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The implications of water security on the food security in Algeria: reality and horizons

انعكاسات الأمن المائي على الأمن الغذائي في الجزائر: الواقع والافاق

Bouchenaf Faiza
Mohammed Cherif Messaadia University- Souk Ahras (Algeria)
f.bouchenaf@univ-soukahras.dz

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Abstract:

This study aims at shedding light on the nature of the relation between the water security and the food security. In this line, the future of the food security of any state is tightly linked to its ability to achieve the water security. Therefore, the Algerian government looks for the best ways to achieve it. In this context, this study used the descriptive analytical method and found out that Algeria has many qualifications that allow implementing the water security project that shall guarantee the achievement of the food security.

Keywords: water resources; water security; food security; climate changes; National Security.
JEL Classification Codes: F52 ,Q25, Q54.

ملخص:

تهدف هذه الدراسة إلى تسليط الضوء على طبيعة العلاقة الموجودة بين الأمن المائي والأمن الغذائي ، حيث أن مستقبل الأمن الغذائي لأي دولة مرهون بمدى قدرتها على تحقيق أمنها المائي ، لهذا نجد أن الحكومة الجزائرية تسعى إلى البحث في الأسباب التي من خلالها يمكن أن تحقق ذلك.

و لهذا الغرض فقد إعتمدنا على المنهج التحليلي الوصفي و توصلت الدراسة إلى عدة نتائج أهمها أن الجزائر تملك العديد من الإمكانيات و المؤهلات التي تجعلها قادرة على تنفيذ مشروع الأمن المائي الذي سيضمن لها الوصول لأمنها الغذائي.

كلمات مفتاحية: الموارد المائية.، الأمن المائي.، الأمن الغذائي، التغيرات المناخية ، الأمن القومي.

تصنيفات JEL : F52 ، Q25 ، Q54 .

Corresponding author: Bouchenaf Faiza, **e-mail:** f.bouchenaf@univ-soukahras.dz

INTRODUCTION:

Recently, the world has been living many climate changes due to natural and anthropic factors that contributed to the water shortage. In this regard, many states work to achieve the water security in the light of the rainfalls decrease that directly affected the food security. In so doing, the states adopted a common vision based on the protection of the water resources, investment in the innovations, and improvement of water management budgets. The security of the water resources is one of the biggest challenges faced by most of the states since these resources are vital for all the life aspects including drinking, industry, agriculture…etc. In this line, Algeria suffers a sharp shortage of the potable water due to many factors, mainly the nature of the climate, the lack of renewable water resources, the demographic boom, the increasing improvement in the living standards, and the increase of the industrial and agricultural activities. All this shall complicate the future.

Based on what has been said, we raise the following problematic: "**to what extent can we say that the achievement of the food security in Algeria depends on its ability to achieve the water security**?" To answer this problematic, we rely on the following sub-questions:

- What is meant by the water security and how can we achieve it?
- Are the available water resources in Algeria sufficient to achieve the food security?
- Is there a relation between the achievement of the food security and the water security?

Hypotheses of the study:

To answer the main question and the sub-questions, we hypothesize that:

- The water security hugely depends on the number of the available water resources in each state.
- The size of the available water resources in Algeria is not enough to cover the current and future needs in the light of the periods of drought.
- There is a relation between the achievement of the food security and the water security.

Importance of the study:

The topic of the water security and its relation with the food security is very important mainly that the size of the available water resources is no more enough to cover the current and future needs in the light of the periods of drought and water shortage.

Method of the study:

To study the topic, we used the analytical descriptive method that describes and narrates the facts of the water resources, their future in Algeria, and the various concepts related to the water security. Besides, it analyses the situation of the water security relying on the statistical tables and figures in order to shed light on the Algerian efforts in this regard and reach findings and suggestions about the necessary requirements to reinforce the government programs and plans to achieve the water security, the food security, and their sustainability. In so doing, the study was divided into three chapters as follows:

1. The conceptual frame of the water security and the methods of reinforcing it.
2. Analysis, reality, and future of the water security in Algeria.

3. The relation of the water security with the food security.

1- The conceptual frame of the water security and the methods of reinforcing it:

UN reports in March 2020 warned that the climate changes shall have a big effect on the availability and the quality of the potable water to meet the basic human needs. This shall endanger the rights of billions of people to potable water and sewage services.

1-1 The concept of the water security:

Water and political studies gave many definitions to the water security as follows:

- The Global Water Partnership (2000) defined water security as being from the level of the house to the global level. Besides, it means that each person has the right to enough secure water to live a clean, healthy, and productive life; reassured that the nature is protected and reinforced . (Global water Partnership (GWP) .2000.p12)
- According to the report of the Human Development in 2006, the water security refers to making sure that any person has a source to get enough secured water at an affordable price to have a healthy, decent, and productive life, and at the same time, preserve the ecological systems that provide water and depend on it. When there is no possibility of getting water, humans face big risks related to security due to the imbalance in health and the shortage in the living means . (The human development report .2006.p4)
- The water security is linked to the water balance. The latter refers to the process of balancing and comparing the total conventional water resources (the supply) in given periods and the total water needs (the demand) during the same period (Al Maaini .2021.p-p.159-192) , Thus, the water security is a stable situation for the water resources that reassures people that the supply covers the demand. Nevertheless, when the supply does not meet the demand, the level of the water security decreases. On the other hand, when the supply exceeds the demand, there is a surplus. Mathematically speaking, the state of the water security in any state at any given period is a function related to the water balance of the state and a direct reflection. Hence, the concept of the water security is relative . (Ismail .2012.p33)
- UN organization concerned with the economic, social, and cultural rights defines it as the right of the human to enough, secure, potable, easy-access water at an affordable price for the personal and household use. These 05 points make the basic pillars for the water security . (ESCWA .2020.p48)

Based on what has been said, we can say that the water security is the ability of getting enough clean water to keep enough levels of food, products, health, and sewage. In this line, the water security is based on the sufficiency and guarantee through time and space. Besides, it is based on three dimension as follows:

- The quality;
- The proximity;
- The sufficiency.

In addition, it is related to the absence of conflicts over water, the achievement of stability, the avoidance of wars, and the food, health, and economic securities. Therefore, the Human Development report in 2006 warned of a water crisis that would lead to war between states that share the water courses and rivers, and from the increase of the casualties resulting from

water shortage or pollution.

1-2 Methods of reinforcing water security:

The world is suffering sharp decrease of drinkable water and its resources. Besides, due to the high consumption of water, it is expected that the water crisis shall continue internationally and increase in the future. In this regard, experts say that there are many methods to reinforce the water security, reduce the water crisis, and achieve the food security as follows:

- Raising awareness to change to water consumption style and adopting new styles;
- Innovating new techniques to maintain water and recycle the wastewater;
- Improving the practices of the public opinion and using economic agricultural systems;
- Increasing the water prices to reduce consumption and developing water desalination stations.
- Improving the process of water collection and developing policies to protect the potable water surfaces.
- Managing the environmental systems in a comprehensive manner. For instance, the plants have a big role in absorbing many substances found in the wastewater. This reduces the costs of water treatment and pumping.
- Improving the infrastructure of the sewage systems.
- Reducing the production of packaged water because the water production makes around 22% of the world water consumption.
- Treating pollution. For instance, oil pollutes water in the transportation processes.
- Fair distribution of drinkable water, linking the public and private sectors, and making research, development, and innovation to find new sources.
- Transferring the water preservation techniques to the underdeveloped regions to avoid negative consequences due to water shortages.
- Having command over the demographic boom . (Saqar .2022)

2- Analysis, reality, and future of the water security in Algeria:

2-1 The water potentials available in Algeria:

The water resources in Algeria are related to the nature of the rains that are, in their turn, related to the climate that is from arid to semi-arid. This climate creates water shortages, makes the conventional methods insufficient, and raises the need to find other unconventional methods for water collection and storage.

2-1-1 The conventional water resources:

The real water resources amount up to 18 billion m^3; of which 10.5 is for the surface water, 5 is for the groundwater, and is 2.5 for groundwater recharge in the North and the High Plateau. According to the international standards, Algeria suffers water shortage as the water consumption per capita does not exceed 600m^3 annually; while the international standard is 1000 m^3 per capita annually (Najib .2018). In this regard, only 75% of this quantity is renewable; 60% is surface water and 15% is ground water, as follows:

- Surface resources: they include 17 water basins in 03 groups. The 1st is of the Mediterranean, the 2nd is of the High Plains and the 3rd is of the Saharan basins. These basins include 12.7 billion m^3. Besides, the surface water resources represent 65% of

the total surface water resources in Algeria. They manifest in the rivers and valleys whose level increases with rainfall and snow. The Northern water basins of the Mediterranean are very important as their resources amount up to 10 billion m^3; i.e., around 90% of the total surface water.

- The groundwater: The technical department of the National Agency for Water Resources and of the Ministry of Developing the Big Water Installations estimated that the groundwater levels reached 7 billion m^3. This quantity is consumable and takes the form of groundwater reserves. These reserves take two forms:

-The reserves of the North with 2 billion m^3 and renewable resources.

- The low supply Saharan basins with 5 billion m^3 and non-renewable water resources. (Ben Hamida .2016) .

2-2 The unconventional water resources:

They manifest in

2-2-1 Seawater desalination:

Water desalination with an amount of 590.85 million m3 annually generates potable water for about 8232305 people through two methods:

- Flash evaporation: It relies on the fact that water evaporates at lower temperatures when exposed to low pressures. Thus, the seawater is heated and then put in the pressure chamber. This causes a flash and changes into a vapor. Thus, the degree of the salt water decreases before the other. Then, it is taken to a 2^{nd}, 3^{rd}, and 4^{th} chambers with less pressure according to the desired water quality . (Bekhit .2008.p97)
- The reverse osmosis: It mainly relies on the movement of the drinkable water from the concentrated salinized solution to the less concentrated solution through a semi-permeable membrane using the reverse osmosis pressure . (Khader .n.d.p5)

2-2-2 Wastewater treatment:

The wastewaters can be reused after filtering them with limited methods using modern technology in order to cover some agricultural needs and other uses. This method generates 38.77 million m^3 for irrigating 6774 acres of agricultural surfaces.

2-2-3 Desalinating the very salted groundwater:

It generates 33.73 million m^3 and supplies 16498 people with drinkable water. The quality of the groundwater affects the human health, the society, and the national economy. In this line, it is used in agriculture, drinkable water supply for humans and animals, in industry, cooling, getting rid of industrial waste, producing energy, oil exploration, etc. (Assaf, al Masri 2007.p6)

2-2-4 Water transportation:

It is mainly related to the projects of:

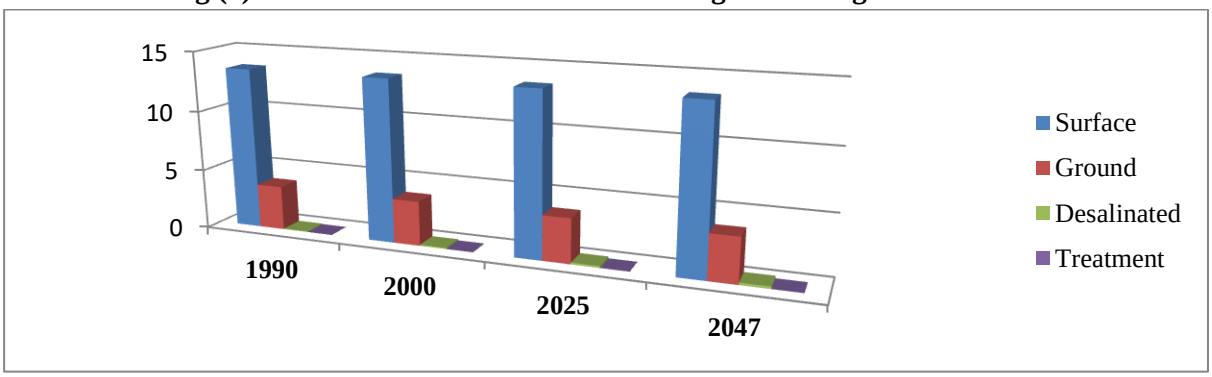
- The complex of Beni Haroun Dam: It started in September 2007 and aims at enhancing and protecting the water supply to 04 million people in 06 Wilayas and for irrigating 4000 acres in 04 big stations.
- The complex of Mostaganem, Arzew, and Oran: It started in the beginning of 2009 to secure the water supply to this region. Table 01 and figure 01 show the development of the water resources in Algeria during 1990-2047:

Table (1): The water resources available in Algeria during 1990-2047

		1990	2000	2025	2047
Conventional water resources	Surface	13.5	13.5	13.5	13.5
	Ground	3.7	3.7	3.7	3.7
Unconventional water resources	Desalinated	0.05	0.1	0.15	0.2
	Treatment	-	-	-	-
Total of the water resources		17	17.3	17.35	17.4

Source: (Mkhimer et Hijazi .1996.p72)

Fig (1): The water resources available in Algeria during 1990-2047



Source: prepared by the author based on the data in table 01

2-2 The average share of the drinkable water per capita (water security):

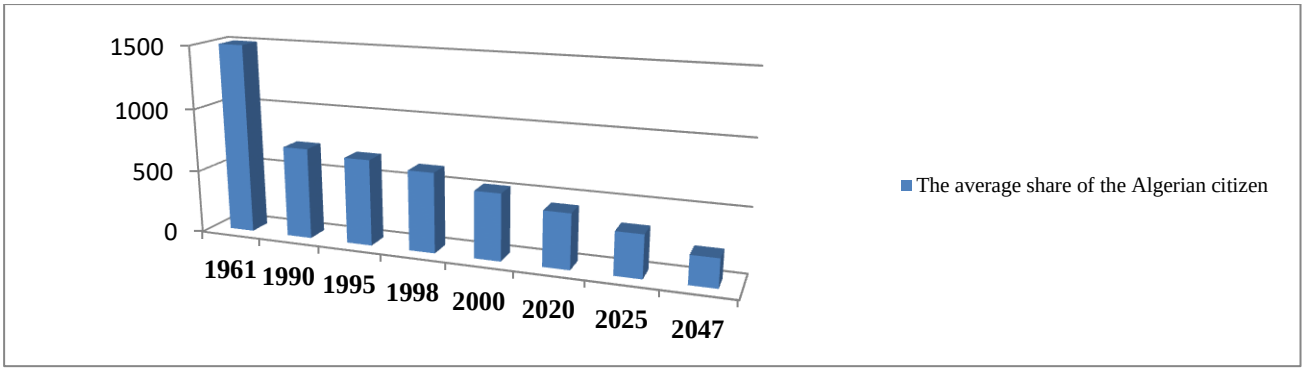
It is the standard that measures the drinkable water sufficiency in the world. It is calculated by dividing the available water resources on the population. In this context, table 02 and figure 02 show that the water security for the Algerian citizen during 1961-2047 passed through 03 phases:

Table (2): The average share of the Algerian citizen of the drinkable water during 1961-2047

	1961	1990	1995	1998	2000	2020	2025	2047
M^3 annually per capita	1500	720	680	630	524	430	334	223

Source: (Mkhimer et Hijazi .1996.p72)

Fig (2): The average share of the Algerian citizen of the drinkable water during 1961-2



Source: prepared by the authors based on the data in table 02.

- **The water exhaustion:** It was during the 1960s where the share was 1500 m^3 per capita in 1961.
- **The water scarcity:** It was during the 1980s and 1990s where the share per capita was less than 1000 m^3 annually and went on decreasing to 6802 m^3 in 1995 and 630 m^3 in 1998.
- **The absolute scarcity:** It was in the beginning of the 3rd millennium where the share per capita did not exceed 500 m^3 annually. Table 02 and figure 02 show the development of the Algerian citizen's share of water during 1961-2047

2-3 The uses of the water resources in Algeria:

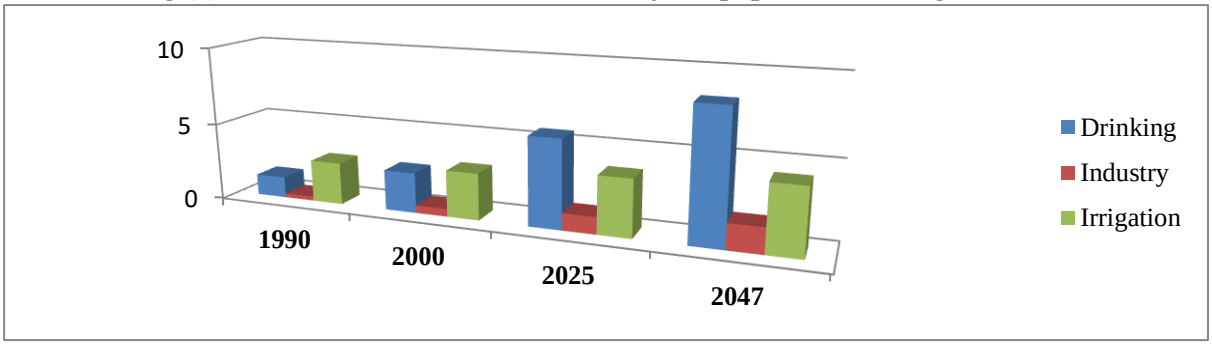
Table 03 and figure 03 show that the authorities must provide drinkable water for the population, focus on rationalizing its uses, and promote anti-waste culture to guarantee the water continuity for the future generations. In this line, we see that the demand on the water for drinking, agriculture, and industry increases slightly with the increase of the demand in the other sectors. Nevertheless, it is necessary to face this positive increase in the industrial side and growth with stringent measures regarding the environmental and biological sides because the industrial activities near the strategic regions and water resources bring about water pollution and degradation due to the trash; thus, sustainable water security in the region is affected. Table 03 and figure 03 show the development of the uses of the water resources in Algeria during 1990-2047:

Table (3): The uses of the water resources by the population during 1990-2047

	1990	**2000**	**2025**	**2047**
Population (million)	25	33	52	78
Drinking	1.37	2.6	5.67	8.36
Industry	2.73	3	3.67	4.25
Irrigation	2.73	3	3.67	4.25
Total needs	4.36	6.1	10.44	14.24

Source: (Mkhimer et Hijazi .1996.p72)

Fig (3): The uses of the water resources by the population during 1990-2047



Source: prepared by the authors based on the data in table 03

2-4 The water balance in Algeria (the water gap):

Table 04 and figure 04 show no deficit in the size of the available water resources compared to the needs for the water resources in general. Thus, there is a positive water resource (surplus) all along the study period. Nevertheless, the increasing population from

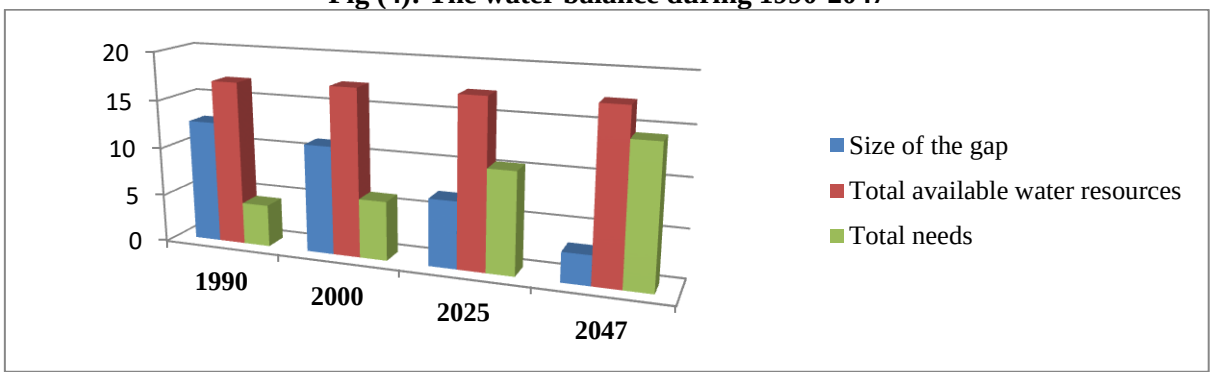
time to another increases the demand on the water resources that increase with a slow non-renewable rate and, thus, raises deficiency (variation between the available resources and the needs) since 1990 and the following years. In this line, the share per capita decreased from 690 m^3 in 1990 to 223 m^3 in 1947; knowing that the international standard is 1000 m^3 per capita annually (Najib .2018). Table 04 and figure 04 show the development of the water balance in Algeria during 1990-2047.

Table (4): The water balance during 1990-2047

	1990	2000	2025	2047
Total available water resources	17	17.3	17.35	17.4
Total needs	4.36	6.1	10.44	14.34
Size of the gap	+12.64	+11.2	+6.91	+3.06

Source: (Mkhimer et Hijazi .1996.p72)

Fig (4): The water balance during 1990-2047



Source: prepared by the authors based on the data in table 04

3- The relation between the water security and the food security:

3-1 The future of the food security in Algeria depends on the availability of the water resources:

The government relies on agriculture as a strategic sector that shall contribute to the diversity of the national economy and achieve equilibrium in the balance of the foreign trade through increasing the exports of the agricultural products to achieve the food security. In this line, the government focuses on agriculture in order to develop and modernize it and raise its yield. Therefore, all the reforms and decisions shall contribute to the food security and the shift from the self-sufficiency to the food sovereignty. In this regard, the government adopted a set of strategies to support its objectives as follows:

3-1-1 Providing the water resources and achieving the food security:

Algeria is an agricultural state with the necessary abilities and potentials to achieve the current and future food security. Providing the food security depends on agriculture that needs water resources. In this regard, there are around 45 billion m^3 of unexploited groundwater and around 81 big dams of 8 billion m^3 in the Sahara. This is not sufficient amid the current circumstances the world is living, mainly Algeria, that include the global warming, drought, and climate changes. In the same context, the only problem the Algerian agriculture suffers is the climate change and the fluctuating rainfall. Therefore, Algeria cannot rely on the dam waters because they do not meet all the needs. In addition, most of the dams are full of mud

and require huge amounts of money to clean them.

3-1-2 Adopting a good method to have a command on the water shortage:

Despite the health crisis that swept the world, Algeria managed to guarantee its food security and ranked among the first African states in the food security scale. Nevertheless, it needs a strategy to shift from the food sufficiency to the food sovereignty with the participation of all the actors of the field. In this line, the climate changes and the challenges must be taken into consideration. Besides, a good strategy that relies on technology must be adopted to face the water shortage, the high temperatures, the soil erosion, and the water salinity.

The future of agriculture depends on solving the issue of the agricultural estate and on giving the full consideration to the agricultural engineers through having command on the good agricultural practices, digitalizing the agricultural sector, and encouraging research by universities and institutes to set a new agricultural strategy and achieve the food security (Abrous .2022).

Besides, it is necessary to raise awareness about the necessity of preserving water and informing people about the availability of usable water.

3-2 The efforts the Algerian government in the achievement of the water security:

The water security is an important topic in Algeria amid the current environmental and climatic changes. Many studies point to a water crisis that manifests in the share per capita of the renewable water resources, the depletion and deterioration of the groundwater, and the water pollution resulting from the industrial activities and their trash. All this pushed the government to look for the suitable strategy to achieve the water security and implement a stringent strategy through:

- The optimal exploitation of the available water resources and rationalization of the consumption. In this line, Algeria enjoyed water security in 1962 and then suffered water poverty in the 1990s and a severe water poverty that is expected to last until 2025. Therefore, it is necessary for the authorities to alleviate the effects of this crisis and achieve the water security.
- Providing alternative and permanent solutions that meet the needs of the related sectors mainly agriculture because water security and food security are two faces of one coin (Aroui .2023). In the light of this situation, the Algerian government took the necessary measures to rationalize the water use and guarantee its sustainability in the light of the strategy of water resources and environment growth. This strategy relies on the National Water Program that identifies a set of projects and structural programs that must be executed in 05 years taking into consideration the priorities of each program. The strategic axes of the five-years program 2015-2019 are based on:
  - The continuity and reinforcement of the policy of mobilizing the conventional and non-conventional water resources to meet the needs. Besides, this policy aims at covering the water deficit in the High Plateau regions to end the discrepancies between the regions of the one state.
  - Rehabilitating, modernizing, and enlarging the irrigation systems in the big, middle, and small-sized irrigated surfaces in order to guarantee the national food security after the execution of the program of 2.1 million acres in the end of 2019.
  - Rehabilitating, enlarging, and modernizing the systems of sewage and drinkable

water distribution, and establishing installations to protect the cities and agglomerations from floods. This aims at enlarging the net of drinkable water and sewage to reach the maximum citizens and protect the environment and water resources from pollution.

-Setting management systems for the infrastructures of the sector that had been established in the light of the previous development plans to guarantee their continuity and help the water management institutions succeed.

- Reinforcing the governance in the sector of the water and environmental resources through taking institutional decisions related to the legal and organizational frame (Al Hbitri .2017.p-p.167.168).

- Taking urgent decisions by the government to focus on desalinating the seawater by a specialized agency, and vulgarizing the plans of water desalination stations all along the coast.
- Devoting a ministry in the last cabinet reshuffle, resuming the projects of used water desalination, and using them in irrigation instead of groundwater (Aroui .2023) . In this regard, the government aims at doing this through:

  - Mobilizing the water resources in order to meet the needs of the citizens and supporting the irrigation sector through the establishment of 26 dams with a total size of 985 million m^3. Besides, it is necessary to take of the mud from 10 dams to increase their size to 45 m^3 and dig 680 wells of 180000 linear meter with an annual size of 172 million m^3.

  - Providing the drinkable water and supporting the program with 2440 Km of pipelines annually. In addition, it is necessary to found a treatment station and 136 reservoirs, and rehabilitate 16800 Km of the drinkable water pipelines annually.

  -Sewage: It is expected to establish 60 stations of treating wastewater and lakes that may filter the wastewaters in the light of the program of enlarging the sewage system and used waters treatment. Besides, the authorities shall establish 6000 complexes for sewage and anti-flood structures and develop 300 Km of valley courses.

  - Irrigation: It is expected to establish 32 big projects of irrigation with a total surface of 23000 acres and 219 small dams of 60 million m^3 that allow the irrigation of 15000 acres (Al Hbitri .2017.p168).
- Moving towards the adoption of the complementary administration of the water resources and the rationalization of their use as a new national policy in 2025 based on 04 principles as follows:

  -Water is a material resource.

  - The water management must be carried out by the water resources department in each region.

  - This resource must not be wasted.

  - It is necessary to promote the notion of periodical accompaniment and monitoring of the water users in each region (Harouche .2012.p66).

  - It is necessary to integrate new technologies to manage and look for additional funding sources. Besides, it is necessary to establish professional efficient bodies in the field of public service management taking into consideration the habilitation of all the actors in various phases and informing them about the modern changes and

information in the field of water (Mohcin .2013.p240).

CONCLUSION

Undeniably, water is vital for any activity and has a big role in the achievement of the economic and social development of any state. In this context, many states work hard to provide all the modern techniques and tools mainly during summer, drought, or the scarce rainfall periods. As the other states, Algeria suffers shortages in its limited and irregular water resources which cannot cover the current and future needs mainly in the light of the continuous droughts. Therefore, water is a scarce and precious resource. In this line, guaranteeing the water security depends highly on the number of the water resources in each state. Hence, the problem increases in Algeria due to the climate characteristics and the irrational use of water in a time where the demand increases due to the demographic boom and the rise of the sectors that consume water such as industry and agriculture. Besides, the food security is endangered because the agricultural development is threatened. Based on what has been said, we can say that:

- The geographic region of Algeria and the arid and semi-arid climate make its water resources limited, irregular, and unequal. In addition, there are other factors such as the demographic boom and the growing agricultural surface that increased a need for water.
- The current and future water problem in Algeria is alarming because Algeria is poor regarding the water security; what menaces the food security.
- Rains are the primary source for water in Algeria, followed by the groundwater. Besides, the coverage of the needs for water through the non-conventional methods is low and needs more projects.
- The size of the water resources in Algeria cannot cover the current and future needs in the light of the recurrent droughts.
- There is a strong relation between the water security and the food security.

Recommendations:

- It is necessary to reinforce and mobilize the conventional and non-conventional water resources to meet the needs and cover the deficits.
- Mobilizing these resources is not enough; rather, we need good management and distribution through modern economic methods in agriculture and industry.
- It is necessary to raise awareness about water and inform the citizens about the rate of the water availability.
- It is necessary to integrate modern irrigation systems and to train the farmers to use them to avoid waste.
- We recommend adopting a good policy based on technology to master the water shortage, the temperature increase, the soil erosion, and the water salinity.
- We must focus more on studies in this field to provide solutions and optimal strategies of managing this resource.
- It is necessary to encourage investment in this field to find solutions to the water crisis.

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