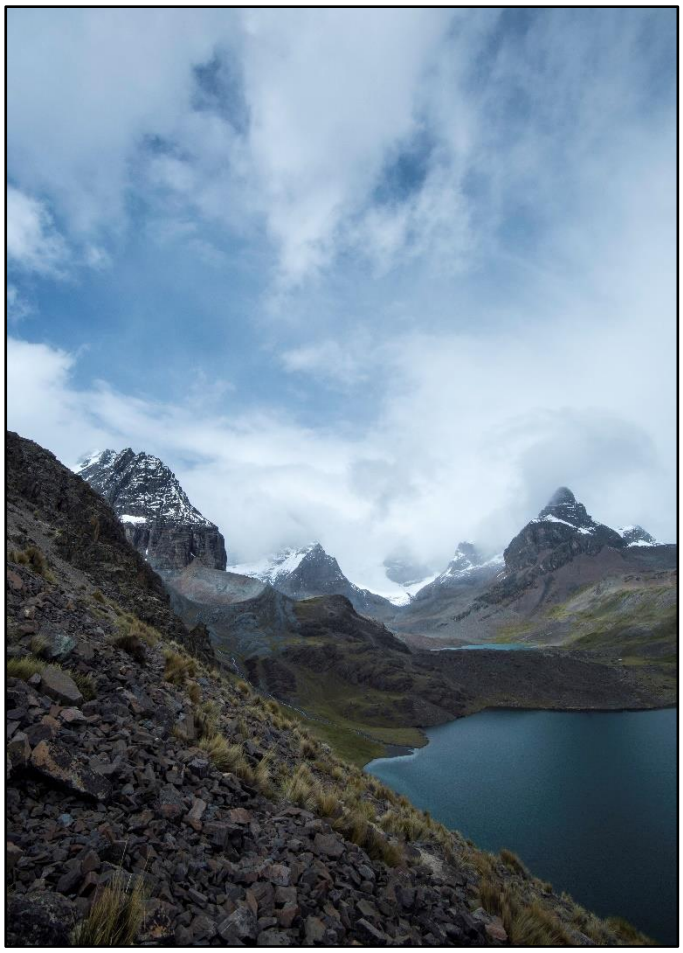
ECOSYSTEM-BASED ADAPTATION AND WATER RESOURCES IN NEPAL AND PERÚ

Tiffany Mayville, Claudia Sanchez de Lozada, Krista Shennum[1]

May 2021

[1] Yale School of the Environment
Email addresses: tiffany.mayville@yale.edu, claudia.sanchezdelozada@yale.edu, krista.shennum@yale.edu

SUMMARY



This report aims to advance knowledge on traditional water resource management and climate change adaptation planning. Interviews with policymakers and government representatives, civil society representatives, and local community members in Nepal and Perú were conducted to understand the knowledge exchange around water adaptation practices and technologies between local communities and state and national actors through the lens of ecosystem-based adaptation. The report assesses the prioritization of ecosystem-based adaptation in the Andean and Hindu Kush Himalayan Regions and the role of sustainable economic development. This analysis also highlights differences between adaptation planning implementation in practice and high-level policies on climate change adaptation, including National Adaptation Plans (NAPs).

Common challenges and good practices are identified through a comparative analysis between Nepal and Peru. Across the two countries, 1) political processes, 2) finance, 3) sector siloing, 4) top-down implementation, and 5) one-size-fits-all approaches strained efforts to implement ecosystem-based adaptation projects and promote effective water management practices.

Good practices in both countries included: 1) community involvement in water resource management, 2) prioritizing holistic approaches in adaptation projects, and 3) institutionalizing financial mechanisms for ecosystem-based adaptation.

TABLE OF CONTENTS

1. KEY TERMS

Adaptation
Ancestral Technologies
Community Adaptation Plan of Action (CAPA)
Civil Society Organization (CSO)
Ecosystem-based Adaptation (EbA)
Green Climate Fund (GCF)
Green Infrastructure
Greenhouse Gas (GHG)
Grey Infrastructure
Gross Domestic Product (GDP)
Instituto de Montaña
Intergovernmental Panel on Climate Change (IPCC)
International Union for the Conservation of Nature (IUCN)
Least Developed Country (LDC)
Lima Adaptation Knowledge Initiative (LAKI)
Local Adaptation Plans for Action (LAPA)
Mitigation
Ministry of Agrarian Development and Irrigation (Ministerio de Desarrollo Agrario y Riego, MIDAGRI)
Ministry of Agriculture and Irrigation (Ministerio de Agricultura y Riego, MINAGRI)
Ministry of the Environment (Ministerio de Ambiente, MINAM)
Ministry of Forests and Environment (MoFE)
Nairobi Work Programme (NWP)
National Adaptation Plan (NAP)
National Adaptation Programme of Action (NAPA)
Nationally Determined Contribution (NDC)
Nature-based Solutions (NBS)
Non-governmental Organization (NGO)
Peruvian Protected Areas Service (*Servicio Nacional de Áreas Naturales Protegidas por el Estado*, SERNANP)
Servico de Agua Potable y Alcantarillado de Lima (SEDAPAL)
United Nations Economic Commission for Latin America and the Caribbean (ECLAC)
United Nations Environment Programme (UNEP)
United Nations Framework Convention on Climate Change (UNFCCC)

2. INTRODUCTION

2.1 CLIMATE CHANGE IMPACTS TO MOUNTAIN REGIONS

Climate change poses unique threats to mountain communities and ecosystems around the world. According to the Intergovernmental Panel on Climate Change (IPCC), high latitude and mountain regions are projected to experience increases in heavy precipitation, glacier and snow melt, periods of drought, and changes to river flow.[i] Globally, increased air surface temperatures are causing glaciers and snowpack to melt, which is leading to increased spring freshwater runoff and decreased summer freshwater runoff. Changes and increased variability in freshwater runoff from high mountain regions may pose difficulties for downstream communities that are dependent on the water resources from mountain regions.[ii] In addition, melting glaciers may deposit sediments into downstream water sources, which can negatively impact drinking water quality.

The Hindu Kush Himalaya and Andes Mountain regions are critical sources of freshwater resources. The Hindu Kush Himalayas provide freshwater resources to roughly 2 billion people on the Asian continent,[iii] while the Andes provide water for more than 100 million people in South America.[iv] These two mountain regions are facing similar problems with water shortages due to rapidly melting glaciers, which will have immense impacts on communities dependent on mountain water resources. While billions of people in downstream watersheds are dependent on the water resources from these two mountain regions, rural, mountain-based communities are uniquely vulnerable to climate-induced changes in the water cycle.

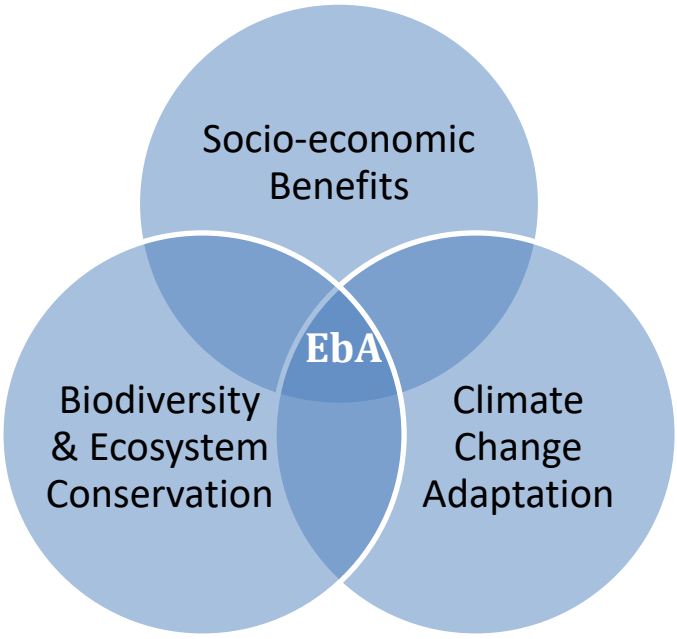
In high mountain regions, including the Andes and Hindu Kush Himalayas, global climate change is posing localized impacts to natural and human water systems. Increases in precipitation events and snow melt contribute to flooding events, which in turn are leading to erosion. This is particularly problematic when flooding events wash away roads, buildings, and other infrastructure in mountainous regions. Without effective water storage, periods of intense drought can prove to be deadly to communities. Agricultural systems dependent on rainfall may also be threatened by climate change's impacts on precipitation. Overall, combined periods of intermittent flooding and drought make it difficult for traditional water management practices to effectively manage freshwater resources.

2.2 ECOSYSTEM-BASED ADAPTATION

Solutions to the climate crisis that center on natural ecosystems are growing around the world. For decades, nature-based solutions have been pursued to mitigate climate change and adapt to climate change impacts. According to the International Union for the Conservation of Nature (IUCN), nature-based solutions (NbS) are "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits."[v] Ecosystem-based Adaptation (EbA) is a sub-set of NbS, which address climate change adaptation. As a subset of the broader field of nature-

based solutions, EbA helps people adapt to the impacts of climate change through conservation, sustainable management, and ecosystem restoration. EbA approaches may include efforts to revegetate a steep mountain slope to prevent erosion, restoring mangroves to protect coastal areas from storm surges, or installing green roofs in urban areas to reduce storm flows to water drainage systems. More recently, governments and climate advocates have turned to the growing field of EbA as a strategy to combat the negative impacts of climate change. These solutions highlight the importance of ecosystem services and biodiversity in reducing the vulnerability of communities to the climate crisis.[vi] Not only do EbA solutions improve natural ecosystems, but they are also more sustainable over the long-term and often-times more cost-effective than grey infrastructure solutions, which utilize human-made materials like cement to adapt to climate impacts. By focusing on the restoration of natural ecosystems, EbA practices can provide social, economic, climatic, and environmental benefits to local communities.

Figure 1: Ecosystem-based adaptation lies at the intersection of socio-economic benefits, climate change adaptation, and biodiversity and ecosystem conservation. *Adapted from Midgley et al*.[vii]



EbA and other NbS are important to ensure that capacity for adaptation measures and centers using nature as an intervention and a means to protect and sustain livelihoods. Implementing EbA solutions in mountain regions is important because of the unique climate risk these area face. Both the Hindu Kush and Andean regions are home to flat plains, mountains, and various ecosystems. Putting nature and people at the center of solutions and figuring out how to develop adaptation solutions addresses the commonality of these issues while focusing on preservation.

2.3 PRIORITY KNOWLEDGE GAPS IN THE CONTEXT OF THE LIMA ADAPTATION KNOWLEDGE INITIATIVE

Efforts to adapt to the impacts of climate change can be ameliorated with international collaboration, coordination, and information exchange. The Lima Adaptation Knowledge Initiative[2] (LAKI) is a joint action pledge under the Nairobi Work Programme (NWP) between the UNFCCC Secretariat and United Nations Environment Programme to prioritize and close key climate change adaptation knowledge gaps in subregions. By advancing knowledge of the adaptation knowledge gaps that government policymakers, civil society practitioners, and local actors face, the LAKI aims to bridge knowledge gaps with existing data and facilitate the exchange of information between relevant stakeholders and institutions Priority knowledge gaps have been identified for the following seven subregions in the context of the LAKI; West Asia Subregion; Southern Africa Subregion; Hindu Kush Himalayan Subregion; Indian Ocean Islands Subregion; Northern Africa Subregion, Andean subregion and Pacific Small Island Developing States subregion. Within each subregion, a multi-stakeholder group of experts worked together to identify, categorize, and prioritize regional climate adaptation knowledge gaps and potential response actions and partners.

This research aims to address some of the priority knowledge gaps in Andean and Hindu Kush Himalayas subregions (priority knowledge gap #2 and #11) (see table 1). This research was conducted in collaboration with the UNFCCC Secretariat, Instituto de Montaña, and the International Union for the Conservation of Nature (IUCN), an NWP partner organization. Through the following Perú and Nepal case studies, this report aims to fill a LAKI priority knowledge gap in the Hindu Kush Himalayan Subregion and a priority knowledge gap in the Andean Subregion, as shown in Table 1.

[2] For more information, see: Lima Adaptation Knowledge Initiative (unfccc.int).

Table 1: Lima Adaptation Knowledge Initiative knowledge gaps.[viii]

Subregion	Thematic Area	Priority knowledge Gap Description	Cluster	Knowledge User
Hindu Kush Himalayas	Water	Weak dissemination of evidence and successful water management practices, adaptation technologies, and water allocation and management during periods of scarcity and abundance (Priority gap #2)	Lack of actionable knowledge (e.g., in need of repackaging existing knowledge)	Water resource planners, policymakers, communities project managers
Andes	Scientific research and climate observation	Gaps in research and the exchange of knowledge on techniques, and in the optimization of technologies for managing hydric resources and adapting to the effects of climate change (Priority gap # 11)	Lack of data	Authorities and ministries for water and irrigation, human consumption, enterprises for drinking water and hydro-energy, ministries and agencies for planning, authorities for the environment, carbon markets, authorities for the environment, plant breeders

Our team addressed these key knowledge gaps and evaluated the institutional and procedural challenges to advancing adaptation plans. Through in-depth research and analysis, this report identifies priorities for policymakers and government officials to integrate into national adaptation planning processes. These priorities are detailed in the *Good Practices* section below.

3. METHODOLOGY

This research aims to advance knowledge about EbA, water resource management, and adaptation planning in mountain communities in Nepal and Perú. In order to understand the exchange of climate change adaptation information and knowledge and current EbA strategies, we coupled desk research on EbA projects, climate adaptation planning, and climate impacts with virtual interviews with key government, civil society organizations (CSOs), and community actors.

This research addressed the LAKI knowledge gaps identified above to advance knowledge on EbA and water resource management. To address priority gap #2 for water in the Hindu Kush Himalayas region, the research explored historical and ancestral practices for water management in Nepal. The objective was to understand what practices exist, how they differ with seasonal dry and wet climate patterns, and how that knowledge is or can be utilized for adaptation planning. Similarly, ancestral practices for water management were also examined in Perú, as well as their use in climate change adaptation planning. We used our findings for both countries to compare their knowledge dissemination practices. Through exploring these practices, this research aims to identify what these practices are and who holds the knowledge to make progress in closing this gap.

Additionally, for priority gap #11 for scientific research and climate observation in the Andean region the focus was in Perú. This research evaluated the exchange of knowledge for water management practices and techniques, including indigenous and ancestral practices, from rural mountain communities to the national government. This analysis was similarly carried over to Nepal to serve as a comparison for differing processes in the exchange of technology knowledge. Through exploring the existing knowledge exchange, this research aims to increase access to data to advance knowledge for this gap.

From November 2020 to March 2021, we interviewed policymakers and government actors, representatives from civil society organizations, and community members in mountainous regions in Nepal and Perú over Zoom, Skype, and phone. These interviews aimed to build understanding regarding the exchange of climate change adaption information and knowledge, both from top-down (national government to local communities) and bottom-up actions (local communities to national government) for both countries. Key interview questions included: 1) how do national environmental policy and decision-making incorporate feedback and inputs from civil society and communities; 2) do local stakeholders feel that they are included in planning and policy-making processes; and 3) what mechanisms exist for policymakers to engage stakeholders inclusively? Table 2 lists the primary interview goals for each stakeholder level.

Table 2: Interview goals for policymakers and government representatives, civil society representatives, and local community members.

Stakeholders	Interview Goals
Policymakers and Government Representatives	• Understand how national policymakers develop and enact National Adaptation Plans (NAPs) • Identify if and how policymakers include and/or prioritize local and traditional water management practices
Civil Society Representatives	• Understand how CSOs bridge gaps between policymakers and communities • Understand how they access and allocate project funding
Local Community Members	• Understand their perception of whether they are consulted for national policy making • Identify local water management practices • Understand how current water management relate to ancestral practices

Based on these interview goals to learn perspectives on national adaptation planning processes and the implementation of EbA projects in each country, our team worked with in-country partners, IUCN Nepal and Instituto de Montaña, to establish criteria for interviewee selection. Namely, we sought to interview government representatives, members of civil society, and community member with knowledge and direct experience working in EbA projects, ancestral water management practices, climate adaptation planning, and climate change adaptation in mountain regions. Interviewees were identified by in-country partners, who worked with our team to set up meetings with the community representatives. Each interview lasted roughly one hour, and we asked similar questions to actors in each region. Annex 1 lists preliminary questions for each group of stakeholders: policymakers and government representatives, civil society members, and local community members.

3.1 LIMITATIONS

Due to COVID-19 restrictions, travel to conduct interviews was prohibited, which impacted the ability of the research team to gain access to community members. While we were able to initiate phone and video interviews, the virtual interview format made it challenging to have nuanced conversations with interviewees. For our interviews in Nepal, language was a barrier to candid conversations since no one on our team speaks Nepali or any regional dialects, so a translator was required for some community interviews, potentially leading to some information or subtle details being lost in translation. Lastly, the interviewees for both countries were recommended by project partners at IUCN Nepal and Instituto de Montaña, based on their experience with EbA projects and adaptation planning. Due to this narrow criteria and previous work with IUCN Nepal and Instituto

de Montaña there is potential for selection bias, meaning interviewees may not have been willing to be completely candid about challenges and shortfalls of EbA processes. In addition, because our interviews were limited to contacts provided by project partners based on their experience in climate adaptation planning and impacts, we only interviewed people who were in support of EbA and using green infrastructure to address climate change impacts.

4. CASE STUDY 1: NEPAL

Despite Nepal's relatively low greenhouse gas emissions – the country's total 2019 emissions were 9,105.161 kt CO_2e,[ix,x] only 0.11%[xi] of the global total – the country, and Hindu Kush Himalayan region, is one of the most vulnerable to climate change impacts due to local climatic conditions, precipitation levels, and local water resources. Rural and mountain communities are particularly vulnerable to the impacts of climate change.

To plan for these impacts and mitigate climate risks, the Nepali government, NGOs, multilateral entities, CSOs are working with municipal governments and communities to develop adaptation plans and implement EbA projects. This section details local and national level action in Nepal on ecosystem-based adaptation. The findings in this case study were informed by video and telephone interviews with government representatives, civil society representatives, and local community members, whose contacts were shared by project partners at IUCN Nepal.

4.1 CLIMATE IMPACTS IN MOUNTAIN COMMUNITIES

The topography and climatic differences of the region contribute to the disproportionate impacts Nepal faces, particularly for water resources. Nepal has five climatic zones, each linked to a specific region and tied to the elevation of each region: 1) tundra and arctic in the High Himal region; 2) alpine and subalpine in the high mountains; 3) cool to warm temperatures in the middle mountains region; 4) sub-tropical in the Siwalik; and 5) tropical in the low-laying plains.[xii]

The geography of Nepal has significant impact on water management and adaptation planning, particularly due to differences in precipitation and water storage capacity. Throughout these climatic zones, precipitation ranges greatly from low, with only 150 to 200 millimeters annually on average in the High Mountains region, up to 1,100 to 3,000 millimeters annually in the low plains.

Photo: Khumbu Glacier, Mount Everest. *Photograph by Tom Matthews*[xiii]

Mountains have a significant impact on water use and storage in this region. This is due to low temperatures at higher elevations, with the High Himal region sitting roughly 5,000 meters above sea level, which leads to lower precipitation. But the high mountains do have the ability to store snow, which holds water for long-term storage. This mountainous geography also lends to Nepal's capacity to provide water to lower lands from these natural storage sources. The cycle of high storage in the form of snow and ice in the mountains to and downstream flows to lower plains impacts the use of water in the higher elevation areas of the country.

Nepal is already facing impacts from climate change, and it is expected that these risks will compound in the coming decades. There has already been recognizable change in temperature and rainfall over the last decade. Between 1991 and 2015, annual average temperatures have risen by 0.23°C per decade and rainfall has decreased by 3.2% on average per decade since 1960.[xiv] The High Himal region is home to many of the world's largest glaciers. As global temperatures rise due to anthropomorphic activities, these glaciers will continue to melt, changing the hydrological cycles of the region and the availability of water.

This disruption of natural cycles also impacts the country's long-term ability to store and use water, especially in natural systems and glaciers. Rising temperatures are increasing glacier loss exponentially, which can have devastating effects on long term water management in the region. Additionally, shifting weather events will impact the occurrence of precipitation in the form of snow in the alpine and subalpine regions, and rising temperatures will cause unseasonable snowmelt. A decrease in snow compounded by an increase in snow melt impacts water flow and quality for communities downstream and reduces the regions' ability to plan for natural water storage.

The risk of climate hazards for water resources are high as extreme weather events, such as drought and intense monsoons, impact natural hydrological cycles and historic water management practices. Extreme weather events in Nepal contribute to floods, landslides, and glacial lake outburst floods, which are caused by sudden drenching precipitation events. These events are further exacerbated by severe droughts drying up soil and making land incapable of absorbing precipitation, thus leading to high runoff.

Water-related climate disasters are exceptionally dangerous and damaging to land and livelihoods in Nepal. They can cause a high risk of death and displacement due to the destruction of land, homes, and even entire towns. Water events can destroy farmland and agricultural spaces, caused by rushing flood waters that cause severe erosion. Such disasters are quite economically impactful and can cost hundreds of millions of dollars. Of significance, these impacts disproportionately affect rural and mountain communities.

Climate change's influence on the water cycle is especially harmful to mountain communities, where rain is already scarce compared to regions lower in elevation. Mountain communities rely on glacier storage and snow melt for water supplies, but as these natural systems shift, the region's historical water management practices are limited.

> *The mountain communities are a dry area, so we depend on agriculture and rain-fed farming. Natural cycles of rain which brings good harvest are being upended, leading to suffering when rains are scarce. Water is very important for farmers in this area and managing water is important for mitigating impact from climate change for mountain communities*. – Civil Society Representative, Nepal

Water scarcity is also leading to migration. Because water resources are drying up, farmers are unable to raise livestock. This is compounded by the harsh living conditions of the High Himal regions. As people are increasingly unable to make a living or survive due to water scarcity, they are migrating out of rural areas to urbanized ones. As noted by one interviewee, entire villages are being abandoned in these rural regions.

4.2 NATIONAL LEVEL ACTION

Nepal is currently in the process of developing its National Adaptation Plan under the UNFCCC process, with planned release for comment in 2021. At this time, we were not able to assess the NAP's inclusion of ancestral technologies as adaptation measures for the protection of water resources or the dissemination these practices. We were able to review Nepal's multi-level framework for adaptation planning and action from the national government, regional governments, and local communities and assessed the planning process outlined in these documents. These different plans have been separated into 1) the National Adaptation Programme of Action (NAPA), 2) Local Adaptation Plans for Action (LAPA), and 3) Community Adaptation Plan of Action (CAPA).

The Nepalese Government began national-level adaptation planning and established the initial NAPA in 2010 as the national level or central government-level planning for adaptation. The purpose of this document is to assess climate vulnerabilities and identify appropriate adaptation measures. Some of its main points include monitoring glaciers and glacial lakes, as well as providing warning systems for water induced disasters. The NAPA also provides a framework for bottom-up adaptation planning.

The NAPA and NAP processes involved collaboration between multilateral organizations and Nepalese Government entities. This includes the United Nations Environment Programme (UNEP) to execute the NAP process and financial support from the Green Climate Fund (GCF). The development and implementation are overseen by the Climate Change Management Division (CCMD) of the Ministry of Forests and Environment (MoFE) in Nepal.[xv]

Nepal is a Least Developed Country (LDC) with a per capita GDP of $1,085 USD. Agriculture comprises the majority of the economy, and 29% of the population lives in poverty.[xvi,xvii] As an LDC, Nepal has its sights set on economic and infrastructure development over the coming decades, and is currently making plans to build out its infrastructure for energy development and transportation, as noted in the 2020 updated Nationally Determined Contribution to the Paris Agreement.[xviii] Additionally, as mentioned by interviewees, this push for economic development is focusing on building roads in rural areas. Intensifying the build out of new infrastructure may lead to significant land use, furthering the country's vulnerability to climate impacts. This is because as a mountainous region, roads and other grey infrastructure removes natural vegetation causing erosion during flooding as the mountain no longer has support to stay together.

EbA projects led by the governments are essential as Nepal continues to undergo socioeconomic changes. Currently there is a growing demographic shift as many youths in the villages leave for big cities or other countries. This shift is driven by the country's push for economic development, but it is also a result of increasing climate impacts and scarce resources in many rural and mountain communities. Earning higher incomes in cities allows young family members to send money back to their home villages to buy food. This in turn leads to people growing less food in villages, making resources even scarcer. Additionally, the flight of youth leaves a gap in passing traditional knowledge and practices down, risking their disappearance. Without the ability to pass on these practices, the loss may lead to exacerbated loss of water conservation storage and conservation when it is needed most as climate impacts impose great risks to these rural regions. These compounding issues will only be exacerbated as climate impacts intensify. Nepal needs to ensure as part of its adaptation planning that they are including many of these socioeconomic dimensions into account.

Nepal has submitted its second NDC to the Paris Agreement, which mostly defers adaptation planning to the upcoming NAP. The NDC did, however, highlight the importance of watershed management and set a policy priority of increasing water supply access and improving water supply.[xix] The push for economic development and urbanization is also highlighted in the NDC. The desire for more infrastructure development under Nepal's NDC is important to note for purposes of this report as it impacts adaptation efforts and watershed resilience.

4.3 LOCAL LEVEL ACTION

As noted above, Nepal has developed a multi-level framework for adaptation planning and action from the national government, regional governments, and to local communities. The LAPAs and CAPAs were developed at the regional and community level to assess adaptation priorities for individual communities and evaluate their specific needs. These plans serve as a key example of a best practice for national adaption planning by ensuring a framework for addressing local need.

Action at the local level can have conflicting interests, especially due to lack of resources and financial support. Provincial and municipal governments have the assets to prioritize conservation of natural resources and are often the frontline to conservation efforts. Often though these areas lack technical experts needed to mobilize funds to implement adaptation projects, especially EbA projects. Therefore, the local governments tend to use funds for other projects that are more tangible and attractive for economic development. Roads is often a prime example of this. According to one representative from an NGO involved in EbA project implementation, funds that can be used to protect water resources have instead been used to build a road which connects the area to access to another water source. This misuse of funds is often due to lack of technical expertise at the local level and focus on bettering livelihoods, which is often linked to infrastructure building.

Roads are often the priority, but they are not typically an easier route to implement. Roads are difficult to construct in the mountains and remote areas, and the action of cutting into mountainsides leads to significant environmental degradation. This loss of natural land in mountain regions often exacerbates landslides during monsoon and flood seasons. Even when a municipal government prioritizes a “green” or “eco” road, the construction can have the same environmental impact. There is a need for this infrastructure to be constructed, especially for rural mountain communities who have the least amount of access, but nature needs to be considered, especially when detrimental impacts can impact water management.

4.3.1 WATER MANAGEMENT PRACTICES

In the mountain communities in Nepal, water is of significant concern – there is either too much or too little due to the patterns of dry and monsoon seasons, which is further polarized by climate change. Monsoons cause floods and landslides followed by dry season with little to no rain. Indigenous water management has allowed communities to survive extreme fluxes in water.

Historically, the extreme seasonality of water availability in the region has led to strong water management practices. Nepal experiences a very arid season and a wet monsoon season. The excessive abundance of water followed by dryness means communities must adopt various practices to store and manage water to ensure survival for the people and their livestock, as well as agriculture. Strong water management is extremely important in mountain regions, where livelihoods depend on water.

In Nepal, it is all about how water is managed. Drought, floods...it is about how you manage water. – Civil Society Representative, Nepal.

Water management practices have a long tradition of following the dry and monsoon seasons flux of water availability. Practices exist to capture excess flood and rain waters during wet seasons and to conserve and protect stored water during dry seasons. Containment ponds are used for harvesting and storing water from natural sources or rain. These containment ponds are crucial during dry, hot seasons when that water is used for irrigation and as a drinking source.

Traditional water management practices have included planting trees or broom grass, or other finance generating activities that allow community members to grow resources that improve watershed quality and are harvestable. Management practices have also long included irrigation canals. Of significant importance is the practice of conserving water by using grey water. Many communities save water from household use and reuse it for watering gardens.

One of Nepal's first EbA projects in Panchase included intentions to protect water resources for a community located next to the headwaters of the Harpan River. This river experienced extreme seasonal fluctuations in flow, leading to the need to access water through natural springs during dry times. As part of their water management practices, this community traditionally constructed ponds to store water for drinking, livestock, and irrigation. Under this EbA project, more than 15 conservation ponds were built upstream in order to let water infiltrate and recharge the water resources (springs) further downstream.

Climate change is directly impacting water resources especially in terms of the rain patterns. Sometimes raining season becomes too long, comes too soon, or comes too late. This affects…agricultural practices too. Some years they have had to postpone the agricultural calendar/schedule to account for the changing rain patterns, so the crops have been delayed. The communities are realizing that they need to conserve the water. Communities are building more ponds and making them bigger in order to collect more water for the community. EbA projects have helped in increasing the number of ponds and/or how big the ponds are. – Community-Based Organization Representative, Nepal

4.3.2 CLIMATE IMPACTS ON LIVELIHOODS

As climate change alters the natural water cycle, communities are making an effort to protect water resources, such as constructing and maintaining concrete-lined ponds. Communities plant trees and other plants around water sources to improve water quality and construct ponds to increase collection. These ponds not only offer water storage for irrigation but are utilized to collect water, which is used for household consumption. Through diversion and collection in containers, water is clean and potable for use.[xx] Additionally, the watershed is conserved through these management practices, not only providing water during droughts, but also protecting land for agriculture and minimizing erosion during strong rainfall events.

EbA has long been practiced in the region, even if that was not the term used. Many traditional practices focus on utilizing conservation and natural systems to protect and conserve water. This is especially important in agriculture – in Nepal, water management and agriculture are closely connected as many efforts to store water are intended to allow for crop irrigation, and poor agricultural practices can impact water and lead to loss of natural storage and contamination. This includes traditional practices of using animal agriculture waste as fertilizer rather than chemical fertilizers, which can contaminate water supplies. Often, these traditional practices can be expanded and spread to further knowledge of EbA.

Climate change-related water scarcity has a drastic impact on agriculture, and in turn on livelihoods in Nepal. The agriculture sector has a huge impact on livelihoods in the region. It contributes to over 27.6% of the country's Gross Domestic Product (GDP) and employs more than two-thirds of the population, which skews significantly to employment of women.[xxi] In Nepal, agricultural practices depend on water and are land intensive. Additionally, agricultural lands are especially vulnerable to climate impacts including floods, droughts, and landslides.[xxii] These elements are important to consider for adaptation planning because of the tie between livelihoods for an LDC and water.

5. CASE STUDY 2: PERÚ

Communities in the Andean sub-region are at the forefront of climate change. At the same time, local communities, CSOs, and government agencies are implementing EbA projects to protect people and ecosystems from the impacts of climate change. The following section details local and national level action in the Peruvian Andes on ecosystem-based adaptation. The findings in this case study were informed by video and telephone interviews with Peruvian policymakers and government representatives, civil society representatives, and local community members, whose contacts were shared by project partners at the Instituto de Montaña, based in Lima.

5.1 CLIMATE IMPACTS ON MOUNTAIN COMMUNITIES

Perú is one of the countries in South America that will be the most affected by climate change impacts on local climatic conditions. Local communities in Perú's Andean Region are at the frontlines of climate change. By 2030, it is estimated that maximum temperatures in the high mountain regions of Perú will have increased by +1.6°C and precipitation patterns will be altered.[xxiii] Climate models predict two different scenarios in terms of climate-induced changes to precipitation. One scenario predicts that annual precipitation in the high mountain regions will decrease by between 10 to 20 percent. A second scenario estimates that, while total precipitation will remain constant, there will be an increase in the intensity and temporal variability of rainfall. This would lead to less but more intense rain days. The already increasing temperatures and changes to rainfall patterns are threatening water resource availability in the mountain regions of Perú. From 1970 to 2014, Perú's glaciers shrank by roughly 40 percent, and existing glaciers in the country are at risk of melting in the next few decades as surface air temperatures continue to rise.[xxiv]

Melting glaciers and erratic rainfall patterns are threatening the quantity, quality, and overall access to water that communities depend on for drinking, livestock management, and agriculture, increasing the region's water stress. The water insecurity disproportionally affects vulnerable communities, including the rural mountain communities in the Peruvian Andes, which rely more heavily on natural resources. Glacial melt, in turn, is altering existing waterways, creating new alpine lakes, and releasing sediments and minerals into waterways. For example, melting glaciers near the Cordillera Blanca, Perú, exposed metal rich rocks, which contaminated surface waters with lead, cadmium, arsenic, and iron, which pose significant threats to human health upon consumption.[xxv]

As mountain communities are disproportionately vulnerable to the impacts of climate change on water systems, decisions made to respond to and adapt to climate change may be most successful when they consider local contexts, including ancestral technologies. Climate adaptation planning at the national and local levels should take local contexts, knowledge, and experiences into account.

5.2 NATIONAL LEVEL ACTION

At the time this report was prepared, Perú had not yet issued their NAP, so we were not able to determine the extent to which the NAP includes ancestral technologies as adaptation measures for the protection of water resources. In lieu of reviewing the NAP, we were able to review Perú's Nationally Determined Contributions (NDCs) to the Paris Agreement. The NDC includes a total of 91 climate change adaptation measures. Of these adaptation measures, thirty are associated with water resources, but only three of these are associated with nature-based solutions or green infrastructure. However, all three of these proposed NbS are associated with some of the ancestral technologies that we have identified during this project. The three water-related nature-based solutions included in Perú's NDC are:

1) Water harvesting interventions, including measures identified and used by local communities.
2) Payment for ecosystem services mechanisms that incorporate green infrastructure for water conservation.
3) Conservation and recovery of natural infrastructure that can provide ecosystem services for water.[xxvi]
4)

5.3 LOCAL LEVEL ACTION

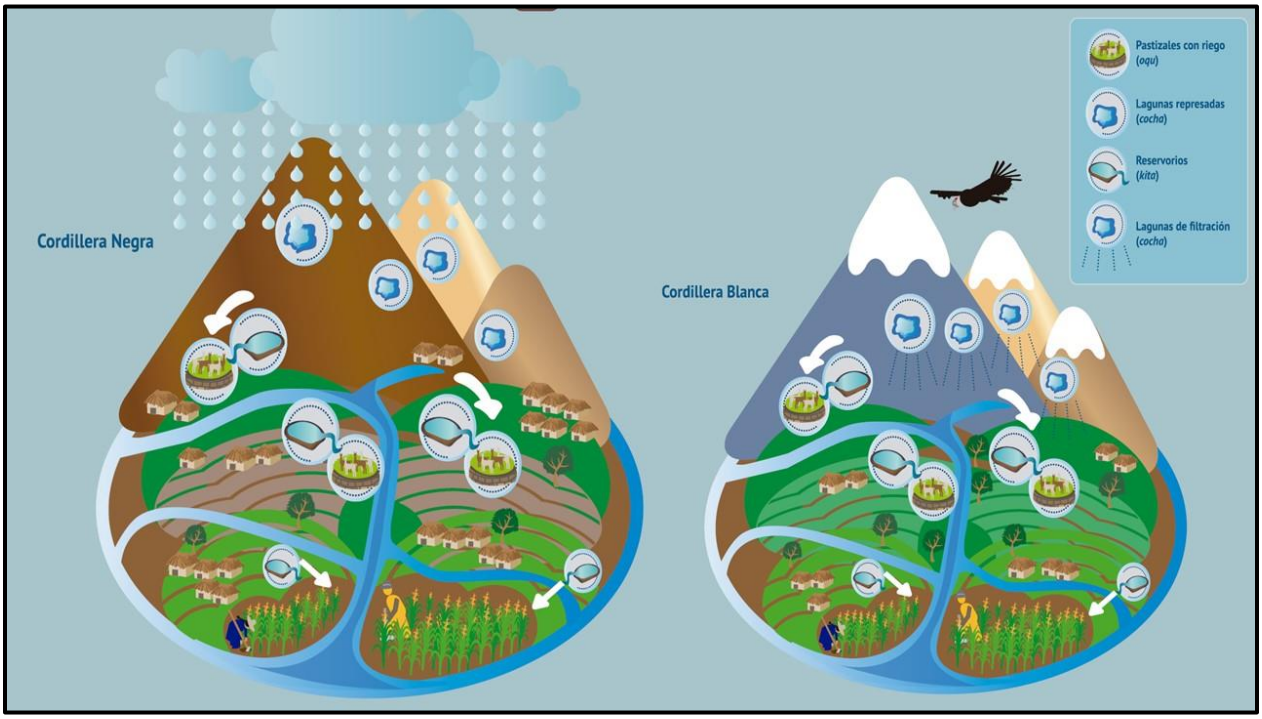
> *"According to our cosmovision, the water, rain, soils, plants, among others, are all beings that are alive. As such, they cannot be managed but they can be nurtured by us. This is a concept that is very common in our culture, but when you try to take this practice outside of your community, it is a concept that is hard to understand."* – Local community member from Peruvian mountain community

5.3.1 ANCESTRAL AND TRADITIONAL TECHNOLOGIES

High mountain ecosystems in Perú provide a good example of how ecosystems are shaped by different societies that adapt to the changing patterns around them. In the case of the high-mountain Andean communities of Perú, it is an interaction that has been taking place for over ten thousand years. In this region, both the high-mountain ecosystems and the societies living around them evolved together as a result of this interaction and relationship.[xxvii]

The communities that have lived in these challenging ecosystems with extreme and changing weather patterns adapted unique practices to survive. Generally, the mountainous areas of Perú (*Sierra*) experience a rainy period between December and March – although this timeframe is shifting due to climate change – and a dry period between April and November. Over time, these communities developed and used a series of very specific and complex technologies that allowed them to manage water, soils, crops, and livestock at different elevations and under different conditions in a successful way (see Figure 2).

Figure 2: Communities in the Andes developed sets of complex ancestral technologies that were very specific not only to the elevation, but the microclimates present in different mountains. Some of these technologies (depicted in the figure) included irrigated grasslands, dammed lagoons, reservoirs, and infiltration lagoons.[xxviii]



Source: *Instituto de Montaña, 2016.*[xiii]

These technologies and practices were meant to take into account the different conditions and climate patterns that are observed at different elevations in order to maximize the quantity and quality of water and food available for the communities. By doing this, these technologies allowed communities to plant different crops with different requirements at different elevations, as well as to provide food and water for livestock in different locations. These practices acted as "buffers," in that they allowed communities to switch to crops at different elevations when extreme weather conditions, like droughts, affected crops at other elevations. While the majority of these ancestral technologies serve different purposes and have multiple benefits, they can be broadly grouped into three categories based on the main intent:

1) ***Subsurface and aquifer water recharge***: Technologies or practices that capture water and allow it to seep into aquifers which then replenish springs, creeks, streams, and lagoons located at lower elevations. Among these are:

    a. Infiltration lagoons (*q'ochas*)[3]: These high-altitude man-made lagoons are used to increase the ecosystem's capacity to retain water and regulate its availability. In these, water filters down to the subsurface, and feeds the high-altitude wetlands

[3] Traditional Quechua names for ancestral technologies are included in italics.

(*humedales/bofedales*) located at lower elevations. These, in turn, could be used for crop irrigation or for livestock.

Photo: *Dr. Kevin Lane*[xiii]

2) ***"In situ" recharge of surface and subsurface soils***: These practices increase surface and subsurface soil moisture content by increasing water retention time. In addition to the benefits for local agricultural practices, these activities are also used to recover or extend high altitude wetlands (bofedales) and terraces. One example of this is:

    a. Constructed wetlands (*oqukuna* – high altitude wetlands): These human-made depressions retain the sediments that are transported by the rain and the wind. The accumulated sediments slow down the flow of rainwater and create high altitude wetlands, which are covered with different grasses. These are used to provide both food and water for local livestock (llamas, alpacas, sheep), during the dry season.

Photo: *Claudia Sanchez de Lozada*

3) ***Surface water storage***: These are technologies that mostly focus on water storage and the regulation of water supply. Some examples of these types of technologies are:

   a. Reservoirs (*kita*): These are typically built close to agricultural areas and are relatively small (between 10 and 30 meters in diameter). Reservoirs are constructed near water bodies (e.g., streams, creeks) and are connected to them via small channels that divert some of the flow. They also capture surface runoff. The bottom of these reservoirs is typically lined with clay-like sediments that allow for the water to slowly seep into the subsurface.

Photo: *Dr. Kevin Lane*[xiii]

b. Micro reservoirs: These are a hybrid version of the *kita*, as they incorporate both green and gray infrastructure. They include longer channels that divert water from springs into the micro reservoirs, as well as a channel or pipeline that transports the water directly to the small farms located further downstream. In some cases, micro reservoirs can also include small pumps for more efficient water transportation.

However, many of these ancestral or traditional technologies stopped being used or are being under-utilized due to social and environmental changes, migration, as well as other factors.[xii]

5.3.2 INFLUENCE OF LOCAL ADAPTATION PRACTICES ON NATIONAL LEVEL ACTIONS

As several of these practices for water conservation at the community level were paused or abandoned, many of these areas experienced degradation due to overgrazing and climate change impacts. In the 1980s and 1990s, some local communities started bringing back some of these ancestral practices that had been abandoned.[ix] NGOs and local governments were involved in a few of these processes. For example, starting in the 1990s, several projects aimed at improving water recharge were implemented by different state governments. Some of these projects included:

1) Proyecto de Manejo de Recursos Naturales en la Sierra Sur (MARENASS)
2) Proyecto Corredor Cusco-Puno
3) Proyecto Manejo Sostenible de Agua y Suelos en Laderas (MASAL)
4) Instituto de Manejo de Agua y Medio Ambiente (IMA) del Gobierno Regional de Cusco
5) Programa de Adaptación al Cambio Climático (PACC Perú) in Cusco and Apurímac

At a national level, one of the first initiatives that incorporated some ancestral technologies for watershed recharge was the National Program for Watershed Management and Soil Conservation[xxix], which was conducted in the 1980s and 1990s. Even though the program mainly focused on soil conservation, it also included several initiatives that improved water recharge.[ix] Slowly, the national government started recognizing the benefits of several of these ancestral practices that were taking place at the community level. However, it wasn't until the 2010s that the national government officially recognized their importance as adaptation measures both for improving water recharge and for the improvement of agricultural practices in these rural mountain communities.

The 2014-2015 National Environmental Awards, administered by the Ministry of the Environment (MINAM), recognized the importance of some of these measures like the ones conducted by the local *Asociación Bartolomé Aripaylla* (ABA) in Ayacucho and the *Asociación Jesus Obrero* (CCAIJO) in Cusco. These two community-led initiatives were documented and included in a 2014 government publication that included lessons learned from twenty of the best adaptation practices in rural communities.[xxx]

It is from one of these two initiatives that the national government recognized that the term "*Siembra y Cosecha de Agua*" (Water Harvesting) comes from. After the publication of this

document, the Ministry of Agriculture and Irrigation (MINAGRI) started promoting these practices. From 2015 to 2016 MINAGRI, along with regional governments and entities, coordinated several workshops to facilitate the exchange of information of these community-led initiatives and promote them.[4] As a result of these workshops, MINAGRI and MINAM (along with regional and multilateral institutions) start exploring the idea of establishing a National Program for the Public Finance of Water Planting and Harvesting.[5] [ix]

In 2017, *Fondo Sierra Azul* was established within the Ministry of Agrarian Development and Irrigation (MIDAGRI – the successor of MINAGRI). The main objective of this national program is the improvement of water safety for agricultural purposes through the promotion of water harvesting activities in the mountain regions of Perú. The program specifically focuses on communities and areas located between 3,800 and 4,500 meters above sea level. Even though the program was originally intended to finance and assist in the construction of different ancestral technologies, *Fondo Sierra Azu*l now appears to focus solely on the construction of small water reservoirs which are combination of green and gray infrastructure. Just in 2019 and 2020, *Fondo Sierra Azul* constructed roughly 600 of these reservoirs. Furthermore, the financing and intervention that *Fondo Sierra Azul* brings appears to just focus on the construction of these reservoirs and any follow up or assistance to the adjoining communities regarding the use of the reservoirs seems to be nonexistent.

[4] These workshops were called: *Seminario Nacional de Siembra y Cosecha de Agua*
[5] Programa Nacional de Inversión Publica en Siembra y Cosecha de Agua

6. DISCUSSION

The following section discusses identified challenges common across Nepal and Perú, as well as good practices for implementing successful ecosystem-based adaptation projects that benefit communities, ecosystems, and the climate.

6.1 COMMON CHALLENGES

While social, political, and economic contexts vary across regions, some common challenges arose in our research on ecosystem-based adaptation in Nepal and Perú. Through our conversations with government, civil society, and community stakeholders in each region, as well as background research, we identified common challenges regarding:

1) political processes, such as political turmoil, government restructuring, and conflicting priorities amongst policymakers;

2) finance, including international adaptation aid and internal budgetary priorities;

3) sector siloing, which focuses on single-sector impacts of a policy or project with little regard to downstream effects;

4) top-down implementation from central and national government bodies who push for project and policies without adequate consultation with local communities; and

5) not ensuring that the needs and potential impacts of projects and policies are assessed for each community, resulting in one-size-fits-all approaches.

Governments and policymakers involved in adaptation planning and EbA project implementation must overcome these five challenges in order to help communities adapt to climate change in a way that effectively promotes ecosystem and human well-being. When these challenges are not adequately overcome or they are a result of adaptation efforts, serious harms to local people and ecosystems may occur. For example, local communities may become disenfranchised if their traditional water management practices are disregarded by national government agencies or ecosystem services may be disrupted if practices do not take unique geographic contexts into account. This can create maladaptations, which are unintended consequences that lead to increased vulnerability to climate risks. Examples of maladaptations include projects that are intended to increase food yield – if chemical fertilizers and seeds are used as opposed to traditional fertilizers and indigenous seeds, this can lead to the cultural loss in indigenous varieties of plant species depended on by communities. Though this impact is unintentional, it can be devastating.

Figure 3. Common challenges for ecosystem-based adaptation in Perú and Nepal.

Understanding these five challenges to implementing EbA, as highlighted in Figure 3, will be key to driving ecosystem-based adaptation practices that truly benefit the environment, climate, and local communities, especially those most at risk of climate impacts. The following section analyzes these challenges in greater detail, in an attempt to identify future opportunities for growth within EbA processes.

6.1.1 POLITICAL PROCESSES

Political processes often act as an obstacle to implementing EbA projects. These include government structural changes and political transitions, as well as changes in policymaking processes and loss of partnerships within government structures. In addition, because climate change adaptation is cross-cutting and involves multiple sectors and regions, many governments find themselves balancing political strategies, such as economic development and climate adaptation, which may be at odds with each other. These opposing priorities can impact the ability to make sound policy decisions and the governments' capacity to collaborate, both within national-level Ministries and between national-provincial-local levels.

Both Perú and Nepal have experienced significant government transitions in the recent past which have slowed down and even hindered some of the climate change adaptation projects/programs that were in place. In Peru, the frequent government transitions in the past 10 years have resulted in existing programs losing funding and being replaced by new programs with similar vision and

goals. While Nepal experienced a different type of transition (from a monarchy to a federal democratic system), the creation of a multi-tiered government structure has impacted the ways in which environmental projects are developed and implemented. Because the country is still in transition, it required external guidance in order to build the necessary frameworks at a regional and local level. This is not inherently detrimental to Nepal's ability to implement EbA projects, but does limit the institutional knowledge capacity, which is part of the prioritized knowledge gap.

Perú

The main challenges for Perú are related to the political instability of the country that has resulted in frequent changes in national leadership. This instability has trickled down and affected both the implementation and the longevity of environmental projects.

Perú's economy is one of the fastest growing in South America and is highly dependent on the country's natural resources. Because of this, it has always been critical for the country to have a strong institutional environmental strategy to ensure their protection and to increase the country's resiliency to climate change impacts. An environmental review of the country conducted by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) and the Organization for Economic Cooperation and Development (OECD) found that, from the early 2000s until 2015, Perú made significant progress in strengthening both their environmental legal framework and environmental institutions, improving the country's information systems, and promoting citizen participation to achieve a more sustainable economic development. In 2005, the country adopted the General Environment Act[6] which paved the way for the creation of the MINAM, the Peruvian Protected Areas Service[7] (SERNANP) and the Agency for Environmental Assessment and Enforcement[8] (OEFA) in 2008. Furthermore, in 2012, the National Service of Environmental Certification for Sustainable Investments[9] (SENACE) was started. And, most recently, Perú enacted South America's first Climate Change Law[10] which established the responsibilities that MINAM has in relation to Perú's NDCs.

While the country has indeed made great progress in strengthening environmental institutions and its legal framework, the process has been neither smooth nor fast. Perú has experienced considerable political instability in the past couple of decades. Since 2011, the country has seen five different presidents, and four of them were not able to complete their full terms. During our interviews, some interviewees reported that this political instability and changes in national leadership can represent a barrier to the implementation of environmental projects.

Several people also mentioned other barriers like continuous changes in politically appointed personnel in some of the environmental institutions, as well as complete overhaul and creation of new environmental programs whenever a new administration reaches power. An example

[6] Ley General del Ambiente
[7] Servicio Nacional de Áreas Naturales Protegidas por el Estado – SERNANP
[8] Organismo de Evaluación y Fiscalización Ambiental - OEFA
[9] Servicio Nacional de Certificación Ambiental para las Inversiones Sostenibles - SENACE
[10] Ley Marco sobre Cambio Climático – No. 30754

mentioned multiple times during the interviews is the current *Fondo Sierra Azul*. This relatively new program was started even though a very similar program was already being implemented. The creation of the new program meant the interruption of the existing program, as well as a lack of continuity.

This lack in continuity and interruption of programs that are already operating and implementing EbA projects presents a significant barrier for the long-term success of these projects. Without addressing this problem and enacting mechanisms that prevent these interruptions, these types of projects will continue being negatively impacted with every government transition.

Nepal

In 2008, Nepal underwent a significant government transition from its long-held monarchy to the current federal democratic republic with a three-tiered government structure consisting of central, provincial, and local bodies.[xxxi] The country is currently still in a "development phase" from the previous federal system following the establishment of the Constitution of Nepal in 2015, which can present challenges to building relationships between the government tiers.

As part of the NAPA, Nepal has done well to establish frameworks to include the provincial and local government tiers in adaptation planning process, as detailed in sections above. However, due to the recent government transition and the development of the multi-tiered government structure, Nepal has relied on non-governmental organizations (NGOs) in the region and multilateral consultants to bridge gaps and provide guidance through the various frameworks for establishing and evaluating adaptation measures.

Interviewees cited that there were differences with level of involvement from different multilateral entities and that these variations can exist as a barrier to the effectiveness of the process. One example provided was that some larger entities, such as UNDP, are brought in for consulting, but were not a part of the NAP process directly. Back in 2011 and 2012, UNDP partnered with UNEP to develop case studies on EbA in mountain regions to assess feasibility and demonstrate the cost-effectiveness of these adaptation measures.

As part of the new government structure, Nepal has seven provincial government entities and 753 local government entities. All these government entities oversee adaptation plans, either through the CAPA or LAPA process. Once concern regarding this process is a potential lack of capacity and technical expertise in the provincial and local governments. According to some sources, while the importance of adaptation due to increased climate risks is understood, planning for them at these levels is weak. The provincial and local governments do not necessarily have the resources or capacity to develop and implement adaptation plans, and they especially do not have funding to carry out such plans. This lack of resources may be a carryover from the still transitioning government in Nepal.

In addition, some of these governments may not prioritize adaptation planning. One interviewee noted that while the local communities are aware of current and future climate impacts, they are more focused on economic development than on climate change. Some local communities want resources for essentials, such as roads, electricity, water, and hospitals. These are legitimate

concerns and are a part of Nepal's sustainable development plans under their updated 2020 NDC. The National Government sometimes meets the demands of local communities, bringing in more roads and other grey infrastructure to the areas. Yet, interviewees also noted that political agendas have influenced the allocation of financial resources to non-EbA projects even when they are not demanded by the communities. For example, a push for rural, economic development encourages some government agencies to prioritize building roads over other needs of local peoples.

> *Nepal is in transition. They are developing, with it comes the want/needs of buildings, roads, etc. [We] need to find the balance between development and adaptation...roads still need to be constructed but in a way that nature is taken into account. It is very difficult to convince policy makers about this balance between development and nature. ...There is no immediate results or outcome with EbA, which is something that people/communities usually want to see immediate results.* – Civil Society Representative, Nepal

As mentioned above, Nepal is currently in transition and is developing economically, increasing needs for buildings, roads, electricity, and other infrastructure. This results in conflicting priorities across the different Ministries, some who want to prioritize fast development and others mitigating climate and enhancing adaptation planning. Such entities need to find a balance between development and adaptation to reduce risks of climate impacts in vulnerable regions.

Infrastructure does need to be constructed but governments need to ensure that nature and impacts on ecosystems are considered for any future project. However, interviewees noted the difficulty to convince policymakers to prioritize this balance. This is highlighted by Nepal's commitment to economic development, as well as the drive for immediate results from projects. Grey infrastructure can offer this, since building out concrete dams are quicker and more noticeable than the time it takes to see the results from green infrastructure or EbA projects.

This highlights the role of the middleman, or where NGOs and CSOs fit in the multi-level governmental matrix. NGOs and CSOs have the capacity to help determine best practices for implementation and carry out case studies to assess plans. These entities can also serve as the intermediary between the central government and the community level. Because the need for communication and collaboration between government tiers is not always met in practice, NGOs and CSOs serve an important gap, especially to fill capacity gaps for local and provincial level projects. However, as noted by interviewees, the central government does not always take feedback from the NGOs and CSO, preventing improvements to political processes.

6.1.2 FINANCE

In the two research focus countries, some interviewees, most notably government representatives, noted that funding for EbA projects acted as a key challenge for implementation. At a high level, the most prominent challenge for project finance is a lack of available funds. Bilateral and multilateral financing mechanisms – including funds originating from the Green Climate Fund, the Global Environmental Facility, or regional development banks – are key for funding existing EbA projects,

but those funding mechanisms often include lengthy and complicated application and reporting requirements, for public and private project developers. Some domestic funding for EbA projects exists in both Perú and Nepal, but those funds are insufficient to meet climate adaptation needs because more funds are required to adapt to climate change and there appears to be a lack of awareness regarding innovative ways of securing climate finance from domestic sources. In addition, the COVID-19 pandemic poses a challenge for climate adaptation financing, including financing for EbA projects. As governments focus efforts on reinvigorating their economies and boosting industries and sectors that were impacted by the pandemic and resulting economic crisis, there will likely be fewer funds allocated to EbA projects.

> *All climate finance is very hard to get. We need a lot of capacity to prepare the projects and access funds. – Representative from the Ministry of Forests and Environment, Nepal*

Perú

In Perú, funding for climate adaptation in mountain regions stems from both domestic and international sources. Domestically, sources of funding, while promising, are limited in scope. For example, Lima's water utility, *Servicio de Agua Potable y Alcantarillado de Lima* (SEDAPAL), reinvests one percent of collected water fees to the EbA project, Proyecto MERESE-FIDA, which conserves ecosystems in the high Andes which act as a key water source for Lima.[xxxii] While domestic programs that expand payment for ecosystem services can prioritize ancestral technologies and promising water adaptation practices, they are currently quite limited in scale.

Government representatives noted that international climate finance prioritizes mitigation efforts over adaptation, which poses a key challenge for implementing EbA projects. In addition, interviewees in Perú noted that traditional and ancestral water management technologies are not particularly expensive, but more work must be taken to promote these types of technologies and build awareness of their potential. Finally, a key challenge for EbA project financing in Perú is the perspective of project developers. In many cases, projects are viewed as single-dimensional financial investments, rather than holistic opportunities to benefit communities while simultaneously creating financial benefit for developers.

Nepal

In Nepal, interviewees reported that most funding for adaptation planning and EbA projects originates from multilateral or bilateral donors. Interviewees identified the following funders as providing support to climate adaptation practices in Nepal: the Asian Development Bank, the Department for International Development (UK), European Union, UNDP, UNEP, USAID, the World Bank, the Green Climate Fund (GCF), and the Global Environment Facility (GEF). Relying on international financing mechanisms proves to be a substantial challenge for funding EbA projects, although government representatives in Nepal noted that most financing for climate adaptation will need to come from international partners and entities.

For example, international funding mechanisms often require an extended, multi-year timeline for applying for grants and require expertise in grant and report writing, which may prove challenging for countries with limited resources or expertise. Interviewees noted that insufficient data and

expertise in grant applications is a problem not only for Nepal, but for many Least Developed Countries (LDCs) in Asia and Africa. Finally, government stakeholders noted that accessing national funds for climate adaptation is challenging, as the Ministry of Finance and the Ministry of Environment operate independently. For national funds to be effectively allocated for climate adaptation, including adaptation practices that protect water systems, effective communication among and between governmental agencies is critical.

6.1.3 SECTOR SILOING

Effective ecosystem-based adaptation requires a holistic integration of biodiversity conservation, socio-economic benefits, and addressing climate change impacts. Unfortunately, this often proves challenging, as adaptation projects can focus on a single target sector, population, or issue. Oftentimes, climate adaptation interventions focus on one sector instead of taking a multi-sectoral approach, which is critical for truly addressing the complex impacts posed by climate change. In particular, when addressing issues related to water management, holistic thinking is necessary due to the widespread impacts of political, economic, and social decisions on water systems. Because of the interconnected nature of the hydrological cycle, actions taken within each sector – forestry, agriculture, etc. – also impact water systems.

> *Adaptation and funding often focus on one sector, but that's not enough for a multi-sector approach to actually address the full impacts of climate change.* – Civil Society Representative, Nepal

In both Perú and Nepal, interviewees noted that projects are most successful when they take multiple sectors into account. In Perú, some current climate adaptation projects rely on concrete reservoirs and other types of grey infrastructure which, while addressing climate-induced water scarcity, do not address the full impacts of climate change. For a more holistic approach, water management projects should take a systems-level consideration of the impact of upstream watershed conservation and local biodiversity preservation, as well as benefits to local livelihoods.

In Nepal, interviewees noted that many climate adaptation projects focus on a single sector due to limitations in climate financing or alternative priorities for funders and project developers. For example, one civil society representative shared that many climate adaptation donors are focused on a single sector or issue, like preserving biodiversity or enabling sustainable economic development. Thus, many projects in Nepal are not currently addressing the widespread and interconnected impacts of climate change. When climate adaptation projects focus on a single sector, they will likely fail to address the full, interconnected impacts of climate change. Therefore, overcoming the challenge of sector siloing is key for driving effective EbA projects.

6.1.4 TOP-DOWN IMPLEMENTATION

Successful EbA programs tend to share a very robust focus on both community and regional needs. Top-down projects are typically developed by national governments or other high-level bodies, while bottom-up projects are designed and implemented by local communities. Programs like the ones implemented in the Canchayllo and Miraflores communities in the *Reserva Paisajística Nor Yauyos-Cochas* included extensive community engagement to determine the various community needs, identify ancestral technologies that the community had used in the past and was interested in revisiting, and determine the scope of the project[xxvii]. In essence, the communities are at the forefront and in the driving seat in both projects. They are the co-creators, provide the technical knowledge and expertise, provide the labor, and are continuously monitoring the success of the project. These two projects are an example of a bottom-up approach, which centers local people and knowledge as key project developers and owners.

Top-down approaches, on the other hand, are typically brought by national governments or high-level actors that are separated from the communities who are impacted by the projects developed. When looking at the EbA projects that are long-lasting in mountain communities in Perú and Nepal, one of the common threads is buy-in from the communities, which is extremely hard to attain through top-down approaches. Furthermore, if EbA projects are implemented with a top-down approach, there is a risk of completely missing the mark in terms of what communities want or need because they focus on high-level goals rather than centering what issues and solutions are relevant and sustainable for local contexts.

<u>Perú</u>

The *Fondo Sierra Azul* in Perú is an example of a top-down program. The initial concept for this program focused on a bottom-up approach that identified and prioritized local ancestral technologies for water harvesting that could lead to an integrative and participatory approach for water management. However, it has since become a top-down project. The program is now focused on implementing just one type of solution (micro-reservoirs) through the construction of dikes and channels to transport water to infiltration lagoons (*q'ochas*). The use of ancestral knowledge has been removed from the project and it has now become an engineered solution that only involves the local communities to provide the labor needed to build infrastructure. In this shift to a more engineered-focused approach *Fondo Sierra Azul* has removed the community from the project design and implementation process. In doing so, the long-term sustainability of these projects could be at risk since the design and technologies used for the infrastructure are not necessarily part of the communities' ancestral knowledge. How will these structures be maintained in the long run? Since members of the community are not involved in the design process, who will be able to troubleshoot and fix these infrastructures if they fail?

As mentioned in Section 5.3, the ancestral technologies used in these Andean communities consist of a very specific and complex set of technologies that were meant to account for different conditions and micro-climate patterns in order to maximize the quantity and quality of water and food available for the communities. While the different ancestral technologies serve different purposes and have different benefits, when used together, they increase the resiliency of the

communities. By focusing and implementing just one solution (micro-reservoirs) Fondo Sierra Azul could have a negative impact on the resiliency of these communities.

Furthermore, the original concept for this program included plans for a community-led monitoring process for the long-term evaluation of the success of water harvesting projects based on ancestral knowledge. However, when asked about long-term monitoring plans for these projects, Sierra Azul representatives mentioned that once the construction of the micro-reservoirs is completed, they leave the community and there is no follow-up. The focus on community-specific solutions and the transfer of ancestral knowledge has been removed and replaced with a one-size-fits-all engineered solution in an attempt to maximize government financing and produce a large quantity of micro reservoirs, almost 600 in 2019 and 2020 combined.

> *"We had high expectations for Fondo Sierra Azul. However, it has changed and has become very technocentric. They have become engineering projects when these are originally farming practices. In the case of Sierra Azul, the program has made people from the community just providers of manual labor." – Local community member from Peruvian mountain community*

Nepal

The CAPA and LAPA frameworks in Nepal shows an effort to decentralize adaptation and impact planning from the federal level. However, even with policies written to incorporate a bottom-up perspective, many interviewees noted a lack of follow-through for incorporating local communities in the adaptation planning process. Even LAPA was primarily developed by the national government and UNDP, according to one CSO stakeholder.

Some sources shared that in Nepal it is a mix of both top-down and bottom up. The main challenge is that communication between the three levels of government is not yet effective and is still a work in progress following the restructuring, as noted in sections above.

In practice, local action is at a minimum – municipalities often do not have a clear understanding of the impacts of climate change. Local planning is weak as many governments do not have the resources or have low capacity. This can often lead to a willingness to implement activities that come from the national level's priorities. This in turn highlights that the central government is not always as knowledgeable about what is happening on the local level, or what the specific needs and vulnerabilities are.

However, the challenge also exists that not having central government support can lead to poor planning. As mentioned above, some rural communities prioritize economic development, wanting roads and infrastructure that is difficult to construct in mountain regions. These priorities are often at odds with EbA, especially when building roads cut into mountains, leading to landslides and other erosions problems. The central government, mainly the MoFE, is working to raise awareness of impacts and importance of EbA adaptation.

6.1.5 ONE-SIZE-FITS-ALL APPROACHES

Top-down implementation usually leads to one-size-fits-all approaches, which is something that came up during our interviews. Because top-down interventions focus on a centralized approach, they continuously fail to include community-specific conditions and needs. One-size-fits-all approaches for EbA projects in mountain communities of Nepal and Perú fail to account for different microclimatic conditions, typologies, land management histories, community social hierarchies, and existing ancestral knowledge. Most importantly, the centralized, one-size-fits-all approach removes communities from the driver's seat because they are not considered as partners in the design and implementation process.

Perú

As mentioned in the previous section, the *Fondo Sierra Azul* is currently implementing centralized one-size fits-all EbA solutions without considering specific community circumstances, knowledge, and needs. Instead of having a collaborative process with the community, where an exchange of knowledge happens both ways, *Fondo Sierra Azul* is now focused on the installation of one single type of solution (micro reservoir) in all the communities that they serve. While this approach might streamline the process and facilitate the installation of a high volume of this particular type of infrastructure, it likely jeopardizes its long-term success in some of these communities.

Nepal

In line with developing one-size fits all approaches, the needs of some communities are not being met. Having to deal with competing needs, the central government often prioritizes economic development over EbA measures. As a developing country, Nepal faces an inherent drive towards gray infrastructure development and a shift towards urbanization. As mentioned in previous sections, the central government often pursues projects based on financial and political interest. There are also examples of communities pushing for the central government to provide these developments. However, an existing challenge remains regarding addressing the needs, vulnerabilities, and interests of each community individually.

6.2 GOOD PRACTICES

Building on interviews with key government representatives and policymakers, civil society representatives, and community members in Perú and Nepal, we identified good practices across regions for bringing strong, effective EbA projects that benefit local ecosystems, communities, and the climate. To fully address the impacts of climate change on water systems, government representatives and project developers should heed the following practices: 1) elevate community involvement and strengthen bottom-up planning and implementation; 2) prioritize a holistic approach in developing adaptation projects; and 3) increase total financing for climate adaptation and access to funds. Not only will pursuing these good practices address the common challenges described in the previous section, but they will also help set the stage for climate adaptation projects to positively benefits local communities and ecosystems in the long-term. The following section describes these three good practices in further detail.

***Figure 4**. Good practices for government representatives and project developers in ecosystem-based adaptation.*

6.2.1 ELEVATE COMMUNITY INVOLVEMENT AND STRENGTHEN BOTTOM-UP PLANNING AND IMPLEMENTATION

As mentioned in the Challenges section, the use of centralized, one-size-fits-all approaches for EbA solutions leads to projects that too often miss the specific conditions and needs of different communities. Furthermore, these types of solutions also exclude local communities from the project design and implementation processes, which can affect the long-term sustainability of the projects. In contrast, community centered EbA projects involve local communities from the beginning of the process in order to fully understand the local conditions and truly develop a long-lasting partnership with the communities.

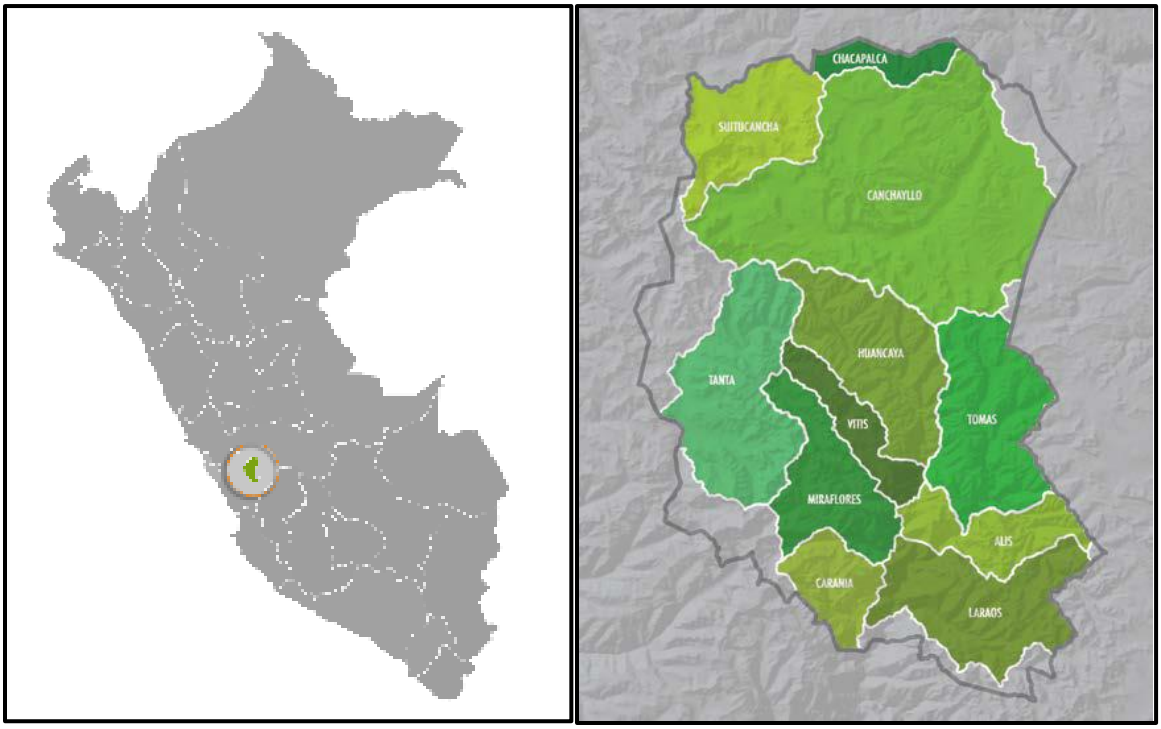
<u>Perú</u>

The Scaling Up Mountain EbA Program[11] in Perú provides a strong example of a successful collaborative effort between the multiple institutions (i.e., IUCN, Instituto de Montaña, MINAM,

[11] The Scaling Up Mountain EbA Program expands the work started as part of the "Mountain EbA Flagship Programme" in three important mountain areas: Himalayas, Mount Elgon, and the Andes, and supports EbA approaches being used in Bhutan, Kenya and Colombia.

SERNANP, Nor Yauyos Cochas Landscape Reserve) that are involved in the project and the local communities.[xxxiii] The local population – members of the Miraflores, Tanta, Tomas, and Canchayllo communities – was at the heart of the project. A group of community members served as local technical experts in charge of compiling the data for the initial diagnostic and became the permanent point of contact between the projects and their respective communities. There was an extensive community engagement process in order to define priorities and preferred strategies.

***Figure 5**. Location of the Nor Yauyos Cochas Landscape Reserve and of the different communities within the Reserve.*



Source: FDA, 2013.[xxxiv]

In addition, community members formed different interest groups that were given specific tasks to conduct throughout the project implementation process. In order to secure community buy-in, the project also built relationships with both the regional and local community authorities. The project also made communication with the community a central part of the project in order to inform every one of the objectives, the expected results, as well as the expectations of everyone in the partnership.[xv]

<u>Nepal</u>

As detailed above, Nepal is a model for developing frameworks to include regional and local needs and contributions in adaptation planning. The implementation of EbA projects and the NAP development process have involved multiple levels of stakeholders, allowing for a holistic understanding of the vulnerabilities and needs for instituting adaptation measures.

Based on the tiered government framework noted in previous sections, Nepal's adaptation planning process is a hybrid mode, with both top-down and bottom-up approaches. For EbA, this allows

opportunity for collaboration between the different government tiers. Resources and expertise from the national level can be utilized by provincial and municipal governments, who have the interest in the conservation of natural resources but do not always have the needed technical experts locally.

Acknowledging rural and mountain community needs for roads and accessibility, and the knowledge of environmental impacts from such construction, technical expertise can be utilized from the national and international level to implement EbA projects to balance adaptation and development. This can be utilized in EbA project implementation as well, as seen in IUCN's Ecosystem Protecting Infrastructure and Communities (EPIC) initiative. This case study noted that EbA approaches, such as bio-engineering and "eco-roads", can prevent erosion and degradation from building roads for rural access. This initiative is an example of the successes of integrating EbA into infrastructure development and the utilization of a hybrid-model, not only from national and local but also tying in support from international entities.

When the initial EbA process was launched, Nepal was a heavily centralized government, so the planning process was top-down. Through the recent political transition, adaptation planning has become more common at the local and provincial levels. This transition and Nepal's history of community engagement and leadership development through efforts of community-based forestry has helped Nepal find success in engaging with community on adaptation planning. Nepal's focus on forest management by communities is an example of the importance of building foundations at the local level for communities to develop their own competencies and leaders, and how that impacts the robustness of adaptation planning processes.

The initial top-down process did provide benefits when EbA projects were first developed in Nepal. With the federal government driving the process, new technologies and interventions were accessible to project developers. One interviewee shared that local governments do have assets allocated for conservation of natural resources. However, they lack local technical experts to mobilize those funds in order to implement adaptation projects. This technical knowledge barrier can lead to these local governments using the funds for other projects, such as building roads. For example, one community used funds that were intended to protect water resources to build a road to access another water source. A mixed process, i.e. hybrid of top-down and bottom-up, allows for federal government guidance on such projects to ensure that support and expertise is available and maladaptation or the misuse of funds is avoided.

Nepal utilizes both top-down and bottom-up approaches, allowing for the resources and expertise of the central tier to be aligned with the traditional knowledge of the local communities while addressing their vulnerabilities. Nepal serves as a good example for a mixed-system that involves top-down direction and support and local planning. One interviewee shared that the central government is not as engaged with writing local adaptation plans, nor do they intervene – they only facilitate and provide technical support. The central government provides support to identify local level person/staff to create and implement the local adaptation. This leaves the implementation with leadership from the local level, allowing them to have more autonomy and control over EbA projects in their communities.

Nepal also demonstrates the importance of elevating community engagement, which allows for an exchange of knowledge and trust. Most activities are implemented by community members and based on traditional knowledge. When EbA projects have been introduced by the central government and multilateral bodies, provincial and community-level stakeholders are consulted to ensure local learning is considered and adopted.

Additionally, elevating communities requires the ability to speak to their needs and allow them to learn with language they understand rather than being confused by the jargon of the international community or outside experts. Accessible language is important. This is especially critical when referring to EbA projects, as the language used may not be a connection to the impacted community. As detailed in an interview, new jargon can become confusing to communities. However, the main point is to ensure "nature" is at the center of it all. Every time "nature" comes up, it aligns with that community's practice and provides multiple benefits to the local communities.

> *Climate Change is the responsibility of all three tiers of government – local, provincial, and central. Local planning is weak because the governments do not have the resources, so other stakeholders must help to share examples, science, policy, and dialogue.* – Civil Society Representative, Nepal

6.2.2 PRIORITIZE A HOLISTIC APPROACH IN DEVELOPING ADAPTATION PROJECTS

A holistic approach refers to process through which every component is considered in the design and implementation of a solution because it is understood that they are all intimately interconnected and dependent of each other. Holistic approaches to climate adaptation also include sectors outside of the traditional environment, including ministries of development, planning, investment, and finance. The community members in Perú who were interviewed for this project consistently pointed to the interdependency of plant species, biodiversity, and livestock with the EbA solutions implemented in their communities. For example, through ancestral knowledge that has been passed through generations, mountain communities in the Peruvian Andes know which species should be planted at which elevations in order to increase water capture, limit soil erosion, maximize crop productivity, and maintain biodiversity.

Furthermore, by acknowledging and addressing the impacts that each of these components have on other aspects, communities can ensure that their present and future needs are protected. A good example of a successful project with a holistic approach is the project implemented by the Quispillaccta farming community in Ayacucho, Perú, which has been implemented since the early 1990s. While the main water harvesting component of this project included the installation of stone dikes and channels in order to increase the size of the infiltration lagoons in the community, the project had additional NbS components, including:

1) Repopulating the lagoons with algae and native fish species
2) Constructing high-altitude wetlands (*bofedales*)

3) Planting native species (e.g., *putaqa*) that are known to help with water retention and are traditionally associated with high altitude wetlands
4) Planting native grasses in areas that had been excessively grazed
5) Building fences around over-grazed areas to allow for grasses to come back
6) Educating the community about optimal silvopastoral practices to prevent overgrazing and protect *bofedales* and other areas
7) Enhancing the community's local regulations regarding livestock grazing, native crops, and deforestation (MINAGRI, 2016)

Like Perú, Nepal is a dynamic region with varying climatic zones, communities, and ecosystems. As part of the NAP process, involved entities must understand the nexus between issues and to see linkages between different sectors to avoid new problems. As noted in the *Challenges* section, Nepal has examples of failures to properly address the holistic needs involved in EbA projects, sometimes leading to exacerbating issues. Building cement pools in some areas may lead to huge erosion risks during flooding – such risks need to be understood to reduce the possibility of maladaptation. If a holistic approach is not taken, the impacts on other sectors could be quite negative.

In the Panchase EbA project, community members cited the applicability of supporting the traditional practices of building pools for holding water, which is especially important for storage through the dry seasons. The EbA project understood the specific needs of the region and incorporated traditional practices into implementation through community consultation. Such holistic approaches also need to address other priorities for the country, such as disaster and poverty reduction. A pathway for EbA projects includes using native species in restoration projects, particularly species such as broom grass, which address both ecosystem adaptation needs and economic needs, and broom grass is a source of livelihoods.

6.2.3 INCREASE TOTAL FINANCING FOR CLIMATE ADAPTATION AND ACCESS TO FUNDS

To effectively bring ecosystem-based adaptation projects that truly address the impacts of the climate crisis on communities and the environment, climate finance must be accessible to governments, project developers, and local communities. Accessibility to climate financing mechanisms includes both an increase in the total amount of money available for EbA projects, as well as greater access to those funds through the reduction of tedious processes that can be difficult to secure. Therefore, financial mechanisms that support climate adaptation and EbA projects should be institutionalized and made readily accessible to groups and individuals working to address the impacts of climate change. Whether funds originate from international or domestic sources, it is critical that local communities have access to funds and are consulted on how funds are used.

Both Perú and Nepal currently have good practices on climate finance that could be shared, scaled up, and replicated in other countries. As described in the finance challenges section, Lima, Perú's water utility, SEDAPAL, reinvests 1 percent of collected water fees to the EbA project, Proyecto MERESE-FIDA.[xxxv] This project conserves ecosystems in the high Andes, which provide drinking

water resources for residents of Lima. Because downstream consumers are dependent on the quality and quantity of water in the mountains, it is a good practice for those users to invest in projects that protect freshwater sources. Scaling up programs that call upon water users to finance EbA projects that restore water sources is strong practice and may provide sustainable and reliable project financing.

In Nepal, national climate adaptation funds are prioritized for activities at the local level. According to the Government of Nepal's National Framework on Local Adaptation Plans for Action,

> *"Both NAPA and the Policy have made mandatory provisions to disburse at least 80 percent of the available budget for the implementation of adaptation and climate change activities at the local level. This is expected to support the most climate vulnerable communities and people to adapt with climate change and improve livelihoods."*[xxxvi]

Prioritizing climate adaptation funds to be dispersed at the local level is a good practice, as it ensures that the individuals and communities who are most directly impacted by the impacts of climate change are able to participate in decision-making processes on how those funds are allocated.

7. CONCLUSION

Climate change is one of the most pressing threats facing mountain communities around the world. Ecosystem-based adaptation has the potential to address the impacts of climate change on natural resources, biodiversity, and communities through conservation, sustainable management, and restoration of ecosystems and ecosystem services. Therefore, governments, civil society organizations, and communities in mountain regions around the globe may benefit from pursuing EbA projects that improve the quality and quantity of natural resources, including water, which mountain communities depend on. This research explored the role of ecosystem-based adaptation and traditional water resource management in mountain regions in Nepal and Perú.

This research was conducted in collaboration with the UNFCCC Secretariat, Instituto de Montaña, and an NWP partner organization. In an effort to advance knowledge of EbA and water resources management in the Andean and Hindu Kush Himalayas subregions two priority knowledge gaps (priority knowledge gap #2 and #11) (see table 1) were selected as guidance for this assessment. To address priority gap #2 for water in the Hindu Kush Himalayas region, the research explored historical and ancestral practices for water management in Nepal. The objective was to understand what practices exist, how they differ with seasonal dry and wet climate patterns, and how that knowledge is or can be utilized for adaptation planning. Similarly, ancestral practices for water management were also examined in Perú, as well as their use in climate change adaptation planning. We used our findings for both countries to compare their knowledge dissemination practices and to identify who holds the knowledge to make progress in closing this gap.

Additionally, for priority gap #11 for scientific research and climate observation in the Andean region the focus was in Perú. This research evaluated the exchange of knowledge for water management practices and techniques, including indigenous and ancestral practices, from rural mountain communities to the national government. This analysis was similarly carried over to Nepal to serve as a comparison for differing processes in the exchange of technology knowledge. Our team addressed these two key knowledge gaps and evaluated the institutional and procedural challenges to advancing adaptation plans.

Through our research we found that, while social, political, and economic contexts vary across Nepal and Perú, some common challenges are present. Through our conversations with government, civil society, and community stakeholders in each region, as well as background research, we identified common challenges regarding:

1) political processes, such as political turmoil, government restructuring, and conflicting priorities amongst policymakers;

2) finance, including international adaptation aid and internal budgetary priorities;

3) sector siloing, which focuses on single-sector impacts of a policy or project with little regard to downstream effects;

4) top-down implementation from central and national government bodies who push for project and policies without adequate consultation with local communities; and

5) not ensuring that the needs and potential impacts of projects and policies are assessed for each community, resulting in one-size-fits-all approaches.

Governments and policymakers involved in adaptation planning and EbA project implementation must overcome these five challenges in order to help communities adapt to climate change in a way that effectively promotes ecosystem and human well-being. When these challenges are not adequately overcome or they are a result of adaptation efforts, serious harms to local people and ecosystems may occur. For example, local communities may become disenfranchised if their traditional water management practices are disregarded by national government agencies or ecosystem services may be disrupted if practices do not take unique geographic contexts into account. This can create maladaptations, which are unintended consequences that lead to increased vulnerability to climate risks.

Building on interviews with key government representatives and policymakers, civil society representatives, and community members in Perú and Nepal, we identified good practices across regions for bringing strong, effective EbA projects that benefit local ecosystems, communities, and the climate. To fully address the impacts of climate change on water systems, government representatives and project developers should heed the following practices:

1) elevate community involvement and strengthen bottom-up planning and implementation;

2) prioritize a holistic approach in developing adaptation projects; and

3) increase total financing for climate adaptation and access to funds.

Not only will pursuing these good practices address the five common challenges we identified, but they will also help set the stage for climate adaptation projects to positively benefits local communities and ecosystems in the long-term.

8. ACKNOWLEDGEMENTS

This paper would not have been possible without the generous support of many colleagues and experts on ecosystem-based adaptation. First, we would like to thank Rojina Manandhar at the United Nations Framework Convention on Climate Change for her support of this project and its development.

Our research in Perú, Florencia Zapata and Mirella Gallardo at Instituto de Montaña provided critical support for our research on ecosystem-based adaptation in the Andes region. In Nepal would not have been possible without Anu Adhikari, Senior Programme Officer for Climate Change, Gender and Social Inclusion at IUCN-Nepal. Many thanks to Annika Min, Wendy C. Atieno, and Ali Raza Rizvi at the International Union for the Conservation of Nature (IUCN) for their supervision of this project and critical assistance in both project development and final review.

We would also like to express our most sincere gratitude to the many civil society and government practitioners in Nepal and Perú who spent countless hours sharing their expertise and perspectives with us.

Finally, we would like to thank Dr. Gordon Geballe and Dr. Amity Doolittle at the Yale School of the Environment for their guidance on this project.

---

[i] Hoegh-Guldberg, O., D. Jacob, M. Taylor, M. Bindi, S. Brown, I. Camilloni, A. Diedhiou, R. Djalante, K.L. Ebi, F. Engelbrecht, J. Guiot, Y. Hijioka, S. Mehrotra, A. Payne, S.I. Seneviratne, A. Thomas, R. Warren, and G. Zhou, 2018: Impacts of 1.5ºC Global Warming on Natural and Human Systems. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

[ii] Hock, R., G. Rasul, C. Adler, B. Cáceres, S. Gruber, Y. Hirabayashi, M. Jackson, A. Kääb, S. Kang, S. Kutuzov, Al. Milner, U. Molau, S. Morin, B. Orlove, and H. Steltzer, 2019: High Mountain Areas. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.

[iii] Scott C.A., Zhang F., Mukherji A., Immerzeel W., Mustafa D., Bharati L. (2019) Water in the Hindu Kush Himalaya. In: Wester P., Mishra A., Mukherji A., Shrestha A. (eds) The Hindu Kush Himalaya Assessment. Springer, Cham. https://doi.org/10.1007/978-3-319-92288-1_8

[iv] International Cryosphere Climate Initiative. Andes and Patagonia. http://iccinet.org/andes-and-patagonia/

[v] International Union for the Conservation of Nature. Nature-based Solutions. https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions

[vi] International Union for the Conservation of Nature. Issues Brief: Ecosystem-based Adaptation. https://www.iucn.org/resources/issues-briefs/ecosystem-based-adaptation

[vii] Midgley, S.J.E. et al. 2012. Payment for Ecosystem Services: A climate change adaptation strategy for souther Africa. Regional Climate Change Programme Southern Africa.

[viii] UNFCCC. Lima Adaptation Knowledge Initiative. https://www4.unfccc.int/sites/NWPStaging/Pages/laki.aspx

[ix] The World Bank. (2016). *CO2 emissions – Nepal*. https://data.worldbank.org/indicator/EN.ATM.CO2E.KT?end=2016&locations=NP&start=2015

[x] Government of Nepal, Tribhuvan University Central Department of Environmental Science (2019). *Final Report on Nepal's GHG Inventory Report for Third National Communication.* Government of Nepal Ministry of Forests and Environment. http://mofe.gov.np/noticefile/Nepal%E2%80%99s%20GHG%20Inventory-Final_version_1562308551.pdf

[xi] ClimateWatch. (2021). *2020 NDC Tracker.* https://www.climatewatchdata.org/2020-ndc-tracker?search=nepal

[xii] Government of Nepal, Ministry of Forests and Environment. (2018). *Nepal's National Adaptation Plan (NAP) Process: Reflecting on lessons learned and the way forward.* https://napglobalnetwork.org/wp-content/uploads/2018/07/napgn-en-2018-nepal-nap-process.pdf.

[xiii] https://www.nationalgeographic.org/activity/water-towers-and-shrinking-glaciers/?utm_source=BibblioRCM_Row

[xiv] Nepal's NAP Process

[xv] Government of Nepal, Ministry of Environment. (2010). *National Adaptation Programme of Action (NAPA).* https://www.adaptation-undp.org/sites/default/files/downloads/nepal_napa.pdf.

[xvi] Nepal's NAP Process

[xvii] Government of Nepal. (2020). *Second Nationally Determined Contribution (NDC)*. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Nepal%20Second/Second%20Nationally%20Determined%20Contribution%20(NDC)%20-%202020.pdf

[xviii] 2020 NDC

[xix] 2020 NDC

[xx] Interview with Mountain Community Representative, Nepal.

[xxi] Nepal's NAP Process

[xxii] Nepal's NAP Process

[xxiii] MINAGRI, 2016. Rumbo a un Programa Nacional de Siembra y Cosecha de Agua: Aportes y reflexiones desde la práctica. Ministerio de Agricultura y Riego del Perú. Viceministerio de Políticas Agrarias. Lima: MINAGRI, 2016. 128 pp.

[xxiv] UNFCCC. 16 October 2014. Peru's Glacier's Shrink 40%. https://unfccc.int/news/peru-s-glaciers-shrink-40

[xxv] Recharte, Jorge. 2017. Opinion: These indigenous communities are models for how to adapt to climate change. The Washington Post. https://www.washingtonpost.com/news/theworldpost/wp/2017/12/06/climate-change-glaciers/

[xxvi] Ministerio del Ambiente Perú, 2020. Catálogo de Medidas de Adaptación. Dirección General de Cambio Climático y Desertificación. Viceministerio de Desarrollo Estratégico de los Recursos Naturales. Enero de 2020.

[xxvii] Zapata, F. and Gomez, A., 2015. Adaptación basada en Ecosistemas de Montana: Experiencia y lecciones aprendidas en la restauración de tecnologías ancestrales y contemporáneas para el manejo de los pastos y del agua en la puna. Instituto de Montaña.

[xxviii] Instituto de Montaña, 2016. Tecnologías Ancestrales – La gestión del agua en la Cordillera Negra y la Cordillera Blanca. Ancash, Perú.

[xxix] Programa Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos – PRONAMACHCS.

[xxx] Lecciones de la tierra. Una travesía de aprendizaje por comunidades rurales del Perú que se enfrentan con éxito al cambio climático.

[xxxi] https://mofa.gov.np/about-nepal/history-of-nepal/#:~:text=On%20May%2028%2C%202008%2C%20the,Prime%20Minister%20heading%20the%20Government

[xxxii] Ministerio del Ambiente Perú. Proyecto MERESE-FIDA. https://www.minam.gob.pe/economia-y-financiamiento-ambiental/fida/

[xxxiii] UNDP, PNUMA, IUCN and IM, 2016. El futuro ancestral: la adaptación basada en ecosistemas. Lima.

[xxxiv] FDA, 2013. Vulnerability and Impact Assessment of the Climate Change in the Nor Yauyos Cochas Landscape Reserve and its Buffer Zone – Technical Summary. Fundacion para el Desarrollo Agrario (FDA). December, 2013.

[xxxv] Ministerio del Ambiente Perú. Proyecto MERESE-FIDA. https://www.minam.gob.pe/economia-y-financiamiento-ambiental/fida/

[xxxvi] GoN,2011.*NationalFrameworkonLocalAdaptationPlansfor Action*. Government of Nepal, Ministry of Environment, Singhdurbar.

ANNEX: INTERVIEW QUESTIONS

To meet the objectives of this project, we conducted interviews with in-country partners and local actors working on water adaptation strategies. The preliminary questions for each group of stakeholders – policymakers and government representatives, civil society members, and local community members – are listed below.

Policymakers and Government Representatives

Background

- What geographic regions are most impacted by climate change? Are those same areas prioritized for climate change adaptation measures?
- What water resources in your country are most impacted by climate change?
- Are water resources prioritized in climate change adaptation measures?

National Adaptation Plans

- What are the main adaptation strategies for water management in place or being considered? (i.e. social, economic, gray infrastructure, green infrastructure, etc.)
- How long does the NAP development process take? What is the timeline?
- Who is involved in NAP development? What ministries or agencies head the process?
- What stakeholders are engaged in the process (i.e. NGOs, community groups, international organizations, UN actors, local municipalities, etc.)? Is the process open for public participation? How are the various stakeholders involved in the NAP development process?
- As the NAP is implemented, what is the process to ensure targets and timelines are met?
- Who is involved in NAP monitoring? Are there progress reports? If so, how often?
- How is the NAP updated? How often?

Communities and Adaptation Planning

- How are policymakers taking into account local and traditional water management practices into adaptation planning? How do you learn about those traditional practices?
- How are policymakers taking into account regional and community needs into adaptation planning? How do you identify those community needs?

Finance

- What financing is currently available for adaptation planning?
- What are the barriers in securing financing for adaptation planning?
- Does available financing for adaptation impact the types of adaptation measures implemented (i.e. in favor of nature-based solutions, gray infrastructure, etc.)?
- Is there explicit funding for nature-based solutions?

Ecosystem-Based Adaptation

- Is EbA a priority in national adaptation policymaking?
- How important is EbA in your NAP?
- What nature-based solutions or activities regarding water management are being pursued?

- Do you see any trade-offs with nature-based solutions?

Stakeholders / Civil Society Organizations (CSOs)

Adaptation Planning

- What is your role in adaptation planning?
- Currently, is the approach to adaptation planning bottom-up or top-down?
- Do you participate in NAP feedback mechanisms? If so, how do you participate?
- Are national climate policies taking local and regional needs into account? How so?
- What are the positive effects of climate and adaptation policies? Are there any co-benefits?
- Are there tradeoffs, maladaptations, or negative consequences with climate adaptation policies?

Ecosystem-Based Adaptation

- Is EbA a priority in your water adaptation projects?
- Do you differentiate between EbA and NbS? If so, how?
- Are there any trade-offs with nature-based solutions?

Finance

- What financing is currently available for adaptation planning? What are the main sources of funding? (i.e. government funding, private foundations, multilateral banks, private businesses, etc.)
- What are the barriers in securing financing for adaptation planning?
- Are there any other challenges with adaptation finance or associated requirements from funders?
- Does available financing for adaptation impact the types of adaptation measures implemented (i.e. in favor for nature-based solutions, gray infrastructure, etc.)?
- Is there explicit funding for NbS? Do funding sources prioritize specific pathways of adaptation planning (i.e. gray infrastructure, nature based solutions, etc.)?

In-Country Partners

- How do you identify partners in local communities? How do you work with local community members?
- How do you identify policymakers that are allied with your work? How do you work with policymakers?

Local Communities

Background

- Tell us about water resources in your community.
- How have water resources changed in recent decades?
- Have there been natural disasters or human-made projects that have impacted water resources?
- Have you noticed changes in the quantity or quality of water available?

Water Management

- What problems do you or your community have with water management?
- How has your community traditionally managed water resources?
- What barriers do you have to implementing traditional water management practices?
- Do decisions about water management practices take climate change into account?
- What is your most pressing concern regarding water access in your community?

National Adaptation Plans

- Are your traditional practices in line with or at odds with national adaptation planning?
- Are you involved with NAP feedback or input mechanisms? If so, do you feel your concerns are heard by policymakers?
- Are you involved in the implementation of NAPs? (i.e. have the government or project developers hired you or people in your community to work on adaptation projects?)
- Do you feel that your traditional practices are reflected in NAPs?