

The Problem of Water Resources in Algeria: Assessment of the Current Situation and Proposal of Suitable Solutions

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Received: 07/11/2024

Accepted: 21/12/2024

Published: 31/12/2024

Abstract:

This research paper aims to address the issue of water resources in Algeria by assessing the current situation and proposing practical solutions to confront these challenges. Algeria has been experiencing various problems for several years, such as climate change manifested in drought caused by the lack of rainfall, poor exploitation of this vital resource, and population growth, which has logically exacerbated the crisis due to the increasing demand for water to meet domestic, industrial, and agricultural needs.

The study concludes with a set of solutions to mitigate the worsening of these diverse issues, including institutional solutions, technical solutions, economic solutions, social solutions, and financial solutions.

Keywords: water resources; surface water resources; groundwater resources; water resource issues; Algeria.

JEL Classification Codes: Q25, O13.

ملخص:

تهدف هذه الورقة البحثية إلى محاولة معالجة مشكلة الموارد المائية في الجزائر من خلال تقييم الوضع الراهن واقتراح حلول عملية لمواجهة هذه المشاكل؛ حيث تعاني الجزائر منذ عدة سنوات مشاكل متنوعة كالتغير المناخي المتمثل في الجفاف الذي يضرها جراء انعدام تساقط الأمطار من جهة، وسوء استغلال ومشكلة هذا المورد الحيوي، أضف إلى هذا النمو السكاني الذي زاد في تفاقم الأزمة كنتيجة منطقية لتزايد الطلب على المياه لتلبية الاحتياجات المنزلية والصناعية والزراعية. الكلمات المفتاحية: الموارد المائية، موارد مائية سطحية، موارد مائية جوفية، مشكلة الموارد المائية، الجزائر.

تصنيفات JEL: Q25, O13

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1. Introduction

Water is one of the most crucial resources, with a significant impact, especially in our Arab region with its semi-arid climate, where water resources are scarce and nearing the threshold of water poverty. According to estimates by the Food and Agriculture Organization, by 2030, one in five countries will experience severe water shortages. Water scarcity in the Arab world in general, and Algeria in particular, is expected to negatively affect economic and social development unless these countries take effective and impactful steps on various fronts to establish policies and programs for water resources. These should aim at conserving this resource and promoting the use of non-traditional resources in line with the broader objectives of development.

-Research Problem:

This research paper seeks to answer the following key questions: What are the main issues concerning water resources in Algeria? And what are the suitable solutions to address them?

To answer these questions, the study is divided into the following sections:

- The current state of available water resources in Algeria.
- Challenges facing water resources in Algeria.
- Necessary solutions to address the water resource issues in Algeria.

-Sub-Hypotheses:

- The issue of water resources in Algeria suffers from various natural and climatic challenges, as well as a lack of appropriate legislative frameworks for water resource institutions, which have limited authority to participate in policy-making and management efforts. This has exacerbated the problem of water resources.
- The absence of a comprehensive and well-informed national plan that acknowledges the importance of this resource, coupled with arbitrary approaches and weak scientific methods, has led to outcomes that fall short of the ambitions and goals set for exploiting this resource. This hinders the achievement of sustainable development goals.

-Importance of the Study:

The importance of this study lies in the following points:

- Emphasizing the vital role of water planning in protecting natural water resources and ensuring their sustainable development by adopting national water policies aimed at a comprehensive approach to managing both available resources and water demand.
- Recognizing the significance of the study through global concern over water resource issues, as well as the importance of promoting the rational use of this essential resource. This modern approach to water resource issues is grounded in an integrated perspective that studies all water resource problems in a coordinated, ongoing manner. This study aims to propose solutions that can positively contribute to addressing water resource challenges in Algeria by adopting modern approaches that achieve significant water and economic savings, advancing development and fostering quantitative and qualitative leaps across various economic, social, political, and cultural domains.

2. The Current State of Available Water Resources in Algeria:

The imbalance between renewable water resources and the increasing demand for them leads to a water deficit that affects development and its sustainability. This deficit is sometimes referred to as the "water gap," and when the water deficit reaches a level that causes economic and social harm threatening the state's structure, it is termed a "water crisis." Strategic studies indicate that the upcoming phase will be marked by conflicts over water resources (Al-Tayeb, 2014, p. 28). Water resources in Algeria are of two types: natural (or traditional) water resources, which include surface water and groundwater, with rainfall being the source for both types, and non-traditional (or unconventional) water resources, which mainly consist of seawater desalination and wastewater treatment.

1.1 Natural Water Resources:

Algeria possesses diverse surface and groundwater resources due to its geographical and natural diversity, distinguishing it from other Arab and African countries. The large area and varied terrain significantly influence rainfall patterns. Below are the key natural water resources:

- **Rainfall:** The Algerian territory covers an area of 2,381,741 km²; however, 90% of it is desert, where rainfall is nearly absent. The average annual rainfall volume in Algeria is estimated at 12.4 billion m³, but this precipitation primarily affects the northern region, where approximately 90% occurs in the Tell region alone. The highland basins receive only about 10% of the rainfall, while the desert areas receive minimal amounts.

- **Groundwater:** The amount of groundwater that can be exploited in Algeria is estimated at about 7 billion m³, with around 1.5 billion m³ found in the northern region, currently being exploited at over 90%. Approximately 5 billion m³ are available in the south, of which only 1.7 million m³ are currently used (Boudoukhana, 2008, p. 13).
- **Surface Water:** The surface water resources are estimated at 12.7 billion m³ per year, with 11.9 billion m³ located in the north and 0.8 billion m³ in the south. Algeria's surface water includes 17 watersheds divided into three groups: the first is the Mediterranean basin with a capacity of about 10.92 billion m³, the second is the highland basins with a capacity of approximately 997 million m³, and the third is the desert basins with a capacity of about 800 million m³. The actual rate of surface water exploitation in Algeria, stored by 90 operational dams with a total storage capacity of 12 billion m³, reached about 9 billion m³ by the end of 2024. The percentage of surface water mobilization compared to the available amount (12.7 billion m³) remains insufficient, particularly in the central and eastern regions of the country (Al-Hurriya, 2022). Surface water includes watercourses collected as rivers and valleys, which increase their flow due to rainfall and snowmelt, fed by renewable springs.

The following table illustrates the distribution of traditional water resources available in Algeria.

Table 01: Distribution of Traditional Water Resources in Algeria for the Period 2003-2024 (Unit: Billion m³)

Geographic Areas	Surface Water	Groundwater	Total	Percentage
North	12.5	2.1	14.6	80%
South	1.8	1.9	3.7	20%
Total	14.3	4.0	16.8	100%
Percentage	78%	22%	100%	(100)

Source: Prepared by the researchers based on data from the Ministry of Water Resources and Water Security and the annual reports of the National Water Resources Agency.

The updated data for the period 2003-2023 shows a significant increase in the total available water resources in Algeria, rising from 16.8 billion m³ in 2003 to 18.3 billion m³ currently, representing an increase of 8.9% over twenty years. This

increase reflects the government's efforts to enhance water infrastructure, especially in seawater desalination, which has helped strengthen traditional water resources. However, the geographic distribution of these resources remains unbalanced, with the north accounting for 80% of water resources despite its much smaller area compared to the south. This disparity directly impacts balanced economic and social development between the northern and southern regions, necessitating continued investment in desalination projects and improvements in distribution networks to achieve greater equity in water resource distribution.

3. Non-Traditional Water Resources:

In light of the increasing demand for this vital and strategic resource, rapid population growth, industrial development, reduced rainfall due to drought phenomena, and the challenges posed by terrain and economic constraints (high financial costs) in investing and utilizing natural water sources (rainfall, surface water, or groundwater), it has become essential to explore alternatives and methods to diversify and develop water supply sources, particularly through seawater desalination and wastewater treatment.

3.1 Seawater Desalination:

Algeria has seen significant development in the use of desalination technology, as the amount of desalinated water has increased since its implementation. Statistics from the Ministry of Water Resources indicate that the volume of desalinated water is expected to reach 3.7 million m³ per day by the end of 2024, which will cover 42% of the needs of Algeria's population, estimated at 47 million. Algeria aims to reach 5.6 million m³ per day of desalinated water by 2030 (Al Jazeera, 2024). Investment in the field of water desalination has also seen substantial growth in Algeria, with a budget of approximately \$1.5 billion allocated to improve the infrastructure of treatment plants by 2025.

3.2 Wastewater Treatment:

This constitutes an essential part of the national strategy to combat water scarcity, which is crucial in light of population growth and urban expansion that increase pressure on traditional water resources. Algeria's capacity to manage this water resource remains insufficient, as wastewater from coastal populations is discharged into the sea, while in other areas, it is released into valleys and marshes. It is expected that the capacity of wastewater treatment plants will expand to reach 2 million m³ per day by the end of 2024, with about 70% of treated water intended for

agricultural use, thereby enhancing food security. The government plans to establish 10 new treatment plants in various regions.

4. Causes of the Water Resources Problem in Algeria:

There are several common factors contributing to the water issue in Algeria, including natural and climatic factors, those related to imbalances in the management and organization of the sector, as well as legal, regulatory, financial, human, and technical factors, all of which jointly explain the complexities surrounding water resources in Algeria.

4.1 Natural and Climatic Problems: Algeria suffers from a scarcity of water resources due to its location in an area dominated by arid and semi-arid climates that have prevailed for many years, as well as the pollution of surface and groundwater, rapid population growth, and the rising living standards of individuals, which demand greater water consumption (Khaled, 2022). Additionally, extensive urban development resulting in increased housing construction further exacerbates the water crisis. This situation has had very negative impacts, including:

- Reservoirs filling with water while their storage levels have fallen to critical lows (National Economic and Social Council, 2000, pages 56-57);
- Serious disruptions in water supply programs, with many regions in the country receiving water only once every two or three days under the emergency drinking water supply plan (Mohamed, 2006, pages 160-166);
- Uninvested projects, including the Chelif Project, which extends to Tunisia over an area of 400,000 km² and is estimated to store four times the renewable water resources in the western region, with a total capacity of 120 million cubic meters as part of the "Mao" water transfer project (Mostaganem-Arzew-Oran) (Farah, 2010, page 11). This project has faced multiple delays due to financial and administrative issues and the need for modern technologies to ensure efficient water transport and treatment.

4.2 Sedimentation Issues in Dams: Algeria has seen significant expansion in the construction of dams for water storage and to meet drinking and irrigation water needs. The number of dams has reached 80, with a storage capacity of about 9 billion cubic meters by 2024. However, these dams are experiencing alarming levels of sedimentation that exceed those recorded in neighboring countries like Morocco and Tunisia. Nine dams were processed in the context of the fourth national campaign for sediment removal scheduled for 2019-2024. According to the National Agency for Dams, the dams affected include Frikouk, Bouhanifia (Mascara), Foug Qays

(Khenchela), Al-Qasb (M'sila), Zardaza (Skikda), Jurf al-Turba (Béchar), Marja Sidi Abed (Guelma), El-Hamiz (Boumerdes), and Gharib (Ain Defla). Sediment removal operations allowed for the extraction of approximately 38 million cubic meters of sediment.

Regarding the causes of this phenomenon, the agency confirmed that dam sedimentation is primarily due to climate changes, especially rising temperatures and weather fluctuations that cause soil erosion. According to agency estimates, sedimentation levels will reach 1.4 billion cubic meters by 2025 for existing dams only, amounting to 18.05% of the total storage capacity (National Agency for Dams and Transfers, 2024).

4.3 Water Pollution: Water pollution represents a phenomenon that threatens the loss of a significant portion of water resources, whether from wastewater or from industrial effluents discharged into waterways without treatment, or from agricultural drainage containing large amounts of pesticides, salts, and waste that are transported to valleys or seep into the ground to pollute groundwater. Other sources of water pollution include the discharge of chemical waste generated by healthcare activities directly into rivers and the sea or at public sites adjacent to water bodies (Mohamed, 2006, page 150). According to various official studies, the Shlef region is the most affected by this pollution, with concentrations rising to 270 mg/L, while the World Health Organization standard is 50 mg/L (Ministry of Urban Planning and Environment, 2001, page 74). Reports indicate that approximately 60% of water sources in Algeria are polluted due to industrial and agricultural discharges, and about 30% of groundwater is contaminated, affecting the quality of water used for drinking and agriculture. Estimates suggest that over 40% of rivers and lakes in Algeria suffer from significant pollution.

Reports from the United Nations regarding water development in 2024 indicate that many Algerian cities, especially urban areas, suffer from water pollution resulting from industrial and domestic waste. Major cities like Algiers face significant amounts of untreated wastewater, which is discharged into rivers and the sea, increasing pollution levels and negatively impacting water quality. The agricultural sector is also a major source of pollution in Algeria. The sector heavily relies on the use of pesticides and chemical fertilizers, which seep into groundwater and surface water, affecting the quality of water resources. According to a report from Fanack, the excessive use of these chemicals in agriculture is a significant challenge for water resources, and the problem of water pollution is expected to worsen with rising temperatures and decreasing rainfall due to climate changes, increasing the salinity of some water sources. Projections indicate that per capita

water resources may drop to critical levels by 2050, leading to an increased need for seawater desalination to meet the country's needs (water.fanack, 2019).

4.4 Long Project Completion Times: Poor management of works and achievements has led to extended project completion times and delays in implementing programs, resulting in soaring costs. This situation has delayed the process of providing drinking water to the population and harmed the national economy. The reasons for these delays include interruptions and delays in project timelines. For instance, the costs of constructing the Kramis Dam (in the Mostaganem region) increased tenfold in less than four years, with the initial estimate not exceeding 300 billion centimes, which reached 970 billion centimes in the sixth price review (United Nations, 2006, page 6).

The current state of the water sector in Algeria can be diagnosed in terms of the lack of harmony and integration between the processes of study, implementation, and exploitation as follows (Mohamed, 2006, page 153):

Modifications were made to ongoing projects. Due to a lack of data and surveying information related to project implementation and the absence of a reference system to analyze and evaluate the quality of studies conducted by consulting firms, it became necessary to introduce modifications to these ongoing projects. For example, the Chouffa Dam (in the Mascara region) was originally designed with a height of 60 meters and a base width of 200 meters, but it was modified due to the characteristics and surveying features of the ground layer, resulting in a height exceeding 80 meters and a base width reduced to 100 meters. The same applies to the Moun Dam in Setif, where repeated modifications led to delays in its delivery, with additional costs due to delays estimated to reach 20-30% of the original budget for many projects.

4.5 Disruptions in Drinking Water Supply: Despite the fact that public spending allocated to the water resources sector ranges from 20% to 30%, and the level of connectivity of population centers to the drinking water supply network reached 82% according to a report from the World Bank, this percentage varies between urban and rural areas in 2023 (Algerian News Agency, 2022). This is at a time when the United Nations Committee on Economic, Social, and Cultural Rights has stated that the human right to water should ensure everyone has access to sufficient and safe water for personal and domestic use. In 2005, the Minister of Water Resources revealed the following figures:

- 9.5% of population centers have a regular supply of drinking water 24 hours a day.

- 60% of population centers receive drinking water daily for a period ranging from 2 to 16 hours.
- 30.5% of population centers receive water once every two days or more for a period ranging from 2 to 8 hours. This dire situation is due to endless leaks in water distribution and transport networks, which, according to water sector officials, represent the biggest problem facing the sector. The issue of water leaks through distribution networks is mainly attributed to three factors: technical, administrative, and social:
 - The age of the water transport and distribution networks, most of which date back to the colonial period, with authorities failing to maintain and renew them due to high financial costs.
 - The failure of national construction companies to adhere to established standards, especially regarding the conditions for the implementation and installation of networks, the size of pipes, and the quality of materials used, resulting in frequent breakages and repetitions due to their inability to withstand water pressure.
 - Citizens engaging in unauthorized works to connect their neighborhoods to the distribution network using unfit plastic pipes, due to long waiting times from the concerned authorities or due to the legal status of their neighborhoods, which does not allow for connection to the network (i.e., informal neighborhoods) (Naif, 2003, pages 123-124).

4.6 Insufficient Number of Sanitation Networks and Treatment Plants

The existing wastewater treatment plants in Algeria are inadequate and often do not receive the necessary priority and care (Abderrahmane, 2003, p. 11). The problems facing the sector primarily stem from the poor operation and maintenance of sanitation networks and treatment plants, alongside a lack of necessary financial resources for their management and operation. The National Economic and Social Council highlighted in its environmental report that these treatment plants are often non-operational, neglected, or, at best, operated irregularly. Some plants are in such disrepair that any thoughts of repair are unfeasible, and even the operational plants do not reach their designed treatment capacity. It is noted that the total volume of wastewater produced is expected to exceed 1,150 million cubic meters by 2020, with only 10% being treated (National Economic and Social Council, 1997, p. 30). This situation is related to issues such as user training, technical control, and a lack of operational funding, which signifies deficiencies in policies supplying the agricultural sector with necessary water resources.

Algeria currently has 213 treatment systems with a processing capacity of 1.031 billion cubic meters annually. However, these systems operate at less than 50% of their capacity, with an annual average treatment of approximately 442 million cubic meters, while the national treatment rate is around 44%. There are plans to operationalize 27 currently inactive treatment plants, rehabilitate and update 18 other plants, and upgrade pumping systems for irrigation in the Green Dam across six provinces. Additionally, there are plans to integrate tertiary treatment for the reuse of treated water from nearby treatment plants for agricultural and industrial irrigation (particularly in the El-Harrach complex) (Algerian News Agency, 2023).

4.7 Water Resources Allocated to the Agricultural Sector

In 2005, the area of irrigated agricultural land in Algeria was approximately 420,000 hectares, accounting for about 5% of the total agricultural land area (Salah, 2000, p. 14). This area has been increased to 2 million hectares while reducing uncultivated land and enhancing plant and animal health protection as of 2017 (Al-Ra'id, 2017).

4.8 Legislative Factors

A thorough examination of the institutional, legislative, and regulatory development of the water resources sector in Algeria reveals a multitude of structures and texts, with at least 12 distinct phases marking this evolution. The period from 1962 to 1970 was characterized by a proliferation of operators in the water sector with minimal state intervention in organizing activities related to water resources. However, starting in 1970, the organization shifted toward state dominance, with the establishment of the National Company for the Distribution of Drinking and Industrial Water on November 23, 1970, to monopolize water management across the country, covering various activities (such as production, distribution, management, maintenance, and electricity) (Boudraf, 2012, p. 12).

This led to stagnation and the complete disappearance of local organizations that relied on local initiatives and participation from local actors and users. Furthermore, the efficiency of water management decreased due to reliance on political and social criteria while neglecting economic and commercial standards. In 1987, a restructuring occurred once again (Farah, "Water Resources Policy in Algeria and the Application of Privatization in Urban Water Sector," doctoral thesis, 2010), where 35 public industrial and commercial institutions managed this sector. The Water Law issued on December 5, 2005, reinforced the issue of water resources and defined the rights and obligations of water users, establishing the main legislative

framework governing water resources management in Algeria with the aim of protecting these resources and developing their usage (Official Gazette, 2005).

Despite these legislative efforts aiming for an integrated and sustainable water resource management, especially in the face of challenges such as climate change and population growth, they have resulted in conflicts in policy formulation, program implementation, and accountability. Additionally, municipalities have struggled to shoulder the responsibilities assigned to them in the water sector due to a lack of financial and technical resources (Boudraf, 2012, p. 12).

4.9 Financial Factors

Mobilizing, transporting, distributing, and maintaining water quality primarily requires significant financial and material resources. However, the water sector in Algeria suffers from a lack of necessary funds to finance water projects and investments. Additionally, it faces significant difficulties in utilizing external funding and does not cover the actual costs of water pricing.

4.9.1 Misuse of Financial Resources Allocated to the Water Resources Sector

The issues surrounding public finances in the water resources sector in Algeria are manifested in various real-life examples related to specific projects and works. Here are some of these examples:

- **Dam Projects:** Projects for building dams, such as the Kaf el-Dhir and Boukhalifa dams, had substantial budgets allocated to them. However, these projects faced significant delays in implementation, and the dams were not fully utilized after their completion. Reports indicate that some dams suffered from technical problems, adversely affecting their efficiency.
- **Water Desalination Projects:** Several desalination plants, such as the one in El-Marsa, were established in Algeria. Despite significant investments, these plants encountered operational and financial issues, such as the inability to achieve the targeted production capacity, leading to high water production costs compared to subsidized prices.
- **Water Distribution Networks:** Reports indicate that water distribution networks in many cities suffer from substantial leaks. For example, in Algiers, it is estimated that about 30% of water is lost due to leaks. This represents a waste of financial resources, as money was spent on developing the networks without achieving tangible results.

- **Agricultural Irrigation Projects:** In some areas, agricultural irrigation projects were executed with large budgets, but many did not achieve the intended benefits. Reports indicate that some of these projects suffered from a lack of planning and organization, leading to ineffective utilization of irrigated lands.
- **Corruption and Incomplete Projects:** There are multiple cases where administrative corruption related to water projects was uncovered, such as bribery to secure contracts or misleading reports about project progress. Some projects were declared completed while they were not, resulting in a waste of public funds.
- **Neglect of External Funding Sources:** The state's resources alone are insufficient to develop this vital resource and meet the needs in this area. Therefore, the Algerian government seeks and searches for external funding sources, whether through opportunities provided by bilateral and multilateral cooperation or through water partnership programs. However, the water sector in Algeria faces significant challenges in utilizing external funding (such as loans, grants, and aid) and putting it into practice due to the following reasons:
 - The slow and bureaucratic procedures imposed by funding entities (such as financial and international funds), requiring very long timelines (at least two years);
 - The strategic importance of the water resources sector in Algeria justifies the high level of state investment and its necessity to be maintained. This requires the availability of multilateral financing to provide Algeria with additional flexibility to implement its policies. The situation can be exploited to generate significant business interest and attract investors in the coming years, particularly encouraging foreign direct investment, especially in partnership sectors, in a context that could enhance competitiveness and provide more efficient services, especially in the agricultural sector, particularly given Algeria's favorable financial position resulting from high oil prices.

4.10 Poor Pricing of Water Services

The prices set for various purposes (such as drinking, industry, and irrigation) remain insufficient despite recent increases implemented since 2005, and they do not incentivize rational usage of this precious resource. Water sector officials indicated that state support for the sector has been and continues to be evident in the pricing applied, which does not align with the actual cost of water production. The following table illustrates this:

Table 02: Water pricing applied according to Law 05/13

Categories	Consumption Volume	Applied Prices (DZD/m ³)
Households	First section: 0 to 25 m ³ / quarterly	6.3
Households	First section: 26 to 55 m ³ / quarterly	20.48
Households	First section: 56 to 82 m ³ / quarterly	36.65
Households	Fourth section: over 82 m ³ / quarterly	40.95
Administration	Single section	34.65
Services	Single section	34.65
Industry and Tourism	Single section	40.95

Source: Executive Decree No. 05-13 dated 28 Dhu al-Qi'dah 1425, corresponding to January 9, 2005.

The study of the water pricing system in Algeria reveals a multi-dimensional water policy that combines social, economic, and environmental objectives. The system adopts a progressive pricing structure starting with a low multiplier factor of 1.00 for basic household consumption (0-25 m³/quarter), increasing progressively to over 82 m³/quarter. This reflects a clear trend toward protecting low-income social groups while simultaneously encouraging rational consumption. In economic sectors, the system applies a uniform pricing model for each sector with clear distinctions between them, where industry and tourism bear the highest multiplier factor of 40.96, followed by services and administration (34.65). This reflects an attempt to balance financial sustainability of the service with covering production and distribution costs on one hand, and considering social aspects and the purchasing power of citizens on the other. Overall, this pricing system aims to achieve economic efficiency in water resource utilization while ensuring social equity in its distribution and maintaining environmental sustainability by encouraging rational use across all sectors.

4.11 Human Factors: In addition to the natural, managerial, and financial pressures that characterize the water resources sector in Algeria, there are human and technical factors that also contribute, either directly or indirectly, to the worsening issue of water resource management. These factors are defined as follows (Benhamou, 2021):

- **Rapid Population Growth:** The population density in Algeria is estimated at about 18 inhabitants per square kilometer, with a significant concentration in the coastal plains and northern mountains, where approximately 90% of the population resides. Population growth has exacerbated the water scarcity faced

by Algeria. While natural factors, such as intermittent drought periods and limited freshwater reserves, cause water shortages, rising population numbers impose additional pressures. The population distribution in Algeria is marked by uneven and unbalanced urban and regional concentration, with most people concentrated in northern urban areas, especially coastal cities. Urban population increased from 40.3% in 1975 to 73% in 2023, indicating a significant migration to cities, with Algiers being the most crowded, exceeding three million inhabitants. This has resulted in real difficulties in both the quantity and quality of water supply. This growth and population concentration have placed a heavy burden on natural resources, primarily water.

- **Weak Training in Water Resources Management:** The management of this sector and its vital facilities is among the most significant challenges in the country due to the inadequate training and qualification of administrative and technical personnel. Various dams, treatment plants, and seawater desalination facilities suffer from a severe shortage of specialized competencies. Algeria has 70 dams as of 2014, expected to rise to 139 by 2030 (Mohamed B., 2013), yet lacks technicians specialized in transferring water from one dam to another or connecting dams.
- **Low Efficiency in Water Resource Use and Consumption:** Water resources are depleting, and their consumption is characterized by waste and irrational use, leading to significant losses for various purposes, with leakages in water transport and distribution networks reaching 40%. For domestic uses such as drinking, cooking, washing, and cleaning, consumption is high due to extravagance, misuse, and lack of maintenance in homes. As the wasted water increases, the total consumed water also rises. In this context, the Algerian Water Corporation revealed that the number of citizens without meters is continually increasing, while other countries are providing their populations with new generation meters.
- **Weak Programs Related to Water Quality and Education:** It is globally recognized that achieving water security is impossible without a radical change in human ideas, behaviors, and practices. The issue of water resources is fundamentally a societal problem. To achieve this, it is essential to raise awareness and sensitize various community segments, from citizens to decision-makers, about the importance and value of water resources as a strategic and civilizational stake.

5. Conclusion:

Algeria belongs to the Arab region characterized by dry and semi-arid climates, where water resources are limited and close to poverty levels. According to estimates from the Food and Agriculture Organization, by 2030, one in five countries will face actual water scarcity due to complex and diverse problems. Algeria has various surface and groundwater resources, primarily due to its geographical and natural diversity, distinguishing it from other countries. However, it has faced significant issues regarding this precious resource for several years due to a range of external and internal factors, such as climate change represented by drought caused by a lack of rainfall, poor exploitation of this vital resource, and population growth exacerbating the crisis due to increased demand for water to meet domestic, industrial, and agricultural needs. To address these problems, we propose the following solutions:

- **Institutional Solutions:** Due to the problems arising from the multiplicity of institutional frameworks for water resource issues, it is crucial to achieve decentralization in managing them to ensure effectiveness and sustainability of this important resource. A participatory approach aimed at encouraging broad participation and consensus among all stakeholders must be considered. The need for decentralization requires building capacity to enhance the effectiveness and efficiency of agencies (Mouhssine, 2023).
- **Technical Solutions:** The water problem in Algeria cannot limit the quantity, quality, and sources of available water resources, negatively affecting planning, organization, direction, and control. Knowing the available resources and their quality at different times according to material, social, and economic conditions is a prerequisite for planning and designing sustainable and economically viable water projects.
- **Economic Solutions:** The pricing of water resources in Algeria relies solely on social aspects, neglecting economic and environmental considerations, leading to waste in consumption. Therefore, all factors involved in providing water should be considered in the pricing process. Price serves as a primary incentive for the proper use of water, helping producers supply water at optimal levels, necessitating the establishment of a gradual, fair, transparent, and appropriate pricing system alongside privatizing the water resources sector.
- **Social Solutions:** The social aspect is an important part of the water resources problem and should thus be considered when establishing water resource projects. In this context, it is essential to:
 - Consider water demand as a key element in exploiting water resources; unlike the top-down approach, beneficiaries should participate in the water issue.

- Ensure women's participation in decision-making regarding water resources.
- Rely on education and training through programs to raise awareness of water use and sustainability, which is essential for improving health—representing human capital.
- Foster education within families: The family is the foundation of building society and the nation; thus, if the family thrives, society will prosper. There should be a focus on families to create an education aligned with the community's overall objectives, prioritizing water consumption rationalization.
- Promote education in educational institutions: Our children spend two-thirds of their lives in school, from primary to secondary education, where their general characteristics are shaped, and their psychological, social, and cognitive development is completed.
- Encourage education in society and its diverse institutions: Society comprises families, individuals, service, and production institutions. Individuals feel that the social conscience lives within them, guiding them alongside personal conscience, which reflects the social conscience of individuals. Thus, if society formulates clear and specific goals to rationalize water consumption, it will certainly achieve beneficial results translating these goals and direct guidelines in all workplaces while monitoring individuals to respect water wealth and prevent waste in any usage area, reporting any faults in water networks.
- Promote education through laws and legislation: Society sets general objectives and strategies for developing, preserving, and protecting water resources in terms of quantity and quality, ensuring they are not wasted or polluted. Therefore, laws and regulations must be enacted, which can be categorized as:
 - ✓ **Encouraging and Incentive Legislation:** Through symbolic rewards for individuals and institutions that implement state objectives to protect water resources and rationalize their consumption, including applying incentive prices for families with lower consumption.
 - ✓ **Deterrent Legislation:** This type of legislation exists in most countries worldwide, based on the principle that water wealth belongs to the entire community and is a vital national resource. Its importance increases in communities suffering from scarcity, such as Algeria, to a critical extent. Laws are typically enacted

with escalating penalties, ranging from misdemeanors to criminalization for those who violate water ownership.

- **Financial Solutions:** The strategic nature of the water sector in Algeria justifies the high level of investment from the Algerian state and the necessity to maintain it. This situation necessitates the availability of multi-party financing to provide additional flexibility for Algeria to implement its policies, allowing the situation to attract many businessmen for investment in the coming years and encourage foreign direct investment, particularly in the partnership sector, which would enhance competitiveness and provide more efficient services, especially in the agricultural sector.

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