

Vulnerability and Adaptation to Climate Change in Central Peruvian Andes Cities

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Abstract

The lack of policies and effective urban management in the planning of sectors like transport, health, industry and housing are common characteristics to high level urbanization cities like Huancayo, the largest city in the Central Andes of Peru and located in the Mantaro River basin.

The effects that climate change will have in cities are not well-known yet, and the purpose of this study is to show that climate changes in the next 50 years might increase the population vulnerability in cities like Huancayo.

Estimates of climate change to the year 2050 in the Mantaro River basin based on IPCC projections and statistical downscaling methods indicate an increase in temperature and a decrease in rainfall during the rainy season (summer). In a city that has grown vertiginously and without planning in the last 30 years and that has already suffered serious droughts in the past; this new factor will aggravate the increasing problems of potable water supply for its use in human consumption and industry due to the population growth and the change land use from agriculture and forest use to urban use.

The adaptation measures to face this situation include a broad range of possibilities, but they must consider social, economic, ecological and political factors, and the roles and opinions of stakeholders involved. We consider that nonstructural measures - incentives to sustainable land use; good use practices of water resources, etc. - rather than structural ones, could be more effectively adopted by local governments - and population - as adaptation measures to the negative consequences of climate change.

Statistical Downscaling

Estimated changes in the local temperature and specific humidity for the Mantaro Basin were taken from the projections done in various research centers participating in the IPCC by using numerical climate

models for the corresponding grid cells. The changes in rainfall were estimated using a linear regression model, which was built based on interannual variability in rainfall observations, for which local changes in relative humidity associated with temperature variability was the best predictor. Changes in relative humidity associated with climate change were estimated from the temperature and specific humidity changes.

Estimates of the effect of climate change on the Mantaro Basin to the year 2050 indicate the following: an increase in temperature of the order of 1°C, an increase in specific humidity of 1 g/kg, but a decrease in relative humidity of 6%, and a decrease of 19% of the precipitation during the summer, which corresponds to the peak of the rainy season.

All of the climate models considered projected increases in both temperature and specific humidity but decreasing relative humidity and rainfall, with relatively low spread among the estimates.

Case Study Area

Huancayo (12°03'51S, 75°12'30"W, 3249 masl) is the largest city in the Central Andes of Peru and is located in the Mantaro River basin and its set of problems is considered representative of the cities in this region. Huancayo has a population of approximately 325,000, and is the economic and commercial center of the Central Andes of Peru.

City Development And Water Resources

During the dry season, the potable water of Huancayo is provided by the melting of the Huaytapallana glacier (5550 msnm), located in the Eastern Cordillera, only 35 km from the city. The melt water forms Lasuntay and Chuspicocha lagoons, which drain into the Shullcas River, a tributary of the Mantaro, the main river of the basin. The water from the Shullcas River is also widely used for irrigation in the numerous agricultural fields that surrounds Huancayo.

Huaytapallana has been experiencing deglaciation in the course of the last decades. This, added to the high seismicity of the zone, has brought as a consequence

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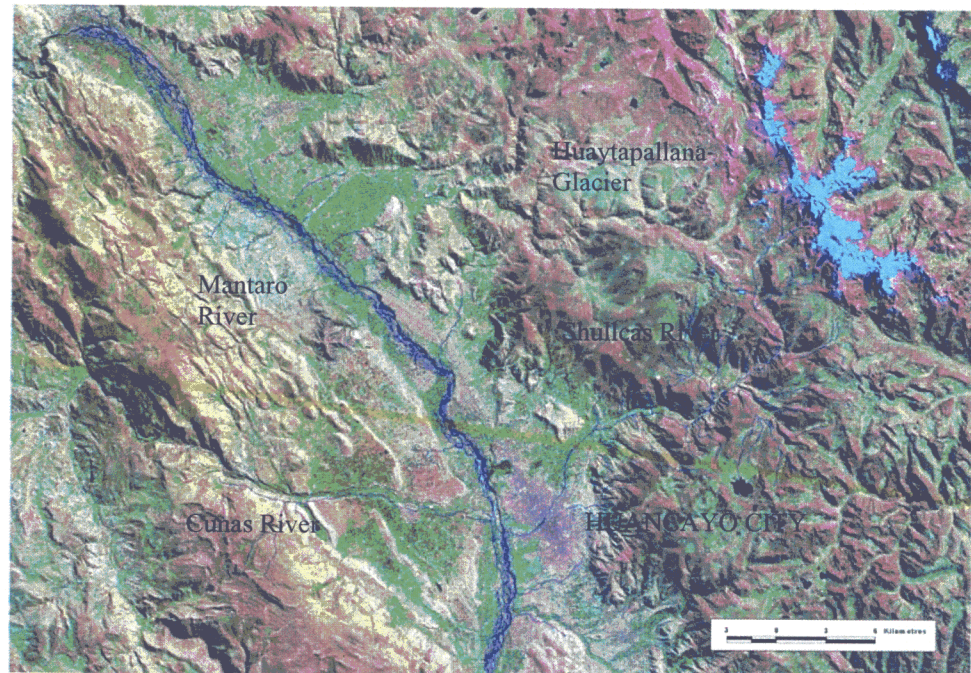


Figure 1. Huancayo city localization

occasional ice mass slides that have caused overflows of the lagoons surrounding the glacier. This happened by the end of 1990, when the overflow of Chuspicocha lagoon created a water and ice flood 30 km down the Shullcas river, causing numerous damages in the zone, and affecting urban and rural infrastructure. To avoid subsequent overflows of the lagoons, retaining walls were constructed in the western side of the Huaytapallana, as well as a small dam on Lasuntay lagoon.

Less than 15 years later, the building of the infrastructures in Lasuntay and Chuspicocha lagoons is being called into question, since they have apparently contributed - along with population growth, land use changes and deforestation - to the current shortage of water supply for both human consumption and agriculture.

Vulnerability And Adaptation

The problems related to water resources – level of deglaciation, lack of potable and irrigation water, etc - that at the moment undergoes the city of Huancayo, as well as the surrounding agricultural zones, are likely to become more and more serious in the next years if we consider the effects of climate change, which may include reduced precipitation and higher temperatures. If we add to this the fast population growth, migration, land use change and deforestation,

the situation could become unmanageable in a few years time.

The measures proposed to remediate this situation must consider the roles and opinions of the stakeholders involved, which include the city population and their municipal authorities, Regional Government, Irrigation Users Board Commissions, Civil Defense, Regional Agricultural Office, etc., in order to be effectively adopted. Also, the biophysical, ecological, social, economic, political and institutional aspects, that are integral parts of the problem, should be considered when devising such measures.

In the past, structural measures have been predominant. Examples of these include the construction of dams, filter galleries, potable water networks extensions, and lately the building of numerous wells for obtaining potable and irrigation water. Nevertheless, due to factors affecting the decision making associated with the implementation of structural measures, such as institutional weakness, overlap of functions between organizations, political opportunism, weakened democracy, corruption, and lack of stakeholders participation, along with the lack or misuse of biophysical information, these measures have only had medium or little success. We anticipate that this will be no different under future scenarios.

In cities near Huancayo like Concepción and Jauja nonstructural measures like incentives to sustainable land use and good use practices of water resource, with the knowledge and support of population have been having good results in the rational management of water resources and other associated subjects like solid waste management. We consider that it is necessary to strengthen the institutions in the region and the role of stakeholders, and that nonstructural measures could be more effectively adopted by local governments and population, like an adaptive strategy against the negative consequences of climate change.

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Figure 2 Huaytapallana Glacier and Lasuntay lagoon view



Figure 3: Dam on Lasuntay lagoon