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Dryland irrigation, the expansion of an agricultural frontier in the Moquegua Region of Peru.

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Peru has a diverse physical geography including coastal deserts, rain forests, and mountain ranges. Future economic, social, and agricultural development of Peru rests upon one critical resource: adequate and fair distribution of water in the dry areas. Such peril has led to significant investment of hydrologic management for both industrial and agricultural purposes including the hyper-arid Moquegua Region where cultivated areas have increased dramatically beyond the original extents of its ancient agricultural frontier roots. The Pasto Grande engineered storage and distribution system was projected to serve a substantial industrial and agricultural population using pre-climate change precipitation models and did not incorporate current rates of glacier retreat feeding surface reservoirs. In this research, the potential sustainability of the expansion of the Pasto Grande system are examined under climatic instability and shifts in precipitation events over decades. Time-series analysis of anthropogenic utilization and rapid expansion of agricultural practices are examined to determine the rates and extents of modification of the hyper-arid land surface into cultivated landscape. Finally, the full projected extents of the project are compared with the actual agricultural utilization in GIS to determine points of climatic induced water susceptibility.

The development and construction of the Pasto Grande project originated with the dual intent of power generation and water distribution within the provinces of Mariscal Nieto and Ilo. Water distribution and retention systems convey fresh water supplies from the main rivers of the highlands to distant pastoral projects as far away as the coastal plains. This ambitious project consists of two-phases, 1) connection of highland rivers from the Tambo Basin with the coastal plains and ultimately transferring and distributing waters in the upper and mid Moquegua Valleys, and 2) conveying water to the low lying areas near the port town of Ilo. Covering vast aerial extents, the overall catchment system includes immense reservoirs, pump stations, and contour canals, some up to 39 km in length. Constructed and implemented portions of the project cover ∼3,000 hectares of land, altering both the built and natural landscapes, and increasing the footprint of agricultural practices. Hillsides and low relief areas once devoid of vegetation are flourishing with agricultural plots of which contribute ∼$8.5 mn annually of edible goods to the economy.

Over-expansion in the face of economic downturns, climate change, water allocation stress, flushing of salt accumulations, and soil and water utilization changes threaten the expansion that has occurred. Salination of established plots due to leaching of newly irrigated dryland soils is a primary driver of soil inequities and quality. In addition desalination of soil exacerbates scour by reducing the frictional and cohesive shear strength of the soil particles. If collapse of the Pasto Grande system was to occur and the distribution system fail, the economic and social impacts from reduced crop yields and the impacts to the natural environment would be vast and devastating. As climate change progresses, further perturbations and instability of hydrologic resources will ensue which warrant revisiting and updating the Pasto Grande project for future hydrological outlooks.