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# The remote-sensing assessment of a threatened ancient water technology in Afghanistan

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ABSTRACT

Studies and reports regarding the water resources of Afghanistan often rely on old and unconfirmable surveys in referring to the decline of the traditional water supply method known as *karez*. This study utilizes remote sensing data to offer a new, large-scale assessment of active and inactive "long-type" karezes in central and southern Afghanistan, providing a major and much needed revision of karez data that has not been updated in print for half a century. The results demonstrate a trend in widespread disuse of the karez, with the notable exception of the Helmand and Kandahar provinces. The project also makes a specific contribution to the international dialogue about water and environmental security in Afghanistan. The analytical methods used in this study show considerable promise for application in other international arenas that share Afghanistan's semi-arid and arid landscapes. The team members of this project would like this work to be understood and appreciated in the broader context of the ongoing efforts to document and protect Afghanistan's rich cultural heritage.



## 1. Introduction

War and conflict in South Central Asia and the Middle East has resulted in significant destruction of cultural heritage, including museums, libraries, and archaeological sites and features. Some destruction has been intentional, as in the case of the Taliban's March 2001 demolition of the colossal statues of the Buddha in Bamiyan, Afghanistan, and the Islamic State's (ISIS, or ISIL, Da'ish) damaging five of the six UNESCO World Heritage sites in Syria in 2014 and 2015, including the explosive demolition of two 2000-year-old Roman temples at Palmyra (Crossette, 2001; Barnard and Saad, 2015). In Iraq, ISIS destroyed parts of the Assyrian and Roman cities of Nimrud, Khorsabad, and Hatra along with an antiquities museum in Mosul (Barnard, 2015a; Barnard, 2015b; Bowley and Mackey, 2015). There has also been inadvertent damage to cultural heritage sites in war zones. For example, Babylon was seriously damaged after a Coalition Forces base was built there with a mission to protect the site (UNESCO, 2009). Protecting cultural heritage sites in war zones is difficult, and even recording cultural resources in such dangerous settings is daunting. However, remote sensing techniques can be used effectively to document sites and features in areas that are too hazardous for ground-based archaeological surveys (Buchli and Lucas, 2001; Parcak, 2010; Comer and Harrower, 2013; Bewley et al., 2016). Although some archaeologists and anthropologists consider reliance upon satellite imagery to be ethically dubious as a distant, panoptic experience, satellite imagery can be effective in cultural heritage assessment and protection, especially when cultural resources are endangered by military conflict (Gibson, 2003; Contreras and Brodie, 2010; Meyers, 2010; Pringle, 2010).

This article presents the final results of an interdisciplinary project based at the University of Kansas involving anthropologists, archaeologists, and geoarchaeologists. The primary research for the article was carried out during the period of 2012–15. Using Google Earth in combination with ESRI ArcGIS, the project aimed to identify and record all recently active karez water supply systems as well as any inactive ones in a large study area encompassing central and southern Afghanistan. Given the enormity of this endeavor, no other method other than by using remote sensing data and techniques would have been practical, even in peacetime. Karez systems are also known as *qanat* and *fogghara* in various parts of Western Asia, the Near East, and North Africa (Balland, 1992a; Lightfoot, 2009; de Planhol, 2011a). They are hand-dug underground tunnels that channel water in semi-arid and arid environments using phreatic pressure and slow gravitational pull (Figs. 1, 2), a living legacy of an ancient strategy that remains today an "appropriate technology" (Hazeltine and Bull, 1999). These systems often run for several kilometers and, if well maintained, can function for centuries. The traditional introduction date of the karez water supply method to

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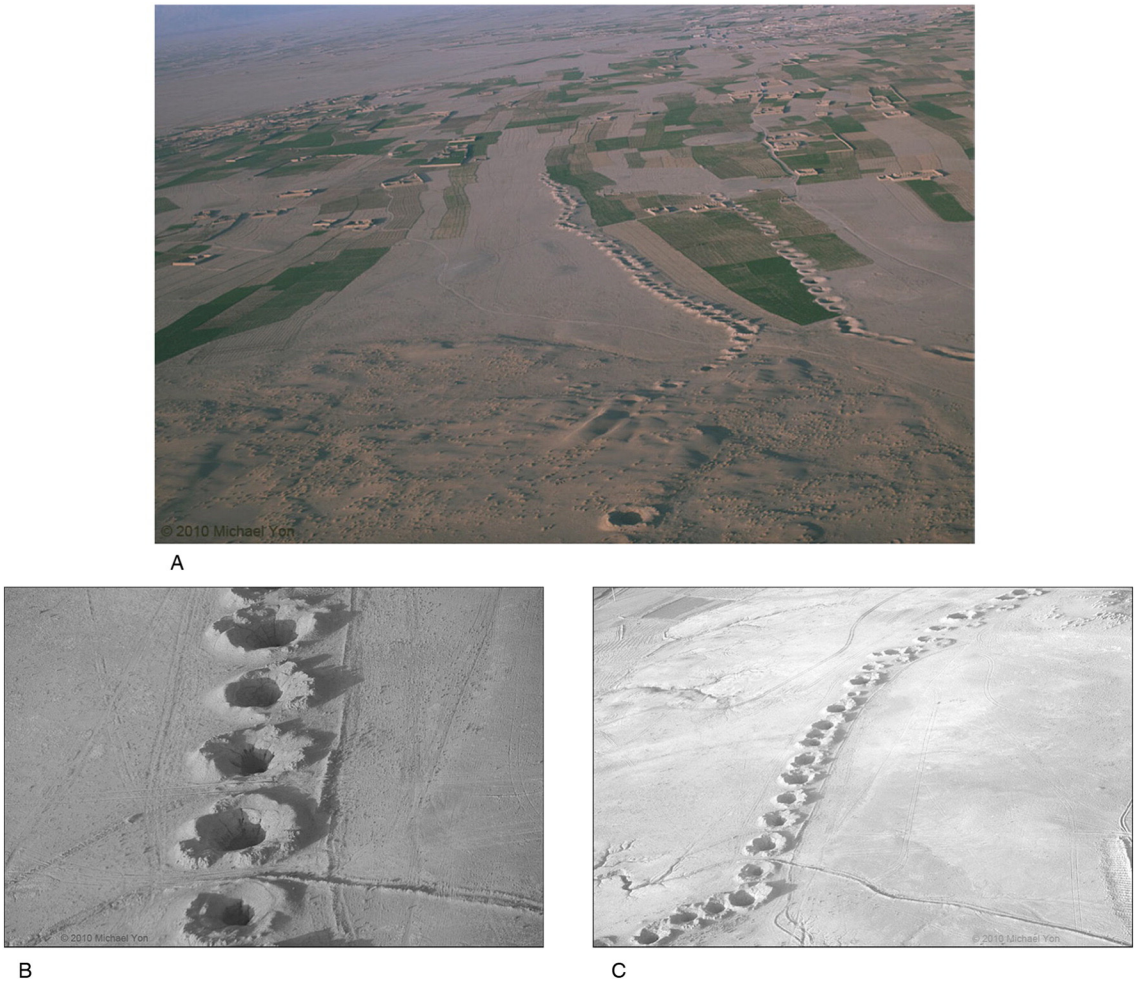


**Fig. 1.** (A) A photograph showing typical karezes in southern Afghanistan; (B and C) Photographs showing details of karezes and their maintenance shafts (image credits: Michael Yon 2010).

Afghanistan dates back to the Achaemenid period (c. 550–331 BCE.) (de Planhol, 2011d).

Karezes are cultural property as well as functioning, sustainable, place-appropriate technology. They have enabled long-term settlement of semi-arid and arid habitats across more than two millennia in a vast territory from northern Africa to western China. However, whether or not they will continue to offer sustainable water supply for these regions into the future is unclear. In the southern half of Afghanistan, karezes have been the only reliable source of water for many rural villages, without which farming and therefore human occupation in the most desolate regions would not be possible. However, they also represent an ancient, labor-intensive, manual technology that has not yet proven amenable to mechanized construction and maintenance. Karez construction and use are also intimately connected to traditional social and religious contexts, ones that can be disrupted when this technology is changed or abandoned. In Islam, water management principles emphasize sustainability and equality, and in Pashtun society, karez construction, use, and maintenance help provide employment, structure social networks, reinforce kinship-based social organization, and sustain local hierarchies of information and control. Leaders within kin-based tribal groups that are structured and conditioned in part by karez use allocate water from the karezes. Water is essential for local agrarian security, including food supply and production for trade, and affects both local and national sociopolitical stability. The ripple effects of alterations to centuries-old traditions in water access, such as the construction of modern pump-driven wells, in regions of conflict may

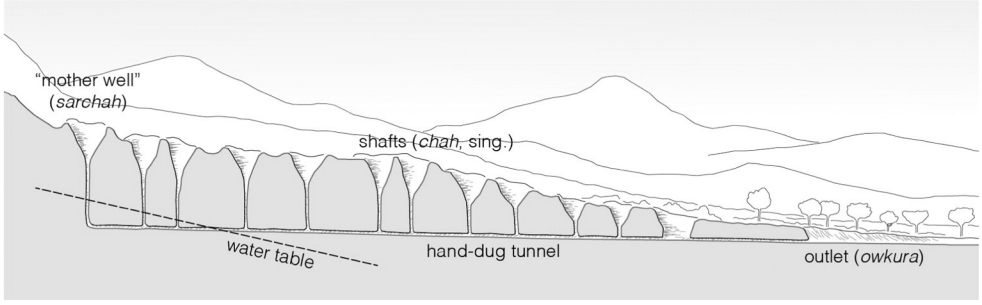


**Fig. 2.** Diagrammatic longitudinal section through a typical karez (image credit: Stinson, after Humlum, 1959).