

GHANAT TRANSITIONS, TECHNOLOGY AND CIVILIZATION FROM PAST UP TO NOW

Mohannad Barshan¹

ABSTRACT

Iranian plateau is a vast desert and annual rainfall in most parts of Iran, except for northwest regions and southern border of Caspian Sea, is about 15 to 25mm. Therefore, Iran is a barren country considering agricultural activities in compare to other parts of the world. Iranians have invented an interesting technique to overcome drought; this technique can transfer water from high lands and mountains to low-altitude areas and deserts. Documents show that Iranians have created Ghanat system and it can be said that lead miners were the first to use this system in northwest of Iran.

In addition to supply the drinking and agricultural water, Ghanat can provide a good atmosphere for good correlation and social cooperation to improve the culture and to establish the society. Two fifth of water used in east of Iran is supplied by Ghanats which are located in this part. Lack of water in these areas and making use of Ghanat has caused maximum utilization of water and traditional collective agriculture. This is why irrigation systems in eastern parts are better than those in western parts and their traditional products are much more than those of western areas. Ghanat is a civilization and a culture; it exists in Iran culture and is integral part of it.

Keywords: irrigation, Ghanat, watering, well, spring, pond, desert

INTRODUCTION

Dry land of Iran has been the cradle of different civilizations and its only problem has been water during 8000 years of compiled history; several civilizations have been disappeared due to drought and lack of water.

In the ancient world, due to lack of tools and little growth of technology, Iranians have brought water from foothills of mountains to the arid areas and deserts by inventing a useful method. Inventing this technology, almost all big cities of Iran located in foothills have been developed and improved.

1- Water Store Expert, Kerman Regional Water Limited Company. Address: Kerman Regional Water Limited Company, Pasdaran Street, Kerman. Water store 09131971692

Ghanat is the basis of evolution of stable and tolerant civilization and is shunning war and violation according to documents. Ghanat is considered the veins of deserts, providing them life, joy and development. Ghanats which can be found throughout Iran are sometimes as old as 2000 years and are witness of our ancestors' attempts to develop this land.

GHANAT TRANSITIONS, TECHNOLOGY AND CIVILIZATION FROM PAST UP TO NOW.

The term Ghanat or sewer has monotonous and similar meanings in Persian dictionaries; the best and most complete definition of Ghanat can be found in a convincing proof(sewer is a water canal which is excavated under ground to flow water in it). In Ennendrag Dictionary we have: pathway of water in underground which is called ghanat in Arabic.

Sewer is derived from the words "mountain and fall" and it refers to water that arises from mountain and then flows downward; in Iran, this irrigating system is usually called Ghanat but in eastern parts of Iranian plateau and Afghanistan it is derived from words mountain+ fall. Sewer is more common in eastern parts of Iran, Afghanistan, central Asia and Turkistan. Moreover, names of some of the villages in these areas are derived from this word.

In central Europe, Ghanat is called water channel while in south and Central America, it is called "caller or filter". Iranian sewer is the most interesting name referred to this irrigating system and it is used in Hoogar region in foothills of Atlas Mounts because people believe that Barmakian brought this system to this area. There are some contradictions among researchers considering the time of innovation of Ghanat and the way of its evolution because its structure has been changed over time. Here, it can be said that Ghanat is one of the most significant innovations of man, affecting their agricultural activities and irrigation of Iranian plateau over several thousands years. It also has influenced on human societies and communities. Constructing Ghanats encouraged people to stay in semi arid and dry areas and improve agriculture. Unlikely, by destroying these Ghanats, most of these areas are abandoned and destroyed. Simplicity is one of the main advantages of this irrigating system so that its structure hasn't been changed so much during past years and remains simple.

In deed, making use of Ghanat dates back to the time when man found out the necessary knowledge. On the other hand, when people learned how to evaluate ups and downs of the earth, solve problems of sloping of the bottom of sewers and use simple tools like pick, wheel, lantern and spade, they could build wells. It is hard to say when and where they were found and evolution of wells can't be referred to one age but it should be noted that water, as an important factor, is found everywhere man lives.

The main reason why wells are extended to most parts of Iran can be found in some points, the most important of which is ecological conditions of different parts in which Ghanat exists. In fact, this irrigating system has been appeared according to special ecological conditions of Iranian plateau especially in hot and semi arid areas. Then, it was extended to other regions with similar ecological conditions. It is impossible to mention the exact location of the first Ghanats, but according to Fagih, they were first found in Kerman; however, his findings aren't proved scientifically. By the way,

Kerman can be considered as at least one of the regions in which Ghanats have evolved and all researchers confirm that Iranian plateau is the origin of Ghanats. Another reason why evolution of Ghanats is referred to Iran is that Ghanats haven't been found in ancient Rome and Greece which are the most developed countries. However, special ecological conditions of these countries caused them not to use Ghanats. In compare to other parts of the world, Iran has the most Ghanats.

Generally, Ghanat system is an easy system which includes a steep tunnel with tens of Ghanats perpendicular to it but Ghanats are divided into three groups considering their shape and structure:

- 1- simple Ghanats: they are those tunnels with a series of perpendicular wells
- 2- Two layered Ghanats: in these Ghanats, there are two tunnels, one of which is located on top of the second one. So far, only one two layered Ghanat has been recognized and it is in Ardestan and the water of one layer doesn't penetrate into the second layer.
- 3- Ghanats branched from river: unlike simple Ghanats, the water in these wells isn't transferred from mountains but it is transferred from rivers to farms. Naser Khosro Ghobadiani has also reported one example of these Ghanats in Tarom. In Shahdad, one of these Ghanats is also found.

In this kind of Ghanat, the water of river was used especially when conditions of the earth didn't allow people to establish an open channel from river to control water to their lands.

In the first place, the most important condition to explore sewers is the existence of permanent and ground water and then slope of the ground. Moreover, if during excavation we encounter bad smelling soil, we should change our way and establishing wells on the way of flood or among valleys is strongly forbidden unless these routes are hard and rough. The best time to excavate wells is on dryness occasions that are Shahrivar and Mehr. The presence of watery lands is the main condition of excavating wells and if it is not considered, digging is completely useless.

Watery land has pores and those lands that have numerous vapor and dew during morning and mountains are always full of water. If desert is cover by laminated rocks, it can be said that there is some hidden water in here. Generally, the best place for excavation is the plains of mountain foothills which have permanent snow and humidity or lands located in vast valleys between these mountains. Therefore, we can talk about channels arising from humid mountains and deserts which are far from mountains but have green plants. Although several centuries have passed from the invention of Ghanats, this method is still usable in Iran and other regions; its structure hasn't been changed a lot and it means that both excavation techniques and tools are those used in thousands years ago. Recently, some new tools are used for excavation but the main tools which are pick, wheel and spade still remain intact.

In digging a new Ghanat, some points should be taken into consideration: presence of watery lands, presence of enough and permanent water and suitability of soil in pathway of Ghanats.

Mother well is in fact the main source of water and is a part of Ghanat, supplying its water throughout the year. They are usually located in watery layers and are considered the deepest wells. In fact, mother well is in foothills and is considered the source of Ghanats. Considering ground water resources, their depth vary from 3 meters to 400 meters. For example, the deepest mother wells are situated around Gonabad.

Ghanat channel is one of three main internal components of an Ghanat, transferring water from mother well to source. Excavating channel is done after determining the borehole.

One of the most important principles which should be taken into consideration in Ghanats structure is the slope of underground channel. In past, well diggers determined this slope and distance from boreholes to place of sources using surveying tools. Karaji states "depth of water should be the same from the beginning to the end". To maintain these channels, water pipes are used to cover bottom and channel of Ghanats and to save water. Karaji believes that in past, bricks were used to cover the internal ceiling of wells and that's why dredge should be done regularly because when the channel of an Ghanat is dried, this channel will be unusable in future.

Source of Ghanat is near the villages and in fact the water passes through the underground ways and opens its way to surface. To determine the place of the source, at first the depth of mother well and then the depth of the first borehole and after that the flat slope of the earth are determined and finally the route of underground channel is determined using scale and compass. One of the most important conditions of choosing the place of sources or openings of wells is that the height of them should be lower than water level in boreholes; that is, necessary slope should be considered so that water can exit the opening of the source easily.

Water of all Ghanats is not usable in the source because sometimes, sources are far from the places in which water is needed so in this case, an open canal or stream is used to transfer water from source to the places; this open canal or stream is called **HARANH**.

There are some reasons why these Ghanats are dried:

- After severe or sometimes mild earthquakes, water level in watery part of Ghanat is lowered and causes shortage of water or dryness of Ghanats.
- Destruction resulted from wars; the first measure conquerors and warriors did to beat cities was to destroy the water resources and this disaster have happened in Iran many times; Sargon the second, was the first to do this method. In the war between Ashk the third and Anitokos, this method was also used.
- Decrease in rainfall, destruction of forests or erosion of soil in foothills that lower the water level and cause dryness of Ghanat. Increase in penetration of rainfall into soil is the only way to prevent this problem.
- Flood is also a factor that causes the destruction of Ghanats so it is better not to build them in these areas. Sometimes, natural fall-down of some parts of Ghanat blocks the flow of water and because water is accumulated in other parts of Ghanat, walls and ceilings will collapse and water is accumulated behind these ruins and finally entire Ghanat is destroyed. It is possible that mud and sly penetrate into Ghanat and inhibit penetration of water and its flow and that's why Ghanats should be dredged regularly.

- Changing the ownership can also be considered a devastating factor. Most Ghanats which are owned by individuals are divided between heirs after death of the owner and thus they are forgotten and their dredge and repairs are delayed and finally are abandoned and destroyed.
- Excavating deep wells is the main factor of destruction. It is apparent since 40s; unfortunately, deep wells have caused the destruction of Ghanats and they can't be a good substitution for them. Equipments of well diggers are so simple and include a wheel, a leather bucket, a pick, a lantern, spade and compass.

To dig an Ghanat, 3 to 5 people are required and if constructor wants to use one wheel, the required workers are:

Pick holder: he is the most experienced excavation worker; in fact, he is responsible for digging, determining the directions and choosing wells' dimensions and underground canals.

Mud collector: his duty is to collect dust and mud accumulated on wells by dibble and to pour it into bucket and give it to collapse puller.

Collapse puller: after mud collector gives the bucket full of dust and mud to him, collapse puller brings it near the bar and changes it with the dust bucket which is fastened to wheel's rope.

Wheel puller: he works on the ground and near the opening of the wells. Turning the wheel and the rope fastened to the wheel, he changes the full and empty buckets.

Bucket receptor: he stands near the wheel and when the full bucket reaches the ground, wheel puller stops the wheel and bucket receptor empties the bucket and then gives the empty bucket to the wheel puller

Different methods of water division in Iran are attributed to different people. For example, in Ardestan, water division was known to be under supervision of Khaje Nasiradin Toosi; in Tabriz and Isfahan, it is attributed to Sheikh Bahaii. In past, to determine the time needed to use water, movement of stars and the sun was done and today it is replaced by clock. To divide water, there is a special unit called arch. In Kangavar Region, water division unit is arch that equals 6 hours of irrigation while in other villages every arch is 12 hours. In fact, owners of wells determine these arches at the beginning of every agricultural year (Mehr) and before cultivation.

The kinds of ownerships are also different so that in some areas, one well has only one owner who sells the water; some have several owners; some are sold as various shares; and finally some of them are endowed.

Ghanat is a traditional phenomenon which is located in some cities of Iran like Kerman but due to new generation that has little knowledge about Ghanats conditions, Ghanats are to be inclined unless a number of them are recognized and kept as some monuments.

Ghanats are essential part of agriculture and encourage people in dry areas to dig lands and plant trees and flowers there. Trying to extract water, these people have made the dead lands of deserts alive.

But new generation wants to experience something new and try to wash old thoughts and pattern away; they don't like mud houses and want to live in cities because they are

told that brick and iron are signs of civilization. Today, technology doesn't know time so deep wells replace sewers. Now, those traditional well diggers who once called their friends from the bottom of the wells are not working and machines and new technologies are replacing them. Dried lands are no longer waiting for water that comes out of wells and in our deserts, we can't see the signs of green nature anymore. People who extracted water from depth and planted green lands and farms are now regretting those green days.

As deep wells are dug and sky refuses its rain to deserts, Ghanats, these significant heritages, are forgotten and abandoned.

According to valid documents, miners in northwest of Iran were the first people who thought of inventing wells several thousands years ago. Following discovering cooper in Zagros Mounts, they accidentally discovered this system of irrigation by creating drainage. These Ghanats date back to the first millennium but making use of Ghanats water for agriculture started some years later.

The first report about water supply was written 700 years bc and in an epigraph of Sargon the second, king of Ashour.

At the time of Great Darioush, the best achievements were made considering irrigation and excavating sewers and achaenemian kings announced that everyone who could find a well, dig it, and plant a land using that water, he and his next five generations were exempted from taxes. At this time, excavating sewers were expanded to Egypt and in Hamant village a sewer were dug and irrigated 5 thousand hectares of lands.

According to Hamdolah Mostofi, after Islam the first excavation was to supply the drinking water of Mecca and it was done by Zobeide Khatoon, Haroonarehid's wife. Iranian scientists have written some books about excavating wells, extracting ground water and determining the quality of water. For example, Abobakr Mohamad Ebnel Hassan wrote the book "extracting ground water". In Mongols attack, irrigating systems and wells were destroyed and most of them were dried and abandoned. In Safavie dynasty, excavating wells were started again due to severe drought. In the Qajar dynasty, Aga Mohammad Khan destroyed the Ghanats and then occupied Kerman. At this time, excavation improved and most Ghanats were dug during 200 past years. Haj Mirza Aghasi was the man who encouraged people to dig Ghanats.

Today, the number of Ghanats is decreasing and sewers are destroying by making use of new technologies. Before land reforms in 1341, there were about 50 thousand series of Ghanats in Iran but after land reforms their development was stopped and their destruction and dryness were started. In less than 25 years, approximately 20 thousand Ghanats were destroyed and it was the ending of sewer civilization in Iran.

Ghanat is a traditional aquatic structure used to extract ground water. Ghanat is in fact an underground channel that transfers ground water to the surface. Although this system was invented in north or northwest of Iran, this method was very useful in dry areas of centre or east of Iran. Although Ghanats can be found all over the world from Japan to Chili, the biggest place in which Ghanats are considered the sources of water supply, is Iran. In dry areas, improving agriculture and building cities or villages is impossible without using water of Ghanats. In fact, in most areas around Iran deserts like Kerman, Yazd, Kashan, SABzevar, Birjand, Gonabad, Ferdos and..., life would be so difficult

without water. The dependency of these people to water of Ghanats is very much and according to experts, without Ghanats, big cities like Kerman, Yazd, Kashan, Sabzevar, Birjand, Gonabad, Ferdos weren't appeared. Therefore, attempts of people in eastern part of Iran caused that over 74% of Ghanats in Iran to be dug in these regions so that there are more than 12600 Ghanats in internal areas like salt deserts. In Iranian plateaus, there are 300 thousand kilometers of Ghanats and according to UNESCO, three fifth of world's Ghanats are in Iran. Among them, the biggest and the longest ones are located in Yazd and Gonabad, showing high techniques of construction. Documents show that there are Ghanats in four continents of Asia, Africa, Europe and America; among them Asia has the most ones. Although they can be found in all cities of Iran, they are more in deserts and dry cities and the most popular ones are located in Kerman, Yazd, Isfahan, Semnan and East Azerbaijan. One of the most significant Ghanats is a two-thousand-year Ghanat in Gonabad; it is 33km long and has 420 wells. Depth of mother well is more than 300 meters and is considered the deepest one in Iran. This Ghanat is a significant phenomenon in the world considering its age, length and amount of watering. Although the first usage of Ghanat was to flow groundwater on the earth, other usages are drainage of water and sweeten the lands. By building wells, the drinking water in tropical islands like Persian Gulf is supplied. Artificial feeding of underground layers, keeping environmental balance and preventing intra-municipal floods are important usages of Ghanats. Not only is Ghanat a valuable memorial of our ancestors, but also it is a huge and important capital for the present generation.

According to report of ministry of agriculture in 1378, annual discharge of Ghanats water for agriculture is more than 10 milliards m³, 70% of which belongs to deserts. Drought and low precipitation in recent years have dried and abandoned the Ghanats. In recent years, water of most Ghanats has been lowered and some of them are completely dried. Irrigation of these Ghanats which once was stable and helped the development of cities is now forgotten. Today, excavating an Ghanat is very costly and utilizing water of deserts or wells cause drop of quality and level of water and decrease the useful life time of wells. Despite modern technologies, value of Ghanats is still kept but to have a better result, old and modern methods should be mixed. According to statistics of ministry of agriculture, number of Ghanats in Iran were more than 44000 in 1367 but bad maintenance, lack of financial and technical support reduces these numbers to 33405 ones with output of 10/7 milliard m³. The irrigating and watering of them in some southern and eastern parts are decreased to 20 to 80% due to recent drought. Watering problems of wells are overcome in areas where reconstruction and controlling operations are done. In most eastern parts of Iran, the wells are destroyed and if this trend continues, in near future there will be no sign of these monuments. In this case, the result of our ancestors' attempts to use groundwater for irrigating will be buried. Destruction of Ghanats is not only decline of one method of irrigation but also is fading of one culture so they shouldn't be allowed to be ruined. Dryness of these wells has caused other strength factors to be destroyed too. Restoring wells can help development of these abandoned places and encourage people to start living there again. Current conditions of Ghanats reveal that if this reduction trend of water level continues, in future we will have more dried wells. In this case, the government must pay more attention to owners and legislators of wells and must try to prevent digging deep wells around Ghanats. To maintain the Ghanats, assigning governmental financial supports to dredge them and to use new technologies in excavating Ghanats are essential.

Ghanat is not an ancient monument but rather it is a good method of extracting water and making use of groundwater resources. Moreover, it is mixed with culture, national and religious traditions of Iranians. Sewers are masterpieces of civilization in Iran and are heritage of our ancestors in deserts. Let's try to keep them from drought and don't let deserts win over villages and destroy our ancestors' attempts.

Iran is the origin of Ghanats and has the oldest and the most historical ones. Ghanats are the basis of evolution of a stable civilization. Ghanats that are ancient symbols of Iran should be known and understood and we must transmit them to the next generations. These masterpieces are mostly built in dry areas like Khorasan, Yazd, Kerman; they bring development with themselves. Unfortunately, most of them that once were veins of life and caused the development of deserts are now dried and destroyed

Ghanat in desert means life. Ghanats are symbols of thought, knowledge, technology, cultural heritage and history of Iran and Iranians. They are valuable capitals hidden under the ground. In fact, Ghanat industry is considered the oldest industry and one of engineering masterpieces of our ancestors as the oldest aquatic structure and water supply. Ghanats was first excavated to extract water and improve rural life and now are dried. Ghanats are reported to be invented before 1780 bc and it is said that since then, well diggers started digging Ghanats in Kerman and Khorasan; gradually it was expanded to all parts of Iran and then to other countries so that they can be found all over the world. However, Iranian plateau has the most wells in the world. According to Hamdilah Mostofi, Ghanats are located in 30 cities of Iran and the most important ones are Gonabad Ghanat with depth of 500 meters and Sanabad Ghanat which is 1220 years old.

Today, those lands that were full of Ghanats and had green landscapes now are so thirsty in dry lands of deserts and those rural Ghanats are to be dried due to unwise measures of unqualified people.

According to authorities, total amount of water extracted is 70 milliard m³, 8 milliards of which is extracted from Ghanats. In fact, according to official statistics, more than 12% of extraction of groundwater is done by Ghanats. Today, there are 33000 active wells in Iran. In Khorasan and Kerman that are the origins of these aquatic structures, more than 4000 Ghanats have been dried during the past years due to continuous drought. Shortage of water which is the worst problem of the third millennium made our ancestors find a solution and they could solve it by digging wells. Today, we can also solve this problem by using our ancestors' experiences and man force.

Life doesn't exist without water and Iranians, knowing this important principle that water flows in deepest parts, invented a method and became able to extract water from depth of 340 meters and it was the beginning of a new civilization.

Experts believe that Ghanats are very valuable because they have been used for several years and can supply water regardless of primary expenses of dredging and maintenance. Because they are owned by farmers, the lands under cultivation will be increased and what is important today is to produce maximum agricultural products by using minimum water and energy. Western countries are going to build such structures with the aim of extracting water without spending huge expenses and by using little fossil and artificial energy to keep the environment clean. Therefore, using modern technologies, we can enhance the efficacy of Ghanats without destroying economical

and social tissues of societies. Stability of Ghanats in cities strongly depends on watering plans and experts of performing these plans are of importance. Improving the culture of watering to maintain water and soil needs national attempt but over past years we have observed that most of wells are dried. One factor of dryness is to dig deep wells around Ghanats. In extracting water from deep wells, in the first years fossil water is used and over time, as level of ground water decreases, watering of wells decreases too. On the other hand, excavating these wells needs lots of primary capitals and it is done by unprofessional owners. Therefore, agricultural products are reduced and villagers are forced to move to cities. Ghanats are found in all parts of Iran and experts believe that digging new Ghanats or restoring them is better and economically more efficient than digging deep wells. Unlike deep wells, Ghanats don't need pump, engine and complex equipment. According to experts, performing artificial feeding plans are very essential for Ghanats; in addition to control surface water, these plans can prevent extraction of water and strengthen the groundwater. It results in increase in the amount of watering and increase of humidity in surface soil. Moreover, Soil erosion is reduced because of permanent plants and agricultural products. When Dr. Ali Shariati visited the construction processes of a sewer in deserts around Yazd, he wrote that building a Ghanat is a jihad in darkness to access water, fight with soil to travel into depth of the earth and to look for water.

Sanaii, great Iranian poet, states that one jug of water inside the house is better than a river outside.

Ghanats are distributed worldwide from Japan to Chili but the biggest place where Ghanats are the best sources of water is Iran. In this region, Ghanats technologies are evolved so they are built efficiently in all cities. If Ghanats weren't appeared, cities like Yazd and villages in foothills of Shirkoh wouldn't exist. Ghanats, in history of Iran, were first invented by miners; they explored Zagros Mountains to find cooper and during their attempts, they encountered ground water. To overcome this problem, they use drainage and accidentally found the technique of digging Ghanats. Documents reveal that this accidental invention dates back to the first millennium but making use of water for agriculture started several years later. For feudal, these systems weren't good so they were destroyed during wars and battles and owners should rebuild them. In Ghanats civilization, there was no relationship between cities and villages due to distances so the communities were close and traveling and immigration was so rare. As population grew, the owners of wells increased and this kind of ownership affected different parts of culture and civilization, one of which is political-economical system. In the scope of Ghanats civilization, there was no important organization to supervise and observe the cycle of production and distribution of products; it means that surplus was enough to improve the production factors like development and reconstruction of Ghanats, development of farms and improvement of production tools. Surplus was always less and lack of water and relative weakness of soil didn't allow for more production. Unlike Ghanats civilization, in river civilization people or farmers had vast lands and huge amount of water and produced more products; on the other hand, owners spend their surplus for themselves and could establish their ownership.

Sewer civilization that couldn't bear big wars, aggression and utilization of their lands by people and slaves, had to compensate its shortage of its resources by handcrafts and business. This kind of civilization has its own properties and its people also have

their own identities. In this civilization, no big and significant castle and big temples like castles of Shoush, Takht Jamshid, Kangavar can be found but architects make unique small structures and garden making is excellent in this arid area; coppersmiths of Kerman, Yazd and Tabas make some dishes all people of Iran know and create important copper works. Goldsmith and business are very important here and these areas are traditionally the origin of merchants. The practical sciences especially sciences related to excavation and maintenance, repair, utilization systems, pedology and geology are of importance in this civilization. Economical activities and handcrafts are found in this civilization. Carpet weaving is excellent in Kerman and Kashan and is exported to all countries. Kenry Patinher in 1810bc writes that "one third of people in Kerman do carpet weaving, and felting and shawl weaving and their products are very famous throughout Asia".

Great epical warriors like Rostam, Sohrab, Esfandiar and Lohrasb are from feudal civilization and have fought with warriors of pasture civilization like Afrasiab, Hooman and etc. heroes of this territory like Pahlaven Abdol and Pahlavan Hassan were so kind and didn't take part in wars and they always talked about peace and thrift. In fact, they always thought about economics and discussion not about war and spending money. In this area, robbery, aggression and treachery were so rare and religious minorities lived in peace and their firetemples, temples and churches were built near mosques. In deed, we can say that Iran in today's world has the properties and characteristics of sewer civilization.

Excavating the longest and the deepest Ghanats of the world represents the successful and continuous attempts of Iranian over thousands of years, affecting life and social relationships of these people. In plateaus of Iran, there are 300 thousand Ghanats and according to UNESCO, three fifth of all Ghanats are in Iran; among them, the longest and the deepest ones are in Yazd and Gonabad. It should be noted that Iran was one of the most civilized countries due to numerous Ghanats and water and all cities and villages could survive by the help of these Ghanats.

Not only can Ghanats extract water from underground but also they can sweeten the lands, reduce the salt of soils and prevent over-accumulation of salt in soil; however, it is true for shallow Ghanats. There are vast deserts like Loot and Tabas in Iran and Ghanats are the only sources of water supply in these areas. They play an important role in supplying water and development of villages. In fact, absence of Ghanats destroys the ecological and hydrological balance of these regions and their presence balances the amount of precipitation and cultivation. As document shows, removal of Ghanats destroyed this balance and finally caused abandonment of these areas. Ghanats are located in all cities but they are more in dry and arid areas. The most important Ghanats are: Bidokht, Salehabad and Sanabad Ghanats in Khorasan; Kerman, Mahan, Bam, Gerdoon and Joopar Ghanats in Kerman; Ashkoor, Mehdi Abad, Restag, Dolat Abad, Gahrom and Mamgan Ghanats in Yazd; in Isfahan, Aroone and Ardestan. Researchers and writers have confirmed the existence of Ghanats in more than 24 countries, the most important of which are: in Asia, Jordan, Afghanistan, Emirate, Bahrain, Pakistan, China, Syria, Turkistan, Russia, Iraq, Arabia, Oman, Palestine, Cambodia, India and Yemen; in Africa, Algeria, Tunis, Libya, Morocco and Egypt; in Europe, Germany, England, Spain, Italy, Cyprus and France; and in America, Peru, Chili and Mexico.

The first report about water supply was written 700 years bc and in an epigraph of Sargon the second, king of Ashour.

At the time of Great Darioush, the best achievements were made considering irrigation and excavating sewers and achaenemian kings announced that everyone who could find a well, dig it, and plant a land using that water, he and his next five generations were exempted from taxes. At this time, excavating sewers were expanded to Egypt and in Hamant village a sewer were dug and irrigated 5 thousand hectares of lands.

According to Hamdolah Mostofi, after Islam the first excavation was to supply the drinking water of Mecca and it was done by Zobeide Khatoon, Haroonareshid's wife.

In the forth century A.H, a book termed "extracting hidden water" was written by Aboobakr Mohannadebn Karaji. He, an Iranian engineer, talked about the structure and maintenance of wells. He writes "while penetrating into soils, water is blocked by hard layers and stops there and if a channel is excavated here, water can go up due to its pressure". He pays more attention to the place and location of wells. He states that "you should know that the best place for digging sewers is the plain of mountains that have permanent snow and humidity or is the lands located between the valleys; sometimes deserts which are connected to humid mountains are good places for digging them. If you find these places, don't ignore them and if you see a desert which is far from mountains but has various green plants, dig it because you will definitely find water." One of the other books about Ghanats is "Mafatihol Olom (keys of sciences) written by Aboabdolah Mohammadebn Yosef Kharazmi. It can be said that importance of Ghanats was so much that made this system a laboratory science.

Ebn Fagih Hamedani refers the invention of sewer to Kerman and states that "one of Iranian kings arrested a group of philosophers and told them to bring water to the surface so that they could use it to plant trees and flowers. Therefore, Kerman changed to a city with trees, rivers and springs.

Hamdolah Mostofi talks about sewers in Tabriz and states that "Tabriz has various plants and water of Mehran Rood which is arising from Sahand Mount flows in this region." Estakhri writes "there are popular bazaars and caravanserai in Rey because Roode, Belisan, Dehak and Roode are very green and there are bazaar and caravanseray in Sharstan which is surrounded by walls; it has water of river and sewer and there are a lot of sewers for farming.

Maser Khosro writes in his log "when I left Toon, a man from Gilak told me a story. He said when we went to Gonabad from Toon, bandits attacked us and some of us thrown themselves to sewers and when bandits went they wanted to save the men who were on the sewer but they had been killed because the sewer was 4 parasangs in deep."

It is obvious that Ghanats can cause permanent residency and improve agriculture. There is no complete information about all Ghanats in Iran but as we know, they were the sources of water supply in most cities. Neishabour Desert was watered by 12000 Ghanats and water of city was always supplied by Ghanats that passed under the houses. Yazd had 400 series of Ghanats and water of Sirjan was supplied by Ghanats. Sirjan had 12000 Ghanats and water of Gonabad and Tabas was also from Tabas. Kerman, Fasa, Jahrom and Shiraz also used these Ghanats. Qom had lots of them before Islam and during Islamic period, more than 20 new Ghanats were built there. Around Tabriz, there

were more than 900 Ghanats. Henry Goblo, a French hydrologist, estimated in 1929A.D that approximately half of lands in Iran were cultivated by Ghanats. Water and drought have been the most important social problems throughout history. For example, in southern stone bench of Takht Jamshid in epigraph of Darioush, we can see that he asked God to save Iran from drought; or on Saalbi History, we see that in Ardeshir Babakan time, sky hadn't been raining for several years but Iranians tried to use different methods to utilize groundwater and the best method was Ghanat. Therefore, water was very holy in Iran in all faiths before Islam and in Islam, water is respected and there are some rules on it and polluting water ended in death.

In some parts on Iran like Kamare village in Khomein Town, Mime and Lazare villages around Abade City, wild and fast water is considered male and silent and slow water is considered female. There are two springs in Aglan Fire temple; one of them is wild and the other one is so silent so they are called male and female respectively. In some parts of Iran, well digger's palm skin shows if the water is male or female. That is, if well digger's skin gets rough, the water is male and if his palm skin gets soft during digging, the water is female. In some parts, an Ghanat is called male that its water fluctuates. This belief still remains in most parts of Iran like in villages of Arak, Tafresh, Malayer, Mahalat, Khomein, Golpaygan, Delijan, Damghan, Shahrood and Yazd. Only one case is told about the marriage of Ghanats and that is Mohammad Hassan Khan Etemadosaltane in 1256A.D talks about this issue when describing Rad village around Charmahal-O-Bakhtyari. He says that" this village has 300 families and its water is supplied by Ghanat, spring and Zayanderood River. He writes that, there is an Ghanat in Saman Village. If this Ghanat doesn't have a wife, he will die and his water is dried so he should have a wife and his wife shouldn't have another husband. The wife should at least get bared once a month and swims into his husband's water. Marriage party is like this: at first it is tried to convince the female which can be a girl or a widow then, people start the party; like a real wedding party, they play the music, dance and sing. People bring the bride to the wedding clothe which is near the Ghanat. After that, a jug of that water is brought to the party. Finally the bride says yes and the party starts and people eat dinner. When the party finishes, the bride should swim in the Ghanat without any clothes. In some villages in Yazd, when the water of well is dried, people gather together and choose the best man of the village. Then, they take him to the mother well and he calls the mother well loudly and others start the party. In some rural parts of Iran, there are some public bathrooms, one of which is built outside the village on desert and it is only for brides and grooms. Pots of water are kept out of the bathroom and they put some leaves of rose on them. At two o'clock in the afternoon, people take bride and groom to the bath and wash them one by one, dress them up and start the party. However, in Sistan and in Sarabandary Tribe, in the wedding night and near sunset, the bride rides a white camel and is taken near the Hamoon River. Here, the men are separated from women; men start playing the music and the bride who is called Shider, goes under the water and then she wears the wedding clothes. The party continues late at midnight and while dancing, people come back to their village.

In some parts of Iran, to make the dried Ghanats full of water, people sacrifice sheep while in other parts, when the wells are dried, cows and sheep are sacrificed to bring the water back to them. But in most parts, when a well is dug and its water flows, people sacrifice sheep or cows. In Shahdad, during drought, 12 Muslims go to mosque and each reads the following verse of Shora sura for 1000 times: He is the God who brings

rain after disappointment of people and enhances his blessings; he is the God who is kind and beloved. In villages of Kashan, people kill sheep and pour its blood into the Ghanat. When the water of Ghanats is lowered, they believe that the demon of Ghanat is sleeping into the Ghanat and wants to marry a woman. Therefore, they choose an old widow and donate her to him and she should swim in this Ghanat every several days and people give her some money in return.

CONCLUSION:

Ghanat or sewer is one of the Iranian's innovations to irrigate and overcome the lack of water; it is considered the main vital factor of development of these areas. It is extended to almost all parts of Iran and if there weren't any Ghanats in these parts, no development would be appeared.

Ghanat is the main resource of water supply for main cities of Iran like Hamadan, Takht-E-Jamshid, Sirjan, Neishabour, Kerman, Tabas, Gonabad, Fasa, Jahrom, Shiraz, Qom, Tabriz and other cities. If the Ghanat systems weren't invented, most thriving cities and communities near Iran, Arabic and African deserts wouldn't exist.

Therefore, Ghanat should be studied and examined considering social, cultural and economical reasons and their distribution worldwide is of great importance so that in America especially in Los Angeles, water has been supplied by Ghanat. We should be agree with Abobakr Karaji; he believes that there is no useful profession but extraction of hidden water because the land can be improved, people can improve their lives and can gain more benefits using this profession.

REFERENCES:

1. Seyed Sajadi, Seyed Mansour, Ghanat: its history and how it expands to the world. Tehran, Italian Cultural Association Press 1361
2. Modarres Zade, Hadi, Ghanat: permanent epepee and symbol of Iran's ancient civilization. Mosaferan Magazine No25.
3. Collection of the articles, volume 1. Yazd: Regional Water Limited Company 1379
4. Collection of selected articles: Ghanat National Congress. Gonabad. Ordibehesht 1382
5. Collection of the articles, volume 1. Kerman, Jahad-E-Daneshgahi 1384.