

# The Water-Food-Energy-Environment Nexus in the Context of Global Change: Ica Basin, Peru

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Mountainous areas with extreme gradients, responsible for providing the main source of water to downstream communities, or “water tower” regions around the world are highly vulnerable to the physical and social drivers of global change. In this research, I analyze the Water-Food- Energy-Environment Security nexus across an extreme altitudinal gradient in the Peruvian Andes. In the Ica Basin of Peru, resource challenges and competition have led to environmental degradation, social deprivation and conflict. Changing hydrologic regimes in the high altitude regions, erosion and invasive species damage in the mid-altitudes, intensified commercial agriculture in the lowland coastal plains, and changing land-use patterns across this gradient have initiated a series of feedback loops that cause broad-scale environmental degradation and directly and indirectly impact livelihoods of farmers and consumers alike. Food security, water security, energy security, ecosystem health and climate change are inextricably linked processes in the basin. I discover that this security nexus changes across the gradient, and that at the individual and family level, communities at higher altitudes experience greater insecurity, vulnerability and risk than those of lower elevations. I contend that the security nexus is a relative and dynamic series of interrelationships, dependent on the material needs and telecommunication networks of communities, and the drivers of global change. As technological dependence increases throughout the basin, the needs of the population and relative resources required to achieve security also increase. This can be extended to theories of global food, water, energy and environmental security—that this nexus is materially dependent and as development processes increase the standard of living, so will the parameters needed to achieve secure communities.



Rafael de Grenade is a post-doctoral research associate for the Udall Center for Studies in Public Policy, coordinating the International Water Security Network research, "Transboundary Water Security in the Arid Americas." Rafael's research, outreach, and teaching have focused on agrobiodiversity, climate adaptation, and food and water security in arid lands. In her research and doctoral studies at the School of Geography and Development (UA), Rafael explored the links among biogeography, cultural ecology, political ecology, and agrobiodiversity of arid regions, with an emphasis on desert springs and oasis landscapes. She uses the tools of bio-social theories, quantitative and qualitative analysis, cartography, and creative writing to develop new ways of thinking about the world's arid regions. She has traveled, worked, or conducted research in over thirty countries. Over the past decade, she has spent extensive time in Latin America and has developed collaborative research and outreach projects on transboundary water policy issues in the United States and Mexico, and Peru, Argentina, and Chile through the Udall Center for Studies in Public Policy and the Aquasec Center For Excellence.