A Survey of the Historical Evolution of Qanats in Iran

Dr. Ali Asghar Semsar Yazdi
Director of the International Center on Qanats & Historic Hydraulic structures (ICQHS)

1. Introduction

In order to review the situation of qanats in the course of the Iranian history, this paper explores some documents on qanats from the first historical records to the present ones. Two periods, before and after Islam, have been investigated. In terms of each period we try to review the situation of qanats keeping pace with the history of kings and governments.

First of all, it seems necessary to present some facts on the geographical and climatological conditions of Iran, for the natural infrastructures had an important role in creating and developing the qanat systems. Suffice to say Iran has a variable climate, and in general, this country has an arid climate in which most of the relatively scant annual precipitation falls from October through April. In most of the country, yearly precipitation averages 250 millimeters or less. The major exceptions are the higher mountain valleys of the Zagros and the Caspian coastal plain, where precipitation averages at least 500 millimeters annually. In the western part of the Caspian, rainfall exceeds 1000 mm annually and is distributed relatively evenly throughout the year. This contrasts with some basins of the Central Plateau that receive 100 millimeters or less of precipitation annually.

2. Before Islam

Henry Goblot explored the onset of this technology for the first time. He stipulates in his book entitled “Qanat; a Technique for Obtaining Water” that during the early first millennium before Christ, for the first time some small tribal groups gradually began immigrating to the Iranian plateau where less precipitation was enjoyed than the territories these groups came from. They came from somewhere with a lot of surface streams, so their agricultural techniques used to require more water which was out of proportion to the water available in the Iranian plateau. So they had no way but fastening their hope on the rivers and springs that originated in the mountains. They faced two barriers; the first was the seasonal rivers which were out of water during the dry and hot seasons. The second was the springs that drained out the shallow groundwater and fell dry during the hot seasons. But they noticed some permanent runoffs flowing through the tunnels excavated by the Acadian miners who were in search of copper. These farmers established a relationship with the miners and asked them to dig more tunnels in order to supply more water. The miners accepted to do that, because there was no technical difficulty for the miners in constructing more canals. In this manner, the ancient Iranians made use of the water that the miners wished to get rid of it, and founded a basic system as named qanat to supply the required water to their farm lands. According to Goblot, this innovation took place in the western north of the present Iran and later was introduced to the neighboring area that was Zagros Mountains.

According to an inscription left from Sargon II the king of Assyria, in 714 BC he invaded the city of Ulu lying on the NW of Uroomiye lake that belonged to the territory of the Urartu empire, and then he noticed that the occupied area enjoyed a very rich vegetation even though there was no river running across there. So he managed to discover the reason how the area can stay green, and realized that there are some qanats behind the matter. In fact it was Ursa the king of the region who had rescued the people from thirst and turned Ulu into a scenic and green land. Goblot believes that the Medeans and Achaemenians were responsible for the spread of the technology of qanat from Urartu (in the western north of Iran and near the present border between Iran and Turkey) to all over the Iranian plateau.
2.1 Achaemenian Empire (550-330 BC)

It was an Achaemenian ruling that in case someone succeeded in constructing a qanat and bringing groundwater to the surface in order to cultivate, or 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 up to 5 generations. During this period, the technology of the qanat was in its heyday and it even spread to other countries. For example, according to 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 the qanat construction dates back to two distinct periods. In Egypt some qanats were constructed by the Persians for the first time, and later Romans dug up some other qanats during their rule over Egypt from 30 BC to 395 AC. In any way the magnificent temple built in this area during Darius’ reign shows that there was a considerable population depending on the water of qanats. Ragerz has estimated this population at 10000 people. The most reliable document confirming the existence of qanats at this period has been written by Polibius who stipulates 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”.

2.2 Seleucidian Era (312-250 BC)

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

2.3 Parthian Era (250 BC – 150 BC)

In terms of the situation of qanats during this era, some historical records have been found. In a study done by Russian oriental scholars it has been mentioned that: the Persians used the side branches of the rivers, the mountainous 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 left from the ancient times, the Parthian kings did not care about the qanats the way the Achaemenian kings and even Sassanid kings used to do. As an instance Arsac III one of the Parthian kings destroyed some qanats in order to make it difficult for Seleucidian Antiochus to advance further while fighting him.

2.4 Sassanid Era (226-650 BC)

The historical records left 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 existed some official rulings on qanats, streams, construction of dam, operation and maintenance of qanat, etc. The government proceeded to repair or dredge the qanats that were abandoned or destroyed by any reason, and construct the new qanats if necessary. A document written in Pahlavi language pointed out the important role of qanats in developing the cities at that time.

3. After Islam (621-1921 BC)

In Iran, the advent of Islam that coincided with the overthrow of the Sasanid dynasty brought about a profound change in religious, political, social and cultural structures. But the qanats stayed intact, because the economical infrastructures such as qanats were of great importance to the Arabs. As an instance, Lombard reports that the Moslem clerics who lived during the Abbasid era such as Abooyoosef Ya’qoob (death 798 AC) 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 same lands cultivated. Therefore, this policy did not differ from that of Achaemenians not getting any tax from the people.

1 an ancient branch of Persian language that was spoken during Sassanid era
who revived the abandoned lands. The Arabs’ supportive policy on the 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 as Ghaem and Naser. After the era of the caliphs this qanat completely fell into ruin because the desert sand filled it up, and later Amir Choopan repaired the qanat and made it flow again in Mecca.”

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 the year 830 AC 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 they 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 took up 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 that during the above-mentioned period the numbers of qanats were so considerable that the authorities were prompted to put together some legal instructions in terms of qanats. Also it shows that from the ninth to eleventh century the qanats that were the hub of the agricultural systems were of interest to the governments. Apart from The Book of Alghani which is considered as a law booklet focusing on the qanat related rulings based on the Islamic principles, there is another book about groundwater written by Karaji in the year 1010. This book entitled Extraction of Hidden Waters takes up just the technical issues associated with 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 levelling, etc. Some of the innovations described in this book had been brought up for the first time in the history of hydrology, and some of its technical methods are still valid and can be applied in the qanat construction. The content of this book implies that its writer (Karaji) did not have any idea that there was another book on qanat compiled by the clergymen. Mohammad bin Hasan quotes Aboo-Hanifeh that in case someone constructs a qanat in an abandoned land, someone else can dig another qanat in the same land on the condition that the second qanat would be 500 zera’ (375 meters) away from the first one.

Ms. Lambpton quotes Moeen al-din Esfarzi who has written the book Rowzat al-Jannat (the Garden of Paradise) that Abdollah bin Tahir (from Tahirian dynasty) and Ismaeel Ahmed Samani (from Samani dynasty) had several qanats constructed in Neyshaboor. Later in the 11th century a writer named as Nasir Khosrow acknowledged all those qanats by 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 ... 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 become if its qanats would flow on the ground surface and instead its people would be underground”.

These documents all certify the importance of qanats during the Islamic history within the cultural territories of Iran.

In the 13th century, the invasion of Mongolian tribes to Iran lead to many qanats and irrigational systems falling into ruin, and many qanats were deserted and dried up. Later in the era of Ilkhanid dynasty especially at the time of Ghazan Khan and his Persian minister Rashid Fazl-Allah, some measures were taken to revive the qanats and irrigation systems. There is a 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, Rashid Fazl-Allah has donated to the public or religious places. This book mentions many qanats running at that time and irrigating a considerable area of
farmlands. At the same time (14th century) another book entitled Jame’ al-Kheyrat was written by Seyyed Rokn al-Din on the same subject of that of Rashid’s book. In this book Seyyed Rokn al-Din names his properties in the region of Yazd donated. These deeds of endowment indicate that a lot of attention was given to the qanats during the reign of Ilkhanids, but it is attributable to their Persian ministers who had influence on them.

In the Safavid era (15th and 16th century) the problem of the shortage of water intensified and led to constructing many water reservoirs and qanats. Sharden the French explorer who made two long journeys to Iran at the time of Safavid reports that:

”the Iranians rip the foothills in search of water, and when they find any, by means of qanats they transfer this water to a distance of 50 or 60 kilometers or sometimes further downstream. No nation in the world can compete with the Iranians in recovering and transferring groundwater. They make use of groundwater in irrigating their farmlands, and they construct qanats almost everywhere and always succeed in extracting groundwater.”

The dynasty of Qajar ruled Iran from the 16th century to the early 18th century. According to Goblot, the time of Qajar can be considered as the heyday of qanats, for the qanats could flourish. Agha Mohammad Khan the founder of Qajar dynasty chose Tehran as his capital city, the city where there was no access to a reliable stream of surface water and it had to rely on the groundwater. The rich supply of groundwater and suitable geological-topographical conditions of Tehran allowed this city to house many qanats whose total discharge amounted to 2000 liters per second. Haj Mirza Aghasi (ruling between 1834 and 1848) the prime minister of the third king of Qajar dynasty encouraged and supported qanat construction throughout the country. Jaubert de Passa who has surveyed the situation of irrigation in Iran reports a population of 50000 in Hamedan, 200000 in Isfahan and 130000 in Tehran in the year 1840. Then he claims that in these cities life is indebted to the qanats which are being constructed in a simple but powerful manner. In a nutshell the period of Qajar that lasted about 1.5 centuries has witnessed lots of endeavors to revive the qanats.

3. The period of Pahlavi

During the period of Pahlavi, the process of qanat construction and maintenance continued. A county that was responsible for the qanats was set up by the government. At that time most of the qanats of the country belonged to the land lords. In fact feudalism was the prevailing system in the rural regions. The peasants were not entitled to the lands they worked on, but they were considered just as the users of the lands. They had to pay the rent of the land and water to the feudals. The feudals could afford to finance all the proceedings required to maintain the qanats, for they were at a high financial level. According to the report of Safi Asfiya who was in charge of supervising the qanats of Iran in the former regime, in the year 1942 Iran enjoyed 40000 qanats with a total recharge of 600000 liters per second or 18.2 billion cubic meters per year.

In the year 1961 another report was published revealing that in Iran there were 30000 qanats out of which just 20000 qanats were still in use with a total output of 560000 lit/se or 17.3 billion cubic meters per year. In 1959 a reform program named as White Revolution was declared by the former Shah. One of the articles of this program addressed the land reform that let the peasants take ownership of a part of the feudals’ lands. In fact the land reform dashed the lords’ hope. They lost their motivation for investing more money in constructing or repairing the qanats which were subject to the land reform law. On the other hand, the peasants could not come up with the money to maintain the qanats, so a lot of qanats gradually got deserted. The introduction of the modern devices that made it possible to drill many deep wells and extract the groundwater much more quickly and easily aggravated the qanats’ annihilation. The pumped wells had a negative impact on the qanats due to

According to a famous story, one day Haj Mirza Aghasi paid a visit to a qanat to find out how they are getting on their work. He asked the worker who was at the bottom of a well if the qanat had reached to the water or not. The worker who did not recognize the prime minister complained that Haj Mirza Aghasi is wasting the country’s budget on the qanats that will never have water. The minister replied: “don’t worry! if the qanat will not get us water, but will get you a living”. The minister’s word has turned into a popular proverb in Iran.
their overexploitation of the groundwater. These changes that occurred in Mohammad Reza Shah’s reign inflicted a great damage on the qanats of the country so that many qanats vanished forever. The statistics related to 14778 qanats estimates the overall discharge of these qanats as 6.2 billion cubic meters per year between the years 1972 and 1973. If we assume the total number of the qanats at that time to be 32000, so their annual discharge could amount to 12 billion cubic meters.

In the year 1963 the Ministry of Water and Electricity was established in order to provide the rural and urban areas of the country with the sufficient water and electricity. Later this ministry was renamed as the Ministry of Energy. Three years later in 1966 the Parliament passed a law protecting the groundwater resources. According to this law the Ministry of Water and Electricity was allowed to ban drilling any deep and semi-deep wells wherever the surveys show that the water table is dropping because of overpumping. In fact this law was passed when the growing number of the pumped wells sounded the alarm about the overpumping and depletion of groundwater leading to the decline in the qanats’ flow all over the country. This law as well as the law of water nationalization that was approved in 1968 and eventually the law of fair distribution of water passed (in 1981) after the Islamic revolution emphasized the definition of the restricted and free areas for drilling. In the restricted areas drilling any wells (except for drinking and industry) were prohibited in order to prevent the continuous depletion of groundwater. So the rest of the qanats had a better chance to survive.

3.2 The time of the Islamic Republic

After the Islamic revolution, special attention was given to the qanats. For the first time in 1981 a conference on qanats was held in Mashhad during which the different options to mitigate the problem were explored. The organization of Jihad Sazandegi took responsibility for the qanats and provided the users of qanats with some funds. Now the same organization which was renamed as Jihad Agriculture is responsible for the qanats and continues to grant some funds to the stakeholders to maintain their qanats. During recent years, the parliament has allowed an annual budget of 13 million USD to go to the construction and maintenance of the qanats. Many other qanats may dry up without this budget, because the owners of the qanats cannot afford to pay the whole expenses.

In the years from 1984-1985 the Ministry of Energy took a census of 28038 qanats whose total discharge was 9 billion cubic meters. In the years 1992-1993 the census of 28054 qanats showed a total discharge of 10 billion cubic meters. 10 years later in 2002-2003 the number of the qanats was reported as 33691 with a total discharge of 8 billion cubic meters. In the year 2000, holding the International conference on qanat in Yazd could draw a lot of attention to the qanats.

4. Conclusion

In the course of Iranian history, the qanat has had many ups and downs. Sometimes the qanats as well as the qanat constructors were supported and encouraged by the governments, and sometimes were deserted by them. Even when the qanats were destroyed for some military purposes, the qanat would start flourishing as soon as the political situation became stable. The risks that are threatening the qanats today differ from those in the past. In other words, in the past the political and military crisis had a negative impact on the qanats, however the qanats could recover as soon as the crisis was over. But the present risks are quite something else, and more destructive. The present risks are acting environmentally so it is not that easy to handle them. Therefore it is a must for the governments and nations throughout the world to think of new legislation for the protection of groundwater resources against any kind of over exploitation.

Qanat civilization is rooted in this ancient hydraulic structure. Over the past 3000 years, the system of qanat has underlain many technological, social, moral, economic and legal principles that have formed an important part of our culture. These principles evolved into the present state by being passed from generation to generation. The present generation is supposed to build on these principles behind which there are three thousand years of history, not to forget about them.