



## **The Rise and Fall of Peruvian Adaptive Agriculture in the Face of Climatic Instability**

Megan Hart (1), Ana Londono (2), and Patrick Williams (3)

(1) School of Computing and Engineering, University of Missouri Kansas City, Kansas City, United States, (hartme@umkc.edu), (2) School of Sciences, Lindenwood University, Saint Charles, Missouri, United States, (alondono@lindenwood.edu), (3) Department of Anthropology, The Field Museum, Chicago Illinois, United States, (rwilliams@fieldmuseum.org)

Ancient adaptation techniques in drylands are an important mechanism for reconstructing the climatic and social constraints of abandoned agricultural production areas. Holocene climatic instability, and irregular rainfall amounts and durations constrain both the social and economic viability of dryland agricultural production. Such basic economic activities in dryland areas, including intensive agriculture of ancient Wari and Inca adaptation, tend to be more directly and abruptly affected by prolific and intense, long term, recurrent, and pronounced droughts. In this study, Terrestrial LiDAR data is combined with archaeological surveys in order to map and investigate Wari and Inca adaptation techniques to the drylands of southern Peru. The highlands of southern Peru are characterized by their aridity, rugged topography, and low vegetation cover. Despite these unfavorable conditions, the Wari and Inca pre-Columbian cultures settled there and converted, over centuries and millennia, an extensive part of the landscape into terraced surfaces for agricultural production. Intensive agricultural practices combined with the aridity of the region, forced both Wari and Inca inhabitants to design and re-envision, not only sophisticated water distribution and conveyance systems, but also effective surfaces for maximizing hydrologic resources across fields and terraces. Wari constructed water conveyance and management structures depicting advanced engineering methods. Long contour water canals and feeder and satellite canals for agricultural production, are examples of advanced engineering design and construction that surpassed traditional technology. In addition, the vast aerial extent of land occupied by the terraces indicates support of a substantial labor force. Much of the costs associated with this massive labor force were feeding, sheltering, and supplying basic human infrastructure such as waste disposal or cleaning drinking water supplies. While sheer extent of land adapted and cultivated into productive lands itself necessitated a massive labor force, the adjacent population center size and diversity also indicates that a growing urban community was fed using dryland cultivation and adaptation techniques. This cultural and social hub surrounded by agricultural terraces exemplifies the nature of the Wari and Inca infrastructure and the resilience of the population. While the Wari and Inca occupation of lands are not the only example of cultural and agricultural adaptation of landscapes over millennia, the resilient nature of Wari and Inca pre-Columbian cultures is exceptional and this uniqueness is depicted in agricultural adaptation to climatic instability.