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## Challenges and solutions for water security in an Andean region: Insights from Azuay district

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### Abstract

Azuay district, situated in the Ecuadorian inter-Andean region, encompasses a mosaic of communities, small towns, and a mid-sized city dotted across valleys and mountain slopes. Here human activities are strongly linked to agriculture, grazing, and forestry. These economic activities put pressure on water quality and quantity, that is to say on water security, affecting the well-being of inhabitants. Further, strategies for assuring water security are still lacking. Therefore, Azuay can be a representative site for studying challenges for water security in the inter-Andean districts. By conducting a literature review, we identified the most studied pressures on water security in Azuay. Then, a systematic literature review was undertaken to identify worldwide solutions aimed at overcoming the pressures on water security identified in Azuay (from the first review). The most studied pressures were natural environment dynamics (20%), grazing and agriculture (62%), and those pressures impacted the water quality of rivers through nonpunctual exports of both natural and added pollutants. Other studies reported pressures of climate change (45%, i.e., extended droughts) on the water quantity, and water quantity effects on the water-related provisioning services of drinking, irrigation, and food production. Other studies reported consequences of urbanisation on the water quantity (38%) resulting in floods, and water quality (14%) in terms of access to sanitation and insufficient waste-water treatment. Hence, grazing and agriculture were human activities that contributed the most to water insecurity. Solutions need to be proposed. To provide water security and water-related services, we selected among the reviewed solutions. To overcome impacts on water quality due to grazing, agriculture, and forestry we proposed nature-based solutions such as streams/river forests and constructed wetlands, for water quantity we proposed to replicate Andean ancestral infrastructures which use soils and ponds as natural infrastructures for water storage. Combined solutions, such as public awareness, filtration tanks, ecological toilets, plus conventional water-treatment plants were proposed in certain towns and urban expansion areas to improve water quality. The pros and cons of all solutions were well-discussed. We integrated knowledge about pressures and solutions for assuring water security in inter-Andean districts and guided their future management.

**Keywords:** Andean communities, ecosystem services, green solutions, mitigation, water provisioning, water scarcity