PERU: ANDEAN HEADWATERS PERSPECTIVE ON CHALLENGES FOR WATER SECURITY IN THE FACE OF GLOBAL CHANGE

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Andean river basin headwaters store and release large volumes of water, and are of paramount importance for Peru's water sustainability. Nearly 40% of the country is drylands (areas where rain or snow amounts are exceeded by evapotranspiration), and only 2% of Peru's water resources drain to the arid coast, a region that hosts about 60% of the population and whose contribution to the GDP is around 80%.

To better manage Peru's scarce water resources, it is essential to understand that: 1) humidity from the Amazon precipitates as it climbs up the Andes, 2) water is stored as glaciers and snow, lakes and wetlands in the headwaters of the basins, and 3) this ultimately drains to the eastern and western slopes of the mountain range ensuring water supply all year long. Every 7 to 20 years, the El Niño climate cycle (warmer ocean currents and humidity on the Pacific coast) disrupts the normal water cycle; promoting heavy rains in the semi-arid and arid western slopes of the Andes. Its impact is stronger in the northern part of the country, where Pacific Ocean warming is most pronounced.

As the population grows and markets expand this will result in: 1) increasing competition between actors over water as a resource[1] that is asymmetrically distributed by location and among different users; 2) the emergence and expansion of contamination sources (human and natural) along the basins.. The already complex reality of Peru (geography, climate, culture, socio – political – institutional processes) reveals a need for solutions that extend far beyond

[1] According to the National Water Authority (ANA), 2% of Peru water resources drain to the Pacific coast, while 97.5% to the Amazon. The remaining goes to the Titicaca Lake between Peru and Bolivia.

conventional engineering approaches (the business-as-usual paradigm among most decision makers). For instance, since the 1980's, small cities located in the semi-arid eastern Amazon slope of the Andes have rapidly grown, making large projects that had been built to transfer water from east to west down the hyper-arid Pacific coast no longer feasible in many areas because of the socio – political implications these have.

Viewing Peru's water management from the headwaters perspective allows us to analyze the socio-ecosystems constituting the basins, and how these are exacerbated by the feedback interrelations existing with human stressors at the regional and local scales.

A peatland area in Ayacucho (southern Andes).

As precipitation patterns and temperatures shift and tropical glaciers retreat, Peru has seen a substantial reduction in their contribution to headwater wetlands and water bodies as well as downstream flows during the dry season. Another problem is exposure of highly mineralized

rock, which, upon coming in contact with precipitation, leads to acid streams loaded with naturally occurring heavy metals and oxides.

Due to geographical conditions, the headwaters in northern Peru are located at lower altitudes, closer to the inter-tropical convergence zone (ITCZ), and are more heavily influenced by the El Niño stream. The combination of low altitude with high precipitation levels makes them hotspots for biodiversity, with the co-existence of ecosystems such as fog-forest and *Páramo* and *Jalca* bogs and peatlands. Upon transiting to the southern Andes, *puna* wetlands can be found above 4000 meters elevation, where no forest exist and precipitation is lower in intensity and frequency.

Several factors reveal the key strategic role Andean wetlands play in the country's water sustainability. First, these are water-regulating ecosystems that store water from precipitation and translate it into steady flow. Secondly, wetlands constitute important carbon sinks.

As was mentioned earlier, precipitation in the Andes comes mainly from the humidity produced in the Amazon. It is known that around 30 – 40% of rain in the Amazon is recycled by evapotranspiration processes of the forest. Over the past decades, driven mainly by market pressures and livelihood opportunities, the Amazon has suffered huge deforestation processes – the National Forest and Wildlife Service estimates a deforestation rate of 13 football fields every hour.

By analyzing processes at the local scale, we focus on contamination and depletion of resources. Expansion of agriculture and cattle raising, increases pressure on the ecosystem services provided by the headwaters. Another important factor to consider is that due to the geology of the Andes, important mineral reserves are found close to wetlands and water bodies in the headwaters. This explains the fact that more than 50% of the mining operations are located

above 3500 meters elevation. The mining sector accounts for 20% of the tax revenues and 11% of the GDP of Peru, and is therefore one of the main economic drivers of the country.

The Andean headwaters perspective allows us to view the impact of interrelating processes in the Amazon and their potential impact on the arid coast, where the most important population and productive centers are located. This integrated view is important for designing solutions that contribute to local development, while generating benefits that extend beyond borders.

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