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Evidence and lessons from Latin America

Traditional communities living across Latin America's mountains possess an extraordinarily broad range of knowledge about their environment and adapting to a changing climate. From water management strategies to agricultural timing and production techniques, traditional practices are making important contributions to adaptation

HOW TRADITIONAL KNOWLEDGE AND TECHNOLOGIES ARE CONTRIBUTING TO CLIMATE CHANGE ADAPTATION IN LATIN AMERICA'S MOUNTAINS

SUMMARY

High climate variability has been a characteristic of mountain ecosystems, even before climate change concerns emerged. Indigenous cultures of Central America and the Andean region have been living in these unpredictable environments for centuries. As a result, they possess a variety of knowledge and technologies that have helped them to adapt their livelihoods to increasing uncertainty and risk. Traditional knowledge has proven to be compatible with scientific knowledge and, despite its local nature, it includes techniques that demonstrate great potential to meet the challenges of climate change expected over coming decades. These cultures therefore have much to contribute to climate change adaptation processes and should participate in adaptation strategy design and implementation. However, social exclusion, lack of information systems and inadequate protection from governments mean traditional knowledge is slowly being eroded. This Brief highlights a selection of indigenous climate change technologies from across Latin America. It then describes how Latin American countries have successfully harnessed indigenous knowledge to improve climate change adaptation policy, and the challenges they face in doing so. Finally, it describes the main contextual factors that explain how and why traditional knowledge and technologies have been gradually incorporated into climate change adaptation policy and practice in Latin America, and offers lessons learned for other regions.

A COMMON CHALLENGE: HARNESSING INDIGENOUS KNOWLEDGE FOR ADAPTATION

Latin America, Africa and Asia face similar challenges in terms of capitalising on their traditional knowledge base and using indigenous technologies to face current climate variability.

In Latin America, a gradual erosion of traditional knowledge has occurred over time as a result of weakening social, economic and political structures amongst communities that have come into conflict with external economic and development dynamics. Limited access to good quality natural resources, such as fresh water, cultivatable land, pasture land and native

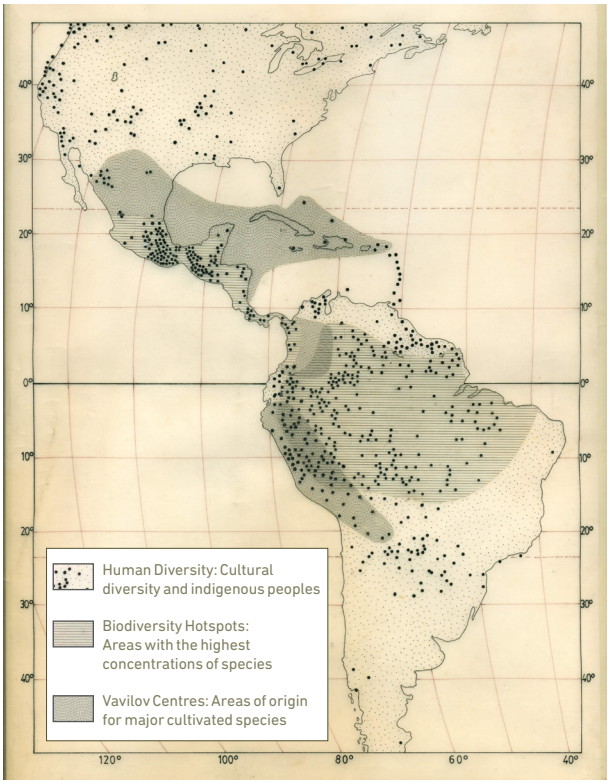

Figure 1: Cultural and Biological Diversity in South America
Source: Taken from the Map "Creators and Conservers of Diversity", published 1999 by Rural Advancement Foundation International (now ETC).

forest, has caused the permanent migration of younger community members to urban areas. This has brought a halt to intergenerational transmission and learning relating to livestock activities and ecosystem management, which in turn, has weakened the social and productive organisation of the communities themselves.

Furthermore, there are almost no information systems to register, use, disseminate, conserve and promote innovation relating to traditional knowledge and technologies. Likewise, the majority of academic institutions fail to incorporate traditional knowledge adequately into research and programmatic work. Communities themselves are not preserving traditional knowledge and technologies in an organised and systematic manner.

Overall, this means traditional knowledge and technologies are not adequately incorporated into regional policies aimed at sustainable natural resource management and adaptation to climate change. There is a lack of adequate legal frameworks to protect the intellectual property rights of traditional communities.

INDIGENOUS ADAPTATION PRACTICES: LATIN AMERICAN HIGHLIGHTS

Over recent decades, 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 technologies are providing adaptation options specific to particular mountain localities and may not be applicable in other regions. However, their potential for application in other areas could be worth exploring where similar geography, climate and cultures exist. This section highlights some of these key technologies being implemented to strengthen adaptation to climate change in Latin America's mountains:

1. Water and Soil Management Practices

Managing soil and water in Mexico: Inhabiting the Mezquital Valley in Hidalgo State, in central-eastern Mexico, the indigenous Otomí people maintain traditional soil and water management practices, including small-scale dams, terraces, evaluating erosion and deposit processes, sedimentation management techniques, and systems for classifying relationships between soils and water, and for soil typology. These practices help the Otomí people to maintain agricultural production during periods of drought and water shortage.[1]

Waru-Waru to manage flood-prone areas: *Waru-Waru* is an ancestral technology that increases soil humidity levels for cultivating tubers and grains. Using elevated beds of soil linked via a network of earth channels, *waru-waru* prevent or delay flooding from nearby Lake Titicaca, located on the border between Peru and Bolivia, or other lakes. The technology helps farmers maintain high yields during dry periods thanks to stored soil humidity and to mitigate the negative impacts of flooding by facilitating drainage. *Waru-Waru* also reduce the impact of extreme weather because they retain heat and maintain soil fertility. This technology helps farmers adapt their agricultural production to current and possible future impacts of climate change.[2]

Mountainside terrace and irrigation systems: Transforming mountainsides into terraces for agricultural production, with and without irrigation, is a technology dating back various millennia and can be found across Central and Southern

[1] Toledo, V., Barrera-Bassols, N. 2008. *La Memoria Biocultural: La Importancia Ecológica de las Sabidurías Tradicionales* (*Biocultural Memory: The Ecological Importance of Traditional Wisdom*). Icaria Editorial, Barcelona.
[2] Altieri, M., Hecht, S. 1997. *Agroecología: Bases Científicas para una Agricultura Sustentable (Agroecology: Scientific Bases for Sustainable Agriculture)*. Secretariado Rural Perú-Bolivia, Peru.

America. During the Inca Empire of the 14th and 15th centuries, which expanded across various Latin American countries, this technology became more sophisticated to include subterranean aqueducts and irrigation systems. These terraces were the preferred method for cultivating corn, the main source of human protein during the Inca era. The terraces are constructed on a base of soil and clay that prevents water losses. It is estimated that the total area of terraced land in Peru is 2 million hectares, of which only 25% is still in use. From an environmental perspective, the terraces promote optimum use of water resources, prevent soil erosion caused by heavy rainfall, and mitigate the impact of harsh cold winds on crops.[3]

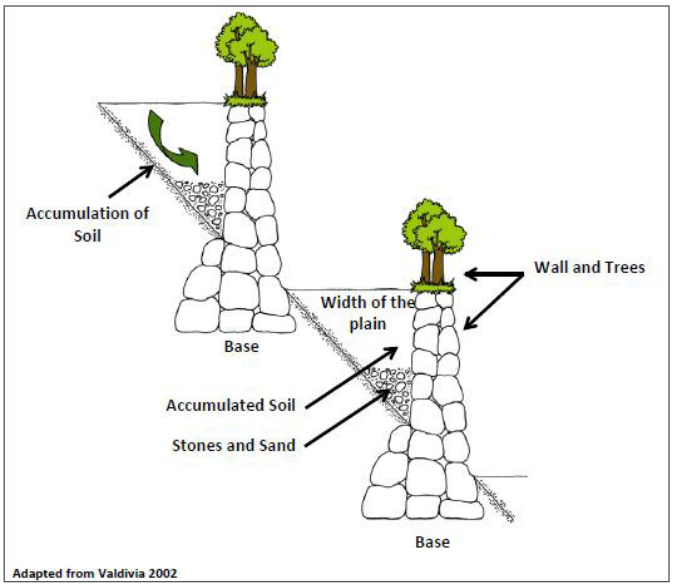

Figure 2: Slow-forming Terraces
Source: Valdivia, R.O. 2002. *The Economics of Terraces in the Peruvian Andes: An Application of Sensitivity Analysis in an Integrated Assessment Model*. Master's Thesis. Montana State University, Bozeman.

Rainwater harvesting for irrigation: In the high plains of Bolivia and the high areas of the Department of Lima in Peru, stone structures are constructed to capture and store rainwater for irrigation. These technologies are gaining importance, particularly given that freshwater supplies are expected to reduce dramatically due to glacial retreat.[4]

2. Strengthening Agrobiodiversity [5]

Conserving agricultural diversity in Mexico: In the Lake Pátzcuaro river basin in the state of Michoacán, Mexico, the Tarrasco indigenous people cultivate corn using a range of land management practices based on agricultural and climatic indicators, as well as local festivals. The knowledge includes a system for classifying and zoning agricultural land use based on the biological characteristics of different corn varieties.[6]

Vertical management of agroecological levels in the Andes: Based on traditional knowledge of climate variability at different altitudes, rural farmers identify areas for optimal production of specific crop and livestock varieties.[7]

Managing native and wild agrobiodiversity: Throughout the Andes, there is a long tradition of agricultural practices that conserve the natural diversity of crops such as potato, quinoa grain, squash and fruits. Traditional mountain communities possess a rich knowledge of the genetic characteristics and varieties of each native crop and its wild relatives. Using this knowledge, the communities apply selective breeding methods to increase the resilience of cultivated crops to variable environmental conditions brought about by global climate change.[8]

3. Agricultural Planning Tools

Applying the lunar and solar calendar in Guatemala: The Mayan calendar provides a guide to agricultural production based on a profound knowledge of the relationships between astronomical and agricultural systems. The Mayan culture has built up a long historical archive of experiences with these practices. In Guatemala, mountain communities still apply

[3] 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.
[4] Chilon, E. 2008. *Tecnologías Ancestrales y Reducción de Riesgos del Cambio Climático (Ancestral Technologies and Climate Change Risk Reduction)*. PROMARENA, La Paz.
[5] To learn more about agrobiodiversity, including other indigenous agrobiodiversity practices, read the ELLA Brief: Strengthening Agrobiodiversity: A Key Strategy for Climate Change Adaptation in Latin America's Mountain Ecosystems.
[6] Chilon, E. 2008, above n4.
[7] Altieri, M., Nicholls, C. 2000. *Agroecología: Teoría y Práctica para una Agricultura Sustentable (Agroecology: Theory and Practice for Sustainable Agriculture)*. UNEP, Mexico City.
[8] Coordinadora de Ciencia y Tecnologia en Los Andes (CCTA). 2009. *Mecanismos de Sostenibilidad de la Agrobiodiversidad Vegetal Nativa en Comunidades Tradicionales Altoandinas de Cajamarca y Huánuco (Sustainability Mechanisms of Native Vegetative Agrobiodiversity in Traditional High-andean Communities of Cajamarca and Huánuco)*. CCTA, Lima.; De Haan, S. et al. 2010. Multilevel Agrobiodiversity and Conservation of Andean Potatoes in Central Peru. *Mountain Research and Development* 30(3):222-231.; Peruvian Ministry for the Environment (MINAM). 2009. *Tercer Informe Nacional sobre la Aplicación del Convenio de Diversidad Biológica Años 2002-2006 (Third National Report about the Application of the Biological Diversity Agreement, 2002-2006)*. MINAM, Lima

this knowledge to agricultural, livestock and forestry activities via techniques for water management, soil fertilisation and harvesting.[9]

Traditional indicators of microclimates in the southern Andean region: Various studies have been carried out into traditional indicators used in Andean mountain ecosystems to understand conditions within specific microclimates. These studies reveal how biological indicators, such as plants and animals, and 'signs' including moon phases and the positioning of the stars, are used by rural communities to guide agricultural and livestock production practices, as well as food conservation techniques.[10]

4. Production Systems

***Frijol tapado* (covered bean) production:** In this technique, beans are sowed then covered with a thick layer of organic material such as firewood, grasses and weeds. This sets off decomposition processes that produce a rich organic fertiliser providing nutrients direct to the bean sprouts. This production system is used in intermediate altitude zones in Central America where it is helping farmers to increase their profits thanks to low operation and maintenance costs. The system does not require the use of chemical fertilisers and can be operated with minimal labour. This practice also reduces agricultural soil erosion on mountainsides where strong rains are often experienced and are expected to increase due to climate change.[11]

Agricultural production using *chinampas*: It is estimated that this technology was developed at least 2000 years ago, and the centre of its use was the Xochimilco-Chalco Lake located in present-day Mexico City. *Chinampas* are a system of platforms and water canals with a base of reeds, constructed in shallow swamp-land zones for cultivating a diverse range of food crops. Above, layers of aquatic vegetation and mud are piled high to about 40cm above the level of the water. After four years of construction, the decomposition of the organic material is complete and can be used as fertiliser. It is an intensive and highly productive system that enables three or four harvests per year depending on the crop, such as corn, pumpkin, jitomate and beans. *Chinampas* reduce soil erosion and help water to filter down towards the roots. It reduces farmers' vulnerability to irregular rainfall, one of the impacts of climate change in mountain ecosystems.[12]

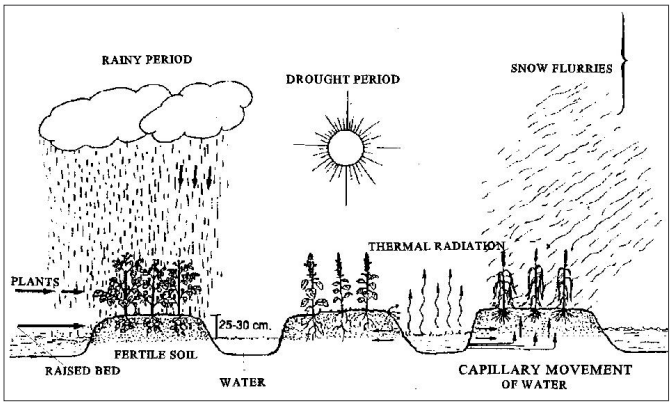

Figure 3: Waru Waru in Puno, Peru
Source: Canahua Murilo, A., Laricio Mamani, L. 1992. *Manual Técnico de Waru Waru, Para la Reconstrucción, Producción y Evaluación Económica, Puno, Perú (Waru Waru Technical Manuel for Reconstruction, Production and Economic Evaluation, Puno, Peru)*. Programa Interinsitucional de Waru Waru, Puno.

5. Post-production Techniques

Processing grains and tubers in the Andes: Pre-Colombian nations across present day Bolivia and Peru developed techniques for preserving Andean grains such as corn, quinoa and kañihua for several years via toasting and preparation of flour. Likewise, various techniques were developed for dehydrating Andean potatoes into different food products, such as *chuño*, *moraya* and *tunta*. These techniques were a fundamental component of household strategies for year-round food security. Preserving foods reduced rural familes' vulnerability to droughts, irregular rainfall and harvest losses, impacts that are set to increase due to climate change.[13]

[9] Bolvito, J., Macario, T., Sandoval, K. 2008. *Conocimiento Tradicional Colectivo y Biodiversidad (Traditional Collective Knowledge and Biodiversity)*. Consejo Nacional de Áreas Protegidas – CONAP, Guatemala City.
[10] Claverías, R. 2000. *Conocimientos de los Campesinos Andinos Sobre los Predictores Climáticos: Elementos Para Su Verificación (Rural Andean Knowledge about Climate Predictors: Elements for Verification)*. Online publication, accessed March 2012.
[11] Altieri, M., Hecht, S. 1997, above n2.
[12] Ibid.; Quiñónez, C. 2005. *Chinampas y Chinamperos: Los Horticultores de San Juan Tezompa (Chinampas and Chinamperos: The Horitculturalists of San Juan Tezompa)*. PhD Dissertation. Iberoamerican University, Mexico City.
[13] Jacobsen, S.Y., Sherwood, S. 2002. *Cultivo de Granos Andinos en Ecuador (Cultivation of Andean Grains in Ecuador)*. FAO, CIP, CRS, Quito.; Alencastre, A. 2009. Las Amunas: Recarga de Acuíferos en los Andes (Amunas: Refilling Aquifers in the Andes). In: de Llosa J. et al. *Cambio Climático, Crisis del Agua y Adaptación en las Montañas Andinas. Reflexión, Denuncia y Propuesta Desde los Andes*. Desco: Red Ambiental Peruana, Lima.; Machaca, J. et al. 2009. La Cosecha de Agua: Una Experiencia de Adaptación al Cambio Climático en la Macroregión Sur (Water Harvesting: A Climate Change Adaptation Experience in the Southern Macroregion). In: de Llosa J. et al. Cambio Climático, Crisis del Agua y Adaptación en las Montañas Andinas. Reflexión, Denuncia y Propuesta Desde los Andes. Desco: Red Ambiental Peruana, Lima.

INCORPORATING INDIGENOUS KNOWLEDGE INTO POLICY AND PRACTICE

The list above is but a short selection from a wealth of indigenous knowledge related to climate change adaptation that exists amongst Latin America's mountain-dwelling communities. Yet the real challenge is capitalising on that knowledge to build better adaptation policy. Latin American countries are slowly doing so, in a variety of ways.

For example, governments across Latin America are increasingly recognising the importance of indigenous knowledge for policy and practice related to climate change adaptation. In Bolivia, Peru and Mexico, indigenous knowledge has been explicitly incorporated into key mechanisms such as the 2007 National Mechanism for Climate Change Adaptation in Bolivia,[14] the Second National Communication on Climate Change of Peru[15] produced in 2010, and the National Climate Change Strategy for Mexico, finalised in 2007.[16]

Initiatives aimed at identifying and disseminating traditional technologies for adaptation have mainly been led by civil society, NGOs and academia, especially in Bolivia and Peru. The Vice Ministry for Science and Technology in Bolivia participated in one such initiative in March 2012 - a virtual forum on ancestral, local and traditional knowledge relating to climate change. The aim of the forum was to provide a space for analysing methodologies and experiences relating to agricultural development and natural resource management within the context of climate change.

Going beyond merely identifying then incorporating indigenous practices, many countries are finding ways to increase indigenous communities' participation in developing adaptation policies. Numerous events held in the region have promoted the participation of indigenous communities in adaptation processes. One example is the two-day event organised by the National Institute for Ecology in Mexico (INE) in 2011 entitled 'Indigenous Peoples, Marginalized Populations and Climate Change: Vulnerability, Adaptation and Traditional Knowledge' and held in collaboration with a variety of international institutions and UN agencies.[17] This workshop has helped disseminate information and advocate for increased recognition of the role of indigenous knowledge in facing the challenges of climate change over the coming years.

Latin American countries still lack information systems to bring together experiences of indigenous knowledge and its contribution to climate change adaptation in a concise and accessible manner. However, some information can be found through systems with a broader focus outside of just climate change. One notable example is the National Commission for Knowledge and Use of Biodiversity in Mexico (CONABIO); created by the Mexican Government in 1992, it is responsible for recovering and analysing traditional knowledge in its various forms.

[14] Ministry for Planning and Development (Ministerio de Planificación del Desarrollo - MPD), Bolivia. 2007. *Mecanismo Nacional de Adaptación al Cambio Climático (National Mechanism for Climate Change Adaptation).* MPD, La Paz.
[15] Ministry for the Environment (Ministerio del Ambiente- MINAM), Peru. 2010. *Segunda Comunicación Nacional a la Convención Marco de Naciones Unidas sobre Cambio Climático (Second National Communication on the United Nations Climate Change Convention).* MINAM, Lima.
[16] Inter-secretarial Commission on Climate Change (Comisión Intersecretarial de Cambio Climático - CICC), Mexico. 2007. *Estrategia Nacional de Cambio Climático. Síntesis Ejecutiva (National Climate Change Strategy: Executive Summary).* CICC, Mexico City.
[17] These included United Nations University, Inter-Governmental Panel on Climate Change (IPCC), Secretary for the Convention on Biological Diversity, United Nations Development Programme (UNDP) and United Nations Organization for Education, Science and Culture (UNESCO).

CONTEXTUAL FACTORS

ENABLING INTEGRATION OF INDIGENOUS KNOWLEDGE INTO POLICY

There are three main contextual factors that explain how and why traditional knowledge and technologies have been gradually incorporated into climate change adaptation strategies in Latin America.

Over the last decade, increased climate variability has been registered across the mountain regions of Central America and the Andes. The intensity and frequency of extreme climatic events has also increased, directly affecting the most vulnerable populations. Gradually, indigenous knowledge is being recognised as an important source of information to provide practical solutions to the challenges faced in mountain areas. This is largely thanks to the effectiveness of indigenous technologies to respond to local conditions while at the same time providing socially and environmentally sustainable options.

Processes of globalisation and, in particular, increased international trade with foreign companies, has prompted strong reactions from civil society organisations. Many indigenous communities perceive foreign investments as a threat to their natural environment and to the quality and quantity of natural resources that form the basis of their livelihoods. These civil society groups are well-organised and promote the value of traditional culture and the rights of traditional communities. This has lead to increased visibility of traditional cultures vis-a-vis national governments and societies and has led to the development of policies and regulations to protect indigenous rights and culture.

A significant increase in resources has become available from international donors and national governments for developing climate change adaptation programmes aimed at mountain ecosystems. Funders have increasingly promoted inclusion of traditional knowledge and technologies into adaptation plans. The increased attention has also generated greater research and documentation of indigenous knowledge and practices.

LESSONS LEARNED

1 Traditional knowledge and technologies from Latin America do not exclude modern science and in many cases are complimentary. For example, traditional water management systems, such as *amunas*, can be implemented alongside modern pressurised irrigation technology to cultivate both native and improved crop varieties, thereby increasing resilience to drought.

2 Having supported rural communities to adapt to climate variability over centuries, traditional knowledge and technologies from mountain regions across Latin America demonstrate great potential to support current and future climate change adaptation processes. Increasingly, this potential is being recognised by governments, with traditional knowledge and technologies being incorporated into climate change adaptation policy and practice. This is largely thanks to the range of economic, social and environmental benefits that they have been shown to provide. Nevertheless, more needs to be done to further integrate this knowledge into climate change adaptation strategies, including establishing adequate and appropriate legal frameworks to protect the intellectual property rights of indigenous communities.

3 In general, indigenous knowledge provides information specific to a particular locality. This is vital for the development of locally-appropriate, low-cost climate change adaptation strategies. At the same time, this means that some indigenous knowledge may not be applicable in other regions, though it could be transferable to areas where similar geography and cultures exist.

4 Special efforts are required to record, disseminate and use traditional knowledge and technologies relating to climate change adaptation. In Latin America, this knowledge base is gradually being lost due to weakening social, economic and political structures amongst indigenous communities.

CONTACT THE AUTHORS

To learn more, contact the authors: Juan Torres, an expert in climate change adaptation in mountains and deserts, jtorres@solucionespracticas.org.pe, and Carlos Frías, Quality Assurance Manager, cfrias@solucionespracticas.org.pe, of Soluciones Prácticas (Practical Action – Latin America).

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