

Management of Polluted Surface Water in Algeria : A solution to reduce water stress

FERRAT Isma*¹, GHERDI Mohamed²

¹Blida 2 University Lounici Ali, i.ferrat@univ-blida2.dz ; ismaferrat@gmail.com

²Blida 2 University Lounici Ali, m.gherdi@univ-blida2.dz; gherdim@yahoo.fr

Received: 17/03/2025

Accepted: 25/06/2025

Published: 09/07/2025

Abstract:

The main aim of this study is to highlight the problems associated with water stress in Algeria, in an attempt to find solutions for better managing this resource and satisfying the demand sectors, particularly the agricultural sector. we used descriptive and analytical method for detailed analysis of content of available literature by authors to prepare this study, The study concluded that wastewater reuse is becoming more and more popular as a potential solution to both the growing demand for water and the water stress primarily caused by climate change. It also encourages better use of water resources by, among other things, utilizing the increasing potential of treated volumes from wastewater treatment plants as an advantageous irrigation solution

Keywords: water management; water stress; polluted water; irrigation; wastewater in Algeria

Jel Classification Codes : M20; M21

* FERRAT Isma

1. INTRODUCTION

Wastewater treatment and reclamation has become a priority in Algeria's water resources strategy. Major investments have been made in the rehabilitation of old plants and the construction of new ones.

This strategy is based on the Protecting water resources ,Protecting citizens against water-borne diseases,The comfort and the well-being of citizens,Coastal protection (Barcelona Convention) and The availability of treated volumes for reuse in agricultur

The Ministry of Hydraulics has created a priority system that is used in the National Water Plan research to identify and schedule future wastewater treatment plants for the years 2010–2030 (Ministère des Ressources en Eau, 2019a), This system is presented as follows:

1. Wastewater treatment for towns located upstream of dams in operation, groundwater and towns with more than 100,000 inhabitants.
2. Wastewater treatment for towns upstream of dams under construction.
3. Wastewater treatment for coastal communities (coastal protection).
4. The rest of the conurbations.

In Algeria, initiatives for the reuse of treated wastewater are promoted by the existence of discharge standards tailored to the reuse of wastewater in agriculture (Official Journal of the Algerian Republic, 1993; 2006), As well as regulatory texts outlining the wastewater reuse modality and the list of crops and the requirements for their irrigation with treated wastewater (Official Journal of the Algerian Republic, 2007)

In Algeria, the natural environment is the subject of various pressures, most of which are related to wastewater discharges from human activities (domestic, industrial and agricultural). These discharges are heavily laden with pollutants and various contaminants, posing health and environmental risks.

Given the scarcity of conventional water resources, Algeria can no longer afford to turn its back on the possibility of reusing the enormous quantities of wastewater discharged into nature or the sea, mainly for irrigation

Major water users in Algeria are irrigation perimeters. As a result of the decrease in the amount of water mobilized in dams, which is mostly caused by frequent droughts and surface water scarcity exacerbated by excessive water withdrawals for drinking water and irrigation. It is thought necessary to implement a strategy based on

diversifying water supply resources, which includes using wastewater for irrigation (Ministry of Hydraulics, 2024)

Based on all these data, we posed the following problem:

How can polluted surface water be managed to reduce water stress in Algeria?

To answer this question, we suggested the following hypothesis:

The reuse of treated wastewater will play a key role in reducing water stress in Algeria.

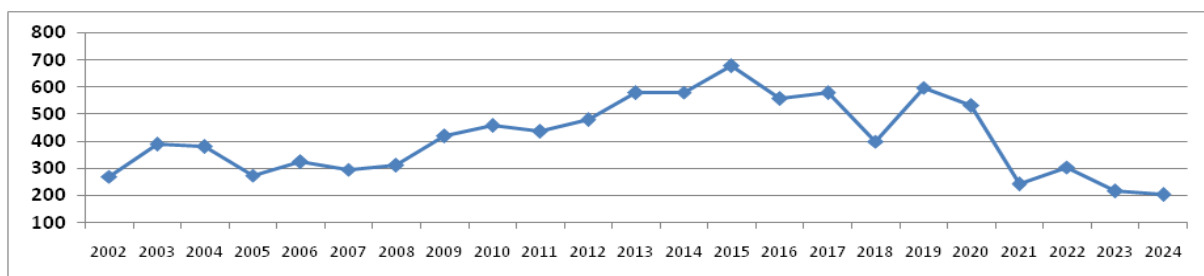
1.1 Study Methodology

Dealing with our problem and verify our hypothesis, we have opted for the descriptive analytical method, which is a scientific method that consists of collecting data and information (bibliographic research) in books or reports from authorized organizations, and then analyzing and transmitting them as scientific information reached.

2. THE DAMS' IRRIGATION SITUATION IN ALGERIA

There are forty-four (44) dams supplying the irrigation perimeters, ten (10) of which provide run-of-river irrigation in the wadi to supply adjoining land. Drawdowns for irrigation from dams are estimated annually at 19% of the overall input recorded at the level of mobilization reservoirs and 15% of the total volume mobilized m^3 .

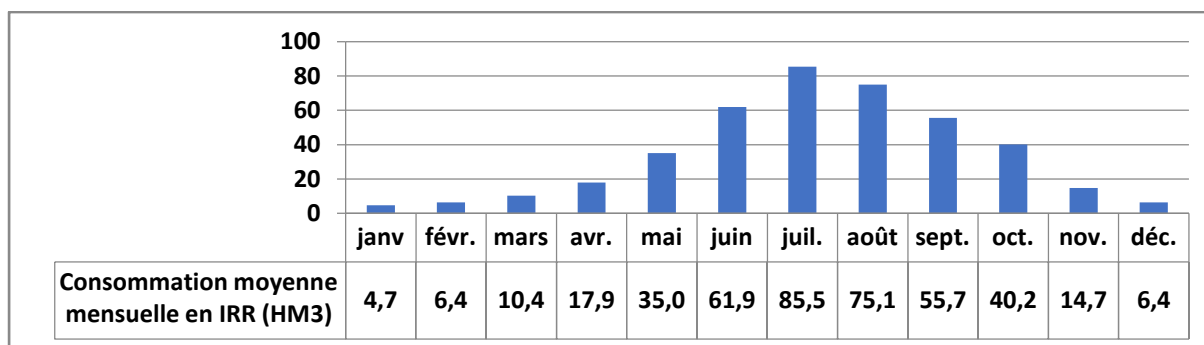
Fig. 1. "IRR" withdrawals from dams



source: National siltation control strategy 2030 "MRE".

The graph in figure 1 shows the variation in annual irrigation consumption from dams over the last eighteen (18) years. Consumption has been stable since 2009, with withdrawals varying between 420 and 580 million m^3 , with a minimum of 400 million m^3 in 2018.

Fig. 2. Average monthly variation in irrigation consumption over the years. " « 2002-2024»



Source: Operating report of National Dams and Transfers Agency (National Agency of Dams and Transfers, 2024)

Average annual irrigation consumption is around 444.94 million m³. In Algeria, agriculture is the main consumer of water, and reforms are mainly focused on transferring the management of irrigated perimeters. Irrigation water requirements are still insufficiently met, despite the many investments made over the last few decades. The majority of irrigated perimeters have a traditional system that does not contribute to improving water use efficiency. Added to this the water tariff does not encourage the main users to save the resource. In this context, the modernization of irrigated perimeters remains an appropriate solution for efficient agricultural water management.

The useful agricultural area covers just 8.5 million hectares, 90% of which is in the northern zone, where over 80% of the population lives. Over the last twenty years, an average of just 5% of this surface area has been irrigated. As a result, the pressure to mobilize and exploit water resources is increasing, and is exacerbated by climatic hazards. Urban and industrial development is taking up more and more arable land, which is limited and not particularly extendable. By 1995, more than 200,000 hectares of usable agricultural area (UAA) had been lost, and the ratio of usable agricultural area per capita was falling steadily, from 0.52 ha/capita in 1967-1969 to 0.21 in 2000 (Ministry of Agriculture, 2003).

The potential for good-quality irrigable soil exceeds 1.5 million hectares, according to studies carried out by the Agence Nationale des Ressources Hydrauliques. The future irrigation targets set by the various national development plans are 1 million hectares, 40% of which will be large-scale irrigation schemes (National Office of Irrigation and Drainage, 2019). Algeria currently has 59 "GPI" irrigation schemes spread across the country, with GPI schemes in operation, under construction or under detailed study as follows:

Table 1. Status of major irrigation schemes

Status of large irrigation schemes	Number
In operation	35
In production	08
Under study	08
Under study	08
TOTAL	59

Source: GPI / ONID synthesis report

In this context, the modernization of irrigated perimeters is essential for the development of irrigated agriculture in Algeria. The sustainability of agricultural development depends on the sustainability of water resource use.

Policies in the water resources sector will strive to encourage users to use resources efficiently.

3. SANITATION SITUATION

Enter Over 200 wastewater treatment plants and lagoons have been built in the last twenty years, which is a considerable number. However, objective constraints are hampering the efficiency of wastewater treatment systems and hindering wider reuse of the purified water produced (50 million m³ are used per year out of the 480 million produced (Ministry of Water Resources, 2022).

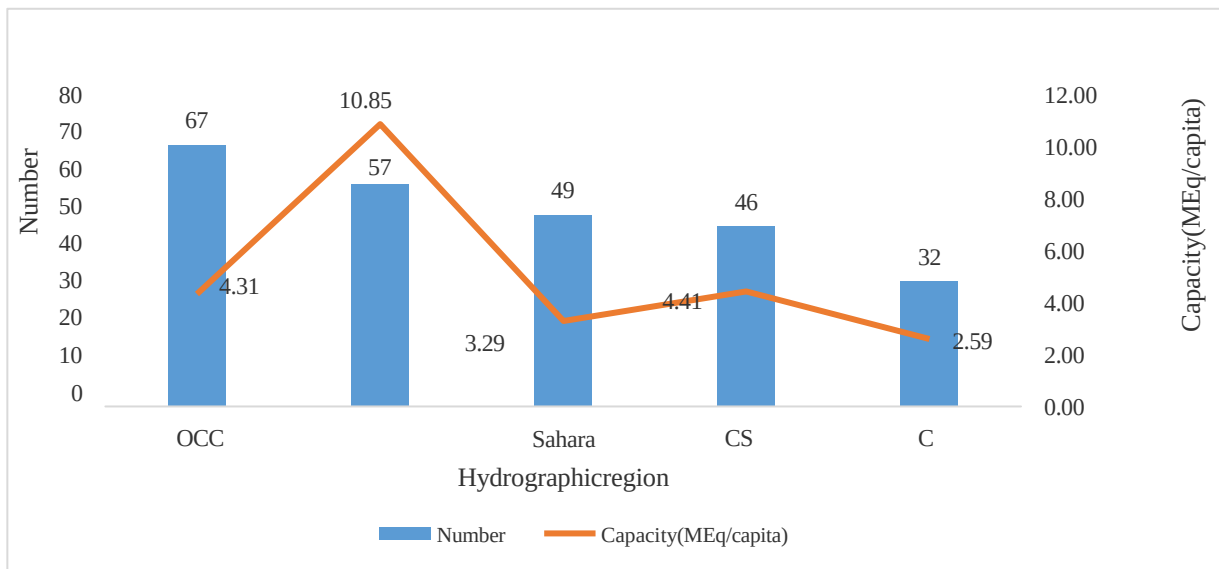
Table 2. Distribution of wastewater treatment plants by hydrographic region

Hydrographic region	Wastewater treatment plant In operation		Wastewater treatment plant In progress		Total	
	Number	Capacity (Equivalent /capita)	Number	Capacity (Equivalent/ capita)	Number	Capacity (Equivalent /capita)
ORANIE CHOTT CHERGUI "OCC	50	3 460 271	17	847 915	67	4 308 186
CHELIF ZAHREZ "CZ	14	1 272 862	18	1 316 090	32	2 588 952
ALGEROIS - HODNA – SOUMMAM "AHS	30	3 560 095	27	7 285 200	57	10 845 295

CONSTANTINOI S SEYBOUSSE MELLEGUE. CSM	32	3 269 062	14	1 142 250	46	4 411 312
SAHARA	36	2 408 601	13	881 672	49	3 290 273
Total	162	13 970 891	89	11 473 127	251	25 444 018

Source : National Agency for Integrated Water Resources Management 2024

Fig.3. Wastewater treatment plants by catchment area



Source: (National Agency for Integrated Water Resources Management, 2024)

One significant limitation is the national sewerage network's unified system, which is intended to absorb both residential and rainfall discharges. Another is the noncompliance with discharge standards laws in the public hydraulic domain and public sewerage networks.

Competing with conventional water resources is the first reflex of administrators and users alike, and they are often limited to prioritizing the use of surface or groundwater resources and the conventional, well-established mobilization and transfer process. A significant number of wastewater treatment facilities have been constructed in urban or semi-urban areas, which adds to the technical complexity of reuse projects based on specific infrastructures due to their design or location. Another factor is the lack of enthusiasm on the part of user sectors (agriculture, industry, and local authorities) to contribute to the generalization of reuse.

Sewage treatment facilities were built with the sole purpose of safeguarding the environment and preventing water-borne illnesses; they were not intended to allow the reuse of treated water.

Budgetary constraints, in terms of both plant operating costs and the cost of reuse facilities, are compounded by delays in standardization, particularly for sewage sludge, which is still considered a waste product rather than a product, and in adapting crops and industrial processes to treated water.

4. LEGISLATIVE ASPECTS

Law n° 05 - 12 of August 04, 2005, relating to water, instituted, through its articles 76 and 78, the concession for the use of purified wastewater for irrigation purposes (JO n°60- year 2005). Also, Executive decree n° 07-149 of May 20, 2007 published in the Journal Officiel de la République Algérienne n° 35, May 23, 2007 (Official Journal of the Algerian Republic, 2007) sets out the terms and the conditions for the use of treated wastewater for irrigation purposes in the form of a concession, together with the related standard specifications. This decree regulates all processes for the use of purified wastewater by treatment plants, by means of an application sent by a concession- holder to the Wali (senior official of the Wilaya or department) of the region. This application includes an agreement with the treatment plant supplying the purified wastewater.

There are 03 interministerial decrees to enable the reuse of treated wastewater for irrigation purposes, involving our two departments and the Ministry of Public Health, Population and Hospital Reform, for the definition of standards and the necessary precautions for use.

Technical control, management of irrigated perimeters and sanitary control, as well as the quality of purified water and agricultural products, are carried out by the territorial directorates of each wilaya under the supervision of the various ministries: Hydraulics, Agriculture, Health, Environment and Trade.

5. USING WASTEWATER FOR IRRIGATION

These As part of the implementation of the action plan drawn up jointly by the Ministry of Agriculture and the Ministry of Hydraulics, the reuse of treated wastewater for irrigation has been a major focus of discussions between the two sectors, with the identification of treatment plants, the perimeters to be irrigated concerned and the drafting of regulatory framework provisions.

In terms of potential, the volume of wastewater discharged nationwide is currently estimated at nearly 600 million m³ and will exceed 1.5 billion m³ by 2035. In order to treat this potential wastewater, the hydraulics sector has embarked on an ambitious program to build wastewater treatment facilities (Reuse of treated wastewater / 2024 assessment / (Ministry of Hydraulics, 2024)

The 2024 saw an increase in the volume reused compared with 2023, from 50 to 110 million m³/year, from 46 treatment systems spread over 27 Algerian wilayas, bringing the reuse rate to around 19% of treated wastewater, distributed as follows:

- Reuse for irrigation (from 28 treatment plants / 17 wilayas): 181,000 m³/day (60%)

Urban reuse: 121,333 m³/day (39.84%) of which:

- Irrigation of green spaces (17 purification systems / 13 wilayas): 113,053 m³/d
- Road washing (3 purification systems / 3 wilayas): 8,280 m³/d
- Industrial reuse (only one case: BeniMered wastewater treatment plant, Wilaya de Blida: 1,200 m³/day (0.39%).(

5.1 Wastewater re-uses systems under construction in Algeria

Five (05) wastewater reuse systems are currently under construction at the Baraki (Wilaya d'Alger), Ain Turck (Wilaya d'Oran), Tissemsilt, Relizane and BordjBouArreridj wastewater treatment plants:

- Watering green spaces along motorway routes, with a total surface area to be watered of around 1,737,268 m²;
- Irrigation of some 1,240 hectares.

5.2 Wastewater re-uses systems under study in Algeria

Studies are currently underway on 5 wastewater treatment systems (Boufarik, Ain Temouchent, Réghaia, Zéralda and Mahelma Nord), covering an irrigable area of over 4,000 hectares, in addition to a general study on the nationwide reuse of treated wastewater for industrial, urban and agricultural purposes.

5.3 Special wastewater reuse program

A special program to rehabilitate and upgrade "STEP" wastewater treatment plants, including equipment for transferring treated water to large-scale irrigation schemes (GPI), has just been launched in the first phase involving 18 treatment plants. By the end of 2030, it will raise the reuse rate to 60% of current installed treatment capacity (National Agency for Integrated Water Resources Management, 2019) (Ministry of Hydraulics, 2024)

6.ECONOMIC VALUE OF WASTEWATER IN ALGERIA: A STRATEGIC CHALLENGE

Alternative solutions like seawater desalination and wastewater reuse are currently gaining traction in Algeria as potential ways to meet the country's increasing water demand and encourage better use of water resources. One such solution is the utilization of wastewater treatment plants' increasing treated volume potential.

Actually, the nation's urban wastewater outflow has risen to around 600 million m³, and by 2035, it is expected to reach 1.5 billion m³. In order to meet more ambitious future goals, like a 60% reuse rate of installed purification capacity, or 900 million m³

of purified water injected into irrigation networks annually, the Ministry of Hydraulics has started a special program to upgrade and rehabilitate wastewater treatment plants.

Additionally, this program will expedite the construction of new wastewater treatment plants. Because of the recent rainfall deficit, which in some parts of the country has had a significant impact on agricultural production, food and subsistence security, and the general well-being of households, withdrawals for irrigation of agricultural perimeters have decreased from 679.3 million m³ in 2015 to 216.98 million m³ in 2023, a decrease of 68%. This makes it imperative to understand the economic impact of using treated urban wastewater in Algeria's agricultural sector. Water stress has already been an aggravating factor preventing the normal and natural replenishment of dams by rainwater.

Although wastewater reuse is still relatively new in Algeria, this condition, which now exists at the level of surface water mobilization systems, indicates that it will only become more necessary in the future. This observation justifies current investment by the Hydraulics sector in research and technological development in the field of wastewater recovery, in order to make up for the deficits recorded in dams.

Water reuse is currently only done on a small scale in Algeria, mainly in isolated instances. Nevertheless, there has been a notable growth in water demand in recent years, and there is evidently growing interest in wastewater recovery and reuse.

Once the wastewater reuse system projects and the special program to rehabilitate and upgrade wastewater treatment plants have been completed, it will be possible to exploit the economic and ecological benefits of this activity, providing a basis for sharing the economic benefits between the various stakeholders.

6. CONCLUSION

Before The Food and the Agriculture Organization of the United Nations (FAO) sees the reuse of urban wastewater in agriculture as a sustainable solution to the world's growing population and the depletion of water resources for agriculture. "Water quality management in the era of climate change" author(s): (Sharma, 2016).

The reuse of treated wastewater offers significant economic and social benefits, including reducing water supply costs, supporting agriculture and industry by providing a stable source of water, especially in times of drought, and preserving freshwater resources, thus contributing to sustainable water management.

It also brings challenges, namely high investment and operating costs, environmental and health risks and social acceptance.

Even so, there are now a lot of economic and social advantages to reusing treated wastewater, but doing so requires careful planning, the right kind of funding, and strict management to optimize the positive effects and reduce the risks.

In Algeria, the presence of specific discharge standards for wastewater reuse in agriculture (Executive Decree no. 93-160 of July 10, 1993 and Executive Decree no.

06-141 of April 19, 2006), as well as the presence of regulatory texts setting out the modalities for wastewater reuse and the list of crops and the conditions for irrigating them with treated wastewater (Executive Decree no. 07-149 of May 20, 2007 and the interministerial decree of January 2, 2012), constitute an incentive for treated wastewater reuse projects (Official Journal of the Algerian Republic, 2006).

Managers, both public and private, have decisions to make when it comes to reusing wastewater in agriculture. They are faced with the need to exploit increasing quantities, in order to meet ever-increasing and transparent communication is needed to ensure acceptance of these practices Demand (Hannachi, Gharzouli, & Djellouli Tabet, 2014).

7. BIBLIOGRAPHY LIST :

1. Hannachi, C., Gharzouli, R., & Djellouli Tabet, Y. (2014). *Étude sur la gestion des ressources en eau en Algérie. Larhyss Journal*, (19), 5-12.
2. Journal officiel de la République Algérienne. (1993). *Décret exécutif n° 93-160 du 10 juillet 1993 réglementant les rejets d'effluents liquides industriels. Journal officiel de la République Algérienne*, n° 46, 5.
3. Journal officiel de la République Algérienne. (2006). *Décret exécutif n° 06-141 du 19 avril 2006 définissant les valeurs limites des rejets d'effluents liquides industriels. Journal officiel de la République Algérienne*, n° 26, 4-5.
4. Journal officiel de la République Algérienne. (2007). *Décret exécutif n° 07-149 fixant les modalités de concession d'utilisation des eaux usées épurées à des fins d'irrigation ainsi que le cahier des charges-type y afférent. Journal officiel de la République Algérienne*, n° 35, 8-12.
5. Ministère des Ressources en Eau. (2019). *Stratégie nationale de lutte contre l'envasement 2030*. Agence Nationale de Gestion Intégrée des Ressources en Eau.
6. Agence Nationale de Gestion Intégrée des Ressources en Eau. (2019). *Bilan annuel 2019*. Ministère des Ressources en Eau.
7. Ministère des Ressources en Eau. (2022). *Situation de l'assainissement en Algérie*. Ministère des Ressources en Eau.
8. Agence Nationale de Gestion Intégrée des Ressources en Eau. (2015). *Note n°01/2015 : Épuration des eaux usées*. Agence Nationale de Gestion Intégrée des Ressources en Eau.
9. Ministère de l'Hydraulique. (2024). *Réutilisation des eaux usées épurées : Bilan 2024*. Ministère de l'Hydraulique.
10. Agence Nationale des Barrages et Transferts. (2019). *Rapport d'exploitation annuel 2019*. Agence Nationale des Barrages et Transferts.
11. Ministère de l'Agriculture. (2003). *Recensement général de l'agriculture 2003*. Ministère de l'Agriculture.
12. Office National de l'Irrigation et du Drainage. (2019). *Rapport de synthèse des grands périmètres irrigués*. Office National de l'Irrigation et du Drainage.

13. Sharma, G. K. (2016). *Water quality management in the era of climate change*. Springer.