



Over 50% of the world's population depends directly or indirectly on mountain ecosystems, which are already being impacted by climate change. So how are Latin Americans that live in mountain areas strengthening their resilience to climate change?

## STRENGTHENING CAPACITIES FOR CLIMATE CHANGE ADAPTATION IN MOUNTAIN ECOSYSTEMS: THE LATIN AMERICAN RESPONSE



### SUMMARY

Mountains provide a broad range of environmental services including water, energy, soils and biodiversity, and are of vital importance for local populations as well as ecosystems and human populations at lower altitudes. Climate change impacts in mountain ecosystems are therefore affecting large geographic areas and millions of people worldwide. In Latin America's mountain ranges in Central America and the Andes, strategies to build capacities for climate change adaptation have generally been participative in nature and have aimed at improving natural resource conservation, providing access to new technologies and capturing traditional knowledge and practices. A strong focus has also been on maintaining water resources and agrobiodiversity. This guide presents a range of experiences, publications and organisations from the region, concluding with lessons that could prove useful to other mountain regions of the world.

### A COMMON CHALLENGE: MANAGING CLIMATE CHANGE IN THE WORLD'S MOUNTAINS

12% of the global population lives in mountain ecosystems and over 50% of the world's population depends directly or indirectly on mountains, which cover 24% of the world's total surface area and provide up to 80% of the planet's freshwater supplies.<sup>1</sup>

<sup>1</sup>Convention on Biological Diversity Subsidiary Body on Scientific, Technical and Technological Advice. [Mountain Biological Diversity](#), Eighth Meeting, Montreal, 10-14 March, 2003.; World Health Organization (WHO) Regional Office for South-East Asia. 2006. [Chapter 2: Introduction to Mountain Regions](#). In: Human Health Impacts from Climate Variability and Climate Change in the Hindu Kush-Himalaya Region: A Report of an Interregional Workshop, India; Swiss Agency for Development and Cooperation (SDC), Mountain Partnership, CDE University of Bern. 2012. [Why Mountains Matter in Global Sustainable Development](#). Draft Version.

### KEY LESSONS LEARNED

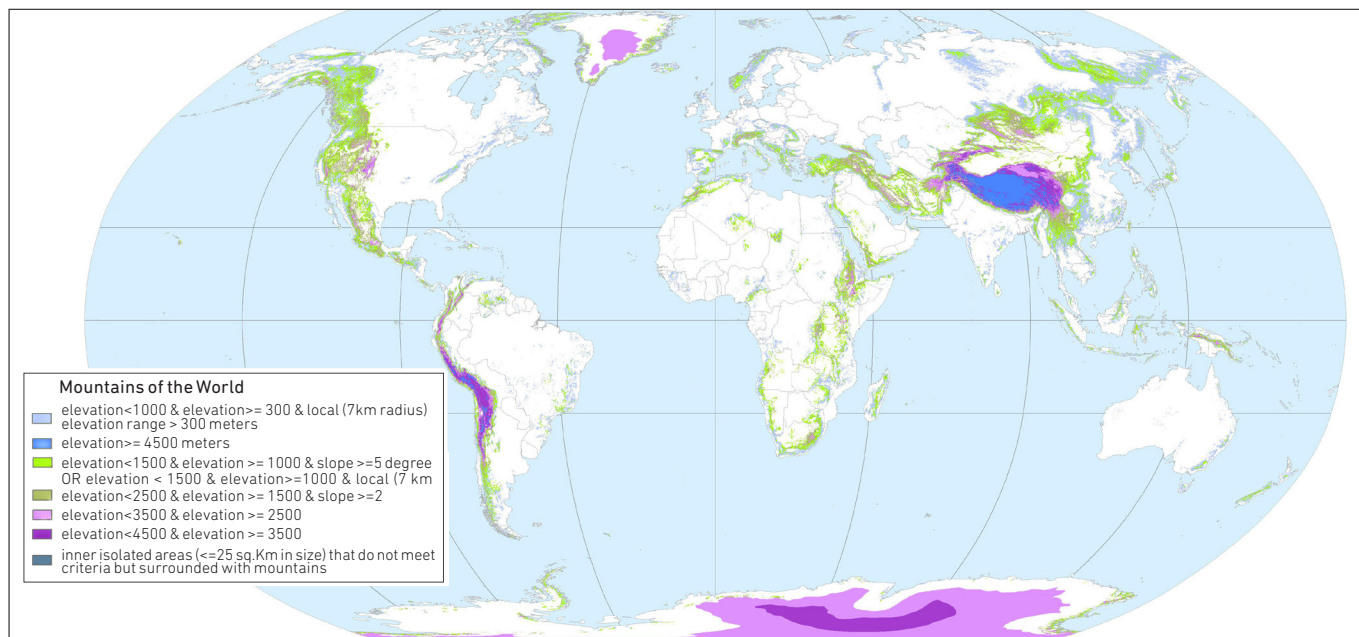
Water resource management is a key issue for mountain regions of Latin America. Existing problems in water management, such as increasing demand, unequal distribution and poor environmental practices, must be tackled with approaches that build adaptive capacity to increasing climate variability.

Strategies aimed at preserving and promoting agro-biodiversity facilitate adaptation to climate change by improving food security amongst rural mountain communities.

Traditional cultures provide a rich source of knowledge and technologies that can facilitate adaptation to climate change and should be incorporated adequately into decision-making processes.



## Mountains of the World



Source: UNEP-WCMC<sup>2</sup>

Over the last decade, increasing information has become available about climate change impacts on mountain ecosystems across Latin America, Africa and Asia. Research shows reductions in the availability of vital ecosystem services, such as freshwater, arable land and biodiversity, which puts the livelihoods of mountain communities at risk. In response, Latin American countries have been developing innovative strategies for climate change adaptation based on both scientific and traditional knowledge. Political interest, research capacity and civil society participation have all contributed to these processes.

This guide presents experiences from across the Latin American region, focusing on strengthening research and its use, disseminating traditional knowledge, improving water management and preserving agrobiodiversity. It draws out enabling and contextual factors as well key lessons that could be useful to countries in sub-Saharan Africa and Asia. Finally, it links readers with additional information available through key publications and organisations.

### Latin America's Mountains

The most prominent mountain range in Latin America is the Andes which has an average height of 4000 meters and

stretches almost 8000 kilometres in length along the Pacific coast from Venezuela to Cape Horn in Chile. Mountains in the Andes are characterised by steep peaks and variable climatic conditions. The source of most major rivers on the continent, the Andean Mountains are also home to a diverse range of micro-climates, from glaciers and ice sheets to tropical forests. Rainfall levels vary greatly, from less than 50 mm/year in the Atacama Desert to as much as 10,000 mm/year in northern Peru and Ecuador.

Central America is a tropical region with a chain of mountains that extends from the Mexican border through Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica and Panama. Most of the major Central American mountains are volcanoes which provide fertile soils and cool temperatures. The main mountain range in Mexico - the Sierra Madre Mountains - includes areas with snow-covered peaks as well as sections that include thick vegetation and humid temperatures.

Latin America's mountains are centres of origin of a variety of crops such as corn, potato, beans, tomato and squash, that are vital for food security across the region. They are also home to mountain cultures, such as the Maya and Inca that have played a leading role in the development of agricultural practices.

<sup>2</sup>United Nations Environment Programme (UNEP)-World Conservation Monitoring Centre (WCMC). 'Mountains and Forests in Mountains (2000)' Dataset. [Website](#) accessed 06 June 2012.



## LATIN AMERICAN RESPONSES

### Research to Support Adaptation Planning and Implementation

Primary data on climate change impacts is an essential component of adaptation planning processes. Likewise, research plays a critical role in the emergence, testing and dissemination of new adaptation technologies. In Latin America, a wide range of organisations are undertaking research into different dimensions of climate change in mountain ecosystems.

Given that water is the resource most affected by climate change in mountain ecosystems, research efforts to monitor distinct aspects of climate variability and its impact on water have been scaled-up over recent years. For example, Colombian scientists, as part of the [National Pilot Programme for Climate Change Adaptation](#) (*Programa Piloto Nacional de Adaptación al Cambio Climático - INAP*) are gathering data on glacial retreat and developing a glacial mass index. Similar studies are being carried out in Peru by the [Department for Glaciology and Water Resources of the National Water Authority](#) (*La Unidad de Glaciología y Recursos Hídricos de la Autoridad Nacional de Agua*). Likewise, activities are underway in Bolivia to monitor the impacts of climate change on water resources via a network of meteorological stations.<sup>3</sup> In Honduras, the [Tropical Agricultural Research and Higher Education Center](#) (*Centro Agronómico Tropical de Investigación y Enseñanza – CATIE*) is carrying out studies into water availability and quality, as well as assessments of land use change and land cover, in order to evaluate water resource depletion.

In addition, research into agriculture and anthropology has identified a broad range of traditional knowledge and technologies that have been used by mountain communities to adapt to climate variability for centuries. These communities

have accumulated a rich source of knowledge and tried and tested technologies that demonstrate great potential for meeting the current challenges of climate change, such as extended periods of drought and higher variability in daily and seasonal temperatures. In countries such as Bolivia, Ecuador and Peru, research initiatives have been carried out to capture and assess traditional knowledge and practices, and in particular, strategies for preserving agrobiodiversity and sustainable water resource management.<sup>4</sup> In addition, prominent researchers including Professor John Earls<sup>5</sup> (in Peru), Eduardo Chilon<sup>6</sup> and Ann Chaplin<sup>7</sup> (in Bolivia) have undertaken work to identify the contributions of traditional knowledge to climate change adaptation strategies.

### Disseminating Traditional Knowledge and Technologies

In addition to researching traditional practices, Latin American actors have also found success in disseminating and promoting these practices. In fact, in Latin America there is growing recognition of the important contributions traditional knowledge and technologies are making to climate change adaptation processes. Consequently, a growing number of adaptation strategies and programmes incorporate traditional practices. Evaluations of traditional strategies for sustainable water management, agro-biodiversity conservation and sustainable agricultural production have been carried out in countries such as Ecuador, Peru, Bolivia<sup>8</sup> and Guatemala.<sup>9</sup>

A variety of traditional technologies exist that are facilitating adaptation to climate change in mountain ecosystems. Here are just a few highlights:

- The *covered bean (frijol tapado)* method used in Mexico consists of laying organic material over the sowed seeds to retain soil moisture and provide a rich fertilizer direct to the bean sprouts. This method has proven to reduce soil erosion and the impacts of climate variability on bean crops.<sup>10</sup>

<sup>3</sup> See, for example: [Bolivia Opens Station of Climate Control](#), website accessed May 2012.; República de Bolivia (Ministerio de Planificación del Desarrollo). 2007. *Mecanismo Nacional de Adaptación al Cambio Climático*. (National Mechanism for Climate Change Adaptation). La Paz.; Paz Rada O., Romero Crespo, S., Tejada Miranda, F. 1997. *Analysis of Climate Scenarios for Bolivia* *Climate Research* 9 115-120.

<sup>4</sup> For case studies of traditional water use and management technologies from Bolivia, Ecuador, and Peru, see: Doornbos, B. 2009. *Medidas Probadas en el Uso y la Gestión del Agua: Una Contribución a la Adaptación al Cambio Climático en los Andes (Tried and Tested Measures for Water Use and Management: A Contribution to Climate Change Adaptation in the Andes)*. ASOCAM, Quito.

<sup>5</sup> Earls, J. [The Character of Inca and Andean Agriculture](#), presentation given in Israel in 1998 sponsored by the Catholic University of Peru and the Peruvian Embassy in Israel.

<sup>6</sup> Chilon, E. 2009. [Ancient Technology and its Effect on Climate Change](#). *CienciaAgro* 1(4) 139-143.

<sup>7</sup> Chaplin, A. 2007. *Perceptions of Climate Change in the Bolivian Altiplano: Ancoraimes and Norte Potosí*. Christian Aid.

<sup>8</sup> Doornbos 2009, above n 4.

<sup>9</sup> Bolvito, J., Macario, T., Sandoval, K. 2008. *Capítulo III. Conocimiento Tradicional Colectivo y Biodiversidad (Traditional Collective Knowledge and Biodiversity)*. Consejo Nacional de Áreas Protegidas, Guatemala City.

<sup>10</sup> Altieri, M., Hecht, S. 1997. *Agroecología: Bases Científicas para una Agricultura Sostenible (Agroecology: Scientific Bases for Sustainable Agriculture)*. Secretariado Rural Perú-Bolivia, Lima.



- In the Andean region, systems such as the *Waru Waru* (terraces) are used to optimise water resources and protect against extreme micro-climatic conditions.<sup>11</sup>
- *Amunas* are traditional systems for re-filling natural water sources by diverting rain water in stone-constructed channels.<sup>12</sup>
- In Mexico, [chinampas](#) are artificial structures of earth platforms and water channels constructed to facilitate intensive agricultural production and avoid soil erosion.
- Climate indicators, including biological changes in plants and animals, as well as astrological signs, are used to programme agricultural activities in nearly all mountain communities. For example, in [Guatemala solar and lunar calendars](#) have been developed based on ancestral Mayan knowledge.

To learn more about the role of indigenous knowledge in the region, read the [ELLA Brief: How Traditional Technologies and Knowledge are Contributing to Climate Change Adaptation in Mountain Ecosystems of Latin America](#).

### Strategies for Sustainable Water Resource Management

Climate change is expected to significantly reduce the availability of freshwater supplies in Latin America, mainly through the complete disappearance of the region's main glaciers over the next 30 years. In response, Latin American governments, NGOs and international development agencies have been developing, testing and promoting sustainable water use through irrigation systems, storage infrastructure and water capture technologies, amongst others. In many cases, the development of new technologies has involved the participation of local communities. Furthermore, an increasing number of programmes are researching and disseminating traditional technologies.

The implementation of technologies for sustainable water use is a common feature of adaptation programmes being carried out in Andean countries. Drip irrigation for small-scale farmers has been introduced with the aim of optimising water use, reducing losses and soil erosion that is caused by irrigation practices based on flooding techniques. Likewise, to improve water storage capacity, water capture projects

have included the construction of reservoirs and micro-dams, conservation of water sources, restoration of natural water sources and methods to reduce water pollution. Bolivia's [National Irrigation Programme](#) offers a key example of sustainable water management in the Andes

One common feature of the Latin American approach to water management is community participation. In general, sustainable water management technologies are managed by Irrigation Boards, which are civil society organisations responsible for administering water sources and ensuring equitable and efficient distribution. Likewise, government authorities are developing water management plans that focus on ecological restoration and prioritise community participation. A notable case is that of Bolivia where more than 150 community organisations have been set up and participate in activities and actions related to climate change adaptation, including water management. [CATIE](#) has also led a programme of work in Honduras and Nicaragua entitled [FOCUENCAS](#) to promoting community leadership in adaptation processes and integrated watershed management.

To learn more about water management in the context of climate change in mountain areas, read the [ELLA Brief: Key Advances in Water Management and Climate Change Adaptation in Latin America's Mountains](#).

### Strategies for Promoting Agrobiodiversity

Preserving and promoting agrobiodiversity is a key climate change adaptation strategy in mountain ecosystems because it can improve food security amongst vulnerable populations. Native crop and animal species raised for food in Central America and the Andes demonstrate genetic characteristics with high resilience to the climate variability. Agricultural production systems based on conserving and promoting agro-biodiversity have been shown to improve the food security of rural households. A number of climate change adaptation initiatives are underway that incorporate this approach. These include:

- The International Potato Center's [Highland Potato Programme](#) is introducing more nutritious potato varieties that also carry resistance to stresses caused by climate change. The programme incorporates farmer testing and builds farmer capacity to manage crop disease.

<sup>11</sup> bid.

<sup>12</sup> Llosa J., Pajares E., Toro O. (eds.) 2009. *Cambio Climático, Crisis del Agua y Adaptación en las Montañas Andinas: Reflexión, Denuncia y Propuesta Desde los Andes* (*Climate Change, Water Crisis and Adaptation in the Andean Mountains: Reflection, Denunciation and Proposal from the Andes*). Desco: Red Ambiental Peruana, Lima.





- In Mexico, Nicaragua and Peru, the coffee company CafeDirect and GTZ collaborated on a project to facilitate adaptation to climate change among coffee producers via [promotion of agro-forestry farming systems](#).
- A [controlled alpaca breeding project](#) implemented by [Soluciones Prácticas \(Practical Action - Latin America\)](#) in partnership with communities living in the Peruvian Andes improved alpaca fertility rates, reduced mortality and improved the quality of fibre and the yield per alpaca.
- [In-situ Conservation of Andean Crops and Their Wild Relatives](#) is a project implemented in the Central Andes by IIAP and UNDP-GEF. The project has contributed to understanding of how wild relatives of domesticated crops, such as the potato, provide a source of 'rustic' genes that can increase resilience to climate variability, such as greater drought and frost.

To learn more about agrobiodiversity and climate change in the region, read the [ELLA Brief: Strengthening Agrobiodiversity: A Key Adaptation Strategy for Latin America's Mountain Ecosystems](#).

## ON-GOING CHALLENGES FOR LATIN AMERICA

Latin American countries have had clear successes in increasing resilience to climate change in mountain areas in the areas discussed above. But what are the challenges countries in the region still face?

### Limited Capacity for Sustainable Water Management

Despite some advances, Latin American countries still lack the necessary capacities to effectively implement sustainable water management practices that address the declining availability of - and increasing demand for - water resources. They also continue to grapple with poor water quality caused by pollution and environmental degradation, inequality of access and the social conflicts that arise as a result. Glacial retreat increases the urgency of overcoming existing problems and developing strategies that build adaptive capacity towards future uncertainty in freshwater availability.

### Increasing Losses in Agrobiodiversity

Another important challenge to climate change adaptation in Latin American mountain regions is increasing losses in

agro-biodiversity. These losses are concentrated in mountain ecosystems where small-scale and subsistence farming systems are the predominant form of agricultural production. The loss of genetic variety of plants and animals has been increasing over recent years due in large part to the promotion of technologies that homogenize the environment. This has reduced populations of native plants that are more resilient to climate change impacts. There is therefore an urgent need to preserve native varieties and develop ways of using their genes to increase the resilience of staple food crops and help to ensure food security worldwide. Appropriate legal protection is required to preserve and promote agro-biodiversity, particularly given the concerns around long-term impacts of biotechnology.

### Erosion of Indigenous Knowledge

Due to high degrees of social exclusion felt by indigenous populations as well as weak social organisation and unfavourable government policies, traditional knowledge is being lost at an increasing rate. Traditional knowledge of the natural environment and of technologies for dealing with uncertain climate conditions is an essential source of information for developing locally-appropriate climate change adaptation strategies. Increased research efforts are therefore required to register and protect traditional knowledge and technologies while promoting their incorporation into relevant policies.

### Poor Policy Coordination and Coherence

National adaptation policies have been established across Latin American countries via transparent and participatory processes. Progress at regional and local levels, however, remains limited. This means that national policies do not adequately incorporate regional and local priorities, nor are adequate plans in place to finance and execute locally-appropriate adaptation initiatives at these levels. This is particularly important for mountain regions where the impacts of climate change can be both locally-specific and unpredictable, requiring flexible responses that reflect changing local needs. Poor coordination and coherence between adaptation policies at different levels has meant that to date only 3 countries - Bolivia, Mexico and Peru - have integrated indigenous knowledge into national adaptation planning. More needs to be done to integrate this knowledge into local, regional and national policies, including establishing adequate and appropriate legal frameworks to protect the intellectual property rights of indigenous communities.

## CONTEXTUAL FACTORS

## ENABLING LATIN AMERICA'S SUCCESSFUL ADAPTATION EXPERIENCES



Latin American governments are increasingly aware of the current and potential future impacts of climate change on economic development and the well-being of society. Over the past decade, climate change, and environmental issues more generally, have been increasingly incorporated into national agendas. Governments have also been creating special branches and agencies dedicated to addressing environmental issues and implementing climate change adaptation strategies.

In many Latin America countries, government institutions, NGOs and international development agencies are providing the main driving force behind programmes and capacity building actions aimed at facilitating adaptation to climate change. This work has been possible thanks to increased funding for climate change adaptation initiatives made available from

both national governments and international development aid.

Civil society actors in Latin America are well-organised and pro-actively participate in decision making processes related to natural resources, traditional knowledge and, more recently, climate change adaptation. This has contributed to the development of adaptation strategies that reflect local priorities and incorporate traditional knowledge and technologies.

Across Latin America, there are an increasing number of projects that are testing, implementing and disseminating 'hardware' options for climate change adaptation in mountain ecosystems. These include improved irrigation infrastructure, like reservoirs and canals, and technologies that optimise water use, such as pressurised and drip irrigation techniques.

### LESSONS LEARNED

**1** A primary concern for climate change adaptation in Latin American mountain ecosystems is the loss of key water sources, such as the region's major glaciers. Given the uncertainty of future climate scenarios, existing problems in water management must be tackled with approaches that build adaptive capacity to increasing climate variability.

**2** Preserving and promoting agrobiodiversity is a key climate change adaptation strategy in mountain ecosystems across Latin America, where it has improved food

security amongst vulnerable populations. Technical and institutional capacity for integrating agrobiodiversity into climate change adaptation strategies for mountain ecosystems can be built by strengthening information flows and implementing regional programmes across the region's mountainous areas.

**3** Traditional mountain cultures of Latin America provide an essential source of knowledge and practices that can facilitate adaptation to

climate change. At the same time, due to the unprecedented nature of climatic change impacts in mountain regions across Latin America, scientific research and development also plays a key role in generating innovative adaptation strategies to face this challenge.

**4** It is necessary to develop adaptation policies that reflect local and regional priorities and that are well integrated into national strategies. This will help to improve the coherence and effectiveness of adaptation efforts.

## CONCLUSION

Being home to some of the world major mountain ranges, Latin American countries have significant experience to offer in strengthening resilience in the face of climate change in mountain ecosystems. Taking a broad look across the continent, some successful strategies emerge, namely improving water governance, building research capacity and strengthening civil society organisations. Disseminating technology and infrastructure – especially through a recognition of the key role of indigenous knowledge – has also been key. While recognising its successes, in the future Latin American countries with mountain ecosystems need to keep their focus on ongoing challenges, such as capacity gaps and erosion of traditional knowledge systems.

## KNOWLEDGE PARTNERS

Some of the most important organisations developing and implementing climate change adaptation strategies in mountain ecosystems across Latin America are listed below. Additional information about these and other organisations

can also be found in the [ELLA Spotlight on Key Organisations: Climate Change Adaptation in Mountain Ecosystems](#).

[Consortium for Sustainable Development in the Andean Ecoregion \(Consortio para el Desarrollo Sostenible de la Ecoregión Andina - CONDESAN\)](#) is a consortium of national and





international research institutes, universities, international development agencies, local and national governments, private sector actors and NGOs focused on promoting the sustainable use of natural resources in the Andean region (Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela).

[Economic Commission for Latin America \(ECLAC\)](#) is one of the UN's five regional commissions, and works in 33 countries in Latin America and the Caribbean. Sub-regional offices are located in Argentina, Brazil, Colombia and Uruguay. The Division for Sustainable Development and Human Settlements (DDSAH) manages the [Economics of Climate Change in Latin America](#) project which includes research on socioeconomic impacts of climate change, adaptation policy and financial planning. This project, as well as the DSSAH's technical reports, includes a focus on the region's mountainous zones.

[Institute for Hydrology, Meteorology and Environmental Studies \(Instituto de Hidrología, Meteorología y Estudios Ambientales - IDEAM\)](#) sits within Colombia's Ministry for Environment and Sustainable Development and is responsible for generating information and knowledge to guide decision making and planning for climate change. Current projects include a [pilot programme](#) for adaptation to climate change in high mountain ecosystems.

[Inter-American Institute for Cooperation on Agriculture \(IICA\)](#) is a specialised technical agency working in 34 countries, principally in coordination with the ministries of agriculture. The institute works on areas including adapting agriculture to climate change, agricultural production with environmental responsibility, efficient and integrated management of natural resources, and food security.

Created by the Environment Ministries from 19 Latin American and Caribbean countries, the [Inter-American Network of Climate Change Offices \(Red Iberoamericana de Oficinas de Cambio Climático - RIOCC\)](#) provides a platform for dialogue as well as opportunities for joint initiatives and face-to-face meetings to exchange and evaluate experiences. Their work includes a focus on the region's mountains areas.

[International Potato Center \(Centro Internacional de la Papa - CIP\)](#) is part of the 15-centre research alliance known as the [Consultative Group on International Agricultural Research \(CGIAR\)](#). CIP is an international centre with its headquarters in Lima, Peru, and offices in 30 developing countries across Asia, Africa and Latin America. In the Andean mountains, the Center carries out research into conservation, agro-biodiversity and the impacts of climate variability on potato varieties.

[National Institute of Ecology \(El Instituto Nacional de Ecología - INE\)](#) is a research institute of the Mexican government's Department for Environment and Natural Resources tasked with both generating scientific and technical information

relating to environmental challenges and with building capacity for improved environmental protection and sustainable resource use. Activities relating to Mexico's sub-humid mountain areas include impact assessments and adaptation strategies in forest and water resource management.

[Regional Centre for Information on Disasters in Latin America and the Caribbean \(Centro Regional de Información sobre Desastres América Latina y El Caribe - CRID\)](#) is a knowledge management, generation and exchange initiative led by the [Pan-American Health Organization](#), [UN International Strategy for Disaster Reduction Secretariat](#), [National Commission for Risk Prevention and Emergency Response in Costa Rica](#), [International Federation of Red Cross and Red Crescent Societies](#), [CEPRENAC](#) and the [US National Library of Medicine](#). Its focus on disaster risk reduction includes the mountain ecosystems of the Latin America region.

[Tropical Agricultural Research and Higher Education Center \(Centro Agronómico Tropical de Investigación y Enseñanza - CATIE\)](#) is a regional centre working alongside more than 200 public and private partners in 14 countries throughout Latin America and the Caribbean. CATIE is currently coordinating a regional project entitled [Potential Impacts of Climate Change on Forest Ecosystems in Latin American Mountain Ranges and Adaptation Management Tools \(CLIMIFORAD\)](#).

[Water Center for the Humid Tropics of Latin America and the Caribbean \(CATHALAC\)](#) is an international organisation working throughout Latin America and the Caribbean, including in the region's mountainous zones. CATHALAC's climate change programme is focused on providing hard data, developing information and monitoring tools, and promoting social networks for knowledge sharing.

## RECOMMENDED READING

Below is a short list of recommended reading on climate change adaptation in mountain ecosystems, with a particular focus on Latin America. Additional information about these and other publications can also be found in the [ELLA Spotlight on Publications: Climate Change Adaptation in Mountain Ecosystems](#).

Altieri, M., Nicholls, C. 2008. Los Impactos del Cambio Climático sobre las Comunidades Campesinas y de Agricultores Tradicionales y sus Respuestas Adaptativas ([The Impacts of Climate Change on Traditional Rural Agricultural Communities and Their Adaptation Responses](#)). *Revista Agroecología* 3 7-28.

CATIE. 2008. *Adaptación al Cambio Climático: el Rol de los Servicios Ecosistémicos* ([Climate Change Adaptation: The Role of Ecosystem Services](#)). CATIE, TroFCCA, SIASSE, San Juan.



Clements, R., Cossío, M., Ensor, J. (eds.) 2010. [\*Climate Change Adaptation in Peru: The Local Experiences\*](#). Soluciones Prácticas (Practical Action – Latin America), Lima.

Doornbos, B. 2009. *Medidas Probadas en el Uso y la Gestión del Agua: Una Contribución a la Adaptación al Cambio Climático en los Andes* ([\*Tried and Tested Measures for Water Use and Management: A Contribution to Climate Change Adaptation in the Andes\*](#)). ASOCAM, Quito.

Franco-Vidal, C. et al. (eds.) 2010. *Experiencias de Adaptación al Cambio Climático en Ecosistemas de Montaña en los Andes del Norte* ([\*Climate Change Adaptation Experiences from Mountain Ecosystems in the Northern Andes\*](#)). Report of Regional Workshop, 19-20 February 2009. WWF, MAVDT, Ideam, Fundación Humedales, Bogotá.

Kohler, T., Maselli, D. (eds.) 2009. [\*Mountains and Climate Change – From Understanding to Action\*](#). University of Bern, Bern.

Llosa, J., Pajares, E., Toro, O. (eds.) 2009. *Cambio Climático, Crisis del Agua y Adaptación en las Montañas Andinas: Reflexión, Denuncia y Propuesta Desde los Andes* ([\*Climate Change, Water Crisis and Adaptation in the Andes Mountains\*](#)). Desco, Red Ambiental Peruana, Lima.

Martínez, A.G. et al. 2006. [\*Vulnerability and Adaptation to Climate Change in the Peruvian Central Andes: Results of a Pilot Study\*](#). Proceedings of the 8th International Conference on Southern Hemisphere Meteorology and Oceanography.

The Mountain Institute. 2009. [\*Climate Change and Mountains: Adaptation and Resilience in Mountain Communities and Ecosystems Around the World\*](#). The Mountain Institute.

UK Department for International Development (DFID), World Wildlife Foundation (WWF). 2011. [\*Climate Change in a Living Landscape: Conceptual and Methodological Aspects of a Vulnerability Assessment in the Eastern Cordillera Real of Colombia, Ecuador and Peru\*](#). DFID/WWF, Santiago de Cali.

## LEARN MORE FROM THE ELLA BRIEFS

These four ELLA Briefs focus in on key aspects of the Latin American approach to climate change adaptation in mountain ecosystems:

[Key Advances in Water Management and Climate Change Adaptation in Latin America's Mountains](#)

Water Basin Councils and citizen participation mechanisms, terracing and 'water raising', and innovative tools for researching vulnerability: these are just a few of the strategies Latin American countries are using to strengthen adaptation to changing water availability in their mountain regions.

[Strengthening Agrobiodiversity: A Key Adaptation Strategy for Latin America's Mountain Ecosystems](#)

With their high levels of agrobiodiversity, Latin American countries are implementing innovative research programmes and policies to conserve native and wild crop and animal species. Their work is helping to both promote diversity and facilitate climate change adaptation.

[How Traditional Knowledge and Technology are Contributing to Climate Change Adaptation in Mountain Ecosystems Across Latin America](#)

Traditional communities living in Latin America's mountain regions possess an extraordinarily broad range of knowledge about the natural environment and adapting to unpredictable climatic conditions. From water management strategies to agricultural timing and production techniques, traditional practices are making important contributions to adaptation policy and practice.

[A Case Study in Innovative Adaptation in Mountain Ecosystems: Bringing Economic, Environmental and Social Benefits Through Agroforestry](#)

Small-scale coffee and cocoa farmers in northern Peru are successfully adapting to climate change challenges and enjoying higher incomes thanks to an innovative agroforestry project.

## CONTACT THE AUTHORS

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To learn more about climate change adaptation in Latin America's mountain environments, read the rest of the [knowledge materials](#) on this theme. To learn more about other ELLA development issues, browse other [ELLA Themes](#).

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