PalArch's Journal of Archaeology of Egypt / Egyptology

HISTORICAL LATERAL IRRIGATION FACILITIES AND WATER-RELATED TECHNOLOGIES IN SHUSHTAR AND DEZFUL-MILL, DUNGEON, GYRE, WATERWHEEL

Parviz Talaeyanpour[1*], *Hossein Moftakhari*[2], *Mirhadi Hosseini*[3]

[1*,2,3]Department of History, Faculty of Literature and Humanities, Kharazmi University, Tehran, Iran.

Corresponding Author: [1*]talaeyanpour@aftermail.ir

Parviz Talaeyanpour, Hossein Moftakhari, Mirhadi Hosseini. Historical Lateral Irrigation Facilities and Water-Related Technologies in Shushtar and Dezful-Mill, Dungeon, Gyre, Waterwheel-- Palarch's Journal of Archaeology of Egypt/Egyptology 18(8), 3265-3273. ISSN 1567-214x

Keywords: Shushtar Mills, Dezul Mills, Dungeon.

Abstract

According to various studies and researchers mills originate in Iran. Due to enjoying several rivers and five large streams in this part of the country, this technology has been used for making wheat flour since ancient times in the province of Khuzestan. Since the Sassanid Empire, historical cities such as Shushtar and Dezful have utilized the energy of water for a variety of purposes such as constructing numerous mills in these two counties due to their two large rivers, i.e. Karun and Dez. The greatest number of mills in Iran, either great in number or size, are located in this county, which resulted in creating a great industrial complex. After Shushtar, the second largest collection of mills of the country, either in terms of number or the technology (indirect energy transmission), is located in Dezful. Dungeon and Gyre are two techniques for water transmission that are used for irrigation and supplying water, which has been used for a long period of time in Iran. There are dungeons in Dezful with two types of application, i.e. dungeons used for irrigation of farms and dungeons used for irrigation of public bathrooms and houses. The technique, construction, measurements, and manner of utilization of these dungeons are different from the dungeons used in other parts of the country.

INTRODUCTION

Since Khuzestan is crucial regarding agriculture and innovation in irrigation and its wide use of various types of irrigation and using the energy of water in a variety of affairs in the country since it possesses the largest volume of surface water of the country (30% of surface water), and the largest fertile plain in the country, plus the possibility of farming during all seasons.

Since old times, people living in this region invented a variety of technologies to use water for irrigation, use the energy of water, transfer, maintain, and utilize it, which is an indication of taste, intelligence, and talents of the people in this region. The technologies for using the energy of water for various purposes and methods of water transfer and using water, among which mills in Shushtar and Dezful are used in great volume and number. Besides, other irrigation and water supply methods were common in this region using techniques such as dungeon, Gyre, etc.

Khuzestan is prominent among other provinces in the country regarding the volume, number, type of technology, technique, and prevalence of these methods and techniques.

Mill: Mo'in Dictionary defines mill as an instrument used for making wheat, barley, and plant seeds' flour (Mo'in, Dictionary, V 1, P 47). Mills were used for grinding rock salt, chalk, and porcelain. The use of mill dates back at least to the Parthian Empire. Strabo was a Greek geographer mentioned a type of mill that the pharmacists of the Parthian Emperor in 67 B.C. built for his palace in Anatolia.

At least there is valid information regarding the prevalent use of mill in Iran during the Sassanid Empire.

In accordance with one of Iranian myth, first Homay Chehr Azad, daughter of Bahman one of the Kayanians, initiated the Ab Asia tradition in Iran, which used to be Dast Asia, about 3000 years ago (Great Islamic Encyclopedia, V1, P 372-1372). Mills were constructed throughout Iran, especially Khuzestan, during Sassanid Empire. The most important workshop collection was active about 50 years ago in Shushtar.

One of the best descriptions of Shushtar mills was carried out by Ms. Dieulafoy. She was living in Iran from 1881 to 1884 due to excavations in Shush and the following is her opinion regarding mills: There is only one neighborhood with a little motion. This neighborhood is close to a large river and next to the dam, which is one of the masterpieces of the Sassanid Empire. This building is great and strong, both the bridge and the dam. Water rises in front of the dam and sets several mills in motion to make wheat and barley flour (Dieulafoy, (20210, p 117).

There are several types of mills in Iran:
1. Headrace mills: In this type of mills, water is poured inside a stokehole and the water pressure applies a force to the gyre and its stokehole is built as a funnel.
2. Gutter mills: Mill that its gyre rotates through the pressure of the energy of water passing a gutter.
3. Rotating mill: Mill that its gyre rotates using the pressure of the energy of water passing through a canal with a high gradient. Rotating or slope mills are built with a slope inside and a passage of water from rivers. Shushtar and

Dezful mills are among the first and third types, which are described as follows.

Fig. 1 Perspective of Shushtar Mill Buildings. Source Shushtar Cultural Heritage Office

SHUSHTAR MILLS

Shushtar has one of the most ancient civilizations and the history of its urban development is structured from the Sassanid Empire. Works in Galalak, which is a part of the ancient city of Dastva and dates back to the Parthian Empire. The highest level of urban development and civilization in Shushtar belongs to the Sassanid Empire. They constructed buildings such as the Salasel Castle, Darioon Creek, canals, bridges, dams, and other facilities for controlling water and the collection of these buildings transformed the city into a museum of water installations. This city is one of the most flourishing cities of Iran during the Sassanid Empire. The architectural works such as the Mizan dam that divides the Karun river into two sections, Gargar dam, and its facilities are an indication of the Iranians stunning skills in containing water and using the energy of water for a variety of purposes.

There are several stories regarding the appellation of Shushtar. Hamzeh Esfahani stated that Shushtar was a superlative adjective for Shush and argued that Shush meant good and its Arabicized is Shushtar or Tustar (Hamzeh Esfahani, p 37-38). In his travelogue, Ibn-e Batuteh wrote that Shushtar has a large and beautiful river with pleasant and perfect falls. Shushtar was conquered by Abu Musa Ash'ari during the reign of the third Yazdgerd. This city maintained its prosperity during the Islamic period and its industries, especially fine silk, are famous around the world.

Regarding its natural location, the city of Shushtar is located close to the entrance of Karun river to the fertile plain of Khuzestan in the northeast of Khuzestan and it is parallel to the western foothills of Zagros mountain. The first settlement of the province was created in this region 8-10 thousand years ago due to this property. Karun river in this city is divided into two sections by Mizan dam, one of which is Gargar and the other is Shatit. Gargar is also

called Dodangeh since a part of it was deviated on account of Mizan dam and it contains merely two portions out of six portions of the total volume of water. These two branches are linked together at Ghir dam again. Gargar branch passes the natural cliff of Gargar at the location of Gargar dam by two diversionary canals and the mils are created on account of this level difference. In the earthquake that occurred in 1921, one of the buildings remaining from the Safavid period was ruined. The mill building was reconstructed during various periods.

Mills are all constructed on natural cliffs. The entrance stairs and stokehole of the mills is a whole piece carved into shape, therefore, it underwent less wearing during various periods of time. The difference between the level of surface water and the exit canal is approximately 6 m and causes sufficient pressure to rotate the water in the mill. Sarab Asiab canal is pertinent to water passage and water enters this passage, then, it enters the stokehole. The input and output water are regulated by a board and sometimes several mills use one canal. The stokehole of the mill is like an incomplete cone and its head narrows in the lower part.

VARIOUS PARTS OF MILL

Mill Stokehole

It is a cylinder that is shaped like a cone in the bottom and the diameter of its bottom section is lowered to increase the water pressure. There is a vent due to which water hits the fins or turbine with pressure.

Wooden Turbine

Comprised of a wooden axis that its diameter increases toward the bottom and the bottom metal peak rotates on the wooden piece that is its support. The upper metal bar at the axis of the upper millstone in the form of T shapes that moves it when moving.

Millstone

Millstone rotates as the turbine rotates and turns grains into flour by applying pressure on the grains between these two stones. The stone is not totally horizontal and it is slightly gradient in order to direct the flour outside so that it can be accumulated in a place and enables the luene to collect the flour. The lower stone is fixed and the upper stone is movable and in the middle, there is a T-shaped iron. This iron is passed from the middle and enters the wooden body of the mill turbine and this iron rotates upon pressure and when water enters the turbine and it rapidly rotates the upper stone.

Wheat is placed inside a sack that is located parallel to the hole inside the millstone and gradually wheat enters the millstone from this hole.

Various parts of mill yard:
1. Barn for keeping livestock.
2. Grain maintaining a place
3. Surroundings of the mill that is used to make flour.

Since they have access to high pressure of water, millstones in the city of Shushtar were larger than millstones in other villages, therefore, they made more flour. From 1951-1960, the petroleum company in Masjed Soleiman rented three mills that made flours merely for the employees of the petroleum company. In the past, the migrating nomads and nomads of the region supplied their flour from Shushtar, and the regions of Lali Gatvand and Masjed Soleiman brought their wheat to this region to make flour.

There are a total of 31 mills in Shushtar, which are located on two sides of the yard and in the eastern corner 10 and the western cabin had 21, which is normal in Iran (Talaein Pour and Rezaei, 2000, p 73).

The mills are used to grind wheat, barley, corn seed, sesame, pepper, and turmeric. Each mill should have 2 or 3 persons in charge, i.e. luene and officer-in-charge of transporting wheat and another person to carry flour to customers' house or bring wheat from their house. When all mills were operating, more than one hundred people were working here. Every three or two mills require one master workman, who is in charge of repairing, restoring, and maintaining various parts of the mill such as stone or wooden parts.

The buildings are commonly-owned and when the mill was purchased or sold or rented the luene was paid in flour and the luene could sell the extra flour and purchased what they need.

Dezfull Mill

Hamdollah Mostofi relates the building in the city to Ardeshir Babakan and said: In this city, a bridge was established on Gondi Shapour river, with the length of 520 and width of 15 foot, it enjoys 42 springs, it is also known as Andimeshk Bridge (Hamdollah Mostofi, p 167). A castle was established close to the bridge to guard it, then, the small city of Dezpol was established close to this castle. During the early periods of Islam, Shush and Gondi Shapour were no longer important. Citizens of these two cities migrated to Dezpol and this city developed gradually (ibid).

Dezul was probably a small town during Sassanid Empire. Yaghut Hamoy believed that it was a part of the city of Ranash and a neighborhood, which is known as Morteza Ali, was apparently a castle that was build during Sassanid Empire. The oldest part of the historical part of Dezful is the castle neighborhood close to the bridge and various types of environment. In the local dialect, the mills are called Asoyoha-ey Rana (Jaliliam, 2004). Rana has remained from Ronash. Dezful used to be known as Ranash or Ronash palace up to the ninth century (Hamoy, 1957, p. 585).

Haj Najm al-molk in his travelogue stated that they have build 20 mills in the middle of the river that leads to a great amount of tax (Najm al-molk, p. 21).

These structures are a built-in form of a ship and break the pressure of water current and it is not clear who and when turned them into the mill.

Apparently, today's Dezful mills used to be a complex of dams and mills. The mills in the middle of the river are mostly used in spring and summer and the marginal mill are used most in winter. As already mentioned the middle mills were used in the dry seasons (Introduction to Iranian Mills, p. 17). Since at this time of the year, water is more pressured at this section. In the winter and early days of spring that the water is swollen and the middle mills are under water, the marginal mills are used. (Talaeian Pour and Rezaei Sadr, 2000, p. 35).

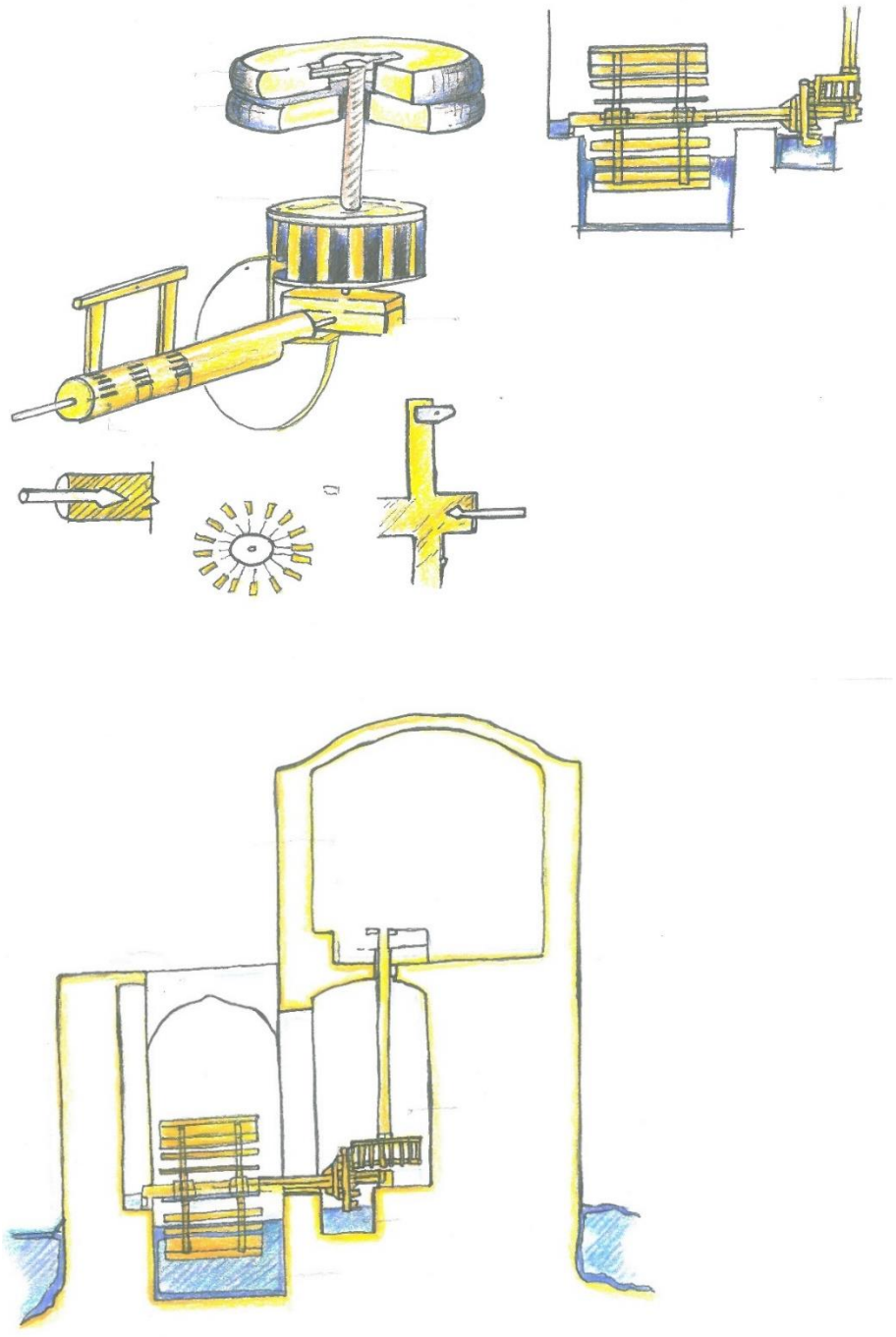

Fig. 2 Image of Dezful Mills which Worked through Indirect Energy Transmission Method

This type of mill is specific to Dezful.

Reference Babak Kial Maryam Rakhsham Khuch Esfahani

Figure 3

Fig. 4. Image of Rivers Dungeons in the Margine of Karun River Bank (Last days of Gajar period). Reference www.7eb0.com

It was investigated and the results demonstrated that this type of mill is specific to Dezful (The Iranian Encyclopedia for Young People, 1998, p. 117).

CONCLUSION

This facility is a part of the technologies pertinent to irrigation and the facilities depending on them. Iranians were among the pioneer nations in using these technologies. The province of Khuzestan enjoys a great volume of surface water and five large streams of the country, therefore, there are plenty of such facilities in various parts of this province, which are considered among the global cultural heritage in terms of importance, technique, etc. Thus, it was included as the World Cultural Heritage in UNESCO list.

Taking into account this issue and the irrigation techniques and methods aside from the mere historical view and with a more practical view and considering its technical details and delicacies might not be directly included in the field of history, however, it is quite important in the field of interdisciplinary research. This can be quite practical in executing the irrigation plans, tourism plans through renovation and changing the application of this historical structural to tourism, etc. In accordance with the investigations conducted by the water and wastewater organization of the province of Khuzestan in the county of Shushtar, it was found that the best way to recover Mianab plain, which was completely fertile during the Sassanid Empire, is to recover and reimplement Darioon river canal located under Salasel Castle. This plan can be carried out by allocating the required fund and establishing electromechanical facilities and electrical vent, and restoring Darioon river canal. Thus, this 1700 years old, or 2500 years old according to reports, the main basis of which was constructed in the Achaemenid Empire was restored and recovered and enabled these structures to continue their work up to the present time.

REFERENCES

The Rihla, Ibn Battuta. (1997). T*rans. Mohammad Ali Movahed. Agah Publications. Sixth Edition.*

Isfahani, H., *Dar Al-Maktab Lebanon.* No date. 1v.

Jalilian, SH. (2014). *Civilization, Cultural, and Political Developments of Khuzestan during Ancient Iran.* Research Institute of Cultural Heritage and Tourism.

Yagut, Al-Hamavy. (1957). *Mujam Al-Bulden. By Mohammad Dabir SIyaghi.* Tahouri Publications.

The Great Islamic Encyclopedia. (1995). *V1. Under Supervision of Kazem Mousavi Bojnourdi.*

Children's Encyclopedia. (1998). *V1. Farhangnameh Children's Publication.*

Dieulafoy. (1999). *Travelogue. Trans. Ali Mohammad Farahvashi.* Gheseh Pardaz. V1.

Talaeian Pour P. (1999). *Shushtar Mills.*

Talaeian Pour P. and Rezaei Sadr H. (1996). *Shushtar Ethnography.* Cultural Heritage Directorate of the Province of Khuzestan.

Talaeian Pour P., Hassani H. and Barabadi A. (1992). *Marvdasht County Ethnography.* Cultural Heritage Directorate of the Province of Fars.

Talaeian Pour P., Mazareian Kh. and Azizi H. (2000). *Dezful County Ethnography.* Cultural Heritage Directorate of the Province of Khuzestan.

Kial B. and Rakhshani Khush Isfahani M. Investigating Dezful Mills. *Cultural Heritage Directorate of the Province of Khuzestan. Bita*

Mustawfi H. (2002). *Nozhat ol-Gholub. By Mohammad Dabir SIyaghi.* Hadis Emrouz Publications. Ghazvin

Mo'in. Mohammad (2005). *Dictionary. 8th Edition.* V1. Zarrin Publications.

Pour Mozhei, SH. (2012). *Studying Iran Mills, especial Consideration of Shushtar Mills.* Cultural Heritage, Tourism and Handicraft Organization.

Najmo Al-Malek, A. (1962). *Travelogue.* By Mohammad Dabir SIyaghi. Elmi Publications.

Online Resources: www.7eb0.com