

**THE ORIGINALITY OF OASIS OF SAOURA IN SOUTH-WEST OF ALGERIA**C. Rezzoug<sup>1</sup>, B Remini<sup>2</sup><sup>1</sup>Department of Hydraulic, Bechar University, 08000, Bechar, Algeria<sup>2</sup>Department of water sciences, Blida University, 09000, Blida, Algeria

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**ABSTRACT**

For centuries the oases of the Saoura continue to manage critical situations of drought and the hostility of the Algerian Sahara through the rational exploitation of water, a rare and precious source of traditional irrigation techniques have proved their efficiency. The use of new groundwater drainage systems of drilling, and the lack of effective management of the Foggaras, has made this system lose its value, deteriorate and let the palm groves disappear. More than 80% of these systems have been abandoned in recent years. With increasing urbanization, population growth, climate change and the uncontrolled proliferation of motor pumps, the level of the water table is lowered and the quality of the water is degraded. The foggaras have gradually been abandoned, which leads to the degradation of the gardens and the old oasis.

**Keywords:** foggara; Traditional; Saoura; oasis; irrigation.Author Correspondence, e-mail: [cherifrezzoug@yahoo.com](mailto:cherifrezzoug@yahoo.com)doi: <http://dx.doi.org/10.4314/jfas.v11i1.7>**1. INTRODUCTION**

The scarcity of the surface water in arid region pushed the man to exploit the groundwater. Various techniques of water catchment have been used for centuries. One technique that has marked the history of hydraulics is the qanat. On the Iranian origin [3], qanat is called foggara



in Algeria and the khattara in Morocco [5]. then it has been developed in more than 30 countries around the world, including Algeria [4].

Oasiens of Saoura have exploited Millenary techniques of water gushing, which have favored the human settlement of arid geographical and climatic zones, these techniques contributed largely to the birth and the perpetuation of an oasis culture and economy. . These ecological systems such as future make it possible to rationalize access to water by preserving the balance and without affecting the natural environment. It is a Millenary technique developed from the Far East to the Far West.

The operation of the foggara is simple and ingenious that can transport water over great distances depending on the hydraulic gradient, the slope of the ground and the piezometric level of the water table. It is a draining gallery that brings water from the water table to the surface of the soil by gravity.

## **2. RESULTS AND DISCUSSION**

### **2.1. Presentation of the study area**

Saoura is a desert region located in the North-Western part of Algerian Sahara. It is bounded on the North by the ksour Mountains and the Moroccan High Atlas, on the West by the Draa Hamada, on the east by the Tidikelt Oases and on the South by the Tanezrouft Plateau. It takes its name from the big wadi Saoura, also known by these oases of palm trees, which spreads along the sure valley and the Grand Erg Occidental like a necklace of pearls [8]. The climate of Saoura is an arid climate. Winter is cold with less rainfall while summer is dry. Given the scarcity of rainfall, hot temperatures and strong evaporation, no agriculture without irrigation is possible in this country. The populations resort to wadi, foggaras and individual and collective pumping.

### **2.2. The importance of wadi of Saoura in relation to the oasis**

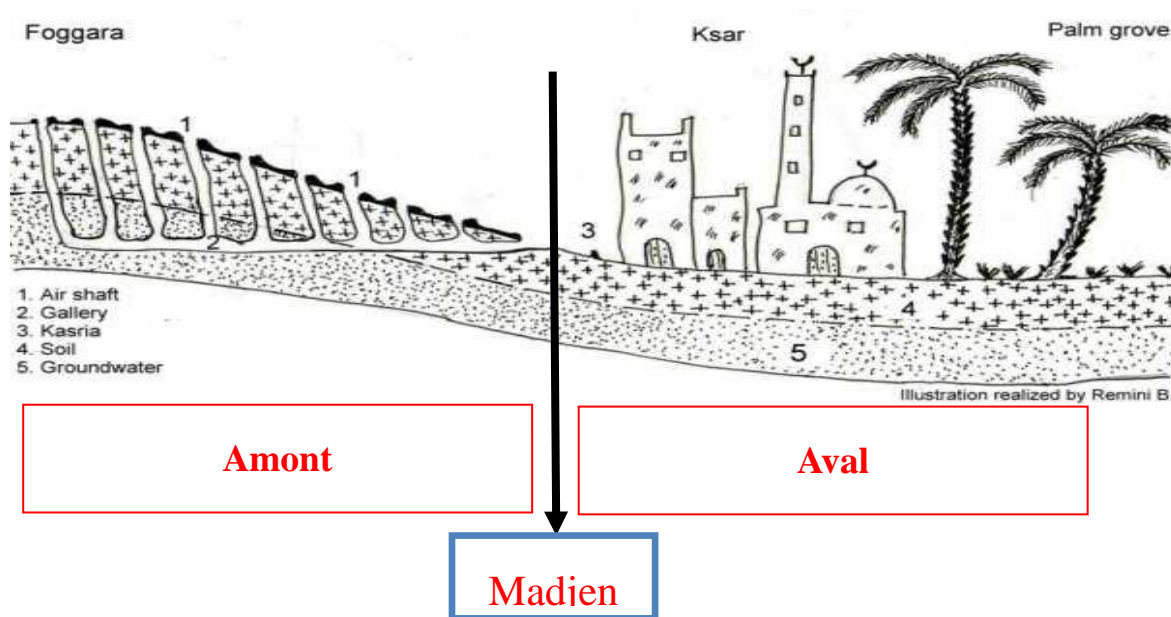
The oasiens of the Saoura hold good agricultural land and contain significant water potential that can flood the regional market with these agricultural products of superior quality.

In rainy season, the wadi Saoura, made up of two wadis Guir and Zousfana drains devastating floods that carry aggregates, silts and mud. Mud rich in organic matter is beneficial for palm

groves. The flood of October 2008 was a catastrophe for the whole region, since the remains of foggaras, seguias, dikes and madjens were completely washed away [2].

### 2.3. Role of foggara in the oases of Saoura

Today the palm groves of the Saoura benefited from these ancestral techniques of adaptation to climate change, moreover it allows the fixation of population and the fight against the silting, the foggaras represents an exquisite of past for a solution of future to the time of climate change, the scarcity of our water resources and the need for optimized environmental management, a fair system of resource allocation, their flow depends solely on the water table (Figure 1), the state of is committed to rehabilitate the system of foggaras but the needs are numerous and urgent and requires a collective mobilization to preserve and operationalize the few dozen foggaras present in the Saoura.



**Fig.1.** Simplified diagram of a foggara

### 2.4. The originality of the foggaras of the Saoura

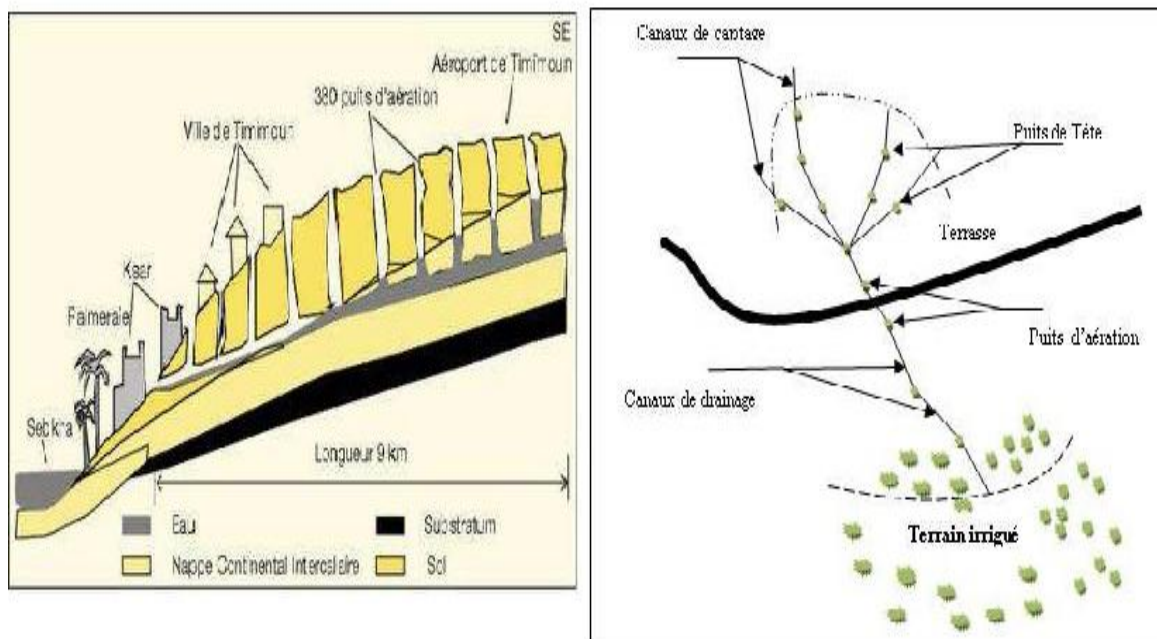
Unlike the foggaras observed in the region of Adrar for example, in the majority of oases in the Saoura, irrigators have dug foggaras to carry water from "Ain" springs [6]. The largest foggara of the Saoura is in Béni Abbès with a gallery length of 1569 m and the smallest in Ouakda with a length of 65 m. The average length of the gallery between two aeration wells is 13 m. But in Ouakda, the average distance between two aeration wells of a foggara is 3 meters.

Always the waters of a foggara cross the ksar to ensure the drinking water supply of the population before accumulating in the madjen (storage basin) to distribute in the gardens. It is the amount of water supplied by the foggara that decides the number of inhabitants of Ksar.

### 3. EXPERIMENTAL

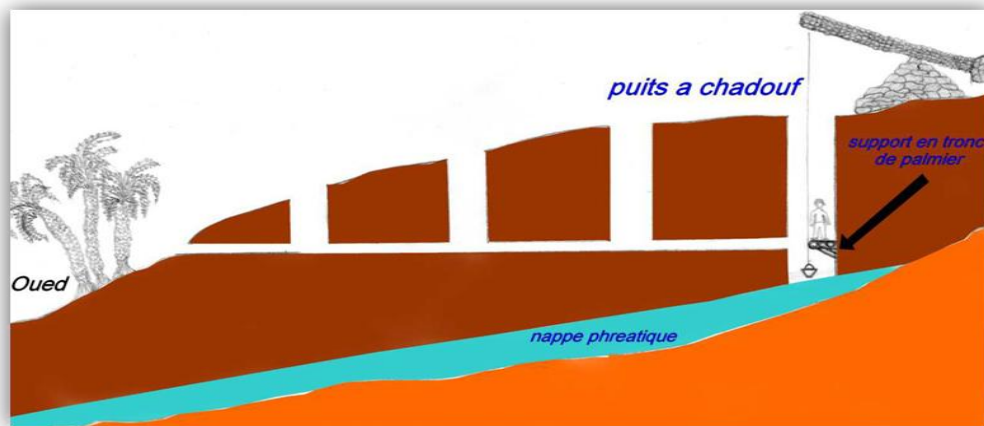
#### 3.1. Techniques for increasing the flow of a foggara with time

The classical actions to undertake and likely to increase the flow of the foggara in the various oases and generally to dig other wells upstream and extend the draining gallery of the foggara not to stop the irrigation of gardens to downstream (Figure 2) [8].



**Fig.2.** Techniques for increasing the flow of a foggara

Farmers to deepen the first well of foggara up to the level of the groundwater, the well are equipped with a stem (tree trunk) to form a balance well. The coupling between the foggara and the balancing well is the originality of the oasis of Ouakda (figure 3).



**Fig.3.** Deepening of the first well of the foggara to replenish the gallery (Ouakda) [7]

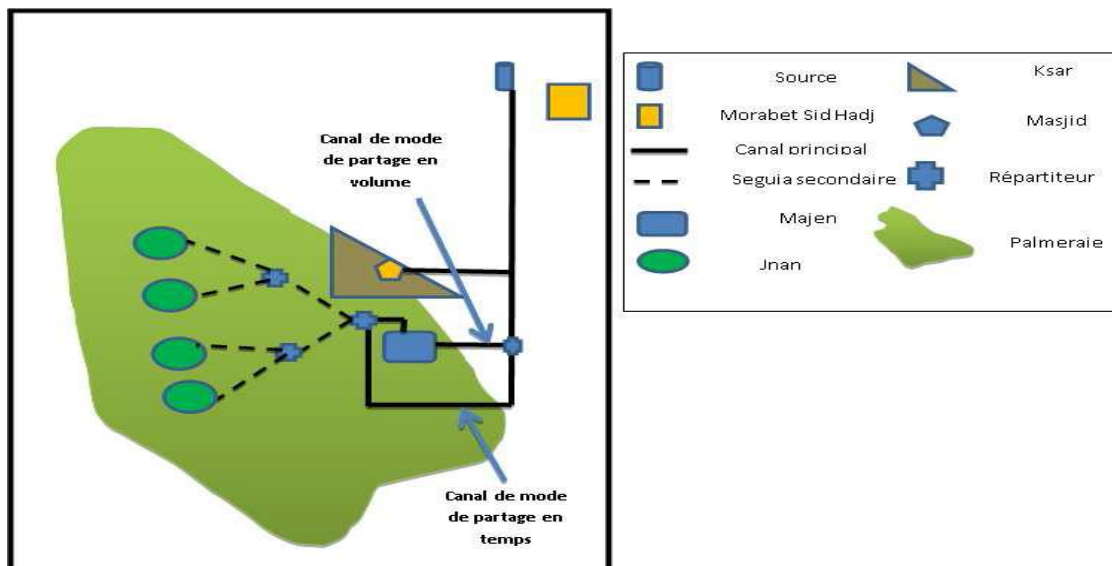
### 3.2. Method of calculating the distribution of irrigation water

For all the oases of planet, the irrigators share the waters of this ancestral system according to the time that is to say in turn, when is called mode of sharing per hour unit. But what is original for the oases of southern Algeria is the mode of sharing foggara waters through instruments for measuring volume quantities and not as a function of time as the case of the oases of Adrar in the South East Algerian for example. In the oases of the Saoura the irrigators are the only ones in all the oases of the world which exploit the waters of the foggaras through the two modes of sharing in time and in volume like the case of the oasis of Boukais (figure 4) . Where the oasiens use the technique of water sharing between the plots in hourly unit of the water coming from the source during the day and in unit of volume for the waters of the source in the evening.



**Fig.4.** example of measurement of the water shares of a foggara according to unit hourly and volume in the oases of the Saoura

For the volumetric distribution, the oasiens of the Saoura used graduated rules on the madjens to estimate the water shares of each irrigant. In the Boukais palm grove: oasiens apply the two modes of distribution in volume and time. They meet at nouaday (plot in the middle of the ksar of Boukais) to manage the distribution of water and the sharing of water shares (Figure 5).

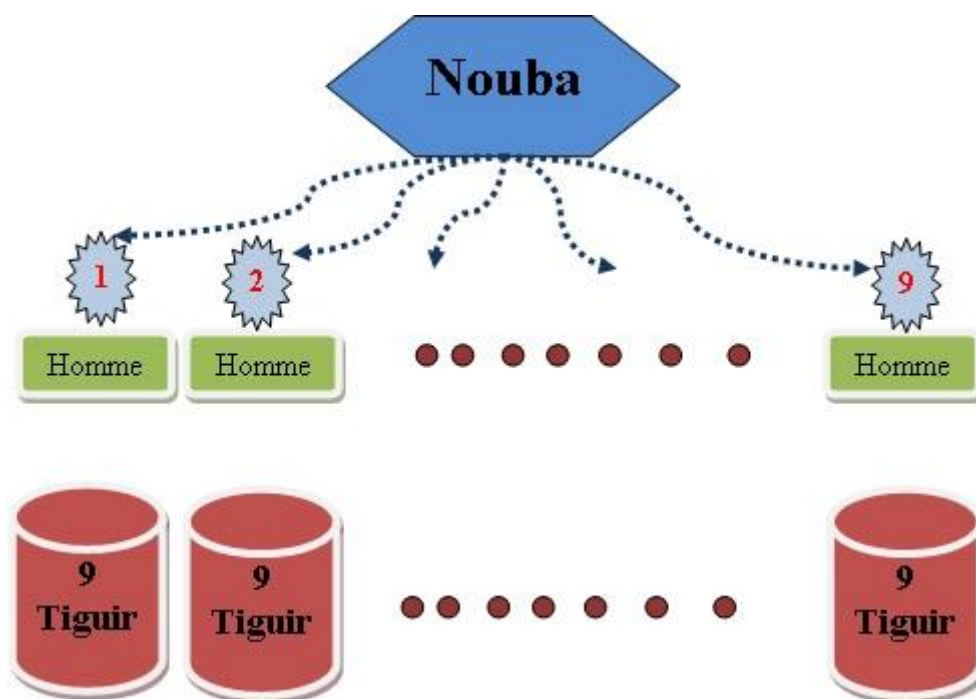


**Fig.5.** water sharing in two modes in the oasis of Boukais in South-East Algeria

For the Kharouba of time (kharouba: unit of measurement in 45 minutes): the irrigators used

an arcade of  $H = 2.2$  m which receives the shadow and projects it on punctuations marked by portions of stone dug in the ground. The beginning or the end of one part is executed by the transfer of the shadow from one marker to another. The kharouba in volume: the irrigators use a rule graduated according to the volume of the madjen (each kharouba is divided in four said positions, four fingers).

In the oasis of Béni Abbès south of the Saoura Valley, water from the great spring is distributed according to a conventional system of 41 noubas for the entire Beni Abbes palm grove (Figure 6). Sharing the amount reserved for the palm grove, based on the water rights of the owners of the source of a total of 41 Noubas for the entire palm grove (the unit of measurement is 1 Tighira = 15 min, 1 man = 9 Tighira = 2 h 15 min, Nouba = 12 man).



**Fig.6.** mode of sharing of foggara waters of Béni Abbès

### 3.3. Contribution of new irrigation techniques

With the addition of new capture techniques (motor pump wells, electric pumps and dams) over-exploited the groundwater, the former fertile lands have been practically abandoned due to lack of water. This leads to an alarming and shocking degradation of palm groves that have been resisted for centuries in a hostile environment (Figure 7).



**Fig.7.** Causes of degradation of the palm grove

### 3.4. Evolution of groundwater quality

It is interesting to note that before the proliferation of modern irrigation techniques (motor pumps and dams), groundwater has relatively low salt concentrations and good quality. Periods of drought as well as the uncontrolled development of motor pump wells are the main causes that explain the deterioration of water quality.

The excessive exploitation of the aquifer has resulted in the continuing degradation of water quality caused by human activities. The evolution of the salinity of the aquifers explains the large number of abandoned surface wells [1].

## 4. CONCLUSION

For more than half a century, the oases of the Saoura have been confronted with the emergence of new techniques of water abstraction whose consequences are disastrous on the environment of the region. The most important example is undoubtedly the drying up of the foggaras following the drawdown of the groundwater and the drying of the springs. The peasants of the Saoura have the chance to dispose of this hydraulic heritage, they have the will to make it live, because the foggara is a means of sustainable development, an element of an organization based on the close participatory and solidarity economy.

Finally, the preservation of the cultural and social heritage of the oasis is essential for sustainable development, it is considered as an important resource in the improvement of the living conditions of the peasants.



## 7. REFERENCES

- [1] Daoudi T., Contribution to the study of the chemical evolution of the water table of Saoura case of Ouakda, seminar at the University of Saida, Algeria, 2014.
- [2] Dhwb., Étude du transfert pour le renforcement de l' AEP de Bechar à partir du champ comptant de Mougheul, rapport interne, 2004, 28p.
- [3] Goblot H., Les qanats une technique d'acquisition de l'eau [Qanats: a technique for acquiring water]. Paris. Mouton. ISBN 2-7193-0459-X, 1979, pp. 231.
- [4] Hofman A., Traditional water management by qanat in Iran is compatible with the concept of IWRM. Technical synthesis Engref center of Montpellier, 2007, 17 p.
- [5] Lightfoot D., Moroccan khattara: traditional irrigation and progressive desiccation. Geoforum. Vol. 27. No. 2, 1996, p. 261–273.
- [6] Malki T., Contribution à l' étude de la situation hydrogéologique de la willaya de Béchar, mémoire de master. Université de Béchar Algérie, 2012, 97 p.
- [7] Rezzoug C, Remini B and Hamoudi S., J. Fundam. Appl. Sci., 2017. 9(1), 378–391, doi.<http://dx.doi.org/10.4314/jfas.v9i1.23>
- [8] Rezzoug C., Techniques et pratiques hydro-agricoles traditionnelles dans les oasis de la Saoura: situation actuelle et perspectives. Thèse de doctorat, université de Chlef. Algérie, 2018.

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