

# Qanat; an Ancient Technique for Adapting to New Climate Changes

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**Abstract:** Global warming could have given rise to climate changes in many parts of the world to a large extent over the past decades. Some regions are struck by destructive floods and unprecedented torrential downpour, whereas some other regions are in the grip of severe droughts. In some areas, the snow coverage is shrinking, resulting in a dramatic decrease in snow melt and the amount of surface streams. Permanent streams are turning into seasonal runoffs, and seasonal runoffs are drying out over time. In such areas the demand for water is still on the rise, though their surface streams are diminishing. Therefore the residents of these areas resort to extracting groundwater which is more reliable to supply water to domestic and agricultural sectors. What may immediately flash through our mind is that pumped well is the best way to abstract groundwater, though our past experiences in arid and semi arid regions tell that such regions are subject to over-exploitation of groundwater and depletion of aquifer accordingly. In some arid zones, groundwater used to be extracted by the system of Qanat over the past centuries without causing any drawdown in water table. Qanat is a horizontal tunnel with a gentle slope that taps groundwater in an area more elevated than cultivated lands. Through this system groundwater is drained out by the force of gravity, fully compatible with nature, without bringing about environmental backlashes.

This paper is aimed at explaining and recommending the traditional know how of Qanat to the regions which turning arid and becoming short of surface streams. In fact if the regions which are affected by climate change use pumped wells in order to supplement the water they need, they would go down the path of the present arid areas where over pumping has done a great damage to groundwater reserves. Qanat never threatens groundwater resources and ensures sustainable utilization of groundwater, so it deserves to be introduced to the areas in need of groundwater.

**Key Words:** Environment, Groundwater, Iwao Koberi, Qanat, Traditional knowledge

## 1. Preface

First of all we would like to express our great pity for the sad passing away of my great friend Prof. Iwao Koberi (**Fig. 1**). He devoted over 50 years of his life to studying water supply in arid and semi arid regions. He also conducted many researches on Qanat system, so that some call him "father of Qanat". May his soul rest in peace.

**Figure 2** shows him at a ceremony in Yazd Iran, which was held on 2<sup>nd</sup> October 2010 to appreciate and award him for his half century of effort and study in the field of Qanat.

## 2. Introduction

Many civilizations came into existence alongside great rivers whereas a number who were short of surface run offs had to find a solution to supply water (Koberi, 2005). They had to bring groundwater on to the earth surface with a reliable water flow and in a sustainable manner. This way was nothing but Qanat which conveyed underground water to the earth surface just by the force of gravity. This water supply system has bestowed life and prosperity on the inhabitants of the arid and semi-arid regions of the world (goblot, 1979).



**Fig. 1. Prof. Iwao Koberi.**



**Fig. 2. Special ceremony for Prof. Iwao Koberi, ICQHS: Yazd-IR Iran.**

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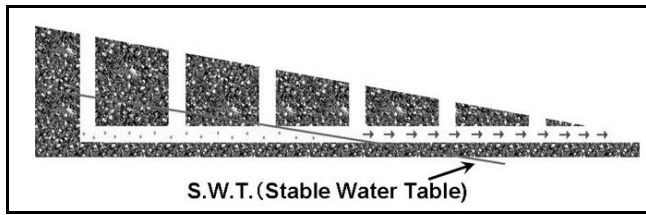


Fig. 3. Longitudinal section of a Qanat.

### 3. Qanat

#### 3.1. Qanat Definition

Qanat is a gently sloping tunnel which drains the groundwater from aquifer and leads it to the surface by using gravity flow conditions (Fig. 3). In fact Qanat benefits from the differences between earth surface elevations to convey water from upstream aquifer to the earth surface down slope. To do so, Qanat enjoys a number of vertical shafts, a subterranean canal and an appearance (Bonine, 1989) (Lambton, 1989).

Qanat is a good example of human's harmony with nature. The endeavors our ancestors used to make to build Qanats are amazing. Qanats paved the way for life and prosperity in the desert, functioned like the veins of desert, and served as a basis for the civilization of Qanat, civilization of hardworking, satisfaction, gentleness, patience and tolerance. A civilization that has ever never waged any war and invasion, and history is awash with examples that the oppressor rulers never originated from this territory (Semsar Yazdi, 2010).

#### 3.2. Qanat and Nature

There is a wealth of traditional knowledge in water management of this technique that can lessen common errors in policy, technical and managerial practices while enlightening valuable hints to those in search of new approaches. We just mention one of its characteristics which is its harmony with nature.

Over the past decades, the pumped wells have played an important role in undermining the underground water and affecting the system of Qanat. However no one can deny that in some regions the only option to exploit groundwater is to drill wells, but it should not be used as a pretext to replace the active Qanat with the pumped wells in other regions (Semsar Yazdi, 2007).

The over-exploitation of groundwater by pumps can cause the water table to drawdown over 50 meters during half a century (Fig. 4).

Under such condition, Qanat can not last long and would vanish, the destiny many of the Qanats in the world are doomed to.

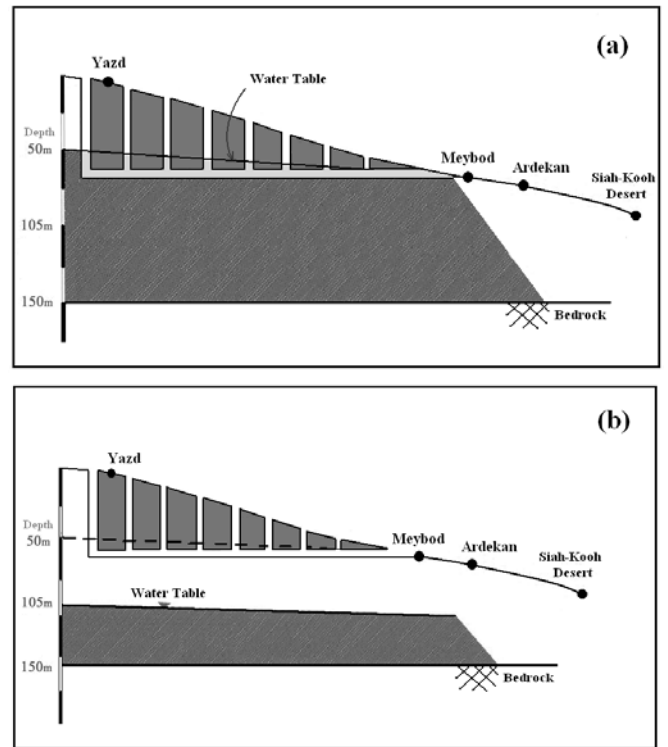


Fig. 4. Drawdown of water table in Yazd plain from 1950 (Fig. a) to 2000 (Fig. b) has caused Qanat annihilation.

The country of Iran possesses 37000 Qanats. These Qanats are discharging 7 billion cubic meters water a year without consuming any kind of fossil fuel or electricity (WRMO, 2005). If this water was to be discharged from the groundwater resources by pumps, 800 Mega Watt electricity would be needed. This electricity can be generated by a huge power plant with its usual problems and environmental pollution. Whereas the Qanat is supplying this amount of water without consuming fossil fuels and electricity which brings about environmental consequences.

Another advantage of Qanat is not to cause drawdown in the water table. Given that the Qanat is built horizontally, it can not extract water from less elevated spots of the aquifer. Qanat is one of the rational groundwater exploitation methods, because (Semsar Yazdi, 2004):

- It does not cause depletion in aquifer.
- It does not consume fossil fuel or electricity, so it does not pollute environment.

### 4. Conclusion

Qanat is a system completely in harmony with nature, and environment friendly. So we suggest building Qanat in the areas whose groundwater level is high and the environmental conditions favor Qanat construction, instead of drilling pumped wells. Thus environment would not be deteriorated and the groundwater reserves would be extracted in a rational manner.

We recommend the construction of Qanat to the regions which turning arid and becoming short of surface streams. In fact if the regions which are affected by climate change use pumped wells in order to supplement the water they need, they would go down the path of the present arid areas where over pumping has done a great damage to groundwater reserves. Qanat never threatens groundwater resources and ensures sustainable utilization of groundwater, so it deserves to be introduced to the areas in need of groundwater

The modern world shouldn't ignore the past experiences which are in harmony with nature, and shouldn't be arrogant over the new advances.

In terms of sustainable development, we can learn much from water relics from whether structural or non-structural point of view. The onus is on us to discover them and incorporate them into the new technologies.

### References

- Bonine M. (1989): *Qanat, Kariz and Khattara: traditional water systems in the Middle East and North Africa*. Middle East and North Africa studies Press Ltd. England.
- Goblot H. (1979): *Les Qanats: Une technique d'acquisition de l'eau*. Mouton, Paris. 236p.
- Kobori I. (2005): *A History of Water Issues*. United Nations University, New York, 190p.
- Lambton A. (1989): *The origin, diffusion and functioning of the Qanat*. Qanat, Kariz & Khattara, traditional water systems in the middle east & North Africa, 305 p.
- Semsar Yazdi A.A. (2004): *Qanat from Practitioners' Point of View*. Yazd Regional Water Authority Publications, Yazd, Iran, 331p.
- Semsar Yazdi A.A. (2007): *Exploitation of Groundwater in Iran from the Last Century to the Present*. 5th IWHA Conference, Pasts & Futures Waters, 13-17 June 2007 Tampere, Finland.
- Semsar Yazdi A.A., Labbaf Khaneiki M. (2010): *Veins of Desert, A review on the technique of Qanat / Falaj / Karez*. Iranian Ministry of Energy Publications, Teran, Iran, 210p.
- WRMO (2005): *Summary of the Report on the Country's Water Resources Situation*. Water Resources Base Studies Department, Publications of Water Resources Management Organization of Iran, Tehran, Iran.