Migration Letters

Volume: 21, No: 8 (2024), pp. 778-787

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)

www.migrationletters.com

The Impact Of The Ghrib Dam On Agricultural Areas In Upper Chelef Perimeter

Souad Zerarka

Received: 06/2024 Published: 12/2024

Abstract:
The western interior regions of Algeria are characterised by a humid and rainy climate in winter, dry and hot in summer, with high temperatures and fluctuating amounts of rainfall during the months of the year, resulting in sudden and torrential rains in a short period of time that erode the banks of the valleys of the water basins feeding the dams, and the erosion of significant amounts of mud and silt and their deposition in the bottoms of the exploited dams causing blockages in the dam channels distributing irrigation water to agricultural areas. This article aims to analyse the issue of the siltation of the Ghrib dam exploited by the National Agency for Dams and Diversions, and its repercussions on the irrigated areas in the Upper Chlef region, as well as the factors leading to this phenomenon. In addition to mentioning ways to minimise this issue, which threatens the surface water in the exploited Ghrib Dam, especially the water available for irrigation.

Keywords: *dam siltation, sludge deposition, irrigation perimeter, erosion.*

Introduction:

The phenomenon of dam siltation is one of the most serious issues facing the world, especially in arid and semi-arid regions characterised by rainy seasons and high temperatures with poor vegetation cover and fragile soils, where sudden and short rains 'showers' erode the water basins, carrying huge amounts of silt, which is deposited at the mouths of the catchment basins feeding the dams with rainwater. Algeria has 110 utilized dams with a large storage capacity of 4.5 billion m^3, but about 20 million m^3 of this water is lost annually due to the deposition of sludge in the dams' bottoms where sand and silt particles clog and block the channels that distribute water from the dams towards different uses, drinking water, industry and irrigation. Therefore, most dams located in the arid and semi- arid regions of Algeria have a short lifespan, not even exceeding 30 years of exploitation, which has a negative impact on the amount of water available from the dams exploited, not to mention irrigation water.

In this article, we will study the erosion of Ghrib Dam, one of the oldest and largest dams in Algeria, but it has not escaped the risk of erosion resulting from the water erosion of the southern slopes of the Zakkar Mountains, and its impact on the water provided to irrigate the irrigated areas in the Upper Chlef region. Based on the above, we asked the following questions:

Is the water available from the Ghrib dam, exploited by the National Agency for Dams and Diversions, sufficient to irrigate the irrigated areas in the Upper Chlef plain, especially that the annual average annual dam degradation reaches 3.2 hm³/year? If this water does not reach the irrigated areas of the plain sufficiently, what are the obstacles that prevented this? What are the solutions to reach the desired goal of expanding the irrigated areas and promoting irrigated agriculture?

In order to reach the desired goals, we relied on the analytical, descriptive, quantitative and holistic approach to reach the required results.

1- Introducing Ghrib Dam:

Ghrib Dam or Mouaten Dam is located in the municipality of Cherfa, Ain Defla, it was built on the Chlef Valley in 1927 and is considered one of the oldest dams in the Chlef plain, its first foundation stone was laid in the 1920s and exploited in 1930, intended to supply drinking water to Chorfa and Ain Defla, irrigate the agricultural areas of the upper Chlef and divert part of its water to the Bourroumi Dam to provide Medea and Bouraghia with drinking water. The storage capacity of the dam is 280 hm³, while the regular capacity is estimated at 115.30 hm³.

2- Siltation of dams:

Most Algerian dams, especially those located in the arid and semi-arid regions of the country, suffer from rapid siltation due to the severity of soil erosion, as the western region of the country is the most affected, with 47% of the total eroded land, followed by the central regions with 27%, and the eastern regions with 26%.

2.1. Ghrib Dam mudslide:

The Ghrib Dam is one of the most exposed dams in the Chlef basin, resulting from the water erosion of the southern slopes of the Zakar Mountains with soft Marnean limestone rocks belonging to the Cretaceous period, in addition to the lack and degradation of vegetation cover as a result of excessive exploitation of humans and animals.

According to the studies and estimates carried out by the National Agency for Dams and Diversions in 2015 on the issue of siltation threatening Algerian dams, Ghrib dam was classified among the old dams at risk of siltation, where the annual average amount of silt deposited was **3.2** hm³/year, against a storage capacity of 280 hm³, with a siltation rate of 58.8%, a significant percentage as it poses a threat

to the surface water stored in this dam as shown in Table 1.

2.2 Erosion of the fodda Valley Dam:

Wadi Al fodda Dam is considered the second dam prone to erosion after Ghrib Dam, as the surface slope in most parts of its basin exceeds 25%, and forests cover only limited parts of the marne and mud lands in the upper part of the basin, which is considered one of the main habitats for soil erosion and silt transported by water to the dam. The Wadi El fodda dam is one of the oldest dams exploited in the Chlef plain, but it remains underutilised in agriculture due to the fact that it was largely flooded after the Ghrib dam, for structural reasons due to the date of construction of this dam (1932) on the one hand, and on the other hand its location in the southern slopes of the Ouansris Mountains, which are more exposed to water erosion and the consequent placement of significant amounts of mud in the bottoms of the dam reservoirs. The average annual amount of silt deposited in the dam's reservoir is 2.66 hm³/year, compared to the dam's storage capacity of 228 hm³.

According to the studies and estimates carried out by the National Agency for Dams and Diversions in 2015 on the issue of siltation threatening Algerian dams, the Ghrib dam was classified among the old dams at risk of siltation, with an annual average of **3.2** hm³/year, followed by the Wadi El Fodda dam, which has an annual average of 2.66 hm³/year of silt deposited at the bottom of its reservoir,

second only to the Ghrib dam, which has an annual average of 2.66 hm³/year. As shown in Table 1.

Table 1: Siltation of some Algerian dams in 2015.

Dam Name	Storage Capacity (hm³)	Average Annual Sedimentation (hm³/year)
Fergoug	18	1.5
Zerdizas	31	0.4
Oued Fodda	228	2.66
Sidi Yakoub	280	0.17
Ghrib	280	3.2
Sidi Ahmed Ben Aouda	235	1
Marja Sidi Abed	58	0.59
Derdour	105.12	0.83
Haraza	76.65	0.28
Kseub	11.6	0.3
Foum el Gharsa	47	0.8
Ghanis	3	0.03

Source: National Agency for Dams and Diversions, Directorate of Maintenance and Monitoring (**2015).**

General view downstream of Ghrib dam the foot of djebel El Bour in the upper CHLEF is devoid of vegetation and exposed to water erosion.

3- Types of irrigated areas:

Irrigated agricultural lands depend primarily on the water stored in dams as the only guarantee of continued irrigation in times of scorching, because most of the wadis whose annual revenue is not controlled dry up in the summer and are used during the spring. Due to the nature of the topic focused on agricultural irrigation, this article will deal with the amount of water directed to irrigation, which is mainly dependent on the water stored in the exploited dams.The Upper Chlef perimeter is divided into three types of areas:

3.1 Equipped area:

The equipped area in Upper Chlef reached 20200 hectares, an area equipped with all irrigation equipment represented by irrigation and drainage networks and includes the following equipment: Compensation stores, which are used in times of drought, and are connected to water pumping stations.

3-2 Irrigable area:

The irrigable area in Upper Chlef reached 19746 hectares, and according to the soil classification carried out by the National Agency for Water Resources for five types of soils, the soils of the irrigable area of the above-mentioned perimeter were classified as belonging to the five categories that must be reclaimed by the irrigation process, by removing excessive salinity from them with washing their horizons, desalting and performing drainage of swamps (resulting from poor drainage) with pumping excess water from the soil.

3-3 Irrigated area:

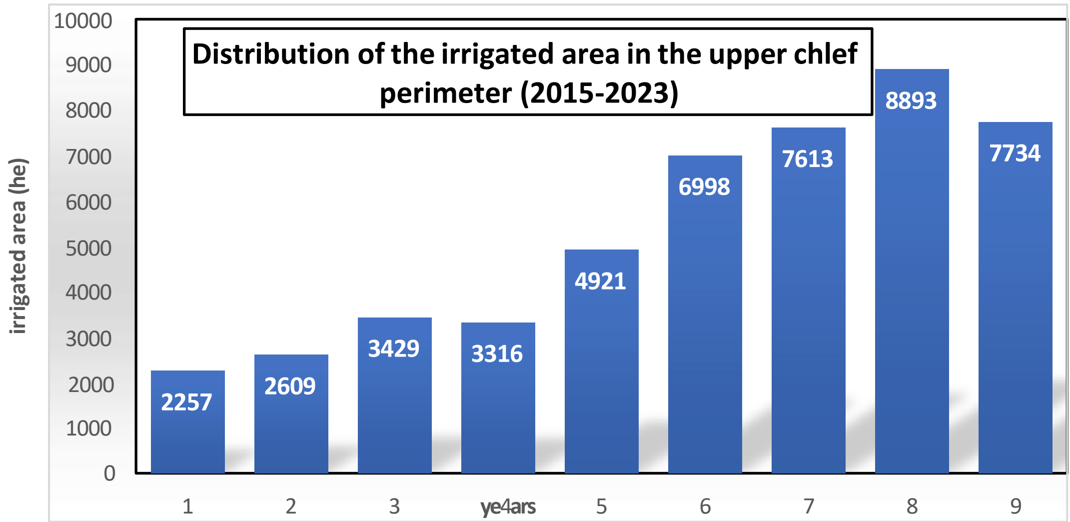
This is the area that is actually irrigated, and this irrigated area changes from year to year, depending on the change in the water stock available in a dam in the plain. The irrigated area in the Upper Chlef plain reached 47770 hectares during the period between 2015 and 2023, where we notice a fluctuation of the irrigated area from year to year, where this area reached its peak in 2022 in the entire perimeter to 8893 hectares, where the perimeter witnessed abundant rainfall, while this area decreased to 2257 hectares in 2015 as a result of fluctuations in precipitation amounts that negatively reflected on the water stock in the exploited dam. As shown in Table 2.

Table 2: Distribution of the irrigated area in the Upper Chlef perimeter between 2015 and 2023

Year	Irrigated Area (hectares)
2015	2247
2016	2609
2017	3429
2018	3316
2019	4921
2020	6998
2021	7613
2022	8893
2023	7734
Total	47770

Source: National Office of Irrigation and Drainage of Khemis Melliana, Annual Outcome of Exploitation, Irrigation Campaign (2015-2023)

Figure 1: Distribution of the irrigated area in Upper Chlef between 2015-2023



4- Irrigation water requirements:

The water destined for irrigation in the Upper Chlef region goes through several stages and different volumes from its source, the Ghrib Dam, until it reaches the irrigation areas, and we will review in the following elements the steps taken by this water.

4-1 **The volume of water available:**

The irrigation water is granted by the National Agency for Dams and Diversions of the state of Ain Defla according to each irrigation season through the requests made by the National Office for Irrigation and Drainage of Khemis Miliana, and the water granted to the National Office for Irrigation and Drainage of Khemis Miliana changes The water granted to the irrigation bureau changes from year to year, depending on the volume of water filled in the dam, where the Chlef area received the highest amount of available water with 49 **hm³** of irrigation water, as shown in Table 3 and Figure 2.

4-2 **Volume of water actually released:**

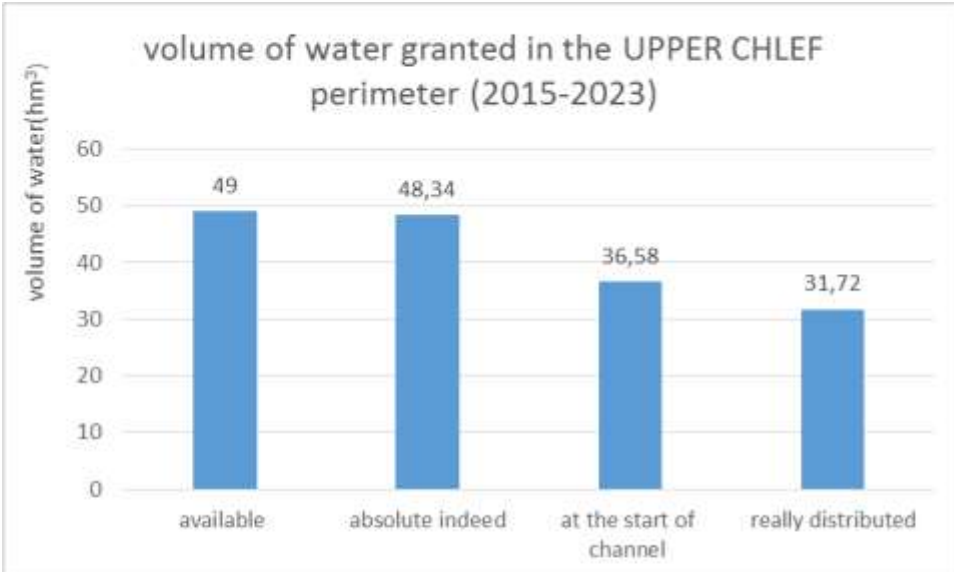
This is the water that is actually released through the channels connected to the main valleys of the irrigated areas of the plain for the channels of the Chlef Valley, where the 'Sewer' irrigation officer opens the irrigation channels directed to irrigation by order of the Directorate of Agricultural Services for the entire area of the ocean, and the'Station Opérateur' works to pump irrigation water for both the jendel and Khamis stations. 48.34 hm³.

Table 3: Volume of water granted in the Upper Chlef perimeter 2015-2023

Water Allocated (hm³)	Available (hm³)	Actually Released (hm³)	At the Start of Channels (hm³)	Really distributed (hm³)
	49	48.34	36.58	31.72

Source: National Office of Irrigation and Drainage of Khemis Melliana, annual exploitation results, irrigation campaign (2015 -2023).

Figure 2: Volume of water granted in the Upper Chlef perimeter (2015-2023).



Source: National Office of Irrigation and Drainage of Khemis Miliana, annual exploitation report, irrigation campaign (2015-2023).

4.3 Water volume at the beginning of the irrigation canals:

The pumping station manager works to control the water that arrives at the beginning of the irrigation canals starting from the previously mentioned utilised dam for the different pumping stations, where we notice a decrease in the volumes of water delivered to the irrigation canals compared to their release volumes as shown in Table 3 and Figure 2. **36.58hm³**

4-4 The volume of water actually distributed:

This is the water that is actually distributed or finally reaches the agricultural areas of the Upper Chlef perimeter where the irrigated areas of the perimeter, from model farms, collective agricultural investments, and individual agricultural investments, actually benefit from it. The volume of water actually distributed from the ocean varies depending on the volume of water stored in the dam of the exploited ‘Gharib’. As shown in Table 3 and Figure 2. **31.72 hm³**

5- Assessment of the lost water in the Chlef area:

Wasted water ranges from 40% to 50 % of the total water distributed, meaning that about half of the money spent on water treatment and purification is wasted. Some of the reasons that lead to wasted water are corrosion of pipes, road excavations, old pipes, poor workmanship, poor laying technique, and damaged joints. As we have already seen in the previous elements that not all the water available for irrigation reaches the irrigated areas of the perimeter, the question that arises is what is the reason for the decrease in these quantities from the place of release from the exploited dams until they reach the agricultural areas?

5-1 The volume of water lost along the way:

Water lost during the irrigation process is a great loss to agriculture, especially when it comes to the “Chlef Plain” region, which is in dire need of this precious and important element, given its limited water resources, rapid population growth and its agricultural nature, which makes it imperative to conserve every drop of water it possesses.

The water lost in the Sahel varies depending on the causes and the stages through which the water for irrigation passes, from its sources to the irrigated agricultural areas. According to the National Office of Irrigation and Drainage of Khemis Meliana, the average annual water loss during the course of the study period was 75,67 Hm³, or 24% of the total water loss, which is a significant percentage due to the 'theft' or, if you will, the pumping of water dumped in the main valleys of the ocean, such as Wadi Chlef, during each irrigation campaign by farmers and their use for personal purposes in the absence of water police and meters to monitor the water consumed. See Table 4

5.2 Volume of water lost through canals:

This is the water that is lost through the canals connected to the water distribution networks available for irrigation of ocean areas, where the average volume of water lost through the canals reached 86.71 Hm³ or 22% due to the age of irrigation canals dating back to the 1920s, in addition to the breakdowns and emergency accidents that disrupt the distribution channels every now and then. See Table 4

5.3 The total volume of water lost:

It is the total amount of water lost from the place of release from the exploited dams until it reaches the agricultural irrigated areas of the ocean, and is represented by the water lost from the exploited dams and the main wadis due to extreme heat and evaporation, as well as water seeping through the soil horizons towards the underground layers or those stagnant in the meadows and marshes. The average total volume of water lost for the study period was 65.61 hm³ (34%). See Table 4.

In conclusion, we can say that the volume of water lost to the perimeter is not negligible, not to mention the low efficiency of the poorly maintained irrigation canals, where the efficiency rate reached almost 40%.

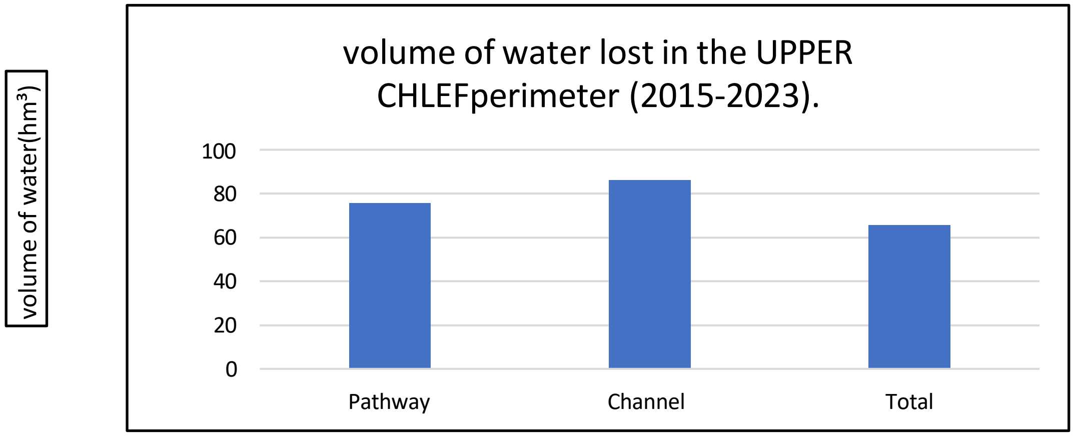
In general, by studying the volume of water destined for agriculture of all types and stages, we conclude that the irrigation water supply for the large irrigation pattern applied in Upper Chlef is insufficient and cannot reach the required volume, in addition to the significant leakage of water on the one hand, and on the other hand the technical condition of the dam. On the other hand, the technical condition of the dam, represented by the clogging of the reservoirs, which prevents the retention of rainwater.

Table 4: Volume of water lost in the Upper Chlef area (2015-2023).

Total (%)	**Total Volume (hm³)**	**Channels (%)**	**Channel Volume (hm³)**	**Pathway (%)**	**Pathway Volume (hm³)**
34	65.61	22	86.71	24	75.67

Source: National Office of Irrigation and Drainage, Annual Outcome of Utilisation, Irrigation Campaign (2015-2023).

Figure 3: Volume of water lost in the Upper Chlef perimeter (2015-2023).



6- Matching irrigation water between availability and consumption:

By studying the volume of water available to irrigate agricultural areas of various types and stages, it is clear that the volume of water granted to the large irrigation pattern in the Upper Chlef region is insufficient, as the region did not benefit from almost half of the available amount for reasons already mentioned in the previous elements, not to mention the theoretical volume required to water the agricultural crops programmed for each irrigation season.

Based on the data in Table 3, and by comparing the annual average water available for irrigation with the annual average water actually distributed in the irrigated areas, and by performing a simple water balance for the study period in which the volume of water available for irrigation of agricultural crops was subtracted from the volume of water actually distributed and utilised by the irrigated areas in the plain, we obtain the amount of deficit or water shortage equal to 17.28 Hm3 , which is equal to 17.28 hm^3. As shown in the following calculation:

$49hm^3 - 31{,}72hm^3 = 17{,}28hm^3$.

Conclusion:

We conclude that the water available for agriculture in the Upper Chlef perimeter is insufficient and does not cover the needs of irrigated agriculture required for large-scale irrigation. We conclude that the plain is witnessing a shortage of irrigation water amounting to 17.28 hm^3 by comparing the size of the available water needs, which is a significant amount in front of the requirements of the agricultural areas programmed during each agricultural season for the period between (2015-2023), not to mention the low efficiency of irrigation channels, which reached 40%, which made things worse.

It became necessary to pay attention to natural reclamation by building protective walls of dikes to protect the banks of the valleys from water erosion to preserve rainwater and spread the culture of environmental conservation by not throwing household and industrial waste on the banks of the main valleys of the plain to avoid clogging the drains leading to these valleys and thus flooding the valleys that spoil the 'plough and the people'. Rehabilitate the old irrigation channels equipped for agricultural areas and repair the damage to the irrigation channels. Commitment to less water-consuming and wasteful irrigation processes, such as drip irrigation for crops that do not require large quantities of water.

In addition to the formation of specialised frameworks in the maintenance of irrigation equipment, as in the case of the difficulty of maintaining the Ghrib Dam and removing the mud deposited in the dam retention, due to the high and expensive costs of maintaining and cleaning this dam from mud, which can reach the cost of building another dam. We propose the reclamation of the banks of the Chlef valley passing through this plain by bank fixing, by building retaining walls to avoid erosion of the valley rocks and the consequent loss of huge amounts of rainwater and its non-utilisation for irrigation, in addition to the afforestation of the upper catchment basins feeding the dam, especially the upper Chlef basin which is vulnerable to water erosion, by maintaining and protecting them by building gabions.) as protective walls against soil erosion and the resulting mud of the Ghrib Dam and the decline in its storage capacity. We also propose to allocate investments to remove the mud, if possible, for the 'Sukhna' hilly barrier located in Upper Chlef, which is completely submerged and classified by the Directorate of Water Resources of Ain Defla as 100% muddy. It could contribute to irrigating large areas of the perimeter.

Bibliography :

<u>Compositions</u> :

1- زوكة محمد خميس : 1999، الجغرافية الزراعية، جامعة إسكندرية ، مصر. **2**-علي أحمد هارون: جغرافية الزراعة، دار الفكر العربي، الطبعة الاولى، مصر، 2000

-3-حسن أبو سمور، جغرافية الموارد المائية، دار صفاء للنشر والتوزيع، عمان، الاردن، الطبعة الاولى، سنة 1999**.**

<u>Theses</u>:

الهيدروغرافي في نهر الشلف، رسالة دكتوراه من الدرجة الثالثة في الجغرافيا، الجزء الثاني، جامعة الجزائر ، الجزائر ص232.

- بوبالط يونس: 2015، تاثير السدود على الواقع التنموي و البيئي ، حالة سد حمام دباغ،

والية قالمة ، رسالة ماجستير في التهيئة العمرانية و البيئة ، جامعة منتوري ، قسنطينة ، الجزائر.

- Guendouz Mostefa : 1982, Le piémont du Zaccar et la plaine de Thémis Miliana (moyen Chéliff), Thèse de Magister en Milieu Physique et Occupation Humaine U.S.T.H.B. Bab Ezzouar, Algérie.
- Henia Latifa , 2008, ATLAS DE L'EAU EN TUNIE, université de Tunis , faculté des sciences humaines et sociales ,Unité de recherche « Grevachot » , p 139 ,140 .Tunisie.
- Sari Djilali : 1977 L'Homme et L'érosion dans L'Ouarsenis (Algérie), société nationale d'édition et de diffusion, Alger, Algérie.

<u>ARTICLES</u> :

- Remini Boualem : L'envasement des barrages et la technique du soutirage : quelques exemples algériens, Chlef le 05& 06 février 2002 .
- Remini Boualem : La problématique de l'eau en Algérie , OPU ,182p.
- Remini Boualem et Bensafia D: Envassement des barrages dans les régions arides exemples Algeriens.2016.
- Remini B. Hallouche W : Evolution de l'envasement du barrage de Oued fodda (algérie) , revue Energie luft , Avril 75-78 .

<u>Appendices</u>:

Ministry of Territorial Planning and Environment, Report on the state and future of the Environment in Algeria, 2001, p26.

National Office of Irrigation and Drainage of Khemis Miliana,Annual Report of Exploitation, Irrigation

Compaign (2015-2023).

National Agency For Dams and Diversions, Directorate if Maintenance and Monitoring (2023).