Qanat - Mina d'aigua

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Esquema d'un qanat

Un qanat o kariz, és un canal subterrani suaument inclinat per transportar aigua des d'un pou o des d'un aqüífer on brolla l'aigua fins a la superfície per al reg i beure, actuant com un aqüeducte subterrani. Construït a l'Iran, l'Iraq i nombroses altres societats, aquest és un antic sistema de subministrament d'aigua des d'un pou profund, que fa ús d'una sèrie d'eixos d'accés vertical. Els qanats encara creen un subministrament fiable d'aigua per als assentaments humans i el reg en climes calorosos, àrids i semiàrids, però el valor d'aquest sistema està directament relacionat amb la qualitat, volum i regularitat del flux d'aigua. Tradicionalment, els qanats han estat construïts a mà a l'Iran per un grup de treballadors qualificats, coneguts com kariz gar. La professió històricament pagava bé i normalment es lliurava de pare a fill.

Segons la major part de la bibliografia consultada, la tecnologia qanat va ser desenvolupada a l'antic Iran pel poble persa en algun moment a principis del primer mil·lenni aC i es va estendre des d'allà lentament cap a l'oest i cap a l'est. [1][2][3] [4][5][6] No obstant això, algunes altres fonts suggereixen un origen del sud-est d'Aràbia. [7] Amés, els sistemes anàlegs semblaven ser desenvolupats independentment a la Xina iAmèrica del Sud, específicament al sud del Perú.

Contingut

Noms
Les variants comunes de qanat en anglès inclouen kanat, khanat, kunut, kona, konait, ghanat, ghundat. [9] [9]

Qan?h (????)és una paraula àrab que significa "canal". [10] En persa, les paraules de "qanat" són k?r?z (o k?r?z; 08001 Barcelona i deriva de la paraula anterior k?hr?z (??????). La paraula qan?t (????) també s'utilitzaen persa. Altres noms per qanat són kahan (persa: ???), Kahn (Balochi), kahriz/k?hriz (Azerbaidjan); khettara (Marroc); Galerías, minas o viajes de agua (Espanya); falaj (àrab: ???) (Unió delsEmirats Àrabs i Oman), foggara/fughara (Nordd'Àfrica). [11] Els termes alternatius per als qanats a Àsia i el nord d'Àfrica són kakuriz, chin-avulz i mayun.

Orígens
Tradicionalment es reconeix que la tecnologia qanat va ser inventada a l'antic Iran[12] en algun moment a principis del 1r mil·lenni aC,[13][14] [15]i es va estendre desd'allà lentament cap a l'oest i cap a l'est. En conseqüència, algunes fonts estatals van ser inventades a l'Iran abans de 1000 aC[16][17] i fins al 3000 aC. [18]En conseqüència, s'estima que els qanats de Gonabad tenen gairebé 2700 anys d'antiguitat. [20][21]

El 2002, l'arqueòleg Walid Yasin Al Tikriti va proporcionar un contrapunt que el qanat no s'originà a Persia. [7] Com a prova, va assenyalar set aflaj de l'Edat del Ferro descoberts recentment a l'àrea d'Al Ain dels Emirats Àrabs Units que es remunten al primer mil·lenni aC basats en forgues, ceràmica, xemeneies i arquitectura. [7] Tikriti va apuntar a les excavacions a Sharjah, per part de l'equip arqueològic francès que hi treballava, així com un equip alemany que treballava a Oman, de possibles aflaj de l'Edat del Ferro. [7] Conclou que la tecnologia es va originar al sud-est d'Aràbia i va ser portada a Persia, probablement per la conquesta sassànida de la península d'Oman. [7] El 1997, el govern va

El 2013, Boualem Remini i Bachir Achour, van declarar que l'origen de la tecnologia qanat és incert, però van confirmar que la tecnologia estava en ús al nord-oest de l'Iran c.1000 aC. [22][23][24]

El 2016, Rémy Boucharlat en el seu article Qan?t and Falaj: Polycentric and Multi-Period Innovations Iran and the United Arab Emirates as Case Studies, va afirmar que l'atribució de la tecnologia als iranians a principis del primer mil·lenni aC és una posició que ja no es pot mantenir. [25] Mentre que Boucharlat sosté evidències arqueològiques indica una innovació policèntrica en lloc d'una difusió radial. [26] [26]

Característiques tècniques

Secció transversal d'un Qanat

A les regions àrides i semiàrides, a causa de l'alta evaporació, les rutes de transport eren en forma de qanats, que condueixen les aigües subterrànies a les zones de consum al llarg dels túnels. A llarg termini, el sistema qanat no només és econòmic, sinó també sostenible per al reg i l'agricultura.... Se sabia que el flux d'aigua subterrània depenia de la mida del gra dels sediments, i, per tant, els túnels de qanats s'omplen de material més agut que les formacions geològiques de mànega circumdants. Els qanats es construeixen principalment al llarg de les valls on es dipositen sediments quartenaris.

— Manual d'aqüeductes subterranis (2016)

Els qanats es construeixen com una sèrie d'eixos verticals ben similars, connectatsper túnels suaument inclinats. Qanats eficaçment lliurar grans quantitats d'aigua subterrània a la superfície sense necessitat de bombament. L'aigua desguassa per gravetat, típicament d'un aqüífer de terra alta, amb la destinació inferior a la font. Els qanats permeten transportar aigua a llargues distàncies en climes secs calents sense molta pèrdua d'aigua a l'evaporació. [27] [27]

El qanat no s'ha de confondre amb el túnel de flux de primavera típic de la zona muntanyosa al voltant de Jerusalem. Tot i que tots dos són túnels excavats dissenyats per extreure aigua per flux de gravetat, hi ha diferències crucials. En primer lloc, l'origen del qanat va ser un pou que es va convertir en una font artificial. En canvi, l'origen del túnel de flux de primavera va ser el desenvolupament d'una font natural per renovar o augmentar el flux després d'una recessió de la taula d'aigua. En segon lloc, els eixos essencials per a la construcció de qanats no són essencials per als túnels de flux primaveral.

És molt comú que un qanat comenci per sota dels contraforts de les muntanyes, on la taula d'aigua està més a prop de la superfície. A partir d'aquesta font, el túnel de Qanat es desemboca suaument cap avall, convergint lentament amb el

pendent més pronunciat de la superfície terrestre per sobre, i l'aigua finalment flueix per sobre del terra on es troben els dos nivells. Per connectar una àrea poblada o agrícola amb un aqüífer, els qanats sovint s'han d'estendre durant llargues distàncies. [28] [28]

Qanats de vegades es divideixen en una xarxa de distribució subterrània de canals més petits anomenats kariz. Igual que els qanats, aquests canals més petits estan sota terra per evitar la contaminació i l'evaporació. En alguns casos l'aigua d'un qanat s'emmagatzema en un embassament, típicament amb el flux nocturn emmagatzemat per a ús diürn. Un ab anbar és un exemple d'un reservori tradicional persa alimentat per qanat per beure aigua.

El sistema qanat té l'avantatge de ser resistent a desastres naturals com terratrèmols i inundacions, i per deliberar la destrucció en guerra. A més, és gairebé insensible als nivells de precipitació, oferint un flux amb només variacions graduals de mullat a sec. Des d'una perspectiva de sostenibilitat, els qanats només són alimentats per gravetat, i per tant tenen baixos costos d'operació i manteniment un cop construïts. Els qanats transfereixen aigua dolça des de l'altiplà de muntanya fins a les planes baixes amb sòls més salats. Això ajuda a controlar la salinitat del sòl i prevenir la desertificació. [29] [29]

Importància
El valor del qanat està directament relacionat amb la qualitat, volum i regularitat del flux d'aigua. Gran part de la població de l'Iran i altres països àrids d'Àsia i el nord d'Àfrica depenien històricament de l'aigua dels qanats; les àrees de població corresponien estretament a les zones on els qanats són possibles. Tot i que un qanat era car de construir, el seu valor a llarg termini per a la comunitat, i per tant per al grup que invertia en la construcció i el manteniment d'ella, era substancial. [28] [28]

Un túnel de qanat prop d'Isfahan

Article principal: Aqüeducte (subministrament d'aigua)

Característiques comunes a les regions que utilitzen la tecnologia qanat
La tecnologia qanat s'utilitza més extensament en àrees amb les següents característiques:[citació necessària]

Absència de rius més grans amb cabals durant tot l'any suficients per donar suport al reg
Proximitat de zones potencialment fèrtils a muntanyes riques en precipitacions o serralades
Clima àrid amb altes taxes d'evaporació superficial perquè els embassaments i canals superficials es tradueixin en altes pèrdues
Un aqüífer a la zona potencialment fèrtil que és massa profunda per a l'ús convenient de pous simples

Impacte dels qanats en els patrons d'assentament
Una ciutat o ciutat típica a l'Iran, i en altres llocs on s'utilitza el qanat, té més d'un qanat. Els camps i jardins es troben tant sobre els qanats a poca distància abans que emergeixin del sòl i per sota de la superfície. L'aigua dels qanats defineix tant les regions socials de la ciutat com el traçat de la ciutat. [28] [28]

L'aigua és més fresca, més neta i més fresca a la part superior arriba i les persones més pròsperes viuen a la sortida o immediatament aigües amunt de la sortida. Quan el qanat encara està sota terra, l'aigua es dibuixa a la superfície a través de pous d'aigua o pous perses impulsats per animals. Els embassaments subterranis privats podrien subministrar cases i edificis per a ús domèstic i reg de jardí també. A més, el flux d'aire del qanat s'utilitza per refredar una sala d'estiu subterrània(shabestan)que es troba en moltes cases i edificis més antics. [28] [28]

Aigües avall de la sortida, l'aigua discorre a través de canals superficials anomenats jubs (j?bs) que corren costa avall, amb branques laterals per portar aigua al barri, jardins i camps. Els carrers solen paral·lelitzar els jubs i les seves branques laterals. Com a resultat, les ciutats i pobles s'orienten d'acord amb el degradat de la terra; aquesta és una

resposta pràctica a la distribució eficient de l'aigua en diferents terrenys. [28] [28]

Els nivells més baixos dels canals són menys desitjables tant per a les residències com per a l'agricultura. L'aigua creix progressivament més contaminada a mesura que passa aigües avall. En els anys secs, els nivells més baixos són els més propensos a veure reduccions substancials de flux. [28] [28]

Construcció
Tradicionalment qanats són construïts per un grup de treballadors qualificats, muqann?s, amb mà d'obra. La professió històricament pagava bé i normalment es lliurava de pare a fill. [28] [28]

Preparatius

Fan al·luvial al sud de l'Iran. Imatge del satèl·lit Terra de la NASA

El pas crític i inicial en la construcció de qanat és la identificació d'una font d'aigua adequada. La recerca comença en el punt on el ventilador al·luvial es troba amb les muntanyes o contraforts; l'aigua és més abundant a la muntanya a causa de l'aixecament orogràfic i l'excavació en el ventilador al·luvial és relativament fàcil. Els muqann?s segueixen la pista dels principals cursos d'aigua procedents de les muntanyes o contraforts per identificar evidències d'aigua subsuperficial com la vegetació d'arrel profunda o les vespes estacionals. Un pou de prova és llavors excavat per determinar la ubicació de la taula d'aigua i determinar si un flux suficient està disponible per justificar la construcció. Si es compleixen aquests requisits previs, la ruta s'estableix sobre el terra.

S'ha de muntar l'equipament. L'equip és senzill: contenidors (normalment bosses de cuir), cordes, bobines per elevar el recipient a la superfície al cap de l'eix, escotilles i pales per a l'excavació, llums, nivells d'esperit o bobs de plomall i corda. Depenent del tipus de sòl, qanat revestiments (normalment cèrcols d'argila cuita) també pot ser necessari. [28][30]

Tot i que els mètodes de construcció són senzills, la construcció d'un qanat requereix una comprensió detallada de la geologia subterrània i un grau de sofisticació de l'enginyeria. El degradat del qanat ha de ser controlat acuradament: massa poc profund un degradat no produeix flux i un degradat massa pronunciat donarà lloc a una erosió excessiva, col·lapsant el qanat. I la mala lectura de les condicions del sòl condueix a col·lapses, que en el millor dels casos requereixen una extensa reelaboració i en el pitjor són fatals per a la tripulació. [30] El 2007, el govern va començar a

Excavació
La construcció d'un qanat sol ser realitzada per una tripulació de 3-4 muqann?s. Per a un qanat poc profund, un treballador típicament cava l'eix horitzontal, un eleva la terra excavada de l'eix i un distribueix la terra excavada a la part superior. [30] El 2007, el govern va començar a

La tripulació sol començar des de la destinació a la qual l'aigua serà lliurada a terra i treballa cap a la font (la prova bé). Al llarg del recorregut s'excavaen eixos verticals, separats a una distància de 20-35 m. La separació dels eixos és un equilibri entre la quantitat de treball necessari per excavar-los i la quantitat d'esforç necessari per excavar l'espai entre ells, així com l'esforç de manteniment definitiu. En general, com més lent és el qanat, més a prop dels eixos verticals. Si el qanat és llarg, l'excavació pot començar des dels dos extrems alhora. Els canals afluents de vegades també es construeixen per complementar el flux d'aigua. [28][30]

La majoria dels qanats a l'Iran corren menys de 5 km, mentre que alguns s'han mesurat a ?70 km de longitud prop de Kerman. Els eixos verticals solen oscil·len entre els 20 i els 200 m de profunditat, tot i que els qanats de la província de Khorasan s'han registrat amb eixos verticals de fins a 275 m. Els eixos verticals suporten la construcció i manteniment del canal subterrani, així com l'intercanvi d'aire. Els eixos profunds requereixen plataformes intermèdies per simplificar el procés d'eliminació del sòl. [28][30]

La velocitat de construcció depèn de la profunditat i la naturalesa del sòl. Si la terra és suau i fàcil de treballar, a 20 m

de profunditat una tripulació de quatre treballadors pot excavar una longitud horitzontal de 40 m per dia. Quan l'eix vertical arriba als 40 metres, poden excavar només 20 metres horitzontalment per dia i a 60 metres de profunditat, això baixa per sota dels 5 metres horitzontals per dia. A Algèria, una velocitat comuna és de només 2 metres per dia a una profunditat de 15 metres. Els qanats profunds i llargs (que molts són) requereixen anys i fins i tot dècades per construir. [28][30]

El material excavat sol ser transportat mitjançant bosses de cuir fins als eixos verticals. Està muntat al voltant de la sortida vertical de l'eix, proporcionant una barrera que impedeix que les restes de vent o pluja condueixin a l'entrada dels eixos. Aquests monticles poden ser coberts per proporcionar una major protecció al qanat. Des de l'aire, aquests eixos semblen una cadena de cràters de bomba. [30] El 2007, el govern va començar a

El canal de transport d'aigua del qanat ha de tenir un pendent descendent suficient que l'aigua flueixi fàcilment. No obstant això, el degradat descendent no ha de ser tan gran com per crear condicions sota les quals l'aigua transicions entre el flux supercrític i subcrític; si això succeeix, les ones que resulten poden donar lloc a una erosió severa que pot danyar o destruir el qanat. L'elecció del pendent és un intercanvi entre l'erosió i la sedimentació. Túnels altament inclinats estan subjectes a més erosió a mesura que l'aigua flueix a una velocitat més alta. D'altra banda, els túnels menys inclinats necessiten un manteniment freqüent a causa del problema de la sedimentació. [29] Un degradat inferior a la baixa també contribueix a reduir el contingut sòlid i la contaminació en aigua. [29] En els qanats més curts el degradat descendent varia entre 1:1000 i 1:1500, mentre que en qanats més llargs pot ser gairebé horitzontal. Aquesta precisió s'obté rutinàriament amb un nivell d'esperit i corda. [28][30]

En els casos en què el degradat és més pronunciat, les cascades subterrànies es poden construir amb característiques de disseny adequades (normalment revestiments) per absorbir l'energia amb una mínima erosió. En alguns casos s'ha aprofitat l'energia de l'aigua per conduir molins subterranis. Si no és possible treure la sortida del qanat prop de l'assentament, cal executar un jub o canal per terra. Això s'evita quan és possible limitar la contaminació, l'escalfament i la pèrdua d'aigua a causa de l'evaporació. [28][30]

Manteniment
Els eixos verticals poden ser coberts per minimitzar la sorra bufada. Els canals de qanats han de ser inspeccionats periòdicament per a l'erosió o les coves, netejats de sorra i fang i reparats d'una altra manera. Per seguretat, el flux d'aire ha d'estar assegurat abans de l'entrada.

Restauració
Alguns qanats danyats han estat restaurats. Per ser sostenibles, la restauració ha de tenir en compte molts factors no tècnics que comencen amb el procés de selecció del qanat per ser restaurat. A Síria, tres llocs van ser escollits sobre la base d'un inventari nacional dut a terme el 2001. Un d'ells, el Drasiah qanat de Dmeir,es va completar el 2002. Els criteris de selecció incloïen la disponibilitat d'un flux constant d'aigües subterrànies, la cohesió social i la voluntat de contribuir de la comunitat utilitzant el qanat, i l'existència d'un sistema de drets d'aigua en funcionament. [31] [31] El 2007,

Aplicacions de qanats
Subministrament de reg i aigua potable
Les aplicacions primàries dels qanats són per al reg, proporcionant aigua al bestiar i subministrament d'aigua potable. Altres aplicacions inclouen refrigeració i emmagatzematge de gel.

Refredament
Article principal: Refredador evaporatiu

Wind tower and qanat used for cooling

Qanats utilitzat en conjunció amb una torre de vent pot proporcionar refrigeració, així com un subministrament d'aigua.

Una torre de vent és una estructura similar a una xemeneia col·la mentia sobre la casa; de les seves quatre obertures, la que hi ha davant de la direcció del vent s'obre per moure l'aire fora de la casa. L'aire entrant es retira d'un qanat sota la casa. El flux d'aire a través de l'obertura de l'eix vertical crea una pressió més baixa (vegeu l'efecte Bernoulli)i dibuixa aire fresc des del túnel de qanat, barrejant-se amb ell. L'aire del qanat es dibuixa al túnel a certa distància i es refreda tant pel contacte amb les parets/aigua del túnel fresc com per la transferència de calor latent de l'evaporació a mesura que l'aigua s'evapora al corrent d'aire. En climes secs del desert això pot resultar en una reducció superior a 15 °C en la temperatura de l'aire procedent del qanat; L'aire mixt encara se sent sec, de manera que el soterrani és fresc i només còmodament humit (no humit). Torre de vent i qanat refredament s'han utilitzat en climes del desert durant més de 1000 anys. [32] El 2007, el govern va començar a

Emmagatzematge de gel

Yakhchal in Yazd Province

Cap a l'any 400 aC, els enginyers perses havien dominat la tècnica d'emmagatzemar gel a mitjans d'estiu al desert. [33] El 2007, el govern va començar a

The ice could be brought in during the winters from nearby mountains. But in a more usual and sophisticated method they built a wall in the east–west direction near the yakhchal (ice pit). In winter, the qanat water would be channeled to the north side of the wall, whose shade made the water freeze more quickly, increasing the ice formed per winter day. Then the ice was stored in yakhchals—specially designed, naturally cooled refrigerators. A large underground space with thick insulated walls was connected to a qanat, and a system of windcatchers or wind towers was used to draw cool subterranean air up from the qanat to maintain temperatures inside the space at low levels, even during hot summer days. As a result, the ice melted slowly and was available year-round.[33]

Qanats by country

Probable diffusion of Qanat technology

Asia
Afghanistan
The Qanats are called Kariz in Dari (Persian) and Pashto and have been in use since the pre-Islamic period. It is estimated that more than 20,000 Karizes were in use in the 20th century. The oldest functional Kariz which is more than 300 years old and 8 kilometers long is located in Wardak province and is still providing water to nearly 3000 people.[34] The incessant war for the last 30 years has destroyed a number of these ancient structures. In these troubled times maintenance has not always been possible. To add to the troubles, as of 2008 the cost of labour has become very high and maintaining the Kariz structures is no longer possible.[dubious – discuss] Lack of skilled artisans who have the traditional knowledge also poses difficulties. A number of the large farmers are abandoning their Kariz which has been in their families sometimes for centuries, and moving to tube and dug wells backed by diesel pumps.[citation needed]

However, the government of Afghanistan is aware of the importance of these structures and all efforts are being made to repair, reconstruct and maintain (through the community) the kariz.[citation needed] The Ministry of Rural Rehabilitation and Development along with National and International NGOs is making the effort.

There are still functional qanat systems in 2009. American forces are reported to have unintentionally destroyed some of the channels during expansion of a military base, creating tensions between them and the local community.[35] Some of these tunnels have been used to store supplies, and to move men and equipment underground.[36]

Armenia

Qanats have been preserved in Armenia in the community of Shvanidzor, in the southern province of Syunik, bordering with Iran. Qanats are named kahrezes in Armenian. There are 5 kahrezes in Shvanidzor. Four of them were constructed in XII-XIVc, even before the village was founded. The fifth kahrez was constructed in 2005. Potable water runs through I, II and V kahrezs. Kahrez III and IV are in quite poor condition. In the summer, especially in July and August, the amount of water reaches its minimum, creating a critical situation in the water supply system. Still, kahrezes are the main source of potable and irrigation water for the community.

Azerbaijan

The territory of Azerbaijan was home to numerous kahrizes many centuries ago. Archaeological findings suggest that long before the ninth century CE, kahrizes by which the inhabitants brought potable and irrigation water to their settlements were in use in Azerbaijan. Traditionally, kahrizes were built and maintained by a group of masons called ‘Kankans’ with manual labour. The profession was handed down from father to son.

It is estimated that until the 20th century, nearly 1500 kahrizes, of which as many as 400 were in the Nakhichevan Autonomous Republic, existed in Azerbaijan. However, following the introduction of electric and fuel-pumped wells during Soviet times, kahrizes were neglected.

Today, it is estimated that 800 are still functioning in Azerbaijan. These operational kahrizes are key to the life of many communities.

International Organization for Migration and the Revival of Kahriz

In 1999, upon the request of the communities in Nakhichevan, taking into consideration the needs and priorities of the communities, especially women as the main beneficiaries, IOM began implementing a pilot programme to rehabilitate the kahrizes. By 2018 IOM rehabilitated more than 163 kahrizes with funds from the United Nations Development Programme (UNDP), European Commission (EC), Canadian International Development Agency (CIDA), Swiss Agency for Development and Cooperation (SDC) and the Bureau of Population, Refugees, and Migration, US State Department (BPRM) and the self-contribution of the local communities.

KOICA and IOM's kahriz rehabilitation project in Azerbaijan

In 2010, IOM began a kahriz rehabilitation project with funds from the Korea International Cooperation Agency (KOICA). During the First Phase of the action which lasted until January 2013, a total of 20 kahrizes in the mainland of Azerbaijan have been renovated. In June 2018, the Second Phase has been launched and by 2022, IOM and KOICA aim to renovate fully a total of 40 kahrizes.

China

Karez gallery near Turpan, Xinjiang, China

Main article: Turpan water system

The oasis of Turpan, in the deserts of Xinjiang in northwestern China, uses water provided by qanat (locally called karez). The number of karez systems in the area is slightly below 1,000, and the total length of the canals is about 5,000 kilometers.[37]

Turpan has long been the center of a fertile oasis and an important trade center along the Northern Silk Road, at which time it was adjacent to the kingdoms of Korla and Karashahr to the southwest. The historical record of the karez extends back to the Han Dynasty. The Turfan Water Museum is a Protected Area of the People's Republic of China because of

the importance of the Turpan karez water system to the history of the area.

India
In India, there are karez (qanat) systems. These are located at Bidar, Bijapur, Burhanpur "(Kundi Bhandara)" and Aurgangabad. The Karez does exist few other places as well, but investigations are in progress to determine the reality. The Bidar karez systems were probably the first one to have ever been dug in India. It dates to the Bahmani period. Valliyil Govindankutty Assistant Professor in Geography Government College Chittur was responsible for unraveling Karez Systems of Bidar and has been supporting District Administration with research outputs towards conservation of the Karez system. He was responsible for mapping these wonderful water system. Bidar is having three karez systems as per Gulam Yazdani's documentation. Detailed documentation of the Naubad karez system was dome by Valliyil Govindankutty in August 2013. A report was submitted to District Administration of Bidar and highlights many new facts which do not exist in previous documentations. The research support provided by Valliyil Govindankutty to the District Administration has led to the initiation of cleaning the debris and collapsed sections paving the way to its rejuvenation. The cleaning of karez has led to bringing water to higher areas of the plateau, and it has in turn recharged the wells in the vicinity. Other than Naubad there are two more karez systems in Bidar, "Shukla Theerth" and "Jamna Mori". The Shukla theerth is the longest karez system in Bidar. The mother well of this karez has been discovered by Valliyil Govindankutty and Team YUVAA during survey near Gornalli Kere, a historic embankment. The third system called Jamna mori is more of a distribution system within the old city area with many channels crisscrossing the city lanes.

The Bijapur karez system is much complicated. The study done by Valliyil Govindankutty reveals that it has surface water and groundwater connections. The Bijapur karez is a network of shallow masonry aqueducts, terracotta/ceramic pipes, embankments and reservoirs, tanks etc. All weave together a network to ensure water reaches the old city. The system starts at Torwi and extends as shallow aqueducts and further as pipes; further it becomes deeper from the Sainik school area onward which exists as a tunnel dug through the geology. The system can be clearly traced up to Ibrahim Roja.

In Aurangabad the karez systems are called nahars. These are shallow aqueducts running through the city. There are 14 aqueducts in Aurangabad. The Nahar-i-Ambari is the oldest and longest. Its again a combination of shallow aqueducts, open channels, pipes, cisterns, etc. The source of water is a surface water body. The karez has been constructed right below the bed of lake. The lake water seeps through the soil into the Karez Gallery.

In Burhanpur the karez is called "Kundi-Bhandara", sometimes wrongly referred to as"Khuni Bhandara". The system is approx 6 km long starts from the alluvial fans of Satpura hills in the north of the town. Unlike Bidar, Bijapur and Aurgangabad the System airvents are round in shape. Inside the Karez one could see lime depositions on the walls. The Systems ends to carry water further to palaces and public fountains through pipe line.

Indonesia
It has been suggested that underground temples at Gua Made in Java reached by shafts, in which masks of a green metal were found, originated as a qanat.[38]

Iran

This qanat surfacing in Fin is from a spring thought to be several thousand years old, called The Spring of Solomon ("Cheshmeh-ye Soleiman"). It is thought to have been feeding the Sialk area since antiquity.

A Kariz surfacing in Niavaran, Tehran. It is used for watering the grounds of The National Library of Iran.

See also: Traditional water sources of Persian antiquity

Cotton is indigenous to South Asia and has been cultivated in India for a long time. Cotton appears in the Inquiry into Plants by Theophrastus and is mentioned in the Laws of Manu.[39] As transregional trade networks expanded and intensified, cotton spread from its homeland to India and into the Middle East where it devastated the agricultural systems already in place there[citation needed]. Much of Persia was initially too hot for the crop to be cultivated; to solve that problem, the qanat was developed[40] first in modern-day Iran, where it doubled the amount of available water for irrigation and urban use.[41] Because of this, Persia enjoyed larger surpluses of agriculture thus increasing urbanization and social stratification.[42] The qanat technology subsequently spread from Persia westward and eastward.[1]

In the middle of the twentieth century, an estimated 50,000 qanats were in use in Iran,[28] each commissioned and maintained by local users. Of these, only 37,000 remain in use as of 2015.

One of the oldest and largest known qanats is in the Iranian city of Gonabad, and after 2,700 years still provides drinking and agricultural water to nearly 40,000 people. Its main well depth is more than 360 meters and its length is 45 kilometers. Yazd, Khorasan and Kerman are zones known for their dependence on an extensive system of qanats.

In 2016, UNESCO inscribed the Persian Qanat as a World Heritage Site, listing the following eleven qanats: Qasebeh Qanat, Qanat of Baladeh, Qanat of Zarch, Hasan Abad-e Moshir Qanat, Ebr?him ?b?d Qanat in Markazi Province, Qanat of Vazv?n in Esfahan Province, Mozd ?b?d Qanat in Esfahan Province, Qanat of the Moon in Esfahan Province, Qanat of Gowhar-riz in Kerman Province, Jup?r – Gh?sem ?b?d Qanat in Kerman Province, and Akbar ?b?d Qanat in Kerman Province.[43][44] Since 2002, UNESCO's International Hydrological Programme (IHP) Intergovernmental Council began investigating the possibility of an international qanat research center to be located in Yazd, Iran.[45]

The Qanats of Gonabad, also called kariz Kai Khosrow, is one of the oldest and largest qanats in the world built between 700 BCE to 500 BCE. It is located at Gonabad, Razavi Khorasan Province. This property contains 427 water wells with total length of 33,113 m (20.575 mi).[46][47]

Ancient Persian water clock

Ancient Persian clock in Qanats of Gonabad Zibad

According to Callisthenes, the Persians were using water clocks in 328 BCE to ensure a just and exact distribution of water from qanats to their shareholders for agricultural irrigation. The use of water clocks in Iran, especially in Qanats of Gonabad and kariz Zibad, dates back to 500BCE. Later they were also used to determine the exact holy days of pre-Islamic religions, such as the Nowruz, Chelah, or Yald? – the shortest, longest, and equal-length days and nights of the years.[48] The Water clock, or Fenjaan, was the most accurate and commonly used timekeeping device for calculating the amount or the time that a farmer must take water from the Qanats of Gonabad until it was replaced by more accurate current clocks.[49] Many of the Iranian qanats bear some characteristics which allow us to call them feat of engineering, considering the intricate techniques used in their construction. The eastern and central regions of Iran hold the most qanats due to low precipitation and lack of permanent surface streams, whereas a small number of qanats can be found in the northern and western parts which receive more rainfall and enjoy some permanent rivers. Respectively

the provinces Khorasan Razavi, Southern Khorasan, Isfahan and Yazd accommodate the most qanats, but from the viewpoint of water discharge the provinces Isfahan, Khorasan Razavi, Fars and Kerman are ranked first to fourth.

Henri Golbot, explored the genesis of the qanat in his 1979 publication, Les Qanats. Une technique d'acquisition de l'eau (The Qanats. a Technique for Obtaining Water),[50] He argues that the ancient Iranians made use of the water that the miners wished to get rid of it, and founded a basic system named qanat or Kariz to supply the required water to their farm lands. According to Goblot, this innovation took place in the northwest of the present Iran somewhere bordering Turkey and later was introduced to the neighboring Zagros Mountains.

According to an inscription left by Sargon II, the king of Assyria, In 714 BCE he invaded the city of Uhlu lying in the northwest of Uroomiye lake that lay in the territory of Urartu empire, and then he noticed that the occupied area enjoyed a very rich vegetation even though there was no river running across it. So he managed to discover the reason why the area could stay green, and realized that there were some qanats behind the matter. In fact it was Ursa, the king of the region, who had rescued the people from thirst and turned Uhlu into a prosperous and green land. Goblot believes that the influence of the Medeans and Achaemenids made the technology of qanat spread from Urartu (in the western north of Iran and near the present border between Iran and Turkey) to all over the Iranian plateau. It was an Achaemenid ruling that in case someone succeeded in constructing a qanat and bringing groundwater to the surface in order to cultivate land, or in renovating an abandoned qanat, the tax he was supposed to pay the government would be waived not only for him but also for his successors for up to 5 generations. During this period, the technology of qanat was in its heyday and it even spread to other countries. For example, following Darius's order, Silaks the naval commander of the Persian army and Khenombiz the royal architect managed to construct a qanat in the oasis of Kharagha in Egypt. Beadnell believes that qanat construction dates back to two distinct periods: they were first constructed by the Persianse, and later the Romans dug some other qanats during their reign in Egypt from 30 BCE to 395 CE. The magnificent temple built in this area during Darius's reign shows that there was a considerable population depending on the water of qanats. Ragerz has estimated this population to be 10,000 people. The most reliable document confirming the existence of qanats at this time was written by Polybius who states that: "the streams are running down from everywhere at the base of Alborz mountain, and people have transferred too much water from a long distance through some subterranean canals by spending much cost and labor."

During the Seleucid Era, which began after the occupation of Iran by Alexander, it seems that the qanats were abandoned.

In terms of the situation of qanats during this era, some historical records have been found. In a study by Russian orientalist scholars it has been mentioned that: the Persians used the side branches of rivers, mountain springs, wells and qanats to supply water. The subterranean galleries excavated to obtain groundwater were named as qanat. These galleries were linked to the surface through some vertical shafts which were sunk in order to get access to the gallery to repair it if necessary.

According to the historical records, the Parthian kings did not care about the qanats the way the Achaemenid kings and even Sassanid kings did. As an instance, Arsac III, one of the Parthian kings, destroyed some qanats in order to make it difficult for Seleucid Antiochus to advance further while fighting him. The historical records from this time indicate a perfect regulation on both water distribution and farmlands. All the water rights were recorded in a special document which was referred to in case of any transaction. The lists of farmlands – whether private or governmental – were kept at the tax department. During this period there were some official rulings on qanats, streams, construction of dam, operation and maintenance of qanats, etc. The government proceeded to repair or dredge the qanats that were abandoned or destroyed for any reason, and construct the new qanats if necessary. A document written in the Pahlavi language pointed out the important role of qanats in developing the cities at that time. In Iran, the advent of Islam, which coincided with the overthrow of the Sassanid dynasty, brought about a profound change in religious, political, social and cultural structures. But the qanats stayed intact, because the economic infrastructure, including qanats was of great importance to the Arabs. As an instance, M. Lombard reports that the Moslem clerics who lived during Abbasid period, such as Abooyoosef Ya'qoob (death 798 CE) stipulated that whoever can bring water to the idle lands in order to cultivate, his tax would be waived and he would be entitled to the lands cultivated. Therefore, this policy did not differ from that of the Achaemenids in not getting any tax from the people who revived abandoned lands. The Arabs' supportive policy on qanats was so successful that even the holy city of Mecca gained a qanat too. The Persian historian Hamdollah Mostowfi writes: "Zobeyde Khatoon (Haroon al-Rashid's wife) constructed a qanat in Mecca. After the time of Haroon al-Rashid, during the caliph Moghtader's reign this qanat fell into decay, but he rehabilitated it, and the qanat was rehabilitated again after it collapsed during the reign of two other caliphs named Ghaem and Naser. After the era of the caliphs this qanat completely fell into ruin because the desert sand filled it up, but later Amir Choopan repaired the qanat and made it flow again in Mecca."[citation needed]

There are also other historical texts proving that the Abbasids were concerned about qanats. For example, according to the “Incidents of Abdollah bin Tahir’s Time” written by Gardizi, in 830 CE a terrible earthquake struck the town of Forghaneh and reduced many homes to rubble. The inhabitants of Neyshaboor used to come to Abdollah bin Tahir in order to request him to intervene, for they fought over their qanats and found the relevant instruction or law on qanat as a solution neither in the prophet's quotations nor in the clerics’ writings. So Abdollah bin Tahir managed to bring together all the clergymen from throughout Khorasan and Iraq to compile a book entitled Alghani (The Book of Qanat). This book collected all the rulings on qanats which could be of use to whoever wanted to judge a dispute over this issue. Gardizi added that this book was still applicable to his time, and everyone made references to this book.

One can deduce from these facts that during the above-mentioned period the number of qanats was so considerable that the authorities were prompted to put together some legal instructions concerning them. Also it shows that from the ninth to eleventh centuries the qanats that were the hub of the agricultural systems were also of interest to the government. Apart from The Book of Alghani, which is considered as a law booklet focusing on qanat-related rulings based on Islamic principles, there is another book about groundwater written by Karaji in 1010. This book, entitled Extraction of Hidden Waters, examines just the technical issues associated with the qanat and tries to answer the common questions such as how to construct and repair a qanat, how to find a groundwater supply, how to do leveling, etc.. Some of the innovations described in this book were introduced for the first time in the history of hydrogeology, and some of its technical methods are still valid and can be applied in qanat construction. The content of this book implies that its writer (Karaji) did not have any idea that there was another book on qanats compiled by the clergymen.

There are some records dating back to that time, signifying their concern about the legal vicinity of qanats. For example, Mohammad bin Hasan quotes Aboo-Hanifeh that in case someone constructs a qanat in abandoned land, someone else can dig another qanat in the same land on the condition that the second qanat is 500 zera’ (375 meters) away from the first one.

Ms. Lambton quotes Moeen al-din Esfarzi who wrote the book Rowzat al-Jannat (the garden of paradise) that Abdollah bin Tahir (from the Taherian dynasty) and Ismaeel Ahmed Samani (from the Samani dynasty) had several qanats constructed in Neyshaboor. Later, in the 11th century, a writer named Nasir Khosrow acknowledged all those qanats with the following words: "Neyshaboor is located in a vast plain at a distance of 40 Farsang (?240 km) from Serakhs and 70 Farsang (?420 km) from Mary (Marv) … all the qanats of this city run underground, and it is said that an Arab who was offended by the people of Neyshaboor has complained that; what a beautiful city Neyshaboor could have become if its qanats would have flowed on the ground surface and instead its people would have been underground." These documents all certify the importance of qanats during the Islamic history within the cultural territories of Iran.

Kariz Gonabad Iran

In the 13th century, the invasion of Iran by Mongolian tribes reduced many qanats and irrigation systems to ruin, and many qanats were deserted and dried up. Later, in the era of the Ilkhanid dynasty especially at the time of Ghazan Khan and his Persian minister Rashid al-Din Fazl-Allah, some measures were taken to revive the qanats and irrigation systems. There is a 14th-century book entitled Al-Vaghfiya Al-Rashidiya (Rashid's Deeds of Endowment) that names all the properties located in Yazd, Shiraz, Maraghe, Tabriz, Isfahan and Mowsel that Rashid Fazl-Allah donated to the public or religious places. This book mentions many qanats running at that time and irrigating a considerable area of farmland. At the same time, another book, entitled Jame’ al-Kheyrat, was written by Seyyed Rokn al-Din on the same subject as Rashid's book. In this book, Seyyed Rokn al-Din names the properties he donated in the region of Yazd. These deeds of endowment indicate that much attention was given to the qanats during the reign of Ilkhanids, but it is attributable to their Persian ministers, who influenced them.[48]

In the years 1984–1985 the ministry of energy took a census of 28,038 qanats whose total discharge was 9 billion cubic meters. In the years 1992–1993 the census of 28,054 qanats showed a total discharge of 10 billion cubic meters. 10 years later in 2002–2003 the number of the qanats was reported as 33,691 with a total discharge of 8 billion cubic

meters.

In the restricted regions there are 317,225 wells, qanats and springs that discharge 36,719 million cubic meters water a year, out of which 3,409 million cubic meters is surplus to the aquifer capacity. in 2005, in the country as a whole, there were 130,008 deep wells with a discharge of 31,403 million cubic meter, 33,8041 semi deep wells with a discharge of 13,491 million cubic meters, 34,355 qanats with a discharge of 8,212 million cubic meters, and 55,912 natural springs with a discharge of 21,240 million cubic meters.[51]

Iraq
A survey of qanat systems in the Kurdistan region of Iraq conducted by the Department of Geography at Oklahoma State University (USA) on behalf of UNESCO in 2009 found that out of 683 karez systems, some 380 were still active in 2004, but only 116 in 2009. Reasons for the decline of qanats include "abandonment and neglect" prior to 2004, "excessive pumping from wells" and, since 2005, drought. Water shortages are said to have forced, since 2005, over 100,000 people who depended for their livelihoods on karez systems to leave their homes. The study says that a single karez has the potential to provide enough household water for nearly 9,000 individuals and irrigate over 200 hectares of farmland. UNESCO and the government of Iraq plan to rehabilitate the karez through a Karez Initiative for Community Revitalization to be launched in 2010. Most of the karez are in Sulaymaniyah Governorate (84%). A large number are also found in Erbil Governorate (13%), especially on the broad plain around and in Erbil city.[52]

Japan
In Japan there are several dozen qanat-like structures, locally known as 'mambo' or 'manbo', most notably in the Mie- and Gifu Prefectures. Whereas some link their origin clearly to the Chinese karez, and therefore to the Iranian source,[53] a Japanese conference in 2008 found insufficient scientific studies to evaluate the origins of the mambo.[54]

Jordan
Among the qanats built in the Roman Empire, the 94 km (58 mi) long Gadara Aqueduct in northern Jordan was possibly the longest continuous qanat ever built.[55] Partly following the course of an older Hellenistic aqueduct, excavation work arguably started after a visit by emperor Hadrian in 129–130 CE. The Gadara Aqueduct was never quite finished and was put in service only in sections.

Pakistan
In Pakistan qanat irrigation system is endemic only in Balochistan. The major concentration is in the north and northwest along the Pakistan-Afghanistan border and oasis of Makoran division.

The acute shortage of water resources give water a decisive role in the regional conflicts arose in the course of history of Balochistan. Therefore, in Balochistan, the possession of water resources is more important than ownership of land itself. Hence afterward a complex system for the collection, channeling and distribution of water were developed in Balochistan. Similarly, the distribution and unbiased flow of water to different stockholders also necessitate the importance of different societal classes in Balochistan in general and particularly in Makoran. For instance, sarrishta (literally, head of the chain) is responsible for administration of channel. He normally owns the largest water quota. Under sarrishta, there are several heads of owners issadar who also possessed larger water quotas. The social hierarchy within Baloch society of Makoran depends upon the possession of largest quotas of water. The role of sarrishta in some cases hierarchical and passing from generations within the family and he must have the knowledge of the criteria of unbiased distribution of water among different issadar.

The sharing of water is based on a complex indigenous system of measurement depends upon time and space particularly to the phases of moon; the hangams. Based on seasonal variations and share of water the hangams are apportioned among various owners over period of seven or fourteen days. However, in some places, instead of hangam, anna used which is based on twelve-hour period for each quota. Therefore, if a person own 16 quotas it means that he is entitled for water for eight days in high seasons and 16 days in winter when water level went down as well as expectation of winter rain (Baharga) in Makran region. The twelve-hour water quota again subdivided into several sub-fractions of local measuring scales such as tas or pad (Dr Gul Hasan Pro VC LUAWMS, 2 day National conference on Kech).

The Chagai district is in the north west corner of Balochistan, Pakistan, bordering with Afghanistan and Iran. Qanats, locally known as Kahn, are found more broadly in this region. They are spread from Chaghai district all the way up to Zhob district.

Syria
Qanats were found over much of Syria. The widespread installation of groundwater pumps has lowered the water table

and qanat system. Qanats have gone dry and been abandoned across the country.[56]

Oman
In Oman from the Iron Age Period (found in Salut, Bat and other sites) a system of underground aqueducts called 'Falaj' were constructed, a series of well-like vertical shafts, connected by gently sloping horizontal tunnels. There are three types of Falaj: Daudi (Arabic: ????????) with underground aqueducts, Ghaili (Arabic: ????????) requiring a dam to collect the water, and Aini (Arabic: ????????) whose source is a water spring. These enabled large scale agriculture to flourish in a dryland environment. According to UNESCO, some 3,000 aflaj (plural) or falaj (singular), are still in use in Oman today. Nizwa, the former capital city of Oman, was built around a falaj which is in use to this day. These systems date to before the Iron Age in Oman. In July 2006, five representative examples of this irrigation system were inscribed as a World Heritage Site.[57]

United Arab Emirates

The falaj irrigation system at Al Ain Oasis

The oases of the city of Al Ain (particularly Al-Ain, Al-Qattarah, Al-Mu'taredh, Al-Jimi, Al-Muwaiji, and Hili), adjacent to Al-Buraimi in Oman, continue traditional falaj (qanat) irrigations for the palm groves and gardens, and form part of the city's ancient heritage.[7][58]

Africa
Egypt
There are four main oases in the Egyptian desert. The Kharga Oasis is one that has been extensively studied. There is evidence that as early as the second half of the 5th century BCE water brought in qanats was being used. The qanats were excavated through water-bearing sandstone rock, which seeps into the channel, with water collected in a basin behind a small dam at the end. The width is approximately 60 cm (24 in), but the height ranges from 5 to 9 meters; it is likely that the qanat was deepened to enhance seepage when the water table dropped (as is also seen in Iran). From there the water was used to irrigate fields.[30][59]

There is another instructive structure located at the Kharga oasis. A well that apparently dried up was improved by driving a side shaft through the easily penetrated sandstone (presumably in the direction of greatest water seepage) into the hill of Ayn-Manâwîr to allow collection of additional water. After this side shaft had been extended, another vertical shaft was driven to intersect the side shaft. Side chambers were built, and holes bored into the rock—presumably at points where water seeped from the rocks—are evident.[59]

Libya

Exit of a foggara in Libya

David Mattingly reports foggara extending for hundreds of miles in the Garamantes area near Germa in Libya: "The channels were generally very narrow – less than 2 feet wide and 5 high – but some were several miles long, and in total some 600 foggara extended for hundreds of miles underground. The channels were dug out and maintained using a series of regularly spaced vertical shafts, one every 30 feet or so, 100,000 in total, averaging 30 feet in depth, but sometimes reaching 130."[60]

Tunisia
The foggara water management system in Tunisia, used to create oases, is similar to that of the Iranian qanat. The foggara is dug into the foothills of a fairly steep mountain range such as the eastern ranges of the Atlas mountains. Rainfall in the mountains enters the aquifer and moves toward the Saharan region to the south. The foggara, 1 to 3 km in length, penetrates the aquifer and collects water. Families maintain the foggara and own the land it irrigates over a ten-meter width, with length reckoned by the size of plot that the available water will irrigate.[61]

Algeria

Water "metering" through a distribution weir on a foggara in Algeria

Qanats (designated foggaras in Algeria) are the source of water for irrigation in large oases like that at Gourara. The foggaras are also found at Touat (an area of Adrar 200 km from Gourara). The length of the foggaras in this region is estimated to be thousands of kilometers.

Although sources suggest that the foggaras may have been in use as early as 200 CE, they were clearly in use by the 11th century after the Arabs took possession of the oases in the 10th century and the residents embraced Islam.

The water is metered to the various users through the use of distribution weirs that meter flow to the various canals, each for a separate user.

The humidity of the oases is also used to supplement the water supply to the foggara. The temperature gradient in the vertical shafts causes air to rise by natural convection, causing a draft to enter the foggara. The moist air of the agricultural area is drawn into the foggara in the opposite direction to the water run-off. In the foggara it condenses on the tunnel walls and the air passes out of the vertical shafts. This condensed moisture is available for reuse.[62]

Morocco
In southern Morocco, the qanat (locally khettara) is also used. On the margins of the Sahara Desert, the isolated oases of the Draa River valley and Tafilalt have relied on qanat water for irrigation since the late 14th century. In Marrakech and the Haouz plain, the qanats have been abandoned since the early 1970s, having dried up. In the Tafilaft area, half of the 400 khettaras are still in use. The Hassan Adahkil Dam's impact on local water tables is said to be one of the many reasons for the loss of half of the khettara.[56]

The black berbers (haratin) of the south were the hereditary class of qanat diggers in Morocco who build and repair these systems. Their work was hazardous.[11]

Europe
Greece
The Tunnel of Eupalinos on Samos runs for 1 kilometre through a hill to supply water to the town of Pythagorion.[63] It was built on the order of the Tyrant Polycrates around 550 BCE. At either end of the tunnel proper, shallow qanat-like tunnels carried the water from the spring and to the town.

A preserved viaje de agua in Madrid.

Italy
The 5,653 m (3.513 mi) long Claudius Tunnel, intended to drain the largest Italian inland water, Fucine Lake, was constructed using the qanat technique. It featured shafts up to 122 m deep.[64] The entire ancient town of Palermo in Sicily was equipped with a huge qanat system built during the Arab period (827–1072).[65] Many of the qanats are now mapped and some can be visited. The famous Scirocco room has an air-conditioning system cooled by the flow of water in a qanat and a "wind tower", a structure able to catch the wind and use it to draw the cooled air up into the room.

Luxembourg
The Raschpëtzer near Helmsange in southern Luxembourg is a particularly well preserved example of a Roman qanat. It is probably the most extensive system of its kind north of the Alps. To date, some 330 m of the total tunnel length of 600 m have been explored. Thirteen of the 20 to 25 shafts have been investigated.[66] The qanat appears to have provided water for a large Roman villa on the slopes of the Alzette valley. It was built during the Gallo-Roman period, probably around the year 150 and functioned for about 120 years thereafter.

Spain
There are still many examples of galeria or qanat systems in Spain, most likely brought to the area by the Moors during their rule of the Iberian peninsula. Turrillas in Andalusia on the north facing slopes of the Sierra de Alhamilla has evidence of a qanat system. Granada is another site with an extensive qanat system.[67] In Madrid they were called "viajes de agua" and were used until relatively recently. See [2] and [3] in Spanish.

Les Amèriques
Qanats a Amèrica, generalment conegut com a puquios o galeries de filtració, es pot trobar a la regió de Nazca del Perú i al nord de Xile. [56] Els espanyols van introduir qanats a Mèxic el 1520. [68] El 1997, el govern va començar a

Al desert d'Atacama, al nord de Xile, els qanats són coneguts com a socavones. [69] Se sap que els socavones existeixen a la vall d'Azapa i a l'oasi de Sibaya, Pica-Matilla i Puqui Núñez. [69] El 1918 el geòleg Juan Brüggen va esmentar l'existència de 23 socavones a l'oasi de Pica, però aquests han estat abandonats des de llavors a causa dels canvis econòmics i socials. [69] El 1997, el govern va començar a

Referències culturals
En una carta escrita el 21 d'agost de 1906 des de Teheran, Florence Khanum, l'esposa nord-americana del diplomàtic persa Ali Kuli Khan, va descriure l'ús de qanats per al jardí a casa del seu cunyat, el general Husayn Kalantar,l'1 de gener de 1913.

"L'aire és el més meravellós que he tingut mai, en qualsevol ciutat. Aire de muntanya, tan dolç, sec i "preservant", deliciós i donant vida". Ella va parlar dels rierols corrents, i l'aigua dolça bombolles als jardins. (Aquesta omnipresència de l'aigua, que sens dubte es va estendre de Pèrsia a Bagdad i d'allà a Espanya durant els seus dies musulmans, ha donat a molts espanyols una paraula d'aigua: aljibe, per exemple, és jub persa, rierol; cano o pipa, és qanat àrab — canya, canal. Així J. T. Shipley, Diccionari d'Orígens de Paraula)."

— Florence Khanum (1906) citada en Arcs dels Anys (1999)

Una de les tradicions més antigues de l'Iran va ser celebrar cerimònies de noces entre vídues i túnels subterranis d'aigua anomenats qanats. [72] El 1997, el govern va començar a

Vegeu també

Suranga – Sistema tradicional de gestió de l'aigua a Kerala i Karnataka, al sud de l'Índia
Rellotge d'aigua – Peça de temps en la qual el temps es mesura pel flux de líquid en o fora d'un vaixell
Ab Anbar – tradicional embassament d'aigua iranià
Preuo o poc després
Història del subministrament d'aigua i sanejament – La història de proporcionar aigua neta i sistemes de sanejament segurs des de l'alba de la civilització
Jardins de Menara
Oasis - Font aïllada d'aigua dolça en un desert
Fonts d'aigua tradicionals de l'antiguitat persa
Yakhch?l – Antiga casa de gel persa
Mamanteo - Sistema de retenció d'aigua estacional utilitzant coberta de terra permeable per a l'emmagatzematge

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A Wikimedia Commons hi ha contingut multimèdia relatiu a: Qanat

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Preuo
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