Editors: Meeta Pradhan, Michael E. Cote

Reviewers: John Furlow, Glen Anderson, Ken Baum, Jonathan Cook, John Harlin

Contact: Michael E. Cote, Engility Corporation, [Michael.Cote@EngilityCorp.com](mailto:Michael.Cote@EngilityCorp.com)

## **DISCLAIMER**

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government



# TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY</b> .....	<b>1</b>
<b>MAPS</b> .....	<b>4</b>
<b>I. BACKGROUND</b> .....	<b>7</b>
1.1. USAID and the High Mountains Adaptation Partnership .....	7
1.2. NAPAs, LAPAs, and the Government of Nepal .....	8
1.3. Main features of LAPA frameworks nationwide .....	9
<b>2. COMMUNITY CONSULTATIONS</b> .....	<b>13</b>
2.1. Introduction and Process in September 2012 .....	13
2.2. Summary of Findings from September 2012 .....	15
2.2.1. Stakeholder Perceptions of Important Assets of the Khumbu .....	15
2.2.2. Summary of Stakeholder Perspectives on Contemporary Changes in Khumbu .....	17
2.2.3. Perceived Climate Variability and Change in Khumbu .....	21
2.2.4. Vulnerabilities and Suggested Adaptation Actions .....	24
2.2.5. Conclusions And Recommendations .....	30
2.3. April 2013 Consultation Meetings/Workshops .....	33
2.3.1. Planning for the Full-fledged LAPA in Autumn 2013 .....	33
2.3.2. Sharing the Community-Based Glacial Lake Outburst Flood Risk Reduction Project .....	34
2.4. September 2013 Consultation Meetings/Workshops .....	35
2.4.1. Approach and Planning Unit .....	35
2.4.2. Participant Selection .....	36
2.4.3. Workshop Planning and Program Components .....	36
2.4.4. Tools and Techniques .....	38
2.4.5. Interviews and Additional Meetings .....	39
2.5. Analysis and Writing .....	40
<b>3. RESOURCE AND HAZARD MAPPING</b> .....	<b>41</b>
3.1. Resource Mapping .....	41
3.1.1. Households and Population .....	44
3.1.2. Villages and Settlements .....	45
3.1.3. Forests and Land-use .....	46
3.1.4. Livestock .....	47
3.1.5. Glaciers and Glacial Lakes .....	48
3.1.6. Rivers and Tributaries .....	49
3.1.7. Infrastructure and Services .....	49
3.2. Climate Induced Hazards and Vulnerability .....	52
3.3. Local Experience of Climate Variability and Extremes .....	54
3.3.1. Seasonal Calendar .....	57
3.4. Timeline Analysis .....	58
3.4.1. Landslides .....	58
3.4.2. Forest Fires .....	59

3.4.3.	Glacial Lake Outburst Floods (GLOF) .....	60
3.4.4.	Windstorms .....	61
3.4.5.	Heavy Snowfall .....	62
3.4.6.	Floods.....	63
3.4.7.	Other Hazards.....	63
3.5.	Estimation of affected vulnerable households .....	64
3.6.	Estimation of households by VDC, wards, and socio-economic groups most likely to be sensitive to different hazards .....	65
3.7.	Hazard and Sector Ranking.....	69
<b>4.</b>	<b>SECTOR-WIDE IMPACT ANALYSIS .....</b>	<b>73</b>
4.1.	Trekking.....	73
4.2.	Lodges.....	73
4.3.	Mountaineering.....	74
4.4.	Porters.....	74
4.5.	Transportation.....	75
4.6.	Airport.....	75
4.7.	Seasonal trade.....	75
4.8.	Communication and Hydropower Stations.....	75
4.9.	Service Sector .....	76
4.10.	National Park and Biodiversity .....	76
4.11.	Drinking water.....	76
<b>5.</b>	<b>ENVISIONING ADAPTATION PLANS OF ACTION .....</b>	<b>77</b>
5.1.	Glacial Lake Outburst Flood (GLOF).....	77
5.2.	Heavy Snowfall.....	78
5.3.	Windstorms.....	80
5.4.	Landslides .....	81
5.5.	Forest fire.....	82
5.6.	Flood .....	83
<b>6.</b>	<b>ADAPTATION OPTION PRIORITIZATION .....</b>	<b>85</b>
6.1.	Adaptation Option Prioritization – Glacial Lake Outburst Flood.....	85
6.2.	Adaptation Option Prioritization – Heavy Snowfall .....	86
6.3.	Adaptation Option Prioritization – Windstorms.....	87
6.4.	Adaptation Option Prioritization – Landslides .....	88
6.5.	Adaptation Option Prioritization Forest Fires.....	88
6.6.	Adaptation Option Prioritization – Floods.....	89
<b>7.</b>	<b>STAKEHOLDER ANALYSIS .....</b>	<b>90</b>
<b>8.</b>	<b>IMPLEMENTATION PLAN .....</b>	<b>94</b>
8.1.	Tentative Budget Summary 2014-2018.....	98
<b>9.</b>	<b>REFERENCES .....</b>	<b>100</b>

**INDEX OF ANNEXES: .....103**

**ANNEX A: STOCKTAKING PAPER: A REVIEW OF NEPAL'S LOCAL ADAPTATION PLANS OF ACTION .....104**

Executive Summary .....	104
An Overview of Climate Change Initiatives and Of the Local Adaptation Plan of Action Process in Nepal.....	104
Background .....	105
Main features of the LAPA Framework.....	106
LAPA Innovations and Experience .....	109
CASE Study.....	110
Follow on activities post Pilot LAPA Phase (post 2011).....	112
Observations, Analysis, and Comments on the LAPA Process .....	113
Stocktaking Overview.....	113
Observations, Analysis and Recommendations for an Improved LAPA Mechanism and Process .....	114
Local Adaptation Plan for Action for the Khumbu Valley .....	124
Next Steps and General Observations .....	125
Acknowledgements .....	126
References .....	127

**ANNEX B: TRANSLATION OF DOCUMENTS FROM THE KHUMBU COMMUNITY CONSULTATIONS SEPTEMBER 2012 .....129**

Workshop #1: Phakding, September 2012 .....	129
Workshop #2: Namche Bazar 14-15 September 2012.....	136
Workshop #3: Dingboche 18-19 September 2012.....	142



# ACRONYMS

BZ	Buffer Zone
CC	Climate Change
CCRD	Climate Change Resilient Development
DDC	District Development Committee
GLOF	Glacial Lake Outbursts
GON	Government of Nepal
HiMAP	High Mountains Adaptation Partnership
HMGWP	High Mountain Glacial Watershed Program
IRG	International Resources Group
KACC	Khumbu Alpine Conservation Council
MACG	Mera Alpine Conservation Group
NAPA	Nepal Adaptation Program of Action
SNP	Sagarmatha (Everest) National Park
SNPBZ	Sagarmatha National Park and Buffer Zone
SPCC	Sagarmatha Pollution Control Committee
TMI	The Mountain Institute
VDC	Village Development Committee
USAID	United States Agency for International Development

# LIST OF FIGURES

Figure 1. Sagarmatha National Park and Buffer Zone (courtesy of World Wildlife Fund/Nepal)

Figure 2: Landuse in the Sagarmatha National Park and Buffer Zone

Figure 3. The seven steps of the HiMAP LAPA process

Figure 4: Sagarmatha National Park and Buffer Zone map of vegetation zones (courtesy of World Wildlife Fund/Nepal)

Figure 5: Namche VDC resource map

# LIST OF TABLES

Table 1: Suggested core and additional LAPA tools

Table 2: Incorporation of LAPA Steps in Khumbu Local Adaptation Planning Process

Table 3: Example management plan covering adaptation actions and community contributions

Table 4: Number of Participants in September 2013 LAPA workshops in the Khumbu region

Table 5: Number of Households per Village Khumbu Region (hh = household)

Table 6: Non-monastery Services in Khumbu

Table 7: Vulnerable Hotspots and Villages

Table 8: Seasonal Calendar

Table 9: Records of Landslides in the Khumbu region

Table 10: Records of Forest fires in the Khumbu region

Table 11: Records of GLOFs in the Khumbu region

Table 12: Record of windstorms in the Khumbu region

Table 13: Records of heavy snow fall in the Khumbu region

Table 14: Estimation of households (HHs) affected directly by different past climate induced hazards

Table 15: VDCs, wards, villages, social groups and households most likely to be vulnerable to different hazards

Table 16: VDCs, wards, villages, social groups and households most likely to be sensitive to different hazards

Table 17: Sector and Hazard ranking

Table 18: Glacial Lake Outburst Flood (GLOF) – Option prioritization

Table 19: Heavy Snowfall – Option prioritization

Table 20: Windstorm – Option prioritization

Table 21: Landslides – Option prioritization

Table 22: Forest fires – Option prioritization

Table 23: Flood – Option prioritization

Table 24: Stakeholder roles and potential adaptation support mechanisms



# EXECUTIVE SUMMARY

The following Khumbu LAPA was developed under the Climate Change Resilient Development project (CCRD), a 4 year, \$31M global project funded by USAID's Global Climate Change Office (USAID/GCC) and managed by the International Resources Group, a wholly owned subsidiary of Engility Corporation. Under the leadership of CCRD's Chief of Party, Dr. Glen Anderson, and in collaboration with USAID/GCC office, CCRD piloted and supported several climate resilient initiatives and activities in over 33 countries. Among these activities include the creation of the High Mountains Adaptation Partnership (HiMAP) in collaboration with the University of Texas-Austin and The Mountain Institute. HiMAP aims to increase awareness of the critical importance of high mountain watersheds in the context of climate change, highland-lowland interactions, and ecosystem services. By 2015 the HiMAP team will have strengthened scientific, social, and institutional capacity for the management of dangerous glacial lakes in Peru and Nepal.

HiMAP has been instrumental in creating the first community-based, participatory glacial lake risk reduction project in Nepal. This effort includes development of the Khumbu LAPA policy document and process, new training programs, a new South-South knowledge exchange, an innovative Glacial Lake Rapid Reconnaissance Team, a mini-hydro generation project, and vital donor coordination. HiMAP established the first high mountain glacial watershed Community of Practice, which creates new opportunities, connections, and shared knowledge between previously disconnected scientists and practitioners. In addition, HiMAP is developing a new generation of climber-scientists fluent in climate change and adaptation issues, research methods, and action projects in high mountain watersheds.

The Government of Nepal initiated climate adaptation planning and implementation with the [National Adaptation Programme of Action of 2010](#). Recognizing the enormous variability within Nepal and within its various communities, Nepal is among the first group of countries in the world to pilot a formal Local Adaptation Plan of Action (LAPA) process that recognized this social and environmental complexity, as well as the wide range of climate change impacts that the country experiences.

The Government of Nepal (GON) created a standard LAPA framework consisting of seven steps for integrating climate change resilience into local-to-national planning processes. These steps include:

1. Sensitization/climate change awareness building
2. Climate vulnerability and adaptation assessment
3. Prioritization of adaptation options
4. Developing local adaptation plan for action
5. Integrating the local adaptation plan for action into planning processes
6. Implementing the local adaptation plan for action
7. Assessing progress of local adaptation plan for action

The GON framework guided the formulation of the Khumbu LAPA. A significant difference is that a focus on development and development needs was incorporated into step 1, Sensitization, so that the final LAPA would in theory address both climate change as well as developmental priorities and action projects. Secondly, following the development of the LAPA (step 4), considerable effort was placed in its mainstreaming into existing or forthcoming sources of development funding, such as those from VDCs or the Sagarmatha National Park Buffer Zone Council. Efforts to include aspects of the LAPA into the revised Sagarmatha National Park Management Plan were also pursued, particularly given the fact that the existing plan contained no reference to climate change.

The Khumbu LAPA contains descriptions of the key methods, processes, findings, results, and materials used in a series of community consultations and District-level meetings held between September 2012 and September 2014. It is meant to serve as a supplementary resource document to the much more condensed Khumbu Summary LAPA published early 2015.

Participants included representatives from local communities, the Ministry of Forests and Soil Conservation, Sagarmatha National Park, SNP Buffer Zone Council, women's groups, eco-club members, teachers, Dalit (traditionally untouchable ethnic groups), NGOs, Village Development Committees (VDC) officials, political party representatives, security forces, and porters.

Eleven (11) different LAPA tools were used throughout the course of the LAPA program, which included timeline analyses, social and physical hazard mapping, climate change impact ranking, stakeholder impacts analyses, and adaptation project prioritization.

Six (6) priority climate-induced hazards were identified and ranked in order of importance as (1) glacial lake outburst floods (GLOFs), (2) landslides, (3) heavy snowfall, (4) windstorms, (5) forest

fires, and (6) floods. Participants determined that a total of 1,284 households would likely to be affected by GLOFs and 927 households by landslides. The impacts of heavy snowfall are more severe in Khumjung and Namche VDCs than in Chaurikharka VDC, whereas windstorm impacts are growing in all three VDCs. Chaurikharka is more sensitive to forest fires than the other two VDCs.

Porters and forests were ranked as the most vulnerable sectors, followed by biodiversity and agriculture. Other vulnerable sectors included the National Park, trekking hotels and lodges, mountaineering, hydropower, livestock, and water resources.

A five-year implementation plan was developed, and prospective donors for each activity were identified. The Sagarmatha National Park and Buffer Zone, Buffer Zone Council, and VDCs were identified as the most promising organizations for mainstreaming priority LAPA adaptation initiatives into existing and future developmental budgets.

The Khumbu LAPA is considered among the most comprehensive and thoroughly produced LAPA's in Nepal to date. The LAPA serves as a model based on unparalleled fluency in the unique physical and cultural aspects of Nepalese people and the Himalayan ecosystems. To produce the LAPA, the team engaged and collaborated with a wide variety of government officials, stakeholders, and beneficiaries over a span of three years. Meaningful knowledge exchanges and facilitated dialogs between groups working on high mountain issues from Peru and Nepal improved the LAPA process by sharing lessons learned and techniques. The LAPA can assist the GON to mainstream adaptation priorities into local and regional plans, which could help overcome the challenges of financing projects independently or on a case-by-case basis. Finally, participation and close engagement with community members shows that incorporating local knowledge into the process remains a fundamental technique for any successful development project in the burgeoning climate resilience sector.

# MAPS



Figure 1: Sagarmatha National Park and Buffer Zone (courtesy of World Wildlife Fund/Nepal)



Imja valley and view of the Khumbu from Kongde, with Ama Dablam on the right, Lhotse, Everest, and other peaks in background, and Namche Bazaar on the left

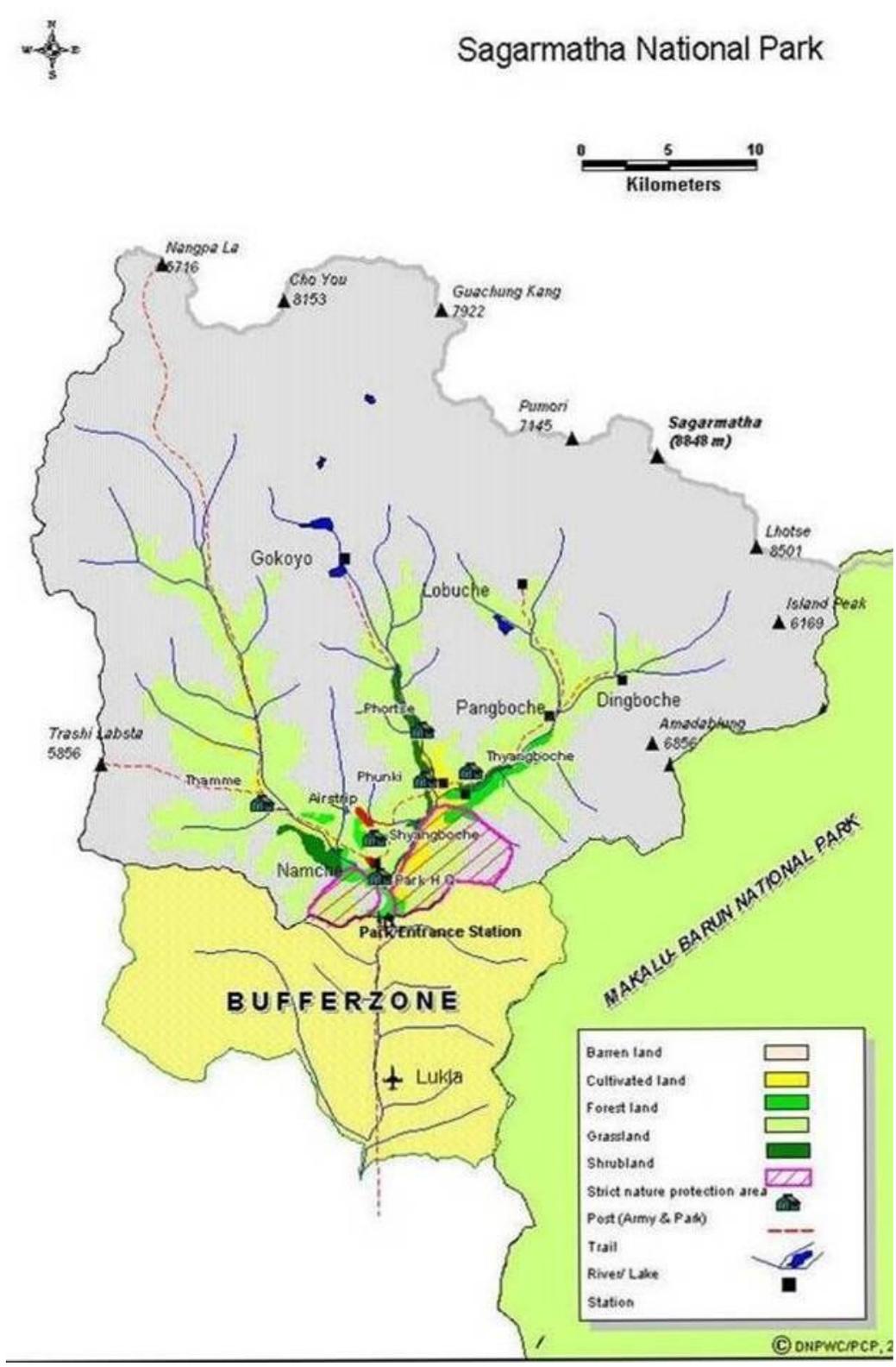


Figure 2: Landuse in the Sagarmatha National Park and Buffer Zone

# I. BACKGROUND

## I.1. USAID AND THE HIGH MOUNTAINS ADAPTATION PARTNERSHIP

Climate change is one of the most important global environment challenges facing humankind, and local communities living within mountainous regions are particularly vulnerable as temperatures rise, glaciers recede, new glacial lakes form, and weather becomes less predictable. Despite this, understandings of the human dimensions of climate change are still in their infancy in mountain regions where there is limited understanding of climate change, climate change impacts, community vulnerabilities, and adaptation opportunities. In response, the USAID-funded Climate Change Resilient Development Project (CCRD) launched the High Mountains Adaptation Partnership (HiMAP) in March 2012. The objectives of HiMAP are giving people living in remote areas a voice in the current dialogue surrounding high mountain climate change risks; establishing a community of Practice (CoP) that strengthens communication and collaboration between scientists and practitioners globally; fostering the next generation of "Climber-Scientists" capable of blending the best of sophisticated technologies with traditional field-based methods; and increasing global awareness for the importance of high mountain, glacial watersheds in general.

The following report provides a description of the community consultation methods used, as well as summary results by village of the assets, vulnerability, and adaptation pilot project recommendations. Annexes include translations of workshop results; workshop agenda and training materials; and agenda of the 8 October, 2012 UNDP Imja Lake First Partner's Workshop, an effort to promote better collaboration and communication between all stakeholders.

The final Khumbu Local Adaptation Plan of Action is based on key findings and results of three separate multi-village community consultation meetings and workshops in the Khumbu (September 2012, April 2013, and September 2013), meetings held in Kathmandu in 2012, 2013, and 2014, and Solu Khumbu District level meetings in March 2013.

The Mountain Institute team would like to express its sincere appreciation to the U.S. Agency for International Development (USAID) and to Engility Corporation for their essential

contributions towards the success of the 2012 and 2013 field work. These contributions included training in climate change and vulnerability/ adaptation approaches in July, 2012; the development of workshop materials during a visit by TMI/Nepal staff to Washington, DC in August, 2012; and participation in all three community consultations in the Khumbu in September 2012.

## **I.2. NAPAS, LAPAS, AND THE GOVERNMENT OF NEPAL**

The Government of Nepal (GON) initiated climate adaptation planning and implementation with The National Adaptation Programme of Action (NAPA), endorsed in September 2010. The NAPA indicates the Government's intention to disburse at least 80 percent of the available budget directly for local implementation of identified adaptation actions. The NAPA also aims to ensure that national adaptation planning supports adaptation by local communities, particularly the climate vulnerable poor.

Recognizing the enormous variability within Nepal and within its various communities, the GON, with the support of civil society, felt it was necessary to design a formal process to go beyond the NAPA and develop adaptive plans that reflect more fully the needs and aspirations of Nepal's diverse communities, and the wide range of impacts experienced from climate variability. Nepal was the first country in the world to develop a formal Local Adaptation Plan of Action (LAPA) process.

With funding from U.K.'s Department for International Development (DFID), a consortium of agencies developed a pilot framework for preparing and implementing LAPAs and piloted this tool in 9 districts across Nepal (selected for their representative qualities and vulnerability) during 2010-11 by the Climate Adaptation Design and Piloting–Nepal Project (CADP-N). Nine (9) international agencies were involved in this effort, with 18 foreign and Nepali experts involved in designing the manual. Results of the pilot activities were summarized and published in a LAPA manual, drafted in 2011.

A detailed history and explanation of the Nepal LAPA program can be found in the Annex A: “Stocktaking Paper: A Review of Nepal's Local Adaptation Plans of Action,” prepared by The Mountain Institute in August, 2013, summarized below in Section 1.3.

### **I.3. MAIN FEATURES OF LAPA FRAMEWORKS NATIONWIDE**

At the NAPA workshop in 2010, participants identified the basic starting unit for the LAPA as the Village Development Committee (VDC) with the recommendation that activities be coordinated by the District Development Committee (DDC). (A VDC comprises 9 wards. A ward may include one or more villages depending on the population size. For example, Namche village of Namche VDC represents three wards whereas Khunde village of Khumjung VDC represents only two.) This process was determined to be the most appropriate scale for integrating climate change resilience into local-to-national development planning *processes and outcomes*. Among other objectives, these administrative units were considered best at capturing location/community specific adaptation priorities and ensuring national level support for local adaptation without fragmentation or large transaction costs. The intent was to enable a match between bottom-up and top-down adaptation planning, and design a mechanism that is bottom-up, inclusive, flexible, and responsible. It was also intended that the LAPA process strengthen decentralized planning efforts and strengthen existing local self-governance rules and regulations. The LAPA Framework was designed to support decision-makers at local-to-national levels to:

1. Identify the most climate vulnerable VDC's, wards, and people and their adaptation needs,
2. Prioritize adaptation options in easy ways with local people setting priorities,
3. Prepare and integrate local adaptation plans for action into local-to-national planning in accordance with the Local Self Governance Act,
4. Identify appropriate service delivery agents and channels for funding to implement local adaptation plans for action,
5. Assess the progress of LAPA to ensure effective planning and delivery, and
6. Provide cost-effective options for scaling out local-to-national adaptation planning.

The standard GON LAPA Framework consists of seven steps for integrating climate change resilience into local-to-national planning processes. These steps include (Figure 3):

1. Sensitization
2. Climate vulnerability and adaptation assessment
3. Prioritization of adaptation options
4. Developing local adaptation plan for action
5. Integrating the local adaptation plan for action into planning processes
6. Implementing the local adaptation plan for action
7. Assessing progress of local adaptation plan for action

However, one significant difference is the Khumbu LAPA is that a focus on development and development needs was incorporated into step 1, Sensitization. This was inserted so that the final LAPA would in theory address both climate change as well as developmental priorities and action projects.

Each step was carefully considered as to why it is important and what actions should be undertaken. A list of appropriate participatory tools was then outlined. Figure 3 shows the process in diagram form.

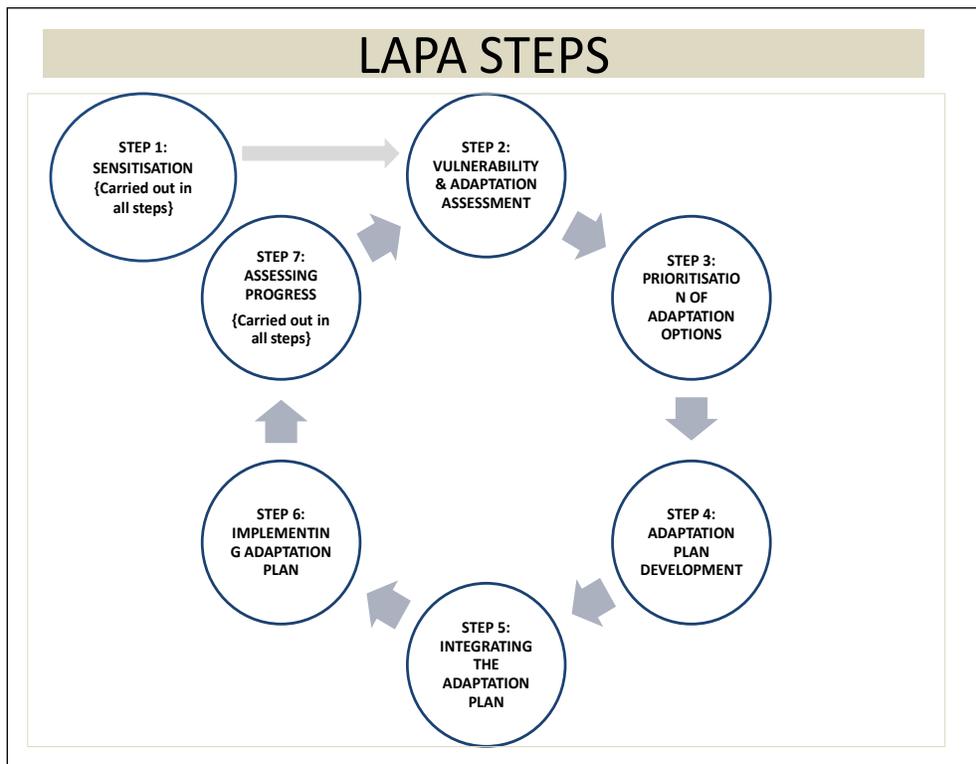


Figure 3. The seven steps of the HiMAP LAPA process

During the pilot phase the design team also proposed a number of appropriate tools to be used at each of the 7 steps in the LAPA process. These tools are listed below.

**Table 1. Suggested core and additional LAPA tools**

LAPA steps	Core tools	Additional Tools
<b>STEP 1:</b> Development Needs and Climate Change Sensitization	<ol style="list-style-type: none"> <li>1. Shared Learning Dialogues (district level)</li> <li>2. Gateway Services Analysis (district level)</li> <li>3. Visuals and stories</li> <li>4. Climatic Hazard Trend Analysis</li> <li>5. Seasonal Calendars</li> </ol>	Climate adaptation capacity assessment and opportunities identification Cause and effect analysis (problem tree) Envisioning climate scenarios Hazard and impact risk analysis Hazard and response analysis Mapping: hazards, vulnerability (social, economic, physical), resources (social, natural, etc) Timeline history regarding changes School level awareness raising tools: essay competition, quiz contest, scouts, eco-clubs, etc.
<b>STEP 2:</b> Vulnerability and Adaptation assessment	Gateway Services Analysis Mapping hazards, risks, vulnerability, resources Disaggregated Vulnerability Matrix Hazard and Impact Risk Analysis Envisioning Climate Scenarios Climate Adapted Well-Being Assessment Visioning High Adaptive Capacity	Cause and effect analysis GIS mapping Hazard and response analysis Seasonal calendars Livelihoods impact analysis Climatic hazard trend analysis Mapping of service provider / institutional analysis
<b>STEP 3:</b> Prioritization of adaptation actions	<ol style="list-style-type: none"> <li>12. Multi-Criteria Ranking</li> <li>13. Participatory Cost-Benefit Analysis</li> </ol>	Impact implementation matrix Pair wise ranking Scenario tool for identifying energy pathways
<b>STEP 4:</b> Adaption plan development	<ol style="list-style-type: none"> <li>14. Service provider analysis</li> </ol> The 4 WH's (what, where, when, who, budget, etc)	Logical framework Inclusion-sensitive budgeting (for example gender and indigenous people-sensitive budget)
<b>STEP 5:</b> Integrating adaption plan	Shared learning dialogue Policy and institutional analysis to identify entry points and/or adopt entry points included in this framework	Sharing best practices and lesson learned with plan decision-makers
<b>STEP 6:</b> Implementing plan	NA	NA

<p><b>STEP 7:</b> Assessing progress (M&amp;E) and informing future plan development</p>	<p>Visioning high adaptive capacity Service providers analysis Behavior change journals analysis Disaggregated vulnerability matrix Mapping risks, vulnerability, and service providers Climate-adapted well-being assessment Self-monitoring and evaluation Most significant change analysis</p>	<p>Mapping hazards, risks, and vulnerability Envisioning climate scenarios Logical frameworks Hazard trend analysis Seasonal calendars Hazard response analysis Gateway systems analysis Policy and institutional analysis</p>
--	---	--

## 2. COMMUNITY CONSULTATIONS

The methodology adopted for the Khumbu included a series of community consultation meetings and workshops conducted during September 2012, April 2013, and September 2013. These consultations/workshops systematically incorporated the various LAPA steps as shown in the table below:

**Table 2: Incorporation of LAPA Steps in Khumbu Local Adaptation Planning Process**

Timeframe	Steps of the LAPA framework
September 2012	Primarily focused on achieving step 1 (Development Needs and Climate Change Sensitization) with workshops in Chaurikharka, Namche Bazaar, and Dingboche Facilitated discussions of: Assets Vulnerabilities Introduction to Climate Change Adaptation actions to minimize vulnerability
December 2012	Two follow up meetings in Kathmandu with Khumbu residents
April 2013	Steps 2-3 (Adaptation Assessment and Option Prioritization); included visits to Thame, Phortse, and Dingboche villages in addition to Chaurikharka and Namche Bazaar
September 2013	Consolidate steps 1-3 and achieving step 4 (Adaptation Plan Development)
December 2013	LAPA draft finalized
March 2014	Mainstreaming LAPA into VDC Development Plans (steps5); meetings with District Soil Conservation Office, Regional Irrigation Office, District Development Committee, District Agricultural Development Office, District Livestock Office, District Forest Office, Local Development Office, Himal Project Office; ½ day meeting held attend by 32 people; LAPA endorsed with plans to fund several adaptation options in 2014
May-June 2014	Integrating and mainstreaming LAPA into VDC Development Plans (step 5); consultations with National Park, Buffer Zone Council, and local communities to integrate LAPA into forthcoming development and management plans
July-Dec 2014	Mainstreaming LAPA (step 5), facilitate implementation of priority projects (step 6), monitor results (step 7), re-assess and re-design where necessary

### 2.1. INTRODUCTION AND PROCESS IN SEPTEMBER 2012

The September 2012 consultation meetings and workshops primarily focused on achieving the first step of the LAPA framework, i.e., identifying developmental needs while sensitizing local people about climate change and vulnerability issues. The program consisted of three parts. Participants were given the opportunity to discuss the range of assets that are important for their livelihoods. They were also provided with general information about climate change and how

climate change interacts with non-climate factors. Linkages were then discussed between different climate change vulnerabilities and the assets that they had previously identified. Also discussed were adaptation capacities necessary to cope with these vulnerabilities, and different adaptation actions to minimize the level of vulnerability. Thirdly, presentations introducing climate change and associated concepts, impacts in high mountain regions such as the Khumbu, and the significance of climate change in global environmental management were made. Meta cards, flex sheets, posters, photos cards, and other tools were used, many of them developed in collaboration with IRG during the August, 2012 training visits of HiMAP staff Ang Rita Sherpa and Phurba Sherpa. The fourth part of the workshop consisted of group work exercises. Participants were divided into two to three small groups for group work to identify valuable assets and to assess how these assets are being affected or likely to be affected by climate change.

Phakding, Namche, and Dingboche villages, representing three Village Development Committees (VDC) of the Khumbu region, were selected as venues for the first round of community consultation meetings and workshops. These villages are centrally located and were selected to ensure maximum participation of local people and other stakeholders in the program.

The process of participant selection was one of the most important parts of the community consultation. We attempted to include all people and organizations that have a real or perceived ‘stake’ in the project and/or its outcomes, including representatives from groups not normally present in workshops. A total of 58 stakeholders attended the workshops, including 7 women, who consisted of farmers, porters, herders, teachers, security workers, representative from the national park, youth clubs, health centers, women’s groups, youth groups, local leaders, lodge/tea shop owners, transport services owners, retail shop owners, lamas (monks) from the monasteries, and the Gomba Management Committee.



Community consultation in Namche Bazaar, September 2012.

## 2.2. SUMMARY OF FINDINGS FROM SEPTEMBER 2012

The following information is all derived from the September 2012 consultations.

### 2.2.1. STAKEHOLDER PERCEPTIONS OF IMPORTANT ASSETS OF THE KHUMBU

#### Forest Resources:

Much of the Khumbu region that lies within the Sagarmatha National Park and Buffer Zone boundaries is comprised of rich forest resources. This resource has been one of the most important fuel and fodder sources since the arrival of the Sherpa people in the 1500s, as well as providing the natural foundations against hazards such as landslides and drought. The dominant forests are mixed broadleaf evergreen and pine forests between 2500-3300 m; fir-birch-rhododendron cloud forests between 3300-4000 m; and juniper shrub-grasslands above 4000 m (i.e., the alpine zone).



#### Agricultural land:

The agriculture of Khumbu is based on subsistence farming—primarily potatoes, wheat, barley, and buckwheat—where cropping options are limited because of climatic conditions, altitude, and aspect. Along with tourism, agriculture represents one of the main sources of income within the Khumbu region.

#### Lodges:

The lodge business is second only to agriculture as one of the most important economic options for the people of Khumbu. Tourism emerged in the 1960s as major source of income for local residents who can operate lodges and provide other services. Today more than 37,000 tourists visit the Khumbu region each year, most on a pilgrimage to the Everest basecamp.



### Mountains:

The snowcapped mountains are the main source of tourism attraction in the region. Mt. Everest, among the world's highest peaks, and other mountains above 8,000 m are the main draws for the trekking, mountaineering, and lodge businesses in this region.



### Trails/Bridges:

Trails are crucial for the transportation of essential goods and for tourism. In a mountainous region like Khumbu, trails are the only means of travel for both visitors and local people alike. Safe, clean, and well-maintained mountain trails are the key to the successful development of sustainable tourism in the Khumbu region.



### Airport:

Runways, buildings, and facilities for passengers are among the region's most valuable assets, as helicopter or Short Takeoff and Landing (STOL) aircraft are the only way to reach the area in a short period of time. The airport built in Lukla by Sir Edmund Hillary in 1964 is critical to the development of tourism and importation of supplies and goods.



### Hospitals/Health post:

Institutions providing medical and surgical treatment, such as the Hillary clinic in Kunde. There are presently two hospitals and several health posts in Khumbu.

### Schools:

Several schools have been established in the region, notably the Hillary schools in Khumjung. Non-governmental organizations and some by the government have supported many of the schools.

### Houses:

The houses of local people were listed as important personal assets.

### Other natural resources:

Other natural resources that include river systems, quarries, and other ecosystems are major assets for local people, providing both direct and indirect benefits.



## **2.2.2. SUMMARY OF STAKEHOLDER PERSPECTIVES ON CONTEMPORARY CHANGES IN KHUMBU**

This section provides an overall summary of stakeholder perspectives, both positive and negative, on recent changes in Khumbu. Section 3.3 identifies source villages and consultations for each reported change.

### **2.2.2.1. POSITIVE CHANGES**

#### Improvement of forest and wildlife conservation practices:

Since the establishment of the Sagarmatha National Park and Buffer Zone in 1975, there has been considerable success in the conservation of natural resources that include reforestation projects, protection of wildlife, increased conservation awareness, and the establishment of the Buffer Zone fund to help communities to continue their conservation activities.

#### Agriculture:

People of the Khumbu region have begun to produce vegetables such as tomatoes, beans, and other vegetables in green houses and earning money from the sale of these vegetables. Without greenhouses the production of tomatoes at such high altitudes would not be possible, and kitchen vegetables are now available throughout most of the year. Likewise, horticulture is emerging as a viable income generating activity in the lower altitude regions between Jorsalle and

Chaurikharka. Sizeable quantities of vegetables are sold at the weekly markets in Namche and Lukla.

#### Education:

Since the 1960s, the governmental and private sectors have established both high and secondary schools that have provided ample opportunity for children of the region to receive a sound education in their own communities. In the past, most school children had to go down to district headquarters to take the School Leaving Certificate (SLC), but this can now be done in the Khumbu. Likewise, the schools here have started using English as the language medium that will allow local students to have a better chance to compete at the college level in Katmandu.

#### Health service:

The new hospitals and the health posts established in the region by the government and private sectors now provide excellent health care and treatment to local people.

#### Infrastructure development:

Infrastructures like trails, metal bridges, schools, hospitals, micro hydropower stations, hotel and lodges have improved significantly in recent years.

#### Transportation:

There have been significant improvements in transportation facilities within the region. One example is the Lukla airport. The airport built in Lukla by Sir Edmund Hillary in 1964 is important to the promotion of tourism and as well as importation of supplies for the region.

#### Tourism:

The number of tourist visiting the area has increased from several hundred in the late 1960s to more than 37,000/year in 2012. Tourism is of critical importance to the region and represents the main source of income for



most communities. Today, Sagarmatha National Park is one of the most important mountain tourism destinations in Nepal, as well as the world.

#### Awareness of environment protection:

People have become more aware of environment and conservation issues. Environmental NGOs such as the Sagarmatha Pollution Control Committee (SPCC) and Khumbu Alpine Conservation Council (KACC) have been established that have provided models of successful pollution control, environment protection, sustainable adventure tourism development.

#### Formation of Local Institutions:

The numbers of local institutions has grown since the establishment of the Sagarmatha National Park and Buffer Zone. There are now many local institutions in the regions that include: youth groups, youth clubs, women's groups, mother's groups, a Gompa Management Committee, the Pangboche Youth Group, Khumbu Alpine Conservation Council, Sagarmatha



Pollution Control Committee, and a hotel management committee. These institutions have played a major role in development work, social mobilization, awareness building, tourism promotion, culture conservation, and environmental protection.

#### Livelihood Improvements:

The majority of people living in the region are now engaged in the tourism business in one form or another. Overall, most people consider their livelihoods to have improved in recent years.



### Employment:

Employment opportunities in the region have increased significantly due to an increase in tourism-related businesses such as hotels, lodges, trekking and climbing expeditions. Porters, guides, high altitude guides, cooking at the hotels, and jobs in retail shops have become a major source of employment in the region.

#### **2.2.2.2. NEGATIVE CHANGES**

##### Environmental degradation/solid waste:

Increases in local and tourist populations, as well as a lack of proper management practices, has resulted in an increase of solid and human waste.

Deforestation has reportedly increased because of the high demand for timber and lumber to build lodges, as well for fuel wood for cooking and heating the hotels and lodges.

##### Agriculture and livestock:

Because of the rapid growth of tourism in the region, occupations are shifting from agropastoralism to tourism as more and more people establish lodges, campgrounds, hotels, and pack animal services. However,



tourism is also suffering from various challenges related to climate change, such as the increasingly unpredictable weather patterns of Lukla that is disruptive to regular flights. The numbers of tourism entrepreneurs are also believed to be reaching unsustainable numbers while creating a prevailing and unhealthy culture of competition.

##### Diseases:

New diseases and pests are invading the Khumbu region because of warming trends. Crops and fodder species appear to be particularly vulnerable, and participants believed that livestock and humans are probably not far behind.

### Population:

Populations of the Sherpa, Rai, and tourist groups have increased which has exerted new stresses on natural resources and the environment.

### Culture:

The traditional Sherpa culture has been influenced and sometimes replaced by western culture and technologies, such that many people have partially abandoned their traditional value, dress, religious rituals and functions.

### Deforestation:

The increase in tourism-related infrastructure, such as hotels and lodges, has accelerated deforestation due to growing demand for fuel wood, structural timber, and furniture.

### Poaching:

Illegal poaching of wildlife within the park and buffer zone is increasing year after year. This is reportedly because many outsiders have moved to the region for its better employment opportunities, illegally hunting various endangered species such as the musk deer and red pandas for additional income.

## **2.2.3. PERCEIVED CLIMATE VARIABILITY AND CHANGE IN KHUMBU**

The effect of climate change was reported to be severe in Khumbu because of its geographical and climatic conditions, high dependency of the local people on natural resources, lack of systematic and sustainable agricultural practices, and lack of enough resources to cope with the changing climate and its impacts. Specific examples discussed during the consultations are shown below:

### Irregular Precipitation Patterns:

The majority of the communities in Khumbu regions are severely affected by climate change due to an increased irregularity of snow and rainfall patterns. Rain and snowfall amounts are believed to have decreased in total amount, but today arrive in the form of heavy storms and blizzards when more consistent and predictable amounts fell in the past. For example, participants at Dingboche said that “it rains when it should snow and snows when it should rain, ruining our crops and agriculture.”

### Delays in Flowering Plants:

Participants from Phakding said that there has been a significant shift in the timing of the flowering of plants as well. They have observed that Rhododendrons have begun to flower earlier than normal, e.g., *R. arboreum* is now seen flowering in mid-January as opposed to its normal timing after mid-March.

### New Kitchen Vegetables:

Participants from Phakding and Namche said that unlike previous years, they have noticed that kitchen vegetables are available throughout most of the year, a combination of those supplied from cold storage and others grown under controlled conditions inside greenhouses.

### Monsoon:

Participants from Namche said that the climate of the Khumbu region is definitely changing. In the past, after the monsoon period ended the weather from late September to December was mainly clear and cold, and these three months had been the best for trekking in the Khumbu region. The majority of trekking agents sold their trip packages during these months because of the favorable weather conditions. However, since the last decade, the weather has been changing from clear to cloudy conditions during this period, with associated and growing problems in flying in and out of Lukla.

### Increases in catastrophic events:

There is an increase in catastrophic events such as landslides, severe storms, and glacial lake outburst floods which damage forest resources, agriculture land, and result in heavy losses of livestock and human life.

### Increased Temperatures:

Participants from Phakding, Namche, and Dingboche said that temperatures have risen during the past decade. Because of this, they reported that fruit, fodder, other trees, and crops are blooming and/or ripening earlier, and that this has been accompanied by an increase in both insects and disease in crops and fodder species.

Participants from Dingboche also said that when it snows now, it melts after only a few days, causing the crops to dry out and die. Without any crops to hold the soil, the wind blows away topsoil resulting in an increased loss of crops each year.

Participants from Dingboche said that climate change and retreating glaciers constitute a major hazard in Nepal and the Khumbu region. The accelerated glacier melting has led to increased glacial hazards in the Himalayas, particularly in the form of glacial lake outburst floods (GLOFs). These new and growing lakes pose a threat to downstream populations, property, and infrastructure. Flash floods from Ama Dablam in 1977, and the Bhote Koshi in 1985, damaged many houses and fields causing the loss of millions of dollars in potential revenue. Global warming in the coming decades will most likely increase GLOF events with the accelerating retreat of glaciers and formation of many new and potentially dangerous glacial lakes.

#### Increase in Insects:

Participants from Namche and Dingboche noted the introduction of insects in communities above 4500m where they had never been seen before. The vulnerability of communities is rooted in their dependence upon sustenance agriculture and outside food grain subsidizes to survive. The land in Khumbu and the surrounding districts is located at relatively high altitudes, with soils being thin, young, and of marginal quality.

#### Changes in Livelihoods:

Agriculture and tourism represent the main sources of income and livelihoods for the Khumbu region, shifting in rank because of geographic location (i.e., tourism is clearly more important for a village on the main trekking trail, such as Namche, than in Thame where the reverse is true). About 80% of communities in Khumbu are involved in the agricultural sector directly or



indirectly, which is highly dependent on the condition of the weather and climate. The lack of non-agricultural opportunities in some communities force them to rely almost entirely on the agricultural sector.

Participants from Namche said that the changing climate in the Khumbu region has affected their livelihoods, especially those who have been relying on tourism as their major source of income, primarily because in recent years the weather has become less predictable than before. As a result, they report that there has been constant drop in tourist numbers in the region during the past several years.

Participants from Phakding said that they too noticed a change in flowering and fruiting patterns in recent years. Some farmers of these settlements were happy with their increased potato and peach harvests, and reported an increased sweetness of the fruit. However, this is not always for others. For example, Phakding participants also reported a decreased size of the potatoes harvested, and that the potato seedlings were smaller because of increases in seedling decay because of extreme and changing rainfall patterns.

Additionally, decreased apple harvest was found to be happening because of reduced flowering, fruiting, earlier growing, and the dying and drying of apple plants, which resulted in a huge economic loss for apple growers. The problem was also associated with an increased loss of agricultural produce by insects and other pests, most of which were unknown to communities only a few years back. Due to lack of rainfall this year, many of the local farmers spoke of the possibility of complete crop failures being likely.

#### **2.2.4. VULNERABILITIES AND SUGGESTED ADAPTATION ACTIONS**

The Khumbu region is a naturally dynamic environment that is prone to natural disasters such as earthquakes, landslides, debris flows, floods, and avalanches. Climate change is exacerbating many of these processes while adding a range of new phenomena and vulnerabilities to the list. Participants isolated the following vulnerabilities and generalized adaptation actions. A table of specific adaptation actions, and community contributions toward their implementation, is provided at the section's end.



Although future workshops will produce more detailed and specific information, the following



will be of great preliminary use to the Khumbu Adaptation Management Plan and the Khumbu Disaster Management Plan (to be developed in 2013 in consultation with the SNP Chief Warden, Buffer Zone, local communities, youth clubs, and NGOs) and also to the UNDP Community-Based Flood and Risk Reduction Project as it moves from the project document to the inception stage.

#### **2.2.4.1. LANDSLIDES:**

In case of landslides, the most vulnerable assets are bridges, houses, lodges, schools, powerhouses, trails and forest resources. In the Khumbu region, landslides could be one of the climate change-related processes most severely affecting these assets, causing adverse impacts on the overall livelihoods of the people by affecting agriculture, transportation systems, and the tourism (trekking) trade.

Suggested Adaptation Action: In the three consultations, the participants suggested that institutions, such as the Sagarmatha National Park and Buffer Zone and District Development Committee, could strengthen adaptation capacities by providing technical and financial resources. They could also help local communities to cope with these new vulnerabilities by providing resources for new forest plantations, conservation of existing forest resources, awareness building activities, construction of gabion walls, and construction of proper drainage systems. Additionally, there is a need for more detailed mapping of landslides, landslide prone areas, and the design of action plan to act to reduce the risk of landslides.

#### **2.2.4.2. DROUGHT**

Drought is likely to affect assets such as agriculture land, crop products, availability of the water resources, and mountain ecosystems as a whole.

Suggested Adaptation Action: Different technologies can be adopted to reduce the risk of water scarcity during the draught condition for which additional financial and technical resources will be necessary. However, cash and in-kind contributions from local communities will also be essential to this process. Adaptation actions to minimize the risk of drought include the construction of proper irrigation systems, introduction of low water use irrigation techniques such as drip and sprinkle systems, and the use of drought-resistant species and improved crops that uses less amount of water.

Construction of new irrigation canals was the highest priority adaptation action because even in the condition of drought, local people will be able to use the water generated from glaciers and

glacial lakes through the canal systems. In addition, local people feel that government policies should be changed so that programs related to improved irrigation systems would be the incorporated with other development activities.

#### **2.2.4.3. FOREST FIRE**

Forest resources, biodiversity, landscapes, and water sources are some of the important assets affected by forest fires. Climatic stressors do not necessarily cause Forest fires themselves, but prolonged dry condition



over a long period during the summer months can act as forest fire triggers.

Suggested Adaptation Action: In the event of a forest fire, skilled human resources could be mobilized with fire extinguishing equipment. Different means of communication, such as mobile phones, can be used to inform the community nearby about fire conditions. To minimize the risk of forest fires, skill development activities for communities could be developed, including different awareness activities that discourage careless activities. The army and police could be useful for fire extinguishing tasks along with local communities.

#### **2.2.4.4. FLOOD**

Local people in Khumbu have the strong impression that flood events will affect productive lands, bridges, houses, lodges, schools, power houses, trails and settlement areas. Many settlements are located along riverbanks, which are prone to flood events and damage. Likewise most of the trails, and nearly all bridges, are located along riverbanks, which would be the first assets to be affected by floods.

Suggested Adaptation Action: To reduce the vulnerability of floods, social institutions could be helpful for different awareness building activities, as well as providing labor in the construction of flood risk minimizing measures such as check dams or forest plantations. In addition, technology, skilled human resources, and financial resources are other adaptation resources that could be helpful during the implementation of adaptation measures.

#### **2.2.4.5. TEMPERATURE INCREASE**

Increased temperatures have had severe impacts on snow, ice masses, glaciers, and glacial lakes. Increasing temperatures will also impact ecosystems, cropping systems, and forest resources of high mountains regions.



Suggested Adaptation Action: Social institutions could play a role against the risk of temperature increase. In addition, technologies, communications, and social networks could be also be used. Activities such as plantations and awareness building could be conducted so as to build community resilience against increasing temperatures. The promotion of seasonal cropping systems would be helpful to maintain microclimatic conditions along with the resilience building. The introduction of alternative energy sources, including hydroelectricity, would reduce the dependency of local communities on fuel wood and petroleum products.

#### **2.2.4.6. HEAVY RAIN**

Heavy rainfall is thought to be one of the new vulnerabilities of the Khumbu region, particularly with its rugged terrain and weak infrastructure.

Suggested Adaptation Action: To minimize the hazard of heavy rain and accompanying flood and landslides, communities and local institutions will need to work and act together. Establishing risk minimizing measures, including improved building locations, locations of trails, zoning to prevent building in flood plains, and financial and human resources will all be essential to success. Plantations and the construction of retaining walls are two measures that can be applied against the hazard of intense rainfall.

#### **2.2.4.7. INSECTS AND DISEASES**

Livestock, crops, and humans are likely to be affected by new diseases which are now are being noticed in the Khumbu region. As mentioned previously, the increasing numbers of pests and other insects along with disease have been recently.

Suggested Adaptation Action: Health posts are already functioning to reduce the impact of new diseases in the region. Well-equipped hospitals and health posts are seen as necessary for the

region. Recently the need of establishing veterinary clinics has also been discussed, along with some agriculture research centers. To minimize the harm of diseases, awareness activities can be conducted, health camps can be established, and research related to the actual impact of disease due to climate change can be conducted.

#### **2.2.4.8. GLACIAL LAKE OUTBURST FLOOD (GLOF)**

GLOFs are one of the most discussed vulnerabilities of the Khumbu, rapidly becoming the major concern of most people. In particular, the increased risk of a GLOF because of the increasing volume of Imja lake is one of the major concerns of local people. Because of increasing temperatures, the rate of glacial recession and growth of Imja is greater than any other lake in the Khumbu region and Himalayan belt of Nepal. GLOFs could also have devastating effects on private and public assets such as forest systems, landscapes, cultivated land, livestock, bridges, trails, houses, and human lives. Some GLOF activity, such as those resulting from earthquakes, may largely be out of human control, but appropriate preventive measures to reduce the threat of floods needs to be taken.



Suggested Adaptation Action: Social networks can be established for that can facilitate information and communication exchange. Likewise, governmental bodies like such as the District Development Committee and Sagarmatha National Park and Buffer Zone can play a lead role in the construction of better infrastructure. The army and police can play a lead role in rescue operations, where helicopters could be used for transportation.

Early warning systems could be one of the best adaptation measures to minimize the loss of life due to GLOFs. Actual mitigation measures, like lowering the level of the lake, should also be investigated to reduce the overall risk of GLOF (please see Annex C, notes from the 8 October, 2012 "UNDP Community-Based Flood and Glacial Lake Outburst Risk Reduction Project: First Partners Workshop for Enhanced Collaboration and Communication", organized and hosted by the High Mountain Glacial Watershed Project). Other adaptation actions could include the

construction of less vulnerable infrastructure, such as high bridges and trails. Shifting settlements towards safer sites could also be one of the measures to reduce the risk of GLOFs to human lives and property.

#### **2.2.4.9. WIND STORM**

Windstorms are another vulnerability experienced in high altitude meadows and wide river valleys. Windstorms have severe impacts on regional geology, usually the weak cliffs that become gradually eroded because of continuous wind action over the years. In the recent days, windstorms have increased because of changes in the temperature balance between upland meadows and low lying river basins. This may affect buildings and other infrastructures in the long run, and have a direct impact on wildlife and forest resources. Human health could also be affected because of the cold conditions brought on by windstorms.

Suggested Adaptation Action: Forest plantations could be established that could reduce the impact of windstorms. Structures could also be designed to withstand the forces of increased wind as well.



#### **2.2.4.10. SOIL EROSION**

Erratic rainfall and windstorms of different intensities triggers increased soil erosion processes. In areas like Khumbu, the availability of agricultural land and rich soils is very low, and found only in old terraces and other pockets in settlements such as Dingboche.

The erosion process and loss of topsoil from agricultural land causes a huge loss to local economies, as soil formation processes at such locations and altitudes take an extremely long time. Soil erosion processes are also likely to affect other assets such as bridges, landscapes, and houses. The different types and magnitudes of erosion vary the level of vulnerability to particular assets.



Suggested Adaptation Action: The Buffer Zone Management Committee, along with the national park, can help to develop mechanisms and programs that could minimize soil erosion processes. Other social institutions can act to raise the awareness of local people to cope with soil erosion, including the establishment of plantations and construction of soil some retaining structures. In addition, skilled manpower will be necessary to introduce new techniques to reduce soil loss and soil erosion. Proper drainage systems also need to be constructed to minimize soil erosion processes. District Development Committee management plans should also address ways to minimize the soil erosion along with the their other development activities.

**Table 3: Example management plan covering adaptation actions and community contributions**

SPECIFIC ADAPTATION ACTIONS	COMMUNITY CONTRIBUTIONS
Install early warning system to alert the communities about the potential GLOF action	Form social networks for information sharing before and during the GLOF events
Pasture management for the long term survival of high altitude species like Yaks	Coordinate with the Government supported Yak Farm at Syangboche
Plantation and retaining structures like gabion walls to control landslides	Labor contribution
Introduction of improved variety of drought resistant vegetables and crop species	Labor contribution
Improved irrigation systems (improved irrigation canals and low water usage irrigation systems-drip, sprinkle irrigation)	Labor contribution
Fire extinguishing equipment to control forest fire	Social Networks
Insurance to minimize the economic risk due to the natural hazards	Communities themselves, but they will require additional information about insurance
Construct green houses to retain the moisture loss	Labor contribution
More awareness on climate change, its vulnerabilities and adaptation actions	Local NGOs/ CBOs (Youth and Mothers' groups)

### 2.2.5. CONCLUSIONS AND RECOMMENDATIONS

Communities in the Khumbu region are more or less familiar with climate change processes and their real and perceived impacts. During the September, 2012 community consultations, communities became more aware about climate change, their vulnerabilities, and prospective adaptation measures. Additionally, the consultations enabled participants to record their thoughts, comments, and recommendations for reducing vulnerabilities associated with climate change, the first time that this has been done in the Khumbu region. The three communities were also brought up to date on the proposed UNDP Community-Based Flood and Glacial

Lake Outburst Risk Reduction Project, as well as the results of recent studies of Imja lake conducted by HiMAP.

Participants from all three consultations suggested that the similar consultations should be conducted in other parts of the Khumbu region (e.g., Gokyo and Thami valleys) that can involve a greater number of stakeholders. Participant also expressed a desire for more climate change related trainings and workshop in the future that could improve their understanding of climate change impacts and adaptation opportunities.

The following recommendations were made by the stakeholders during these workshops to minimize their vulnerabilities to the impacts of climate change in the Khumbu region. Because they were the result of the first detailed, long-term series of community consultations held in Khumbu, we considered them to be of a first generation nature to be refined in future consultations and field investigations. 2013 activities would isolate the following recommendations into priority adaptation actions that communities and stakeholders could undertake; assess their economic feasibility; explore funding and co- financing opportunities; and implement a series of adaptation pilot projects.

This process would also be assisted by the concurrent development of a Khumbu Adaptation Management Plan and Khumbu Disaster Management Plan in collaboration with local communities, SNP Chief Warden, the Buffer Zone, Sagarmatha Pollution Control Centre, and other stakeholders. They would directly and consistently inform activities and decisions of the forthcoming UNDP Community-Based Flood and Risk Reduction Project, with an inception date project for the first quarter of 2013.

HiMAP declared its intention to develop a "Khumbu Model" of community-based risk reduction approaches by December 2013 (see the remainder of this report). The model will be transferable, blending the best of community-based consultations and transparency, rapid reconnaissance field studies that provide reliable data critical to risk reduction opportunities, and promotes collaboration between all stakeholders.

The volume of Imja lake and its probability of a flooding has threatened local people living within the entire region. Local people want the problem to be fixed, and recommend lowering the volume of the Imja lake to minimize the risk of a GLOF. This is the first and foremost recommendation put forth by stakeholders during all three September 2012 consultations.

In Dingboche, local people recommended that a hydropower project be established along with the lake risk reduction project. Hydropower could reduce the dependency of local communities on fuel-wood (that often results in ecosystem destruction) and non-sustainable petroleum products (that emit carbon into the environment). Hydropower would also represent a renewable source of clean energy.

Forest resources that are an essential asset of the region have the potential of being negatively affected by the impact of climate change. Forest resources are the basis for adaptation measures against landslides, soil erosion, the cooling of microclimates, and reversal of ecological disturbances. It was often mentioned that forests are necessary for the majority of domestic needs such as fuel wood, timber, and other construction materials, and local communities suggested that forest resource conservation and management mechanisms were of an extremely high priority.

Trails are among the most important assets for livelihoods, especially the trekking trails of the Khumbu region, that could be affected by climate-related vulnerabilities such as erosion, landslides, floods, and GLOFs. The participants of the consultations suggested a range of different methodologies that can improve the condition of trails while reducing their vulnerabilities to climate change impacts. They included improvement of drainage systems (both natural and human-caused), construction of retaining structures at weak sections that prevent trails from subsiding, introduction of bioengineering for the natural stabilization of trails, and plantation activities.

Agriculture is the major basis of many livelihoods and has been heavily impacted because of climate change. Appropriate adaptation strategies need to be developed for the region's long-term agricultural sustainability. Adaptation strategies can include the introduction of better irrigation systems including drip irrigation and improving the condition of the existing irrigation canals. In addition, participants suggested the introduction of new crop species that use less water and species that are suitable to the changing climatic conditions, including drought-resistant species. Income diversification mechanisms in agriculture, such as the introduction of high valued crops and medicinal plants, should also be considered.

Animal husbandry in the region, especially yak, is one of the traditional livelihood activities. The low incomes currently generated by yak raising have forced many local people to adopt other income generating activities, such as the hotel business and other tourism-related activities. Still,

climate change has the potential to degrade the condition of pasturelands. Participants from Dingboche in particular expressed strong concerns about the future of livestock management along with rangeland management in this region.

### **2.3. APRIL 2013 CONSULTATION MEETINGS/WORKSHOPS**

The second round of community consultations was held in April 2013. The April consultations primarily focused on achieving steps two (climate vulnerability) and three (adaptation assessment, prioritization, and adaptation options of the LAPA framework). As such, this series of consultations was designed to develop a better understanding of local climate-induced hazards, a rapid assessment of climate change-induced vulnerability, as well as local adaptive capacities to reduce risks and vulnerability.

The consultations were held in Phakding, Namche, Thame, Gokyo, Phortse, and Pangboche. The consultations in Phakding and Namche focused mostly on sharing results of the previous workshops held in September 2012, and encouraged participants to begin prioritizing the identified adaptation options. Introductory consultations were held in Thame, Phortse, and Pangboche. A total of 57 people participated in the April consultations, including 32 school children in Thame, which the team instructed in the basics of climate change during an afternoon school presentation.

#### **2.3.1. PLANNING FOR THE FULL-FLEDGED LAPA IN AUTUMN 2013**

Both series of community consultations provided a solid platform to plan for the third round of community meetings and workshops that focused on the development of a full-fledged LAPA for the Khumbu region. There were, however, four major challenges to overcome:

1. Ensuring the participation of marginalized and vulnerable stakeholders such as the poor, other disadvantaged groups, and women;
2. Minimizing the apathy that local people seem to feel for consultations and workshops (perhaps because of their busy schedules and workloads in the tourist trade);
3. Ensuring local ownership of the adaptation plan for resource mobilization, implementation and sustainability.

To address the challenges outlined above, considerable time was spent in a literature search and planning to further improve the basic LAPA methodology, including identifying additional appropriate participatory planning tools and techniques.



Left: Thame school students, April 2013, following a HiMAP primer on climate change presented by Phurba Sherpa (far left)

### **2.3.2. SHARING THE COMMUNITY-BASED GLACIAL LAKE OUTBURST FLOOD RISK REDUCTION PROJECT**

Both the September 2012 and the April 2013 meetings/workshops were used to inform local people about the forthcoming UNDP/Nepal “Community-Based Glacial Lake Outburst Flood Risk Reduction Project,” a project to be implemented by the Department of Hydrology and Meteorology with technical and financial support from UNDP/Nepal. HiMAP has been conducting research and risk modeling studies of Imja lake since 2011 and has provided UNDP with the detailed results of the bathymetric surveys, ground penetrating radar, and risk modeling studies in three separate reports. Additionally, HiMAP hosted a “partners workshop” for the Imja project in October 2011, supported an expert evaluation of Imja lake and the proposed risk reduction project by Ing. Cesar Portocarrero in 2012, and continues to share the results of the LAPA and other initiatives in the Khumbu.

The April 2013 meetings/workshops were also used to share latest results of scientific studies conducted by the HiMAP project concerning Imja glacial lake and likely impacts that a glacial lake outburst flood (GLOF) would have on the Khumbu valley’s inhabitants, infrastructure, and economies.

## **2.4. SEPTEMBER 2013 CONSULTATION MEETINGS/WORKSHOPS**

### **2.4.1. APPROACH AND PLANNING UNIT**

Currently two planning approaches are being practiced in Nepal. The first approach uses the Village Development Committee (VDC) as the planning unit. The second approach utilizes user groups, mostly community forest user groups (CFUG), as the planning unit. While these approaches are appropriate for the establishment of highly localized adaptation priorities and capacities, they were felt to inadequately address the regional adaptation priorities of the Khumbu. Thus, a different approach was developed.

The Khumbu adaptation planning approach considers the Sagarmatha National Park and Buffer Zone as a single planning unit, thus moving beyond the VDC as the main planning unit. There are multiple reasons for utilizing a larger geographical unit for adaptation planning:

1. Three VDCs in the Khumbu region are included in the Sagarmatha National Park and Buffer Zone area.
2. The three VDCs have similar geographies, being situated in a high, glaciated mountain ecosystem.
3. All three VDCs have similar socio-economic and cultural characteristics, and they have been facing similar environmental and development issues for centuries.
4. All three VDCs have experienced similar climate change–related issues and climate induced hazards, such as the formation of new glacial lakes, increases in landslides, and increases in windstorms.
5. The Sagarmatha Buffer Zone Council has provided leadership to plan and implement various conservation-related activities using their Buffer Zone revenue for over a decade in all three VDCs.
6. Buffer Zone revenue can potentially be a major source of funding for the implementation of LAPA-identified priorities, as well as leveraging other sources of funding. The available Buffer Zone fund for 2013 was reportedly Rs. 50 million, nearly US\$ 500,000.00. A tourist visiting the Sagarmatha National Park pays Rs. 3,000/- daily as an entry fee, and 50 percent of the entry fee is earmarked as Buffer Zone revenue.
7. In the event of a GLOF from Imja lake, the settlements of all three VDCs will be affected such that local adaptation options and actions are more efficiently planned in an integrated manner.
8. Tourism and mountaineering constitute the backbone of the local economy, and are two sub sectors that are among the most vulnerable to climate induced hazards and change (e.g., through cancelled flights, heavy snow fall, trails damaged by landslides, etc.).

For the reasons stated above, the development of a single LAPA that includes the results from all three VDCs was suggested. This integrated and comprehensive approach was felt to be more

appropriate, effective, and efficient in the development of a climate change adaptation plan for the Khumbu region.

#### 2.4.2. PARTICIPANT SELECTION

The LAPA framework stresses the importance of involving poor and vulnerable communities within the LAPA development process, and careful planning was therefore required to maximize their participation. Priority was given to ensuring participation by women, Dalit (low or “untouchable” caste), and the poor (e.g., trekking porters) in the consultations. Participants included local leaders, students, teachers, religious leaders, farmers, lodge and teashop owners, porters, women’s groups, VDC representatives, national park representatives, youth groups, security personnel, shop keepers, non-governmental organizations, former VDC and ward officials, and government line agency representatives.

**Table 4: Number of Participants in September 2013 LAPA workshops in the Khumbu region**

VDC	Male	Female	Comments
Phakding	26	10	An additional 4 park staff and a Joint Secretary from the Ministry of Forests and Soil Conservation attended the workshop.
Namache	24	8	An additional 6 park staff and the same Joint Secretary from the Ministry of Forests and Soil Conservation attended the workshop.
Khumjung	27	12	Plus an additional 4 park staff.
Total	77	30	Plus 9 park staff, including the Joint Secretary. 4 park staff and the joint staff were repeated in more than one workshop.
Total Participants			107 local participants + 9 park staff = 116

107 of the 120 invitees attended the consultations (Table 4). There were an additional nine participants from the national park, including a Joint Secretary for the Ministry of Forests and Soil Conservation. Of the total 107 local participants, 30 were women, a higher percentage than in previous consultations. Additionally, there were two Dalit participants and six porters, most likely reflective of the low comparative percentages of both groups living in the Khumbu.

#### 2.4.3. WORKSHOP PLANNING AND PROGRAM COMPONENTS

Careful planning was required in order to find suitable dates and venues to run the workshops. For venues, the villages of Phakding, Namche, and Khumjung were selected because they are centrally located, easily accessible, and contain good lodging and meeting facilities. The workshops were planned to take place between 9 and 24 September 2013.

Choosing the right dates to conduct consultations is crucial to maximizing participation. September is the beginning of the autumn tourism season in the Khumbu, the period when most of the local people return from their winter stays in Kathmandu to their villages to run tourism-related services.

Each workshop was limited to two days in order to avoid losing participants. Past experience has shown that Khumbu residents are reluctant to participate in longer workshops because of their domestic and business commitments.

Planning the workshop entailed the development of workshop materials, content, identifying tools to facilitate the different components of the workshop, identifying the lead facilitator for each component, developing supporting materials, and arranging travel, food, meeting, and lodging logistics.

The first day of each consultation started with a welcome note from the park representative. This was followed by self-introductions by each of the participants and facilitators. The second session consisted of introducing workshop objectives, the workshop agenda, and a 45-minute introductory presentation on climate change and its impacts on high mountain regions such as the Khumbu. This was followed by a 20-minute presentation highlighting the LAPA framework, Government of Nepal (GON) climate change policy and initiatives, key findings from the two previous consultations, and participant expectations from the current workshop. After a break for tea, participants were divided into two groups with two facilitators each. Flex sheets, drawing paper, and flip charts were provided to record results of discussions and key findings. Participants presented and discussed their work with the entire group at the end of the day.

The second workshop day started with reviewing the results of the first day. After the review, participants were asked to remain in their previous groups. Participants re-convened into a single large group for the last part of the exercise: completion of the visioning exercise and development of an adaptation action plan. Group presentation results were captured on paper and hung on the wall for reference. Notes were taken during discussions, which facilitators used as reference in developing the final action plan.

Prior to the meetings, a local resource person was hired to distribute invitation letters to potential participants from a wide range of sectors (e.g., tourism, National Park, teachers, NGO, Army, police, women's groups, etc.). He was also responsible for following up with invitees to ensure their arrival. An extra day for organizers was arranged prior to each venue's workshop in

order to review the status of participants, to follow-up with especially valuable individuals, to collect additional information such as baseline documents, to reflect on previous meetings, and to make appropriate changes in the upcoming workshop.

#### **2.4.4. TOOLS AND TECHNIQUES**

Although many of the nationally recommended tools in the overall LAPA framework were useful, several local examples from previous LAPAs in Nepal were even more valuable for various practical reasons. As part of HiMAP's Khumbu LAPA and stocktaking process, approximately 40 examples of Local Adaptation Plans of Action (LAPA) and Community Adaptation Plan of Action (CAPA) documents were reviewed during the spring of 2013. These documents were produced during the past two years by various national and international organizations including CARE Nepal, WWF Nepal Program, Li-Bird, Livelihood and Forestry Program, Multi-Stakeholders Forestry Program, and Hariyo Ban Program.

The LAPA/CAPA stocktaking analysis (Annex A) showed that existing documents provide limited insight into overall methodology. However, many of the results and discussion sections provide useful information on participatory tools used to collect information. Eleven (11) participatory tools and techniques were identified as being the most promising and appropriate for the Khumbu LAPA consultations. The tools and techniques used in the Khumbu LAPA development are listed below:

1. Social map – records settlements, villages, trails, bridges, services, forests, agriculture areas, rivers, streams, development activities, and other prominent features.
2. Vulnerability map – records villages, communities, forests, and agriculture areas that have been or are prone to climate-induced hazards such as flooding, forest fires, GLOF, windstorm, snowfall, draught, and agriculture pests and diseases.
3. Seasonal calendar – analyzes the local climate change experience over the years. The experience is recorded using a monthly calendar and compares past experience with the present across climate variables.
4. Historical timeline analysis – analyzes occurrence and frequency of different climate-induced hazards during the past three decades and their impacts on these on communities, villages, agriculture and forest land, and infrastructure.
5. Affected areas/households analysis – records impacts of climate-induced hazards on villages, households, and socio-economic groups based on social and vulnerability maps and historical timeline analyses.
6. Climate-induced hazards ranking and impact analysis – analyzes hazards identified in the vulnerability map and the impacts of these on different sectors. A scale of 0-4 was used to score the local experience of intensity and the extent of the impacts on different

- sectors. This process records the ranking of various hazards in terms of their impacts on sectors that have been the most affected.
7. Climate change impacts on different sectors – analyzes the present and potential impacts of climate change on different priority sectors as identified in the climate change ranking and impact analyses.
  8. Adaptation visioning – records the impacts of the five most significant hazards as ranked and prioritized by climate change ranking and impact analysis tools. Adaptation visioning analyzes the impacts of the top six hazards, the likely impacts of these hazards during the next five years, current adaptation practices, potential adaptation measures, and visions for the future. The context for all is developing climate resilient communities.
  9. Adaptation prioritization – records different adaptation programs and activities using four criteria—effectiveness, cost-effectiveness, feasibility, and target group orientation—and prioritizes them. A scale of 0-3 was used to score each criterion.
  10. Stakeholder analysis – records and prioritizes different organizations and institutions, governmental and non-governmental organizations, and the private sector using a Venn diagram. This tool helps define the significance and importance of climate adaptation plans as well as the roles and responsibilities of each organization.
  11. Implementation plan – based on adaptation prioritization, a detailed implementation plan of action was developed. The plan included the top six identified hazards, the adaptation activities, and their ranking in terms of importance and priority, possible funding sources, and responsible organizations.

#### **2.4.5. INTERVIEWS AND ADDITIONAL MEETINGS**

Besides facilitating workshops and meetings, informal interviews with open-ended questions were also conducted. Approximately 20 local people, including six women, two porters, and two Dalits were interviewed about their perceptions of climate change issues, and also to validate, cross-check, and synthesize some of the issues raised during the consultations.

The HiMAP team also visited Salleri, the district headquarters of Solukhumbu district, for five days in March 2013. The visit was used to contact the District Development Committee (DDC), the Chief District Office (CDO), the District Forest Office (DFO), and other district-based line agencies that are likely to have a role in the LAPA implementation process. Informal meetings were held and briefings provided regarding HiMAP objectives and the importance of the LAPA process. District-based line agencies showed a high interest in the LAPA process. Many said that this was the first time that their agencies had been contacted and informed about climate change issues and the LAPA development process. They pledged their full support in the development and implementation of the LAPA.

Meetings in March 2013 were also held with the Director General of the Department of National Parks and Wildlife Conservation and the Chief Warden of Sagarmatha National Park

and Buffer Zone (SNPBZ). These meetings discussed the forthcoming September consultations and the role that the SNPBZ could play in this process. As a result of these meetings, the Joint Secretary of the Ministry of Forests and Soil Conservation, the Chief Warden, the Assistant Warden, and other park staff agreed to participate in the September 2013 workshops.

## **2.5. ANALYSIS AND WRITING**

The Khumbu Adaptation Plan of Action is based on the key findings and results of three separate community consultation meetings and workshops in the Khumbu (September 2012, April 2013, and September 2013), two smaller meetings held in Kathmandu in 2012, and Solu Khumbu District level meetings in March 2013. Results were extracted from meeting notes, interview transcripts, group work notes, tables, and summaries to identify recurrent themes and sub-themes. A table of contents was developed to organize themes and sub-themes. Headings and sub-headings were then used to develop a structure for the LAPA. Survey and research findings from different organizations were used to validate or explain field findings and results. It is hoped that the Khumbu LAPA will make a significant contribution to the development and refinement of the LAPA process in Nepal in terms of scale, coverage, content, ownership, integration with other development planning and programs, fund mainstreaming into existing and future sources of financing, and fund leveraging.

# 3. RESOURCE AND HAZARD MAPPING

Resource and Hazard Maps were prepared to develop a better understanding of local perceptions of, and experience with, different climate-induced hazards, as well as to identify areas and resources at risk from these hazards.

## 3.1. RESOURCE MAPPING

Resource maps provided detailed information about forests, land-use practices, agriculture, trails and bridges, hospitals, health-posts, monasteries, settlements or villages, and rivers. The results below are based on the information provided during the mapping exercises, as well as other references used to assist the LAPA process, particularly to cross-check and present facts and figures.

The Khumbu region is located in the northeast of Nepal and comprises three Village Development Committees (VDC)—Chaurikharka, Namche and Khumjung—of Solukhumbu district. Each VDC is comprised of 9 wards, each of which may include one or more villages depending on the population size. For example, Namche village of Namche VDC represents three wards, whereas Khunde village of Khumjung VDC represents only two. Khumbu shares a border with Tibet, an autonomous region of the People’s Republic of China. Nangpa La is a main pass between Tibet and Nepal. The altitude of this region varies widely, from 2,300 m to 8,848 m, the latter being the altitude of Sagarmatha (e.g., Mt. Everest), among the highest peaks in the world. The region is dominated by steep and rugged terrain broken by three major glacial and river valleys—the Bhote Kosi, Imja Khola, and Gokyo Kosi. The Imja Khola and Bhote Koshi are major tributaries of the Dudh-Koshi river system.

Ecologically, the Khumbu region includes sub-temperate to high alpine ecosystems and is bestowed with rich floral and faunal diversity. While a mixture of broadleaf species are found in the lower altitudinal area, conifer species dominate the higher vegetated south-facing slopes. The vegetation changes above 4,000 m, where it becomes dominated by dwarf rhododendrons, alpine shrubs, herbs, and grasses. Above 5,500 m the vegetation changes to lichens and alpine tundra (see Annex B, Vegetation Notes). The region harbors many wildlife species, including the

endangered Himalayan black bear, musk deer, and snow leopard. The region also holds 118 species of birds, including the Danphe pheasant, Himalayan Griffon, and yellow-billed chough.

Socio-culturally, the Khumbu region is home to Sherpa people who migrated from eastern Tibet during the 14<sup>th</sup> century. Today they continue to share close linguistic, religious, and cultural ties with Tibet. Traditionally, Sherpas were agropastoralists, cattle breeders, and traders. These occupations dominated the local economy for centuries. In the last four decades, however, tourism, particularly mountaineering and trekking, has become the dominant sector of the Khumbu region. Few households do not have a family member working in the tourism industry in some capacity. Many Sherpa now travel in Europe and the US during the off season, often with the financial assistance of tourists that they befriended during the trekking or climbing seasons. Some Sherpas have become successful tourism entrepreneurs, running trekking agencies, equipment companies, airlines, helicopter services, up-scale resorts, and hotels.

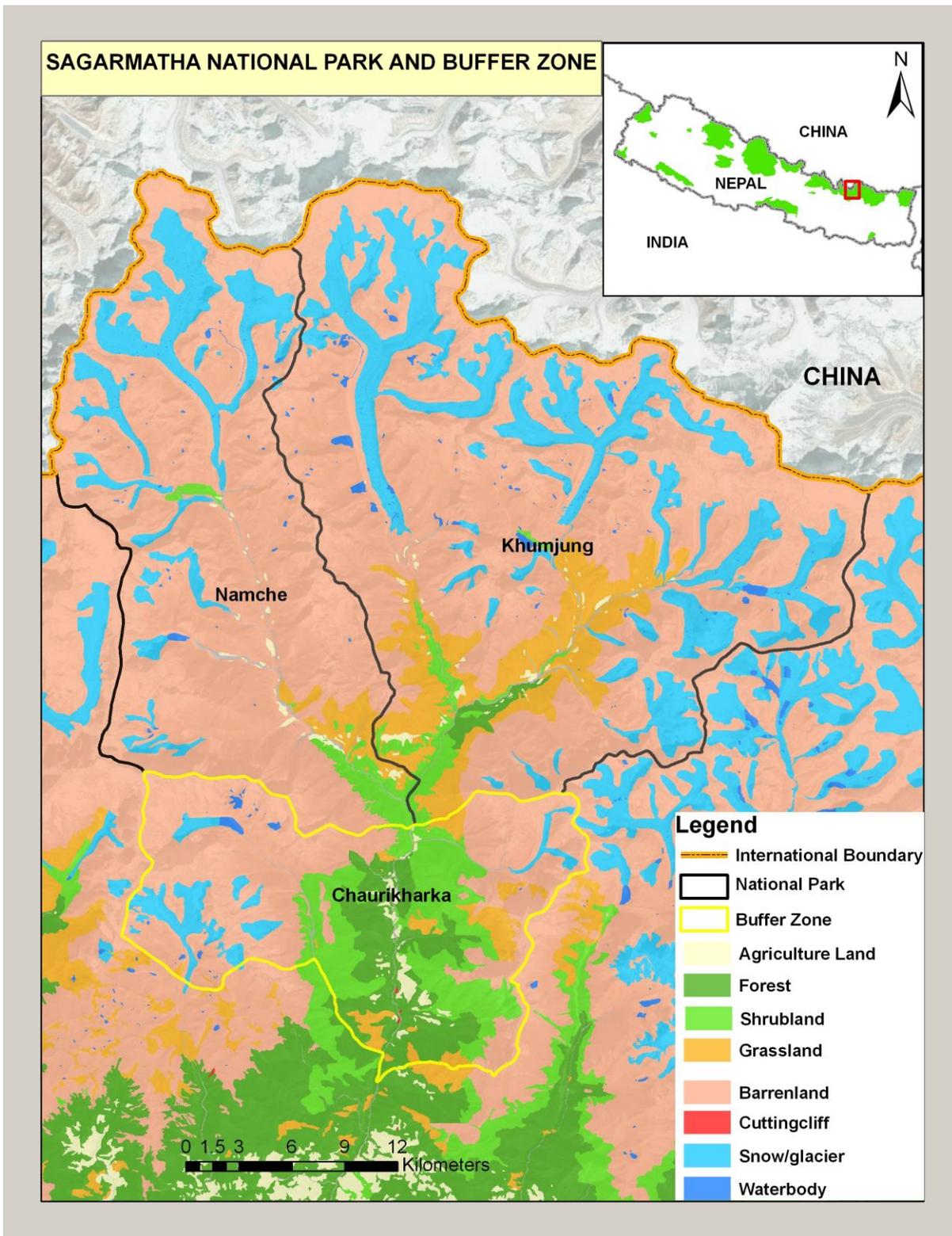


Figure 4: Sagarmatha National Park and Buffer Zone map of vegetation zones (courtesy of World Wildlife Fund/Nepal)



Figure 5: Namche VDC resource map

Tourism development in the Khumbu has been largely credited for improving the local economy and living standard of the Sherpa people. The unprecedented growth and uncontrolled activities of tourism with increased pollution problems (e.g., solid and human waste), however, has raised concerns for the sustainability of the environment. The region is also particularly vulnerable to climate change impacts because of its extreme topography, remoteness, lack of transportation facilities, and tourist-driven and dependent economies that are easily disrupted by the increasingly inclement weather, landslides, floods, and other climate-related factors.

### 3.1.1. HOUSEHOLDS AND POPULATION

The most recent census report shows that there are a total of 1,999 households in Chaurikharka, Namche, and Khumjung VDCs. Chaurikharka, with 968 households, is the largest VDC.

Khumjung and Namche VDCs have 551 and 480 households, respectively. There has been a significant growth in number of households during the last decade. The number of households in Namche and Chaurikharka since 2001 has doubled, from 285 to 480, and from 418 to 968, respectively. Khumjung VDC, however, experienced a slower growth rate, from 429 to 551 during the same period (DDCS 2001; NPHC 2012).

The total population of the Khumbu region is 7,161 (NPHC 2012) with an almost equal ratio of males to females. Chaurikharka VDC contains almost 52 percent of the total population of the

Khumbu region. Khumjung VDC contains 27 percent, and Namche 21 percent, of the total population. Among the three VDCs, only Chaurikharka has experienced a significant population growth, from 2,248 in 2001 to 2,568 in 2011 (DDCS 2002 and NPHC 2012), although this is still well below the national average of 2.25 per annum (CBS 2002). The population growth rate in Khumjung VDC has declined, and Namche has remained unchanged.

These figures reflect that while local population figures have remained more or less unchanged, the number of buildings constructed in the Khumbu is booming. There are several explanations for this trend. First, local people are building new lodges and renting them out. Second, out-migration of local people for jobs and other opportunities is increasing, as is the in-migration of non-Sherpas from neighboring districts who are now running lodges, shops, and teahouses on lease from Sherpas. These new in-migrants are maintaining the population equilibrium of the Khumbu region, but as “non-residents” they have not been fully accounted for in the national census. Third, many Sherpas are now part-time residents in Khumbu and part-time in Kathmandu or even outside Nepal, which further confuses the figures.

Sherpas still constitute 92 percent of the Khumbu population, the largest of all the region’s ethnic groups. Tamangs represent the second largest ethnic group (3%), followed by Rai (1.5). Dalit and other ethnic groups combined constitute the remaining 3.5 percent of Khumbu’s population. Sherpa and Nepali are the two dominant languages spoken in the region. The Nyingmapa sect of Mahayana-Tibetan Buddhism is the dominant religious order among the Sherpa. They also practice pre-Buddhist animistic traditions, such as worshipping ancestors and nature, and celebrate numerous ceremonies and cultural festivals throughout the year that relate to their diverse traditions.

### 3.1.2. VILLAGES AND SETTLEMENTS

**Table 5: Number of Households per Village Khumbu Region (hh = household)**

VDC	Large villages > 40 hh	Medium villages: 20-40hh	Small villages: <20 hh
Chaurikharka	Lukla Chaurikharka Choplung Ghat Phakding Monjo Jorsalle	Sano Gumila Thulo Gumila Surke Muse	Toktok Benkar Chumoa Thadokosi

Namche	Namche Thamo Thame Teng Thame Og	Hilajung Taranga Chanakpa	Phurte Samden Pare Jarok Theso Thengbo Lungden
Khumjung	Khunde Khumjung Phortse Pangboche Dingboche Pheriche	Tashinga Tengboche Debucho Milingo Shomare Dhole Luza Macherma Phanga Gokyo Chukung	Sanasa Kyanjuma Shyangboche Phungi Tenga Worsho Chura Phulangkarang Mongla

The Khumbu region has 54 villages of variable sizes spread across all three VDCs. Khumjung, Kunde, Namche, and Lukla are the largest villages. Lukla is the largest village with 365 households. Khumjung has 180 households, Kunde 70, and Namche 238. There are a number of very small villages, for example, Mong La, Phortse Thanga, and Dugla, with only 3 households each.

Based on the number of households, villages can be divided into three categories:

1. Large villages: These villages contain over 40 households. 18 villages in the Khumbu fall within this category. These villages represent more than one ward of a VDC.
2. Medium villages: These villages contain 20-40 households. They either represent one ward or are required to join one more village to become a ward of a VDC. Seventeen (17) villages are included in this category.
3. Small villages: These villages contain less than 20 households, some as low as 3 to 5. Villages under this category must join with more than two other villages to constitute a ward of a VDC.

### 3.1.3. FORESTS AND LAND-USE

Except for Lungden, all other villages in the Khumbu region have convenient access to forests. There are nine Buffer Zone Forest User Groups (BZFUGs) in Chaurikharka VDC that manage these forests, and through these groups local people have been able to exercise their user rights. Forests in Namche and Khumjung VDCs are located within the national park and are protected by national park law. The park, however, gives access rights to locals, who are allowed to collect fuelwood twice a year and timber once a year with permits. Forests are still the main source of

fuelwood. The local use of fuelwood, however, has declined considerably in recent years due to the availability of alternative fuels such as kerosene, LPG, and electricity, which are increasingly being used by households and lodges alike. New, locally driven conservation initiatives, such as the Khumbu Alpine Conservation Committee (KACC) that banned the harvesting of shrub juniper in the alpine zone, have also resulted in decreased fuelwood use. Nevertheless, dozens of Rai porters (from outside the Khumbu) can still be seen on the trails at selected dates each fall and spring, carrying 90 kg loads of fuelwood to the houses or lodges of their Sherpa employers.

Villages in the Khumbu region are clustered. Every house has a small plot for a kitchen garden and, with the exception of Lungden, all villages are surrounded by agriculture fields. Traditionally, the local people maintained two types of settlements: *Yersa*, highland settlements, were seasonally used for tending livestock along with potato and hay fields, while *Gunsa*, lowland settlements, were permanent villages with agriculture fields. Buckwheat, potatoes, wheat, garlic, and radishes used to be the main crops grown. Most of the *Yersa* settlements now have been converted into tourist towns with lodges, restaurants, and cafes, also offering transport and Internet services. While traditional crops are still being cultivated in *Gunsa* settlements, new vegetables such as cauliflower, cabbages, spinach, carrots, and onions are gaining popularity with the increased numbers of trekkers and mountaineers. Plastic sheds and greenhouses are now being used widely, especially in Chaurikharka, Namche, and Khumjung VDCs, to grow vegetables. Peach, pear, plum, apricot, and apple are popular fruit trees for villages between Lukla and Jorsalle, although Namche and Khumjung VDCs, being situated at higher altitudes, grow no fruit trees. Hay is also becoming an increasingly popular crop. Because of the large number of yak and *dzopkios* used to carry tourist gear to the Everest basecamp region, raising hay is considered more profitable than growing potatoes.

#### **3.1.4. LIVESTOCK**

Yaks and cows are the two most popular livestock types in the Khumbu region. Khumjung VDC has the highest number of yaks and cows, 849 and 1,105, respectively (SNP/SCAFP 2002).

Namche has the second highest number of yaks and cows, 597 and 522, respectively

(SNP/SCAFP). *Dzopkyo*, a cross breed of a bull and a yak, is popular in Chaurikharka VDC.

Animals such as goats, horses, and mules are kept but their numbers are low. While mules and *dzopkyo* are used as pack animals in Chaurikhara VDC, yaks are used more in the higher altitude Khumjung and Namche VDCs. These animals are widely used by mountaineers to carry their food and equipment on expeditions (typically in spring and autumn). According to locals, the

number of livestock, particularly cows, goats, and horses, has declined in all VDCs, but the number of yaks and *dzopkyo* is increasing slightly, mainly to transport goods for climbers.

### **3.1.5. GLACIERS AND GLACIAL LAKES<sup>1</sup>**

Currently, global warming is changing the water storage functionality of snow and glaciers, as well as changing frequency, magnitude, and seasonality of rainfall. Glacier response to warming trends is increasingly recognized as being heterogeneous and subject to a range of variables that can include debris cover, altitude, aspect (Kargel et al. 2011), and latitude (Armstrong 2010). As glaciers melt in the Himalaya and Andes, hundreds of new glacier lakes, holding millions of cubic meters of water, have been created. Usually contained by moraine dams of unconsolidated boulders and soil, these lakes present a risk of glacial lake outburst floods (GLOF). Triggering factors for GLOFs include “...lake area expansion rate; up-glacier and down-valley expansion rate; dead-ice melting; seepage; lake water level change; and surge wave by rockfall and/or slide and ice calving” (Watanabe et al. 2009). GLOFs rapidly unleash stored lake water, often causing enormous devastation downstream that can include high death tolls as well as the destruction of valuable farmland and costly infrastructure (e.g., hydroelectric facilities, roads, and bridges). Examples include the 1941 GLOF above Huaraz, Peru, that killed nearly 6,000 people within minutes (Hambrey and Alean 2004; Carey 2005; Carey 2010); the 1985 Langmoche outburst in the Sagarmatha National Park, Nepal, that destroyed the US\$ 2 million Thami hydroelectric facility, hundreds of hectares of cropland, and dozens of bridges downstream (Vuichard and Zimmerman 1986); and the 1998 outburst of the Sabai Tso in the Hinku valley, Makalu-Barun National Park, Nepal, that destroyed trails and seasonal settlements for nearly 100 km downstream (Cox, 1999; Osti and Egashira 2009).

According to Bajracharya et al. (2007), 24 new glacial lakes have formed and 34 major lakes have grown substantially during the past several decades in the Mt. Everest and Makalu-Barun National Parks of Nepal. They suggest that at least 12 of the new or growing lakes within the Dudh Kosi watershed, nine of which are located in the remote Hinku and Hongu valleys of Makalu-Barun National Park, are “potentially dangerous” based on their rapid growth over the past several decades, as evidenced in time lapse remotely sensed imagery (Bajracharya et al. 2007; Xu et al. 2007; Bolch et al. 2008; Watanabe et al. 2009).

---

<sup>1</sup> From: Byers et al. 2013. Glacial lakes of the Hinku and Hongu Valleys, Makalu-Barun National Park and Buffer Zone, Nepal. Natural Hazards. April (DOI: 10.1007/s11069-013-0689-8).

In Sagarmatha National Park, there are six glacial lakes in Gokyo valley, collectively known as the Gokyo lakes. The other main glacial lakes are Cho la, Imja, Nozongba, Dzongla, Lhotse, Baruntse, Thangbo, and Digcho. The main glaciers include Khumbu, Nozumba, Imja, Lhotse, Dig Tso, and Thangbo. Imja glacial lake has been investigated for more than 20 years (Armstrong 2010). The lake has experienced particularly rapid growth in area and volume since the early 1960s, leading to both local and international concern over the risk of a catastrophic GLOF event. The most detailed studies of the lake to date (bathymetry, ground penetrating radar, risk reduction modelling) were completed by the HiMAP Glacial Lake Rapid Reconnaissance Team between 2012 and 2013. Results of the research are available in three reports<sup>2</sup>. The forthcoming UNDP/Nepa “Community-Based Glacial Lake Outburst Flood Risk Reduction Project” intends to lower the lake by at least 3 meters, install an early warning system and develop disaster management capacities within the Sagarmatha National Park.

### **3.1.6. RIVERS AND TRIBUTARIES**

There are three main river systems in the Sagarmatha National Park: the Bhote Kosi, which originates in the Thame valley; the Dudh Kosi in the Gokyo valley; and the Imja Khola that originates in the upper Imja valley. All three merge to form the Dudh Kosi at the base of the Namche hill, north of Jorsale.

### **3.1.7. INFRASTRUCTURE AND SERVICES**

#### Trails:

The Khumbu region is considered to be a remote area because it is not yet connected to the national road network. It takes three days of walking from the airport at Lukla to reach the nearest road, in Salleri. There are two airports in Khumbu, one at Lukla, the other at Syangboche. Lukla has regular twin-engine flight services run by national and private airlines, Shyangboche is limited to helicopters and single-engine planes. Shyangboche’s airport is used primarily for delivering food, fuel, construction materials, and timber. From the airports an extensive network of trails leads to many trekking and mountaineering destinations. Famous mountains for climbing include Mt. Everest, Lhotse, Pumori, Ama Dablam, and Thamserku. Island Peak and Baruntse are the two most popular “trekking peaks” in the region, a term designated by the

---

<sup>2</sup> (Bathymetry: <http://www.crwr.utexas.edu/reports/2012/rpt12-6.shtml> GPR: <http://www.crwr.utexas.edu/reports/2012/rpt12-3.shtml> Modeling: <http://www.crwr.utexas.edu/reports/2013/rpt13-6.shtml>)

Nepal Mountaineering Association for 33 semi-technical to technical peaks throughout Nepal that are between 5700 and 6400 m in height. In terms of trekking destinations, the trail networks in the region can be grouped into six different routes and destinations as listed below:

1. Renzola-Nangpa La/Rolwaling route – Lukla-Chhoplung-Thadokoshi-Ghat-Phakding-Toktok-Benker-Monjo-Jorsalle-Namche-Phurte-Thamo-Thame-Thametang-Lungden-RenzoLa (from Thametang a traditional trade route leads over Nangpa La to Tibet). Another trail from Thame leads to Tashilapcha and to Rowaling.
2. Gokyo route – Namche-Kyangjuma-Mong La-Phrotse Thanga, Dhole, Machherma to Gokyo.
3. Everest Base Camp route – Namche-Kyangjuma-Phungithanga-Tangboche-Debuche-Pangboche-Pheriche-Dukla-Lobuche-Gorakshep (Kala-pathar)-Everest Base Camp.
4. Island Peak/Imja route – Namche-Kyangjuma-Phungithanga-Tangboche-Debuche-Pangboche-Dingboche-Chhukung-Island Peak Base Camp.
5. Lower Solu route – Lukla-Surke-Paiya-Pangam-lower Solu.
6. Mera Peak route – Lukla-Thulikharkaa-Chhutanga-Chhetharpu pass – Naulekh to Mera peak.

#### Bridges:

There are 30 bridges, mostly suspension. They are located at Phugithanga, Pangboche, Dingboche, Pheriche, Dukla, Phortshethanga, Nala, Gokyo, Khunde, Thame, Thamo, Phurte, Lumdeng, Thameteng, Thadokoshi, and Toktok. Monjo, Surke, Muse, Phakding, and Lukla have two bridges each, and Jorselle four.

#### Education:

There are only two high schools in Khumbu, one in Khumjung and the other in Chaurikharka. There are five primary schools in Khumbu, located in Phortse, Pangboche, Thame, Thamo, and Monjo, plus lower secondary schools in Namche and Sano Gomila. These are all public schools but also receive support from international organizations such as the Himalayan Trust, which was founded by Sir Edmund Hillary (who made the first ascent of Everest) and has been providing funds for teacher training, curriculum development, scholarships, and school infrastructure development for several decades.

#### Health Care:

There are four hospitals in the Khumbu region. The Khunde hospital is public and is supported by the Himalayan Trust. The other hospitals are in Namche, Lukla, and Muse and are private.

Namche village has the only dental clinic in the region, supported by a number of international organizations, including the American Himalayan Foundation. There are five health posts or clinics, located in Chhoplung, Lukla, Thame, Machherma, and Pheriche.

#### Drinking water supply:

Except for a few small settlements, most villages in the Khumbu region have access to drinking water. Freshwater supplies in villages along the main trekking trails are becoming scarcer because of a combination of changing precipitation patterns, the drying up of historically reliable springs, and new water demands imposed by flush toilets and showers built for tourists. Local people are already taking steps to adapt to these recent changes in freshwater availability. For example, there is a project funded by the Indian Government (US\$500,000.00) to pipe water from the Kyalo glacier to Kunde, Khumjung, and Namche villages; and a Himalayan Trust project (US\$65,000.00) to provide new drinking water to Lukla.

#### Electricity:

Except for a few small settlements, all villages in the Khumbu region are electrified. Power companies in Tengboche, Pangboche, Phortse, and Lukla are privately owned. The electrification schemes in Monjo, Toktok, Ghat, Thame, Khumjung, Khunde, and Namche villages are community owned and managed. Electric power in this region is not yet sufficient for heating or cooking. It is not connected to the national power grid.

#### Communication:

In the last decade the communication network in the Khumbu region has improved remarkably. All large villages have landline and mobile network services. Medium and small villages are well connected by mobile services. Internet services are also available in tourist villages.

#### Tourism related services:

Apart from Pulung-Karang, Nagarjung, Pare, Thulo Gumila, Sano Gumila, Tate, and Muse, all other villages in the Khumbu region have lodges, restaurants, cafes, and teashops. Villages such as Tengboche, Dingboche, Pheriche, Debuche, Pangboche, Shomare, Lobuche, Gorakshep, and Gokyo have the highest number of lodges, with more than 10 in each village. Lodges/restaurants above Shomare village are mostly owned by Khunde and Khumjung residents, and are operated only during trekking and mountaineering seasons.

**Table 6: Non-monastery Services in Khumbu**

Services	Villages where they are located
National park offices and posts	Namche (headquarters), Shyangboche, Tashinga, Debuche, Phortse, Thenga, Phurte, Monjo, and Lukla
Police posts	<u>Khumjung, Namche</u> Lukla, and Chhoplung
Army posts	Phungi-Thenga, Namche, Thamo, and Jorsalle
Yak farm	Shyangboche
EVK2 research station	Lobuche
Himalayan Rescue Association	Pheriche
Banks (6)	Lukla and Namche
Khumbu Bijuli Company (Khumbu Electricity Company)	Namche
Sagarmatha Pollution Control Offices	Lukla and Namche
Tree nurseries	Phurte, Tashinga, and Shomare
Shima Prashan Office (border security office)	Namche
Cooperatives (2)	Lukla and Namche
Post offices	Lukla, Chhoplung, and Namche
Porter Progress Office	Lukla
Horticulture Farm (Japanese aid)	Chhoplung
Airports	Lukla and Shyangboche
Nepal Telecommunication Offices	Lukla and Namche

Monasteries:

There are 16 monasteries in the Khumbu, located in Khunde, Khumjung, Tangboche, Debuche, Pangboche, Phortse, Dingboche, Lukla, Muse, Phakding (near Thulo Gomila), Chhuplung, Ghat, Thamo, and Thame. Namche has two monasteries. Additionally, Nagarjung has meditation shelters and caves. Other existing services are presented in Table 6.

**3.2. CLIMATE INDUCED HAZARDS AND VULNERABILITY**

Hazard maps were used in the consultations to identify hazard types, vulnerable hotspots, and vulnerable villages in the Khumbu region (Table 7). The major climate-induced hazards identified in the Khumbu were landslides, windstorms, glacial lake outburst flooding (GLOF), heavy snowfalls, irregular rainfall, water scarcity, forest fires, drought, new agriculture pests and diseases, and overcast or prolonged cloud cover. Examples include the following:

1. Landslides are common in Chaurikharka, Namche, and Kumjung VDCs, with 18 villages being particularly vulnerable.
2. Glacial Lake Outburst Floods (GLOF): A number of villages in Khumjung and Chaurikharka VDCs are vulnerable to GLOFs, particularly from Imja lake. Four villages

- of Namche VDC along the Bhote and Dudh Kosi rivers experienced extensive damage in 1985 during the Dig Tso GLOF; they are even more vulnerable today because of the growth in infrastructure (eg, lodges and farms) on the lower river terraces since 1985.
3. Villages of Khumjung and Namche are vulnerable to heavy or prolonged snowfall. Livestock are vulnerable to heavy snow because of the difficulties in keeping them warm and fed. Mountaineering is also vulnerable to heavy snowfall, which can result in the cancellation of expeditions leading to financial hardship for locals.
  4. Three villages were reported to be vulnerable to water scarcity (Kunde, Khumjung, and Namche). The drying of water sources has also been experienced in Chaurikharka VDC, but has had no significant impact to date.
  5. All villages besides Namche are vulnerable to windstorms, which have extensively damaged the roofs of houses and resulted in increased windfall in forests.
  6. Forest fires are more common in Chaurikharka VDC, and four villages are particularly vulnerable.
  7. Four villages of Namche and Chaurikhara VDCs are vulnerable to drought. To date only Thulo Gomila has experienced an impact.
  8. Three villages in Chaurikharka VDC are vulnerable to flash floods and river flooding.
  9. All villages are vulnerable to new agriculture pests and diseases, but their impacts are not yet significant.
  10. Overcast or prolonged cloud cover is becoming a nuisance for flight operators. The number of flight cancellations from May to October is increasing every year. This has made the tourism industry in the Khumbu region among the most vulnerable of sectors. The best time for fall trekking and flights now appears to be in November-December as opposed to October-November in the past. Lodge/trekking/climbing operators may have to start promoting the early winter season among international clients as the best time to come. Alternatively, people can be encouraged to trek up to Lukla instead of flying, but this adds several days to a week of hiking to each trip, which makes it less attractive to many.

The frequency and impacts of these hazards will be discussed in detail in the following sections covering the seasonal calendar, historical timeline analyses, and impacts of hazards on different sectors.

**Table 7: Vulnerable Hotspots and Villages**

Hazards	Vulnerable villages	Comments
Landslides	Khunde, Phortse, Dingboche, Shomare, Pangboche, Pulang Karang, Thole, Nala, Renzo La (way to Gokyo), Tengboche, Phungithanga, Ghat, Thadokoshi, Phakding, Monjo, and Muse	A bridge and a trail section at Dingboche area is at a higher risk. The trail in Nala is at a high risk. Tengboche and Phungithanga landslide destroyed a water mill. A suspension bridge at Thadokoshi is at a higher risk.
GLOF	Chukung, Dingboche, Pheriche Shomare, Pangboche, Debucho, Tengboche, Phungithanga Thame, Thamo, Thame Teng, (lower area), Samde (lower part), Phurte (lower part) and Pare Jorsalle, Monjo, Toktok, Benkar, Phakding, Ghat, Thadokoshi (lower part), Chhoplung (lower), Muse, and Surke	The lower parts of Thamo, Samde, Phurte, and Pare suffered extensive damage as a result of the 1985 Dig Tso GLOF.
Heavy or prolonged snowfall	All villages in Namche and Khumjung VDCs	
Water scarcity	Shyangboche, Pangboche, and Phortse	Shyangboche has no water source. Pangboche and Phortse have poor water sources.
Windstorm	Except the village of Namche itself, all villages in Khumjung, Namche, and Chaurikharka VDCs are vulnerable	
Forest fire	Phortse and Thamo, Monjo, Thulo Gomila, Phakding, and Ghat	
Drought	Samde, Thame, Thamo, Thulo, and Gomila	
Flood	Surke, Ghat, and Lukla	
Agriculture pests and diseases	All villages	Pests and diseases not known in the past are damaging fruits, vegetables, and potatoes.
Overcast or prolonged cloud cover	Lukla airport	Flight cancellation is high during June to October months. October is the traditional peak trekking season.

### 3.3. LOCAL EXPERIENCE OF CLIMATE VARIABILITY AND EXTREMES

A seasonal calendar analysis was used to understand the local experience of climate variability and extremes and evaluate the use of climate information for planning. Different climate variables were discussed comparing local experience during the last three decades with the present. All observations are experiential (subjective); few have been quantified. Results are summarized below:

Monsoon (rainy) Season):

The monsoon is starting later but lasting longer. The monsoon rain in the Khumbu region used to start at the end of May or early June, ending the last week of August. Now it starts about two weeks later, usually around the second week of June, and ends in late September.

Winter (cold) Season:

Winter is starting earlier and milder. In the past, winter used to start in November and end in February. Now winter is starting a month earlier (October) and ending in February.

Summer (warm) Season:

Summer is starting earlier, lasting longer and becoming warmer. The Khumbu region used to experience summer for nearly four months, from April to July. Summer now starts in February and lasts five or six months until August or September.

Frost:

The Khumbu region is experiencing overnight frost for longer periods. There is a slight variation in frost conditions across the three VDCs. Chaurikharka VDC, for example, used to get frost between November and mid-February, but now frost can occur until mid-March. Khumjung VDC used to get frost from mid-November to December; it now lasts until mid-February. Namche VDC has experienced no observed change in frost patterns.

Snowfall:

Although the winter in general has shortened and is milder in the Khumbu, the region has been experiencing heavier snowfall for more extended periods of time. Snowfall used to start in December and last until March, but now starts as early as September and may last until May. Cumulatively, however, Khumbu is receiving less total snowfall during the winter season than in previous decades.

### Hailstones:

Hail was never a problem for Namche and Khumjung VDCs. Chaurikharka used to get occasional hailstorms from March to May, but the region has not experienced any hail in recent years.

### Clouds:

Cloud cover and prolonged overcast conditions are becoming a major problem in the Khumbu region, particularly for flights and mountain viewing. Extended cloud cover used to be common from mid-May to August; now it is common from mid-April to October, sometimes extending to the middle of November.

### Drought:

Dry periods are getting longer, although droughts are mainly experienced in Chaurikharka VDC. Mid-March to the middle of May used to be the dry or drought period for Chaurikharka VDC; it now extends from February to June.

### Avalanches:

Avalanches are not a problem in Chaurikharka VDC because of its low altitude, but are common and problematic in Khumjung and Namche VDCs. Both VDCs are experiencing avalanches earlier than in the past, beginning as early as March now as compared to May/June in the past.

Additional key information provided by local people regarding climate variability that were not included in the seasonal calendar are:

- The rise in temperature. Summer is getting warmer and the winters milder, but include increased climate extremes such as heavy snowfall and windstorms.
- The mountains are receiving less snow cover, glaciers are receding, and glacial lakes are getting larger.
- Changes in rainfall patterns are being experienced. Heavier rains of shorter duration are causing increased landslides, soil erosion, and riverbank undercutting.
- New insects, diseases, and pests have been noticed. For example, mosquitoes were non-existent a decade ago in Chaurikharka VDC, but are quite common now. New diseases and pests harmful to vegetables and crops are appearing.
- Forest fires are now occurring more frequently. A decade ago they were rare.

### 3.3.1. SEASONAL CALENDAR

Table 8: Seasonal Calendar

		Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Monsoon	Before												
	Now												
Winter Season	Before												
	Now												
Summer Season	Before												
	Now												
Frost: Chaunri Kharka	Before												
	Now												
Frost (Namche)	Before												
	Now												
Frost (Khumjung)	Before												
	Now												
Snowfall	Before												
	Now												
Hailstone (Chaunrikharka)	Before												
	Now												
Cloud	Before												
	Now												
Drought (Chaunrikharka)	Before												
	Now												
Avalanche	Before												
	Now												

### 3.4. TIMELINE ANALYSIS

A timeline analysis was used to obtain insights on past hazards, type of hazards, their intensities, and impacts of these hazards on local people, resources, infrastructure, and livelihoods.

#### 3.4.1. LANDSLIDES

The frequency of landslides occurring since 1991 in the Khumbu region is presented in Table 8. A total of seven incidents of landslides were recorded causing damage to infrastructure and agricultural fields, in some instances resulting in human casualties. The 1991 landslide (actually a torrent) at Shomare was the most deadly, killing eight people, including five Army soldiers serving in the national park.



2012 landslide at Ghat that killed six people and destroyed five homes

The timeline analysis shows the rise of landslide incidents. In 2011 and 2012 a total of landslides were recorded, compared to three between 1991 and 2005. The Ghat landslide in 2011 killed five people. Chaurikharka is the most vulnerable to landslides of the three VDCs—five out of seven landslides since 2001 occurred there. Khumjung is the second most vulnerable VDC, while Namche VDC has no landslides on record. In one instance the Buffer Zone provided funds for the construction of gabions and forest plantations. Otherwise, it has been up to the people affected by landslides to rebuild their own lives, including repairing damaged fields, houses, and infrastructure.

**Table 9: Records of Landslides in the Khumbu region**

Year	Location	VDC	Impacts	Adaptation Action
1991	Shomare	Khumjung	8 people died, including 5 Army and 3 local people.	
2001	Surke	Chaurikharka	Damaged agriculture land and bridges.	Some minor efforts made
2005	Khunde	Khumjung	This was actually a torrent, or sudden concentration of water and debris that was linked to rapid snowmelt on the upper slopes of Khumbu Yul Lha. It destroyed the potato farm owned by eight local people and damaged three houses. Based on the presence of multiple parallel levees on each side of the torrent, it has historically occurred at least once every 50 years.	Buffer Zone provided gabion boxes and supported plantations.
2011	Choplung	Chaurikharka	Damaged trail, drinking water, and bridge.	Some minor efforts
2011	Ghat 6	Chaurikharka	5 people died and 5 houses displaced.	Rescue and plantation
2012	Monju	Chaurikharka	Damaged power house.	
2012	Lukla	Chaurikharka	Trail, hospital, and forest destroyed.	Some minor efforts made

### 3.4.2. FOREST FIRES

Forest fires have been historically rare in the Khumbu, but there have been three recorded incidents of forest fires since 1998. Chaurikharka VDC appears to be more prone to forest fires than the other two VDCs. Namche VDC has had only one forest fire, in 1998. Forest fires are detrimental to wildlife and forests, but thus far there is no record of damage to property or human casualties. Forest fires have been controlled with the help of security personnel, the Army, police, and local people.

**Table 10: Records of Forest fires in the Khumbu region**

Year	Location	VDC	Impacts	Adaptation Action
1998	Top Danda	Namche	Destroyed forests and wildlife	Forest fire was controlled with the help of local people, Army, and police.
2010	Phakding	Chaurikharka	Destroyed forest and wildlife	Forest fire was controlled by the local efforts.
2012	Monju	Chaurikharka	Destroyed forest and wildlife	Forest fire was controlled by local efforts.

### 3.4.3. GLACIAL LAKE OUTBURST FLOODS (GLOF)

The Khumbu region has experienced five glacial lake outburst floods (GLOF) since 1977, with

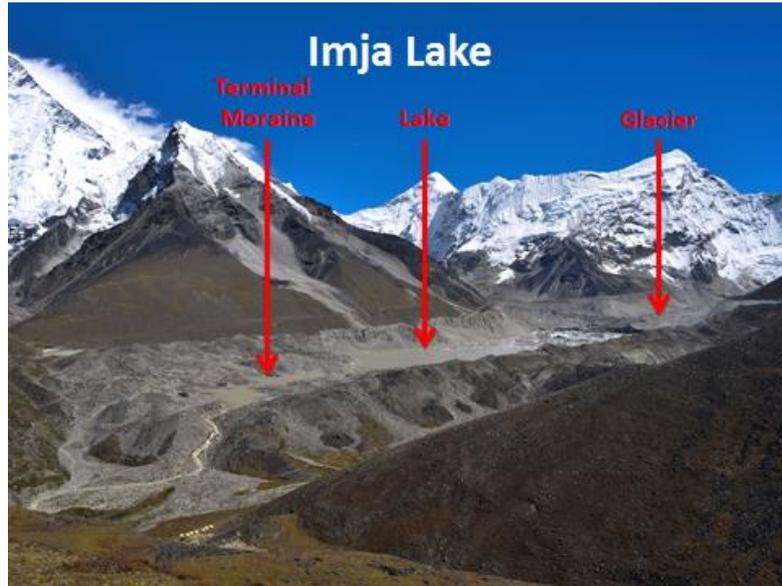
Khumjung the most vulnerable of the three VDCs.

Four out of the five recorded GLOF events occurred in this VDC, destroying trails, bridges, water mills, power stations, water supplies, and houses. People and livestock were killed during the 1985 Dig Tso GLOF that destroyed a power station

near Thamo, swept away 15 houses, five bridges, and killed livestock and five

people (more people would have died had it not been for a holiday that most people were attending in villages far above the Bhothe Kosi). The total cost of this Dig Tso GLOF was estimated to be approximately US\$ 4million.

The frequency of GLOFs has increased since 1985. The Army, police, and local people participated in rescue and relief operation during GLOF incidents. The national park, VDC, and DDC provided financial and technical support to repair or build infrastructure. Eco-Himal, an Austrian NGO, provided support to repair bridges in Thame.



Imja lake, showing the terminal moraine that is at risk of breaching in the event of a GLOF.

**Table 11: Records of GLOFs in the Khumbu region**

Year	Location	VDC	Impacts	Adaptation Action
1977	Mingbo	Khumjung	A wooden bridge from Dingboche to Lumsa damaged. A new lake formed in Pangboche.	A wooden bridge was constructed with support from National Park and local people.
1985	Thame	Namche	A powerhouse swept away, 15 houses, agriculture land, 5 bridges, trails, and property destroyed. Some livestock killed.	Materials were taken to safe places from the houses located near the river, four bridges were repaired by VDC and Eco Himal.
1988	Gokyo	Khumjung	A wooden bridge at Phortse swept away.	A bridge was constructed in a new site.
1991	Nagding	Khumjung	Damaged a powerhouse owned by the Tengboche monastery, and a water mill.	The monastery did maintenance of the powerhouse and the Buffer Zone supported the reinstallation of the water mill.
2009	Gorakshep	Khumjung	Swept away bridges at Thukla and Pheriche and destroyed four pieces of land suitable for residency.	DDC supported the construction of bridges.

#### **3.4.4. WINDSTORMS**

Three villages of Khumjung VDC and Namche VDC experienced a very strong windstorm in 2012, which completely destroyed six houses, blew off roofs (corrugated iron sheets) from many houses, and killed a local from Khunde. No other windstorm of such intensity has taken place in living memory. This and other windstorms have also felled a large number of dead and living trees. Local communities collected donations from different national and international organizations to help cover the costs of the damage. The national park, Army, police, VDC, DDC, and The Mountain Institute also provided rescue and relief funds and support to windstorm victims.

**Table 12: Record of windstorms in the Khumbu region**

Year	Location	VDC	Impacts	Adaptation Action
2012	Khunde	Khumjung	4 houses were completely destroyed and one person killed in Khunde.	Donation collection, TMI, National Park, Army, Police, Mother's group, VDC, DDC
2012	Pangboche	Khumjung	School damaged.	Korean Hospital provided service
2012	Tengboche	Khumjung	2 houses damaged.	
2012	Namche	Namche	1,000 trees damaged 15-20 roofs were damaged.	Cleared the trail by removing downed trees with the help from Army and National Park staff

**3.4.5. HEAVY SNOWFALL**

Namche and Khumjung VDCs experienced an unusually heavy snowfall event in 1996, with accumulations of 3 m in the higher country that damaged houses and stranded over 700 trekkers, mountaineers, and their staff in the upper Bhote, Gokyo, and Imja valleys. Thirteen Japanese and 13 Sherpa staff, stranded in the Gokyo valley, were killed when an avalanche buried the stone hut they had sought shelter in. Lodges ran out of basic supplies, causing more misery to the stranded local people, mountaineers, and trekkers. A heroic helicopter rescue operation by the Government of Nepal evacuated all of the stranded tourists and staff within two to three days, one of the most successful and largest mountain rescues ever launched in Nepal.

Khumjung and Namche VDCs experienced another spell of heavy snowfall in 2012 that damaged a school building, two houses, the roofs of 15 houses, and destroyed nearly 900 trees. Local communities received financial assistance from the national park, security personnel, local youth clubs, and private hospitals to collect the dead trees, repair trails, and for rescue and relief operation.

**Table 13: Records of heavy snow fall in the Khumbu region**

Year	Location	VDC	Impacts	Adaptation Plan
1996	Phanga	Khumjung	24 people died including 12 foreigners. Hundreds of trekkers and mountaineers were stranded. Lodges ran out of basic supplies causing more misery to stranded trekkers/mountaineers.	Local people, youth clubs, police, and national park personnel were involved in rescue operations. Private helicopters were used, and more than 700 trekkers, mountaineers, and support staff were rescued.
1996	Thame	Namche	Damaged 2 houses, 4 persons were buried in the snow—one died and 3 were able to come out from the snow cover.	
2012	Pangboche	Khumjung	School damaged	Korean Hospital provided service.

2012	Tengboche	Khumjung	2 houses damaged	
2012	Namche	Namche	900 trees damaged 15-20 roofs were damaged	Cleared the trail by removing fallen trees with the help of Army and National Park staff.



Periods of heavy snowfall are becoming increasingly common in the Khumbu.

#### **3.4.6. FLOODS**

A flash flood (torrent) in 2009 destroyed a bridge near Pangboche. An alternative wooden bridge was constructed with support from the national park and local people. Chaurikharka VDC has been experiencing a rise of flood incidents, but the damage so far has been small.

#### **3.4.7. OTHER HAZARDS**

Drought and water scarcity, linked to changing precipitation patterns, are starting to become issues during the winter, especially in Chaurikharka VDC, lasting until the arrival of the monsoon. Water scarcity is also a problem in the villages of Khunde, Shyangboche, Namche, and Phortse during the winter, exacerbated by leaking septic systems at lodges that contaminate existing streams that would otherwise be potable. Phortse is currently looking for funding for a new water supply system, while Khunde, Namche, and Khumjung have started a new project with funding from the Indian Embassy to pipe water in from the Kyalo glacier to the northwest. This project may resolve the water scarcity problem for these three villages.

### 3.5. ESTIMATION OF AFFECTED VULNERABLE HOUSEHOLDS

**Table 14: Estimation of households (HHs) affected directly by different past climate induced hazards**

Hazards	VDC	Affected Households							
		HHs	Sherpa	Rai	Tamang	Dalit	Other	Rich	Poor
Landslides	Chaurikharka	7	2	2	3				
	Namche	18	15			3		12	6
	Khumjung	10	10					4	6
Floods	Chaurikharka	5	1	2	2				
	Namche	105	99			2	4	89	16
Windstorms	Khumjung	25	25					11	14
Drought	Namche	1	206			4	8	185	33
GLOFs	Namche	15	15						15
Forest Fires	Chaurikharka	329	310			7	12	280	49
	Namche	245	225	7	5	8		132	113
Heavy Snowfall	Khumjung	15	15					5	10
	Namche	144	136			3	5	122	22
Avalanches	Khumjung	16	15			1		1	14
Frost	Namche	218	206			4	8	185	33

Table 14 presents an estimation of households that were directly affected by the different climate-induced disasters mentioned above. Results are summarized below:

1. The impact of forest fires was much more severe in Chaurikharka and Namche VDCs (probably due to lower elevations with more forests).
2. Impacts of heavy snowfall and frost were much more widespread in Namche and Khumjung VDCs (probably due to higher elevations).
3. Forest fires affected 162 households of Namche and Chaurikharka VDCs.
4. The impact of heavy snowfall was severe in Namche VDC.
5. Heavy snowfall affected 144 households of Namche VDC, compared to only 15 households of Khumjung VDC.
6. Namche was the most affected VDC by frost.

### 3.6. ESTIMATION OF HOUSEHOLDS BY VDC, WARDS, AND SOCIO-ECONOMIC GROUPS MOST LIKELY TO BE SENSITIVE TO DIFFERENT HAZARDS

**Table 15: VDCs, wards, villages, social groups and households most likely to be vulnerable to different hazards**

Hazards	VDC	Ward	Villages	D	O	RH	PH	TH
Landslides	Chaurikharka	6, 5, 1, 4	Monjo, Muse Phakding, Ghat, Thadokoshi,	8	13	326	58	384
	Khumjung	2, 4, 5, 6, 7, 9	Dhole, Khunde, Tengboche, Phungithanga, Renzola, Dingboche, Shomare, Pangboche, Pulung Karang, Phortse, Nala	8	14	331	58	389
	Namche	5,6,7, 9	Thamo, Samde, Thame, Thyangboche, Hilajung	4	6	152	27	179
GLOF	Chaurikharka	1-9	Monju, Jorsalle, Chaurikharka, Chhoplung, Muse, Surke, Gomila, Phakding, Toktok, Benkar, Ghat, Thadokoshi, Shyangma, Tate, Lukla, Sano Gomila	19	34	823	14 5	968
	Namche	4-8	Phurte, Thamo, Pare, Samde, Thame, Thame Teng,	4	7	169	30	199
	Khumjung	6,7	Debuche, Tengboche, Phungithanga, Chukung, Dingboche, Pheriche, Shomare,	2	4	99	18	117
Heavy Snowfall	Namche	1-9	Namche Bazar, Phurte, Samsing, Theso, Thamo, Pare, Samden, Mende, Thamo Teng, Thame, Thame Gompa, Thame Teng, Hilajung, Chanakpa, Taranga, Maralung, Lungden, Langmoche	10	17	408	72	480
	Khumjung	1-9	Khumjung, Gokyo Valley, Khunde, Tengboche, Debuche, Phungithanga, Pangboche, Dingboche, Pheriche, Chukung, Lobuche, Gorakshep	11	19	468	83	551

D: Dalit; O: Others; RH: Rich Households; PH: Poor Households; TH: Total households

Tables 15 and 16 present VDCs, wards, villages, social groups, and households most likely to be sensitive to different climate induced hazards or disasters. Using 2011 national census data and local information, the number of poor households was estimated to be 15 percent of the total number of households. The national poverty figure is 22.5 percent (World Bank 2012). Although the people below the poverty level is higher in mountain regions than in the middle hills and Terai, the poverty figure in the Khumbu region is lower than most mountainous regions because of the income derived from tourism and mountaineering. Dalit and other disadvantaged households were also estimated using the census data, and represent 2 and 3.5 percent of total households, respectively. The remaining represents Sherpa population.

Results summarized in tables 15 and 16 include villages or communities that are and will likely be vulnerable to different climate induced hazards.

1. 22 villages representing 14 different wards of Chaurikharka, Namche, and Khumjung VDCs are likely to be vulnerable to landslide hazards. Some villages have already experienced landslide impacts. Khumjung and Chaurikharka VDCs appear to be most vulnerable to the landslides. A total of 927 households are at risk, of which around 15 percent are poor.
2. A total of 1,284 households across all three VDCs are likely to be sensitive to GLOFs. An Imja GLOF would have disastrous results on local infrastructure, arrivals of trekkers and mountaineers, agriculture fields, the economy, and overall development of local livelihoods of the region. Other glacial lakes that are at risks of GLOFs include Nozumba and Dig Tso, which would significantly impact Khumjung VDC.
3. Households of Khumjung and Namche are most likely to be affected by heavy snowfalls like those experienced in 1996 and 2012. Livestock and poor households will be particularly sensitive to heavy snowfall. Additionally, heavy snowfall during the trekking/mountaineering seasons, autumn or early spring will have significant impacts on trekking and mountaineering, and thus on local livelihoods.
4. 15 villages spread from 5 to 9 wards of Namche VDC and 3 villages in wards 1, 7, and 9 of Khumjung VDC are likely to be affected by drought, even though impacts to date have not been significant.
5. All villages of Chaurikharka, Namche, and Khumjung VDCs are vulnerable to windstorms that have been occurring more frequently in recent years.
6. Five villages of Chaurikharka VDC are most likely to be vulnerable to forest fires. Similarly, three villages, which are located close banks of the Dudhkosi River, are likely to be vulnerable to flash floods.
7. The Khumbu region is experiencing the introduction of new agriculture pests and diseases in recent years that are harmful to potatoes, carrots, cabbages, cauliflower, and leafy vegetables. Among the three VDCs, Chaurikharka seems to be the most vulnerable to these new pests and diseases.

Prolonged periods of cloud cover and overcast conditions are becoming more frequent, resulting in an increased cancellation of flights. Because the economy is now largely cash based and tourist driven, the potential damage to local economies and livelihoods is extremely high, unless changes are made to current visitation patterns (e.g., shifting the peak autumn season to November instead of October), and/or a road is constructed to Lukla.

Wards 5 to 9 of Namche VDCs, which include 15 villages with 218 households, are more prone to frost. Potatoes and vegetable cultivation has already been negatively impacted.

Four villages of Khumjung VDC are prone to avalanches, and a total of 471 households are vulnerable.

**Table 16: VDCs, wards, villages, social groups and households most likely to be sensitive to different hazards**

Hazards	VDC	Ward	Villages	D	O	RH	PH	TH
Drought	Namche	5-9	Thamo, Pare, Samden, Mende, Thamo Teng, Thame, Thame Gompa, Thengbo, Thame Teng, Hilajung, Chanakpa, Taranga, Maralung, Lungden, Langmoche	4	8	185	33	218
	Khumjung	1,7,9	Shyangboche, Pangboche, Phortse	5	9	213	38	250
Windstorm	Chaurikharka	1-9	Monju, Jorsalle, Chaurikharka, Chhoplung, Muse, Surke, Gomila, Phakding, Toktok, Benkar, Ghat, Thadokoshi, Shyangma, Tate, Lukla, Sano Gomila	19	34	823	145	968
	Khumjung	1-9	Khumjung, Gokyo Valley, Khunde, Tengboche, Debuche, Phungithanga, Pangboche, Dingboche, Pheriche, Chukung, Lobuche, Gorakshep	11	19	468	83	551
	Namche	1-9	Phurte, Samsing, Theso, Thamo, Pare, Samden, Mende, Thamo Teng, Thame, Thame Gompa, Thame Teng, Hilajung, Chanakpa, Taranga, Maralung, Lungden, Langmoche	10	17	408	72	480
Forest Fire	Chaurikharka	1, 5,6	Monjo, Thulo Gomila, Phakding, Ghat	6	10	247	44	290
Flood	Chaurikharka	4,6	Surke, Muse, Ghat	3	5	121	21	142
Agricultural Pests and Diseases	Chaurikharka	1-9	Monju, Jorsalle, Chaurikharka, Chhoplung, Muse, Surke, Gomila, Phakding, Toktok, Benkar, Ghat, Thadokoshi, Shyangma, Tate, Lukla, Sano Gomila	19	34	823	145	968
Prolonged Cloud Cover	Chaurikharka	8	Lukla	7	13	310	55	365
Frost	Namche	5-9	Thamo, Pare, Samden, Mende, Thamo Teng, Thame, Thame Gompa, Thengbo, Thame Teng, Hilajung, Chanakpa, Taranga, Maralung, Lungden, Langmoche	4	8	185	33	218
Avalanche	Khumjung	1,2,3, 4,5,7, 9	Khumjung, Khunde, Phortse, Pangboche	10	16	400	71	471

D: Dalit; O: Others; RH: Rich Households; PH: Poor Households; TH: Total households

The vulnerability analysis shows that all villages and households of the Khumbu region are sensitive to different climate induced hazards. While Namche and Khumjung VDCs are prone to drought, windstorm, snowfall, frost, and avalanches, Chaurikharka VDC is more prone to forest fires, flood, new agricultural pests and diseases, and prolonged cloud cover. All three VDCs are prone to GLOFs and landslides.

### **3.7. HAZARD AND SECTOR RANKING**

Nine different hazards were identified from the resource and vulnerability maps, timeline, and vulnerability analyses. The National Adaptation Plan of Action (NAPA) has identified six sectors that are most likely to be impacted by climate variability and climate induced hazards: (1) agriculture and livestock, (2) forests and biodiversity, (3) water, (4) human health, (5) infrastructure, and (6) energy and livelihoods. For the purpose of the Khumbu LAPA process, these sectors were further broken down into 25 sub-sectors with the objective of simplifying community consultations and workshop facilitation. A multi-criteria ranking was used with a scale of 0-4 to assess the impacts of nine different hazards across the 25 sub-sectors. In the scale, 0 implies no impact, 1 low impact, 2 moderate impacts, 3 high impact, and 4 very high impact. The mean scores from three VDCs were then used to determine those sectors most sensitive to different hazards, ranking the hazards in descending order, from highest to lowest.

Hazards were ranked in order of potential impact:

1. GLOFs
2. Heavy snowfall
3. Windstorms
4. Landslides
5. Forest fires
6. Floods
7. Drought
8. Agricultural pests/diseases
9. Avalanches

Sector vulnerability is presented in Table 17 and summarized below:

1. Porters: Porters are considered a sector because they represent a poor and marginalized group of people, most of whom live outside Khumbu but come to work seasonally. Porters were ranked first in terms of the sector that is most sensitive to climate-induced hazards. GLOF and heavy snowfall are likely to have very high impact on porters, as are floods, because of disruptions in trail and transportation systems. Other hazards will

- have from low to moderate impacts on porters. Forests are most vulnerable to windstorm, forest fires and landslide, hence, were also ranked first.
2. Biodiversity and agriculture: Biodiversity and agriculture were ranked second among the most impacted sectors. Climate induced hazards such as forest fire, windstorm, GLOF, and drought are most likely to have high impacts on biodiversity, whereas GLOF, drought, and snowfall are likely to have high impacts on the agriculture sector. Other hazards are likely to have low to moderate impacts. Hazards such as agricultural pests and diseases are most likely to have no impacts on biodiversity. Similarly, forest fires and avalanches are not likely to have any significant impacts on agriculture.
  3. Livestock, national park, and hydropower were ranked third among the most impacted sectors. Forest fires, drought, and heavy snowfall are likely to have a high impact on livestock. National park resources, including forests and biodiversity, are likely to be highly affected by forest fires, windstorms, and GLOFs, and hydropower plants are likely to be very highly affected by GLOFs. Other hazards will have moderate impacts on the hydropower generation and its infrastructure.
  4. Lodges and trekking: Lodges and trekking were ranked fourth among the most heavily impacted sectors. Hazards such as agriculture pests and diseases and GLOF are most likely to have high impacts on lodges. Other hazards are likely to have low to moderate impacts. Lodges are not likely to be impacted by avalanches. Landslides and GLOFs are likely to have high impacts on trekking. Other hazards will have low to moderate impacts on lodges and trekking, including drought.
  5. Human health: Human health as an impacted sector was ranked fifth. With the exception of landslides and avalanches, most other hazards are likely to have moderate impacts on human health.
  6. Mountaineering, transportation, drinking water systems, and trails: These sectors were ranked sixth. While avalanches are likely to have high impacts on mountaineering, other hazards will most likely have low to moderate impacts. Similarly, forest fires will have no impacts on mountaineering. Transportation sectors are likely to be highly impacted by GLOFs, snowfall, and floods. Hazards such as forest fires, agriculture pests and diseases, drought, and avalanches are likely to have no impacts on the transportation sector.
  7. The drinking water sector is likely to be highly impacted by GLOFs. Other hazards are likely to have low to moderate impacts. Trails also are likely to be highly impacted by landslides and GLOFs. Other hazards will have low to moderate impacts. Hazards such as agriculture pests and disease are likely to have no impacts on trails and drinking water supplies.
  8. Water resources, gompas and temples.
  9. Bridges: This sector was ranked seventh, with GLOFs considered the most likely to have a high impact on bridges.
  10. Schools and Hospitals: Hazards such as windstorms, landslides and heavy snowfall are likely to have moderate impacts on schools as well as hospitals.
  11. Telephone towers and airports: These sectors were ranked tenth. While windstorms and heavy snowfall are likely to have very high and moderate impacts on airports, telephone

- towers are unlikely to be impacted from hazards such as windstorm, GLOFs, and heavy snowfall.
12. Seasonal trade: Windstorm and GLOF are likely to have moderate impacts on seasonal trade, which was ranked eleventh.
  13. -14) Irrigation, banks, and fuel wood are ranked twelfth, thirteenth, and fourteenth, respectively. Climate induced hazards are likely to have no or low impacts on these sectors.

**Table 17: Sector and Hazard ranking**

Sectors	Hazards									Total score	Sector Ranking
	Lds	FFs	AgPD	Wstm	GLOF	Dgt	SF	Flood	Avlh		
Trekking	3	1	2	2	3	0	2	1	1	15	4
Mountaineering	2	0	2	2	1	1	2	0	3	13	6
Hotel and Lodge	2	1	3	2	3	1	2	1	0	15	4
Porter	2	1	1	2	4	1	4	3	0	18	1
Transportation	2	0	0	2	3	0	3	3	0	13	6
Seasonal Trade	0	0	0	2	2	0	1	0	0	5	11
Agriculture	2	0	2	2	3	3	3	2	0	17	2
Livestock	1	3	1	1	2	3	3	1	1	16	3
Forest	3	3	0	3	2	2	2	1	2	18	1
Human Health	1	2	2	2	2	2	2	0	1	14	5
Water Resources	2	1	0	0	2	3	1	1	0	10	7
Bridges	2	0	0	1	4	0	1	1	0	9	8
Irrigation	1	0	0	0	2	1	0	0	0	4	12
Trail	3	1	0	2	3	0	2	2	0	13	6
Telephone Tower	0	1	0	2	2	0	2	0	0	7	10
Hydropower	2	2	0	2	4	2	2	2	0	16	3
Airport	0	1	0	4	0	0	2	0	0	7	10
School	1	1	0	2	1	0	2	1	0	8	9
Hospital	2	1	0	1	2	0	1	1	0	8	9
Gompas and Temples	2	1	0	2	2	0	2	1	0	10	7
National Park	2	3	0	3	3	1	2	1	1	16	3
Drinking Water	2	1	0	1	3	1	2	2	1	13	6
Bank	0	0	0	0	1	0	1	1	0	3	13
Biodiversity	2	3	0	3	3	3	2	1	0	17	2
Fuel wood	0	1	0	0	0	0	1	0	0	2	14
Total score of Hazard	40	29	13	45	59	25	48	26	10		
Hazard wise Rank	4	5	8	3	1	7	2	6	9		

Lds: landslide; FFs: Forest fires; AgPD: agriculture pests and diseases; Wstm: windstorm; SF: Snowfall; Avlh: avalanches

# 4. SECTOR-WIDE IMPACT ANALYSIS

## 4.1. TREKKING

Flights between May and October are becoming unreliable to and from Lukla, primarily because of prolonged periods of cloud cover or overcast conditions that can cancel flights for a week or more at a time. If this problem continues, the number of trekkers and mountaineers visiting the Khumbu region may decline, and could shorten the trekking season and mountaineering seasons considerably, unless visitation patterns are changed to take advantage of the fact that November, as opposed to October, now appears to have the most clear days. The Khumbu may also lose its share of highly profitable high paying tourists (“quality tourists”) who travel with a tight schedule and expect the best in accommodations. Overall, the tourism sector, and thus the livelihoods of thousands of Sherpa and non-Sherpa who depend on tourism for a living, is likely to be at a high risk and may result in a significant loss of employment opportunities, as well as a rise in social conflict.

## 4.2. LODGES

Erratic climatic conditions are starting to have impacts on the occupancy rate of lodges. Although lodges in Lukla face overcrowding because of the increased number of cancelled departing flights, the number of trekkers staying at lodges along the trekking trails is declining. The experience of 2012 was a reminder of what could happen if no proactive adaptation measures are taken to offset the impact of climate change. When Lukla had no flights for more than a week due to heavy snowfall, most lodges ran out supplies, significantly increasing prices for food and drink. Lukla was crowded with trekkers, but lodges beyond it experienced poor occupancy as trekkers planning to visit the Khumbu region were stuck in Kathmandu. Some trekkers had to use kitchens and dining halls for sleeping. Due to the delay in rescue operations, many trekkers ran of the money and had to sell whatever valuables they had to sustain themselves. Many were worried that they would miss their international flights home. If these current trends continue, the number of trekkers and mountaineers in the Khumbu region is likely to decline as trekkers and mountaineers seek national parks with more reliable access.

However, current tourism monitoring in the Khumbu has yet to show any signs of a decline in annual tourist numbers.

### **4.3. MOUNTAINEERING**

Climate variability, including increases in windstorms and heavy snowfall, can have direct impacts on mountaineering expeditions. Because of erratic weather conditions, mountaineers are increasingly facing problems in completing their expeditions as planned within the permitted timeframe, often resulting in the cancellation of expeditions and/or lower success rates. Incidents of avalanche are also increasing, and this has increased the risks to mountaineers and their staff alike. Additionally, there is also concern about changing snow conditions. Mountains in general are receiving less snow, and snow is melting faster, exposing more rocks along expedition routes that were previously snow or ice covered, resulting in more treacherous conditions. These changing conditions of mountains are now demanding, according to workshop participants, more sophisticated mountaineering gear and equipment, and the overall cost for mountaineering expeditions increased. If this trend continues, the Khumbu region is likely to receive fewer expeditions as climbers search elsewhere for more suitable conditions, and this could have severe impacts on the Khumbu economy and livelihoods of the local people.

### **4.4. PORTERS**

Porters are the group of people who are most vulnerable to almost all climate-induced hazards. The majority of porters in the Khumbu region are outsiders, mostly from Tamang and Rai communities that live below Lukla. They are loosely organized as a group and often work with friends, family members, or relatives. Porters are normally recruited at the Lukla airport. They either work through trekking agents or independently. The porter charges around Rs. 1000 per day, which is barely enough to buy two basic meals once above Tengboche. Porters usually stay at teashops run by members of their own ethnic groups who provide better prices for food and drink and do not charge for beds. Flight cancellations have a major impact on porters, as they often have to wait for a week or more to get jobs. The money they make for their services may not even be enough to pay back their debts incurred while waiting at Lukla for employment.

Porters are most likely to be affected by GLOFs, landslides, heavy snowfall, and windstorms as these climate-induced hazards could destroy trails and bridges, as well as putting their lives at very high risk. There is also a risk that porter services may soon decline, as they are likely to look for other more reliable and secure jobs, such as overseas employment. A decline in the number of porters is likely to affect trekking services and the transportation of food and essential

supplies to the Khumbu region. This in turn will push up prices of essential commodities, making the Khumbu region very expensive for both the local people and trekkers alike.

#### **4.5. TRANSPORTATION**

Climate induced hazards, particularly prolonged cloud cover and windstorms, are likely to affect the reliable transportation of food and other essential supplies. Flights are the major form of transportation in the Khumbu region. Due to increased flight cancellations, local lodge owners and shopkeepers have been ferrying goods back and forth from the Kathmandu airport, which is both cumbersome and expensive. Kathmandu airport does not have proper storage facilities, so the risk of losing goods or ruining food items if not flown to Lukla on time is very high. There is the option of using helicopter services for transporting food and other commodities from Jiri, but this service is comparatively expensive as the helicopters have to be chartered. The problem with transportation is not only affecting tourism and lodges, but also development projects. It is becoming increasingly difficult to complete development projects on time due to delays in receiving construction materials, as well as the increased difficulties of even reaching Lukla.

#### **4.6. AIRPORT**

Increased cloud cover and overcast conditions are not only affecting the transportation sector, but also increasing the danger of using the Lukla airport. If this problem persists, the number of flights to Lukla is likely to decline, which will have wide implications on tourism and local livelihoods.

#### **4.7. SEASONAL TRADE**

Seasonal trade with Tibet used to be the main supplement to local incomes. Erratic climatic conditions, however, are starting to have impacts on trade; the number of traders from Tibet and neighboring villages is declining sharply. Food and other commodities are more expensive as a result, and if this trend continues seasonal trade in this region is likely to decline, or cease altogether.

#### **4.8. COMMUNICATION AND HYDROPOWER STATIONS**

Heavy snowfall and windstorm are likely to affect communication towers and hydropower schemes, causing major disruption in the communication network and the hydropower supply. Maintenance and operation of these services are likely to become more expensive.

#### **4.9. SERVICE SECTOR**

Heavy snowfall and windstorms are likely to affect hospitals, schools, and monasteries. Staff may not be able to provide regular services such as running hospitals, clinics, and schools, or to perform the daily rituals of monasteries. Hospitals may run out of supplies such as medicines, or may not be able to cope with the increase in patients injured or affected by different hazards, due to a lack of staff and medicines. Windstorms and heavy snowfall may also cause great damage to physical infrastructure.

#### **4.10. NATIONAL PARK AND BIODIVERSITY**

Forests and wildlife are most likely to be affected by windstorms, forest fires, and heavy snowfall. Monitoring and patrolling activities will be difficult, and wildlife poaching and other illegal activities may increase as a result. Climate variability may also affect native wildlife and vegetation. It may increase migration of low altitude wildlife to higher altitudes, and high alpine habitats may degrade as competition for food between immigrant and resident species increases.

#### **4.11. DRINKING WATER**

The Khumbu region is likely to experience longer periods of drought in the summer and freezing of water in the winter, both contributing to water scarcity. There are also other non-climatic stressors, such as pollution from leaking septic tanks or toilets situated over or near seasonal water courses, and increases in waterborne diseases may further amplify the water scarcity problem. Water scarcity is already affecting households and particularly lodges, where there are increased demands for water because of flush toilets and showers. Agriculture and hydropower are also likely to be affected.

# 5. ENVISIONING ADAPTATION PLANS OF ACTION

This section analyzes current impacts, possible impacts in the next five years in the absence of adaptation measures, adaptation actions that have already been in practice, adaptation options that could be considered in the future, and a vision for the future of top six hazards identified in section 3.6.

## **5.1. GLACIAL LAKE OUTBURST FLOOD (GLOF)**

Current impacts: As mentioned previously, recent GLOFs in the Khumbu occurred in 1977 near Pangboche and in 1985 in the Bhote Kosi valley. Some scholars believe that a substantial number of other GLOF events have occurred in contemporary times, but that they were either too remote or small in magnitude to have been noticed. Occasionally, torrents, or sudden concentrations of water and flooding due to rapid snow melt or heavy rainfall, have been reported erroneously to have been GLOFs, such as the torrent event near Kunde in 2009. The most destructive GLOF in the Khumbu's recorded history, the Langmoche flood, occurred in 1985 and destroyed bridges, a hydropower station, drinking water systems, agricultural land, and houses, and killed five people.

Possible impacts in next five years: It is impossible to predict the occurrence of GLOFs in the next five years. Research and survey reports of the last two years show that the Imja glacier is melting and calving at a much faster rate than previously thought—as much as 200 m/yr as opposed to the previously accepted 35 m/yr. In the event of an Imja GLOF, damage to local populations, visitors, infrastructure, and the Khumbu and national economy could be substantial.

Current Adaptation Practices: A number of research papers and surveys have been completed to assess status of glacial lakes in the Khumbu region, including Imja lake, the most detailed being those conducted by the HiMAP in 2012 and 2013 (see references). All results have been shared with local people, the Government of Nepal, and donor organizations, including the UNDP/Nepal, which is planning to lower Imja lake by at least 3 m. Following past GLOF

events, the District Development Committee, Village Development Committee, the National Park and Buffer Zone, local people, monasteries, and the Khumbu Bijuli Company provided financial, technical, and labor support to repair damage (to hydropower stations, water reservoirs, and bridges), and/or to locate infrastructure to higher elevations or safer sites.

#### Future Adaptation Options:

1. Research and monitoring of glacial lakes is needed, particularly those that are at higher risk of flooding.
2. Develop local capacities in disaster and relief operations.
3. Install early warning systems and communication networks to disseminate warning information quickly and effectively.
4. Develop systems to protect infrastructure from GLOFs.
5. Lower the level of Imja lake to a level that reduces its risk of flooding.
6. Establish rescue and relief funds and institutions responsible to manage them.
7. Solicit and access expert support in GLOF mitigation.

Vision for Future: A glacial lake monitoring system established and regularly updated. Early warning systems are installed and communication network established. Local people are trained in GLOF risk reduction. Rescue and relief funds and institutions responsible for these are established and operationalized. Appropriate adaptation measures are in place to safeguard infrastructure, such as trails, bridges, water systems, and hydropower stations. Guidelines on climate-smart infrastructure developed and training provided. Imja glacial lake water level lowered to a safe level.

## **5.2. HEAVY SNOWFALL**

Current impacts: Khumbu winters are increasingly experiencing climate extremes, such as heavy snowfall. Heavy snowfall can make the lives of the Khumbu people very difficult, disrupting transportation systems, increasing shortages of food and other essential commodities, restricting access to hospitals, clinics and schools, and negatively affecting peoples' health because of the extreme cold. It can affect hundreds of trekkers and mountaineers who are stranded at Lukla and in high mountain villages for weeks at a time. Water supplies and hydropower can also be affected by freezing and icing problems.

Heavy snowfall is particularly hard on livestock as farmers face major challenges to keep them warm and well fed. The ripening and harvesting of crops and cultivation of seasonal vegetable is often delayed, thus reducing production. Heavy snowfall has direct impacts on porters. They

work for trekking companies at a minimum wage and often without warm clothing, appropriate equipment, or life insurance. They increasingly suffer from frostbite, snow blindness, and other high altitude-related ailments that also put their lives at high risk.

Possible impacts in next five years: If climate extremes such as heavy snowfall continue to increase, which appears to be the case now, it will have broad impacts on local economies and livelihoods. The porter, transportation, livestock, and infrastructure sectors will be at high risk. There will be an increased risk of avalanches, affecting the mountaineering sector. There will be shortages of food supplies, animal health will decline due to shortages of winter feed, and livestock populations may decline. Prices of food and vegetables will increase and agriculture production will decline due to the increased uncertainty in agriculture cycles which may delay the ripening and harvesting of crops and vegetables. Trekking and mountaineering expeditions will find it difficult to recruit porters, as portering may be seen as among the most hazardous of occupations.

Current adaptation practices: Construction of plastic houses or greenhouses is becoming popular in the Khumbu region to protect vegetables from cold winters and/or heavy snowfall. A few porter shelters have been built to protect porters from climate extremes. There is also a clothing bank run by a non-governmental organization that provides warm clothes and boots to porters at a nominal price. Still, more is needed. Farmers have been storing hay and grass for winter feeding and improving livestock sheds to keep their animals warm and safe. Local people are also improving the insulation of their houses with solariums.

Future adaptation options:

1. Improve weather forecasting systems and make the weather report easily available to trekking groups, expedition groups, and local people.
2. Identify sites for porter shelters and construct and equip them with communication, medical, and food supplies.
3. Raise awareness and train local people, particularly trekking guides and porters, on snow and ice handling skills and risk reduction.
4. Design and demonstrate improved livestock sheds and increase hay and livestock feed production.
5. Design and demonstrate effective greenhouses, both in terms of cost and structure.
6. Establish clothing banks for porters and lobby for porter insurance.

Vision for future: Risks related to heavy snowfall are reduced. Effective weather forecasting systems established and information easily available. Porter shelters at key locations established and equipped. People working in tourism are trained in snow and ice skills. Improved livestock sheds are built. Training on hay/silage production provided and production of winter feed increased. Veterinary service provided. Improved green houses are used for vegetable production. Improved and cold resistant varieties of crops and vegetable are used. Training on house insulation is provided and house insulation systems improved. Clothing banks established and use of these by porters increased. Insurance coverage for porters provided by their employers.

### **5.3. WINDSTORMS**

Current impacts: Windstorms caused extensive damages in the Khumbu in 2012 in all three VDCs. Many houses were damaged, as the gale force was particularly hard on roofs, many of which were ripped apart and blown away. Nearly 1,000 trees in Namche's forests were destroyed. Infrastructure such as power poles and communication towers were damaged. Many people suffered from coughs and colds, and crops were also damaged. Flight cancellations were high between April and May and from October to January, thus affecting tourist arrivals. Windstorms were also detrimental to mountaineering expeditions, particularly to autumn expeditions, and as a result only one autumn expedition is recorded for 2012 and none for 2013.

Possible Impacts in next five years: If the current trends of windstorms continue in terms of frequency and strength, a widespread loss of forest resources, biodiversity, household property, and even lives will result. Flight cancellations are likely to increase even more than at present.

The number of autumn climbing expeditions may decline, or even discontinue. Infrastructure, houses, hydropower stations, communication networks, and the transport sector will be at a higher risk. Health and safety risks of trekking and mountaineering will increase. All these will have dire consequences on the local economy and livelihoods of the Khumbu region.

Current adaptation practices: Local people have started fastening their roofs more firmly. With the help of the National Park and Buffer Zone, they have been clearing fallen trees and have planted trees in the newly cleared areas. The companies responsible for power supply and telecommunication have started to repair the damage to hydropower stations and communication lines. Water sources have also been protected. Similarly, mountaineering expeditions and trekking groups are using better mountaineering gear and equipment to better ensure their health and safety.

Future adaptation options:

- a) Changed building design with stronger foundations and much more secure roofs to reduce risks of windstorms.
- b) Establish forest nurseries and increase the number and size of plantations.
- c) Explore and establish alternative options for transporting food supplies and other essential commodities.
- d) Better regulate the use and distribution of windfall.
- e) Review mountaineering policies to ensure flexibility in decision making for climbing routes during the climbing season.

Vision for Future: The risks of windstorms on houses and infrastructure are reduced. Forest nurseries are established and plantations are established. Policies regarding mountaineering are reviewed and appropriate changes made to give more freedom to mountaineers in selecting routes during the expedition period. Local people are well trained, equipped, and funded in forest fire and windstorm risk reduction. Alternative options of transportation are established, and food and other essential commodities are available at reasonable prices in the local market.

## **5.4. LANDSLIDES**

Current impacts: The occurrence and increased frequency of landslide incidents are damaging forest resources, wildlife, infrastructure, trails, and bridges. Agricultural land and local properties have also been damaged, and in several instances lives have been lost.

Possible impacts in next five years: Increased landslides will make travelling more risky. They may damage trails and bridges permanently, and alternative routes may have to be found.

Settlements in landslide prone areas may have to be relocated. New agriculture land may need to be found to replace landslide damaged fields. Overall, landslides will have negative impacts on the livelihoods of people, and may also increase risks to trekkers and mountaineers.

Current Adaptation Practices: The District Development Committee, Village Development Committees, and the National Park and Buffer Zone have been providing financial and technical support to affected communities. These include repairing damaged trails and bridges, or in some cases relocating them to safer sites. Gabions have been used as check dams. Some landslide areas have been planted with seedlings and fenced against cattle.

Future Adaptation Options:

1. Use bio-engineering and other landslide control measures.
2. Establish forest nurseries and provide tree saplings to new plantations.
3. Construct check dams.
4. Relocate landslide prone settlements.
5. Identify causes of landslides and take appropriate measures to reduce their risks, such as drainage management.
6. Adopt a “plant 2 trees for one cut tree” policy and enforce it.
7. Adopt and enforce stringent forest conservation policies, post warning signs at landslide prone areas, and control livestock grazing.

Vision for Future: Check-dams are built and other bioengineering measures practiced. Forests are well protected. Degraded and landslide prone areas are covered with plantations and fenced. Landslide prone areas are well posted. Locals, trekkers, and mountaineers are well informed of the potential landslide risks. Landslide prone settlements are relocated. Livestock are stall fed or controlled from free grazing in forests.

## **5.5. FOREST FIRE**

Current impacts: Incidents of forest fire in the Khumbu region have increased since 1998. Forest fires occur during the pre-monsoon period, between March and June, impacting forests, wildlife, and water supplies. Forest fires intensify the problem of water scarcity, and are damaging to forest biodiversity, visibility, livestock, tourism, and humans. They create haze and decrease visibility, contributing to flight cancellations and poor mountain views for tourists. Haze is also detrimental to human and animal health.

Possible impacts in next five years: If the current rate of forest fires continues for another five years, forests and biodiversity of the Khumbu region are likely to be at a higher risk. Increased

flight cancellations will occur due to haze, resulting in a loss of tourist-related income and employment. Fires will also increase the likelihood of water sources drying up and water scarcity problems. More importantly, fires will increase health and safety risks to villages and people living near forests.

Current adaptation practices: Security personnel such as the Army and police, the National Park, and local people are currently involved in controlling forest fires. Some villages have received forest fire training and awareness building programs from different organizations, and they have also been provided with firefighting equipment. The Park has also been providing sapling and fencing support to plant seedlings in burned forest areas. The Buffer Zone Forest User Group in Chaurikharka VDC has established rules and regulation to control forest fires, such as prohibiting matches or lighters in forests during the dry season.

Future adaptation options:

1. A more aggressive awareness building campaign, as well as better forest monitoring during high forest fire risk periods.
2. Identify forests that are most vulnerable to forest fires and develop fire controlling lines.
3. Develop, train, and equip forest fire squads.
4. Develop and enforce stricter rules and regulations to control forest fires.
5. Cover burned areas with plantations, and fence them against cattle.
6. Protect water sources.

Vision for future: Forests are regularly monitored during forest fire prone periods and the risk of forest fires is reduced significantly. Forests vulnerable to forest fires are identified, and forest fire lines developed. Squads of forest fire fighting squads are trained and equipped. Stronger rules and regulations to control forest fires are made and enforced. Previously burned forests are replanted and fenced. Appropriate measures are taken to protect water sources and villages.

## **5.6. FLOOD**

Current impact: The risks of flash floods is increasing every year, particularly in Chaurikharka VDC. Recent floods have swept away houses, agriculture land, and infrastructure such as trails and bridges. Forests have been destroyed, and wildlife and livestock killed. Floods have triggered landslides, caused soil erosion problems, and polluted water bodies.

Likely impact in next five years: Increased flooding events are likely to destroy agriculture and forest lands and increase the risk of property loss. Out-migration and destruction of

infrastructure are likely to increase, and the tourism, transport, and service sectors will be affected.

Current adaptation practices: Local people, with the help of security personnel, have conducted rescue operations. Gabions and check dams have been used to control floods. The VDC, DDC, and the National Park and Buffer Zone have provided support to repair damaged infrastructure.

Future adaptation options:

1. Identify flood prone areas and adopt appropriate bioengineering measures to control floods and reduce their risks.
2. Widespread use of gabions and check dams to protect river banks and villages, property, and lives.
3. Plantations established more widely.
4. Build awareness and provide training on flood risk reduction.
5. Establish relief and rescue funds and build institutions to manage them.

Vision for future: Flood prone areas are identified and appropriate bioengineering measures adopted. Gabions and check-dams widely used and river banks protected. Previously flooded areas are reforested with plantations and fenced or protected to allow regeneration. Increased local awareness of floods and residents trained on flood risk reduction. Relief and rescue funds established and institutions built to manage them. A flood coordination mechanism is in place. Stakeholders are better coordinated for rescue and relief operations.

# 6. ADAPTATION OPTION PRIORITIZATION

Using the results of section 5, a list of adaptation options was produced. Four criteria were used to assess each adaptation option:

1. Effectiveness (the likely success of each option at reducing risks),
2. Cost-effectiveness (whether benefits outweigh costs),
3. Feasibility (the likelihood of securing funds and technical know-how for a project), and
4. Reaching target groups (whether the option reduces risks to poor and marginalized people as well as providing direct benefits to other target groups).

A scale of 1-3 was used to score each option. They were then prioritized based on scores, with the highest scores considered to be the top priorities. Results are presented below.

## 6.1. ADAPTATION OPTION PRIORITIZATION – GLACIAL LAKE OUTBURST FLOOD

**Table 18: Glacial Lake Outburst Flood (GLOF) – Option prioritization**

	Adaptation measures	Effective ness	Cost	Feasi bility	Reaching target groups	Total Scores
		1-3 (A)	1-3 (B)	1-3 (C)	1-3 (D)	
1	GLOF survey, research and monitoring	3	3	3	3	12
2	Safer site survey for infrastructure such as water supply systems, hydropower, trails and bridges	3	3	3	3	12
3	GLOF rescue and relief funds	3	3	3	3	12
4	Early warning system	3	3	3	3	12
5	Puja	3	3	3	3	12
6	GLOF early warning system network installation	3	2	3	3	11
7	GLOF risk reduction training and exposure visits	3	2	3	3	11
8	Porter shelter construction	3	2	2	3	10
9	GLOF awareness and risk reduction training and exposure visit	3	2	2	2	9

10	Reducing water level of risky glacial lakes	3	1	2	3	9
11	Training on GLOF-proof infrastructure (site selection and stronger structure)	3	1	2	3	9
12	Emergency shelter construction and management	3	1	2	3	9
13	Insurance for porters	3	2	1	3	9
14	Rainwater harvesting and storage	1	1	2	1	5

A total of 14 adaptation options to reduce the risks of GLOFs were identified. Options 1-5 received a full 12 points and are the top priority adaptation options because they are considered to be effective in reducing risks, the benefits of these options outweigh costs, they are feasible, and they deliver direct benefits to target groups or communities. Priority options also include performing pujas or worshipping to appease local deities against any natural disasters. Adaptation options 6-12 are considered to be expensive. Lowering the level of Imja lake was considered to be very effective in terms of reducing risks and reaching target groups, but this will be an expensive undertaking that is also technically challenging; partnering with the forthcoming UNDP GLOF risk reduction project will be important. Option 12 received only 5 points, hence is not a priority.

## 6.2. ADAPTATION OPTION PRIORITIZATION – HEAVY SNOWFALL

**Table 19: Heavy Snowfall – Option prioritization**

	Adaptation options	Effectiveness	Cost	Feasibility	Reaching target groups	Total Scores
		1-3	1-3	1-3	1-3	
1	Weather monitoring and forecasting	3	3	3	3	12
2	Snow and ice management training	3	3	3	3	12
3	Green/plastic house demos	3	3	3	3	12
4	Agriculture training on hay/silage making and storage	3	1	2	3	9
5	Trails and extension of cold resistant seed varieties of crops	2	2	2	2	8
6	Porter shelter with emergency food and medical supplies	Covered under GLOF				
7	Porter insurance clothing banks	Covered under GLOF				
8	Improved livestock shed construction (demos and support)	3	2	2	2	8

A total of eight adaptation options to reduce risks associated with climate extremes, such as heavy snowfall, were identified. Options one, two, and three received a full 12 points. Options six and seven have already been covered under GLOF so are omitted from this table. Option four scored 10 points, whereas five and eight scored eight points each. Impacts of option five—use of cold-resistant seed varieties—is particularly difficult to determine, so it scored less across all criteria and ranked as a low priority.

### 6.3. ADAPTATION OPTION PRIORITIZATION – WINDSTORMS

**Table 20: Windstorm – Option prioritization**

	Adaptation measures	Effectiveness	Cost	Feasibility	Reaching target groups	Total Scores
1	Windstorm awareness and risk reduction training	3	3	3	3	12
2	Nursery, plantation and fencing	3	3	3	3	12
3	Review and amend mountaineering policy	3	3	3	1	10
4	Develop reliable weather forecasting system	Covered under heavy snowfall				
5	Firefighting training and equipment	3	2	3	2	10
6	Training on windstorm resistance building structure and demos	3	1	2	3	9
7	Windstorm rescue and relief funds	3	1	2	3	9
8	Establish alternative transportation system	3	1	1	2	7

A total of eight adaptation options were identified to reduce the risks of windstorms. Options one and two scored a full 12 points each and are considered to be top priority options. Option three through five scored 10 points each. These options are likely to provide more benefits to mountaineers rather than targeted groups. Option four has already been covered under heavy snowfall and is thus omitted from the table. Options seven and eight received nine points each. Option eight received only seven points, and was the least favored adaptation option.

## 6.4. ADAPTATION OPTION PRIORITIZATION – LANDSLIDES

Five adaptation options were identified to reduce the risks of landslides. Except for option five, all others scored a full 12 points and are ranked as top priority options. Option five received only six points. While relocation of landslide-prone villages can be effective, this was considered to be prohibitively expensive and not feasible. Relocation may also not necessarily benefit target groups.

**Table 21: Landslides – Option prioritization**

	Adaptation measures	Effectiveness	Cost	Feasibility	Reaching target groups	Total Scores
1	Forest nursery establishment, plantation and fencing	Covered under forest fires				
2	Sign posting at hazardous sites	3	3	3	3	12
3	Gabion boxes and check dam construction	3	3	3	3	12
4	Landslide awareness and risk reduction training	3	3	3	3	12
5	Relocation of landslide prone villages	3	1	1	1	6

## 6.5. ADAPTATION OPTION PRIORITIZATION FOREST FIRES

Five adaptation options were identified to reduce the risks of forest fires. All received a full 12 points. Option two was covered under forest fires and is therefore not included here.

**Table 22: Forest fires – Option prioritization**

	Adaptation measures	Effectiveness	Cost	Feasibility	Reaching target groups	Total Scores
1	Forest fire awareness and risk reduction programs	3	3	3	3	12
2	Forest nurseries, plantation and fencing	Covered under forest fires				
3	Survey forest most vulnerable to forest fires	3	3	3	3	12
4	Form, train and equip forest fire fighting squads	3	3	3	3	12
5	Forest fire-line construction	3	3	3	3	12

## 6.6. ADAPTATION OPTION PRIORITIZATION – FLOODS

Only three adaptation options were identified to reduce the risks of floods. Since adaptation options related to floods have already been covered under GLOF, this section deals specifically with flash floods, which are ranked as sixth among the most damaging hazards. While option one scored a full 12 points, making it the highest priority option to reduce risk of flash floods, option two scored only 10 points because river bank protection was considered to be too expensive and unlikely to receive support.

**Table 23: Flood – Option prioritization**

	Adaptation measures	Effectiveness	Cost	Feasibility	Reaching target groups	Total Scores
1	Flood awareness and risk reduction training	3	3	3	3	12
2	River bank protection (use of gabion boxes retention walls and plantation)	3	2	2	3	10
3	Early warning system installation	Covered under GLOF				

# 7. STAKEHOLDER ANALYSIS

A Venn diagram was used to identify different organizations—governmental, non-governmental, and community groups—active in the Khumbu region. The purpose of this exercise was to analyze an organization’s potential roles and responsibilities in the implementation of the Khumbu LAPA. The names of the organizations, their roles, and their potential support toward the implementation of adaptation actions is presented below the diagram in order of ranked importance.

Explanation:

- a) Size of circle indicates the importance and significance of organization.
- b) Distance between circles indicates their relationship, i.e, further the circle means less influence on the local affairs.
- c) Overlap indicates close working relationship.

Seven categories of stakeholder are active in one way or another in the Khumbu region and can play roles in implementing the Khumbu Adaptation Plan of Action, as outlined below:

- a) Local Government Organizations include Village Development Committees (VDC) and the District Development Committee (DDC).
- b) Governmental Organizations include the Sagarmatha National Park and Buffer Zone (SNPBZ), the Department of National Parks and Wildlife Conservation (DNPWC), the Yak Farm, Nepal Police and Nepal Army, the Ministry of Tourism and Civil Aviation (MoTCA), and the Department of Hydrology and Meteorology (DHM).
- c) National and Local Non-Governmental Organizations include Nepal Mountaineering Association (NMA), Trekking Agency Association of Nepal (TAAN), Sagarmatha Pollution Control Committee (SPCC), Khumbu Alpine Conservation Council (KACC), and Red Cross.
- d) International Non-Governmental Organizations include Eco-Himal, Himalayan Trust, United Nations Development Organizations (UNDP), and The Mountain Institute (TMI).
- e) Community-Based Organizations include Buffer Zone Council (BZ), Buffer Zone Forest User Groups (BZFUGs), User Groups, Mother’s or Women’s Groups, and Youth Clubs.
- f) Private organizations include hydropower companies and telecom.

- g) Other organizations include hospitals/clinics, schools, monasteries, and the airport.

Detailed of stakeholders, their roles, potential adaptation support they could provide, and community expectations from them are discussed in the table below:

**Table 24: Stakeholder roles and potential adaptation support mechanisms**

<b>Sagarmatha National Park and Buffer zone</b>		
<b>Roles</b>	<b>Potential Adaptation Support</b>	<b>Local Expectations</b>
The national park and buffer zone area management, particularly to protect biodiversity, and manage/monitor tourism and mountaineering activities. Collects entry fees, manage buffer zone revenue and support buffer zone development programs.	Forest nursery establishment and management, plantation and fencing, awareness generation and training, research and survey, repair and maintenance of infrastructure, weather monitoring and forecasting services, sign postings, and provision of construction materials such as timbers	Technical and financial support to implement activities that are more targeted to protect forests and biodiversity.
<b>Buffer Zone Council and User Groups</b>		
The buffer zone area management, including development of a five year plan and annual plan for using the buffer zone revenue. Implement and monitor BZ program activities.	The buffer zone revenue can become a major source of funds to implement activities identified in adaptation plan of action.	Integrate KHPA into buffer zone plans and access the buffer zone fund to implement it.
<b>Village Development Committee</b>		
<b>Roles</b>	<b>Adaptation Support</b>	<b>Community Expectations</b>
Overall development of Village Development Committees. Works closely with DDC to identify, plan, implement and monitor development activities and projects.	Incorporate adaptation plan of action into VDC planning and use VDC funds to implement the plan.	Incorporation of KAPA into VDC planning and programs.
<b>High Mountain Adaptation Partnership Program (HiMAP)</b>		
HiMAP is a USAID funded initiative implemented by TMI. HiMAP programs include climate change sensitization, survey and study glaciers and glacial lakes, and helping the local people to develop KAPA.	Technical and financial support to develop KAPA and help leverage funds from different sources to support its implementation.	Technical and financial support to finalize and implement KAPA.
<b>Community Based Glacial Lake Outburst Flood Risk Reduction Program (CBGLOFRP)</b>		
A joint undertaking of DHM and UNDP. It will work with the local people and other stakeholders to install the early warning system, lowering the water level of Imja lake and developing community capacity in GLOFR risk reduction.	Technical and financial support to reduce the Imja GLOF risks.	Technical and financial support to reduce the Imja GLOF risks.
<b>District Development Committee</b>		
Overall development of the district. Works closely with VDCs to identify, plan, implement and monitor development activities or projects.	Incorporation of KAPA into DDC plans and programs. Financial and technical support to implement KAPA, particularly to strengthen infrastructure.	Incorporation of KAPA into DDC and VDC planning and programs.
<b>Community-based Organizations or Buffer Zone User Groups (Youth Clubs, Mother's/women's</b>		

<b>groups, Buffer Zone Forest User Groups, Khumbu Alpine Conservation Council, etc)</b>		
Promote and protect groups' right in natural resource management.	Search and rescue operation, humanitarian services and conservation activities.	More active roles in disaster risk reduction and management.
<b>Nepal Army</b>		
Protection of the Sagarmatha National Park.	Search and rescue operation during disasters. Fire-fighting and relief operation.	Well-equipped and trained in rescue and relief support. Effective forest monitoring to control forest fires.
<b>Nepal Police</b>		
Public security and maintenance of law and order.	Search and rescue operation, fire-fighting and emergency services, disaster relief and management and blood donation.	Emergency and disaster rescue and relief services.
<b>Hospitals/Clinics</b>		
Preventive and curative health care to general public	Medical aid and care.	Well-equipped and adequately staffed medical care services.
<b>Telecom</b>		
Tele communication service	Manage communication network services.	More resilient and reliable communication network system to aid disaster management
<b>Red Cross</b>		
Humanitarian and relief services	Relief services.	Relief services during the emergency and disaster situations.
<b>Airport</b>		
Air transport services	Air transport services to aid relief and rescue work.	Reliable air transport services.
<b>Hydro power companies</b>		
Electrification services	Protect power stations and transmission lines for disasters.	More reliable power supply.
<b>Monasteries</b>		
Manage festivals, perform pujas (rituals) and manage monasteries	Perform pujas to appease local deities and protect villages	Pujas for village protection
<b>Schools</b>		
Provide primary and secondary education services.	Students and teachers are involved in public awareness programs. Schools are used as safe venue to shelter affected people.	Schools, teachers and students can play important role in rescue and relief operation.
<b>Ministry of Tourism and Civil Aviation</b>		
Tourism policy and enforcement.	Review current mountaineering policy to provide more flexibility to expedition groups for changing routes and adjust timeframe.	More adaptive mountaineering policy.
<b>Nepal Mountaineering Association</b>		
Collects royalties for trekkers' peaks and promotes mountaineering policy in Nepal.	Porter shelters. Review and amend mountaineering policy	Financial support to build more porter shelters
<b>Sagarmatha Pollution Control Committee</b>		

Waste collection and management	Environmental awareness programs.	Support for environmental awareness programs.
<b>Trekking Agency Association of Nepal</b>		
Promote and protect interests and right of trekking agencies.	Environmental awareness, and safety of trekkers and trekking staff.	Porter insurance and provision of appropriate gears and cloths.
<b>Porter Progress</b>		
Works for the right and protection of porters.	A cloth bank at Lukla to provide warm cloths and trekking gears to porters at a nominal price.	An additional cloth bank in Namche.
<b>Eco-Himal</b>		
Supported the Khumbu Electrification and ecotourism development initiatives.	Supported maintenance and relocation of Thame power station.	Technical and financial support to strengthen other power stations.

# 8. IMPLEMENTATION PLAN

A five-year implementation plan was prepared covering the period from 2014 to 2018. The plan lists adaptation options and prioritizes them in the order of 1-4. Units used are either number or times, quantity, the rate per quantity, the number of beneficiary households, the number of vulnerable households that will benefit from the programs, and possible source of funds. Units and other acronyms used include the following:

P: priority; U: unit; Qt: Quantity; R: Rate; #: number; m<sup>3</sup>: cubic meter; m: meter; BH: Beneficiary households; VH: Vulnerable households; PSF: Possible source of funds; CBGLOFRRP: Community-based Glacial Lake Outburst Risk Reduction Program; SNPBZ: Sagarmatha National Park and Buffer Zone; HiMAP: High Mountain Adaptation Partnership; DDC: District Development Committee; VDC: Village Development Committee; TAAN: Trekking Agency Association of Nepal; CBOs: Community Based Organizations (mother groups, youth groups, buffer zone user groups); NMA: Nepal Mountaineering Association; SPCC: Sagarmatha Pollution Control Committee; DHM: Department of Hydrology and Meteorology. \*indicates areas in which HiMAP may provide technical support and backstop.

	Adaptation options	P	U	Qt	Rate	Total	BH	VH	PSF	Sites	Responsible Agencies
1	GLOF survey, research and monitoring*	1	#	5	400	2000	1284	193	CBGLOFRRP, SNPBZ, HiMAP, DDC, VDC	Covers all potential GLOF sites but with increased focus on the Imja lake	SNPBZ
2	Safer site survey for infrastructure such as water supply system, hydropower, trails and bridges and develop a climate smart guidelines	1	#	1	1000	1000	1284	193	DDC, SNPBZ, VDC,		SNPBZ, VDC
3	Emergency rescue and relief funds	1	#	3	2000	6000	1284	193	CBGLOFRRP, NPBZ, HiMAP, DDC, VDC	Lukla, Namche, Khumjung	SNPBZ and VDC
4	Clothing/gear banks for porters	1	#	2	1000	2000		*1	TAAN, NMA, CBOs	Lukla, Namche	Porters Association
5	Puja	1				0		0	Locals	All the villages	Monasteries and all the people
6	GLOF early warning system network installation *	2	#	4	1400	5600	1284	193	CBGLOFRRP, NPBZ	Chhukung, Dingboche, Shomare, Pangboche, Phungi, Thame, Thamo, Jorsalle, Monjo, Toktok, Phakding, Ghat, Thadokoshi, Chhoplung, Surke	CBGLOFRRP DHM, SNPBZ, Locals
7	GLOF rescue and relief operation training	2	#	3	300	900	1284	193	HiMAP, CBGLOFRRP		CBGLOFRRP
8	Porter shelter construction	3	#	6	8500	51000		0	DDC, SNPBZ, TAAN, NMA, MoT, SPCC	Tagnag, Dzongla, Dingboche, Chhukung, Thame, Lungden	VDC, SNPBZ
9	GLOF awareness and risk reduction training and exposure visit*	4	#	2	1300	2600		0	HiMAP, CBGLOFRRP	An exposure visit will be organized outside the Khumbu region (Tsho Rolpa or Bhutan)	CBGLOFRRP

10	Lowering water level of Imja Glacial lake*	4							CBGLOFRRP, SNPBZ, HiMAP, DDC, VDC	Imja Lake	SNPBZ, CBGLOFRRP
12	Emergency shelter construction and management	4	#	3	8000	24000		0	VDC, SNPBF, TAAN, NMA, CBOs	Chaurikharka, Thamo, Khumjung	SNPBZ, CBOs
13	Porter Insurance	4					0	0	TAAN, NMA, CBOs	Chaurikharka, Thamo, Pangboche	TAAN, Porters Association
14	Weather monitoring and forecasting	1	#	3	1200	3600		0	DHM, SNPBZ, EvK2	Dingboche, Thame, Syangboche, Gorekhshep	DHM, SNPBZ, Yak farm
15	Snow and Ice management training	1	#	3	800	2400	1999	300	NMA	Phortse, Lobuche, Dingboche, Thame	NMA, CBOs, SPCC
16	Green/plastic house demos and nominal support	1	#	50	100	5000		0	HiMAP, NPBZ, VDC, DAO	In all villages	SNPBZ, DAO
17	Agriculture Training on hay/silage making and storage	4	#	3	300	900	1031	155	DAO, Yak Farm	Khumjung, Thame, Pangboche	Yak farm
18	Improved livestock shed construction (demos and support)	4	#	3	300	900	1031	155	Yak Farm, VDC, NPBZ	Khumjung, Thame, Pangboche,	Yak farm
19	Windstorm awareness and risk reduction training	1	#	3	300	900	1999	300	NPBZ, CBOs	Phakding, Thamo, Khumjung,	SNPBZ
20	Nursery, plantation and fencing	1	#	5	3000	15000	1999	300	NPBZ, VDC	Covers all villages in 3 VDCs	NPBZ, KACC, CBOs
21	Review and amend mountaineering policy***	3	#	1	500	500		0	NMA, NPBZ, CBOs		NMA, SNPBZ, TAAN
22	Firefighting training and equipment***	3	#	11	300	3300	1416	212	NPBZ	9 wards of Chaurikharka, Khumjung and Namche VDC	NPBZ
24	Training on windstorm resistance building structure and demos	4	#	3	300	900	1999	300	VDC, NPBZ	Covers all three VDCs	VDC SNPBZ
25	Windstorm rescue and	4	Covered by Emergency relief rescue and relief fund								

	relief funds										
26	Sign posting at hazardous sites *	1	#	50	20	1000	1 9 9 9	300	HiMAP, NPBZ	Chhoplung, Ghat, Chaurikharka, Phakding, Gomila, Monjo, Debuche, Pangboche, Dingboche, Thamo, Thame	SNPBZ
27	Gabion boxes and check dam construction	1	m 3	80 0	10	8000	1 9 9 9	300	DDC, VDC, NPBZ	Ghat, Chhoplung, Chaurikharka, Phakding, Monjo, Jorsalle, Toktok, Dingboche, Pangboche, Debuche, Phungithanga, Thamo, Thame,	VDC, SNPBZ
28	Landslide awareness and risk reduction training*	1	#	3	300	900	1 9 9 9	300	NPBZ	Phakding, Thame, Pangboche	SNPBZ
29	Forest fire awareness and risk reduction programs	1	#	3	300	900	1 9 9 9	300	NPBZ	Chaurikharka, Thamo, Khumjung	SNPBZ
30	Survey most vulnerable forest to forest fire	1	#	1	400	400	1 9 9 9	300	NPBZ		SNPBZ
31	Form train and equip forest fire fighting squads		Covered by windstorm								
32	Forest fire-line construction	1	m	10 00	3	3000	9 6 8	145	NPBZ	9 BZCFUG in Chaurikharka VDC	SNPBZ
33	Flood awareness and risk reduction training	1	Covered by GLOF								
34	River bank protection (Use of gabion boxes, retention wall and plantation)	3	Covered by GLOF								

## 8.1. TENTATIVE BUDGET SUMMARY 2014-2018

Figures in '000'

	Programs	2014	2015	2016	2017	2018	Total
1	GLOF survey, research and monitoring	350.00	350.00	400.00	450.00	450.00	2000.00
2	Safer site survey for infrastructure and develop a climate smart guidelines	300.00	700.00				1000.00
3	Emergency rescue and relief funds	1,000.00	1,000.00	2,000.00	2,000.00		6000.00
4	Clothing/gear banks for porters	300.00	1,000.00	700.00			2000.00
5	GLOF early warning system network installation	400.00	2,600.00		2,600.00		5600.00
6	GLOF rescue and relief operation training		300.00	300.00	300.00		900.00
7	Porter shelter construction	8,000.00	16,000.00	1,000.00	8,000.00	18,000.00	51000.00
8	GLOF awareness and risk reduction training and exposure visit	600.00	1,500.00		500.00		2600.00
9	Lowering water level of Imja Glacial lake						
10	Emergency shelter construction and management	4,000.00		12,000.00	8,000.00		24000.00
11	Weather monitoring and forecasting	2,400.00		1,200.00			3600.00
12	Snow and Ice management training			800.00	800.00	800.00	2400.00
13	Green/plastic house demos and nominal support	1,500.00	1,000.00	1,000.00	1,000.00	500.00	5000.00
14	Agriculture Training on hey/silage making and storage	300.00	600.00				900.00
15	Improved livestock shed construction (demos and support)	300.00	300.00		300.00		900.00
16	Windstorm awareness and risk reduction training		300.00	300.00		300.00	900.00
17	Nursery, plantation and fencing	2,000.00	5,000.00	5,000.00	2,000.00	1,000.00	15000.00
18	Review/amend mountaineering policy		500.00				500.00

19	Firefighting training and equipment	500.00	300.00	1,000.00	1,000.00	500.00	3300.00
20	Training on windstorm resistance building structure and demos	300.00	600.00				900.00
21	Sign posting at hazardous sites	400.00	400.00			200.00	1000.00
22	Gabion boxes and check dam construction	1,500.00	1,000.00	2,000.00	1,500.00	2,000.00	8000.00
23	Landslide awareness and risk reduction training	300.00		300.00		300.00	900.00
24	Forest fire awareness and risk reduction programs		300.00		300.00	300.00	900.00
25	Survey most vulnerable forest to forest fire	400.00					400.00
26	Forest fire-line construction	500.00	1,000.00	1,000.00		500.00	3000.00
Total in NRs.		25,350.00	34,750.00	29,000.00	28,750.00	24,850.00	142700.00
Total in US\$ (exchange rate 1 US\$ = NRs. 95)		266.84	365.79	305.26	302.63	261.58	1502.11
Staff Salary and benefits		80.05	109.74	91.58	90.79	78.47	450.63
Office and field cost		16.01	21.95	18.32	18.16	15.69	90.13
Grand Total		362.91	497.47	415.16	411.58	355.75	2,042.86

# 9. REFERENCES

- Benn, D., Bolch, T., Hands, K., Gulley, J., Luckman, A., Nicholson, L., Quincey, D., Thompson, R. and Wiseman, S. 2012. Response of debris-covered glaciers in the Mount Everest region to recent warming, and implications for outburst flood hazards. *Earth Science Reviews* 114 (2012), 156-174.
- Bernbaum, E. 1980. *The Way to Shambala: A Search for the Mythical Kingdom beyond the Himalayas*. New York: Anchor Books.
- Byers, A.C. 2005. Contemporary human impacts on alpine landscapes in the Sagarmatha (Mt. Everest) National Park, Khumbu, Nepal. *Annals of the Association of American Geographers* Vol. 95(1), March, 2005. pp.112-140.
- Byers, A.C. 2007. An assessment of contemporary glacier fluctuations in Nepal's Khumbu Himal using repeat photography. *Himalayan Journal of Sciences* Vol. 4, No. 6: 21-26.
- Byers, A.C., Culhane, T., Marcinkowski, D., Vaidya, S., and Howe, C. 2011. Protecting and Restoring the World's Alpine Ecosystems through NGS Explorer Collaboration and Exchange: The Role of Awareness Building, Improved Conservation Practices, and High Altitude Alternative Energy Development. Interim Report to the National Geographic Society-Blackstone Challenge Grant Program. Report. Washington, DC: The Mountain Institute.
- Byers, A.C. 2013a. The Nature of Everest. In: Anker, C., MacDonald, B., Coburn, B. and Breshears, D. 2013. *The Call of Everest*. Washington, DC: National Geographic Society.
- Byers, A.C. 2013b. Three sides of Everest: there's more to a mountain than its summit. *Natural History Magazine*, April 2013.
- Byers, A.C., McKinney, D.C., Somos-Valenzuela, M.A., Watanabe, T., Lamsal, D. 2013. Glacial Lakes of the Hongu Valley, Makalu-Barun National Park and Buffer Zone, Nepal. *Natural Hazards*, April (DOI: 10.1007/s11069-013-0689-8).

- District Development Committee Solukhumbu (2059 B.S.). District Profile of Solukhumbu, DDC Solukhumbu.
- District Development Committee, Solukhumbu Periodic District Development Plan, 2058/059-2063/64), DDC Solukhumbu.
- Fürer-Haimendorf, C. von 1975. Himalayan Traders: Life in Highland Nepal. London: John Murray.
- Government of Nepal 2011. LAPA Manuel: Local Adaptation Plans for Action (LAPA). Kathmandu: Ministry of Environment.
- Kodas, M. 2008. High Crimes: The Fate of Everest in an Age of Greed. New York: Hyperion.
- Jeffries, M. 1991. Mount Everest National Park: Sagarmatha, Mother of the Universe. Seattle: Mountaineers Books.
- Lachapelle, P. 1998. Managing sanitation in protected areas: Problems and challenges in Sagarmatha (Mt. Everest) National Park, Nepal. *Himalayan Research Bulletin* XVIII (1): 53-57.
- Manfredi, C., Flury, B., Vivlano, G., Thakuir, S., Khanal, S., Jha, R., Maskey, R., Kayastha, R., Kafle, K., Bhochhlbhoya, S., Ghimire, N., Shrestha, B., Chaudhary, G., Giannino, F., Carteni, F., Mazzoleni, S., Salerno, F. 2010. Solid waste and water quality management models for Sagarmatha National Park and Buffer Zone. *Mountain Research and Development* (30): 2, 127-142.
- McDowell, G., Ford, J., Lehner, B., Berrang-Ford, L., and Sherpa, A. 2012. Climate-related hydrological change and human vulnerability in remote mountain regions: a case study from Khumbu, Nepal. Springer-Verlag: *Reg Environ Change*.
- Mountain Spirit (2004). Socio-economic Data Collection in Sagarmatha National Park and Buffer Zone for Decision Support System. Technical report submitted to CESVI cooperazione e sviluppo onlus via Broseta 68/a 24128 Bergamo Italy.
- Mountain Spirit (2007). Baseline Survey for Community Based Tourism using Appreciative Participatory Planning and Action (APPA). Report prepared for the Mountain Institute, Kathmandu

Mountain Spirit (2002). Successful Community Initiative in Chaurikharka, Namche and Khumjung VDCs , Solukhumbu, Nepal. Project document submitted to WWF Nepal program, Kathmandu.

Mountain Institute (2012) Community Consultation Program on Climate Change Vulnerability and Adaptation in Solukhumbu District, Nepal.

Spoon, J. 2013. From yaks to tourists: Sherpa livelihood adaptations in Sagarmatha (Mount Everest) National Park and Buffer Zone, Nepal. In: Lonzy, L.R. (ed.) 2013. Continuity and Change in Cultural Adaptation in Mountain Environments, Studies in Human Ecology and Adaptation 7. New York: Springer Science-Business Media.

UK Guardian 2013. Everest: Tourism and Climate Change Provide New Challenges. 24 May, 2013.

United Nations Development Programme 2013. Project Document: Community Based Flood and Glacial Lake Outburst Risk Reduction Project. Kathmandu: UNDP.

U.S. Agency for International Development (USAID) 2013. Climate Resilient Development: A Guide to Understanding and Addressing Climate Change. Washington, DC: USAID.

# INDEX OF ANNEXES:

1. Annex A: Stocktaking paper by Brian Peniston
2. Annex B: Translation of Documents from the Khumbu Community Consultations September 2012
3. Annex C: September 2012 community consultation cards, posters, other tools (PDF attachment)

# ANNEX A: STOCKTAKING PAPER: A REVIEW OF NEPAL'S LOCAL ADAPTATION PLANS OF ACTION

*By: Brian Peniston Director, Mountain Livelihoods and Innovation, The Mountain Institute  
8 August 2013*

## **EXECUTIVE SUMMARY**

The following report examines the Local Adaptation Plan of Action (LAPA) mechanism in Nepal and is a review of the history of the mechanism and the process and methodologies used to conduct LAPAs in Nepal. It is an illustrative guide rather than an exhaustive study, and is based on a qualitative and quantitative review of a finite number of documents that were available at the time of writing. The review also includes information gathered through interviews conducted with development professionals in Nepal, which may or may not represent the whole development sector. Based on this review, several observations and recommendations are offered as ways to possibly proceed and strengthen the LAPA process and mechanism. These recommendations are not intended to represent the views of USAID Washington D.C., USAID/Nepal, Engility Corporation, nor any of the persons or organizations interviewed.

## **AN OVERVIEW OF CLIMATE CHANGE INITIATIVES AND OF THE LOCAL ADAPTATION PLAN OF ACTION PROCESS IN NEPAL**

To understand the LAPA process one must start with the context of climate change initiatives in Nepal. An ideal starting point for gaining this understanding comes from The Government of Nepal's own manual on Local Adaptation Plans of Action, which states:

*“As a Party to the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, Nepal is making every effort to benefit from these instruments through institutional strengthening, policy formulation and programme development. In this endeavour, the Climate Change Policy (2011) is under implementation. More over efforts are underway to benefit from carbon trading. In international forums, Nepal has been continuously drawing the attention of the international community to the profound impacts of climate change on the mountains and call for collaborative efforts for their mitigation. In the spirit of her international commitments and national needs, Nepal has prepared the National Adaptation Programme of Action (NAPA) to support vulnerable people in adapting to the adverse impacts of climate change.*

*“To implement NAPA priorities, the Government of Nepal has also endorsed the National Framework on Local Adaptation Plans for Action (LAPA). This LAPA Manual, which has been approved by the Ministry of Environment, will be an effective instrument to implementing NAPA Priority Programmes. The LAPA Framework provides opportunities for immediate and effective delivery of adaptation services through the implementation of NAPA priorities. This LAPA Manual describes its guiding principles, LAPA formulation steps, a monitoring and evaluation approach, and provide stools that are practical and simple. The Framework and Manual together provide opportunities to formulate and implement LAPA in an integrated manner with the participation of the poorest and most climate vulnerable communities.”*

*(Source: Government of Nepal, Local Adaptation Plan of Action Manual, 2012)*

## **BACKGROUND**

The Government of Nepal (GON) initiated climate adaptation planning and implementation with The National Adaptation Programme of Action (NAPA), endorsed in September 2010. The NAPA indicates the Government’s intention to disburse at least 80 percent of the available budget directly for local level implementation of identified adaptation actions. The NAPA also aims to ensure that national adaptation planning supports adaptation by local communities, particularly the climate vulnerable poor. To achieve this objective, participants in the NAPA inception workshop identified the need to develop **Local Adaptation Plan for Action (LAPA)** to mainstream local adaptation needs into development planning.

Recognizing the enormous variability within Nepal and within its various communities, the GON, with the support of civil society, felt it was necessary to design a formal process to go beyond the NAPA and develop adaptive plans that reflect more fully the needs and aspirations of Nepal’s tremendously diverse communities, and the wide range of impacts experienced from

climate variability. Nepal was the first country in the world to develop a formal Local Adaptation Plan of Action process.

With funding from DFID, a consortium of agencies developed a pilot framework for preparing and implementing LAPA and piloted this tool in 9 districts across Nepal (selected for their representative qualities and as vulnerable districts) during 2010-11 by the Climate Adaptation Design and Piloting-Nepal Project (CADP-N). Nine (9) international agencies were involved in this effort, with 18 foreign and Nepali experts involved in designing the manual. Results of the pilot activities were summarized and published in a LAPA manual, drafted in 2011. (A brief summary document of the LAPA history, design mechanism and contents of a model LAPA is attached as Annex 1 for convenience).

### **MAIN FEATURES OF THE LAPA FRAMEWORK**

At the NAPA workshop in 2010, participants identified the basic starting unit for the LAPA as the Village Development Committee (VDC) with the recommendation that activities be coordinated by the District Development Committee (DDC). This process was determined to be the most appropriate scale for integrating climate change resilience into local-to-national development planning *processes and outcomes*. Among other objectives, these administrative units were considered best at capturing location/community specific adaptation priorities and ensuring national level support for local adaptation without fragmentation or large transaction costs. The intent was to enable a match between bottom-up and top down adaptation planning, and design a mechanism that is bottom up, inclusive, flexible, and responsible. It was also intended that the LAPA process strengthen decentralized planning efforts and strengthen existing local self-governance rules and regulations. The LAPA Framework was designed to support decision-makers at local-to-national levels to:

1. Identify the most climate vulnerable VDC's, wards, and people and their adaptation needs;
2. Prioritize adaptation options in easy ways with local people setting priorities;
3. Prepare and integrate local adaptation plans for action into local-to-national planning in accordance with the Local Self Governance Act;
4. Identify appropriate service delivery agents and channels for funding to implement local adaptation plans for action;
5. Assess the progress of LAPA to ensure effective planning and delivery;
6. Provide cost-effective options for scaling out local-to-national adaptation planning

The LAPA Framework was designed to consist of seven steps for integrating climate change resilience into local-to-national planning processes. They include (Figure 3):

1. Sensitization
2. Climate vulnerability and adaptation assessment
3. Prioritization of adaptation options
4. Developing local adaptation plan for action
5. Integrating the local adaptation plan for action into planning processes
6. Implementing the local adaptation plan for action
7. Assessing progress of local adaptation plan for action

Each step was carefully considered as to why it is important; what actions should be undertaken; and, a list of appropriate participatory tools to use was outlined. Figure 3 shows the process in diagram form.

During the pilot phase the design team also proposed a number of appropriate tools to be used at each of the 7 steps in the LAPA process. These tools are listed below.

### Suggested tools to use when conducting a LAPA

LAPA steps	Core tools	Additional Tools
<b>STEP 1:</b> Sensitization	<ol style="list-style-type: none"> <li>1. Shared Learning Dialogues (district level)</li> <li>2. Gateway Services Analysis (district level)</li> <li>3. Visuals and stories</li> <li>4. Climatic Hazard Trend Analysis</li> <li>5. Seasonal Calendars</li> </ol>	Climate adaptation capacity assessment and opportunities identification Cause and effect analysis (problem tree) Envisioning climate scenarios Hazard and impact risk analysis Hazard and response analysis Mapping: hazards, vulnerability (social, economic, physical), resources (social, natural etc) Timeline history regarding changes School level awareness raising tools: essay competition, quiz contest, scout, eco-club, etc.
<b>STEP 2:</b> Vulnerability and Adaptation assessment	Gateway Services Analysis Mapping hazards, risks, vulnerability, resources etc Disaggregated Vulnerability Matrix Hazard and Impact Risk Analysis Envisioning Climate Scenarios Climate adapted Well-Being Assessment Visioning High Adaptive Capacity	Cause and effect analysis GIS mapping Hazard and response analysis Seasonal calendars Livelihoods impacts analysis Climatic hazard trend analysis Mapping of service provider /institutional analysis
<b>STEP 3:</b> Prioritisation of adaptation actions	<ol style="list-style-type: none"> <li>12. Multi-Criteria Ranking</li> <li>13. Participatory Cost-Benefit Analysis</li> </ol>	Impact implementation matrix Pair wise ranking Scenario tool for identifying energy pathways
<b>STEP 4:</b> Adaption plan development	<ol style="list-style-type: none"> <li>14. Service provider analysis</li> </ol> The 4 WHs (what, where, when, who, budget etc) NO CARD	Logical framework Inclusion sensitive budgeting (for example gender and indigenous people-sensitive budget)
<b>STEP 5:</b> Integrating adaption plan into the local to national planning process	Shared learning dialogue Policy and institutional analysis to identify entry points and/or adopt entry points included in this framework	Sharing best practices and lesson learned with plan decision-makers
<b>STEP 6:</b> Implementing plan	NA	NA

<b>STEP 7:</b> Assessing progress (M&E) and informing future plan development	Visioning high adaptive capacity Service providers analysis Behavior change journals analysis Disaggregated vulnerability matrix Mapping (risks, vulnerability, and service providers) Climate adapted well-being assessment Self-monitoring and evaluation Most significant change analysis	Mapping hazards, risks and vulnerability Envisioning Climate Scenarios Logical frameworks Hazard trend analysis Seasonal calendars Hazard response analysis Gateway systems analysis Policy and institutional analysis
--	---	---

## LAPA INNOVATIONS AND EXPERIENCE

When conducting the pilot LAPAs, different organizations experimented with several new techniques as ways to increase community engagement. Several of these innovations are worth mentioning here.

For example, The Britain Nepal Medical Trust (BNMT) established “monitoring groups” during the LAPA piloting phase. During the planning phase, small scale community meetings were held, explaining the need to monitor changes during the LAPA process, related to both the progress of LAPA implementation and to understand climate trends that might affect LAPA implementation. Two “monitoring groups” were formed, a) at the ward level to monitor changes among “the most vulnerable” and locally experienced trends and b) a second village level group which monitored planned activities and fed information from the ward-level group to village level decision-makers. The groups were nested and the “village” level groups were “accountable” to the ward level group. This mechanism was thought to improve interactions between the two groups and provide more focused analysis whether implemented activities influenced vulnerability of beneficiaries; and if not, why not; and what could be done better.

Another group working at the pilot stage instigated a series of Shared Learning Dialogues at district and VDC level. Farmers, cooperative members, Forest User Group (FUG) members, VDC secretaries, and District Development Committee members participated. Officers from District line agencies, Cooperatives, Women’s groups, NGOs and Journalists also participated. The dialogues covered cross-sectoral issues along with the status of gateway systems at ward level. The information was used to assess how vulnerable the wards are and identify marginal communities. The information collected during the dialogues was shared back with local people during a final shared learning dialogue held in the district headquarters. These initial dialogues were also used to share scientific information on greenhouse gas emissions and climate change, temperature and rainfall variability, projected effects of climate change, climate change

adaptation, and gateway systems generally raising awareness while enhancing communication across sectors. This forum was also used to share information on the status of local gateway systems, identifying the most and least vulnerable wards, describing national and district scenarios of temperature and rainfall, and identifying marginal communities. A second round of sharing helped identify possible programs for planning local adaptation and agencies for implementation.

Outcomes from the Shared Learning Dialogue process were as follows:

1. Information on climate change science delivered at local level
2. Status of gateway systems at local level assessed
3. Most and least vulnerable wards identified
4. Local scenario of climate change prepared
5. Possible programs for enhancing adaptation identified
6. Possible agencies for implementing adaptation plan identified

Each of these innovations tried to integrate local level planning exercises and tools more explicitly with district level planning efforts and coordinated climate change adaptation efforts. Historically, government interventions have been more top-down with limited engagement of local communities from the onset.

## **CASE STUDY**

The United Kingdom Department for International Development (DfID) supported development of the CAPA framework, which is based upon the principles of inclusiveness, responsiveness, flexibility and iteration. HTSPE, the International Institute for Environment and Development, and local NGOs were involved in LAPA piloting. The information presented here is drawn from the NGO pilot reports and informal consultation with individuals involved in piloting.

The early lessons from LAPA piloting indicate that it is proving effective in overcoming barriers in adaptive governance. It has contributed to raising awareness and the capacity of communities and local institutions to take leadership in designing adaptation responses based on available resources. Community leadership and ownership of the adaptation process is key to LAPA. The local adaptation planning process has successfully linked community-based adaptation with the national adaptation planning process, providing a framework and mechanism for facilitating a top-down and bottom-up mix of adaptation responses.

Local adaptation planning and the framework around adaptive governance in Nepal are

providing good examples and lessons in support of the current discussion of the adaptation paradoxes, i.e., how to link global policy making to local responses. It is also helping Nepal to take leadership in demonstrating local preparedness and actions towards climate change governance. Although the pilot activities are in an early phase, there are already encouraging results. Existing mechanisms are so far proving effective in mainstreaming climate change adaptation at the local level.

Several field pilots have identified a wide variety of tools that can be effectively used to assess climate vulnerable households or communities. The participatory tools and methods proposed by various agencies and scholars have been refined and adopted during LAPA piloting as a basis for integrated vulnerability assessment. Social analysis system tools that emphasize collaborative enquiry and social engagement, such as problem dynamics (assessing climate change issues), option domain (identifying adaptation options) and multi-stakeholder brainstorming workshops, were liked by communities, as they provided a visual basis for communities to understand and interpret the situation. Social analysis tools, such as those available through the Social Analysis Systems approach, were received well by NGOs and government officials due to their applicability and usefulness in terms of understanding power dynamics, institutional settings and differences among risk and adaptation thresholds. These lessons suggest that integrated vulnerability assessment can be an effective entry point to the LAPA planning process.

The pilot projects identified awareness raising, local capacity building, a participatory and inclusive process of planning and delivery and collaboration among communities, NGOs and local government bodies as important elements in shaping local adaptive governance and the effectiveness of the local adaptation responses. One of the crucial lessons is that more inclusive approaches will reduce conflict, although even then it may not be possible to include or incorporate all the different perspectives and stakeholders, especially in light of local political pressures.

The LAPA experience showed that although a range of institutions are relevant for local adaptation planning, relative strengths and weaknesses for playing different roles depended on context. Local government agencies were identified as having the most potential among others for matching top-down and bottom-up climate change planning. Recognition of existing local institutions and mechanisms for sharing risks and benefits could be a good starting point for developing adaptive responses. Regarding technological innovations, existing systems and practices need to be built on. The degree of robustness in relevant systems and relative strengths

and weaknesses need to be studied and understood. Facilitating the exchange of information and knowledge among communities and groups will be a powerful means of fostering the adaptive capacity of communities.

### **FOLLOW ON ACTIVITIES POST PILOT LAPA PHASE (POST 2011)**

One further follow-on effort, the NRRC Flagship 4 Project was designed and is being implemented in mid- and far West Nepal. This DFID funded effort uses the LAPA process to identify the most vulnerable communities threatened by climate change, involve them in the decision-making to identify climate-related hazards and risks and prioritizing adaptation actions. The intent is to mainstream climate change adaptation approaches from local to national level planning processes and to ultimately integrate these approaches into district development planning, like most LAPAs. Specifically, this project uses the LAPA process, led by the District Authorities (i.e. the Chief District Officer's office) but implemented by CBOs and community mobilizers at the VDC/community level. This project was signed in 2012 and is now finalizing designs for 70 VDC-level LAPAs to address the needs of 400,000 people in 14 mid- and far-western districts. Approximately 40 LAPAs have been conducted so far. It is part of a US\$21 million project committed by DFID and the European Union.

Under this mechanism, sub-VDC level planning is also being conducted, using a mechanism called Community Adaptation Plans of Action (CAPA) as they determined that there was too much variability at the VDC level and that going further down to a user groups level would be more effective. Under this project funding up to 300,000 Nepal rupees (approximately \$3,100.00 USD) will be provided at the CAPA level to conduct climate adaptation projects, according to one informant.

CARE and World Wildlife Fund are also conducting user group-level adaptation planning exercises in project areas using USAID/Washington funding under a program called the SCAPES project in Eastern Nepal, and Hariyo Ban in Central Nepal. Under SCAPES, a series of CAPA and LAPA exercises were conducted in Taplejung District around the Khanchenjunga Conservation Area Project (KCAP) in partnership with district based Federation of Forest User Group staff (FECOFUN). The process used is a fairly simple, standard participatory rapid rural appraisal procedure and is largely a community resource mapping exercise on community perceived vulnerabilities due to climate change impacts. No specific innovations were noted in implementing these projects aside from the emphasis on the user group levels (for CAPA) as the starting point instead of the VDC.

Several other agencies have been conducting LAPAs in Nepal since 2010. The author and the TMI team were not able to obtain additional documents for review. While transparency is a perceived value among the NGO and INGO communities, this does not always translate into open sharing of documents and information.

### **OBSERVATIONS, ANALYSIS, AND COMMENTS ON THE LAPA PROCESS**

Nearly all documents examining the LAPA and LAPA process acknowledge the value of the LAPA process and particularly commend Nepal for prioritizing a process that emphasizes a bottom up, participatory, community driven approach. The commitment to decentralizations is also consistently commended.

Many documents refer to the value of starting at the local level, including direct interactions with community institutions. A quick review of development success in Nepal indicates that performance of program implementation remains consistently weak , and hence getting development assistance to the local level helps overcome this constraint. A number of large and small problems have contributed to this weakness, political instability, corruption, and lack of accountability being consistently identified as serious problems. Decentralization is one way to address several of these constraints simultaneously, therefore, increasing the likelihood that implementation efforts can better reach to the poor and marginalized social groups.

### **STOCKTAKING OVERVIEW**

As part of the Nepal LAPA stocktaking, meetings were held with other potential donors, who may provide additional leveraged funding and help mainstream the High Mountain lessons learned into broader future programs. Meetings were held with U.S. Agency for International Development, Office of Japanese Cooperation to Nepal (JICA), US State Department Environmental Hub Office, United Nations Development Program, World Wildlife Fund, Dolpa Institute, Resources Himalaya Foundation, Himalayan Research Expeditions, Federation of Community Forest User Groups (FECOFUN), Nepal Federation of Indigenous Nationalities (NEFIN), International Center for Integrated Mountain Development (ICIMOD), World Food Program (WFP), Ministry of Forest and Soil Conservation (MOFSC), Wildlife Works Carbon, Red Panda Network, and the Multi Stakeholder Forestry Programme.

In Nepal TMI talked with several other agencies that have been conducting LAPAs and reviewed several completed LAPAs. A number of agencies have been conducting LAPAs including DFID (70 LAPAs completed with another 400 in progress), WWF (approximately 20 LAPAs completed with more in process, some in partnership with CARE), and others including

Himali Conservation and Development Agency (HCDA), Federation of Community Forest User Groups (FECOFUN), Himawanti (Himalayan Women's Association) and others.

After review of the work of these organizations, the preliminary conclusion is that most LAPAs have followed the guidelines developed by Government of Nepal, but these guidelines have limitations. The January-July 2013 stocktaking and review of dozens of LAPAs in Nepal revealed that many are of inferior quality and utility. Many are no longer than 4 pages, provide only the briefest of vulnerability and adaptation analyses, and conclude with a sentence or two stating that "a committee has been selected which will be in charge of project implementation." The goal of the HMGWP is to produce a model LAPA that is based on its unparalleled fluency in the region (physical and cultural); meaningful and participatory dialogue with stakeholders; community- and Nepali-driven nature of the entire LAPA process; and incorporation of additional components described above.

## **OBSERVATIONS, ANALYSIS AND RECOMMENDATIONS FOR AN IMPROVED LAPA MECHANISM AND PROCESS**

All of these efforts deserve sincere recognition and acknowledgement for the purity of their intention and of the clarity and thoroughness of the processes that are described. Unfortunately, that does not mean that they cannot be improved upon. Several comments and suggestions follow. Comments and observations fall into seven categories, including 1) unit size and ecological processes, 2) planning process, 3) decentralization versus coordination, 4) financing mechanisms, and 5) incorporation of scientific data, 6) cultural elements of climate change and 7) monitoring and evaluating impacts and results.

### **(1) THE LAPA UNIT SIZE**

First, one must examine the issue of the correct LAPA unit size. To encourage a bottom up, community driven process and try to ensure that climate change adaptation happens at the community level, the designers of the LAPA process choose the Village Development Committee as the basic planning and implementation unit. While there are many valid reasons for this choice, including a very legitimate desire to encourage and strengthen the decentralization process in Nepal, this choice involves some trade-offs.

On the positive side, quoting from the GON LAPA Manual of 2011:

*"The VDC and the municipality have been identified as the most appropriate unit for integrating climate change resilience into local-to-national development planning processes and outcomes. The VDC or the municipality as administrative and geographic units are able to capture location/community specific adaptation priorities and ensure that national level support for local adaptation does not get fragmented or incur large transaction costs. Integration at*

*these units enables a match between bottom-up and top down adaptation planning. The VDC or the Municipality as operational unit refer to the Village and or Municipality Development Councils, and the Village or Municipality Development Committees. Whilst the Council is responsible for executive decision making, Village or Municipality Development Committees are responsible for planning, integration of the LAPA into Sectoral and development planning processes, coordination, monitoring and evaluation, and service delivery. These Village and Municipality Development Committees are competent to consolidate and channel both development and climate adaptation budgets. To ensure delivery of adaptation services in a timely and effective manner capacity building of these local bodies would be necessary.”*

However, this trend to devolve into smaller rather than larger administrative units can result in promoting decentralization at the expense of reducing the potential for impacts at scale. Among LAPA practitioners there are two main camps evolving, one that wants to work more at the ecological and less at the administrative boundary level, and the other that wants to devolve to even more decentralized levels. A number of organizations in Nepal have argued that the climate adaptation planning process needs to go beyond VDCs and reach down to the user group or community level, and they have developed a process called Community Adaptation Plan of Action (CAPA). While many natural resource management decisions are made at the user group level, and these institutions (such as community forest user groups and irrigation user groups most notably) are effective units of local, decentralized resource governance, they may be too small to promote climate change activities that build resilience at a more substantial level. As an example, building a local check dam may control erosion and build "resilience" in one smaller gully and impact the fields of a small number of households in that micro watershed, but will do little to enhance resilience to the extreme rainfall events that have occurred in Nepal these past few weeks and destroyed homes and infrastructure downstream, causing damage and loss of life to thousands of people. Balancing the needs at the local, micro level and the larger scale geographic needs will continue to present a challenge and promote debate.

Applying this concept to the High Mountains project, one can see a new possibility for expanding the High Mountain Khumbu LAPA work, using it as a foundation to create a model for a more hybrid LAPA process. This process would go beyond the individual VDC level (the current standard limited to the VDC level, with restricted potential funding levels), expanding the concept to interconnected VDCs that function more as ecological units, which may help raise larger leveraged funding such as a Khumbu-wide Adaptation Plan. This might better position the current High Mountain work for complimentary funding through other mechanisms such as National Park Buffer Zone Funding, which occurs at these larger ecological unit levels.

## **(2) LAPA PLANNING PROCESSES**

As with many things designed by committee, the LAPA planning process perhaps errs on the side of comprehensiveness rather than efficiency. The list of suggested participatory tools to use when conducting a LAPA is very comprehensive, perhaps even too comprehensive. The emphasis on using a wide variety of known and field tested participatory tools is a strong indicator of Nepal's commitment to try to ensure that climate change adaptation efforts reach into the lowest and generally marginalized groups. The recommended tools to use to accompany the seven step LAPA process are all well-known and field-tested tools that can help development projects reach into the lowest levels of society. Nepal remains ahead of many developing countries in the use and adaptation of participatory tools, and these recommendations demonstrate a clear leadership role in climate change adaptation globally. Many of these participatory tools are powerful ways to ensure greater inclusion and better gender balance if used correctly and thoroughly. The tools table listed is a thorough and comprehensive list of the appropriate tool to use at each step in the seven steps LAPA process, and is indeed impressive for its comprehensiveness.

However, conducting each of these techniques in a thorough and comprehensive manner will require considerable investment of both time and money to complete them properly. As a result, a number of LAPAs are stripped down due to either funding or time constraints and are conducted as simple PRA (participatory rural appraisal) exercises that assess community perceptions on climate change vulnerability. These are useful documents but provide largely qualitative information. It may well be that they are conducted primarily as pro forma documents completed in order to qualify communities to apply for Government of Nepal (GON) Adaptation Funds, which are provided under UN and bi-lateral assistance mechanisms. These Adaptation Funds are provided at the Village Development Committee (VDC) level. According to one informant, communities that meet these criteria can apply for grants up to Nepali Rupies 300,000 (approximately \$US 3,210 per VDC). Many produce simple hand drawn, village sketch maps with superficial write up of the generalized findings. This is adequate to apply for and compete for small GON project funding under the Adaptation Fund mechanism but provides an inadequate basis to design larger more comprehensive projects that are more likely to result in lasting and sustainable climate change resilience, even at the community level. Hopefully the process being used in the TMI High Mountain LAPA work has the potential to fill this gap.

### **(3) DECENTRALIZATION VERSES COORDINATION**

The LAPA experience in Nepal is still in its infancy and there remains much to learn. The Government of Nepal is interested in using the agreed framework for LAPA to drive the adaptation mainstreaming agenda. This will require working with other sectors and stakeholders to look for potentials and opportunities to upscale LAPA learning across different watersheds and geographical areas in Nepal will be useful.

There remain some challenges however. Authors of some studies in Nepal conclude that the

*“responses of Nepal’s political constituencies towards climate change crisis are diverse, inconsistent and non-coherent. Responses usually emerge from individual understanding, often based on limited knowledge of the whole issue. There is little internal discussion among the political bodies, many of them are exposed to international and NGO led activities and therefore get different perspectives. These are further complicated by the conflicting ideological and political orientation of political parties and leaders. However, it is surprising that there is huge variation even within the leaders of particular political party partly due to little serious homework and discussion on the issue within the parties.*

*.... there is shared view that climate change is primarily due to industrialized countries and that Nepal as a LDC should get aid to better adapt to the changing global climate. However, many have not gone beyond this general situation and there is little understanding and explanation of our adaptation priorities let alone the programmes. “(Naya Sharma Paudel, CAPD-Forest Action 2010; Responding to climate change in a transitional politics: review of political context in relation to designing LAPA in Nepal).*

If one agrees with Paudel’s conclusions, then the decision to focus on a decentralized approach may contribute to this lack of understanding as it complicates coordination and working across sectors as they generally do not have operational arms functioning at the VDC level. Coordination is further complicated as climate change is typically categorized under the banner of “environment” programming rather than mainstreaming it into environmental as well as larger development efforts. “This presents a challenge to establishing climate change as a cross-cutting issue rather than an environmental one,” concludes a 2011 report by the Capacity Development for Development Effectiveness Facility for Asia and Pacific, a “community of practice” organization working in the Asia-Pacific region. DFID Climate Change professionals agree, stating that ideally “we shouldn’t have separate climate change projects,”.... and .....“Local development should look at the needs in the area with climate change in mind.” However, the mechanisms to integrate climate change into regular or existing development work remain weak and ineffective. The situation is further complicated by the fact that the apex body

in Nepal for all Climate Change issues is the Ministry of Environment, Science and Technology (MOEST), a Ministry that does not have regional or district level staff in place, nor large budget authority.

There is widespread agreement that decentralized decision making and planning for climate change adaptation are appropriate for Nepal as it reaches into the grassroots and aids with inclusion, but these decisions come with drawbacks, and create coordination challenges. As the mainstreaming mechanisms remain weak and the coordination between Ministries lacking, particularly when this requires some sharing of resources (especially funding), creative problem solving will be required to address this issue.

#### **(4) LAPA FINANCING MECHANISMS**

Ensuring that climate change money flows to the most vulnerable communities will require the right structure to be effective. While the topic of climate financing is slightly outside the discussion of the LAPA, it is worth raising a few points for consideration. As the flow of funds is planned to go via the District to the vulnerable VDCs, this will require the building the capacity within existing district level structures. Lessons learned from other development sectors have relevance and important lessons can be learned on creating effective decentralized funding structures. (For a detailed analysis, please see Neil Bird, Climate Change Finance, Overseas Development Initiative 2012, listed in the references). An institutional mapping of VDC, Municipalities and DDC functions, powers, capacities and relationships would be useful to identify which agencies have the skills and manpower to assume these additional duties.

As mentioned in an earlier section, effective adaptation responses will require a coordinated approach and a multi-disciplinary response across multiple different agencies in order to be effective. The current structure of providing each VDC with Rs. 4.6 million, depending on population and proposed project priority, of funding for prioritized projects achieves the decentralization goal and aids in bottom up approaches, but does not guarantee that funds will be utilized in a way that addresses larger climate related challenges. The proposed development of LAPAs to implement adaptation actions for communities in a number of districts of Mid and Far West Nepal will be a strategic learning opportunity, particularly with the national climate change policy stating ‘at least 80 percent of the total funds available for climate change activities flow to the grassroots level’. Both the fund flow mechanism and mechanics of local fund management will need to be examined carefully. Even when these issues are carefully resolved, the issue remains that small chunks of approximately \$3000 investments may not address larger

watershed or landscape level climate challenges like drought, floods or catastrophic hazards like glacial lake outbursts. At present there is no mechanism within the LAPA process for adjacent communities to work together and pool their adaptation funds to address a larger climate problem. In fact the current incentives encourage communities to act independently of one another, while climate change impact may demonstrate that communities are dependent upon each other such as in downstream communities depending on the predictable flow of water from upstream communities and water sources.

The experience of development finance flows suggest several different models to secure local level service delivery: one where funding passes through central ministries to Local Bodies; another where central funds pass directly to community groups, or models like emergency relief funding which flow through district authorities to vulnerable communities. Each approach has advantages and disadvantages, characterized by the difference between an emphasis on short-term, high impact as opposed to an approach that gives greater weight to long-term, institutional development. If carefully designed and transparently implemented, the LAPA experience may offer insights and help strengthen the function of local government bodies. Nepal does have some experience in creating effective decentralized funds management that passes through village development committees like the health facilitation management committee & the village forest coordination committee. This learning could be valuable as more climate change funds are disbursed through adaptation funds. These institutions are better suited to providing good governance & are more credible at the local level. As Bird states,

*"Such committees also have the capacity to manage financial resources, which includes the capacity to account for resources, ensure quick disbursement targeted at climate adaptation, and M&E. New guidelines, for instance, ensure that District Development Funds and Village Development Funds practice results based management/ disbursement of funds. Responding to climate change has been included as a result area" (Neil Bird, Climate Change Finance, 2012)*

##### **(5) INCORPORATION OF SCIENTIFIC DATA INTO THE LAPA DESIGN AND PROCESS**

The current LAPA design process is exceptionally strong in using participatory processes to assist vulnerable communities to identify perceived climate change threats and then prioritize community-based responses. One significant area of weakness is that there is no mechanism described that explicitly seeks out and incorporates available scientific knowledge into the planning and decision making process. While much of Nepal lacks quality scientific data, there is

no justification for not capturing the data that is available and incorporating it into the LAPA and the community priorities. This could considerably improve the technical quality and usefulness of LAPAs, moving them from simple statements of perceived climate risk to much more evidence based planning tools. Improved quality and more comprehensive LAPAs will enhance the competitiveness of proposals submitted for consideration under the Government of Nepal (GON) Adaptation Funds and would strengthen the competitiveness of any proposals that communities submit to other donors to seek funding from other agencies that address larger climate change issues and problems. This combination of a community based but science driven approach is a niche and gap that the High Mountain LAPA process is helping to fill. While the Khumbu area is exceptional in Nepal in that it has been studied more than most remote regions, one is consistently surprised how much data is available for many parts on Nepal when the search includes a thorough review of development reports and other “grey literature”.

#### **(6) CULTURAL DIMENSIONS OF CLIMATE CHANGE ADAPTATION**

As strong as the LAPA design is on collecting community inputs into climate change impacts, the process is surprising lean on collecting data on any cultural dimensions of climate change. Although it may appear counter intuitive, culture is thoroughly impacted by climate change, ranging from timing of holiday schedules such as timing of festivals, planting dates, and architectural styles (e.g., flat roofed architecture in arid zones that now leak during the unseasonally heavy rains events). Many local people also have strong cultural associations with the land and landscape features and collecting and understanding these perceptions adds value to climate change findings and helps local people as they prioritize climate adaptation actions. An example from the TMI experience in the Khumbu region is that a number of local people mentioned that they started to notice climate change impacts only after they ceased conducting local rituals acknowledging local natural deities, and focused more on making more money from tourism. While these are qualitative findings, understanding them can help climate professionals create increased climate change awareness and prioritize responses to climatic events. Developing a few new tools to incorporate this type of information will strengthen future LAPAs and make climate change concepts more accessible to local people.

As an example, interviews with Lama Tenge and other monks were conducted by HMGWP staff during a half day visit to the Thame monastery on 20 April, 2013. Changes that Lama Tenge has observed in recent times include the following:

1. Changing and irregular weather and precipitation patterns (e.g., previously, snow never fell in April whereas now it is abundant),
2. Wind storms, never recorded in Khumbu history, with velocities so powerful that roofs are blown off of houses and hundreds of trees were knocked down,
3. Hail storms during the monsoon that damage or destroy potato crops,
4. Decreased river levels, and
5. Lack of obtaining sufficient freshwater.

Lama Tenge also provided the following interpretation of why climate change is occurring:

*"Thirty years ago, people were poor but happy. They farmed, ate tsampa, used the forests, and respected nature. Every three months every household would request the services of a monk from the monastery to do a three day puja (worship) for the gods. Now, tourism has come, nobody helps their neighbors anymore, and all people think about is money. Many families no longer do the pujas, trash is everywhere, and instead of burning a bit of juniper each morning as a sign of respect for the gods they burn garbage. Sacred sites have become polluted, and more people are using tobacco. People now have no respect for nature, they're abusing nature, and the gods are angry and are changing the climate to show their displeasure."*

*(From: Byers, A.C. 2013. Trip Report: Community Consultations Phase II: Imja, Thame, and Gokyo Valleys, 15-30 April 2013. HMGWP.)*

The parallels between the east and west in “not respecting nature,” and the resultant consequences of climate change and a warming planet, are of note.

#### **(7) LAPA MONITORING AND EVALUATION:**

One challenge of any local planning tool like a LAPA lies around monitoring and evaluation. The initial LAPA pilot worked with 9 partner organizations to develop monitoring and evaluation guidance, piloting some of LAPA approaches and identifying a framework. Early lessons suggest that outcome-based monitoring is relevant for improving adaptive capacity and improving climate change governance. The pilots also suggested that cost benefit analysis can be a strong decision support tool for the identification and prioritization of climate adaptation measures and development plans, hence their inclusion as a tool in the priority setting step. This is also a way to draw-down resources to reach out to the most vulnerable communities or households.

Such a highly decentralized planning tool presents many monitoring and evaluation challenges. While the LAPA process is very thorough in its design and specifically mentions a number of tools to use at each step, the actual use of the tools varies considerably in each setting. This

makes comparability challenging and limits the ability of managers to compare one project's results to another. One reason for the high degree of variability is that different projects choose to invest different levels of resources in the LAPA process, ranging from simple PRA style community perception surveys to much more comprehensive multiple nested consultations with community members such as the TMI Khumbu consultations. A further trade-off is that in areas where limited projects funds are likely to be available to implement prioritized projects, investing large sums of money in data collection and community consultation can raise expectations without providing many opportunities for follow up projects. Another monitoring challenge is that two levels of monitoring are required, one to monitor the LAPA process and another to monitor the impacts of any prioritized climate change adaptation projects that are implemented. The wide range of impacts from climate change presents a wide array of potential solutions and action projects, which in turn requires a wide range of monitoring tools. Demonstrating clear cause and effect also is challenging, for example one cannot state without qualification that construction of a check dam has resulted in reducing impacts of flood or controlling soil erosion. Such uncertainty results in the use of more qualitative tools that remain unconvincing to some policy makers.

One example of a successful multi-activity monitoring framework is the Strategic Program for Climate Resilience in Nepal (SPCR). That project developed a results framework that can help guide future climate change actions, being the first such framework explicitly designed for a national climate programme. This is a large scale multi-national donor funded project in Nepal with 7 components and the strongest component from a monitoring perspective is the component that seeks to build climate resilient mountain watersheds. This component has the most similarity also to the High Mountain project and it seeks to improve participatory watershed management, taking into account impacts of climate change, enhanced efficiency of water use in farming systems, and improving access and reliability of water resources. The general indicators being used in that project include participatory plans developed and implemented, erosion control measure implemented and improved surface water storage capacities, community adaptation of water use plans and lessons learned being feed back into the national development practice. While imperfect, the indicators developed and used under this project have some value for measuring the effectiveness of the LAPA projects as well.

## **TMI PROGRESS TO DATE ON KHUMBU LAPA**

The focal work area of TMI in Nepal continues to be the Khumbu Valley. This work was comprised of two subtasks covering (i) designing, partnering, and initiating a Local Adaptation Plan for Action (LAPA) for the Khumbu Valley; and (ii) continued GLOF reconnaissance, risk modeling, and community-based risk mitigation in partnership with UNDP/Nepal. Task two will not be discussed in this report as it is covered elsewhere. During Year Two, the HMGWP expanded linkages with local communities and civil society organizations, as well as with local and national government agencies and entities (e.g., Department of National Park and Wildlife Conservation (DNPWC), Buffer Zone Management Committee, Sagarmatha Pollution Control Committee (SPCC), etc.) as a means of enabling, supporting, and facilitating the LAPA production for the Khumbu. Guidelines and a plan for execution of the LAPA were produced in early 2013, building on the information obtained during the September 2012 community consultations; follow on meetings with stakeholders in Kathmandu; and LAPA introductory and climate change impact assessments in communities in the Thame, Gokyo, and Imja valleys in April-May 2013. A Nepali, Ph.D.-level LAPA team leader was hired in April, 2013; two local, M.A.-level resource persons (one female, one male) were recruited from the Khumbu region; and the final community consultations, adaptation prioritization, funding source identification, and intervention mainstreaming workshops will be conducted in August-September 2013.

The facilitation of the LAPA production process has built on TMI's decades of work in the region, the 2012 community workshops, IRG/Engility's training of trainers' workshop in Kathmandu (which engaged local stakeholders in climate change adaptation and development activities and planning), plus various trainings of TMI staff in climate change principles and V&A methodologies. It has capitalized on progress made by the HMGWP in advancing plans for adaptation and disaster management in the Khumbu, and is attempting to leverage funding from the UNDP *Community-based Glacial Lake Outburst and Flood Risk Reduction in Nepal Project* which was approved in April 2013. The implementing agency for this project is the Nepal Department of Hydrology and Meteorology (DHM), which the HMGWP has consulted with regularly since September 2013. The UNDP has requested significant support from the HMGWP, in both the social as well as physical sciences, in undertaking a number of activities in consultation with local stakeholders, and the UNDP is anxious to incorporate the unparalleled community and technical expertise of the HMGWP and its international experts. Co-financing opportunities (e.g., bidding on selected project tasks, activity cost sharing) were discussed

beginning in May, 2013, and the HMGWP has been invited to participate in the forthcoming Inception Workshop (August or September, 2013).

### **LOCAL ADAPTATION PLAN FOR ACTION FOR THE KHUMBU VALLEY**

As a complement to its NAPA planning process (National Adaptation Programme of Action), under the UNFCCC, Nepal has developed a national framework for Local Adaptation Plans for Action (LAPA) to integrate climate change adaptation into local development planning and climate-smart development. The aim is to (i) enable communities to understand the consequences of climate change and partner with them in determining adaptation priorities, (ii) implement flexible climate-resilient adaptation (land and resource use) plans, and (iii) inform and catalyze integrated approaches (e.g., for climate-smart development) between sectors and stakeholders, reinforcing the sustainability of the project. Nepal expects that the LAPAs will provide a mechanism to mainstream adaptation in the development agenda of local government bodies. The Government of Nepal's (GON) guidelines state that these processes should address such elements as:

1. Promoting community-based adaptation through integrated management of agriculture, water, forests, and biodiversity.
2. Building and enhancing adaptive capacity of vulnerable communities through improved systems and access to services for agricultural development.
3. Community-based disaster management for facilitating climate adaptation.
4. GLOF monitoring and disaster risk reduction.
5. Forest and ecosystem management in supporting climate-led adaptation innovations.
6. Adapting to climate challenges in public health.
7. Ecosystem management for climate adaptation (e.g., Ecosystem based Adaptation).
8. Empowering vulnerable communities through sustainable management of water resource and clean energy supply.
9. Promoting climate-smart urban settlements.

Additionally, the HMGWP will integrate three components designed to enhance the utility and sustainability of the LAPA planning documents produced. They include (a) assisting stakeholders in the identification of prospective funding sources for each of the priority climate change adaptation interventions identified (e.g., Buffer Zone, VDC, GON, international donors), (b) purposely mainstreaming high priority climate change adaptation interventions with District- and local-level development priorities (e.g., adding water collection systems and climate smart designs to the construction of new community buildings), and (c) actively leveraging co-

financing for the implementation of priority climate change and risk reduction interventions (e.g., National Geographic Society alternative energy grants, UNDP/Nepal subcontracts).

As an overall conclusion, the TMI Nepal LAPA is progressing well and is on track for completion by the end of December 2013. Several areas for additional information and strengthening are nevertheless recommended. These are the need to: 1) increase gender inclusiveness in LAPA participants, 2) increase perspectives of the season migrant workers who populate the Khumbu and 3) broaden LAPA participation to include more inputs from the economically disadvantaged Khumbu residents, e.g. include more non-lodge owners. Representation from all three categories can be strengthened and enriched in future consultations. The other task that remains is to take the valuable lessons learned during the High Mountain project and seeks ways to mainstream these findings into future development efforts including into USAID Nepal's emerging 5 Year Country strategy.

#### **NEXT STEPS AND GENERAL OBSERVATIONS**

Based on meetings with USAID Nepal Mission staff, opportunities to mainstream and expand the High Mountain project were explored. USAID Nepal Mission priorities for the next five years are in West Nepal, and mainstreaming the High Mountain impacts will require consistency with their priority geographies, particularly West Nepal. These are areas harboring extreme levels of human impoverishment, and environmental degradation – made worse by growing climate change impacts and vulnerabilities. USAID Nepal clearly appreciates the innovations, impacts and accomplishments of the High Mountain project. One outcome from the HMGWP work is that the HMGWP work has contributed to the foundation for USAID Nepal to mainstream climate change into all other program sectors. More detailed discussions indicated that the 5 Year USAID Nepal Country Strategy will focus on integrating climate vulnerabilities and impacts into **natural resource management** with a focus on 4 elements **including biodiversity conservation, forests, soils and water** as topical headings. Opportunities to expand the High Mountain learning in multiple sectors abound, with particular overlap in the areas of water storage and water management activities as obvious starting points for integrating the Khumbu High Mountain lessons learned, but applied in the geographies of West Nepal.

Beyond USAID Nepal, discussions with UNDP/GEF were positive and UNDP's seems keen to integrate much of the High Mountain learning into their new GEF project designed to mitigate risks from growing natural hazards such as Glacial Lake Outburst Floods. The contracting mechanisms are being sorted out and it is important for High Mountain staff to be present at the

Planned Inception workshop in order to incorporate the High Mountain learning into their project implementation, especially in the areas of glacial lake monitoring, design of community based early warning systems and mitigation of GLOF risks through engineering work.

## **ACKNOWLEDGEMENTS**

Overall guidance for this report has been provided by USAID (Nepal and Washington DC), Engility and members of The Mountain Institute's High Mountain Glacial Watershed Team. Thanks are due to Dr. Alton Byers (TMI), Meghan Hartman (Engility Corporation), Jonathan Cook (USAID), Glen Anderson (Engility) and John Furlow (USAID), who provided support and guidance to the author. Particular thanks are due to the team of staff and consultants working on the TMI High Mountain project in Nepal, especially Mr. Ang Rita Sherpa, Mr. Shailendra Thakali, Mr. Dambur Thapa, Mr. Bheen Rai and Mr. Phurba Sherpa who shared their valuable insights and helped collect and assemble documents including providing on the spot translations of documents available only in Nepali language.

Many persons were interviewed and many documents were reviewed as part of this report. The author is grateful to all individuals for freely giving of their time and to many organizations for sharing their documents and experience describing their work.

Responsibility for the content of this paper rests solely with the author including any material errors, omissions, or errors of interpretation or fact. In particular, no responsibility for the opinions shared here should be attributed to The High Mountain Glacial Watershed Nepal Team, Engility Corporation, USAID Nepal, USAID Washington DC, the Government of Nepal or the people of Nepal, nor to any of the persons interviewed during the course of this study.

## REFERENCES

- Bird, Neil 2011. The Future for Climate Finance in Nepal. ODI – Capacity Development for Development Effectiveness Facility in Asia and the Pacific. Kathmandu: Unpublished report prepared for UNDP and Government of Nepal.
- Climate Adaption Design & Piloting – Nepal project team with inputs from CBVA and DCEP project teams, 18 August 2011. The LAPA Framework: Local Adaptation Plan of Action: Summary of Key Steps and Key Actions. Kathmandu: unpublished report.
- Government of Nepal, 2011. LAPA Manual, Local Adaptation Plan of Action (LAPA) Manual. Kathmandu: Ministry of Environment, Singh Durbar.
- Karki, G. and Regmi, B. 2012. Local Adaptation Plan of Action Discussion Paper. Kathmandu: unpublished report.
- LEAD Newsletter 297: 19-21<sup>st</sup> December 2012. Local Adaptation Plan of Action (LAPA) development and consultation workshop in Muzaffaghar, Punjab [www.lead.org.pk](http://www.lead.org.pk).
- Ministry of Environment 2010. Climate Change Vulnerability Mapping in Nepal. Kathmandu: Government of Nepal.
- Paudel, N.S. 2010; Responding to Climate Change in a Transitional Politics - Review of political context in relation to designing LAPA in Nepal. Report: prepared for CAPD- Nepal.
- CARE, WWF, and USAID 2011. Climate Vulnerability and Capacity Analysis and Community Based Plan of Action; April 2011; Dadheli Community Forest User Group, Kalikhola VDC Wards 1-4, Taplejung. Report. Kathmandu: CARE.
- CARE, WWF, and USAID 2010. Climate Vulnerability and Capacity Analysis and Community Based Plan of Action, Lelep Community Forest User Group, Lelep VDC Ward No. 3; Lelep Village, Taplejung. Report. Kathmandu: CARE.
- Tiempo Climate Portal, National Adaptation Plans of Action (various dates)(a Web based collection of articles on NAPAs globally, including Nepal).
- Upreti B.K and Bhattarai, T.N. 2011. Adaptation to Climate Change, NAPA to LAPA. Document produced by UK Department of International Development (DFID)- funded

Climate Change and Development Knowledge Network project. Kathmandu:  
Government of Nepal, Ministry of Environment.

Regmi, B. and Subedi, R. 2012. The LAPA Process. Tiempo Climate Cyberlibrary (on- line publication).

Rupantaran Nepal 2012. Consolidating Learning of Local and Community- based Adaptation Planning: Implications for Adaptation Policy and Practice. Kathmandu: Unpublished report prepared for Livelihoods and Forestry Project (LFP), Interim Forestry project (IFP) and Rupantaran Nepal.

(Note: 87 other climate change documents were also consulted but not referenced or quoted as they dealt with topics not specifically related to LAPAs or NAPAs in Nepal).

# ANNEX B: TRANSLATION OF DOCUMENTS FROM THE KHUMBU COMMUNITY CONSULTATIONS SEPTEMBER 2012

## **WORKSHOP #1: PHAKDING, SEPTEMBER 2012**

### **PARTICIPANT EXPECTATIONS FROM THE COMMUNITY CONSULTATION**

1. To discuss the negative impacts of climate change on the Khumbu and potential mitigation measures
2. To identify climate change impacts in the Khumbu region and adaptation measures
3. To better understand the idea of climate change mitigation
4. To know more about climate change and replicate the skills and knowledge gained from the workshop
5. To know the causes of climate change
6. To know the status of climate change impacts on the Khumbu region
7. To mitigate the impacts of climate change on human beings, agriculture, and livestock
8. To better understand the likelihood of an Imja lake outburst flood and what mitigation measures exist

## WHAT ARE THE COMMUNITY'S IMPORTANT ASSETS?

1. Forest
2. Wildlife
  - Medicinal and Aromatic Plants
3. Agriculture/Livestock: modern agriculture system
4. Health
5. Health center
6. Doctors
7. Education
8. Schools
9. Culture
10. Basic Infrastructure
11. Hotels/Lodges
12. Bridges
13. Schools
14. Electricity
15. Natural resources
16. Rivers
17. Streams
18. Mountains
19. Snowcapped mountains
20. Normal climatic conditions
21. Transportation
22. Air transport
23. Motor road
24. Communication
25. Tourism
26. Institutions
27. National Park
28. Buffer zone council
29. Buffer zone community forest
30. Awareness
31. Institutions
32. Religion
33. Agriculture development

## WHAT HAS CHANGED?

### *Positive changes:*

1. Forests, wildlife, medicinal and aromatic plants: Sagarmatha National Park and Buffer Zone Area (conservation through plantations), improvements in conservation
2. Agriculture: introduction of greenhouses and improvement in vegetable production
3. Education: schools established and teaching English
4. Health: hospitals and doctors providing health services to the people of the region
5. Basic infrastructure: bridges (metal bridges), micro-hydro and electricity
6. Transportation: Lukla airstrip and numbers of heli pads
7. Communication: Cell phone and internet service
8. Tourism business: increase in tourist numbers visiting Khumbu region, increase in numbers of hotels/lodges with good facilities
9. Agencies such as the Sagarmatha Pollution Control Committee (SPCC) working in pollution control and garbage management
10. Drinking water supply: piped water now available
11. Income: increased through tourism and improving economic status
12. Language: English language introduced and expanded
13. Employment: increase in opportunities

***Negative Changes:***

1. Climate: temperature increase
2. Air pollution: carbon emissions increased
3. Environment: landslides, deforestation, increase in garbage deposition including non-degradable plastics
4. Agriculture: less productivity, decrease in agro-farming and livestock rearing
5. Health and population: invasion of new diseases, increased population
6. Religious and cultural impacts: adoption of westernized fashions and the practice of this new way of life style is harming traditional culture
7. Price increases in daily use commodities
8. Increase in the rate of snow melting in comparison to previous times
9. Less availability of fuel wood and timber for daily use
10. Increase in catastrophic

### Which specific inputs do you require to sustain your livelihoods?

Required resource	Important inputs for meeting needs	Needs currently being met?
1. School (Higher/Secondary)	1. Improvement in educational system, qualified teachers, school buildings, library, financial resources	1. Not yet
2. Health	2. Human resources, hospitals, financial resources	2. Not yet
3. Electricity	3. Technology, financial resources	3. Yes
4. Agriculture and Agriculture Development Center	4. Seeds, seedlings, land, organic farming system	4. Not yet
5. Forest	5. Plantation, weeding operation, forest fire control	5. Very few
6. Transportation	6. Human resource mobilization, management of appropriate place	6. Not yet
7. Normal climatic condition	7. Plantations, human resources	7. Very few
8. Hotel business	8. Skilled manpower, quality service and facilities	8. Yes
9. Awareness generating program	9. Involvement in program	9. Little
10. Skilled development training	10. Participation in trainings	10. Not yet
11. Trails, bridges (infrastructure)	11. Land management	11. Yes

What would you like to achieve?	What is necessary to reach your goals?	What is preventing you from reaching those goals?
<ol style="list-style-type: none"> <li>1. High quality education</li> <li>2. Better health</li> <li>3. Modern agriculture</li> <li>4. Electricity</li> <li>5. Business and enterprises</li> <li>6. Promotion of tourism</li> <li>7. Conserved forest and wildlife</li> </ol>	<ol style="list-style-type: none"> <li>1. Qualified manpower, books and training, buildings</li> <li>2. Skilled manpower, training, awareness infrastructure, financial resource</li> <li>3. Improved seeds and seedlings, fertilizer, irrigation, training appropriate climate and productive land</li> <li>4. Financial resources</li> <li>5. Financial resources, transportation</li> <li>6. Quality service and facilities, resources, transportation</li> <li>7. Community participation, awareness, financial and technical support from NGOs and INGs</li> </ol>	<ol style="list-style-type: none"> <li>1. Lack of skilled manpower, financial resources</li> <li>2. Lack of resources (financial and human), lack of awareness</li> <li>3. Inadequate training for farmers, climate, lack of agriculture institution, technology</li> <li>4. Resources</li> <li>5. Lack of institution for paying tax, bad weather for import of commodities</li> <li>6. Financial resource, awareness, skill training, governmental carelessness</li> <li>7. Population pressure, financial constraints, poaching, forest fire, lack of training and awareness program</li> </ol>

### Check list from after the field visit:

#### *Assets in Phakding*

1. Crops
2. Bridges
3. Forest resources
4. Lodges
5. Yaks

#### *Other assets*

1. Horses
2. Gompa
3. Power house
4. Himalayan thar (wildlife)
5. Private houses

6. Public toilets
7. Trails
8. Drinking water
9. Water falls
10. Birds
11. Cattle
12. Musk deer
13. Religious sculptures
14. Schools
15. Human resources
16. Communications
17. Greenhouses
18. Agriculture land
19. Mountains
20. Stone (quarries)

#### *Issues and Problems*

1. Landslides: damaged trails, difficulties in transportation
2. River pollution: garbage disposal into rivers, drinking water problem
3. Solid waste: pollution

#### *List of Other Issues and Problems*

1. Deforestation
2. Degradation of natural resource
3. Damage to productive agriculture land
4. Population increase
5. Excess mule numbers and traffic jams
6. Fuel wood use for cooking and heating, deforestation
7. Narrow trails, difficult to walk
8. Excess of hotels and lodges with unhealthy competition

### Seasonal Calendar

Jan, Feb, Mar	April, May, Jun	July, Aug, Sep	Oct, Nov, Dec
Plant potatoes Pant vegetables Loshar Fire wood collection Winter vacation	Potato propagation Vegetable growth Dumji Budhhajaynti Fapar sowing New Year Trekking starts Sow maize	Potato digging Vegetable growth Animal shed Dashain/Tihar Trekking Season Tusa picking	Dashain /Tihar Compost preparation Snowing Marriage season Cold season Trekking Wheat sowing

### Adaptive Capacity

Vulnerability	Adaptive capacity
Flood Landslide Forest fire Drought Deforestation Temperature increase	Human resource, institutions Institutions (National Park and Buffer Zone), technology Communication, institutions (community mobilization) Financial resource Institutions Institutions

### Adaptation Actions

Vulnerability	Available adaptation action	Not available but important actions
Landslide	Plantation	Insurance, land slide control measure
Drought	Pipe irrigation, greenhouse	Alternative irrigation (i.e. drip irrigation, irrigation canals, insurance, pipe, sprinklers)
Forest Fire	Community mobilization for fire extinguishing	Modern fire control techniques/skilled manpower
Floods	Community mobilization, bridge construction	Gabion wall, insurance
Temperature increase	Mobilization of different organization	Reduce carbon generating activities

### Adaptation Planning

Climate Vulnerability	Assets Affected by Vulnerability	Available Adaptation Capacity	Adaptation Actions
Landslides	Bridges, houses, lodges, schools, power house, trails	Resources, institutions, National Park (nurseries)	Plantation, conservation of forest, increase awareness
Drought	Crops, water resources, and other natural resources	Resources, technology	Alternative cropping, develop irrigation canal, change in government policy, drip irrigation
Forest Fire	Forests, biodiversity, landscape, water sources	Human resources, communication	Fire extinguishing equipment, skill development of community, awareness

## **WORKSHOP #2: NAMCHE BAZAR 14-15 SEPTEMBER 2012**

### **PARTICIPANT EXPECTATIONS FROM THE COMMUNITY CONSULTATION**

- To discuss the impact of climate change
- To minimize climate change impacts in the Khumbu region
- To better understand climate change and its process
- To learn about climate change and its impacts
- To know about global warming
- To discuss ideas to cope with climate change at the local level
- To identify climate change adaptation strategies
- To know about the potential threats of Imja Lake
- To know about climate change research and studies of the Khumbu region

## WHAT ARE THE IMPORTANT ASSETS?

- Roads/trails
- Drinking water
- Electricity
- Tourists
- Hotels/lodges
- Agriculture/local products
- Forests
- Pollution control
- Toilets
- Airplane services
- Himalayan mountains
- Rivers
- Water falls
- Airports
- Bridges
- Employment
- Natural resources
- Landscapes
- Wildlife
- Normal climatic condition
- Communications
- Basic infrastructure and facilities
- Health centers
- Education
- Transportation
- Businesses

## WHAT ARE THE COMMUNITY'S NEEDS?

- Motor roads
- Quality education
- Social solidarity
- Cultural and religious harmony and cultural promotion
- Health centers
- Awareness programs on pollution and pollution control
- Good behavior with guests
- Effort on pollution control, like setting up trash bins
- Community involvement in conservation of forest and wildlife and increase in plantation activities
- Promotion of domestic tourism as well as international tourism
- Hospitals
- Vocational training, skill development training
- Conservation of cultural and natural assets
- More study and research on climate change
- Use of modern technology in agriculture
- Increase in security
- Drinking water
- Alternative energy

## WHAT HAS CHANGED?

### *Positive Changes*

- Development activities
- Increase in tourism
- Expanded market
- Improved ways of living
- Improved livelihoods
- Improvement in communications
- Trail and bridge improvement as well as facilities for sewage systems
- Plantations
- Formation of various organizations like SPCC, women groups, youth groups
- Lama school, library
- Employment opportunity
- Health, education, electricity, drinking water
- Increase in research and study activities

### *Negative Changes*

1. Climate change and its impacts
2. Solid waste
3. Change in culture
4. Increased feeling of individualism
5. Increased cost of living
6. Deforestation
7. Illegal poaching
8. Political instability
9. Unhealthy competition in enterprises
10. Cultural degradation
11. Increase in dependency on the outside world
12. Lack of social unity

### **WHAT ARE THE COMMUNITY'S GOALS?**

- Expand road facilities
- Provide quality service to tourists
- To be excellent guides
- To be good administrators
- Develop a sense of rule of law
- Manage local teachers in schools and provide quality education as well as increase the number of schools
- Increase the number of international and domestic tourists
- Conservation of forest and wildlife
- Improve education standard
- Make the region a pollution free area
- Develop healthy tourism enterprises
- Develop the area as one of the most attractive tourist destinations
- Develop modern facilities in the area
- Conserve local and traditional culture
- To be self reliant in the production sector

### What specific inputs do you require to sustain your livelihoods?

What are your needs?	What is preventing you from reaching those goals?
<ol style="list-style-type: none"> <li>1. Government policies and commitment</li> <li>2. Training on knowledge and skill development</li> <li>3. Honesty, loyalty and commitment</li> <li>4. Physical resources</li> <li>5. Financial resources</li> <li>6. Marketing</li> <li>7. Educational institutions, technical teachers</li> <li>8. Formation of different institutions</li> <li>9. Training and awareness on tourism enterprises</li> <li>10. Skilled teachers and technology development</li> <li>11. Workshops and meetings</li> <li>12. Transportation</li> <li>13. Hotel, lodge</li> </ol>	<ol style="list-style-type: none"> <li>1. Instability of government</li> <li>2. Lack of financial resources</li> <li>3. Lack of human resources</li> <li>4. Lack of positive attitude</li> <li>5. Geographically remote area</li> <li>6. Lack of unity among entrepreneurs</li> <li>7. Financial resources</li> <li>8. Lack of awareness and trainings</li> <li>9. Geographic remoteness and skilled human resources</li> <li>10. Lack of knowledge and unity among local people</li> <li>11. Financial and other resources</li> <li>12. Lukla weather</li> <li>13. Financial resources</li> </ol>

#### DISCUSSION ON CLIMATE CHANGE (QUESTIONS AND COMMENTS)

1. What has been said about the risk of Imja Lake? How does climate change impact agriculture? Is temperature really increasing?
2. Why was there less snow last year than this year? Are there climate change impacts on wildlife?
3. What are developed countries doing to control climate change? Now, mosquitoes are common in Namche.
4. Flies are being seen at the Everest Base Camp. Ice is melting and cracks are increasing.
5. Last year, the weather was very bad in the peak tourist season. Namche Bazar is warmer than 10 years earlier.
6. If we plant trees...then when there is heavy rain, heavy rain is linked with landslides, am I right?
7. Nowadays, climate change is becoming common in Nepal, this is a global issue, why are we worried about this?
8. What actions have developed countries done to reduce the increased temperature caused by global warming?
9. What is global warming and Imja Lake outburst? We are always in fear of an Imja burst. Why are temperatures varied by year to year?

### Seasonal Calendar

Jan, Feb, Mar	April, May, Jun	Sep, July, Aug	Oct, Nov, Dec
<ul style="list-style-type: none"> <li>Annual exams and School vacation</li> <li>Hotel lodge cleaning</li> <li>Visit Kathmandu</li> <li>Buy food stuffs</li> </ul>	<ul style="list-style-type: none"> <li>Season of potato and vegetables</li> <li>Dumji Budhhajaynti New Year</li> <li>Trekking start</li> </ul>	<ul style="list-style-type: none"> <li>Fire wood and fodder collection</li> <li>Animals in shed Dashain/Tihar</li> <li>Trekking Season</li> <li>Potato collection</li> </ul>	<ul style="list-style-type: none"> <li>Tourist peak season Snowing</li> <li>Marriage season Trekking</li> <li>Wheat sow</li> </ul>

### Adaptive Capacity

Vulnerability	Adaptive capacity
<ol style="list-style-type: none"> <li>1. Forest fire</li> <li>2. Soil erosion</li> <li>3. Deforestation</li> <li>4. Increased temperature</li> <li>5. GLOF</li> <li>6. Flood</li> <li>7. Land slide</li> <li>8. Drought</li> <li>9. Strong wind</li> </ol>	<ol style="list-style-type: none"> <li>1. Communication, human resources, social institution</li> <li>2. Gabion wall, institutions</li> <li>3. Social institutions</li> <li>4. Technology (greenhouses for agriculture)</li> <li>5. Human resources, technology, financial resources</li> <li>6. Human resource rescue equipment, technology (gabion wall)</li> <li>7. Gabion wall, human resources rescue equipment, information</li> <li>8. Financial resources, institution, tools, water pipe, information</li> <li>9. Technology, shelter</li> </ol>

### Adaptation Actions

Vulnerability	Adaptation Actions
<ol style="list-style-type: none"> <li>1. Landslide and flood</li> <li>2. Soil erosion</li> <li>3. Forest fire</li> <li>4. Habitat degradation</li> <li>5. Glacial melting</li> <li>6. Danger to Glacial Lake Outburst Flood</li> <li>7. Avalanche</li> <li>8. Drought</li> </ol>	<ol style="list-style-type: none"> <li>1. Plantation and gabion wall construction, capacity building of locals</li> <li>2. Plantations</li> <li>3. Communication, community mobilization</li> <li>4. Plantations, grazing land management</li> <li>5. Get involved with awareness activities by governmental or non-governmental sectors</li> <li>6. Reduce water level by constructing drainage</li> <li>7. Early warning system</li> <li>8. Alternative irrigation and greenhouses</li> </ol>

### Adaptation Planning

Climate Vulnerability	Assets Affected by Vulnerability	Available Adaptation capacity	Adaptation actions
Floods	Village, bridge, trail	Financial resources, technology, communication m	Wall, check dam construction
Landslide	Forest, agriculture land, hotel, house	Resources, technology, communication	Plantation
Forest Fire	Forests, wildlife	Human resources, institutions, communication	Awareness, fire extinguished by mobilization of community people and army police
Environment pollution	Human health	SPCC	Garbage management
Temperature increase	Himalayas, crops	Social network	Awareness
Glacial lake outburst flood	Private and public property, forest, bridge, infrastructure	Social network	Early warning system
Wind storm	Forest, wildlife	Communication	Strong structure, increase awareness, social mobilization, resource allocation
Soil erosion	Productivity of land	Nursery bio-engineering	Plantation

### Assets and Vulnerability

Assets	Vulnerability
<ol style="list-style-type: none"> <li>1. Himal</li> <li>2. Trail</li> <li>3. Wildlife</li> <li>4. River/stream</li> <li>5. Bridge</li> <li>6. Forest</li> <li>7. Glacial Lake</li> <li>8. Crop</li> <li>9. Settlement</li> <li>10. Hydropower</li> <li>11. Other infrastructure</li> </ol>	<ol style="list-style-type: none"> <li>1. Temperature</li> <li>2. Landslide</li> <li>3. Deforestation</li> <li>4. Flood /landslide</li> <li>5. Flood</li> <li>6. Forest fire/storm</li> <li>7. Avalanche/outburst</li> <li>8. Drought /adverse climate</li> <li>9. Landslide/flood</li> </ol>

## WORKSHOP #3: DINGBOCHE 18-19 SEPTEMBER 2012

### WHAT ARE THE COMMUNITY'S IMPORTANT ASSETS?

1. Forests: herbs, wildlife
2. Natural resources: rivers/streams, mountains
3. Infrastructure: hotels/lodges, bridges, electricity
4. Agriculture
5. Health

6. Culture
7. Transportation
8. Communications
9. Schools
10. Tourism
11. Economy based agricultural system

#### **WHAT HAS CHANGED?**

##### ***Positive changes***

- Khumbu Alpine Conservation Council has been working for a better environment
- Hotel, trails and trekking routes are improved
- Lodges have more facilities
- Environmental conservation awareness is increasing
- Local institutions and clubs have been established
- Community participation in social activities has increased
- Alternative energy users are increasing
- People are health conscious

##### ***Negative changes***

- Melting of glaciers due to the climate change or other causes
- Animal herding and agricultural culture is disappearing and agricultural patterns are changing
- Fashion and traditional culture is becoming more Westernized
- Hotels and lodges are increasing haphazardly
- Population growth

## What would you like to achieve? What are your goals?

What is your goal?	What is necessary to reach your goal?	What is preventing you from reaching this goal?
<ol style="list-style-type: none"> <li>1. Better education</li> <li>2. Sound environment</li> <li>3. Modern agriculture</li> <li>4. Healthy life</li> <li>5. Tourism</li> <li>6. Electricity</li> <li>7. Safe drinking water</li> <li>8. Improved trails</li> </ol>	<ol style="list-style-type: none"> <li>1. Educational policy</li> <li>2. Plantations/conservation</li> <li>3. Skilled manpower</li> <li>4. Hospitals</li> <li>5. Good infrastructure</li> <li>6. Governmental support</li> <li>7. Community mobilization</li> <li>8. Community participation</li> </ol>	<ol style="list-style-type: none"> <li>1. Economy</li> <li>2. Population growth</li> <li>3. Lack of skilled manpower</li> <li>4. Scarcity of doctors</li> <li>5. Poor economy</li> <li>6. Lack of financial resources</li> <li>7. Lack of awareness</li> <li>8. Community unity and financial resource</li> </ol>

### CHECK-LIST OF ASSETS:

#### *Assets*

- Crops
- Bridges
- Forest resources
- Lodges
- Yaks

#### *Other assets*

1. Himal/mountains/glaciers
2. Rivers
3. Religious/cultural traditions
4. Education
5. Medicinal and aromatic plants
6. Forests
7. Lakes
8. Environment
9. Wildlife
10. Houses
11. Land
12. Monasteries
13. Water
14. Ponds

### ***Issues and Problems***

1. Landslides
2. Over grazing
3. River pollution
4. Population growth
5. Solid waste pollution because of increased tourism

### ***Other Issues & Problems***

- |                                   |  |
|-----------------------------------|--|
| 1. Climate change                 | 7. Deforestation                                 |
| 2. Unsystematic grazing           | 8. Poaching                                      |
| 3. Narrow trails                  | 9. Overgrazing                                   |
| 4. Forest fires                   | 10. Increasing temperature                       |
| 5. Glacial melting                | 11. GLOFs  |
| 6. Insufficient forage for cattle | 12. Glacial melting and water shortage in future |

### **Seasonal Calendar**

<b>Jan, Feb, Mar</b>	<b>April, May, Jun</b>	<b>July, Aug, Sep</b>	<b>Oct, Nov, Dec</b>
<ul style="list-style-type: none"> <li>• School vacation</li> <li>• Hotel/lodge cleaning</li> <li>• Visit Kathmandu</li> <li>• Buy food stuffs</li> <li>• Firewood permit</li> </ul>	<ul style="list-style-type: none"> <li>• Season for potato and vegetable planting</li> <li>• Dumji Budhhajaynti New Year</li> <li>• Trekking start</li> </ul>	<ul style="list-style-type: none"> <li>• Firewood and fodder collection</li> <li>• Dumji, Pangi</li> <li>• Animals to sheds</li> <li>• Dashain/Tihar</li> <li>• Dingboche closed</li> </ul>	<ul style="list-style-type: none"> <li>• Tourist peak season</li> <li>• Potato harvest</li> <li>• Marriage season</li> <li>• Wheat sow</li> <li>• Losar</li> </ul>

### **Adaptive Capacity**

<b>Vulnerability</b>	<b>Adaptive capacity</b>
Landslides	Social institutions
Droughts	Communication and financial resource
Forest fires	Social institutions
Floods	Social institutions
Crops	Financial resources
Health	Human resources
Deforestation	Social institutions
Trails/roads	Human resources/financial resources
Himalayas	Social institutions

## Adaptation Actions

Vulnerability	Adaptation Actions
<ul style="list-style-type: none"> <li>• Danger of a Glacial Lake Outburst Flood</li> <li>• Forest fire</li> <li>• Landslide and flood</li> <li>• Avalanche</li> <li>• Drought</li> </ul>	<ul style="list-style-type: none"> <li>• Involve awareness activities by governmental or non-governmental sectors</li> <li>• Manage water resources and implement fire control training and community mobilization activities</li> <li>• Plantation and gabion wall construction</li> <li>• Early warning system</li> <li>• Alternative irrigation systems and greenhouses</li> </ul>

## Assets, Vulnerability, and Adaptation Capacity

Assets	Climate Vulnerability	Available Adaptation Actions	Adaptation Actions
Trails/roads	Landslide, floods	Gabion wall and construction	Gabion wall and drainage construction
Agriculture/crops	Climate change/ weather	Irrigation	Seasonal cropping system
Forests/wildlife	Fire, deforestation	Increase awareness of people about the possibility of forest fires from throwing cigarettes, establish local institutions like KACC	Fire extinguishing equipment, awareness
Bridges	Floods/landslide	Proper site selection for bridge	Gabion wall, metal bridge
Himalaya	Climate change/increased temperature	Conservation of forests	Plantation, reduce emissions of carbon dioxide
Tourism	Temperature increase	Social institutions	Awareness
Wildlife	Deforestation/forest fire	Plantation, use of alternative energy like kerosene and gas	Plantation, construct hydropower
Hotel/lodge	Flood, landslide	Build better hotels	Insurance

## Adaptation Planning

Task for Adaptation	Your Contribution	External Support
Gabion wall, drainage and black topped road	Labor contribution	Financial and technical
Metal bridge	25% labor contribution	Financial and technical
Tree plantation	Community participation	Nursery establishment and financial
Worldwide awareness program of climate change	Local level awareness	Request to support different NGOs
Increase in the number of wildlife	Coordinate with park in conservation	Technical support
Micro-hydro	Labor and financial support	Financial and technical
Maintenance of trails roads	Labor contribution	Financial
Awareness for culture conservation	Community mobilization	Publicity
Information center established for tourists	Provide local physical facilities (i.e. office) and provide information to tourists	Financial support from related organizations, like the Tourism Board

Introduce alternative crops	Green house establishment	Support of agriculture department for technology and financial support
Establish micro-hydro	Labor contribution	Financial and technical support
Pollution control	Stop use of plastics	Awareness program
Promote yak husbandry	Request to community	Governmental support
Promotion of KACC	Community mobilization	Financial and technical inputs

### QUESTIONS POSED AFTER HIMAP PRESENTATIONS

The following discussion questions regarding climate change arose after Dr. Deane McKinney and Dr. Alton Byers made their presentations:

- What is the Imja rumor, is it going to outburst?
- What is the reason of snowfall in the mountain?
- I never heard about climate change but I have seen changes in the Khumbu region.
- What could be the actions to fight against climate change?
- Why are climate change impacts a source of tension for some NGOs who are working in the mountains, like TMI, or mountain people, like Sherpas ?
- Before people have no Jasta Roof, now all of have Jasta roofs and burn heating stoves, it may be the cause of climate change. We need a climate change awareness program.
- Why are governmental and non-governmental institutions not serious about climate change awareness activities?
- I do not believe that landslides are caused by climate change.
- When will you complete the study of Imja lake?
- There are so many scientists and students that have been studying Imja lake, but no one has done any action. We need action as soon as possible to save Imja lake if it is going to outburst. Otherwise, don't say Imja is a danger.
- We believe in Buddhism and strongly suggest that you do a Buddhist Karma Puja before doing any actions in the Imja Lake.
- The National Park people should be involved in the Imja research.
- Last year we left the village due to the Imja burst scandal. Now all of the Khumbu dwellers are worried about the Imja vulnerability.
- We suggest to you people to make small hydro from Imja lake. Is it possible or not?
- Electricity is the best option to save the Imja.

### **WORKSHOP FEEDBACK FROM PARTICIPANTS**

1. Wonderful workshops, had never participated in a course like this before
2. Pleased to know the impact of climate change
3. Such types of awareness oriented workshops should be focused on the community
4. No more research should be done, go to action
5. More workshops should be continued in this region.
6. Educational level of participants should be separated
7. Methods using posters and cards are easier to understand
8. We believe TMI and Alton Byers
9. KACC is doing the best work on climate change and community issues in this region
10. Electricity from Imja is most important
11. Hopeful that there will be action in Imja in 2013

### **COMMUNITY ISSUES**

- In what ways is the climate changing?
- What is climate change doing to our natural environment?
- How fast is climate change happening?
- Are the impacts of climate change positive or negative?
- What economic opportunities will arise from climate change?
- How do we protect our community from environmental change?
- What is the Imja lake burst scandal?



**U.S. Agency for International Development**

1300 Pennsylvania Avenue, NW

Washington, DC 20523

Tel: (202) 712-0000

Fax: (202) 216-3524