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THE WATER SHARING SYSTEM IN THE ZIBANS PART 2: CASE OF OASES OF SIDI OKBA, SERIANA, GARTA AND THOUDA

LE SYSTEME DE PARTAGE DES EAUX DANS LES ZIBANS PARTIE 2 : CAS DES OASIS DE SIDI OKBA, SERIANA, GARTA ET THOUDA

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ABSTRACT

This study examines the water division in the oases of Garta, Sidi Okba, Thouda and Seriana located on the outskirts of Labiod River. For centuries, these oases have been supplied with water by systems of small dams built along the Labiod River. However, at the beginning of the fifties, these four oases were supplied by the great dam of Foum El Gharza. If today, the technique of collecting water by small dams has been replaced by a large dam, however the traditional water distribution network has not been changed. In the absence of the accelerated siltation, the capacity of the dam with an initial volume of 47 million m^3 was reduced to less than 30% of the initial volume. To remedy this problem, boreholes were installed in the oases, which caused the water table to drop.

Keywords: Oued Labiod - Foum El Gherza dam - Palm grove - Water sharing.

RESUME

La présente étude traite le partage des eaux dans les oasis de Garta, Sidi Okba, Thouda et Seriana situées sur la périphérie d'oued Labiod. Durant des siècles, ces oasis ont été alimentées en eau par des systèmes de petits barrages construits le long de l'oued Labiod. Cependant, au début des années cinquante, ces quatre oasis ont été alimentées par le grand

barrage de Foum El Gharza. Si aujourd'hui, la technique de captage des eaux par des petits barrages a été remplacée par un grand barrage, cependant le réseau traditionnel de distribution d'eau n'a pas été modifié. Faute de l'envasement accéléré, la capacité du barrage d'un volume initiale de 47 millions de m^3 a été réduite à moins de 30% du volume initial. Pour remédier à ce problème, des forages ont été installés dans les oasis, ce qui a provoqué un rabattement de la nappe.

Mots clés : Oued Labiod- Barrage de Foum El Gherza – Palmeraie –Partage des eaux.

INTRODUCTION

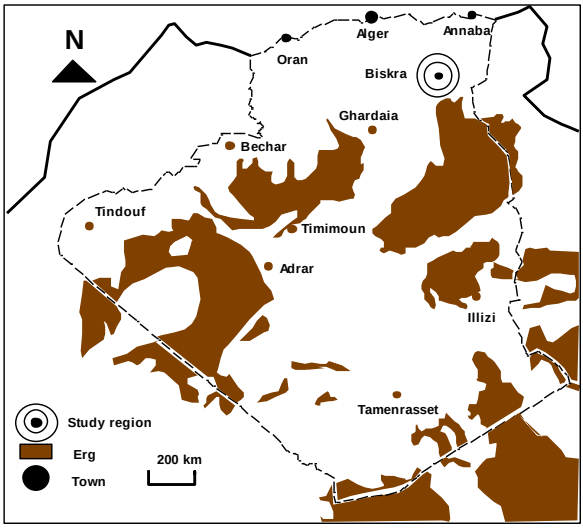
Arid regions are characterized by an average annual rainfall that does not exceed 100 mm and a temperature of around 50 °C in times of drought. Basement water is the main source for the development of oases. However, wadis in desert regions drain occasional floods which can bring back significant amounts of water in a few minutes. This is how, thanks to genius and know-how, the oasis inhabitants have invented methods of collecting groundwater. For example, the foggaras system is used to exploit water from the aquifer in the regions of Touat and Gourara (Ghachi et al, 2021; Remini, 2017)). Other ingenious systems have been used in the M'zab valley for the collection of flood waters drained by the M'zab River (Remini, 2020a; Remini, 2020b; Remini, 2020c). Ancestral dams made by lime and stone were used in Sahara for the storage of surface water, this is the case of the Tiout dam in the wilaya of Naama which supplied the ancestral ksar and the irrigation of the gardens of the palm grove (Ait Saadi et al, 2015; Remini, 2019). Considered to be one of the largest wadis in the Algerian Sahara, the Labiod River which originates in Jebel Chelya in the Aurès Mountains, which ends in the Ziban region, was a source of water for the oasis inhabitants of the peripheral regions of the River. This is how, thanks to ancestral techniques such as bunds made from local materials and earthen seguias, the oasis inhabitants were able to exploit the flood waters of the Labiod River. Dozens of oases have been developed over the past ten centuries. This article examines the evolution of irrigation of palm groves: Sidi Okba, Seriana, Guarta and Thouda using small traditional dams until the impoundment of the large dam of Foum El Gharza.

STUDY REGION AND WORK METHODOLOGY

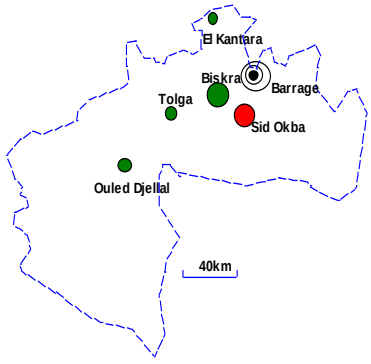
Situation and characteristics of the study region

Composed of four oases: Sidi Okba, Seriana, Garta and Thouda, the study region is located in the wilaya of Biskra, 400 km as the crow flies southeast of Algiers (fig. 1 (a and b)). For agricultural purposes, the oases use the water from the Foum El Gherza dam for the irrigation of more than 375,000 palm trees. The study region has an arid climate with an average annual rainfall of around 100 mm and a temperature which can exceed

47 °C. However, the Labiod River which passes by these oases drains occasional extremely violent floods which often cause damage to the environment.



a) Location of the wilaya of Biskra



b) The boundaries of the wilaya of Biskra

Figure 1: Situation of the study region (Remini, 2016)

METHODOLOGY OF WORK

Several king missions were organized in the oases: Garta, Sid Okba, Thouda and Seriana during the period: 2000-2020. Surveys were carried out among local people and farmers. Investigations are being carried out on the dam sites, the seguias, the sources and the boreholes. Data was collected from the agricultural services of Biskra. Data on traditional

water sharing processes were collected from farmers. Data on irrigation flows and water quality were collected from the Agricultural Directorate of the wilaya, the National Water Resources Agency of Biskra and the National Dams Agency.

RESULTS AND DISCUSSIONS

Evolution of water catchment techniques

Small dams (Essad)

After the natural water sources which sprang up on the outskirts of the oases: Seriana, Sidi Okba, Garta and Thouda dried up, the local population turned to the exploitation of surface water from the Labiod River which is near these oases. In the beginning, the farmers, thanks to the difference of the coasts, built souagui in earth to divert the flow of the wadi towards the gardens of the oases. Over time, farmers began to build small dikes to store and divert water from the Labiod River (site of the current Foum El Gharza dam) (fig. 2 and 3). From these dams, the oasis Garta is irrigated by the seguia Gharbia. The oases Seriana, Thouda and Sidi Okba were irrigated by the seguia Charkia. In 1950, the Foum El Gherza dam was put into operation on the Labiod River to store a volume of water of 47 million m^3.

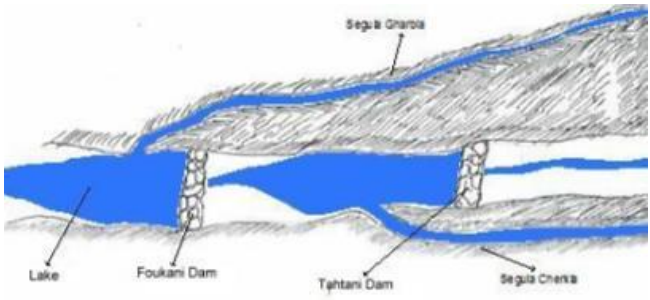


Figure 2: Diagram of the traditional dam system in the Labiod River (Diagram, Remini, 2016)

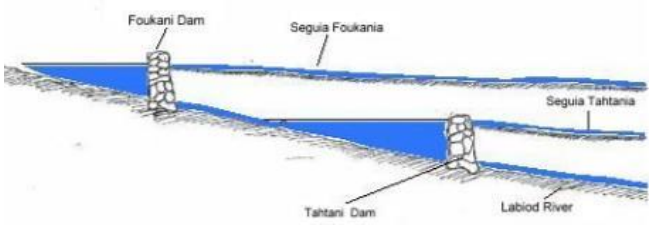


Figure 3: Diagram of a longitudinal section of the dams (Diagram Remini, 2016)

The Great dam of Foum El Gherza

With a capacity of 47 million m^3, the Foum El Gherza dam was put into operation with the aim of irrigating the 375,000 date palms in the oases of Garta, Sidi Okba, Thouda and Seriana (fig. 4). The old irrigation network has been maintained while modifying the main souagui. The network is connected directly to the dam by a free surface channel 1.5 km long (fig. 5 (a and b) and 6).

Figure 4: A view of the dam of the Foum El Gherza dam (Photo. Remini, 2017)

a) Canal on the ground (Photo. Remini, 2017)

b) Raised canal (Driouech and Remini, 2016)

Figure 5: Channel bringing water from dams to the oases: Garta, Thouda, Seriana and Sidi Okba

Figure 6: Diagram of the hydro-agricultural development of Foum el Gharza

Irrigation networks in the oases

The network is equipped with around ten kilometers of seguias (open-air canals) made of earth or cement (fig. 7). Six main dividers, locally called Mekssem, intended to share the water between the different districts (fig. 8 (a, b, c, d, e and f)). Secondary dividers called Fardh intended to divide the water from the secondary seguias between the gardens (fig. 9 (a, b, c, d, e and f)). To recover the water leaks from the dam barges, the network was connected by an earthen seguia to the Labiod River (downstream of the dam). In addition, two underground conduits were built in the network to strengthen the irrigation of the palm grove of Sidi Okba. With the decrease in the useful capacity of the dam following silting up and repeated droughts, the network was reinforced by 4 boreholes (fig. 10 (a, b, c and d).

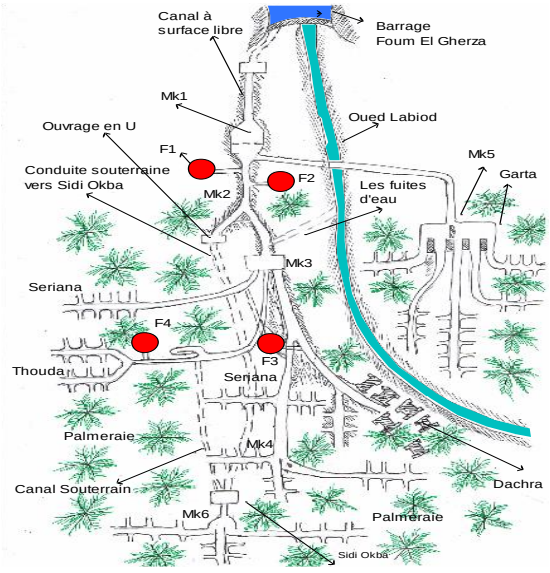


Figure 7: Complete diagram of the traditional irrigation network for the palm groves of Sidi Okba, Garta, Thouda and Seriana (Schema, Remini, 2016)

Figure 8: The existing Mekssems in the network (Photo. Driouech and Remini, 2016)

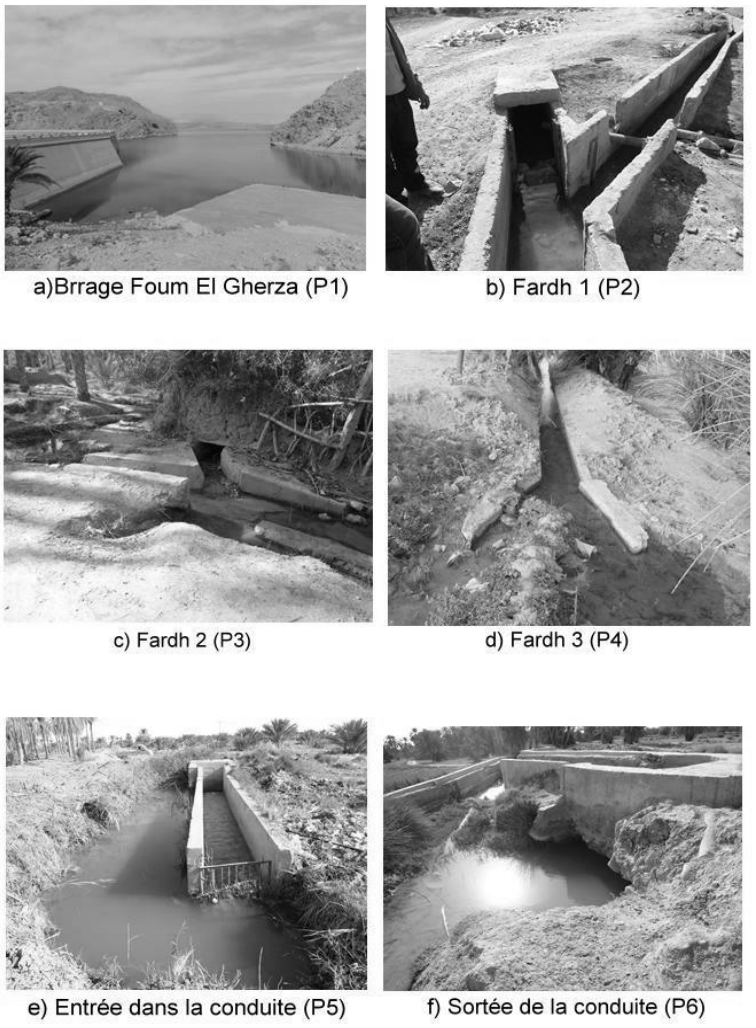


Figure 9: Some Fardhs in the distribution network (Photo. Deriouech and Remini, 2016)

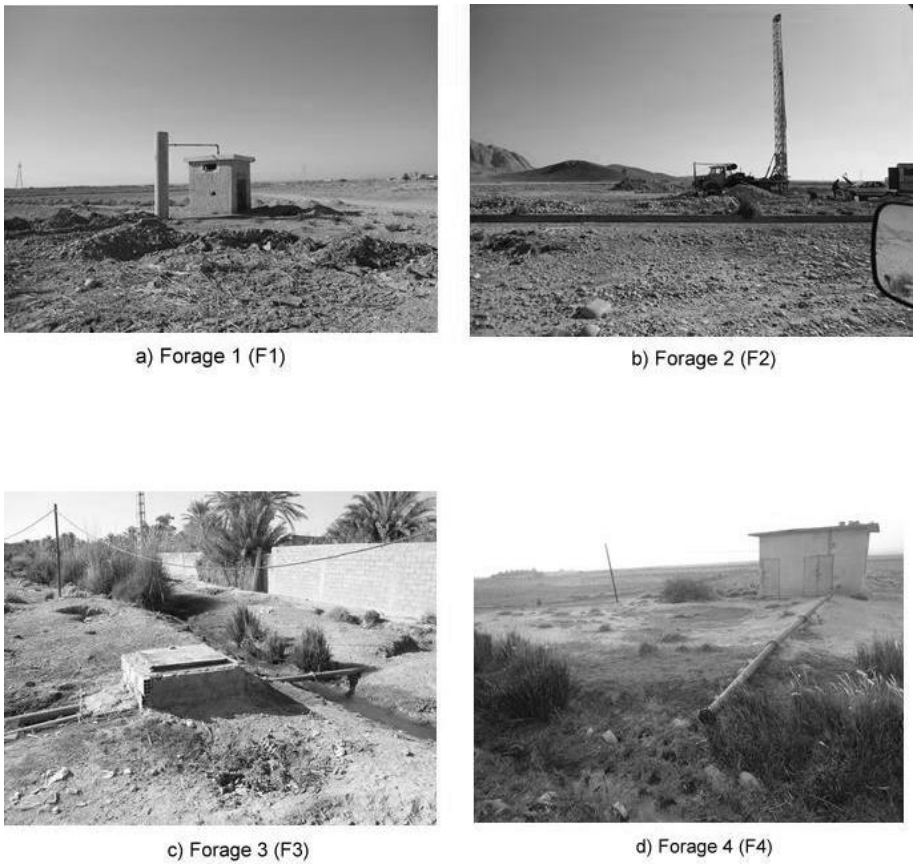


Figure 10: Drilling in the network (Photo. Driouech and Remini, 2016)

The 1,500 m long main canal from the exit of the dam to the large Mekssem (Mk1). The first part of the 500m long canal is underground. The second part is 1000 m long and has a free surface. From the Makssem Mk1, the channel is divided into two branches; one 6 km in length goes towards the oasis Garta which is located on the left bank of the Labiod River. The other 900 m long branch goes towards Makssem Mk2 which is located on the right bank of Labiod River. From this divider, the seguia is divided into two channels. The first goes to the oasis of Sidi Okba and the second goes to the oasis of Seriana. Once the water arrives at the entrance to each oasis, it will be shared between the owners' gardens following a network of earthen seguias.

Garta oasis network

The irrigation network of the oasis Garta has a main seguia which comes from the Mekssem MK1 to the distributor of Garta with a length of 6 km. (fig. 7, 8a and 8e). The

latter has five openings that distribute the water between the farmers' gardens. Today, with the reduction in the water quota from the dam due to siltation problems and leaks in the main seguia, the farmers are installing wells with motor pumps.

Network of the oasis of Sidi Okba

The palm grove of Sidi Okba is the most important than the others (fig. 11). Its network is considered the largest network with a total of 25 km seguias. Thanks to the five distributors installed in the Sidi Okba network, the main seguia is subdivided into 14 secondary seguias. Most of the water goes to the oasis of Sidi Okba. However, in recent years the flow has sharply decreased due to the silting up of the dam. This prompted farmers to install boreholes and motor pumps.

Figure 11: A view of the palm grove of Sidi Okba (Photo. Remini, 2015)

Seriana Oasis Network

The Seriana network is made up of a main seguia 1.5 km long from the Mk1 distributor, up to Mk3 the latter divides the main seguia into 3 secondary seguia: one goes towards Sidi Okba and Thouda, and the other two are direct towards Seriana (fig. 7, 8a and 8c).

Thouda oasis network

The Thouda network is considered to be the smallest network in the region. Its water share is the smallest for the 4 oases since it contains 5% of the total flow. The network contains a single distributor which divides the secondary seguia, 3 km long, into two

tertiary seguias (fig. 7, 8c and 8d). In recent years, the network has been reinforced by collective drilling. Farmers have equipped their wells with motor pumps.

The role of the Foum el Gherza dam in the irrigation of palm groves

Operated in 1950, the Foum El Gherza dam with a capacity of 47 Mm^3 is intended for the irrigation of 375,000 date palms distributed between the oases of Seriana, Thouda, Garta and Sidi Okba. Each oasis receives its quantity of water according to the number of palm trees. This is how most of the water was allocated to the oasis of Sidi Okba. We have mentioned to you in Table 1, the shares of water intended for each oasis.

Table 1: The water shares affected by the dam to the 4 oases (Agricultural Directorate of Biskra)

Oasis	Share of water (%)
Sidi Okba	60%
Seriana	15%
Garta	20%
Thouda	5%

The construction of the Foum el Gherza dam on the Abiodh wadi has greatly contributed to the irrigation of the palm groves of Garta, Sidi Okba, Thouda and Seriana. This is how it was from the date of impoundment until 2016, a period of 66 years, the dam provided a total volume of 600 million m^3 for the 4 palm groves. Figure 12 shows the annual water volumes during the period: 1950-2016.

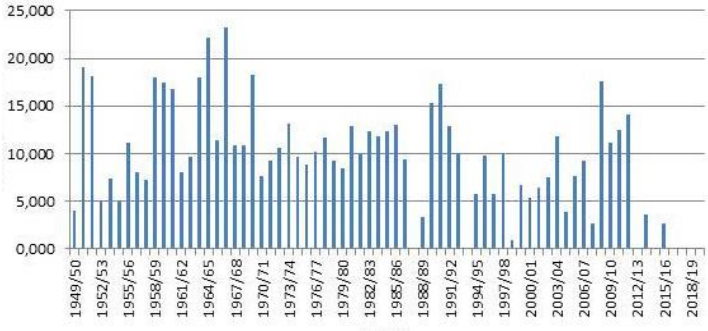


Figure 12: The annual irrigation water volumes affected by the dam to the 4 oases (Source ANBT)

The dam located in a hyper arid region fills up annually thanks to high intensity floods from the Labiod River, especially during the months of April, May and June. The Labiod River, about 100 km long, which begins from the Cheleya Mountains to the Aurès peaks. The Labiod River carries considerable quantities of fine particles from the watershed with an area of 1300 km^2. Labiod River is well known for these violent and devastating floods

which each time cause damage and adverse consequences on the environment. In addition to a solid appearance of fine particles that settle at the bottom of the Foum El Gharza dam, the Labiod River carries large particles, palm tree trunks and even animal corpses. Usually, these deposits cause enormous problems for dam managers when operating the bottom valve.

The Foum El Gherza dam is classified among the Algerian dams most threatened by the phenomenon of siltation since its capacity does not currently exceed 10 Mm^3 (fig. 13) (Remini, 2019). In this state, the dam becomes unable to meet the irrigation demand of the 4 palm groves.

Figure 13: A view of the siltation condition of the Foum El Gherza dam (Photo. Remini, 2018)

Leaks from the dam contribute to irrigation

In addition to the phenomena of siltation, the dam in view of its location in an arid region a considerable mass of water evaporates annually. In the Foum El Gherza dam, the volume of evaporated water was evaluated during the period 01/09/1950-29 /02/2016 to be more than 220 Mm^3. The construction of the dam in a site favorable to infiltration, the dam is therefore subject to water leaks through the two banks of Maestrichian limestone-type rocks (Remini et al, 2018) (fig. 14 et 15). Figure 16 represents the evolution of the volumes of leaks during the period: 1950-2016. It is interesting to note that during the year, 1959/1960, a volume of water leaks of more than 10 Mm^3 of water was recovered and directed towards the irrigation of the 4 palm groves.

Figure 14: Water leak at the left bank of the dam Foum El Gherza (Photo. Remini, 2016)

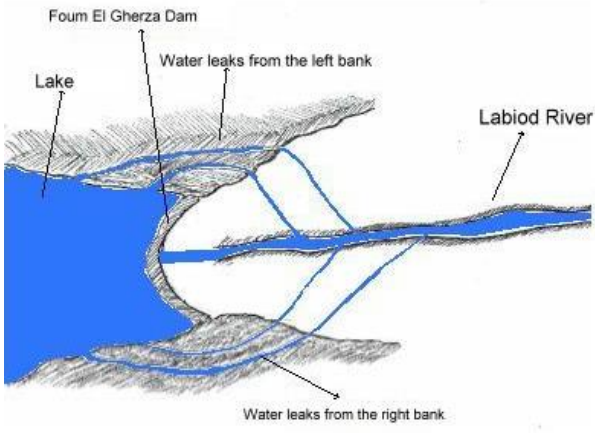


Figure 15: Probable diagram of the dam's water leakage routes. (Schema Remini, 2016)

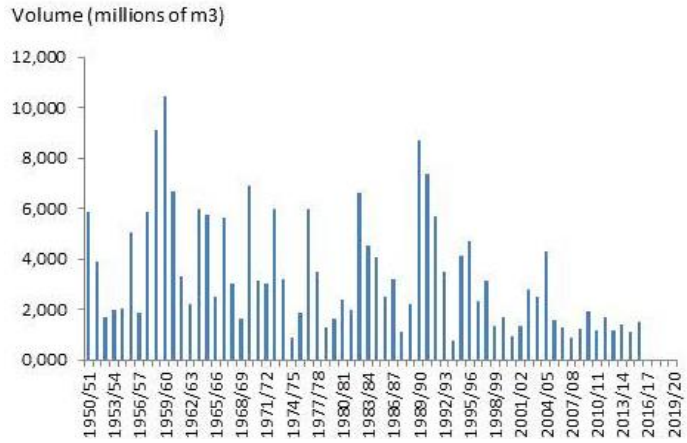


Figure 16: Evolution of water leaks across the two banks of the Foum El Gherza dam during the period: 1950-2016 (ANBT data)

The Mekssem, an essential element for the sharing of water

During the period: 2000-2020, we carried out several work missions in the oases of the Algerian Sahara. Visits and investigations were carried out in the water sharing systems of the oases of Touat, Gourara, the valley of M'zab and Zibans. The three sharing systems are almost identical. Only, we were impressed by the presence of parters in the three distribution networks. On the other hand, in the Saoura valley, the watershed network is made up of seguias and without parters.

In the oases of Touat, Gourara and Tidikelt, the partiter is called Kasria (fig. 17). In addition, he is called Tissanbadh in the M'zab valley and Mekssem in the Ziban region (fig. 18, 19 (a et b) et 20). The essential element in water distribution networks is an ingenious work whose role is to share water between farmers. According to our investigations and surveys that we carried out with farmers and the local population, it is possible that there was a transfer of know-how from the oases of Touat to the oases of M'zab and then to the oases of the Zibans.

If today, the kasria of the foggara and the Tissanbadh of Ghardaïa continue to play their roles of sharing the waters, the Mekssem of the Ziabans does not function as before. At the beginning when the small dams (Essed) supplied the palm groves with free water (them from floods and springs), the Mekssem shares this water according to the contribution of each beneficiary in the upkeep and maintenance of the network. Today, however, the palm groves are supplied by the Foum El Gherza dam. The water is chargeable, the flow is no longer continuous, but it is managed by the dam manager. The role of the Mekssem is limited to directing the flow to the neighborhoods and gardens of the farmers. The water shares are chargeable and depend on the number of palm trees.

Figure 17: A kasria in an oasis of Timimoun (Photo. Remini, 2008)

Figure 18: Tissanbadh of the water distribution network of the oasis of Ghardaïa (Photo. Remini, 2008)

a) Upstream part

b) Downstream part

Figure 19: Mekssem of the water sharing network in the oasis of Sidi Okba (Photo. Remini, 2014)

Figure 20. Even the first Mekssem at the arrival of the main seguia takes the form of a triangular basin like that of the kasria (Photo. Remini, 2012)

CONCLUSIONS

The oases of Sidi Okba, Thouda, Garta and Seriana were initially supplied with water from the Wadi of Labiod thanks to small earth dams built by farmers. It is a system of several stepped dikes for the irrigation of over 375,000 palm trees. During the 1940s, the ancestral system was abandoned and replaced in the early 1950s by the construction of the large dam of Foum El Gherza with a capacity of 47 million m^3. On the other hand, the water distribution and sharing network has been maintained. Composed of several kilometers of seguias and more than 6 Mekssem, the water sharing system in the oases of Garta, Sidi Okba, Thouda and Seriana uses the unit of time like that of the oasis of Chetma.

Today, this hydraulic heritage is in a degraded state. Due to the lack of accelerated siltation, the dam became unable to meet the irrigation needs of the palm groves. This prompted the hydraulic services to resort to boreholes to fill the deficit.

ABBREVIATIONS

Essed: Ancestral Dam
Foggara: horizontal well
Foukani Dam: Highest dam
Kasria: parter
Mekssem: parter
Tissanbadh: parter of galleries
Seguia: earthen canal
Souagui: plural of seguia
Seguia Gharbia: West Canal
Seguia Cherkia: East Canal
Tahtani Dam: Lowest dam

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