Remittances Review
April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

Received : 25 February 2024, Accepted: 31 March 2024
DOI: https://doi.org/10.33282/rr.vx9i2.126

Use of Groundwater in the Algerian Desert Regions

Dr. Kheireddine Bentarzi[1], Dr. Nadhira Attalah[2]

Abstract:

Water is regarded as one of the basic elements for life on the surface of the Earth, and its presence increases in significance in desert areas featured by harsh nature. Where there is an important rise in temperatures and a lack of precipitation, which results in water scarcity. Therefore, the need arises to extract groundwater to exploit it for drinking and irrigating agricultural lands.

The groundwater network in the Algerian desert extends over an area estimated at about 2 million km2 and is one of the largest water reservoirs in the world. Accordingly, desert groundwater provides about 95 percent of the water consumption needs of the population in the desert regions of Algeria .

Among the desert areas abundant with significant groundwater in Algeria, we mention the Ain Salah region. Its groundwater contributed greatly to the local development of the region and encouraged population stability. This prompted the Algerian authorities to give great significance to the completion of a huge project: the extension of a transportation pipeline—groundwater from the Ain Salah region to Tamanrasset, a distance of approximately 750 km.

Keywords: Groundwater; desert regions; population stability; dams; Ain Saleh; Tamanrasset.

[1]- Laboratory of History, Civilization and Applied Geography, Higher School of Teachers, Bouzaréah (Algeria). bentarzi.kheireddine@ensb.dz

[2]- Laboratory of History, Civilization and Applied Geography, Higher School of Teachers, Bouzaréah (Algeria). Attalah.nadhira@ensb.dz

Remittances Review
April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

Introduction:

The proportion of water on the Earth's surface is estimated to be 71%. Allah Almighty highlighted the significance of water, stating: "**And We made from water every living thing**." (Surah Al-Anbiya, Verse 30). Due to the importance and necessity of water for sustaining life on Earth, we note the establishment of most ancient civilizations around rivers and valleys, such as the civilizations of Mesopotamia and the Nile Valley. Indeed, in every human settlement, the availability of water is essential. Most of the ancient Algerian cities were founded around valleys and springs. For instance, the city of Tlemcen was established along the Sefsaf Valley, and the city of Algiers (the current capital of Algeria) used to be supplied with water from one of the eastern valleys. Furthermore, Bejaia was founded on one of the banks of the Great Valley (currently known as Soummam).

Freshwater sources include groundwater, springs, rivers, valleys, rainfall, and snow. Groundwater is the most important source, forming between layers of the Earth over specific periods. It accumulates within the fine pores of sedimentary rocks, originating from rainwater, snowmelt, lakes, springs, rivers, and valleys. Groundwater exists beneath the Earth's surface at different depths.

Through this study, we aim to highlight the significance of groundwater in Algerian desert regions and the locations where it is available in the Algerian desert. Moreover, we will discuss one of the projects, often called the project of the century: the water pipeline connecting Ain Salah and Tamanrasset.

1- Drought Threatens Water in Algeria:

Until today, humans have exploited freshwater resources and managed them fragmentedly because their understanding of ecosystems is also fragmented. The goal is to concentrate on one factor at a time, whether navigation, irrigation, energy generation, recreational fishing, or even limited measures for water quality, without regard for the entire system. However, the river does not stop at the water's edge, and healthy wetlands are not simply places to grow cattails or shelters for ducks

April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

(Raphael, 1995, p.16).

Decreasing the quantity of chemicals and waste we produce and add to our regional waters is one of the most important environmental successes in recent years. The Clean Water Act in the United States and the Rhine Action Plan in Europe have significantly enhanced water quality by reducing industrial and local waste pollution. Better sewage water treatment and changes in industrial processes have lowered the amount of heavy metals entering the Rhine by 40%. On a continental scale, getting rid of lead in gasoline and phosphates in detergents has led to a tangible reduction in these harmful substances in water at a low cost to consumers and industry. However, reducing pollutants from dispersed sources, such as runoff from farms and homes, remains challenging **(Kaal, 1996, p. 119).**

The natural aspects have significantly changed in most parts of the world, and it is apparent that as we restore the health of modified freshwater systems, we should not only focus on individual species or isolated settlements. It is essential to conserve and restore ecosystem processes to their natural state. Typically, the first step includes reducing pollution severity, controlling invasive species, and enhancing water flow and quality. In many places, it is better to set a more realistic goal for restoring and revitalizing some ecosystem functions and to encourage nature in its processes of reproduction and balance. The system can fulfill self-sufficiency once human pressures and stresses are relieved and natural processes are supported (such as maintaining sufficient water flow features throughout the system and at the right time of the year). This may take time, but it is expected to continue longer (Raphael, 1995, p. 121).

1- **Geography of water resources in Algeria**:

. For more than 20 years, Algeria has been exposed to severe and continuous drought. This situation has prompted us to question the stability of the climate, and even to study how to take into account such a phenomenon and plan for it. Before that, we try to identify areas various water resources. Algeria is characterized by a climate that is hot in summer and moderate to cold in winter. Rainfall is almost non-existent in summer, with a very high rate of evaporation, which results in a complex water

April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

system with fluctuations in the seasons over the years. As for rain, it falls about 100 days a year maximum, and sometimes the rate of fall may exceed 100 mm in less than one day, and a large portion of the year's rain may be concentrated within a few days, with snow sometimes falling on the mountain peaks,

Rainwater forms the backbone of water resources in general, as it is a source of recharge for groundwater basins, natural streams, springs, and valleys. Rainfall amounts vary from one region to another, as we saw previously.

It must be noted that Algeria lacks large rivers such as the Nile, the Tigris, the Euphrates and the Jordan River, when compared to the Arab countries. Therefore, water resources are the sum of groundwater as a result of torrents and seasonal rains, which are affected by climate and environmental changes .

These natural problems are added to other problems represented by human factors. such as the increase in population, the increase in demand for water, and the administrative and bureaucratic problems related to the management of this vital resource, in addition to economic, financial, social, and cultural problems, making the matter more complicated and it can become We add other problems represented by the lack of international agreements as a result of pollution. Environmental issues regarding water and the unfair and unbalanced distribution of water (Noureddine Haroush, pp. 61-62)

2. Water governance:

The average annual rainfall in the north of the country is more than 500 mm and can sometimes reach 1,500 or 2,000 mm. The rain gradually decreases as we go south until it is less than 100 mm per year in 4 areas bordering the desert and is almost non-existent in the desert areas. Drought is therefore considered the greatest cause of concern, as water resources are limited and are expected to be fully exploited soon, which puts the country at risk of failing to cope with periods of drought, in addition to the possibilities of climate change and the adverse effects that may accompany it. Water resources in Algeria consist of traditional resources, such as rainwater, groundwater basins, and surface water, and unconventional resources, such as desalination and filtering of sanitary and agricultural wastewate.

Algeria, for instance, is characterized by water scarcity due to its geographical location, which is situated amidst a dry and semi-arid belt, making it one of the regions in the world most in need of preserving its available water resources and finding new water sources to meet the daily needs of its population and ensure the continuity of other economic activities. Water scarcity is met with significant population growth, reaching approximately 46 million people by 2023. This population growth has been accompanied by an increase in individual income, resulting in a rise in food demand, estimated at an annual increase of 5% in consumption rates, leading Algeria to import about 50% of its food needs.

Furthermore, the threat of desertification is gradually encroaching on most Algerian lands, raising a challenge to fulfilling water security. Moreover, there are concerns about environmental pollution in river basins, necessitating the adoption of water policies and strategies in this area.

3- Geography of water resources in Algeria:

Water sources and sources include surface water such as valleys, streams, lakes, seas, spring water, groundwater, and rainwater. Algeria has diverse water resources, mainly due to the geographical and natural diversity that distinguishes it. The large area and diversity of terrain are factors affecting the precipitation process, which constitute a major source of water resources for the country, as the total volume of water resources in Algeria is estimated at 19 billion m3/year, of which 13 billion m3/year. On the northern side and 5.2 billion cubic meters on the desert side. These resources are distributed between groundwater and surface water. The country's potential for renewable water is estimated at 75%, 62% for surface water and 15% for groundwater.

4- Water sources in desert areas and their uses:

4-1-Water dams:

Modern dams are divided on the basis of their structural form and the materials used in their construction. Modern dams are of various types, namely: heavy dams, bridges, reinforced dams, and bridges. Concrete is usually used to construct these

April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

types, and there may be one building containing one or more types of these dams. For example, an arched dam may contain a heavy dam and a bridge to reduce a certain stability. The bridge may also contain a concrete part and a heavy dam part containing channels to drain excess water. There are economic and engineering considerations that determine the choice of the appropriate type of dam for a particular area, and the costs of the types of dams depend. Depending on the availability of building materials and the proximity of transportation, the conditions for laying foundations are often determined by the type of dam that will be built in a particular area. (Diab Al-Hafiz, 2013, p. 5)

Wadi Mezi Dam or Saklafa Dam. This dam is a unique model in the world because it is among the three dams that exist at the global level (Algeria - Afghanistan - Mexico). This type of dam stores water underground in the same amount as it is stored above the surface, or what is known as barrages. (Barage).

2. Water and its Impact on Civilizational Aspects:

Retaining water for storage and use is mainly linked to constructing dams to concentrate the natural water flow at a specific location. Accordingly, it becomes possible to generate electricity, divert water from rivers into channels, implement irrigation systems, supply water, increase river depths for navigation purposes, control river flow during floods and droughts, and establish artificial lakes for recreational purposes. Controlling water and employing it through dams profoundly affects the economic potential of vast regions.

Among the initial phases of development for any developing country is acquiring the ability to utilize dams for energy generation, agricultural production, and flood prevention, helping create a clean environment. The abundance of groundwater in desert regions has allocated specific areas for cultivating strategic crops, which are rotated annually as needed, such as wheat and sugar cane, and different industrial crops, like plants employed for extracting different types of oils (such as sunflowers and cottonseeds).To produce these crops and others, it is necessary to provide the required quantities of water, which requires basic means of storage. Like many other countries, Algeria has prioritized modern dams to fulfill water security, self-sufficiency, and food security.

Remittances Review
April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

3. Dams and Their Role in Fulfilling Water Security:

Modern dams are classified based on their structural form and the materials employed in their construction. Numerous modern dams include gravity, arch, buttress, and bridges. Concrete is commonly utilized in constructing these types of dams, and a single structure may contain one or more of these dam types. For instance, an arch dam may involve gravity and bridges to reduce specific stresses. Similarly, a bridge structure may incorporate a concrete section and a gravity dam containing channels for draining excess water.

Economic and engineering considerations determine the appropriate type of dam for a particular area. The costs of different types of dams rely on the availability of construction materials and transportation proximity. The conditions for laying foundations often dictate the type of dam to be built in a specific area (Al-Hafez, 2013, p. 5).

Wadi Mezi Dam or Saklafa Dam. This dam is a unique model in the world because it is among the three dams that exist at the global level (Algeria - Afghanistan - Mexico). This type of dam stores water underground in the same amount as it is stored above the surface, or what is known as barrages. (Barage)

This dam allows the storage of the same amount as what is present on the surface of the earth. It is considered one of the most important tourist, historical and recreational facilities in the region since the completion of its construction until today. This dam has witnessed and continues to witness the influx of thousands of visitors coming from the various municipalities of the state, and outside it, where they are captivated by the picturesque natural scenery. On the banks of the valley, whose sides are surrounded by majestic pine trees and adjacent to the edge of the mountain separating it from the pastoral surroundings, and despite all this, the local authorities remain unable to rescue this vital and important tourist facility from the neglect it has been subjected to

unicipality

of Tadjemout and its residents. It irrigates 1500 hectares of agricultural land, extending approximately 20 kilometers through natural or topographic flow systems.

April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

This system plays a significant role in expanding agricultural areas, which are manageable for the state budget. Tadjemout municipality, located about 50 kilometers from the headquarters of the Laghouat province, possesses important agricultural wealth that, if scientifically used, could greatly benefit. More than one irrigated orchard from this underground dam is one of the three dams completed globally today. (Source: Kerdan Palace / One of the palaces of the Algerian Sahara. Tadjemout Dam: Located on the M'zi Valley in the southern foothills of the Amour Mountains, 50 kilometers away from the headquarters of Laghouat province).

On the banks of the Tadjemout Valley, there are over 600 types of fruit-bearing trees, in addition to 1500 hectares of fertile land that once supplied nearby model villages and towns with different vegetables and fruits. During the French occupation, these lands were cultivated by the elderly, who were renowned for growing high-quality wheat and barley. They also cultivated sugar beets and sugarcane, which supplied the Khemis Miliana sugar factory.

Today, this vital tourist facility witnesses significant neglect, as it is outside the concern of the relevant authorities, who have yet to make an effort to enhance and rehabilitate it.

Numerous institutions have conducted successful experiments in recent years, resulting in significant cotton production and a successful cheese-making process. Unfortunately, these successes did not see the light of day due to the turnover of several administrations, leading to the neglect of these projects. If properly employed, these initiatives become essential water and economic resources and sources of employment. In addition to building dams on valleys and rivers, the state has also focused on transferring groundwater from its sources to areas lacking this vital resource, as seen in the Ain Salah-Tamanrasset pipeline project.

4. Water Transfer via Ain Salah Pipeline: Tamanrasset:

This project cost the state treasury 197 billion dinars and transports approximately 100,000 cubic meters of water daily, covering the province's water needs until 2040. See the following picture representing the project of the century, quenching the thirst of the Ahaggar people.

Remittances Review
April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

Source: Echorouk Online, March 15, 2011 AD, Issue 5833

The water transfer from Ain Salah to Tamanrasset is classified as one of the massive projects that the authorities have worked on to benefit citizens in the southernmost part of the country—a step towards fulfilling balanced development across the nation. Later, a desalination project was added to bring the water to residents' aspirations.

In 2011, the capital of Ahaggar witnessed a transition between two eras, during which the region moved from one phase to another. This period marked the beginning of a change in one of the essential aspects of daily life, thanks to the project of the century, a term coined for the water transfer operation from the capital of Tidikelt, Ain Salah, situated 750 kilometers away, to the capital of Ahaggar, Tamanrasset. This achievement partially ended the long-standing problem of water scarcity in the region, reducing the heavy dependence on purchasing water tanks, which burdened the residents.

However, the demand for the latter has recently become a source of frustration and dissatisfaction due to the process of supplying water to the population, which has

April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

been experiencing frequent and prolonged fluctuations and interruptions, particularly in some neighborhoods during the summer season. This happens when the price of water marketed through tanks has tripled, reaching 1000 to 1500 Algerian dinars per liter, compared to its usual price of 500 dinars.

Mansour Terra, the director of drinking water supply at the Ministry of Water Resources, considers the project to transfer drinking water from Ain Salah to Tamanrasset as the project of the century par excellence, given its strategic significance and the resources allocated by the state to accomplish it.

For many years, this province has suffered from a severe shortage of drinking water. After several studies, the state settled on transferring water from the north, particularly from the Ain Salah basin, which administratively belongs to Tamanrasset, over a distance of 750 kilometers and at an altitude of approximately 1200 meters. Once seen as an important challenge, this project has become a source of great pride after being completed within the specified timeframe (from 2008 to 2011), totaling three years. The project contains 48 wells dug to a depth of 600 meters over a total distance of approximately 48 square kilometers. The water is then transported to six large pumping stations covering a total area of 60 kilometers. The next phase includes transportation through pipelines. The transportation method is parallel, meaning that two lines ensure a continuous water supply in case one line experiences a malfunction or failure. This doubles the distance covered by the pipelines from 750 kilometers, the distance between Ain Salah and Tamanrasset, to 1260 kilometers.

Upon reaching Tamanrasset, the state allocated a reservoir of 50,000 cubic meters to store water divided into two sections to avoid emergencies. Consequently, 100,000 cubic meters of drinking water will be transported daily to the city. At the same time, the daily demand from the population, which numbers around 200,000 people, is approximately 20,000 cubic meters of water for the city's residents .

Moreover, the project will help alleviate the Algerian desert regions' water crisis and contribute to fulfilling more stability for the southern population, revitalizing economic activity, and developing agricultural production, particularly crops that rely on irrigation, such as palm trees .

Remittances Review
April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

The Ministry of Water Resources affirmed that present efforts in the water resources sector are concentrated on improving the provision of drinking water services and enhancing its quality to benefit the region's residents. More important efforts are being made to distribute drinking water across all municipalities in this province and reduce the salinity levels the population complains about.

The water directed to citizens meets all national and international standards. The water resources sector in Tamanrasset province has a water supply network extending over 2,753 kilometers, including 1,712 conveyance channels and 1,041 kilometers of distribution channels. Water filtration is conducted directly through a station with a capacity of 50,000 cubic meters per day.

Tamanrasset is supplied with water from Ain Salah through 8 pumping stations as part of the giant project. The water is stored in 162 storage facilities, including tanks and others for distribution, with a total capacity of over 143,000 cubic meters. The connection rate to Tamanrasset reached 97%, benefiting more than 55,000 residents (Ennahar newspaper, 04/04/2011.

This massive project adds to Algeria's significant achievements in this vital and strategic sector, including the Beni Haroun Dam in the east of the country, the largest dam in Algeria and the second-largest in Africa, with a water capacity of nearly one billion cubic meters. Furthermore, the Koudiat Asserdoune Dam is in the Bouira province east of the capital. Alongside these projects, 13 seawater desalination plants have been launched along the 1200-kilometer Algerian coastline.

The Ministry of Water Resources affirms its commitment to establishing a modern distribution network for Tamanrasset, considering urban expansion. The aim is to protect water from leakage and have better control over the network, which is in line with the qualitative development process that the sector is undergoing nationally.

Furthermore, the stability in supply is ensured through the Ain Salah project, which benefits six African countries and extends to South Africa, passing through Nigeria. Each major pumping station is equipped with three large pumps operating on gas or diesel and can also be operated with natural gas, complying with standards applied in Europe.

Remittances Review
April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

5. Groundwater Types:

There are two types of groundwater as follows

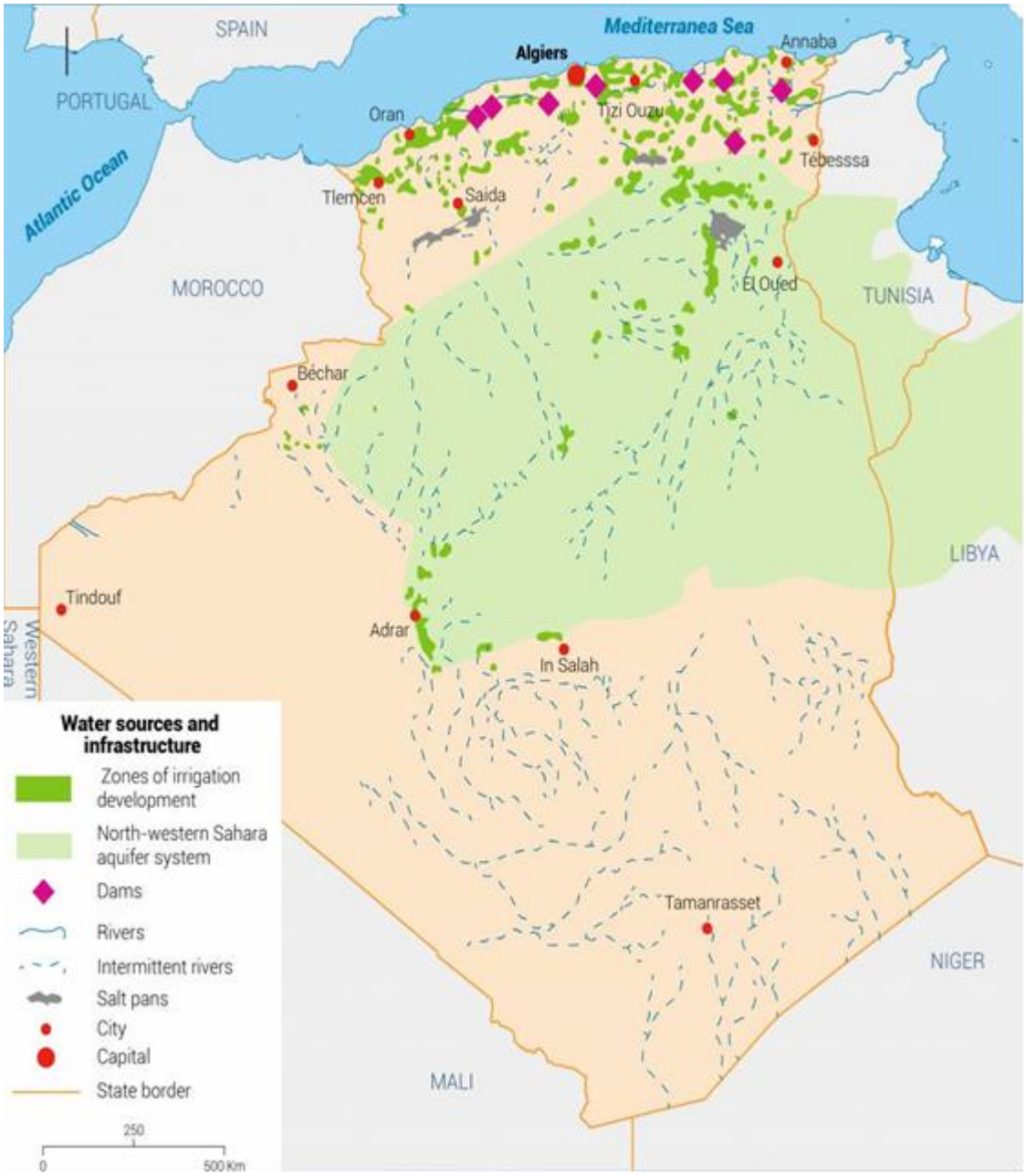
5.1 Renewable Groundwater:

Renewable groundwater is represented by layers within the geological structure in the Mediterranean climate region, where the precipitation rate exceeds 350 mm annually, reaching over 500 mm annually in some areas. These regions include the southern regions of the Saharan Atlas Mountains. The geological layers store a significant amount of groundwater, and due to their permeability, a certain percentage of this water seeps into other layers that form the basin (Fares Al-Heithi, 1999, p. 89).

5.2 Non-renewable Groundwater: These are ancient waters that seeped into the groundwater layers during the rainy period of the Pleistocene era, estimated to be over 10,000 years old. This type of water is found in Algeria, covering 80% of the total area. Among the most famous of these groundwater reservoirs are:

- **The Great Western Erg in Algeria**: Located south of the Atlas Mountains, it is fed by rainfall in the northern mountain range. It covers an area of 330 km2 and has a storage volume of 1500 million m3.
- **The Great Eastern Erg**: Situated east of the Great Western Groundwater, between the Tunisian and Algerian borders, and covers an area of 375 km2. It has a storage volume of 1.7 billion m3 and is naturally fed around 600 million m3 (Achour, 2014).
- **Tanezrouft Basin**: This basin is located south of the Great Western Aquifer and covers an area of 240 km2. It has a storage volume of 0.4 billion m3 and is naturally fed around 80 million m3 (Fares Al-Heithi, 1999, p. 90).

Remittances Review
April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)



Remittances Review
April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

6- The reality of water security:

- **Daily supply reaches about 70%:**

The process of supplying drinking water to the residents of the capital of Ahaggar reaches a daily rate of 70%, averaging 16,000 cubic meters per day, allowing the majority of citizens to benefit regularly. As for the remaining 30% of the population, water authorities work on providing them with a scheduled supply on an alternating basis, day by day.

One of the most prominent problems impacting water supply populations is the irrational use of this valuable resource and its excessive and wasteful squandering, which negatively impacts the supply process, particularly since the urban area is expanding rapidly and increasingly. The number of residential neighborhoods is growing due to the distribution of a considerable number of housing units, estimated at 3000 housing units in the last three years, raising the challenge to distribute them regularly countered by the squandering that has become one of the features of the citizen in Adrar's capital, who would be the first and last victim in case of any emergency, yet despite this the sector works to develop plans to address these consequences.

- **Significant Projects:**

The coverage rate reached 98% in the capital of Ahaggar, with ongoing efforts sought to improve existing structures and establish new ones to accommodate the rising population density in the region. Furthermore, the aim is to extend the "Project of the Century" to different villages near the capital, such as the project connecting the villages of Aqrambabat and Amsel over a distance of 34 kilometers, implementing a project to link two water reservoirs, each with a capacity of 500 cubic meters, for 38 billion centimes.

Numerous projects have been implemented regarding new residential neighborhoods in the capital, including the installation of two reservoirs in the neighborhoods of

April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

Tabarkat and Adrian, each with a capacity of 4000 cubic meters, and another reservoir in the Qa'at al-Wad neighborhood, each with a capacity of 1000 cubic meters, for neighboring areas.

Moreover, efforts are underway to provide drinking water to isolated areas, or what is commonly referred to as shadow areas, through the implementation of specific projects to equip and connect numerous wells in the municipalities of Idles, situated 230 kilometers from the capital of Ahaggar, Silt, 140 kilometers from the capital, and Ablassa, 100 kilometers away, as well as neighboring areas such as Ikalan and Ihelifen. Additionally, projects are underway to strengthen the water supply in the Tadeliket capital (Ain Salah) with three reservoirs, each with a capacity of 500 cubic meters in Daghmasha, Azawiyah, and Iksitan. Projects are also ongoing for nomadic populations and the establishment of ten wells in the Tinzouatine deserts, 400 kilometers from the capital of Ahaggar.

- **Overcoming the Urbanization Challenge:**

To secure water for the city, the authorities have launched numerous projects, such as the Ain Salah project, to supply water to the high plateau cities at a rate of 600 million cubic meters annually. Furthermore, the state has allocated considerable financial and human resources to provide drinking water to the population by implementing massive projects, such as redirecting water from the Chlef Valley to the Mostaganem-Arzew-Oran corridor (MAO).

The project to transfer water from Ain Salah to Tamanrasset will permit the establishment of living centers every 100 kilometers, equipped with different facilities such as gas stations, post offices, restaurants, and more along the pipeline linking Ain Salah and Tamanrasset.

It is worth mentioning that this massive project, costing the public treasury $3 billion, will help the region to be supplied with this vital resource at a volume of 35 million cubic meters annually, at a rate of 100,000 cubic meters per day, with each citizen receiving a share of around 168 liters per day. Efforts will be intensified to distribute drinking water across all municipalities in this province and to decrease further the

salinity levels the population complains about. Notably, the water provided to citizens meets all national and international standards.

Conclusion:

In conclusion, groundwater in the Algerian Sahara constitutes a significant water resource, particularly regarding recent studies that have indicated the presence of approximately 40 trillion cubic meters of fresh water in the Algerian desert. A vast sea of groundwater exists between Algeria, Tunisia, and Libya, with the largest share of Algeria covering around 700,000 km2, compared to about 250,000 km2 in Libya and 80,000 km2 in Tunisia.

The Algerian authorities must employ all available means and best methods and make every possible effort to exploit the huge groundwater resources available in the Algerian Sahara, whether through supplying drinking water to citizens or irrigating agricultural lands. They must work on distributing this water to all Algerian provinces in a way that serves the national interest and contributes to fulfilling economic development and water and food self-sufficiency together. The water crisis in the Algerian desert is fundamentally due to mismanagement and the absence of a rational water policy. The authorities must rationalize water use, decrease waste, rely on non-conventional water resources, enhance the network's performance, and involve the population in water management.

References :

1. Bourahla, Mohamed. (1998). "Dams in Algeria: Study of Achievements." Master's Thesis, University of Bouzareah, Algeria.
2. George, Wakil Mikhail. (2005). "Financial Institutions." Directorate of Books and University Publications, Aleppo, Syria.
3. Al-Nasr Newspaper. (04/04/2011).
4. Diab, Imad Mohamed. (2013). "Dams and Water Reservoirs in the Arab World."
5. Al-Heithi, Sabri Fares, & Abu Samar, Hassan. (1999). "Geography of the Arab World." 1st ed., Dar Safa Publishing and Distribution, Amman, Jordan.
6. Wakkas, Youssef. (2008). "Water Resources in the Bouira Province and Their Uses." Master's Thesis, School of Higher Teachers, University of Bouzareah, Algeria.

April 2024,
Volume: 9, No: 2, pp.2416-2432
ISSN:2059-6588(Print) | ISSN 2059-6596(Online)

7. Alouche, Wassila. (2013). "Water Wealth in the Middle Region of Morocco: Mapping, Facilities, and Exploitation." Master's Thesis, University of Constantine.
8. Chouki, Asaad, & Nabil, Raphael. (1986). "Development of Water Resources in the Arab World and Rational Use." Conference on Water Resources and Their Use.
9. Al-Arf, Bachir. (2015). "Impact of Dams on Regional Development in the Western Part of Tissemsilt Province." Master's Thesis, School of Higher Teachers, University of Bouzareah, Algeria.

Foreign References :

1. Achour, Abdelkader. (2014). "Integrated and Intersectoral Approach in the Development of the Watershed of Sidi M'hamed Ben Taiba Dam." Master's Thesis, National School of Forestry, Batna.
2. Geer, Malle Kaal. (1996). "Cleaning up the River Rhine." Scientific American, January.
3. National Research Council. (1995). "D.C. National Academy Press."
4. Heath, Raphael. (1995). "Hell's Highway." New Scientist, June 3.
5. 11- Noureddine Haroush, Water Management Strategy in Algeria, Policy and Law Notebooks, Issue Seven, Journal of the University of Algiers, June 3, 2012