



## **The delicate balance between irrigated landscape and climate changes in human history**

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Irrigation is well-known for its potential to bring wealth to society – through stable food production, which enabled ancient urban societies to develop – but can also potentially be very harmful to the landscape and food production on the long run – through salinization or increased vulnerability to droughts or floods, which may have caused ancient urban societies' collapse. Irrigation is a blessing in disguise. In this paper, I propose to study the delicate balance between successful irrigated landscapes and their potential degradation and collapse, conceptualizing irrigation development as the result of series of short-term human actions modifying the natural environment, with potential production benefits in the short run, but potentially severe consequences on both humans and nature on the long run – decades or centuries – with increasing vulnerability of human societies to climatic changes. It is conceivable that once certain environmental thresholds are passed, irrigation systems become more vulnerable, societal resilience decreases and relatively small – climatic – changes can cause disasters and abandonment.

With successes, degradation and collapse in irrigation resulting from a – partially hidden – process of human-environmental interaction of decades or centuries, we do face a problem of ambiguity of temporal scales and the importance of human agency in analyzing landscape change. Our society is not the first to challenge irrigation problems, as the archaeological record is filled with irrigation-related disasters – very often climatic changes – causing societies to collapse. However, these disasters are often defined in terms of centuries, limiting options to incorporate influences of human agency on increased vulnerability in the analysis. I argue that improved understanding of human construction of irrigated landscapes, their potential turn into anti-landscapes and human agency to avoid that yields new, interesting questions in the debate on the collapse of ancient civilizations – and potentially our own.

I will introduce two irrigation settings to discuss these general concepts in a little more detail. A first study will be the Indus Basin in Pakistan, where irrigation is supposed to be heading for disaster, especially because groundwater levels drop dramatically. This current irrigation crisis is real enough, with Pakistani farmers having increased problems in sustaining livelihoods, but the irony of human-induced groundwater levels and their interpretation is hard to miss. Since the early twentieth century, Indus groundwater levels had dramatically risen because of large-scale irrigation development by the British. About fifty years ago, rising groundwater levels were seen as main threat and tubewells were installed to lower groundwater levels. These same tubewells are now blamed for depleting the groundwater. Is the problematic landscape being created today the old, dry landscape of the eighteenth century? My second detailed setting will be the Peruvian North Coast. Civilizations like Chimú, Moche and Inca have created and managed successful irrigation systems, but it is clear they continuously had to balance between success and failure to avoid the anti-landscape. Being surrounded by an archetypical non-landscape – the desert – these irrigation systems and societies show considerable changes over time, in terms of canal routing, irrigated area, building sites, etcetera. Such modifications would have had their short-term benefit, but also created new vulnerabilities to increasing pressure from society and environment.