

Ancient Qanat System in Qasr Allam (Bahariya Oasis)

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ABSTRACT:

As access to water was the top priority for the inhabitants of arid and semi-arid regions in the ancient world, the Qanat System was one of the most popular methods adopted to make the best use possible of the subterranean water streaming down the foothills, for both irrigation and daily use. This paper, first, will provide a historical overview of the Qanat Systems in ancient world: their geographical distribution and possible origin. Then, the study will focus on the Qanat System of Qasr Allam in Bahariya Oasis, Egypt, as the case study. Qasr Allam is considered as one of the richest Qanat Systems in Bahariya Oasis and a perfect example in Egypt to give more insight on its historical and geological significance. We will trace the remains of the Qasr Allam Qanat lines still existing, using the modern scientific methods including maps by Google Earth and the analysis of the satellite images. Therefore, the current study is considered a documentation work.

Key Words: Qanat, Foggara, Arid, Bahariya, Qasr All'am.

1. Introduction

Herodotus (484–425 BCE) described Egypt as “a rainless area but extremely fertile. Egypt is the gift of the Nile” (Brown, 1965. p.68). In addition, the Ancient Egyptian civilization has been well known as the production of interaction between nature and people all over the Nile Valley and Delta. The Nile for Egypt has been the life-giving river for millennia. By the drinkable water and the fertile lands of the valley, it created the geography of civilization and made Egypt the first state and superpower in history.

However, the surrounding deserts where low rainfall and arid climate prevail to the west lay the Sahara Desert and to the east, a harsh mountainous wasteland offered a highly-challenging environment for any kind of inhabitants to ensure permanent water supplies. In order to survive in such a tough environment and high temperature as in the Egyptian Oases, people had to find a permanent source of water. Wells were good to begin with, but cropping in the desert required cheap, permanent and dependable access to water. Therefore, the Qanats System was the best solution.

Qanats System is a traditional technique of water management in arid regions that taps into the water table using tunnels make use of phreatic pressure in alluvium to collect and transport water (**Fig.1**). These systems move water through both subsurface tunnels and surface canals to serve settlements and irrigate agricultural fields (Egitto, 2013, p.97).

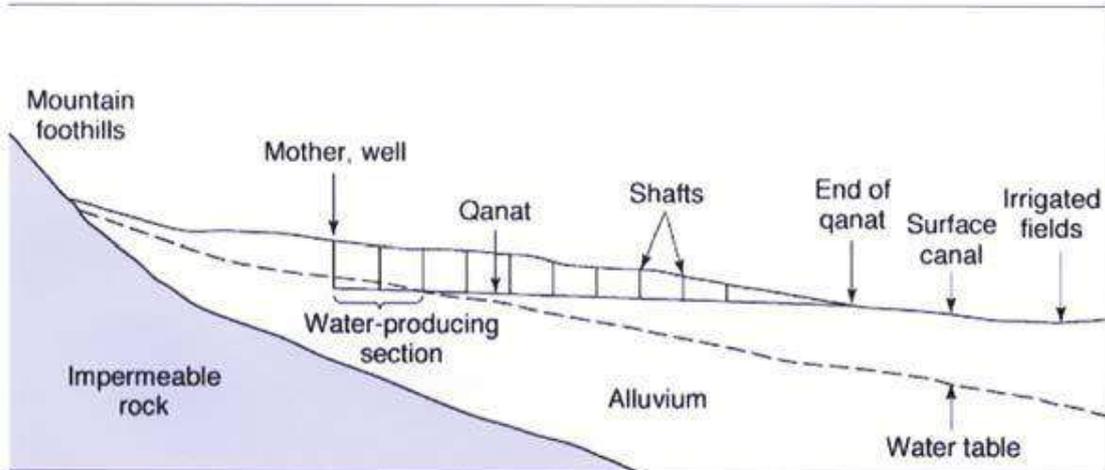


Fig.1: Qanat System (Mays, 2010, p.473)

The technique of the Foggara- Qanats was considered at that time as a breakthrough technology in hydraulics. It allowed people to exploit the oases water in high quantities and without excessive consuming of energy. The rapid spread of this abstraction of groundwater in the Arab countries has generated the proliferation and development of a multitude of oasis in the desert (Boualem and Rabah, 2012, p.3) (Fig.2).

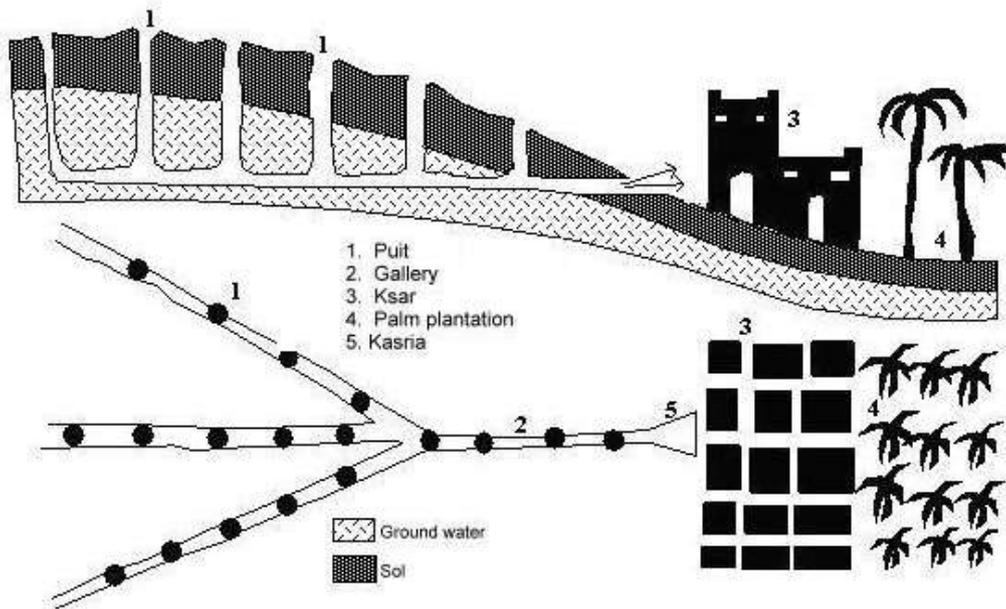


Fig. 2: Diagram of Foggara-Qanat (Boualem and Rabah, 2012, p.2)

2. Qanat Systems in Ancient World

The oldest Qanats have been found in the northern part of Iran and date back to around 3,000 years ago when the Arians (Aryans) settled in present day Iran (Javan et al., 2006). The longest (71 km with 2,115 vertical shafts) and oldest (over 3,000 years) is exist in the ancient city of Zarch. Presently there are about 33,000 operational Qanats in Iran (Mays, 2010, p.4) (Fig.3).

The system supplies 75% of all the water used in the country, providing water not only for irrigation but also for house-hold consumption. Until recently before the building of the Karaj Dam, the million inhabitants of the city of Tehran depended on a Qanat system tapping the foothills of the Alburz Mountains for their entire water supply. (Mostafaeipour, 2010, p.63).

Then, the widespread of the Qanat System from Persia to the neighborhood arid and semi-arid countries has happened in a rapid way. We can attribute this rapid spread to four key factors (**Fig. 3**): the Silk Road, Arab expansion, Roman expansion and Spanish colonization (Mostafaeipour, 2010).

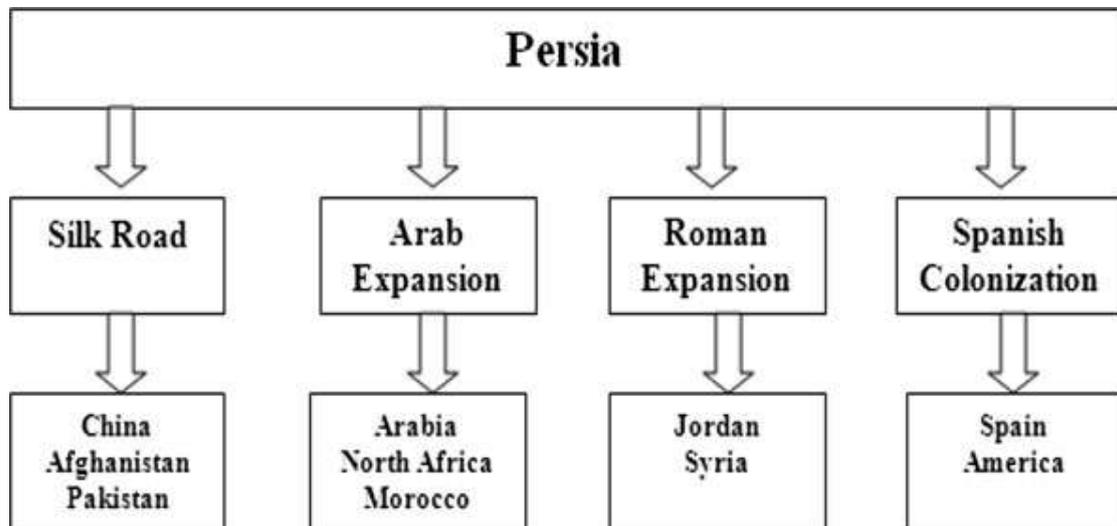


Fig. 3: Spread of Qanat system from Persia (Mostafaeipour, 2010, p.64).

The reason for the lack of Qanat existence in other parts of the world is geographical characteristics of regions and sufficient amounts of rainfall and rivers. That is the reason why we do not find Qanats in Northern America, Australia, parts of Europe, Russia, and main Southern parts of Africa (Mostafaeipour, 2010, p.65).

Since the Achaemenid Empire in 532-332 BCE, the 'Qanat' has become the central irrigation system in the arid and semi-arid lands (Shams, 2014, p.69). The digging of the first Foggaras in the Arab world took place from 1500 to 2000 years in the Sultanate of Oman. The estimated total number of Foggaras is 11500. Currently, this number has declined to 4200. It is now operational in 3017 Aflaj regions of Muscat, Al Batimah Al Dhahira Ad Dhakhiya Ascharquia and the Sultanate of Oman.

According to Ben Brahim (2003), on the 570 Khettaras dug in Tafilalet, 250 Khettaras were operational in 1997 and only 150 in 1'an 2000.

In Syria, on the 239 Romani Qanats inventoried, only 29 remained operational (Lightfoot, 1996). In Jordan, the 32 Aflaj inventoried, only 8 are operational (Lightfoot, 1997, p.446).

In Yemen, on the 94 Qanats dug, 40 remain operational until 1960. In the plain of Sana'a, only two remained in operation Qanats (Lightfoot, 2000, p.222).

3. Bahariy Oasis Qanat Systems

Bahariya is the closest Oasis to Cairo, part of the highly populated Giza Governorate, between latitudes 27° 48' and 28° 30' N and longitudes 28° 32' and 29° 10' E, about 370 km southwest of Cairo and 190 km west of Samalut in the Nile Valley (Catuneanu et al., 2006, p.121).

Bahariya Oasis looks like an upside down charging bull, it is surrounded by several rows of high escarpment encloses a valley floor littered with hills and mountains. The depression is 94 kilometers long and 42 kilometers wide and contains 2,000 square kilometers. It stands 128 meters above sea level with its lowest point near Qasr. This is the highest elevation of any of the Oases. (El-Sisi et al., 2002: p. 63)

The escarpment encircles the entire depression. Its lower portions, as well as much of the depression floor, are composed of Cretaceous sandstones, topped by Eocene limestone, Oligocene basalt, and dolomite. The Eocene strata, found mostly in the North is filled with nummulites, many lying on the surface. The

Northern portions of the scarp, including Gebel Ghurabi, are shales, clays, and sandstones. The western scarp is 175 meters high, with steep slopes, contains a number of wadis where the caravan roads are found. This scarp is really three, one following the other: the first is Nubian sandstone, the second limestone, and the third, or outer scarp, is chalk. The eastern scarp is also multilayered, actually two scarps, one behind the other. Toward west the white chalk, which dominates the Farafra landscape, predominates. (El-Sisi et al., 2002: p. 63)

With this geological formation (**Fig.4**) which is a part of the great Sahara, it created the allowed Nubian Aquifer System occurs, which is formed by predominantly continental sandstone of Mesozoic and Palaeozoic ages (pre-Senonian strata) (Thorweihe, 2002, p3). Its major structural elements are the Kufra Basin in southeastern Libya and the Dakhla Basin in south-western Egypt, each with an aquifer system up to 4000m thick. Based on effective porosities of 7-10% of the sediments. The total ground water storage amounts is 150 000 km³ (Thorweihe and Heintl, 2002, p.3).

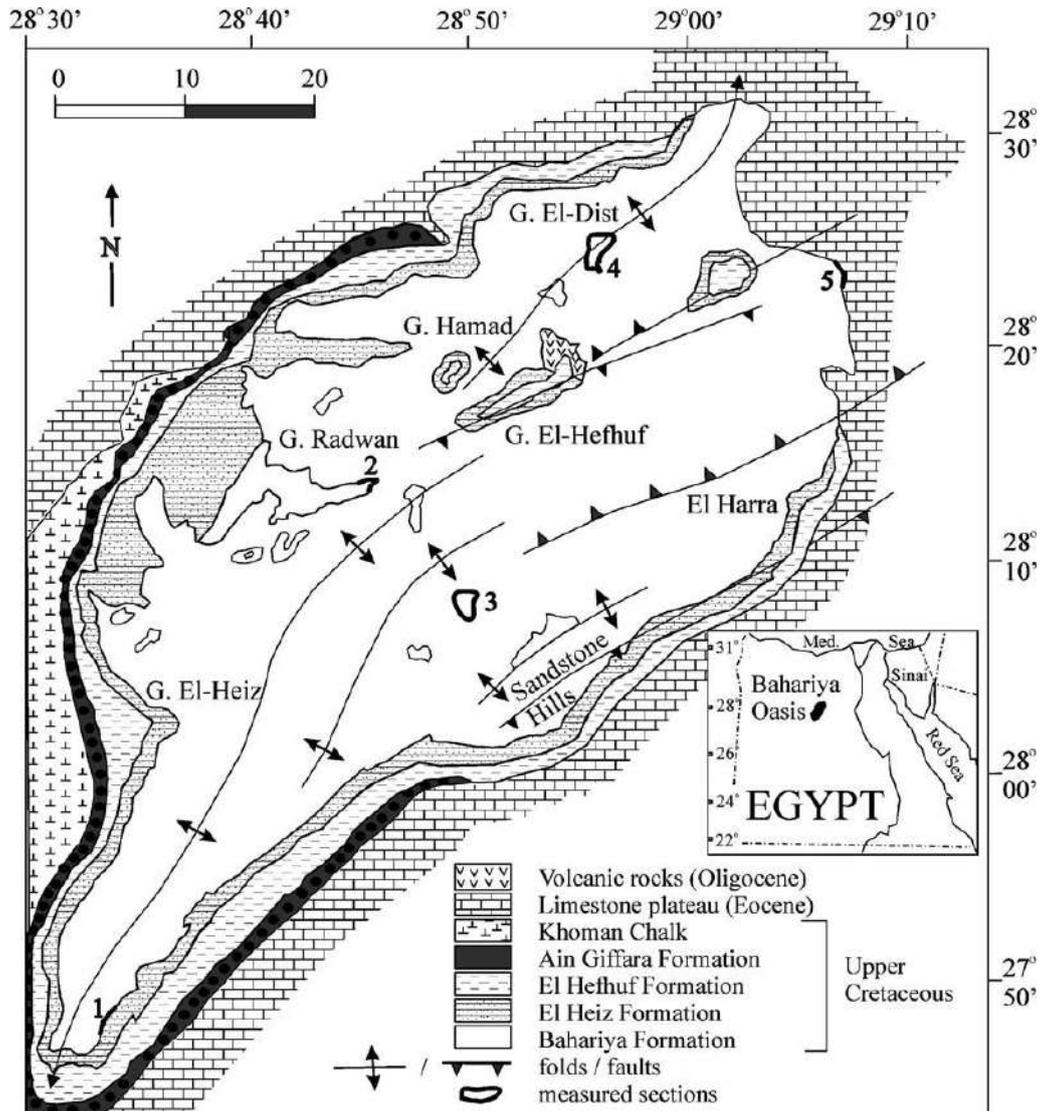


Fig.4: The stratigraphic of the bed rock of El Bahariya (Catuneanu et al., 2006, p.121)

The groundwater formed in the Late Pleistocene older than 20 000 years and in the Holocene between 14 000 and 4000 a BP. This distribution of periods of groundwater recharge is in accord with the Quaternary geological findings in the region as well as in areas in central and Western Sahara.

As a perfect permanent source for water, Qanat system was used in a large scale in Bahariya as a good example of the interaction between the communities with the surrounding environment. Remains of this Qanat lines observed in different sites such (Dospel, 2013. Pp.276:278) as:

- 1- Qasr Allam (the current case study): the richest site in Bahariya with Qanat Systems.
- 2- Qaret el-Tob: a roman fort to the North-east of Qasr Allam with remains of Qanat network.
- 3- Qusour Mouharrib: East of Bawiti, the satellite images shows an intensive networks o qanat lines there beside ancient settlement and roman fortress.
- 4- Ain el-Muftella: most well preserved temple in Bahariya related back to the 26th Dynasty with some vertical shafts which are the remains of the qanat line.
- 5- Central Bawiti: as it seems in the satellite images one of the longest quant lines in Bahaiya, which served the ancient sentral settlement of the oasis.

4. Qasr Allam Qanat System

The richest site with Qanat system in Baharyia Oasis situated in the South East side of the Oasis (**Fig. 5**).



Fig. 5: Qasr Allam in the south East side of the Oasis (IFAO)

Qasr 'Allam is a well preserved fortified construction, which has in some ways the appearance of a mud brick Mastaba (**Fig 6**). It was considered as Roman or Islamic fort. However, in reality, all the pottery found on the surface is from the fourth century BC.

The ceramic material confirms the date of the occupation of Qasr 'Allam, end of the Third Intermediate Period/beginning of the Late Period. The identification of the previously proposed site as a "Roman fort" or "Arab" is definitively disqualified. Demotic text mentioning Horus the Great provides an important key to the interpretation of the site that may have been part of the "domain of Amun" (*pr Imn*) quoted on seal impressions discovered in 2004 (Clonin, 2000-2014).

The structures excavated (**Fig.7**) and identified so far belong to service areas, production, storage and habitat. Activities hosted on the site were controlled by an administration and probably depended on the "domain of Amun" in Bahariya (Colin, 2009). Therefore, there is good reason to suppose that the site of Qasr'Allam included a temple dedicated for God Amun, a herd of sacred animals, service buildings, storage, and habitat that housed the priests and other local officials.



Fig. 6: The main building of Qasr'Allam fortress in the shape of mud brick Mastaba (Satellite Image from Google Earth)



Fig 7. Service unit with the remains of a domestic oven probably like "tannur" (Colin, 2009)

4.1. The Qanat System of Qasr Allam

Work field revealed four lines of the Qanat system in Qasr'Allam:

- **First line (B001):** Allam-Mouftella line

It has a North-South axis almost in vertical shape with clear covered shafts line with 357m long. With central coordination point of latitude $28^{\circ}20'30.67''N$ and longitude $28^{\circ}50'22.87''E$.

It seems that this line was a part of a great long Qanat System, which connected Qasr'Allam and Ayn el-Mouftella. There is a route of a line of bushes confirmed the presence of the continuous of this Qanat line, which seems to connect the area of 'Ayn al-Mouftella and the area north/east of the fort, where several wells and water projects had been identified in previous years. Marchand

was able to identify 225 bucket waterwheel fragmented from that area (Colin, 2000:2014) (Fig 6 a, b).



Fig 6a: Allam-Mouftella line (B001) in 2003 and the shafts clear enough to identify the vertical Qanat line which should be reached to Ayn el Mouftella. Qasr'Allam fortress seems clear to the west side of the Qanat line (Google Earth)

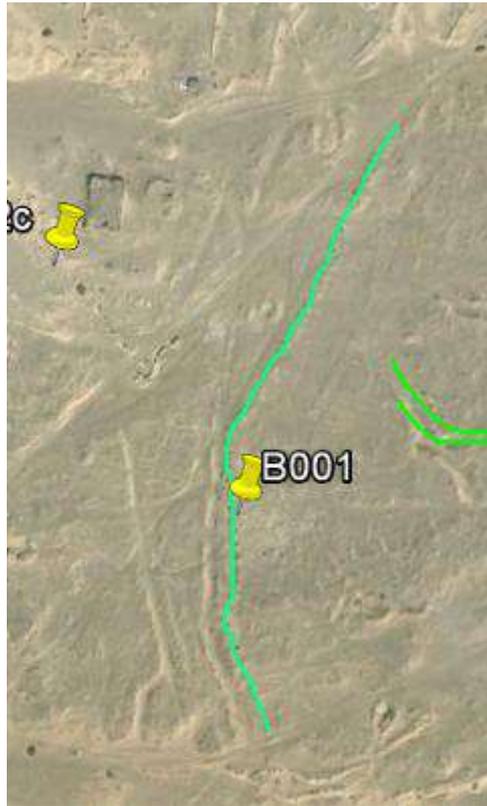


Fig. 6b: (B001) (Google Earth)

- **Second line (B002a-B002b): Ain Walid line**

Actually, they are two parallel lines, having both of them the East-West Axis almost in horizontal lines:

- B002a: with a length of 857m and central latitude point $28^{\circ}20'31.41''\text{N}$ and longitude $28^{\circ}50'39.47''\text{E}$.
- B002b: with a length of 816m and central latitude point $28^{\circ}20'30.45''\text{N}$ and longitude $28^{\circ}50'40.01''\text{E}$.

It is remarkable here that we have two lines of Qanat systems from almost the same source for the subterranean water. Should be the necessity for more water was the main reason to erect such another Qanat system in the place which is a good indicator that Qasr 'Allam population increased with the time (**Fig. 7 a, b**).

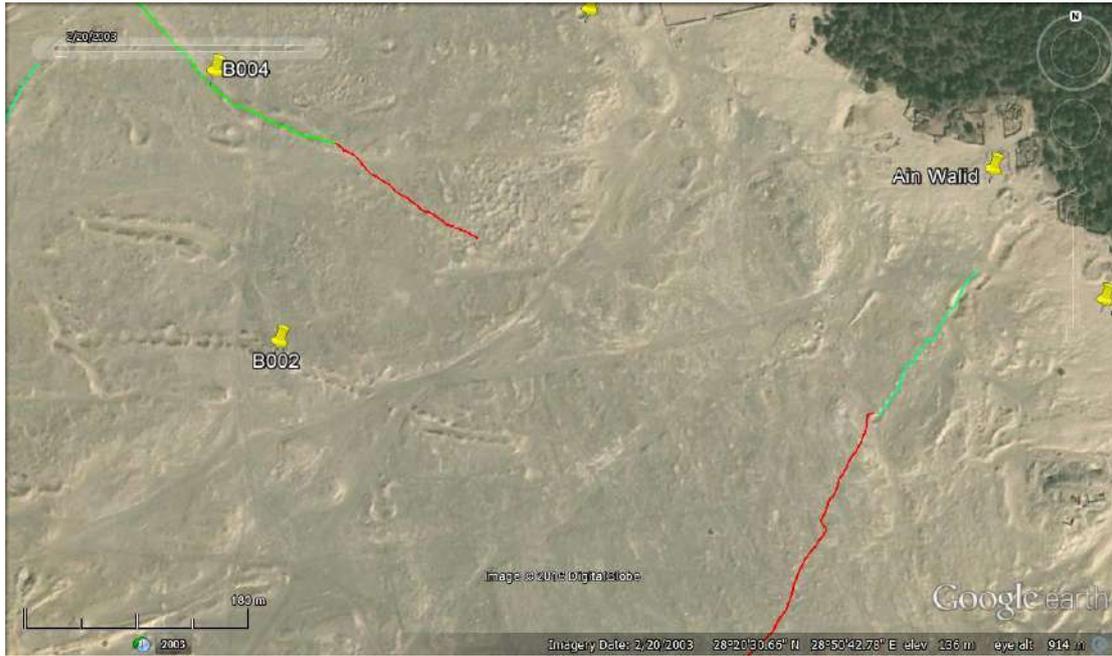


Fig. 7a: Location of B002 in 2003 (Google Earth)

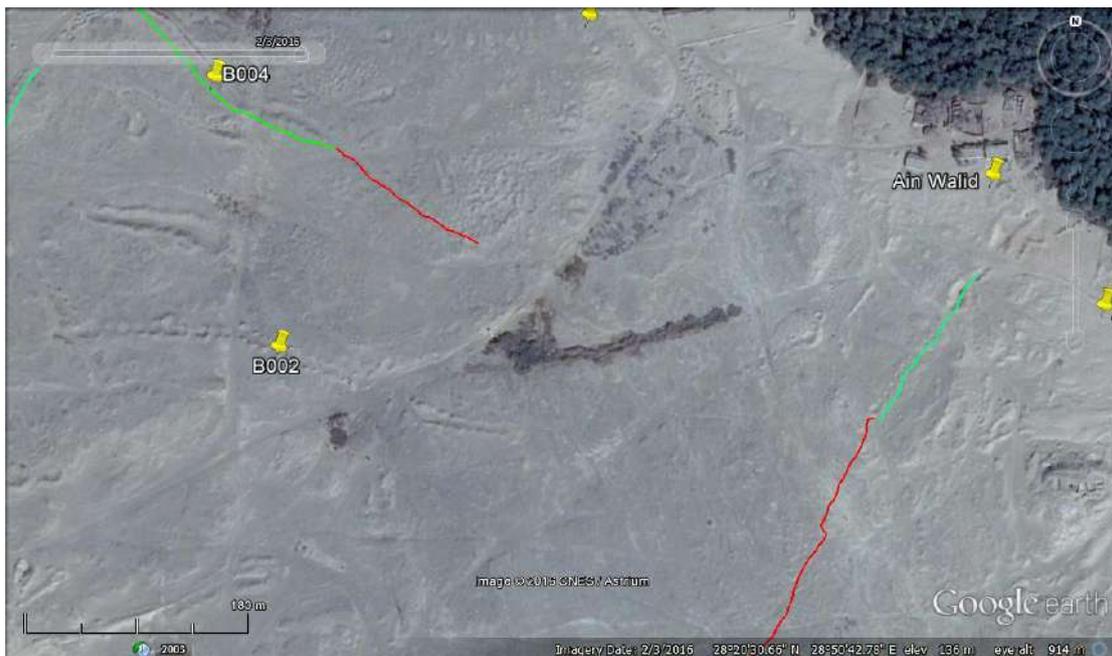


Fig. 7b: The Location of B002 in 2016 (Google Earth)

- **Third line (B003): Ain Helwa Line**

It has North-East to South-West Axis. It is a particular line with special aspects: it seems one of the longest lines In Qasr' Allam but it is not complete line shafts any more.

We can divide this line to 4 sections:

- “B003b” starting from the North-Eastern side with length of 232m with coordination of latitude $28^{\circ}20'31.09''\text{N}$ and longitude $28^{\circ}50'54.71''\text{E}$. In this section, the shafts of the line still exist even they covered but we can recognize them.
- Non clear shafts but with few traces, with the satellite images analysis we suggest that this section was connecting “B003b” and “B003a” with a length of 667m with the coordination of latitude $28^{\circ}20'21.43''\text{N}$ and longitude $28^{\circ}50'43.78''\text{E}$.
- “B003a” with clear covered shafts line with a length of 294m. Its coordination is a latitude $28^{\circ}20'12.83''\text{N}$ and longitude $28^{\circ}50'30.81''\text{E}$.
- This the end of B003 line or Ain Helwa line with no traces found with a length of 436m with a coordination of latitude $28^{\circ}20'8.86''\text{N}$ and longitude $28^{\circ}50'19.34''\text{E}$. (**Fig 8 a, b, c, d**).

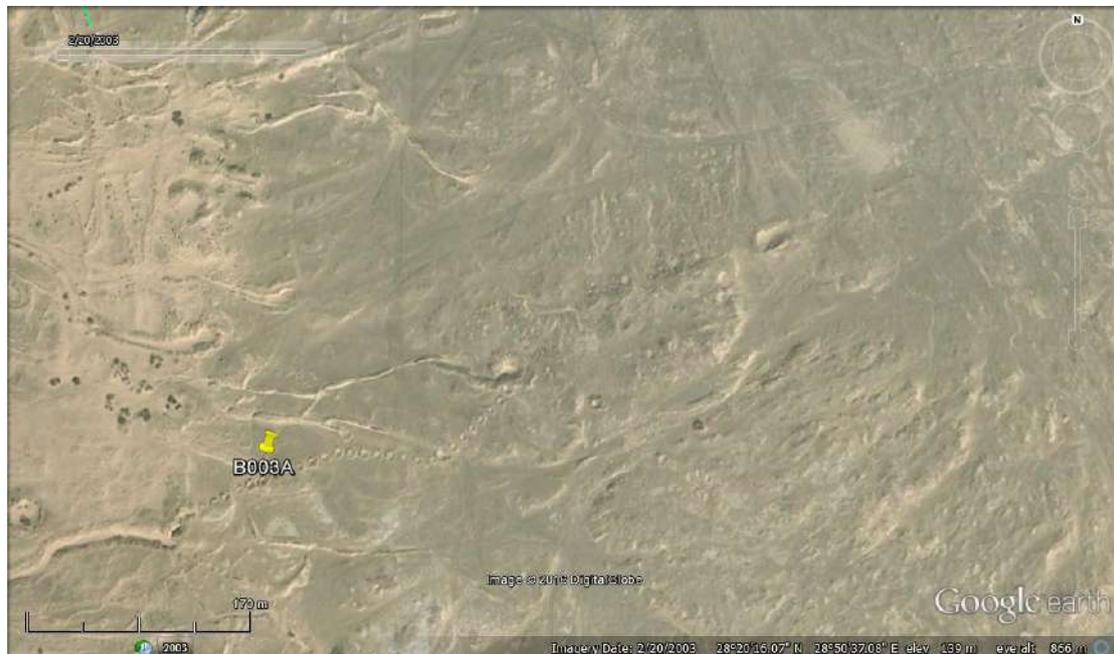


Fig. 8 a: B003 line with clear shafts line in part and unclear in another part (Google Earth 2003)



Fig. 8b: B003 during 2016 (Google Earth)

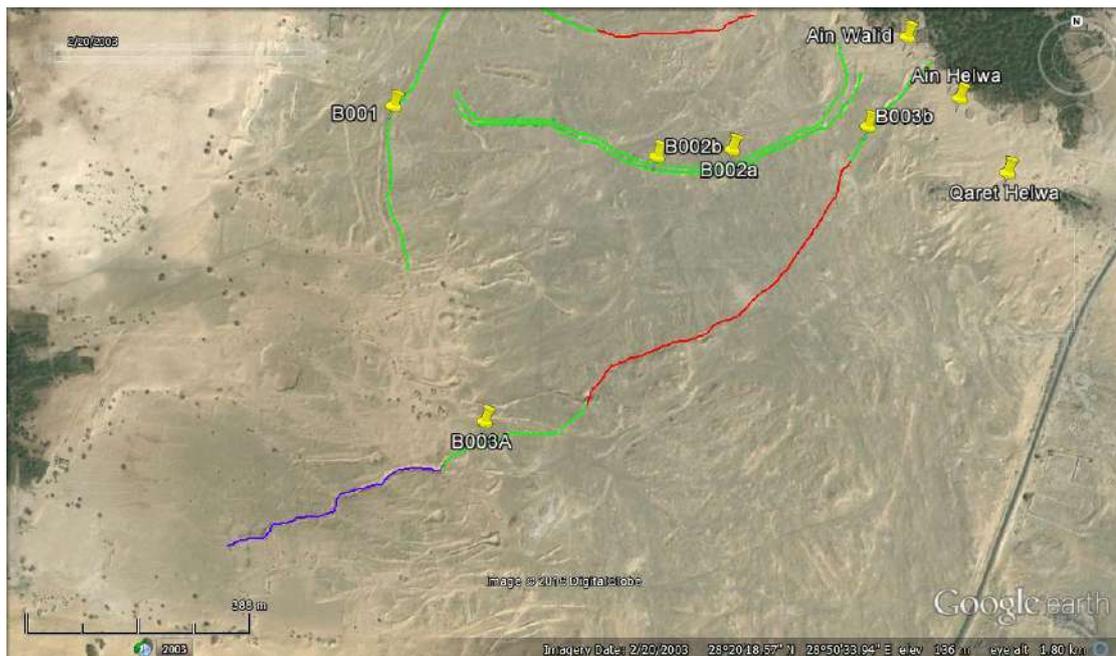


Fig. 8c: B003a and B003b with the green lines showing the shafts still exist and the red line indicating the disappeared part of the shafts (Google Earth 2003)

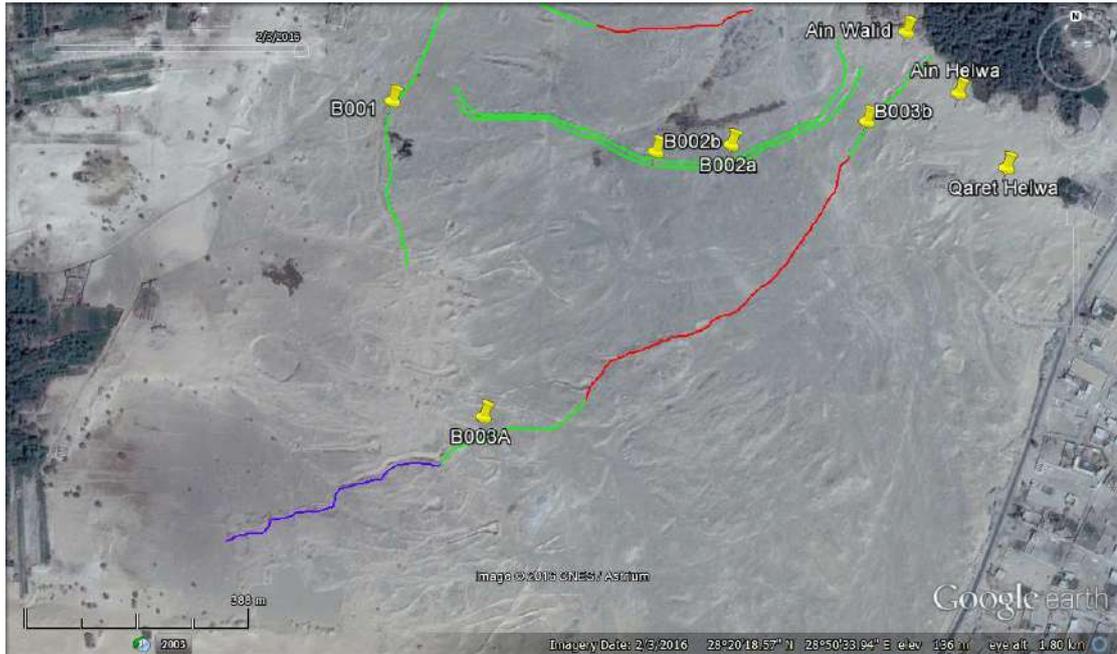


Fig. 8d: The Situation for B003 in 2016 (Google Earth)

- **Fourth line (B004)**

It has East-West Axis with length of 207m for the existing shafts line with coordination of central latitude point $28^{\circ}20'37.42''\text{N}$ and longitude $28^{\circ}50'33.10''\text{E}$, and for a length of 282m with a coordination of latitude $28^{\circ}20'35.87''\text{N}$ and longitude $28^{\circ}50'41.03''\text{E}$ (Fig. 9 a, b).



Fig. 9a: line B004 with its two section the clear exist shafts line and the disappeared one in 2003(Google Earth)



Fig. 9b: the situation of B004 in 2016 (Google Earth)

5. Results and discussion (Conclusion):

The existence of such a large number of Qanat Lines (**Fig10 a, b**) in one place is a clear indication of the intensity of human activities in this site, which extended over several eras according to the archaeological remains.

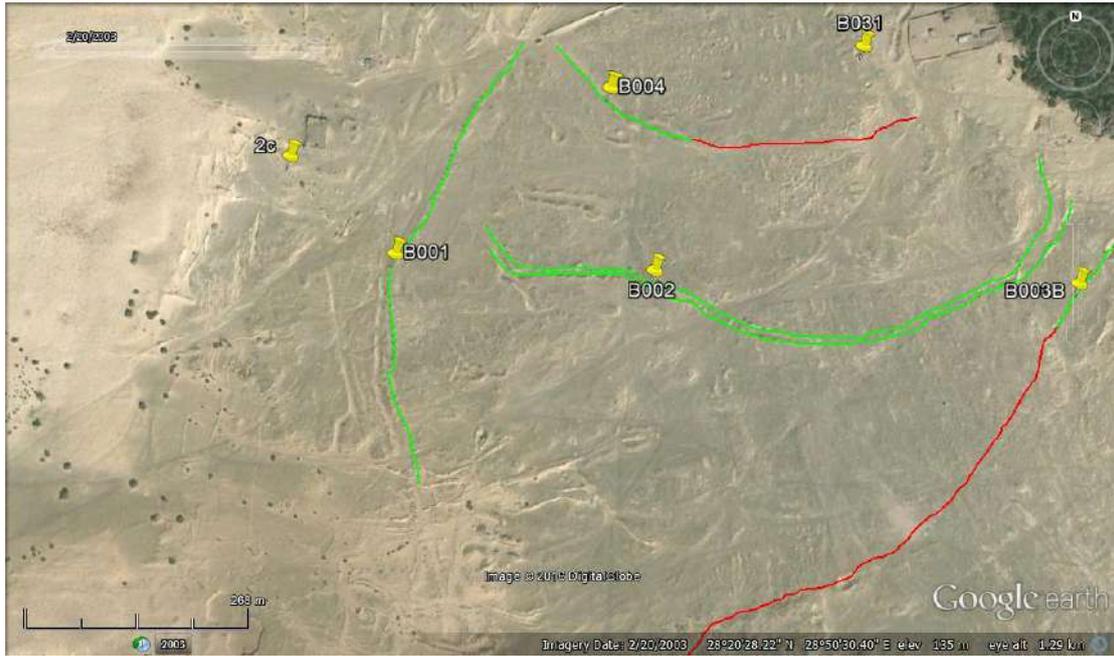


Fig 10a. The green line identifies the vertical axis of (B001) in 2003 (Google Earth)



Fig. 10b: The same line (B001) with the current situation of 2016 (Google Earth)

Based on the analysis of Qasr 'Allam archaeological records and the exploration of the deposits, we can define three main phases in the ancient evolution of the local landscape:

- 1) The oldest man-made levels are characterized with mud deposits where some ceramic remains and some terracotta figurines clearly belonging to the end of the Third Intermediate Period. With remains of hydraulic mining sector now called Ayoun (which is the Qanat line) which is part of the development of contemporary religious field of Qasr 'Allam.
- 2) After a long hiatus, black earth dotted with salt crystallization sign the development of an important cultivation. These layers are rich in small stone tools and eroded sherds, salinized and very broken characteristics of an external environment marked by agricultural work with observations of significant pieces designate the Roman era.
- 3) Of the same historical period appears to date the beginning of the silting that covered a vast sheet terroir Qasr 'Allam evidence of a major change in the environment, and more human activates which seems to related to the Roman period (Colin, 2014).

Unfortunately, wild growth of real estate and, above all, the very recent cultivation of surfaces yet included in the archaeological site of Qasr 'Allam, farmers have marked the fertile black soil of the Roman era and have already caused irreparable damage and narrowed the area accessible to researchers.

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