

A HISTORICAL REVIEW ON THE QANATS AND HISTORIC HYDRAULIC STRUCTURES OF IRAN SINCE THE FIRST MILLENNIUM B.C.

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INTRODUCTION

In order to review the situation of Qanats and Historic Hydraulic Structures in the course of the Iranian history, this paper explores some documents on these structures from the first historical records to the present ones. To do so, we try to review the situation of qanats and historic hydraulic structures keeping pace with the history of kings and governments.

First of all, it seems necessary to take up 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 millimeters 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.

ELAMITES (14TH CENTURY. BC)

The oldest hydraulic structure in Iran is the water supplying system of Chagazanbil temple dating back to 3300 years ago when Elamits lived in southern Iran.

This temple is located 30 Km away from east-south of Shoosh city where Elamits used to worship.

The hydraulic system of this temple which provided people with water contains water storage tank, some water transfer canals and a reservoir. In this system, water was transferred from Karkhe River to the water storage tank through a 50 Km long canal and

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then after physical treatment, was transferred to the reservoir. So, this system made it possible for that people to get access to fresh and safe drinking water.

Regarding the Qanats and their antiquity, it is Henry Goblot who explores 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 enjoyed less precipitation 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 Uhlü lying on the western north of Uroomiye lake that belonged to 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 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 Uhlü into a scenic and green land. Goblot believes that the influence of Medians and Achaemenians 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.

ACHAEMENIAN EMPIRE (550-330 BC)

According to the ancient records, the Achaemenian kings had built some important hydraulic structures in their territory. Some of these structures have completely been destroyed over time, and some of them have been rehabilitated by the next dynasties like Sassanids.

At that time, the most important part of Iran, like the south (Fars) and the west-south (Khoozestan), which had many surface water resources, were the center of Achaemenian Empires' attention. In order to cultivate the mentioned area, the Achaemenian empires, had constructed several dams in those parts, out of which some are still existing and there are some remaining left from some of them.

Some structures built by Achaemenians, are as follows: the great Kurosh dam, the Daryush dam and Daryush canal, Ramjerd dam and Bahman dam in Fars and also water transfer systems at some temples and palaces.

Regarding the Achaemenians attention toward the dam construction, Herodot, the ancient narrator, writes: "today, the king Daryoush has obstructed the gaps of the mountains and put a big door on each to stem the flow of water. The plain between the mountains has turned into a lake due to the base flow of the rivers coming in. according to the king's order the doors toward the lands need of water should be open until these lands are irrigated. Another order is to direct the water to the farm lands that need less water than the aforesaid lands".¹

In addition to the dams built by the Achaemenians, one of the important hydraulic structures dating back to this era was the swage system constructed for draining and disposing of the surface runoff at Perspolice in Fars.

The study on situation of Qanats in this period shows that: It was an Achaemenian ruling that in case someone succeeded in constructing a qanat and bring groundwater on 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 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's reign shows that there was a considerable population depending on the water of qanats. Ragerz has estimated this population a 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".

Needless to say during this period, not only the experts got access to the hydrological knowledge and could do the accurate and surprising calculations, but also the knowledge on hydraulic structures developed considerably. The examples of this issue are the hydraulic structures constructed at that time, which are still existing and in use, such as Bahman dam in Fars province.

In any way, the era of Achaemenian was a unique period in the history of Iran in terms of building dams.

SELEUCIDIAN ERA (312-250 BC)

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

1- Water solution in Fars history, Vol. 1, Page. 73

PARTHIAN ERA (250 BC – 150 AC)

In terms of the situation of qanats during this era, some historical records have been found. In a study done by the Russian orientalist 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 and hydraulic structures 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.

The only hydraulic structure built in this period is the canal of "Nahr-ol-malek" or "Nahr-shahi", divided from Forat River.

SASSANID ERA (226-650 AC)

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 language¹ pointed out the important role of qanats in developing the cities at that time.

At this era, especially at the time of Shahpur I, there was a boom in the industry of dam construction. At that time, Shooshtar one of the principle cities of Iran, was the center of governments' attention, and many dams were built there across the Karun river. Also, there were some extensive irrigational canals in Shooshtar and its surroundings. For example, the canal of Gargar, left from Ardeshir-Babakan, and the canal of Darion, left from the Great Dara, are a part of that irrigational system.

Besides, the Sasanid dynasty cared about the maintenance and rehabilitation of the hydraulic structures. At that time, there was a county named as "Kast-Fozood" that was responsible for the maintenance of water canals and dams, the construction of dams and ditches.

Some important bridges and dams built at the Sasanid era are as follows:

The great bridge and dam of Shooshtar (Shadorvan), Mizan dam, Gargar bridge and dam, Shooshtar water mills, Dezful bridge and dam, Dokhtar dam, Shahrestan bridge, Aghili dam, Ayar dam, Mahi bazan dam, Dara dam and Ghir dam, Lashgar bridge and dam, Shah Ali bridge and dam, Karkhe dam, Khak dam, Argan dam, Shahre-loot dam, Darvaze dam and Izad-khast dam.

1- an ancient branch of Persian language that was spoken during Sassanid era

AFTER ISLAM (621-1921 AC)

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 and hydraulic structures stayed intact, because the economical infrastructures such as qanats were of great importance to the Arabs. As an instance, M. Lombard reports that the Moslem clerics who lived during 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 who revived the abandoned lands. 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 from these facts that during the abovementioned 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 leveling, 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.

According to the historical records, related to Ale-Booye dynasty, there were a lot of involvements in the hydraulic structures. Abbas Garoosi, in the first chapter of his book "history of water and irrigation in Kerman" quoted some issues on some 11th century historians and writers as recited below:

Moqdasi describes the prosperity in the exploitation of the rivers in Khuzestan at the time of Ale-Booye. Aboodalaf also refers to the water wheels in Shooshtar, and Mostoofi explains in his book "Nozhatol Gholoob" a big water wheel bringing up the water of Dez River to a height of 25 meters in order to supply water to the city of Dezfool and its farm lands.

At the beginning of 11th century, Narshakhi names 12 rivers running in Bokhara, and each has supplied water to lots of villages. He writes: "each river as mentioned covers many villages, and it is said all the rivers were dug by people except for the river of A'a and Khatfar which were already created by the flow of water".

These evidences confirm that the kings of Ale-Booye were concerned about the hydraulic structures. Also, the dam of Amir in Fars dating back to Ale-Booye period is ranked among the most important dams in Iran. In this regard Nasery writes: "this dam is one of the wonders of Fars. This dam was constructed by the king of Azadol dowle Deylami in the year 944 A.D. My tongue as well as my pen is not able to express my wonder in its magnificence and greatness".

Felanden, the French scientist and explorer who visited this dam in 1220 A.D, says: "so efforts were made in constructing this dam that it could have lasted even until now. This dam is called as the dam of Amir (king) ... shows that the ancient kings were very wise, for they knew that the prosperity and dignity of the country would bring more dignity and pride to them. Therefore they did their best to improve the infrastructures of their territories, which eventually could lead to the prosperity of the country. The king whose name has remained is Azadol dowle Deylami ruling in the 11th century. The peasants still pray for his soul when they harvest their crop".¹

In addition to the dam of Amir, the dams of Feyz Abad, Tilkan and Movan are ranked among the structures of Ale-Booye era.

Ms. Lambpton quotes Moeen al-din Esfarzi who has written the book Rowzat al-Jannat (the garden of paradise) that Abdollah bin Tahir (from Taherian 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".

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

In 13th century, the invasion of Mongolian tribes to Iran fell many qanats and irrigational systems 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 irrigational systems.

His notes in "the arrangement of the nourishing of the deserted lands", the 37th chapter of his book entitled "Jame ol Tavarikh" which means "comprehensive history" represents the concern about the subject of water and prosperity at that time. The examples of the most important hydraulic structures built at that era are Saveh dam and Kabar dam.

There is another 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 bridges, dams, water reservoirs and qanats.

Many hydraulic structures have remained from that time. For example, the most important bridges and dams in Isfahan, many hydraulic structures in Kerman and many water reservoirs in Yazd belong to safavid era.

Two of the most important hydraulic structures of Safavid, mentioned in many history books and travel accounts, are Allah-verdi-khan Bridge (Sio-se-pol) and Khajoo Bridge and dam, located in the ancient city of Isfahan, across the Zayande-rud river. Sharden the French explorer, who came to Iran at Safavid era, has explained these two structures in details, in his travel account.

Also, at that time, there were many hydraulic structures like water reservoirs and ice-houses in some dry cities like Yazd and Kerman.

Most of the water reservoirs in Yazd have an inscription reading the name of their founders and the date of their construction. These inscriptions show that some of the reservoirs date back to the Safavid era.

Meanwhile, one should mention some structures in Kerman like Moayedi ice-house and hoz-panj water reservoir, left from Ganj-Ali-Khan, the governor of Kerman at Safavid time, and Ali-mardan-khan water reservoir, left from his son named as Ali-mardan-khan.

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 country¹. 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 century has witnessed lots of endeavors to revive the qanats. At that time there was also a high attention to hydraulic structures. One can refer to Emad-Abad dam in Fars province, water reservoir of Haji-Yadgar in Firooz-Abad Meybod, water reservoir of Do-rah in Rahmat-Abad Yazd and water reservoirs of Takht-Ostad and Jo-horhor in Yazd, as some examples of the hydraulic structures built at the time of Qajar.

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 reformative program named as White

1- 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 has gotten 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.

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 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. This figure shows a great decrease in flow rate of qanats.

In the year 1963 the Ministry of Water and Electricity was established in order to build dams and 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.

At this period, the executive procedures of 19 dams began out of which 13 came into action. The Regulated annual water of these active dams amounts to 13.228 million m³. Most of these dams were designed and constructed by foreigner consulting engineers and contractors. At this time, 553000 Hectares irrigational and drainage networks were constructed.¹

In the year 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 in 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.

THE TIME OF THE ISLAMIC REPUBLIC

The Islamic Republic of Iran, focused on the subject of the management of the surface and ground water since its beginning. In this era, not only, many dams have been constructed, but also, the knowledge of designing and constructing dams has been localized.

According to the statistics published by the Ministry of Energy, since the beginning of Islamic Republic of Iran (1979) the executive projects of 152 dams has lunched, out of which 72 dams came into action by 2005.

1- Water Resources Management Organization's report on present situation of Iranian dams

The Regulated annual water of these active dams amounts to 11.623 million m³. At this time, the irrigational and drainage networks developed and 1115000 Hectares of the main irrigational and drainage networks were added to the existing networks in Iran.¹

After the Islamic revolution, a special attention was given to the qanats. For the first time in 1981 a conference on qanat 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 the last 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 do not afford to pay the whole expenses.

In the years 1984-1985 the ministry of energy took 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.

Creating the International Center on Qanats and Historic Hydraulic Structures in Yazd and establishment of Qanat collage in Taft are two examples of governments support in this regard.

CONCLUSION

Taking into account that this paper examines the qanats on one hand and the hydraulic structures like dams, bridges, water reservoirs, water mills and ice-houses on the other hand, in the various historical periods, so, at conclusion, we try to analyze these two subjects (Qanats – hydraulic structures) separately:

Qanats: In the course of the Iranian history, 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. Even when the qanats were destroyed for some military purposes, the qanat would start flourishing as soon as the political situation got 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 quit 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 more think of the new legislations about the protection of groundwater resources against any kind of over exploitation.

1- Water Resources Management Organization's report on present situation of Iranian dams

Qanat civilization is rooted in this ancient hydraulic structure. Over the past 3000 years, the system of qanat has underlain many technological, social, moral, economical 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.

Hydraulic structures: people's needs in the course of history resulted in constructing different buildings such as hydraulic structures that provided safe water for drinking, sanitation and agriculture. These needs resulted in constructing dams, water supplying networks, sewage system, irrigational and drainage networks and water treatment systems, out of which some are still remaining.

Our forefathers constructed the dams in order to use efficiently the surface waters and created many canals in order to transfer water to the consumers. These structures are manifest in the skill of our ancestors in the field of hydraulic, hydrology, architecture, civil, etc, which evolved through tens of thousands of years.

Also, sometimes people's need for overcoming the nature especially in dry regions, led them to construct some structures for keeping water cold or producing ice such as water reservoirs or ice-houses. The engineering and architectural aspects of these structures are very interesting and considerable.

According to the historical records, in some periods, there was more concern about the hydraulic structures and in some other periods, these structures were left deserted. In fact, the more stable the governments and political systems, the more attention was paid to the prosperity of the country and construction of the dams, Qanats, canals, etc, which brought profit to the public. Whenever the governments were in the grip of a war, the hydraulic structures were neglected.

The results of this study show that the dynasties of Sasanid and Safavid were more concerned about the prosperity of the country, agriculture and hydraulic structures. The documents dating back to those times, which took up the subject of the hydraulic structures in details, prove this fact. Whereas the historical records related to some other dynasties mentioned nothing about the hydraulic structures, but they explain the story of the invasion and occupation of other territories in detail. As a result we realize that in the course of history the hydraulic structures have had many ups and downs along with the system of qanats, but in general the knowledge of their construction kept evolving. In fact, the science of the water related modern facilities such as dams, water supplying networks and sewage systems being used by human, today, have historical roots in our ancestors' wisdom.

From this approach, we see some structures such as water reservoirs, ice-houses and water mills have developed just for a while and then stopped due to the development of technology and the advent of the more proper substitutes. For this reason, lots of them are out of action and left useless. Needless to say it is a must to maintain and safeguard these structures as a symbol of our ancestors' elaboration and invention, for these structures are very valuable from different perspectives such as architecture, tourism, etc....

REFERENCES:

- 1- Abdollah Garoosi-Abbas, Water and Irrigation History in Kerman Province, Iranian national committee on irrigation & drainage, 2003, Tehran
- 2- Abubakr Mohammad Al-haseb Al-karaji, Extraction of Underground Waters, Kadivjam-Hosein, Iranian national commission for UNESCO, 1994, Tehran
- 3- Afshar-Iraj, Memorials of Yazd, Iranian association for national cultural prides pub, 1995, Tehran, Vol 1 & 2.
- 4- Farhangi-Bijan, A General View on Iranian Dams, Iranian national committee on large dams, 1993, Tehran
- 5- Henri Goblot, Les Qanats Une technique d'acquisition de l'eau, Sarv ghad moghadam-A, Papoli Yazdi-M.H, Astan Ghods Razavi pub, 1992, Mashhad
- 6- Hoseini Fasaie-Haj Mirza Hasan, Farsname Naseri, Rastegar Fasaie-Mansoor, Amirkabir pub, 1999, Tehran, Vol 2.
- 7- Javaheri-Parham, Javaheri-Mohsen, Water Solution in Fars History, Iranian national water museum, 1999, Tehran, Vol 1& 2.
- 8- Kouros-Gholamreza and others, Water and Irrigational Methods in Ancient Iran, The Ministry of water & electricity, 1971, Tehran
- 9- Lambpton-A, Lord & Peasant in Iran, Amiri-Manoochehr, The cultural & scientific publishing company, 1998, Tehran
- 10- Rashid-ol-din Fazlollah, Jame-ol-Tavarikh
- 11- Shardan, Travel account, Yaghmaee-Eghbal, Toos pub, 1995, Tehran, Vol 4.
- 12- Water Resources Management Organization's report on present situation of Iranian dams, 2005