

EL AGUA ES VIDA, AL-MĀ' AL-HAYĀT, AMAN IMAN, WATER IS LIFE: TRADITIONAL IRRIGATION SYSTEMS AS A SOLUTION TO CLIMATE CHANGE

EMILY HAYES-RICH

ABSTRACT

With the growing pressure of climate change threatening many desert ecosystems around the globe, many communities have been returning to traditional forms of technology. From 2022 to 2023, I spent my Fulbright project using remote sensing and community-based archaeological survey to study one of these traditional technologies, an ancient irrigation system in Morocco known as the *kbettara*. This short piece for *Fulbright Chronicles* outlines some findings from my recently published article, which showed that the *kbettara* is a sustainable and drought-resilient technology for arid regions. Furthermore, I discuss the personal connection between Morocco and New Mexico that drew me to this project.

Keywords: traditional water management • *acequia* • *kbettara* • Morocco • New Mexico • communal systems



The sun is just starting to peak over the tops of the mountains, bathing the Jebel Kest in a warm, early pink glow. The *adhan* (call to prayer) echoes off the cliffside. Most of the landscape in the Tafraoute valley is barren. Small shrubs and gnarled Argan trees force their way through the rocky surface. But here, in the small *douar* (town) of Imi N'Tizghet, the *adhan's* morning sound is matched by the soft gurgling of water flowing through small earthen canals. The presence of water has created a pocket of greenness, with tall palms providing shade and shelter for a thriving agricultural system. The *adhan* ends, and the white mosque from which it came now stands silent, a stark contrast to the mudbrick homes around it, which blend seamlessly into the landscape. I stand on the porch of Mostapha's house overlooking this tiny valley. It is January 3rd 2023, and I am celebrating the new year in Imi N'Tizghet. It is my third time visiting this region, and I am back now to spend another few weeks further documenting the valley's ancient irrigation systems. The Tafraoute Valley is home to a cluster of *kbettara*, a water management technology that has provided life to this region for centuries. By New Year's 2023, I had been fortunate enough to document well over 300 *kbettara* throughout several dozen communities in Morocco. However, I kept coming back to Imi N'Tizghet, to the Tafraoute Valley. It is the one that felt the most like home.

FIELDWORK AND MYTHOLOGY

From 2022 to 2023, I completed a Fulbright Research Grant in Morocco. My project involved a community-based archaeological survey of 473 *kbettara* systems throughout 96 rural oasis communities in the Anti-Atlas, southern Sahara, and Upper Draa Valley. The goals of this research were to create a holistic understanding of the distribution and usage of the *kbettara* across Morocco. Throughout this research, both in Morocco and at my home institution, the University of New Mexico, I used a combination of remote sensing and community-based archaeological surveys. Due to the structure of the *kbettara* system, the ventilation/maintenance shafts (which provide access to an underground tunnel) are easily visible on most high-definition public satellite imagery. Using remote sensing techniques, I was able to produce a map that showed the status and distribution of around 2,500 *kbettara* systems spread throughout six modern Moroccan provinces.

COMMUNITY ENGAGEMENT AND FINDINGS

While on the Fulbright grant, my research methodology focused on community-based archaeological surveys of the *kbettara*. This type of research usually entails trained archaeologists working with descendent communities that are currently involved or have historically been involved with the heritage being studied. Throughout the project, approximately 300 community members actively participated in collaborative surveys. While previous literature indicated that the *kbettara* was an abandoned system used very scarcely throughout the country, the results of my research showed that this system is very much alive and still represents an integral part of many oasis water management practices.

COMPARING ACEQUIAS AND SEQUIA

In Imi N'Tizghet, the *kbettara* has been the sole source of water for at least 800 years. There was much about Imi N'Tizghet that reminded me of my home in Pojoaque, a rural town in northern New Mexico. The mudbrick homes, which provided cool spaces to shelter from the hot summer months and warmth in the cold, high altitude winters; the brisk and clear morning air before the sun had time to bake the landscape; the smell of the ground after it had rained; and the vast expanse of land stretching as far as the eye could see. But, what most reminded me of home were the small, earthen canals that carried water from the mountains down to the valley.

The desert has always been my home. Growing up, however, I was very quickly exposed to the harsh reality facing my beautiful, arid piece of land. One of my earliest memories is of the Cerro Grande fire that consumed much of the mountain forest only mere miles from my house. It was supposed to be “the fire of the century,” but less than a decade later, the Las Conches fire burned bigger and brighter than its predecessor. The *arroyo* (a semi-active

riverbed) by my house ran drier, the mountain I had been raised skiing on received less snow, and the summers became hotter as each year passed. Nevertheless, the small earthen irrigation canals that ran past my house never stopped flowing.

These traditional irrigation and water management systems go by many names and are interconnected with many histories. In northern New Mexico, I knew them as *acequias*. For over 300 years, earthen canals brought water from mountain springs, seasonal rivers, and nearby reservoirs to towns across the state. They are a communal system, and rights to the water are connected to historical land ownership traditions. Management of the water is done by locally elected community members, known as *mayordomo*, who facilitate the distribution of water. There are annual cleanings of the canals in which everyone with use rights comes together to ensure that debris is removed and that any damaged ones are repaired. For this reason, the *acequia* systems are considered not only a physical system but also a social one. Frequently throughout northern New Mexico, the phrase “*el agua es vida*” is uttered; water is life.

PRESERVING HERITAGE, SUSTAINING FUTURES

The deep history of the *acequia* is also important to its continual use as an irrigation system. In towns and villages throughout the region, the thread of tradition runs strong, creating bonds between people and the land of their ancestors, their culture, and their traditions. In general, *acequias* in Pojoaque were connected to the Spanish heritage of the community. Throughout Northern New Mexico, many irrigation systems have histories that connect back to the Pueblo and tribal people who settled and practiced agriculture in this region. An example of this is at the border of Southwestern New Mexico/Southeastern Arizona, where there are ruins of a complex network of earthen irrigation canals that the Hohokam people developed.

In Morocco, the earthen canals are known as *seguias*, and the word is the linguistic root of the word *acequia*. In form and function, they are almost identical. A similar communal system dictates the management of the *seguias* canals, and the position of *mayordomo* is known as *amazǧal*. Traditionally, this role is inherited through generations, but in many communities across Morocco, it is also a locally elected position. Similarly, rights to the water from the *seguias* canals are inherited, and this method is known as *nouba*. Like northern New Mexico, there are semi-annual and annual cleanings of the canals in which members of the community gather in what is known in some communities as *tizwi*. Moroccans also have their own words that are commonly uttered in the oases: *al-mā’ al-bayāt*, *aman iman*; water is life.

While the *segua* of Morocco can draw their water from springs, rivers, and reservoirs (like their sister systems in Northern New Mexico), there is an additional water management technology that is used in these deserts. A subterranean tunnel is dug from the aquifer to the surface, allowing the groundwater to flow naturally and create a “man-made” spring. This system allows water from the aquifer to be used without requiring an external source of power to pull water up, like what is necessary to use a well. Furthermore, the structure of the underground tunnel taps only the upper layers of the aquifer, which keeps the groundwater recharge cycle in balance. In Morocco, it is known as the *kbettara*, but this unique and complex piece of technology can be found in 46 countries around the world and is called by names such as *qanat*, *karez*, *galeria*, *aflaj*, *foggara*, *mambo*, *puquio*, *surangam*, and *kanerjing*. Deserts from Japan, across Central Asia, Europe, North Africa, and Central and South America have been using this technology (some for over 3,000 years) to bring water to arid and semi-arid regions. Both the physical and social structures of these traditional technologies have been developed over centuries and have been shown to be drought-resistant and sustainable ways of practicing agriculture in desert lands.

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The first *kbettara* that I entered was in the small *douar* of Tazoult in the Anti-Atlas. It was mid-afternoon, and I was surveying the *kbettara* with my research (and life) partner Jackson, Muhammad, who is a member of the local Ammeln Association, and two members of Tazoult, one of whom was the local *amazɣal*. We were walking along the ventilation shafts of their community’s inactive *kbettara*. We are nearing the mother well (the first ventilation shaft at the start of the *kbettara*) when the *amazɣal* looks at Muhammad and says this is an excellent spot for him to take me down into the *kbettara*. This suggestion was relayed to Muhammad in *tashlbeet* (a local Amazigh dialect that I only know a few words of) rather than in *darija* (the Moroccan dialect of Arabic I spoke). Therefore, it was quite shocking to me when Muhammad suddenly opened the ventilation shaft and started climbing into it, then looked up at me and told me to follow him. I turned and stared at the two older men, and they eagerly gestured at me to follow. It was roughly 10-15 meters (32-50 feet) down. The bottom was hot and humid, and even though this *kbettara* was not in use, the ground was muddy. Muhammad decided it would be a good idea to walk down the tunnel and go up at the next ventilation shaft. I followed him, at some points crawling on my hands and knees in the mud, until we reached the exit. When I finally emerged, I felt a newfound appreciation for my New Mexican *acequias* whose water comes from the surface and not the depths of the earth.

Conflicting narratives surround the history of this complex subterranean technology. Until recently, the most common theory was that the qanat (*kbettara*) system originated in 6th-century BCE mountains that span modern-day western Iran, eastern Turkey, and northern Iraq. Scholars argue that it was diffused around the world through empirical expansions, slave trades, and technology sharing. However, recent archaeological studies challenge this theory, suggesting independent nodes of development catalyzed by changing climates and adaptive water management. The history of the Moroccan *kbettara* is similarly contested, with competing theories that the technology was first constructed in Marrakech during the 12th century C.E., carried with the spread of Islam in the 8th century C.E., constructed during the Roman occupation of North Africa in the first century C.E., or adopted by local Amazigh populations through diffusion between the oases of North Africa, possibly originating from the Libyan Fezzan over 2,000 years ago.

Despite the importance of the *kbettara* to both the heritage of Morocco and the continual agricultural and domestic water use in oases throughout the country, the *kbettara* are facing widespread abandonment. As of 2023, between 65% and 80% of the systems are estimated to be inactive. The reasons behind the widespread abandonment of these systems range from climate change to introducing modern technology (such as the pump well), to shifts in cultural/political/economic values, and rural exodus. Despite the difficulties that the Moroccan *kbettara* are facing, hundreds of communities across Morocco are still incredibly dedicated to the preservation and management of their systems. Likewise, New Mexico has from 800 to 1,000 working *acequia* systems across the state. The tradition has been held there for centuries by farmers who see the *acequias* as sustainable, environmentally friendly, and resilient water management systems.

One of the things that I often said in the oases was “*bladi bhal bladek*,” which, in Moroccan Arabic, roughly translates to “my land is like your land.” Many people in the oases would say things to me like, “I bet you’ve never seen anything like this in America,” to which I would respond with stories about New Mexico. Stories of the *acequias* and of the mudbrick houses. I’d show them pictures of home, and they would light up saying “*bladek bhal blad?*” “your land is like my land!” It was this connection that initially inspired my research, and it was what continued to fuel my passion for this project. As I continued to study, it became clearer that for various communities, traditional forms of water management are often more resilient and sustainable than modern technologies; however, their local and global importance is often negated. By bringing awareness to the connections between rural arid and semi-arid communities around the world (starting with my personal connection between Morocco and New Mexico), I believe that the ancient technologies that have sustained desert communities for thousands of years can continue to sustain them well into the future.

I continued this inter-community dialogue when I returned to the United States, and people would ask me about my Fulbright. In New Mexico, everyone I talked to would light up when I said I was studying something like the *acequias*. People were thrilled to hear that the *acequias* were not only valued within their community but also within so many other communities around the world. Traditional water management systems do not exist as isolated technologies. They are part of a large narrative of community-based water management systems that are valuable not only within the local contexts in which they are used but also as a global heritage and way of life. The findings of this research echo similar studies that have been undertaken in Algeria, Iran, Iraq, Afghanistan, Pakistan, Oman, and many other countries. It is crucial to acknowledge that this research is not solely applicable to the Moroccan *khattara* but to countless other communities around the world who recognize the importance of traditional forms of water management.

The sun is starting to peak over the top of the mountains, bathing the Sangre de Cristo in a warm, early pink glow. The sound of my neighbor's rooster echoes. Most of the landscape in Pojoaque Valley is barren. Small shrubs and angry looking cholla cactus force their way through the rocky surface. The rooster's morning crows are matched by the soft gurgling of water flowing through the small earthen canals. Tall cottonwoods loom over the apple orchard, and my neighbor is out tending the fields. Today is his turn with the *acequia* water. I sit on the porch, looking out at this beautiful little valley. It is September 2023, and I have just returned from Morocco. In the transition period between the end of my Fulbright and the start of my new, post-graduate career, I am back at my childhood home in Pojoaque. This morning especially, I am missing Morocco. Along my morning walk, the small, earthen canals line our county road. My parent's house resembles Mostapha's in Imi N'Tizghet, a place where I spent so much time because it reminded me of home. But now that I am home, home reminds me so much of Morocco. And the sound of the water flowing through the *acequias* brings me back there, and it reminds me that water is life, *al-mā' al-bayāt, aman iman, el agua es vida*.

NOTES

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BIOGRAPHY

Emily Hayes-Rich holds an M.S. in Anthropology, Public Archaeology from the University of New Mexico and a B.A. in History from Lewis & Clark College. She received a Fulbright Research Grant and an American Institute of Maghreb Studies Award to Morocco 2022-2023, where she studied the *kbettara* (qanat), a traditional water management system. While in Morocco she was affiliated with Mostapha Nokraoui and Hassan Adounouh of AIDECO in Imi N'Tizghet, Taфраoute. She also worked closely with Hassan Elmrani of the Centre d'Etudes Oasiennes, Jorf, PhD candidate Abdoulah Saadi at the University of Ibn Zohr, Agadir, and the Miftah Essad Foundation for the Intangible Heritage of Morocco, Rabat. Her research focuses on the importance of traditional knowledge as a way of mitigating the effects of climate change in rural, arid and semi-arid communities around the world. She has conducted archaeological studies, research, and professional work across six US states in the Southwest and Pacific Northwest, South Korea, Australia, and Morocco. Currently, she works as an archaeologist in the Pacific Northwest and is based out of Portland, Oregon. She can be reached at her email: emily@hayes-rich.com
