THE COMMUNITY BENEFITS OF IRAN'S TRADITIONAL QANAT SYSTEMS

GUIDING PRINCIPLE 7: ENHANCING ECONOMIC BENEFITS

Infrastructure should create employment, support local businesses, and build amenities that benefit communities, thereby maximizing and safeguarding its economic benefits.


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BACKGROUND

Iran occupies a large expanse of predominantly arid or semi-arid land in West Asia. Of the country's 376 kilometres[3] average rainfall per year, an estimated 66 per cent evaporates before reaching the countries' rivers, and all streams are seasonable and variable (Food and Agriculture Organization of the United Nations [FAO] 2008, p. 3). In this geographic context, *qanats* – traditional water systems for transporting and distributing water from sources in upland areas to dry plains (Manuel, Lightfoot and Fattahi 2018) – have historically provided a solution that sustains livelihoods and economic opportunities. They bring a reliable source of water and employment (both directly and indirectly) to farms in the driest parts of the country, where livelihoods would otherwise be severely constrained.

QANATS

Qanat systems are based on a simple and resource efficient technology. They comprise an underground gallery and tunnel system for transporting large quantities of water by gravity, a series of vertical shafts and community institutions for water sharing. They may also incorporate watermills, reservoirs and *hammams*. Recycling and re-use of water is encouraged at different stages along the tunnels, and only the overflow of groundwater pours into the gallery and enters the system (Labbaf Khaneiki 2020). As a result, unlike tube wells, *qanats* do not draw down the water table (Manuel, Lightfoot and Fattahi 2018). The core concept of the *qanat* is "humans adjust themselves to the water available; not the other way around" (Labbaf Khaneiki 2020). The construction of *qanats* is labour-intensive, requiring traditional knowledge and craftsmanship, in addition to unskilled labour. Over time, their underground siting has made them resilient to natural hazards, as well as conflict.

The use of *qanats* spread across West and Central Asia, and to other parts of the world. Increasingly, however, they have been replaced by less sustainable pump systems. *Qanats* represent a timeless innovation that integrates local economic needs with cultural heritage and aesthetic considerations. They hold renewed relevance in a world where addressing climatic variability and livelihood creation are matters of utmost priority.

LABOUR-INTENSIVE DESIGN, CONSTRUCTION AND REHABILITATION

The construction of *qanats* requires skilled and unskilled workers, thereby creating employment for different levels and forms of enterprise. The underground tunnel system consists of a vast network for tapping aquifers at the heads of valleys and then conducting and controlling the flow of water to different settlements. Digging the tunnels involves significant manual labour, as well as engineering skills, while traditional knowledge is needed for design, maintenance and familiarity with local environments (Saberioon and Gholizadeh 2010). Many tasks are therefore appropriate for local workers and do not rely on external technologies. This helps to stimulate local economies and knowledge, and is also a useful dynamic in the context of supply chain disruption.

Qanats use a people-centred design with rest areas built in for workers (UNESCO 2016). They can take several years to construct, which represents a limitation where infrastructure needs are urgent. However, once established, maintenance is relatively low in cost when considered across the entire lifecycle.

Because of their sustainability, *qanats* have been used and rehabilitated for many centuries by private landowners as well as village cooperatives (Manuel, Lightfoot and Fattahi 2018). For example, in recent rehabilitation projects in the wider region, local people were hired to carry out refurbishment work which provided direct income generation, and

communities were trained in managing their *qanats* to guarantee the sustainable supply of water for multiple uses (UNESCO 2012). Integrating these traditional skills into modern contracting methods, along with vocational training for infrastructure, can ensure that the economic and cultural dimensions of sustainability are not traded off against one another.

SUPPORTING LOCAL LIVELIHOODS

In addition to the built infrastructure assets (including tunnels, reservoirs and watermills), *qanats* incorporate a broader system, based on principles of governance for equitable water sharing across different communities and sectors. This system safeguards livelihoods in challenging natural environments.

In the eastern and central areas of Iran in particular, *qanats* are a reliable system providing livelihoods and food security for local communities, in the absence of adequate rainfall and reliable surface water for irrigation. They have allowed those living in the deserts adjacent to mountain watersheds to create a large oasis in an otherwise stark environment (Saberioon and Gholizadeh 2010). For example, in Kashan, Isfahan Province, around 20,000 farmers are either directly or indirectly linked to a *qanat* (FAO 2014, p. 5). Here, *qanats* have supported the production of ancient varieties of pomegranate, fig, pistachio, apple, apricot and medicinal plants as well as many livestock breeds, all of which are central to the local agriculture sector and hold important biodiversity value.

Most farms in Kashan are smallholdings and family farms, with the average family farm being around 0.7 hectares in size (FAO 2014, p. 5). The *qanat* system is based on collective work, with local institutions determining the amount of water and land available for each member of the community (i.e. several small plots). Principles of governance that have evolved slowly over hundreds of years ensure equitable allocation and limit the number of water disputes (Labbaf Khaneiki 2020). As a result, the benefits brought about by *qanats* are inclusive and cover a relatively large number of people. Indeed, in Razavi Khorasan Province, for example, women play an important role in all stages of *qanat*-based saffron production, typically performing tasks ranging from harvesting to packaging (Iran, Agricultural Planning, Economic and Rural Development Research Institute 2018, pp. 79-80).

Due to the *qanats*' traditional design and aesthetic appeal, they also bring tourism opportunities. Eleven of Iran's *qanats* are preserved as UNESCO world heritage sites (UNESCO 2016). In Kashan, *qanats* are used as sites for tourism while in operation for agricultural and other uses. Furthermore, *qanat* infrastructure can be developed for generating energy, breeding fish, sanitation and air-conditioning (Labbaf Khaneiki 2020). These applications highlight the value of *qanats* as a form of multipurpose infrastructure which can be developed in a way that enhances economic benefits across different sectors. It also highlights the importance of careful and culturally appropriate design for long-term and diverse benefits.

REPLICABILITY

Qanats represent a culturally appropriate infrastructure solution for supporting livelihoods across arid and semi-arid regions. They were historically considered as viable solutions for communities across the Persian and Arab world, and variants of *qanats* were adapted in other parts of Asia, Europe and Africa. Today, building new *qanats* is constrained by the lengthy construction time needed. However, with attention from government, there remains value in rehabilitating and enhancing existing *qanats* to create new (and sustain existing) employment and livelihoods. The principles, skills and technologies embodied in these traditional infrastructure systems can also be incorporated into modern practices or integrated with nature-based solutions.

Flexible infrastructure projects that create economic opportunities are currently a priority for policymakers. More costly, modern solutions are not always required where traditional knowledge can bring sustainable solutions for new demands.

KEY INSIGHTS

> The sustainable delivery of water and other essential services through *qanat* systems has historically stimulated local economies with far-reaching co-benefits.

> *Qanats* hold potential for employment creation, requiring diverse skills for a construction and rehabilitation.

> As a form of multipurpose infrastructure, *qanats* have supported local enterprises and livelihoods in sectors ranging from agriculture to tourism.

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