ELLA Brief
ELLA Area: Environmental Management
ELLA Theme: Adaptation in Mountain Environments

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Evidence and lessons from Latin America

Water Basin Councils and citizen participation mechanisms, terracing and 'water raising', 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.

KEY ADVANCES IN WATER MANAGEMENT AND CLIMATE CHANGE ADAPTATION IN LATIN AMERICA'S MOUNTAINS

SUMMARY

Within mountain ecosystems across Latin America, Africa and Asia, increasing climate variability, gradual glacial melting and more frequent and intense extreme weather events are negatively affecting the ability of water cycles to self-regulate. This is leading to increased water scarcity which is already affecting one in three people worldwide.[1] This Brief begins by describing the main challenges to providing sustainable and equitable access to water in the face of climate change impacts. It then highlights four key strategies being implemented in Latin America that are improving sustainable water management policy and practice while also facilitating climate change adaptation. Examples from across the region and contextual factors that have underpinned improvements in water management and adaptation provide key lessons to be considered by other countries and regions.

COMMON CHALLENGE: SUSTAINABLE AND EQUITABLE WATER ACCESS IN THE FACE OF UNCERTAINTY

Throughout the mountainous regions of Latin America, climate change is reducing the availability of water resources due to increases in average temperatures, changes in rainfall levels and patterns, and the increasing frequency and intensity of extreme weather events.[2] In countries such as Colombia, Ecuador and Peru, glaciers have been retreating at an unprecedented rate over the last few decades. Vulnerability studies predict that many will disappear completely in less than 30 years.[3]

In addition to the direct impacts of climate change, Latin American countries also struggle with increasing water demand, poor water quality caused by pollution and environmental degradation, and inequality in access and the social conflicts that arise as a result. Countries across South Asia and Sub-Saharan Africa are facing similar challenges. Due to the combination of these environmental, physical, economic and social factors, experts project that by 2025, 1.8 billion people will live in countries or regions with absolute water scarcity (see Figure 2).

[1] World Health Organization (WHO). *10 Facts About Water Scarcity*. Online publication, accessed March 2012.
[2] Parry, M.L. (eds.) *et al.* 2007. *Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the IPCC on Climate Change*. Cambridge University Press, Cambridge.
[3] Ibid.

Figure 1: Principal River Basins of Latin America

Source: P. J. Depetris, P.J., Paolini, J.E. 1991. Chapter 5: Biogeochemical Aspects of South American Rivers: The Paraná and the Orinoco. In: Degens, E., Kempe, S., Richey, J. (eds.) SCOPE 42: *Biogeochemistry of Major World Rivers*. Scope.

In mountain ecosystems across the world, the most challenging issue relating to sustainable water management is the high level of uncertainty about future climate change impacts. This makes planning for water management particularly complicated and highlights the need for approaches that build capacity to adapt to the unexpected.[4] In particular, this likely means prioritising these actions:

1. Reduce vulnerability to unpredictable changes in the availability of water, for example, through improving research and information sharing capacities or developing water storage technologies
2. Protect and restore ecosystems that provide critical resources and services in relation to water and land
3. Reduce existing discrepancies between water demand and supply[5]

FOUR KEY STRATEGIES FROM LATIN AMERICA'S EXPERIENCE

To address these challenges, Latin American countries have implemented some common strategies to strengthen climate change adaptation related to water management in their mountain regions. Below, four of these key areas of focus are highlighted: water governance; research; technologies and infrastructure; and civil society.

Strengthening Water Governance

Several Latin American countries have developed a new vision in legislation relating to water resources, which has played a key role in strengthening governance and building adaptive capacity. This new legislation's principal aims have been to:

1. Incorporate a broader, more integral understanding of sustainable water management into public policy
2. Clearly define the roles and responsibilities of relevant public institutions
3. Set out the rights and responsibilities of water users
4. Integrate issues of environmental conservation and sustainability into policy and practice, rather than merely focusing on water use and extraction

This new package of water legislation has typically involved establishing two key institutions:

1. National Water Authorities: Through these agencies, clearly defined roles and responsibilities relating to water management are centralised within one public institution, helping to avoid overlapping and gaps, and leading to improvements in coordination between relevant government agencies. National Water

[4] Ensor, J., Berger, R. 2009. *Governance for Community Based Adaptation*. Practical Action Discussion Paper. Practical Action, Rugby.; Chapin, F. S. *et al.* 2006. *Policy Strategies to Address Sustainability of Alaskan Boreal Forests in Response to a Directionally Changing Climate. Proceedings of the National Academy of Sciences of the United States of America* 103(45): 16,637-16,643.; Smit, B., Wandel, J. 2006. Adaptation, Adaptive Capacity and Vulnerability. *Global Environmental Change* 16: 282-292.
[5] Bergkamp, G. *et al.* 2003. *Cambio: Adaptación de la Gestión de los Recursos Hídricos al Cambio Climático (Change: Adapting Management of Water Resources to Climate Change)*. IUCN, San José.

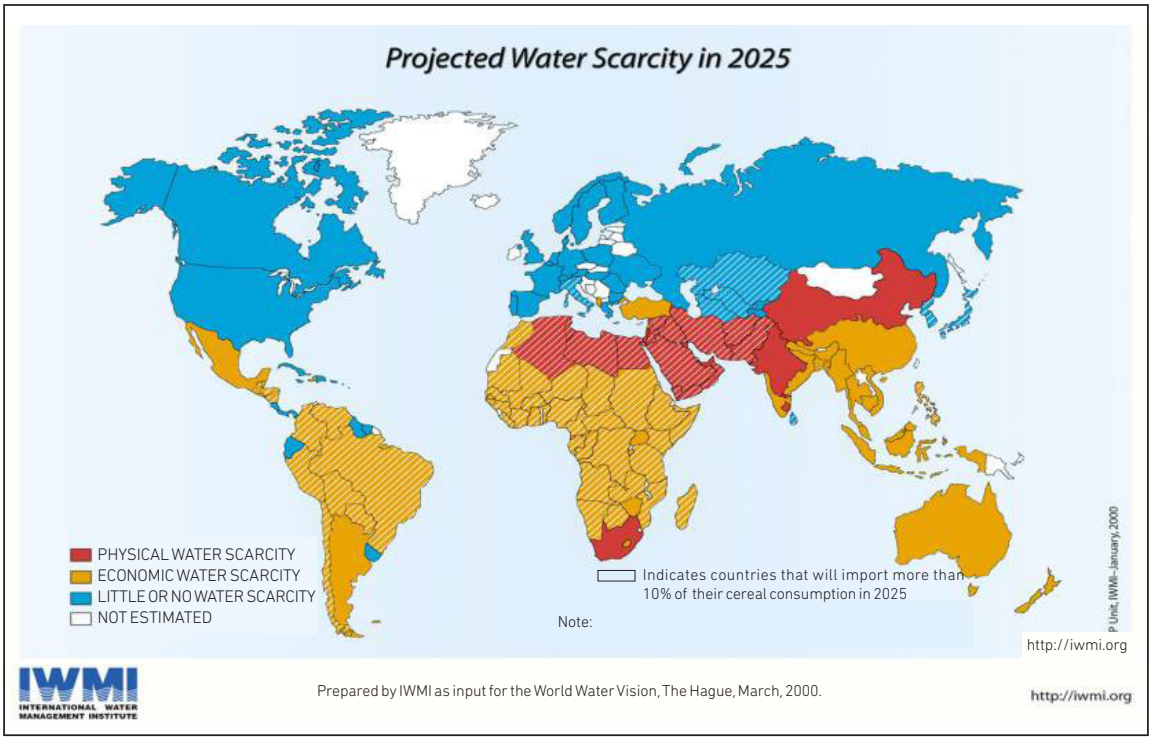


Figure2: Projected Water Scarcity in 2025
Source: International Water Management Institute (IWMI). 2000. *Projected Water Scarcity in 2025*. Prepared for the World Water Vision, The Hague.

Authorities have been coordinating research into and monitoring of the impacts of climate change on water resources in mountain ecosystems in a number of countries, including Brazil,[6] Ecuador,[7] Mexico[8] and Peru.[9]

2. Water Basin Councils: These are consultation platforms, such as the *Consejos de Cuenca* in Mexico, that bring together different water users.[10] Water Basin Councils create a space for civil society participation in decision making and facilitate the development of more locally-appropriate and sustainable adaptation and water resource management strategies. In opening up spaces for increased civil society participation, Latin American governments are moving towards achieving a more integrated approach to sustainable water management, as advocated by the IPCC.

Focus on Research

In Latin America there is increasing recognition of the need for rigorous scientific research into water resources and climate change adaptation in mountain ecosystems to inform decision making. In many countries, research initiatives led by public institutions are providing primary data for analysing the climate change impacts on water resources:

- Peru: The National Water Authority's Department of Glaciology and Water Resources (*La Unidad de Glaciología y Recursos Hídricos de la Autoridad Nacional de Agua*) has set up monitoring stations at each of the country's principal glaciers. They are supported by Local Disaster Risk Prevention Committees that bring together representatives from local communities.
- Colombia: The Institute for Hydrology, Meteorology and Environmental Studies (*Instituto de Hidrología, Meteorología y Estudios Ambientales - IDEAM*) is undertaking similar activities to monitor glacial retreat. Likewise, the National Pilot Programme for Climate Change Adaptation (*Programa Piloto Nacional de Adaptación al Cambio Climático - INAP*) is gathering and analysing information relating to water cycles with the aim of elaborating a glacial mass index.

[6] Dos Santos, J. L. *The Establishment of the National Water Agency*. Unpublished case study.; Porto, M., Kelman, J. 2000. Water Resources Policy in Brazil. *Rivers – Studies in the Science Environmental Policy and Law of Instream Flow 7*(3).
[7] To learn more, see Ecuador's National Water Secretariat website (Spanish only).
[8] To learn more, see the English-language website of Mexico's National Water Commission.
[9] To learn more, see Peru Shared Vision Planning on the International Center for Integrated Water Resources Management website, as well as Peru's National Water Authority webpage.
[10] Mestre, E. 2001. *The Design of River Basin Organizations in Mexico – The Example of Lerma – Chapala*. Paper presented at the 5th River Basin Management Workshop, Washington, DC.

- Bolivia: The National Meteorology and Hydrology Service (*Servicio Nacional de Meteorología e Hidrología – SENHAMI*) has established climate change monitoring networks with 100 hydrological stations nationwide.
- Ecuador: Experts are using CRiSTAL (Community-based Risk Screening Tool – Adaptation and Livelihoods) in 13 sustainable water management projects within the National Climate Change Adaptation Programme (PACC) in Ecuador.[11] An important feature of the tool is that gathers primary data on climate change impacts through participation from community members.

In Bolivia, Ecuador and Peru, various research initiatives are underway to capture traditional knowledge and practices relating to sustainable water management.[12] In Latin America, rural native communities in high mountain ecosystems have been living with and adapting to climate variability over millennia. As such, these communities provide an essential source of knowledge for the development of locally-appropriate climate change adaptation and water management strategies (see Text Box).[13]

Developing and Disseminating Technologies and Infrastructure

Across Latin America, various types of infrastructure and technology are improving water storage capacity and promoting more efficient water use in times of scarcity. Some key examples are presented here:

- Some countries are implementing national programmes to promote irrigation technologies. In Bolivia, for example, the National Irrigation Plan aims to increase irrigation in the agriculture sector and promotes drip irrigation technologies to mitigate the impacts of drought in zones where populations are vulnerable to food insecurity.
- Household technologies are being promoted in response to temperature rises and water shortages

Highlight on Traditional Knowledge: Water-raising

Amongst traditional high mountain communities practices known as "water-raising" provide a range of mechanisms for facing changing climates and adapting to water shortages. Here are two examples:

Amunas

Amunas, a type of rainwater harvesting system, is a technique to divert rainwater into canals constructed out of stone to channel it towards natural springs or constructed dams. Water that is collected during the rainy season can be stored for dry periods, thereby improving year-round availability for crop irrigation and household use and decreasing risk of harvest losses from drought.

Agricultural Terraces

Crop terracing is a strategy for reducing soil erosion and minimising water use in times of scarcity. In Peru, these terraces have been constructed since the age of the Inca Empire in the 15th and 16th centuries. A terrace is a levelled surface used to cultivate on sloping, hilly or mountainous terrain, and is effective for growing a wide range of crops such as rice, potatoes and corn. Terraces facilitate adaptation to climate change by optimising water use. This is particularly relevant in mountain areas that depend on melting glaciers for their water supply and where there is uncertainty about future rainfall patterns. During 2012, AGRORURAL, an agency of the Peruvian Ministry of Agriculture, is implementing a programme to recuperate 300,000 hectares of terraces with $100 million funding from the Inter-American Development Bank and the Peruvian Government. The project's main objective is to support Andean indigenous communities to adapt to climate change.

Sources: 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.; De la Torre, C., Burga, M. 1985. *Andenes y Camellones en el Perú Andino* (*Terraces and Raised Field Agriculture in the Peruvian Andes*). Consejo Nacional de Ciencia y Tecnología (CONCYTEC), Lima.; Lindemann, T., Morra, D. 2007. *Pro-Actively Coping with Climate Change and Globalization in the Peruvian Andes*. FAO, Rome.; Earls, J. 2003. *The Character of Inca and Andean Agriculture*. Based on a presentation given at the XVI Latin American Congress on Strategies for the Era of Complexity and Imagination, CENTRUM PUCP, Lima.

[11] Gálmez, V., Encinas, C. 2010. *CRiSTAL. Herramienta para la identificación Comunitaria de Riesgos - Adaptación y Medios de Vida* (*A Tool for Community Identification of Risks – Adaptation and Livelihoods*). PACC Ecuador, Quito.
[12] See, for example, these two key publications: 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.; 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.
[13] To learn more about indigenous knowledge related to other aspects of adaptation, read the ELLA Brief: How Traditional Knowledge and Technologies are Contributing to Climate Change Adaptation in Latin America's Mountains.

via the Climate Change Adaptation Programme in Hermosillo, Mexico led by the National Institute for Ecology.

- In Honduras, CATIE has funded research work for university students looking at water captured in protected areas using aqueducts.
- Colombia is promoting integrated ecosystem management to conserve water resources in the Programme for Adaptation in High-Mountain Ecosystems led by the Institute for Hydrology, Meteorology, and Environmental Studies (IDEAM). The same programme is leading water conservation efforts in the mountains of Chingaza in order to protect wetland areas. Activities are also underway to recover natural vegetation in the Río Blanco river basin and facilitate water capture methods via agroforestry systems.
- Mexico is implementing measures to protect water sources from pollution and to rehabilitate small-scale wells and infiltration galleries. Also, natural channels and riverbanks are being restored in order to prevent overflowing and flooding. These activities are being carried out by public institutions working in the environmental sector, as well as a diverse range of national and international NGOs.

Strengthening Civil Society: A Vital Piece of the Jigsaw

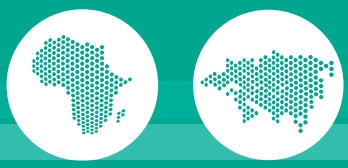
Latin American countries have focused on strengthening civil society participation in decision making as a key ingredient in their water management and climate change strategies.

- One key way this has been achieved is via establishing Water Basin Councils, as mentioned above, to administer water distribution with improved equity and efficiency through management tools like a user registry, water use regulations, water distribution maps and inventories of structural works. Water Basin Councils are responsible for constructing and maintaining irrigation infrastructure and promote alternative, locally-appropriate technologies.[14]
- In 12 regions of Peru, including 5 mountainous regions, Regional Disaster Risk Prevention Networks (*Grupos Regionales de Gestión de Riesgo - GRIDES*) have been established to facilitate community participation in conservation activities aimed at reducing the risk of damage to local livelihoods and infrastructure from climatic events. In many instances, these committees work with the support of municipal councils and other relevant public entities.[15]
- In Bolivia, 150 community organisations have been set up with support from international development agencies. These organisations, including representatives from the country's high mountain zones, attend international events where they are advocating for an International Climate Court of Justice to provide a legal mechanism to take action against developed countries responsible for causing global climate change that impacts their water resources. Likewise, Bolivia's Solón Foundation works to give marginalised mountain communities a greater voice in relation to water privatisation.

[14] Tortajada, C. 1999. *River Basins: Institutional Framework and Management Options for Latin America*. Contributing paper to the World Commission on Dams.; Garcia, L. 1999. *Review of the Role of River Basin Organizations in Latin America*. Contributing paper to the World Commission on Dams.
[15] Christian Aid, Oxfam America, Soluciones Prácticas (Practical Action - Latin America). 2011. *Redes de Gestión de Riesgo y Adaptación al Cambio Climático* (*Risk Management Networks and Climate Change Adaptation*). Soluciones Prácticas, Lima.

CONTEXTUAL FACTORS

ENABLING LATIN AMERICA'S SUCCESSFUL ADAPTATION RESPONSE



From the middle of the twentieth century onwards, the diversification of productive activities in Latin American economies led to a need for governments to legislate water use for distinct purposes. Private and public investments in new sources of energy, namely petrol and gas, as well as in new industrial plants along with growing water demand in urban areas made it evident that water resources were no longer needed for agricultural and livestock activities only.

Conflicts emerging over distinct uses of water have become more intense in recent years due to the opening-up of national economies to international trade. Latin American governments and international development agencies have been supporting small-scale agricultural producers to improve their competitiveness in order to benefit from opportunities for increasing income by accessing new export markets. Some of this support has been delivered through programmes aimed at improving water distribution and use. Likewise, programmes have been initiated to strengthen local organisations in water management practices and to strengthen government institutions in legislation, regulation and control.

Rises in the global price of raw minerals significantly increased the profitability of extractive industry activities. The largest investments in mining in Latin America are generating social conflicts with rural peasant farming communities across the Andean region, such as in Peru and Bolivia. These conflicts, stemming from competition for water and extractive activities' environmental pollution, are likely to intensify during the next decades, especially given that global climate change is diminishing water supplies in these areas. These issues have placed water supply and demand high on Latin American government agendas.

LESSONS LEARNED

1. The most challenging issue relating to sustainable water resource management in mountain ecosystems across Latin America is the high degree of uncertainty regarding the future impacts of climate change. Consequently, planning must be oriented towards building adaptive capacity to the unexpected.

2. Adaptation to increasing climate variability in mountain ecosystems requires building the capacities of people and institutions to interact with government initiatives and encourage broad participation from civil society. Adaptation is not only a matter of introducing new technologies.

3. In Latin America, establishing water legislation and new public institutions responsible for administering water resources have provided an adequate basis for implementing new institutional mechanisms to better face the challenges of climate change adaptation during this century.

4. It is vital that scientific research into conservation and sustainable water use at the sources of water basins in high mountain zones be included in climate change adaptation planning processes. Latin America shows how this research can provide important information on local water capture and storage technologies that have enabled communities to carry out productive activities over centuries.

5. Given that climate change impacts in mountain ecosystems are so local in nature, adaptation strategies for sustainable water resource management must be developed through participatory processes and incorporate local knowledge and practices. It is also necessary to ensure that vulnerable and marginalised populations are adequately represented in order to avoid contributing to social exclusion and increasing poverty levels. In Latin America, Water Basin Councils have shown to be a successful mechanism for securing civil society participation in planning, implementation and monitoring processes.

CONTACT THE AUTHOR

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