

# **Climate change and water in the Bolivian Altiplano**

## **Introduction**

The earth's climate is changing, but those changes are not evenly distributed across the planet. In some regions climate changes are especially acute, such as melting glaciers that threaten to reduce water supplies. The natural and human systems in those areas are often particularly vulnerable to changes in temperature, precipitation, and extreme events. Furthermore, some of the most vulnerable places are also some of the poorest, and a lack of resources often impedes effective adaptation strategies that can buffer the impacts of climate change. While greenhouse gas emissions are driving human contributions to climate change on a global scale, the impacts are felt locally and require place-based actions. A critical question many regions are now asking is what can be done to help vulnerable communities adapt to climate change in the near-term, while governments debate global-scale agreements to address climate change in the long term.

## **The unique Altiplano**

The high plain of the Andes Mountains in South America, called the Altiplano, is one region on the frontlines of climate change. It is among the highest deserts in the world, located at nosebleeding elevation of around 14,000 feet above sea level, and covers parts of Bolivia, Peru, Argentina, and Chile . The only plateau with a higher average elevation is the Tibetan Plateau in Asia. In an article for National Geographic, writer Alma Guillermoprieto says of the Altiplano: “perhaps nowhere on Earth does a landscape remind us so vividly that there was a time before human time”.

It might seem that not many species could survive in the unforgiving terrain of the Altiplano, but there are many surprises. Not the least of which are large populations of flamingos – 3 of the world's 6 flamingo species breed in Altiplano salt lakes. They are joined by llamas, alpacas, vicuñas, vizcachas, foxes, and Andean mountain cats, among many others. The Altiplano is also home to the Andean Condors, one of the largest birds alive.

In Bolivia, millions of people call the Altiplano their home, the majority of whom are descents of the Aymaran culture that predates the Incan Empire. About 2.3 million people, or a quarter of the entire Bolivian population, live in the major urban areas of the Bolivian capital, La Paz, and its neighboring city, El Alto. Many rural communities also dot the vast high plain, and most of people who live in them earn meager incomes from small-scale farming, including growing the staple crops of quinoa—a cereal-like grain—and potatoes. Most of the inhabitants live in poverty, earning less than \$2 dollars a day.

### **Disappearing water**

Farmers in the Altiplano have been noticing differences in the climate for years – after all, their livelihoods depend on timing their agricultural practices to predictable climate patterns. In recent interviews many rural people reported widespread changes. They stated that temperatures are getting warmer, sleet storms are more unpredictable, rains are beginning later than they used to, and when the rains finally arrive, they are heavy. Also, household surveys conducted in 2006 revealed that droughts in recent years are more frequent and intense than in the past (drought has the greatest impact on livelihoods for many people). Also, many people perceive reductions in the total amount of rain per year and that less water is available now than ten years ago (see course materials for the full report of these interviews).

This is troubling news for people living off the land. Delayed starts to the rainy season can stunt the roots of important potato and quinoa plants, yielding smaller crops. Sleet events, if they occur after planting, can wipe out crops altogether. Warmer temperatures dry out the landscape faster, and shorter wet periods can lower groundwater tables and streamflows. The Altiplano, however, has a built in buffer system to help sustain river flows and groundwater—glaciers.

Many rural communities of the Bolivian Altiplano draw drinking and irrigation water from hand-dug wells and rivers that are fed by small glaciers. For La Paz and El Alto, four reservoirs located in glaciated watersheds provide about 80% of the water supplies for 2.3 million people. Most of Bolivia's glaciers are small, less than a square mile, which makes them particularly sensitive to warming temperatures. Recent trends in glacial mass are troubling: in the last 35 years, Bolivia's glaciers have lost about 50% of their mass. Climate projections suggest that many will disappear altogether within the next three decades.

### **Altiplano people and agriculture**

The rural people who make the Altiplano their home persist mainly on small-scale farming activities. Farming here is largely subsistence-based, though a portion of the harvested crops is often sold in small local markets. Potatoes and quinoa are the mainstays of Altiplano agriculture, and over millennia these crops have adapted to the high and dry conditions of the area. The Andean region is the birthplace for potatoes, and in Bolivia there are over 200 varieties of potatoes cultivated in the Altiplano, many of which are staples in the Bolivian diet.

Because potatoes and quinoa have long adapted to the climatic conditions of the Altiplano, they do not require extensive irrigation or the application of pesticides. Typical farming practices are sustainable, and relative to industrial style farming practices have little negative impact on the surrounding environment. However, projected changes in climate could threaten to push even these highly adapted crops to the brink, threatening the livelihoods of many Altiplano communities.

## **TERRA**

TERRA is an organization created in 2000 to help buffer Altiplano communities from the impacts of climate change. TERRA provides funding and expertise to improve access to water, helping to improve both health and agricultural productivity in rural areas. Their goal was to find a way to give rural communities, which are often neglected by other development agencies, access to clean drinking and irrigation water in an attempt to mitigate the impact of human-caused climate change.

An important element necessary to sustain the benefits of water systems and other development projects is for local leadership to be an integral part of the planning, development, and operation. According to TERRA, the Altiplano is riddled with failed projects because national and international organizations have swept in, told the community what infrastructure they need, built it, and then left. They suggest that a better approach is to create vested interest, which is often accomplished if the people contribute a portion of the cost, with money and/or labor. TERRA has made this an integral component of their development strategy.

According to TERRA, community development should be informed by sound science, and the production of knowledge should be considered humanitarian goal. Science is not free. The U.S. science budget in 2010 was more than \$136 billion. In poor regions like Bolivia, however, scant resources limit science endeavors, elevating the need for international science aid.

Zack Guido, one of the founders of TERRA, conducts research in the Altiplano region to determine how much glacial melt and rainwater contribute to water and groundwater supplies. He carries out this research by collecting water samples in both the dry and rainy seasons from deep and shallow wells, rivers, and meltwater flushing from the toes of the glaciers. If precipitation and glacial melt have different chemical signatures, it will be possible to determine the percent that each contributes to rivers and groundwater aquifers. This information can help shape future studies that look at how climate changes will drive glacial reductions and changes in future precipitation, and how those in turn will impact people and ecosystems. Equipped with that knowledge, scientists and managers will be able to develop effective adaptation projects.

## **Outcomes**

Working in the rural Altiplano is not without its difficulties. There are geographic, cultural, and financial barriers that all must be transcended for a project to be successful. TERRA has had its successes and has also faced challenges that remain to be overcome. The towns of Chaquiri and Capiri are villages they have worked with, and illustrate what it is like to work towards buffering Altiplano communities from climate change.

### *Town of Chaquiri*

The 25 families living in this rural community have never had clean water flowing from spigots in their homes. Instead they drew water from hand-dug shallow pits that were contaminated and often dry during recurring droughts. Or they collected water from a spring, located a long distance from their homes. In 2005 this community used government funds to construct a 120-ft deep groundwater well. However, for 3 years it laid idle because there was insufficient money to buy a pump and to build the required distribution system and a storage tank. In Chaquiri, residents earn approximately \$2 a day.

Community leaders solicited Terra for help. TERRA agreed to finance 75% of the project, with the community providing the rest in order to promote a sense of ownership among community members. TERRA's portion of the project involved setting up a water committee, paying for materials for the storage tank and distribution system, and providing technical expertise to oversee the project. The community agreed to provide labor and buy the pump.

The project began by forming a water committee that would be charged with ensuring proper use of the water and establishing monthly fees that finance future maintenance needs. With the help of an outside organization, the communities wrote binding rules and regulations for the water use and mediated the election of a governing body.

TERRA also constructed a 2500 gal tank using a new economical design. The cylindrical tank is made of rebar and entwined with chicken wire that reduces the amount of cement and lowers material costs without compromising strength. The community also dug two miles of trenches in rocky soils that connected each house to the water tank. The 125 people living here now have drinking water in their homes for the first time in the community's long history.

### *Town of Capiri*

One hundred families live in the rural town of Capiri. The climate is very harsh there; the dry season extends from about June to September and is extremely dry. Year-to-year variability is influenced by changes in Pacific Ocean surface temperatures known as El Niño and La Niña events. During El Niño summers rainy seasons can fail to deliver sufficient rains for agriculture, and the farmers are left no choice but to abandon the cultivation season. In recent years, people have complained that rains are starting later than normal. All three of these circumstances reduce agricultural productivity and degrade the welfare of Capiri inhabitants.

TERRA partnered with Capiri to build an irrigation system that would make this village less vulnerable to climate changes while improving quality of life. TERRA provided support to install a well, a windmill pump, and a storage pond. However, this well has been locked since it was completed three years ago. TERRA staff recently spoke with

local leaders in Capiri to find out why. The leaders were newly appointed, and none of them fully understood the well infrastructure project. One thought the windmill was just a community adornment.

This highlights a critical problem that hinders efforts to provide infrastructure that can buffer impacts of climate change. These projects generally rely on local leadership but leaders change often. If there is no effective continuation strategy between old and new leaders, projects can be doomed to failure.

### **The future...?**

What is on the horizon for the human and natural communities of the Altiplano? No one can say. This region is widely expected to be one of the first places where human-caused climate change will affect a large geographic area and the lives of millions of people. But TERRA co-founder Zack Guido, who has worked in the Altiplano for 11 years, remains optimistic: “The more time I spend in this region thinking about climate change, the more I think that no matter what the future climate has in store for this region the people of the rural altiplano can adapt quite well. They’ve been living in an extreme world for thousands of years, preserving in spite of the high altitude, rocky soils, intense sun and dry seasons, and deep freezes.” Guido also believes that significant challenges lie ahead and that vigorous efforts are needed to help ensure that local adaption minimizes threats while exploiting advantages. “The goal,” according to Guido, “is to create mutually beneficial futures, for both people and the environment. Both improving access to water and science pursuits can move us down that path.”

## **RESOURCES:**

TERRA's website: <http://www.terradevelopment.org/>

New York Times article on Bolivia and climate change:

<http://www.nytimes.com/2009/12/14/science/earth/14bolivia.html?pagewanted=all>

National Geographic article for context and photos of the Altiplano:

<http://ngm.nationalgeographic.com/2008/07/bolivias-new-order/altiplano-guillermoprieto-text/1>

National Geographic article on climate change and Andean crops:

<http://news.nationalgeographic.com/news/2008/10/081001-peru-potato-climate.html>

Millenium Ecosystem Assessment Reports:

<http://www.unep.org/maweb/en/index.aspx>