

# Renovation of Qanats in Syria

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## Summary

In the summer of 2000, a small group of Syrian villagers living near the borders of the steppe Southeast of Aleppo renovated and cleaned their own common water source with international help. Their source is an ancient Byzantine water supply system called qanat. The cleaning was a pilot project in an effort to contribute to the preservation of the qanats of Syria. This paper describes the research and action undertaken by an international research team at ICARDA that conducted a nation-wide survey of Syrian qanats in 2001. Within the framework of the UNU project on traditional water management, some of the most important qanat sites were re-visited in August 2002. It was found that some have considerably decreased in flow during the last half-year and are at the verge of extinction. Ironically, the qanats have been flowing for 1500 years and over the last 15 years they are drying up. What is the benefit of this sustainable water supply system in this time of ecological farming, increasing environmental awareness and within a changing social and economic environment? Are informal, national and international institutions able to maintain a traditional common water source like a qanat when groundwater abstraction through pumping gives much more short term benefit for a larger population?

## Introduction

### Modern challenges for traditional systems

The research project described in this paper looks at the use and values of a potentially sustainable qanat system in a changing modern environment. Lightfoot (1996) defines qanats as

"a form of subterranean aqueduct- or subsurface canal- engineered to collect groundwater and direct it through a gently sloping underground conduit to surface canals which provide water to agricultural fields."

In Syria many ancient qanat irrigation systems have been abandoned due to falling water tables as a result of the increased use of modern electric and diesel-pumped wells. Lightfoot (1996) stated that

"New and often rapacious water technologies have all but replaced traditional irrigation systems in the Middle East, aggravating an impending water crisis and further complicating regional water compacts [...] traditional, low-impact irrigation technologies can no longer support the region's rapidly burgeoning numbers of peoples."

In modern times, qanats are not able to provide enough water for large-scale agriculture and lose their importance. Traditionally, qanats should be cleaned on a regular basis to prevent silting, collapsing and disfunctioning. It helps in keeping the qanat flowing even in dry seasons. But as soon as qanats are giving less water, young people lose interest and start looking for revenues in off-farm work. The urban environment is financially much more attractive than traditional qanat farming. This group of youngsters literally abandons qanats. With the abandonment of qanats the indigenous knowledge and community co-operation critical for qanat upkeep also disappears and more qanats collapse or dry up. A vicious circle is complete.

As a result a valuable cultural heritage is vanishing. Not only are qanats relics of a prosperous past, but also sustainable and environmentally friendly systems of extracting groundwater. In Qarah, Syria, we have seen that combining ancient qanats and modern drip irrigation systems for fruit trees might prolong the life of some qanats and encourage younger generations to commit to their upkeep. Another option to think of is to encourage eco-tourism based around qanats to provide alternative income for the farmers.

## **Qanats in Syria**

In 2001, our team from ICARDA explored qanat sites in Syria guided by a map published by Dale Lightfoot from Oklahoma State University (USA) in 1994. We documented geographical, socio-economic, and hydrological characteristics and interviewed local experts and officials from various institutions. We found a total of 42 qanat sites containing 91 qanats, of which 30 were still in active use. Others were dry or drizzling and almost abandoned. We tried to cover most of Syria however it is likely that Syria used to have a lot more qanats in the past. These however are difficult to re-locate and beyond repair.

In Syria, the concentration of running qanats is located around Damascus, Homs and in the steppe areas. The qanats used to provide the main water supply for drinking and agriculture. It is difficult to determine the age of qanats because of the small amount of artefacts that are found inside the tunnels. However we can say through circumstantial evidence that Syrian qanats were already in use during the Roman period. The digging technique and type of the qanats varies considerably throughout the country.

The water of Syrian qanats is used mainly for irrigation since the date they were dug. The division of the water is based on a local system of rights and regulations. The groups of users for each qanat we found is relatively steady and each user household has an irrigation share measured in time, the so-called "dor" (turn). Irrigation shares can be traded among the users and are usually attached to land.

## **Case study in Northern Syria**

As we have seen in countries like Oman, renovation of neglected qanats is viable. Successful renovation of Qanats in Syria is technically possible but thorough social and hydrological assessment is required in advance of renovation. A pilot renovation was done in 2000 in a village East of Aleppo and our team initiated a qanat cleaning based on the priorities and traditional knowledge of the community. The qanat was dated of the Byzantine period considering an oil lamp, which was found in the tunnel. The qanat is the only source of water in the village. In collaboration with the museum of Aleppo, the scientists started up the cleaning of their own qanat.

## **Methodology and approach**

The research and development methodology of the case study is based on one of the action models described by Chambers (1985):

"Action anthropology begins with the premise that the anthropologist should operate within the framework of goals and activities initiated by groups seeking to direct the course of their development. The action anthropologist may use his or her technical skills to help a group clarify its goals, but generally avoids the temptation to direct the project."

Action research is a subset of applied research. In this case the action is the actual cleaning and renovation of the qanat system in Shallalah Saghirah.

The project followed an integrated holistic approach led by the priorities and needs of the community. The anthropological action research was supported by other disciplines such as hydrogeology, archaeology, biology, agronomy and soil science. An interdisciplinary team of scientists of both social and bio-physical disciplines thus

collected data on various topics. In general the data collection can be divided into a social focus and a technical focus.

Initial contacts with the community were established in the second part of 1998, but the actual project started in October 1999. Since then a good rapport has been developed with the local community. Overnight stays during the fieldwork enhanced and strengthened the relationship and mutual trust between researchers and respondents. Hydrological measurements are being taken regularly, the social organisation, history of the village and water rights system in use is being investigated; and a genealogy of the households in the village has been finalized. Key informants, both male and female, have been interviewed on their sources of income.

### Area description

The village of Shallalah Saghirah is located 65 km SE of the city of Aleppo in the western part of the Khanassir Valley bordering the eastern slopes of the Jabl Al Hass. The Khanassir Valley is located between the 200-mm and the 250-mm rainfall isohyets, while Jabl Al Hass is located between the 250-mm and 350-mm rainfall isohyets (Figure 1). The 200-mm isohyet demarcates the cultivated zone to the west and north and the steppe areas to the east. Shallalah Saghirah is a typical village because it finds itself in time and space in transitional zone. Spatially, because it is located between two different rainfall zones at the border of the steppe area; in time because, as both Lewis and Jaubert describe, this area has known rapid environmental, cultural and economic changes over the past 100 years. The village does not have electricity except from private generators and until recently was not influenced by modern developments elsewhere in the world. However, the arm of modernization reaches everywhere; television has made its entrance and the younger generation is travelling in-and outside Syria for off-farm migration work.

According to Lightfoot, the qanat system of the nearby town of Khanassir has been abandoned after the introduction of motor-pumped wells. A similar situation could be the future of Shallalah Saghirah. From 1998 until 1999 a groundwater and well survey has been undertaken by Hoogeveen and Zöbisch (1999) in the Khanassir Valley to investigate the groundwater system and its use by farmers. They mention that part of the water pumped from the aquifer in the centre of the valley, is replaced by salt water from the Jaboul Salt Lake in the north. Therefore, water tables in the valley are not falling as much as in those areas with comparable pumping activities. The limestone layer from which the qanat in Shallalah Saghirah derives its water is not very productive due to its low permeability and porosity. Therefore it is believed that the nearby pumping activities are having little influence on the discharge of the qanat. Nevertheless, also this ancient qanat system gives less and less water every year, according to the local inhabitants. They have mentioned that many shafts of the qanat system are filled with debris collected over the years and that children have thrown stones in the shafts. Yet regarding the physical environment of the qanat, cleaning and renovation of the system could be beneficial for both the people and the environment. Elderly inhabitants and some of their sons expressed willingness for cleaning and renovation, but they do not have the financial means to do it. There is also a certain reluctant attitude towards cleaning the system by some of the local inhabitants. Birks (1994) mentions that the change in socio-economic circumstances may be the main reason for this reluctant attitude. Through applied anthropological research and community development this project tried to overcome the various obstacles that prevent the sustainable use of an ancient qanat system.

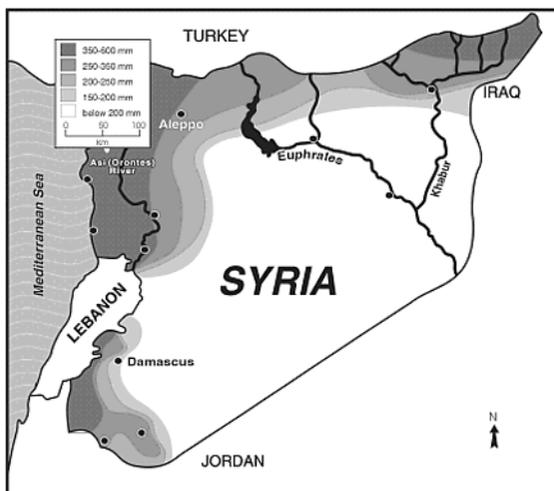


Figure 1. Location map

## Hydrogeology of the Qanat in Shallalah Saghirah

The qanat has been dug in the limestone rock that is dated Middle Eocene. The limestone consists of chalk like clayey limestone and marl. Flint has been observed in the limestone layers exposed to the surface. According to the inhabitants of Shallalah Saghirah the water in the mother well is tapped from a layer where flint is present. After production and transport through the qanat, the water is directed through a small open canal (*saqeh*) running through the village and collected in a reservoir (*birkeh*) at the end of the open canal.

This *birkeh* has been built in the 1950's to collect the water that is used for irrigation of a community garden. The *birkeh* can be opened and closed for irrigation from an outlet closed off with stones and cloth. Several discharge measurements of the water entering the *birkeh* have been taken in the winter 1999/2000. The maximum observed discharge was 1.1 l/s. This was measured when the villagers did not use the water from the *saqeh*, and the full discharge of the water production section entered the *birkeh*.

In contrast, measurements that were taken when water was drawn from the *saqeh* gave an average discharge of 0.35 l/s. The water extracted by the qanat system in Shallalah Saghirah has been tested and proved to be of good chemical quality. The results of the chemical analyses of a sample taken on June 11, 1999 are presented in Table 1. Values are compared with the standards for drinking water given by the World Health Organization, Excrements from bats present in the qanat cause biological contamination of the water that is harmful to human health. Therefore biological testing of the water has been listed as a priority.

**Table 1** Composition of the water of the Qanat compared to the drinking water standards of the WHO. sources: Appelo (10), Hoogeveen and Zöbisch (4).

Parameters	Observed values 1998	Max. values for drinking water	for
EC(at25 °C)	850		
(dS/m)	8.2		
PH	91.9	175	
Na <sup>+</sup> (mg/l)	1.95		
K <sup>+</sup> (mg/l)	27.34	50	
Mg <sup>++</sup> (mg/l)	58.12		
Ca <sup>++</sup> (mg/l)	107.77	300	
Cl <sup>-</sup> (mg/l)	170.86		
HCO <sub>3</sub> <sup>-</sup> (mg/l)	114.31	250	
SO <sub>4</sub> <sup>-</sup> (mg/l)	26.04	50	
NO <sub>3</sub> <sup>-</sup> (mg/l)	3.3		
IB_err	Calcium		

## Social History, Mobility and Income Sources of Shallalah Saghirah

The inhabitants of the village of Shallalah Saghirah are descendants of one ancestor called Musa Oqlah Hariri. Musa originated from the clan of Al-Hariri on the Hawran Plain in the south of Syria. Batatu mentioned that the clan was dominant in eighteen villages on the Hawran Plain, its main seats being at Da'il and *shaykhh* Miskîn. Musa was one of the two sons of Oqlah Al-Hariri who decided to migrate from the Hawran to the Khanassir Valley during the end of the 19<sup>th</sup> century. The Ottoman Sultan Abdul Hamid, who ruled from 1876-1909, owned estates northwest of Khanassir Valley. Musa worked on these estates to prevent his sons from being sent to the Ottoman army. Lewis describes the area of Khanassir Valley during that time as a frontier area with nomadic Bedouin tribes in the east and Ottoman landowners in the west. After several years, Musa bought the land of Shallalah Saghirah illegally from a local landowner. This transaction was witnessed by a powerful Bedouin *shaykhh* from the Feda'an tribe named Mujhim Ibn Muheid.

Two years after he had bought the land, Musa started to clean the Motherwell of the qanat (*ras el nebe'*). Musa's five sons, Rashid, Mahmoud, Qanoush, Khatib and Ali helped him with this. After the cleaning, the water returned. Hearing of this discovery, the former landowner wanted to have his sold share back. Musa obviously refused and went to Mujhim Ibn Muheid. The powerful *shaykhh* offered his protection, and from this day on, the protection and settlement of Shallalah Saghirah was established. Musa and his five sons lived prosperously on the benefits they gained from the water of the qanat.

After the land reform initiated by the Syrian government in 1958, the land of powerful landowners was divided among individual families and the property of Shallalah Saghirah became officially governmental property.

However, the inheritance rules from before 1958 are virtually still in use among the villagers with regard to landownership.

Until the 1960s the inhabitants of Shallalah Saghirah could be divided in five main households, called *biout*. These are the households of the five sons of Musa: Rashid, Mahmoud, Qanoush, Khatib and Ali. The term *bayt*, plural *biout*, is the arabic term commonly used for household. In Shallalah Saghirah it is nowadays used to refer to the patrilinear descendants of a particular *bayt* in the past. The definition of household and anthropological approaches to the Arab family in family studies have been discussed by Young and Shami. In the case of Shallalah Saghirah, family (*ahal*) refers to all descendants of Musa, which means the whole village is one family. *bayt* refers either to the patrilinear descendants of the past five households (one of the five sons of Musa) or to the present small nuclear households.

During the times of economic and political change in the 1960s, some villagers left. In 1977 the village was empty for two years because of a dispute with another village. They fled to Raqqa, 150 km east of Aleppo. Currently only the *biout* of Rashid, Khatib and Ali are represented in the village by men. The *bayt* of Qanoush is represented by three women married to men of the *bayt* of Ali. The *bayt* of Mahmoud completely left the village.

There always has been a relatively high level of mobility of people in rural areas of Syria. Kin relations are a very important reason for travel. Of course, the villagers of Shallalah Saghirah have relatives in the Hawran plain from where they originally migrated and they have regular contact with each other. Traditionally, the inhabitants of Shallalah Saghirah are used to travel seasonally with their sheep to northern areas of Aleppo province in late spring and summer to let them graze on areas with higher rainfall. Birks (1994) mentioned that since the 1970s international migration in the Arab region altered the social organization of many villages. As well since the evacuation of Shallalah Saghirah in 1977 some family members stayed in other villages in Khanassir Valley and Raqqa. With respect to social mobility and relationships they have connections with the cities of Aleppo and Raqqa, the town of Azzaz (60km north of Aleppo), and Sfeereh, Rasm El Nafl, Fijdan and other villages in Khanassir Valley. Regarding international labour migration, the village has connections in Lebanon and Saudi Arabia. Jordan used to be a target for labour in sheep shaving but this work has shifted to Saudi Arabia. Lebanon is a preferred destination especially with the younger generation. They work as construction worker in Beirut. Marriage arrangements are changing in the village. Young men migrate to be able to earn their bride wealth to be paid to marry their parallel cousin or, since recently, also a non-related bride. Stevenson (1998) finds the same in Yemen:

"Patterns of marriage arrangement are an indicator of changing father-son relations. Remittances so inflated the cost of marrying that most fathers were unable to finance their son's marriages. Young men migrated to be able to marry and provide in most of their own marriage costs."

Until 1977, the main income source was agriculture. Sheep, rain fed barley, irrigated fruit trees and vegetables in the garden of the qanat (*bustan*) provided enough food and income for the people. After the evacuation in 1977, the sources of income changed radically. Alongside with the two year evacuation, in the mid 1970's modernization and rural-urban migration patterns have altered the socio-economic landscape considerably as described by Stevenson. The current income categories are summarized in Table 2. Selling sheep on the market is now usually practised by the older generation. They own most of the sheep and have a long-term relationship with their seasonal contractors in the northern parts of Syria. The amount of income depends on the rainfall during the year. One of our key informants told us that in a good year he would receive a total of 170.000 Syrian Lira (45 S.L.=1 USD) for selling sheep. He estimated that in a dry year like this year, he might not receive more than half of this amount.

Category	Value
Sheep	170,000 S.L.
Barley	100,000 S.L.
Vegetables	50,000 S.L.
Fruit trees	20,000 S.L.
Other	10,000 S.L.
Total	350,000 S.L.

## Water Use and Rights in Shallalah Saghirah

The villagers use qanat water to irrigate a community garden (*bustan*) to grow food crops such as onions, cucumbers, tomatoes and other vegetables for additional nutrition of the households. The garden also contains fruit trees such as mulberry, figs and pomegranates. In addition to that, they grow irrigated barley to provide feed for the sheep. The western part of the *bustan* contains the trees and the eastern part the arable land. Besides the irrigation of the *bustan*, elderly people in the village make use of the qanat water by irrigating small-scale private plots for growing vegetables and herbs.

The division of landownership of the *bustan* is essential to understand the rights for irrigation times. The five sons of Musa divided the *bustan* into five equal parts. They decided that each of them had the right to irrigate his land every five days. The agreed order was: 1. *bayt* Rashid, 2. *bayt* Mahmoud, 3. *bayt* Qanoush, 4. *bayt* Ali and 5.

*bayt* Khatib. This order has not changed since then. The descendants of each of the five sons divided the land in mutual agreement according to inheritance laws. The ones who emigrated lost their rights on irrigation water. However, they can claim it back whenever they return, but only if they did not sell their land. Presently, the descendants who hold the right to irrigate and are resident in the village are seven elders: *bayt* Ali, *bayt* Khatib and *bayt* Rashid. These seven are called the *haquon* ("the holders of the right").

Patrilinear descendants of *bayt* Mahmoud and *bayt* Qanoush, have either sold or rented their land to *bayt* Ali. Therefore descendants of *bayt* Ali hold the right to use the water from the *birkeh* three out of five days. Descendants of *bayt* Khatib hold the irrigation right one day and *bayt* Rashid also one day. For example, on the first day (Day 1) *bayt* Rashid can open the *birkeh* to irrigate at sunset (*maghreb*), the following three days *bayt* Ali will irrigate and the last day (Day 5) *bayt* Khatib until it is again the turn of *bayt* Rashid. The descendants of each *bayt* have made separate arrangements among each other for their individual turns, but this complicated matter will be presented in later publications.

## Action on village level in pilot project

### Method of intervention

Together with the local village elders and their sons, the priorities of the community with regard to the use, repair and maintenance of the qanat were discussed and determined. During the focus meetings, participatory tools like community maps were used to facilitate the discussion between qanats users. From these focus group meetings, and based on the local technical knowledge, a plan for the cleaning and renovation was developed and generally agreed upon. This cleaning and renovation took place in the summer of 2000 with financial support of the Dutch and German Embassies in Damascus.

### Constraints and reluctant attitudes towards Qanat cleaning....an agreement.

Several focus group meetings have been held with the *haquon*. In the beginning it was impossible to get all seven of them together due to an internal dispute between family members of different *biout*. Some attempts in the past have been done by family members to ease the tension and mediate between the different *biout* through so-called "wedding alliances." In this case, a son of a particular *bayt* decides to marry a wife from "the other side" as a way of alliance. However, from time to time tensions arise and are expressed in little disputes.

With respect to the qanat, the use of rubber pipes for irrigating personal plots outside the rotation system was the subject of such a dispute. The villagers use rubber pipes as siphons to draw water from the *saqeh* for domestic water use. This is allowed throughout the daytime. However when someone uses this pipe for irrigation, this should be done according to the rotation system. Villagers accused each other of the use of these pipes for irrigation without following the rotation system.

The village does not have a chief (*mukhtar*) and disputes are not solved immediately by the family themselves. Therefore weak leadership is forming a constraint for the regular maintenance of the qanat. Mainly the *haquon* are accusing each other whereas the younger men are much more occupied with other things like migrant work to earn money for their wedding. Birks mentions that the pull of young men towards migrant work is another constraint and reason for a reluctant attitude towards qanat work.

Despite the latent constraints and reluctant attitudes, a general willingness was felt for cleaning the qanat as was expressed in the group discussions. Also some men of the younger generation became more and more interested through the discussions and fieldwork conducted. But after some time, it was realized that without getting the *haquon* together, the cleaning would not take place at all.

However, the presence of the scientists and the many group meetings had apparently stimulated the *haquon* to settle their differences during the feast (*'aid al fitr*) after the Islamic fasting, *Ramadan*, in January 2000. Therefore, another focus group meeting was planned, this time with all *haquon* present. It was felt there was a need to create an informal institution and this was suggested to the *haquon*. They supported this idea and in the focus group meeting, the *haquon* made an informal written agreement among themselves to regulate the maintenance and renovation work of the qanat. They agreed upon regulations for the use of rubber pipes to extract water, and made a list of all the workers that would be available for the cleaning work, and at what times throughout the year. This last point is important because of the seasonal migrant work that many young men are doing. Also, it was decided that the *haquon* would be forming a committee that represents the village. With this agreement and

a technical work plan/budget, the committee and the researchers will initiate a search for funds necessary for cleaning and renovation.

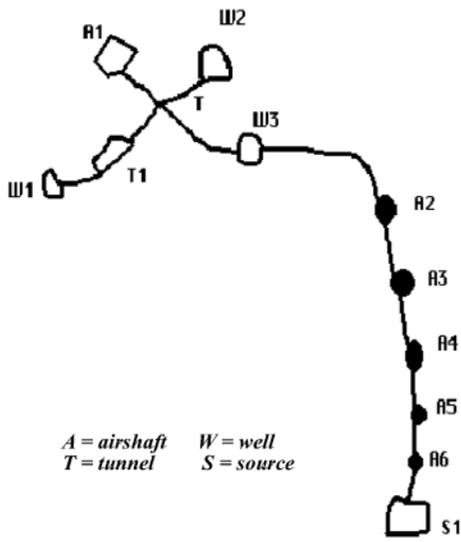


Figure 2. Community map of the qanat

### Priority Activities

Before the informal agreement, several focus group meetings were held with the *haquon* who had a good relationship with each other. In the first group meeting, a map was drawn of the construction of the qanat by the respondents themselves. This map was used in other group meetings. An interpretation of the map is presented in Figure 2. Because the dispute had little to do with the qanat itself, the *haquon* gradually came to an agreement on the technical work plan. First of all, the *haquon* decided that the cleaning work should be done by the villagers themselves. Also Birks mentioned that repair and improvement should be carried out by local communities themselves instead of imported labour.

The *haquon* put together priority activities for the renovation work using the indigenous terms for the important parts of the qanat. Because the water production section of the qanat is of direct benefit to the *haquon*, they decided that this should be their first priority of cleaning. They stated correctly that if this dries up, the village will have to evacuate again. The priorities based on the different sections of the qanat system are summarized below according to activity:

1. It was suggested to start at air shaft A1 called *sundug* ("the box"), which is closed by debris and boulders from above. This airshaft connects the western well (W1), called *jub el saghir* ("little well"), with the main tunnel. This airshaft provides oxygen for workers down in the qanat tunnel. Once this airshaft is cleaned from above, it is possible to observe the damage on the *jub el saghir*.
2. According to the *haquon*, water well W1 is filled with debris from above and the basalt walls are collapsed at certain places. After cleaning airshaft A1, this well should be cleaned from above and below and a wall should be constructed to enforce the well and prevent future collapsing.
3. Tunnel T1, which leads towards W1 is intersected by a low roofed reservoir of 3 by 3 m. This reservoir, called *el ghurfah* ("the room") is supposed to be filled with water and debris. This room needs major cleaning.
4. An unsuccessful attempt was made in the past to drill an airshaft in the Motherwell (W2), called *ras el nebe'* ("head of the spring"). It was suggested to locate W2 from above and drill a shaft to make it more accessible for the workers. The well needs major cleaning. Next to that the tunnel towards the Motherwell (T) and two shafts (A3, A4) need cleaning.
5. Airshafts A2, A5 and A6 need some cleaning but their construction is completely intact. Also the first water production well (W3) needs cleaning of the walls.

6. S1 is the source of the qanat, where the water reaches the surface (*al a'yn*). This source needs extending of the walls if more water is collected. Also, the canal (*saqeh*) running from the source to the collection reservoir (*birkeh*) needs reconstruction and the reservoir needs to be cleaned from debris.

The technical work plan developed by the *haqoun*, includes the priority activities and the estimated number of working days for each activity. The activities would cost in total 360.000 SYL which converted into USD is 7, 826 \$ (Table 3).

Activity	#Working days	Costs
1	10-15	125.500
2	10-15	160.500
3	10	31.000
4	5	13.000
5	5	30.000
6	10	15.000
Total	60	360.000

**Table 3.** Cost of renovation

### Cleaning work

After developing a research proposal based on the outcome of the group meetings, local funds were granted by the Dutch and German Embassy in Damascus and cleaning work started on 17 June 2000. A group of workers was compiled by the village committee and they chose a supervisor from the village community itself. The community work plan was followed and a weekly work programme with names of the workers was made by the supervisor. The whole cleaning activity was officially regarded as an archaeological excavation since it concerned a Byzantine site. Therefore on daily basis the worksite was attended by a representative of the Aleppo Museum, who was very instrumental in keeping the work spirit high. In case of difficulties between workers, he would always mediate.

The first steps, of cleaning the *sunduq*, went quite smoothly, the team spirit was high and work progressed. After 6 weeks however, the spirit was getting less and after some troubles between the villagers' elected supervisor and some group members, the elected group supervisor thought that it was best if the workers programme was made by the government representative of the Museum. This was done and everything was back on track again.

The team developed more and more and a certain community strengthening was noticeable. Until some 4 weeks before the proposed final date; a cousin who had been doing migration work in Lebanon returned back to the village and decided to pick up an old revenge case. The workers group split up in two factions and the work had to be halted for 22 days until the problems between the cousin and his family were solved. Eventually it was solved with the help of a Bedouin judge and the work could continue. The spirit of before, however, had deteriorated significantly. The final day was on 16 September 2000 and was concluded with the slaughtering of three sheep for a communal meal.

### Impact and Lessons Learned

The technical impact of the cleaning was measured by a flow meter, placed in the open channel running through the village and we measured an increase of water flow in winter time, which means that the recharge from rainfall is directly caught by the tunnel and the water is free to flow. Another promising result is that 16 young men from the community are trained for qanat cleaning and are able to maintain their qanat in the future. Whether that is socially sustainable can only be observed on the long term. When we returned in the summer of 2002, the village was divided in different descendant groups like before the cleaning and social tension was still present, but the qanat was flowing and had given a substantial amount of water throughout the year.

The cleaning raised a lot of attention of Syrian and international officials, which benefits the public awareness on these sustainable water supply systems. This awareness is necessary to ensure a future for those working qanats who are still left in the world. From the experience we have had with the cleaning in Shalalah Saghirah, we have developed some feasibility criteria that can be used for any other qanat sites in the Middle East.

These criteria are :

1. A stable groundwater level: pumping is a major threat to qanats. If there is a fast decrease of groundwater level, it is impossible to re-use qanats for agriculture unless the pumping stops within a range of 3.5 km from the qanat tunnel
2. Consistent underground tunnel construction: many of the ancient qanat workers died because of the danger of the job and potential collapsing of tunnels. If there is any doubt about the consistency of the underground construction, care should be taken and renovation reconsidered out of safety reasons
3. Strong social cohesion in community: this is a condition for any management of qanats as a common water resource. It should be noted that social cohesion differs and that it therefore should be studied on a case to case basis. In the Arab rural areas, a strong village or family leader is usually a condition for good social cohesion.
4. Clear ownership of qanat: this is a condition, not to have any problems or conflicts about claiming ownership when there is more water coming from the qanat.
5. Existing system of rights and regulations on water, to be used when water increases.
6. Willingness of users, who are the ultimate beneficiaries and if they are not willing to clean, the work is not likely to be sustainably.

### **Application of results pilot project**

Lessons learned from the pilot renovation led to the development of renovation criteria that can be used to decide whether it is profitable to renovate. In 2001 we conducted a national survey of remaining qanat sites in Syria. We used a structured method of observation and reporting that brought together researchers from several disciplines to conduct interviews with knowledgeable farmers and prepare reports on hydrogeology, damage status, irrigated gardens, and gradient of the tunnels.

From our survey data, we selected three possible sites for renovation: Dumayr, Qarah and Arak. In March 2002 renovation has finished in Dumayr with the generous support of the Swiss Development Cooperation Fund. The users community is well organised in a traditional system of "water committees" and "water guards" supervised by the farmers' cooperative. The cooperative also paid part of the renovation costs themselves from their credit system. Also actively involved were the General Directorate of Antiquities and the Regional Directorate of Irrigation of the Awaj/Barada Basin that is active in qanat renovation in Damascus Province. In this way both the formal and the informal institutions are participating. The ultimate responsibility and monitoring of the renovation is with the farmers' cooperative. We hope with this effort to encourage preservation of indigenous knowledge on qanats that still barely exists in Syria and by starting with the community needs and priorities to revive sustainable qanat use for the future.



## **Institutional Framework**

In August 2002 we found some of the qanats we surveyed dried up since the last eight months. Especially the qanats of Qarah were in an alarming state of deterioration. Although an annual budget for qanat maintenance is allocated to the Regional Irrigation Directorate of Awaj/Barada Basin, no national plan for qanats in Syria exists. Qanats officially fall under the Law on Antiquities and the Directorate of Antiquities has just started to register some of the sites. Both Directorates should be working together in qanat preservation. Since 2000, international conferences have been organised by UNESCO in Yazd (Iran) and Muscat (Oman) and the qanat issue has been raised at Johannesburg in September 2001. The IPOGEA/EU project that is developing national research and development plans for the preservation of foggara's/qanats in Italy, Spain, Morocco, Algeria and Tunisia, is a good example of a regional effort in protection of Qanats in the Mediterranean region.

## **Conclusions**

Cleaning of an ancient qanat is not an easy exercise. Not only is the work itself technically difficult also the social organisation around a qanat has major implications on the sustainability of a qanat system. In the pilot case of Shalalah Saghirah there is a good hydrological result of qanat renovation that was based on community work plan, however tensions between individuals and weak leadership may hamper the progress and prevent maintenance of the qanat on the long term. Also the changing economic circumstances that force the younger generation to look for other sources of income than agriculture and the high social mobility that is found at village level influences the sustainable maintenance of the qanat.

The project aimed to characterize and describe the social and physical world around a qanat in order to understand the different forces that affect the use of a qanat in a modern environment.

The project showed that focused group meetings on community level help in developing successful project proposals. The approach used starts with the direct users of the qanat water. Individuals who expressed the need for renovation but do not have financial resources, can serve as facilitators and key informants to motivate other inhabitants. Focus group meetings can help them to conceptualize their needs, rank their priorities and formulate a work plan and budget, themselves. Also focus group meetings can enhance communication between qanat users when problems from the past need to be solved. The creation of an informal institution such as a committee of elders, when weak leadership is present in a qanat village can possibly help in enhancing the sustainable use and maintenance of qanat systems.

Lessons learned from the pilot renovation led to the development of renovation criteria based on an interdisciplinary approach, these criteria are:

- A stable groundwater level
- Consistent underground tunnel construction
- Social cohesion in community
- Clear ownership of qanat
- Existing system of rights and regulations on water
- Willingness of water users to contribute

On a national level, qanats are rapidly drying up in Syria. Based on a national survey conducted in 2001 and with the knowledge of the pilot study, three sites were chosen for possible renovation as still provide a substantial supply of irrigation water. The Drasiah qanat of Dmeir was chosen to be renovated, which was concluded successfully in the spring of 2002.

During a field survey in the summer of 2002 further rapid drought among qanats was found. A thorough plan should be developed on national level where all stakeholders are represented. This should provide an institutional framework that is vital in the sustainability of the use of the ancient qanats of Syria.

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