Public awareness and safeguarding traditional knowledge: challenges and conflicts in preserving and representing kārīz/kănérjing in Xinjiang, PR China

Constantin Canavas

ABSTRACT

Strategies of stimulating public awareness and implementing measures to safeguard traditional knowledge of the water management techniques generally known under the terms qanāt or kārīz involve paths of imbedding the technique into the history of a given society. The present study approaches such strategies in the case of the underground water networks in the arid regions in Xinjiang, North Western China, known there under the terms kārīz or kănérjing. There is an on-going debate concerning the beginnings of the construction of kārīz in Xinjiang. A recent revival of this technique started with a movement of kārīz (re)construction in the 1950s–1960s. In recent decades the kārīz/kănérjing water network has suffered due to the expansion of deep well drilling. At the same time the issue has become an object of museum representation. The first museum, Turfan Kariz Paradise, opened its gates in 1992; the Karez Folk Custom Garden, with a more pronounced event and commercial character, was inaugurated in 2000. Both exhibitions are near Turfan. They both demonstrate the traditional construction and maintenance techniques, and stress the strong linkage between local society and the specific traditional water technology. This paper argues that preserving the kārīz/kănérjing in the area of Turfan has become a delicate instrument in the political balance involving local authorities, the provincial government in Urumuqi and the central government in Beijing.

Key words | kănérjing, kārīz, qanāt, traditional knowledge, Turfan

INTRODUCTION

Water management techniques are substantially survival technologies – a fact that attributes particular importance to the goal of preserving the knowhow associated with them. This is precisely the case with the traditional technique of extracting and transporting water in arid regions of Central and East Asia – whether for irrigation or drinking – generally known as qanāt or kārīz (kāhrez). This technique is characterised by sophisticated (empirical) knowhow, high labour demand for construction and maintenance, but low-tech demand for (traditional) equipment. Such water networks consist of underground canals leading water from the source (generally near a mountain) to the places of consumption, and are visually traceable through the rings of accumulated soil dug out from the aligned shafts between the mother-shaft and the outlet of the underground canal. Historical centres where this technique has been developed are found in the Iranian plateau (from where the technique was presumably spread in the Arab-Islamic world), and in arid regions in North Western China (nowadays Xinjiang), where it is known under the terms kārīz (Uyghur) or kănérjing (Mandarin Chinese).

The present study focuses on ‘rediscovering’ this technique and introducing the issue into the political discourse, representation practice, and tourism policy in the People’s Republic of China (PR China). A major claim of the study is that the way the technique and the related practices are described pre-conditions the discourse about the societal embedment of the technique, and yields an...
implicit assessment of the on-going political strategies regarding its management. This critical analysis is based on comparing studies on the history of the technique, as well as on assessing models of its transmission across several regions. The reconstruction of the recent history and the description of the current state are based on information obtained during a field study in summer 2005 and summer 2011 in Turfan. Quantitative data were obtained from the authority for heritage preservation in Turfan, as well as from the material provided by the exhibitions in the kārīz museums near Turfan. In Xinjiang (PR China), especially in the Turfan oasis, the kārīz/kanēřīŋ network is supported by the provincial authorities, and is promoted as a traditional Uyghur technique which serves the politics of showcasing the technology of an ethnic (Uyghur) minority as part of the national (technological) heritage and as a contribution to the national environmental programme. The central administration, on the other hand, appropriated the issue in a discourse of technology transfer ‘inside’ China, thus linking the irrigation heritage of East China with the pre-modern kārīz/kanēřīŋ network in the areas of the Uyghur ethnic minority. Both Chinese heritage discourses are represented in two permanent exhibitions, ‘Karez Paradise’ and ‘Karez Folk Custom Garden’, which are major tourist attractions of Turfan for both national and international visitors.

**Underground tunnels for water-extraction and water-transport: traditional water management in arid regions**

A common assessment concerning traditional water management techniques is that their survival up to the present somehow implies their sustainable character. It is a major issue for historical approaches to consider critically such assertions and to place them into the context of both past and present understanding of water management, before declaring idealised past experience as a panacea for (all) present problems.

Traditional water management techniques comprising underground water tunnels are known in different regions between the Iberian Peninsula and China (and even beyond these limits) under the terms cuniculi, qanāt, kārīz (kahnēz) or kanēřīŋ. Depending on the focus of the description: provenance of the principle, digging technique, goal of the tunnel system, regional expansion of societies with this technical knowledge – several ways of describing the technique are used, and several models of associating the variety of terms for assigning its existence in several regions and cultural environments on the one hand, with more or less plausible diffusion models on the other, have been proposed.

In modern representations this technique comprises a mother well which guarantees the access to the aquatic horizon, as well as numerous vertical wells (shafts) to the underground tunnel canal which runs between the mother well and the final surface outlet. In most cases there is also a distribution network of several tunnel canals.

*Functional* descriptions of the technique tend to pre-conceive interpreting models of its historical development; therefore, such descriptions have given rise to controversies. Whereas most authors consider it as a network of underground water canals, Goblot (1979: pp. 10 ff.) stresses the relationship to mining activities. From a different point of view Glick (1995: p. 77) refers to qanāt/kārīz as a ‘filtration gallery’, since ground water continuously filters into the canal (see also English 1968: p. 170). Focusing on the digging technique in the classical Mediterranean world, Grewe (2007) underlines the difference between cuniculi (underground tunnels in South Etruria, Italy, presumably excavated since as early as the 6th century BCE in the unidirectional way of qanāt as a system of many short, straight sections of underground tunnelling between vertical shafts), and underground tunnels dug following the counter-excavation technique. Further construction details have been used in refining the typology of the underground water tunnels. (For detailed descriptions of qanāt or qanāt-like networks in the Mediterranean context see Martínez-Santos & Martínez-Alfaro (2012) and Voudouris et al. (2013).)

The ‘goals’ of the technique in its various options are irrigation, water supply and drainage. The ‘motivation’ – if not for the initial shaping, at least for the further development and application of the technique in irrigation and water supply networks – is based on the specific water demand of arid, dry regions with poor rainfall. The qanāt technique is characterised by constructing a sloping underground tunnel from or through the aquifer to a surface outlet. Important ‘conditions’ are sustainable water source (e.g. proximity to mountain with snow/water), and
impermeable ground layer(s) underneath the sloping tunnel. More detailed descriptions can be found in the special literature on the \textit{qanät/kārīz} technique. For general considerations, like the issues summarised here, and for further orientation the works of English (1968), Glick (1970: pp. 182–184), Goblot (1979; pp. 10–43), Golab (1951) and Kortum (2004) are very informative. In the introduction of his treatise Goblot (1979) presents a critical comment of several approaches.

Characteristic ‘advantages’ of the \textit{qanät/kārīz} technique for irrigation and water supply purposes are as follows:

(a) Water comes to surface by gravity flow; thus there is no need for elaborate or expensive water raising devices.
(b) \textit{Qanät/kārīz} canals need less of a slope than surface canals do.
(c) Water losses by evaporation are largely prevented or at least reduced.

There is much literature on the typology of \textit{qanät/kārīz} networks in several regions; detailed descriptions are far beyond the scope of the present study. Typical \textit{qanät/kārīz} landscapes are marked by rings of dug-out soil from shafts (vertical wells) along the underground tunnel. The shafts are dug every 20–70 (in some cases up to 150) m, and their depth is ca. 20–200 m, or even more; English (1968) mentions that the depth of the mother well at the village of Gunabad near Birjand in Iran is more than 300 m. The lines of rings on the earth surface mark the \textit{qanät} trajectory over 10–100 km between the mother shaft and the water outlet. At the exit of the canal there is generally a water distributor, followed eventually by metering weirs and a network of irrigation canals.

Although some of the above characteristics are visible or traceable on the earth surface, the major parameters remain invisible. Thus, the construction of \textit{qanät/kārīz} depends largely on mental or material representations of the ‘unseen’ system (i.e. of the earth layers and the ground-water table).

**Technically related terms:** \textit{qanät, kāriz (kâhrez), kânéřing}

Our interest in the etymology of the technical terms used for the techniques of underground water extraction and transportation studied in this paper is mainly motivated by the presumed correlation between linguistic influences and the paths of development – or the roads of (possible) technology transfer up to China. The term \textit{qanät} derives presumably from Akkadian \textit{qanāt} (‘reed’, ‘rush’), from which it then found its way into Hebrew, Aramaic, and Arabic. Probably from Aramaic it was then transmitted to Greek and Latin (‘pipe, canal in the shape of a reed’), and through Arabic it entered into Persian terminology (Lambton 1978: p. 528).

The etymology of \textit{kāriz} is presumably related to the Persian \textit{kāriz/khāriz} (‘underground canal’), from which also the Old Turkish term \textit{karyz} was derived. There are more terms in use in several regions which were influenced by the Arab-Muslim expansion during the 7th–8th century CE. The term \textit{kāriz/kâhrez} is used in Eastern Iran, Afghanistan, and in North West China (here in the form of the Uyghur term \textit{korag}), whereas in North West China the Mandarin term \textit{kânérjìng} is also used, especially in official documents.

The Chinese term \textit{kânérjìng} is probably the phonetic incorporation of the Persian \textit{kāriz/khāriz} (‘underground canal’) which was adopted as \textit{karyz} in Old Turkish. Through Turkish the term found its way into Uyghur; Uyghurs constitute the major minority ethnic group in that region. Kâ(r)ı/z presumably stays for \textit{kāriz, jìng} in Chinese means ‘well’. This etymology could imply transmission paths from the Iranian plateau through Turkic tribes to the Uyghurs at the Turfan basin. In terms of current political narratives it would strengthen the importance of ethnic minorities in contributing and preserving crucial techniques in present-day China. In fact this is a significant part of the message transmitted through the exhibitions dedicated to \textit{kār(ı)/kânérjìng} in Turfan, an oasis at the North Eastern edge of the Taklamakan desert with a long history associated with the legendary Silk Road.

Apparent the terminology (\textit{qanät}) was transported through the Arab-Muslim expansion eastwards and westwards. The methodological question remains, however, open. Does the linguistic basis imply ‘necessarily’ technology transmission paths, i.e. from Iran – through the Islamic expansion – towards East (\textit{kārtz}) and West? Or were underground water canal systems with the \textit{qanät} characteristics parallel independent developments in the specific regional context?
Models of development and diffusion of technology: questions of terminology and methodology

The theories about the emergence and development of the qanāt/kārīz technique are strongly correlated with the ‘terminological’ background and the ‘functional representation’ inherent in any approach. Regarding the case of Xinjiang, North West China, two opposing approaches with significant consequences are presented by Goblot (1979) and Needham (1971).

Goblot (1979: pp. 10–43) focuses on the mining tradition as the ‘mother’ technique. According to his approach, the qanāt/kārīz, a mining installation or technique using galleries of cross-cuts to extract water from the depths of the earth . . . can only have been initially developed in regions and societies with rich (underground) mining tradition and experience – eventually as a by-product of the attempt to follow the slope of the ore layer and to conceive an effective drainage of the water in the mine; both goals could be achieved by using qanāt/kārīz canals. In this sense the technique should be of Iranian origin, and should have been transmitted from the Iranian plateau both eastwards and westwards. According to archaeological evidence (e.g. Neely 1974; Braun 1974: pp. 2 ff.) qanāt systems were apparently first used in Iran in Pre-Achaemenid times. Even if the role of the Etruscan-Roman cuniculi (‘small canals’) as a probably independent development mainly for water drainage, and as a possible transmission nucleus towards the East is not very clear – for the dissemination of the technique and the development paths in China it is only the Iranian node that remains geographically important.

Focusing on the affinity to water extraction (snow water; ground water table) and water transport technologies via underground canals, Needham (1971: pp. 333–334) considers independent development in several hydraulic civilisations as possible and plausible. Moreover, the construction of immense water canals since the Han dynasty (e.g. a canal mentioned to have been built in 150 BCE), and the references to long-distance water transport in the historical sources render early imperial China a favourite candidate for the earliest qanāt/kārīz realisations. The author considers qanāt/kārīz as an elaborate underground water transport technique, and argues on the basis of the functional similarity between a subterranean canal (which is often constructed in order to circumvent a mountain) and the Iranian qanāt/kārīz constructions. By regarding the technique as just one way of water transport, J. Needham considers qanāt/kārīz systems in their ‘goals’ comparable to the river canals of East China. It is precisely this epistemological background that pre-conditions the discourse about the societal embedment of the technique. The underground kārīz systems are – just like the Great Canals – the particular regional solution to the same global problem of water management conceived as a unifying bond all over China. In modern political terms, as we shall comment below, answering the global (common) quest, in the imperial as well as in the PR era, comprises contributions of the ethnic groups – the Han majority in the East as well as the minority nationality of the Uyghurs in the North West. Thus, an apparently descriptive discourse of the history of technology focusing on functional and intentional similarities yields the basis, and an implicit assessment of the on-going political strategies regarding not only water management, but also the delicate issue of the political balance between the Han group and the minority nationalities.

Societal embedding as a prerequisite of safeguarding traditional knowledge of the water technology

Functional similarities, however, may lead to erroneous conclusions if they are considered with no reference to the societal and historical conditions under which the specific aquatic technique was realised. Modern studies on the societal embedding of qanāt/kārīz networks in different environments are scarce; in order to bridge the gap in the availability of sources, modern scholars would project ethnographic data from ‘traditionally’ organised rural societies back to the pre-modern past. The methodological argument is the hypothesis that forms of work organisation in the qanāt/kārīz remain stable, and that they are transmitted without major changes in ‘traditionally’ organised rural societies. This hypothesis is supported by the stable character of the tools found in conjunction with constructing and maintaining the qanāt/kārīz. The stability in the use of tools is also supported by comparison with the few extant written medieval sources on this technique, such as the 11th century CE handbook on qanāt by al-Karājī (Grewe 1998: pp. 33–40; Grewe 2007: p. 322).
Several ethnographically orientated studies of the Middle East are concerned with still functioning qanāt/kārīz systems in the Iranian highlands. Braun (1974: pp. 54 ff.) describes several activities relevant to, and professional groups involved in, the design and construction of qanāt/kārīz networks in the Iranian highlands, e.g. the water-finder, the diggers, etc. Similar ethnological material is also documented by English (1968). (J. Wessels has documented the societal impact of projects regarding the rehabilitation of qanāt networks in Syria (Wessels 2008). See also Lambton (1978), especially for historical evidence, as well as Schneier-Madanes/Courel (2010: pp. 127 ff.).)

As mentioned above, the provenance of the qanāt/kārīz networks in Xinjiang, North West China, has been assessed differently by scholars, and is integrated into diverging narratives. The assumption of an early Uyghur (i.e. Turkic) development – presumably under Iranian influence across the Silk Road, as proposed e.g. by Kortum (2004: pp. 188 ff.) – would imply a local water administration regime. On the issue of Han Chinese influence, the role of the imperial or the provincial government would appear more dominant. The extant qanāt/kārīz networks were presumably constructed during the Qing dynasty, i.e. after 1644 CE. The material (tools, documents) presented in the kārīz exhibitions in Turfan (see below) is accompanied by regional but poor historical documentation, so that the mentioned argument of tool stability can’t be checked satisfactorily for the period before 1949. Moreover, the focus of the documentation is directed toward the period after the establishment of the People’s Republic.

Some theoretical remarks concerning the preservation of qanāt/kārīz

Safeguarding traditional knowledge is an important condition for preserving the traditional qanāt/kārīz. However, practical engagement in the preservation requires more – especially in environments where radical political and social changes take place. Qanāt/kārīz networks are not only hard and complicated to dig; they also demand a great effort to preserve them – e.g. to keep the numerous wells and canals free from sand. The various factors which determine the capability of the qanāt/kārīz technique to survive through history in a given region under changing societal conditions can be summarised as follows:

(a) Capability of the technique to be adapted to the changing social, political and environmental conditions (‘adaptability’).
(b) Specific ‘vulnerability’ of the technique, i.e. sensitivity towards loss of knowhow (interruption in the transmission of experience), failure of maintenance, environmental changes, or hostile human impact (e.g. intentional destruction during war).
(c) Persistence and efficacy of knowhow transmission through generations.

The determinants of assessing the above factors depend on the modalities through which the management of the technology is embedded in the local societal system (e.g. the societal agreement on distributing work load and costs for construction and maintenance). Therefore different local organisation forms may result in a high or low vulnerability of the qanāt/kārīz/qānērjing technology with corresponding impact on its efficiency.

In the following the above issues will be discussed with respect to recent developments and the actual situation of preserving the kārīz/qānērjing aquatic systems in Xinjiang, North West China.

Revival of kārīz/qānērjing in Xinjiang (NW China)

An interesting example of politically and socially motivated changes, during which the adaptability of the kārīz technique can be demonstrated is the case of the kārīz in the Turfan basin, Xinjiang province, North West China. A practical revival of the kārīz technique in Xinjiang started with a movement of kārīz (re)construction in the 1950s–1960s. The motivation and the organisational basis (e.g. arrangements with the potential users for participating in the reactivation and maintenance of the kārīz system) were provided by the local communist authorities after the proclamation of the People’s Republic (Golab: 1951). Sixty years later the kārīz water is no longer considered as the main source for irrigation and water supply in the Turfan region and the province. The interest has shifted from the role of survival technology which had to be organised on a purely local basis in the 1950s to a
factor of symbolic politics of sustainability, as well as of political influence and privileged use of ideologically positive-loaded issues in the relations between local authorities, the (autonomous) provincial and the central government.

According to data from the documentation in the two kārīz museums in Turfan, including additions and adjustments based on data provided by the local authorities for heritage preservation in August 2011, the Xinjiang kārīz system has currently a length of 5,272 km (312 km open channel length). The diminishing interest in kārīz water over recent years and the changes in respect to labour cost and alternative water resources, as well as in respect to the power of the local authorities in comparison to the first years after the proclamation of the People’s Republic are determinant factors in the negative trend in the use of kārīz. In 2003 there were 614 water-carrying kārīz systems out of a total of 1,190 kārīz systems in Turfan; in 2011 only 432 of them were still functional. Nevertheless, a large part of Turfan’s water supply (ca. 30%) still depends on underground kārīz – a significant fact for this city exposed to extremely high temperatures, especially during the summer. (Several studies on kārīz systems in Xinjiang were presented at the 3rd International Conference on Karez Irrigation, in 1993 in Urumuqi. More information on the past and present state of kārīz in Xinjiang can be found in ‘Karez in Xinjiang’, published by the Xinjiang Karez Research Society (2006).)

On the other hand the increasing political significance of the kārīz technique and its preservation has been documented on several occasions. On the provincial level, the Xinjiang authorities promoted and supported the presentation of the traditional technique in a kārīz museum located in extant kārīz segments in Turfan (Turfan Karez Paradise). The museum was launched in 1992 with an investment by the Xinjiang Karez Research Association. Some years later, in 2000, a second kārīz museum opened its gates, the Karez Folk Custom Garden, with a more pronounced event and commercial character. Both exhibitions stress the strong linkage between society and the specific traditional water technology. In both museums the attention and the involvement of governmental representatives in the integration of the traditional technology into political programmes are demonstrated by documents (photographs, signed agreements, etc.) of visits to the Turfan kārīz museums attended by several members of the provincial and the central government. This engagement demonstrates how the kārīz issue has become a part of the strategic balance between central government, provincial government, and local authorities regarding the major issue of ethnic minority nationalities.

On September 29th 2006 the ‘Ordinance of the Karez Protection in Xinjiang Uygur Autonomous Region’ was released by the Standing Committee of the Tenth National People’s Congress of Xinjiang Uygur Autonomous Region. The Chinese text uses the term kânérjìng, the English translation uses the (transliterated) Uyghur term kanez. The ordinance took effect on December 1st 2006; it sets the kārīz networks in Xinjiang under the protection of the Water Administration Department of the province, the Xinjiang Uygur Autonomous Region. By means of the Protection Ordinance the provincial authorities recognise the status of the kārīz wells as key regional monuments, formulate technical guidelines to prevent kārīz water sources from being exhausted, and claim a ‘protecting’ role in local policy by adjusting specific symbolic parameters in the relations to the Uyghur ethnic group in PR China. A key issue in this policy balance is the dominant discourse concerning the harmonious link between the traditional water-management technique (kārīz) preserved by an ethnic minority, and the major irrigation networks of East, Han-dominated China. As we have indicated above, this link obtains its scientific legitimation through the technology diffusion model claimed by the highly estimated scholar J. Needham, but it is also compatible with a model suggesting the autonomous (or further) development of the kārīz technique by the local populations.

The abundant information in both exhibitions is an important element in representing the dominant discourse, in demonstrating political interest, as well as in stimulating public awareness and motivating public interest towards a traditional technology which links local history with national preoccupations and global sustainability potentials. The kārīz/kânérjìng tradition is thus raised to the level of national heritage which deserves to be protected and preserved – beyond efficiency assessments or economic indications.
CONCLUSIONS

Construction and maintenance of the qanāt/kārīz/kâmêrîng network presuppose a more or less large degree of collective participation – primarily on the material-organisational, but also on the symbolic level. In times of active use of the network these activities become eminently societal and political issues. In the actual context of recession in the use of the network, public awareness is stimulated by initiatives which showcase the heritage character of the technique.

In the modern Chinese discourse the narrative on the origin not only touches scientific questions, but also has political connotations. The question, whether the technology is linked to the Han Chinese hydraulic tradition of the East coast, or whether it is entirely affiliated to the Iranian/Turkic subterranean canal experience (i.e. a technology embedded in the Uyghur ethnic minority group) becomes thus an issue in the politics of balance between the Han majority and the minority ethnic groups.

Does the qanāt/kārtz technique actually yield conditions for sustainable water management? Any answer to this question depends on the specific societal embedding or the technique. In Iran the technique represents a complementary issue in urban development; its efficiency mainly depends on changing environmental and societal conditions. An important factor often neglected in the sustainability debate is the conflict between the qanat/kārtz technique and the building of deep wells in respect to exploitation of subterranean water resources. Similar societal-juridical conflicts rise among existing qanat/kārtz systems in the sense that neighbouring mother wells compete with each other in draining the water table. Such conflicts were already documented in 1968 by English. Recent experiences of these conflicts in several countries have been documented by several authors (e.g. Kobori 2009; Lightfoot 2009; Semsar Yazdi & Labbaf Khaneiki 2010, pp. 130 ff.; Semsar Yazdi & Labbaf Khaneiki 2012, pp. 308 ff.). In both conflict cases the comparative assessment of the impact on the environment remains ambiguous.

Finally one should keep in mind that qanāt/kārīz systems are important infrastructure components and – in many cases – the organisational backbone of societies which depend on them – in rural Iran, in Xinjiang or elsewhere. The specific type and grade of societal embedding of the technique determines the resistance of the given society to transformation processes related to the access to natural resources. On the other hand, the adaptability of the technique to the (changing) conditions of the given society (e.g. managing maintenance under several regimes of qanāt/kārīz ownership) is a determinant for its future development – or decline.

REFERENCES


First received 31 December 2013; accepted in revised form 1 April 2014. Available online 16 April 2014