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The reality and prospects of water security in Algeria during the period 2000-2020

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Abstract

The study aims to determine the reality and prospects of water security in Algeria, where the variable of water uses and the variable of internal water resources were selected because of their importance in achieving water security, and the The lack of a cointegration relationship between water uses and internal water resources in Algeria in the long term approach was adopted on the study variables during the period 2000-2020, through conducting quantitative statistical tests of the stability of the time series of model variables.

The study also recommends the need to adopt a strategy to rationalise the use of water resources in line with the internal water resources in Algeria, because the balance between these variables is considered the most important source of achieving water security.

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1. *Introduction*

Water is a renewable natural resource, While the amount of water on Earth remains constant, the increasing population has raised concerns about the sustainability of water as a resource. This has prompted the search for strategies to address water scarcity, leading to the concept of water security, Water security is a significant and evolving concept that adapts to the changing needs and interests of human life. Water security has garnered legal and political focus at both the international and national levels because of its sensitivity and direct link to the survival and preservation of humanity. Algeria, similar to other nations globally, is presently experiencing a drought, The scarcity of rainfall had a detrimental effect on the decrease in surface water, particularly due to the absence of major rivers in the region. Additionally, the rise in population growth, the expansion of economic activity and industrialization, and the need to ensure food security resulted in a substantial surge in the demand for water, particularly in the agricultural sector, Algeria implemented a water security strategy due to the absence of contemporary methods for extracting, collecting, and distributing water, This strategy involves investing in water resources and devising policies to explore methods of conserving and efficiently using water in order to address the issue of inconsistent water supply to those in need.

1.1 The main problem

Algeria is actively addressing contemporary global concerns, particularly water security, through strategic investments in water resources, This includes the establishment of seawater desalination facilities, the construction of dams, and other related activities, Based on the information provided, we can now state the primary question of the problem as follows:

Is there a common cointegration relationship between water uses and internal water resources in Algeria in the long term ?

1.2 Study hypotheses

In order for a study to be carried out in which each of the problems posed above is taken into account, the hypothesis of the study has been formulated as follows:

- The null hypothesis: The lack of a cointegration relationship between water uses and internal water resources in Algeria in the long term.

- Alternative hypothesis: The existence of a The lack of a cointegration relationship between water uses and internal water resources in Algeria in the long term relationship between water uses and internal water resources in Algeria in the long term**.**

1.3 Objectives of the study

Through this study, we aim to achieve the following objectives:

- To identify the theoretical framework of water security.
- To show the reality of Water Resources statistically in Algeria.
- To test the relationship between water supply (internal water resources) and water demand (water uses) in Algeria

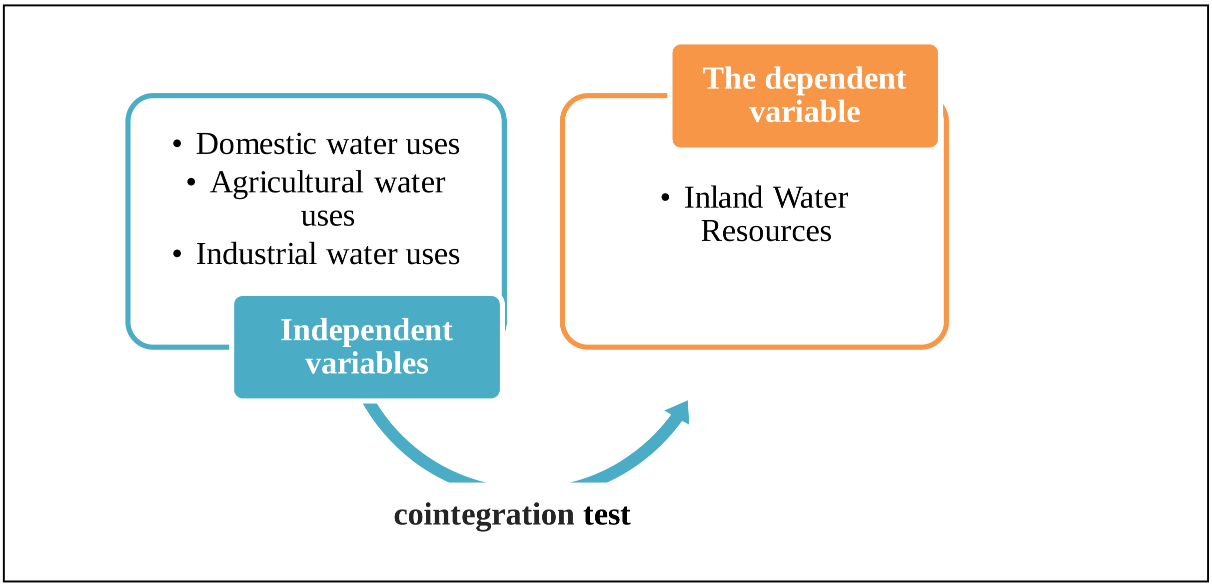
1.4 The Methodology of the study

In the preparation of this study, the descriptive and analytical approach was used to determine the reality of water security in Algeria.to determine the relationship between the study variables during the period 2000-2020, the time series stationarity test and the cointegration test were tested, and the results were obtained using the statistical program Eviews10.

1.5 Study form

The study model expresses the boundaries of the subject and clarifies the nature of the relationship between the variables of the study, On this basis, the researcher aims to embody the problem of the study and the goals expected to be achieved by presenting this scheme, and the following figure shows that:

Figure 01: sample study



Source: prepared by the researcher.

1.6 Previous studies

most of the studies are based on describing the reality of water security in algeria without measuring water security statistically, through our presentation of the following studies

A- bougherara salah, Siham aabaci (2020) Which came under the title: " Investing in water resources: a way to achieve water security ", As the aim of this study was to identify the various investments in the water resource that would provide water for domestic, agricultural, and industrial consumption, the study relied on the descriptive approach in the theoretical narrative and the analytical approach in the analysis of ways to invest in water resources, and the study has reached the following results: Investment in water resources plays an important role in achieving water security by ensuring sufficient water in drinking, disinfection, agricultural, and industrial fields, especially within the framework of partnerships.

B- Afef Zahrawi (2021) Which came under the title " Water security and its relationship to food security in Algeria ", where this study aimed to determine the correlation between water security and food security, and in this study was based on the comparative approach to determine the relationship between water security and food security, the study also reached the following recommendations: efforts must be devoted to serving the land and we use every inch of it, and we must use the available water rationally, and this requires attention to water security without neglecting its impact on food security.

***The location of this study from previous studies*:**

- The subject of our study combines the most important elements of water security: water uses and internal water resources, as previous studies have not touched on the search for the extent of the relationship between these variables, and therefore it is considered more comprehensive and detailed.
- This study is characterised by proposing a scientific and standard guide to the model of measuring the reality of water security in Algeria.

2.General concepts about water security

In contemporary society, water has emerged as a crucial resource for attaining food security, a goal pursued by nations in response to the global drought-induced decline. Consequently, it has become imperative to devise solutions that guarantee water security.

2.1 The concept of water security

Before defining water security, it is necessary to analyse this term consisting of security and water, and the following table shows this.

Table 01: Water Security Concept

	The concept
Security	It is defined as "the position in which a person feels that he is not exposed to any danger, threat, or assault, and it is the position in which he feels safe from danger and that he is reassured".
Water	It is defined as" transparent liquid without colour, smell, or taste, and it is also a chemical compound found in the liquid state, often consisting of two hydrogen atoms and one oxygen atom".
Water security	It is defined as "the ability of the population to sustainably maintain access to sufficient quantities of water of acceptable quality for the maintenance of livelihoods, human well-being, and socio-economic development, to ensure protection from waterborne pollution and water-related disasters, and to preserve ecosystems in a climate of peace and political stability".

Source: prepared by the researcher based on: (belazzouz, khledj, & abbou, 2023, p. 81), (ASSI, 2023, p. 196), (aabaci & bougherara, 2020, p. 6).

Through the above table, water security can be defined as: developing plans to ensure sustainable water consumption to reduce the risk of scarcity and pollution; considering water resources as one of the most important elements of life that are used in various fields.

2.2 The foundations of water security

The concept of water security is based on a number of foundations, including the following: (EL-HABITRI, 2017, p. 166)

✓ Viewing water as an economic commodity implies that it is not freely available and, therefore, can be wasted or not efficiently utilised. Utilising them will result in environmental harm.

✓ Water is one of the basic requirements for development; without it, development processes in various economic sectors cannot be carried out.

✓ The competition for water resources between countries sometimes makes this vital commodity a pretext for war, and some countries may use it to wage wars against their neighbours to seize their water or obtain a sufficient share of the available water resources in the region.

2.3 Levels of water security

Based on its importance in human life, water security is based on a number of dimensions, which we summarise as follows: (oum saad, 2022, p. 534)

❖ Securing human survival by safeguarding fundamental necessities, along with the incorporation of the right to water into domestic laws.

❖ Saving water for consumption and protection from disputes over water.

❖ Ensuring the availability of water is crucial for sustaining agricultural activities, supporting various livelihood needs, promoting social and religious practices, fostering a healthy living environment, establishing sanitation systems, and safeguarding against the adverse impacts of droughts and destructive floods.

❖ Agriculture is the primary consumer of water in order to enhance food production and meet the demands of a rapidly growing population and the increasing preference for

3.The reality of water use in Algeria

By taking a look at the totality of these resources, we note that Algeria has realised the importance of water security and put it on its priorities due to the water crisis and the scarcity it faced in the nineties of the last century and with the beginning of the current millennium, and this is in order to preserve social peace and development in all its aspects.

3.1 Sources of Water Resources in Algeria

The water resources in Algeria differ due to its geographical location and the development that Algeria has witnessed in the search for non-traditional water sources, which are as follows:

3.1.1Traditional water resources in Algeria: It encompasses both groundwater and surface water. Groundwater refers to the water beneath the Earth's surface, stored within its layers as a result of rainwater seepage (renewable groundwater basins). Surface water, on the other hand, refers to the water found in rivers, lakes, oceans, and seas, originating from springs and snow. Some of this surface water can be stored in dams and reservoirs. Traditional water sources in Algeria consist of the following:

a- Rainwater: Algeria possesses both surface and subsurface water resources, which are mostly replenished by rainfall. The extensive geographical expanse and the varied topography have given rise to multiple factors that influence the process of precipitation.

However, the desert region covers 85% of this area and experiences very little rainfall. In contrast, the northern region has a Mediterranean climate and receives approximately 192 billion cubic metres of rainfall. However, much of this rainfall flows towards the sea and evaporates due to high temperatures. As a result, the distribution of precipitation decreases in two directions: from north to south and from east to west.

Precipitation is primarily concentrated in the northern region of the country, occurring for a maximum duration of 100 days. Additionally, snowfall is observed on the summits of the Atlas Mountains. The annual precipitation is predicted to be approximately 65 billion 3M, with the majority of it undergoing evaporation. Heavy precipitation, which often lasts only a few minutes but drops enormous volumes quickly, is a hallmark of the autumn and winter rains. This intense rainfall leads to torrents that can damage agricultural crops, cause soil erosion, and create muddy dams. The absence of soil receives little advantage from rainfall, as the majority of it drains into the ocean due to the rugged terrain of the northern areas, requiring a velocity of 2000 metres per second.

b- Ground water: Groundwater is geographically distributed into

✓ To the North: The technical departments of the National Agency for Water Resources (ANRH) and the Directorate of Major Water Facilities (DGAIM) have estimated the amount of groundwater under the National Water Plan at about 9.1 billion 3m per year. These resources, which facilitate their mobilisation, are currently exploited by more than 90%, approximately 7.1 billion 3m per year, as the layers are known as overexploited.

✓ From the South: With the exception of the ghir Valley ,Mizab Valley, and the sawla Valley, the desert area has minimal presence. However, it does possess substantial groundwater resources that have accumulated over thousands of years. These resources are located at considerable depths, approximately 2,000 metres below the earth's surface, except in the Adrar area, where groundwater can be found at depths ranging from 200 to 300 metres.

Currently, Algeria uses around 7.1 billion cubic metres of this significant water resource each year to fulfil the agriculture and drinking water requirements of the population in the southern region. Therefore, there is still a remaining supply of 3.3 billion cubic metres of usable water that can be utilised for the purpose of cultivating crops in arid regions and reclaiming formerly unusable land. Currently, this choice is the most suitable as it incurs significant expenses for the state's treasury to send it to the North, as stated by the competent officials of the Ministry of Water Resources.

c-Surface waters: Surface water encompasses all the water resources present on the Earth's surface, including water stored in dams or other man-made structures as well as water flowing in rivers.

✓ Dams: Many nations have started harnessing the capacity of seasonal valleys and permanent rivers by constructing dams, which allow for the storage of excess floodwater and the utilisation of stored water during droughts for drinking and agricultural purposes. These exemplify exemplary instances of water resource development in arid regions, which should be further promoted. The primary impediment to the development of dams is the exorbitant expense associated with their construction.

Algeria has 112 dams with a total storage capacity of more than 10 million cubic metres. Through the dam-level emergency programme, projects have been planned to mobilise a total of 11 billion cubic metres and a regular total volume of 6 billion cubic metres, These are as follows:

- ❖ 50 exploited dams (a capacity of 0.7.5 billion cubic metres).
- ❖ 12 dams are under construction (estimated at 70.1 billion cubic metres).
- ❖ The launch grid is estimated at 700 million cubic metres.
- ❖ 30 in-depth studies, of which 9 are ready (an estimated 40.2 billion cubic metres).
- ❖ 27 achievable initial studies (an estimated 150 million cubic meters)

d-Water quarries refer to water basins, which are also known as mountain lakes. Their storage capacity does not surpass one million cubic metres. Primarily, they are used for the purpose of hydrating and providing water to cattle. In addition, they consist of earthen embankments with a vertical dimension varying from 5 to 15 metres. Water quarries were neglected by public authorities due to their perception as insignificant obstacles. (benkellouche & bellil, 2022, pp. 07-08)

Inconsequential. This model was observed in the Greater Kabylie region, constructed by the Soviets or even preexisting prior to the colonial era (Bukhalifa Dam). The anticipated number of barriers in 1979 was 44, with a capacity to absorb 21 million cubic meters. The location of the area is in the northern states, characterised by abundant precipitation. The cities mentioned include Bouira, Tizi Ouzou, Boumerdes, and Constantine. During a span of two years, from 1985 to 1987, a total of 667 checkpoints were successfully carried out in various locations with the active support and facilitation of the authorities. A total of 35 million cubic metres, out of the total capacity of 79 million cubic metres, were successfully utilised. However, the progress of the operation deteriorated towards the end, prompting the establishment of 130 more checkpoints in 1992 to attain maximum capacity. The sum amounts to 113 million cubic metres. The 1993 assessment conducted by the sector about the administration and utilisation of these dams revealed that 80% of the facilities are ablaze, 75% of their water is allocated to the agricultural sector, 5% is used for livestock rearing, and 20% remains untapped in Algeria. Additionally, there are approximately 1365 water reservoirs established to harness rainfall water for the purpose of expediting the construction of 627 water reservoirs and restoring 458 previously constructed reservoirs, with the specific aim of channelling them towards agricultural use. This dam is classified as a small-scale irrigation infrastructure. During the early 1980s, when the irrigation industry initiated a programme, it went unnoticed. This initiative focuses on conducting comprehensive research and attaining notable accomplishments to support and enhance small-scale agricultural investments in the mountainous regions of the northern part of the country. (megharbi, 2016, pp. 105-109)

3.1.2 Unconventional water resources in Algeria: Algeria has faced multiple water crises due to drought and population growth, resulting in a twofold increase in water use. This increase is not limited to domestic use but also extends to the industrial and agricultural sectors. As a result, Algeria has turned to contemporary methods of obtaining water, such as desalinating seawater and purifying wastewater.

a-Seawater desalination: also known as desalinization, refers to the process of removing a significant amount of salt present in seawater and oceans and converting it into drinkable water for human consumption and for irrigating agricultural crops. Despite its high cost, there is a disparity in the expenses associated with generating one cubic metre of water. The price of water in Singapore is $0.24 per cubic metre. Cameroon has the highest price, amounting to $2 per cubic metre. This can be attributed to the water's quality, geographical location, and human factors. Algeria has initiated the establishment of seawater desalination facilities at Algiers, mestghanem, and oran, each with a capacity of 500,000 cubic metres. The focus has been on the advancement of desalination facilities in coastal regions to facilitate the transportation of accessible water to hilly and inland locations.

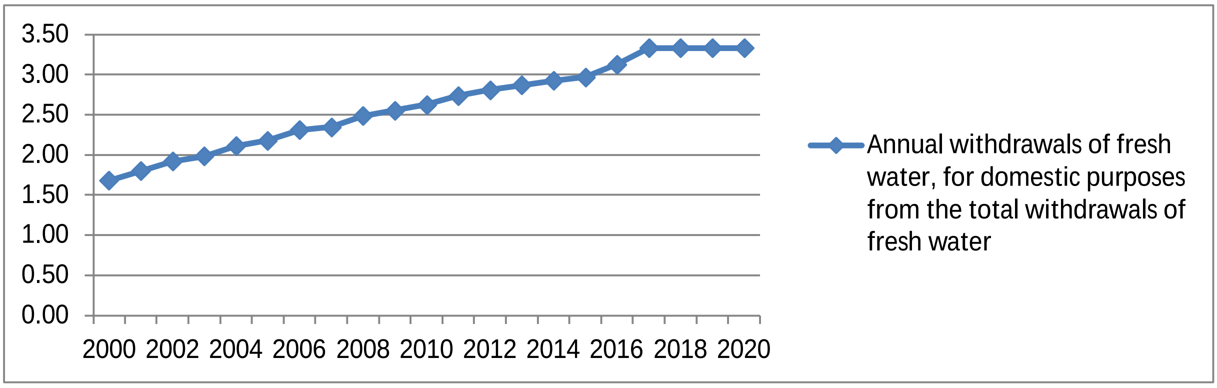
b- Wastewater treatment: is the process of purifying waste water from impurities, pollutants, and organic matter to make it usable. Algeria is currently treating 570 million cubic metres, equivalent to 75% of the volume of water used. Algeria is trying to upgrade treatment capacities to 2 million, equivalent to 85% of the total volume of drainage. (Seebach, 2016, pp. 348-349)

3.2 Water uses in Algeria

Algeria, like other nations, regulates the use of water resources based on the specific requirements for domestic, agricultural, or industrial purposes, as outlined below:

***3.2.1 Domestic water uses in Algeria**:* many factors play a major role in the increase in the percentage of water resource uses, most notably the annual increase in population, which directly affects the increase in domestic water consumption for drinking, cleaning, and domestic use. The following graph shows the volume of domestic water consumption in Algeria during the period 2000–2020.

Figure 02 :Annual withdrawals of fresh water, for domestic purposes from the total withdrawals of fresh water

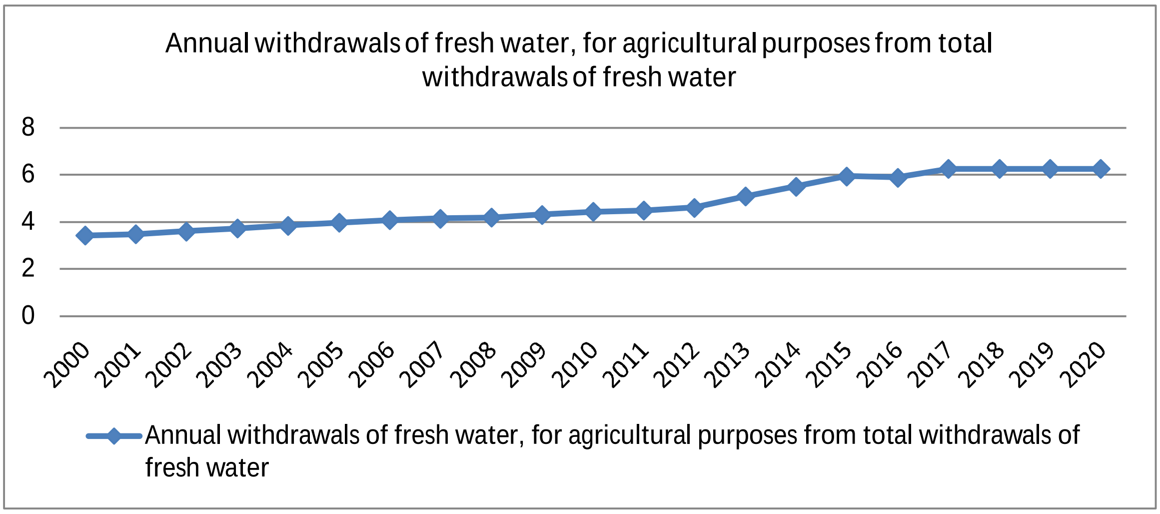


Source: prepared by the researcher based on : (THE WORLD & BANK, Annual freshwater withdrawals, domestic (% of total freshwater withdrawal), 2021)

The provided data illustrates a gradual increase in yearly fresh water withdrawals for household use, rising from 1.68 billion cubic metres in 2000 to 3.332 billion cubic metres in 2020. This rise can be attributed to the sustained high rates of population growth during this time.

3.2.2 Agricultural water uses in Algeria: Algeria's agricultural sector occupies a large part of its economy as a contributor to the realisation of its food security strategy. Among the most important factors it needs are water, which is used to water and to expand agricultural areas. The data show the water resources allocated to Algeria's agricultural sector during the period 2000–2020:

Figure 03 : Annual withdrawals of fresh water, for agricultural purposes from total withdrawals of fresh water

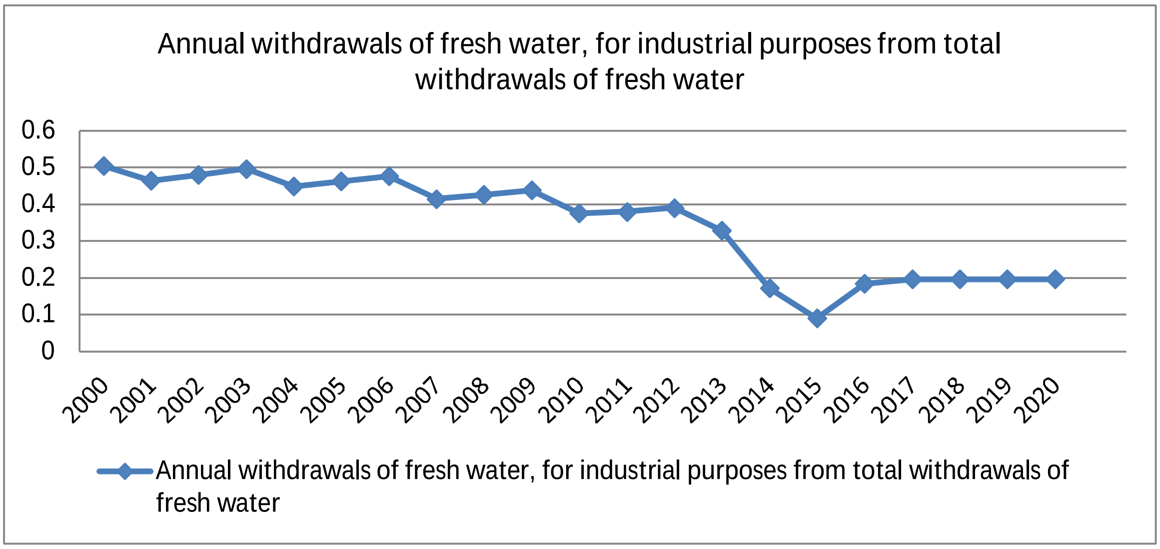


Source: prepared by the researcher based on (THE WORLD & BANK, Annual freshwater withdrawals, agriculture (% of total freshwater withdrawal), 2021)

Based on the provided diagram, the yearly extraction of freshwater for agricultural purposes exhibited a consistent upward trend from 2000 to 2015, reaching a peak of 5.940 billion cubic metres. Subsequently, it remained stable at 6.272 billion cubic metres between 2017 and 2020. During this period, around 60% to 66% of total freshwater withdrawals were attributed to agriculture. The rise in water usage in the agricultural industry can be attributed to Algeria's pursuit of food security as a prominent aspect of its agricultural economy.

3.2.3 Industrial water applications in Algeria: Water has a crucial role in industry, serving as an intermediary in the manufacturing process, where it is utilised for refrigeration operations and waste management. It has the potential to be used as a raw material in certain sectors. As the industrial trend intensifies, the demand for water to fulfil its purpose also grows. The graphic depiction illustrates the allocation of water resources for the industrial sector in Algeria from 2000 to 2020.

Figure 04: **Annual withdrawals of fresh water, for industrial purposes from total withdrawals of fresh water**



Source: prepared by the researcher based on: (THE WORLD & BANK, Annual freshwater withdrawals, industry (% of total freshwater withdrawal), 2022)

Through the above figure, the data show a decline in the use of freshwater for industry during the period from 2000 to 2020, based on the amounts drawn and the percentage shown in the table, as a result of the weakness of Algeria's industrial sector.

3.3 Mechanisms for achieving water security

Water security largely depends on the number of water resources available in each country, and there are several ways to develop these water resources. The mechanisms for achieving water security include the following: (zahraoui, 2021, p. 72)

3.3.1 Protection of non-renewable groundwaters**:** non-renewable groundwaters are protected by:

- ✓ To carry out exploration and geological studies that determine the size of this resource and to study ways of developing and maintaining it.
- ✓ Commitment to state policy aimed at the conservation of water sources.
- ✓ Development of an information base on water sources, including quantity, quality, and utilisation rates.

3.3.2 The desalination industry has emerged due to the scarcity of fresh water, which is the main supply of drinking water,In order for the desalinization sector to support the process of growth, it is essential that it does not have a large impact on existing water supplies. However, it is crucial that future approaches in this industry show potential for effectively addressing water shortages. Renewable energy sources like solar, wind, and nuclear power can be utilised to desalinate water, offering a sustainable solution for water desalination in the future.

3.3.3 Enhancing regional collaboration for water resource management: The matter of scarce water resources in the foreseeable future is a regional concern. It is anticipated that cooperation among neighbouring states in the establishment of new water sources and the management of water resources will be a crucial aspect of regional and international collaboration in the coming years. The primary areas of collaboration could revolve around scientific research, technical advancement, and the sharing of knowledge in water resource development and management.

3.3.4 Integrated Water Resources Management (IWRM) has gained significant attention in recent years, particularly in arid regions. This has led to the development of theoretical scientific concepts such as supply and demand management, water pricing, efficient use, consumption rationalisation, and others. These concepts aim to achieve a satisfactory level of integrated management, which, in turn, strives to uphold the fundamental principles of water management. Integrated Water Management is founded on the principles of active involvement, decentralisation, and the delegation of irrigation management to users, all within a framework of coordinated legal and regulatory systems.

3.3.5 Water policy development: The development of water policy is well defined and based on a strict legal and regulatory basis, which requires the enactment of necessary laws, the development of institutional and technical capacities, the knowledge base and the means of assessment and control to control the problem, and the creation of continuous mechanisms to harmonise the challenges of water realities with trends in development and environmental policies. The resolution of the water resources problem remains a major and consistent objective that requires that it be brought to the level of strategic objectives and that programmes be developed, the most important of which are:

•increased attention to groundwater and the pursuit of its development.

•Development of water-use rationalisation tools

• introduction of modern irrigation systems, promotion of their use, and protection of groundwater and surface water from pollution.

4.An examination of the actual utilisation of water in Algeria in accordance with water security prerequisites

Algeria possesses a wide range of natural resources, resulting in a broad array of water resources, including surface water, groundwater, and precipitation. However, the problem of drought and scarcity has arisen in Algeria due to its geographical location and the distribution of climatic regions, including the Mediterranean region, the steppe region, and the Sahara region. These regions cover a significant portion of Algerian territory and experience extremely low, if not nonexistent, rainfall.

Using the statistical data collected earlier, a standard model was developed to analyse the relationship between the independent variable (water uses) and the dependent variable (internal water resources) in Algeria from 2000 to 2020. The model aims to assess the long-term balance between these variables. The model is as follows:

X: Independent variable (water uses).

Y: Dependent variable (internal water resources).

After entering the model data into the Eviews10 programme, the following results were obtained:

4.1 test the variables for stationarity (ADF)

was conducted by graphically representing both series x and y (see Appendix 1). The graphical representation revealed an upward trend in both series, indicating their instability. This observation was further confirmed by testing the unit roots, which indicated that the series has a root of:

4.1.1 stationarity test for variable Y using time series analysis: the differences were taken, and the stability of the Y series was re-tested, and the following table shows this:

Table 02: results of the time series stationarity test(Y) ADF

			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.030115	0.0001
Test critical values:	1% level		-2.728252	
	5% level		-1.966270	
	10% level		-1.605026	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(Y(-1),2)	-4.781281	0.950531	-5.030115	0.0004
D(Y(-1),3)	2.500270	0.792699	3.154121	0.0092
D(Y(-2),3)	1.465027	0.515251	2.843325	0.0160
D(Y(-3),3)	0.528945	0.216686	2.441071	0.0328

Source: Programme Output.Eviews10

It can be seen from the above table that when taking the first differences with the presence of a cutter, the series turns out to be stable. (0.0001) is smaller than 5%, and the concentricity T (-5,03) is smaller than the statistical T at 5%, which means the series is **stationarity**, as it was noted that the series is stable in the plane with no categorical, first, or second differences.

4.1.2 stationarity test for variable X using time series analysis: The disparities were assessed, and the durability of the X-series was reassessed, yielding the subsequent table:

Table 03: results of the time series stationarity test (X) ADF

			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-7.141428	0.0000
Test critical values:	1% level		-2.699769	
	5% level		-1.961409	
	10% level		-1.606610	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(X(-1),2)	-1.500000	0.210042	-7.141428	0.0000

Source: Programme Output.Eviews10

When taking the first differences with the existence of a cutter, it came out that the series is stable where PROB (0.000) is smaller than 5% and the computed T (-7,14) is smaller than the statistical T at 5%, which suggests that the series is stable. Upon examination, it is evident that series X and Y lack the root of unity and consequently stabilise when the initial differences are taken. Therefore, their degree of integration is 1, and they satisfy the criterion for the integration test.

4.2 The Cointegration Test

after assessing the stability of the time series, which was stabilised by taking the initial differences, the regression equation was calculated with the preservation of the remainder.

$$Y=a+BX_T+U_T$$

Where:

Y: dependent variable (inland water resources)

X: independent variable (water use)

A: constant coefficient

B: regression coefficient

UT: the residuals

The (ADF) roots of the module were tested for the residuals, and the following table shows that:

Table 04: test for stationarity of residuals with the DICKEY-fuller test

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.822076	0.0001
Test critical values:	1% level	-2.685718	
	5% level	-1.959071	
	10% level	-1.607456	

Source: Programme Output.Eviews10

After comparing the calculated T (-4,822) with the tabular T, which was extracted from the DICKEY-fuller table and estimated at (-2,76), it is found that the calculated value is smaller than the tabular value, which explains the lack of integration between the two series and indicates the presence of false regression.

To confirm the cointegration test, the cointegration was tested by the engle-granger method, and the following table shows this:

Table 05: Testing the cointegration of time series by the Engle-Granger method

Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=4)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
X	-0.811515	0.9324	-1.509423	0.9537
Y	-4.822076	0.0053	-21.97569	0.0034

*MacKinnon (1996) p-values.

Intermediate Results:

	X	Y
Rho - 1	-0.075471	-1.098784
Rho S.E.	0.093000	0.227865
Residual variance	0.295348	0.004744
Long-run residual variance	0.295348	0.004744
Number of lags	0	0
Number of observations	20	20
Number of stochastic trends**	2	2

Source: Programme Output.Eviews10

The results of the above table explain that the calculated test significance value (prob) is larger than 5% for the dependent variable series, and the remainder of the dependent variable estimated at (-4,822) is smaller than the tabular value of the DICKEY-fuller table. This is explained by the failure to achieve the integration condition between the two series, which indicates the absence of balance or ***cointegration*** *between the two variables, and hence we cannot utilise the error correction mechanism to estimate.*

The statistical results obtained in the cointegration test show that the calculated test value (prob) is greater than 5% of the dependent variable chain, and the dependent variable condom estimated (-4.822) is smaller than the scale value of the DICKEY table. We accept the **null hypothesis:** The lack of a cointegration relationship between water uses and internal water resources in Algeria in the long term.." We reject the alternative. This indicates that the frequency of water use for domestic, agricultural, and industrial purposes in Algeria is irrational. Therefore, the strategy of water consumption or use must be changed in line with the assets and internal water resources of Algeria so that the balance between water supply and demand can be achieved to ensure water security in Algeria.

4.3 Prospects for achieving water security in Algeria

The Algerian government has been urgently addressing the issue of drought and water scarcity in order to safeguard their water security. This is due to the persistent lack of rainfall, which has been decreasing over the past decade, similar to other nations in the region. At present, Algeria is providing 75 dams in the process of exploitation; 5 more will shortly enter service, and 5 more will be under construction. Dams represent only 33% of the water resources produced nationally, compared with 50% of the groundwater and 17% of the water produced by treatment and purification plants.

According to the same statistics, Algeria's groundwater stock is comparable to 7.5 billion cubic metres, with an annual utilisation rate of 51 percent to 52 percent, with 2.5 billion cubic metres concentrated in the north, while its southern water stock is assessed at 5 billion cubic metres. According to expert assessments, Algeria's domestic academic studies are regarded as a weak country in terms of water resources. The yearly per capita consumption rate is estimated at less than 600 cubic metres, while the World Bank pegs it at 1,000 cubic metres per year. In all industries, Algeria uses around 17 billion cubic metres of water, whereas its demands surpass 20 billion cubic metres per year. To fulfil this, Algeria made investments in irrigation and water resources between 2001 and 2016 to achieve dams, saltwater purification facilities, and sewage, according to earlier declarations by officials and experts.

In order to balance the water needs and water resources available in Algeria, Algeria has hastened the development of schemes that include the following:

✓ The number of saltwater desalination plants has been expanded to 19 in the 2024 horizon, with the first phase drawing 11 offshore stations with a production capacity of 2.11 million cubic metres per day.

✓ Within the framework of the emergency plan, the government has constructed three more stations with 70,000 cubic metres per day, in parallel with five additional stations designated Supplementary Programme, which will deliver 1.5 million cubic metres per day in 5 governorates in the horizon of 2024. The National Water Strategy 2021–2030 intends to meet the demands of Algerians for drinking water by desalinating saltwater by up to 60%.

✓ The wastewater, estimated at more than 1.5 billion cubic metres per year, has been repurposed and is currently being treated by 220 stations distributed throughout the country.

✓ The optimum utilisation of 30,000 billion cubic billions of water stored in the "big hollow" layers, provided careful attention is paid, particularly with regard to their high salinity, depth, and relative temperature, while they are only minimally refilled.

On the other hand, a package of further direct technical proposals has been provided, as follows:

Mandatory water metres are set everywhere.

• minimising water evaporation in dams.

• application of new and fair tariffs.

• Treatment and reuse of industrial and domestic wastewater.

• Rainwater collection for each house or building.

• Combat the deposition of semen in dams (which causes the loss of 30 to 40 million cubic metres of water per year).

• Geothermal energy for early vegetable production. (hadhaka, 2023)

5.Conclusion

Water security is a vital pillar for obtaining human security and preserving its components. We must deal seriously with these challenges. The problem of water does not lie in its availability or scarcity, but rather in individuals' understanding of rationalisation and rational usage. The individual is the central force driving growth and possesses the capacity for transformation. The function of the state is not confined to giving financial support. Consumer awareness must be spread in order to increase communication with society. No matter how good the policies implemented are, they will not be effective until society supports them.

Results and recommendations of the study: In this study, we shall offer the diverse findings and recommendations that have been made as follows:

✓ Algeria's water balance is currently in a deficit scenario due to factors such as acute climate unpredictability, geographical issues, and other economic and social variables that impact water supply and demand.

✓ The present and forthcoming situation in Algeria is characterised by instability. It is classified as a poor country for water resources, which will endanger the expansion of some sectors, such as agriculture, industry, and others.

✓ The fragility of water availability in Algeria is mostly related to irrational exploitation of water.

✓ The lack of complementarities between water uses expressing water demand and inland water resources expressing water supply explains the challenge of establishing water security in Algeria and the statistical tests utilised.

✓ Lack of training in the administration and management of the water sector in Algeria The demographic expansion in Algeria has caused an imbalance between the water demand rate and its supply rate.

✓ Water resource governance necessitates the active involvement of several stakeholders, such as community actors, non-governmental organisations, and both the private and public sectors, which provide support and exert influence over the government and its local administrations.

✓ Developing laws, regulations, and strategies to promote sensible use of water in various places in order to balance water supply and demand by recognising water balance as a reflection of water security.

✓ Algeria must develop water resource development projects by making major investments in this sector.

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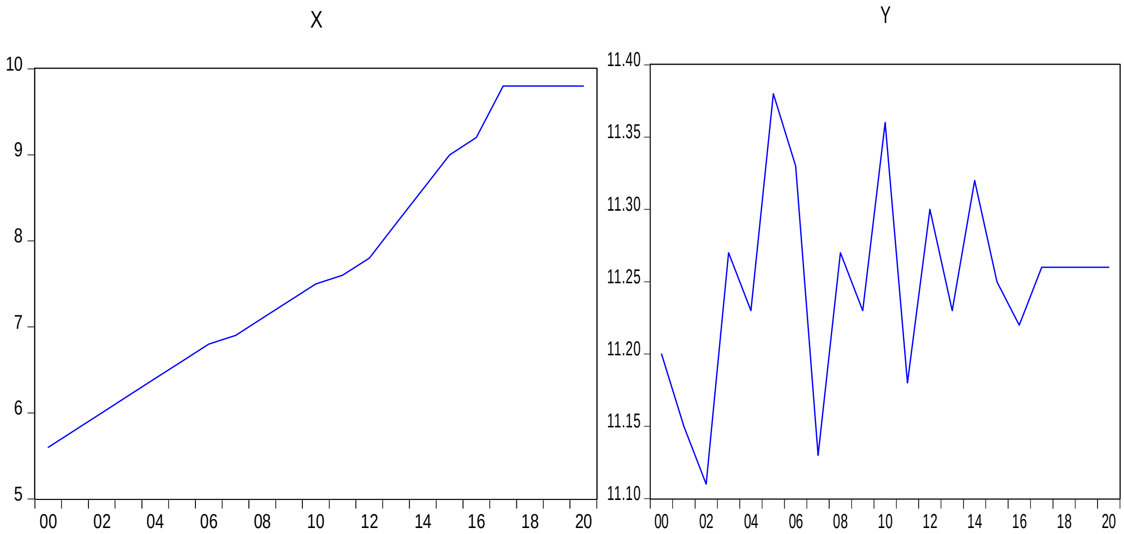
7. *Appendices*

Appendix 01: Graphical representation of the study series



Source: Programme Output.Eviews10

Appendix 02 : Water resources of Algeria

Annual withdrawals of fresh water, for domestic purposes from the total withdrawals of fresh water	Annual withdrawals of fresh water, for agricultural purposes from total withdrawals of fresh water	Annual withdrawals of fresh water, for industrial purposes from total withdrawals of fresh water	Total annual freshwater withdrawals (%of internal resources)	Annual withdrawals of fresh water, total (billion cubic meters)	Inland Water Resources	The years
1,68	3,416	0,504	**50**	**5,60**	11,20	**2000**
1,798	3,48	0,464	**52**	**5,80**	11,15	**2001**
1,92	3,6	0,48	**54**	**6**	11,11	**2002**
1,984	3,72	0,496	**55**	**6,20**	11,27	**2003**
2,112	3,84	0,448	**57**	**6,40**	11,23	**2004**
2,178	3,96	0,462	**58**	**6,60**	11,38	**2005**
2,312	4,08	0,476	**60**	**6,80**	11,33	**2006**
2,346	4,14	0,414	**62**	**6,90**	11,13	**2007**
2,485	4,189	0,426	**63**	**7,10**	11,27	**2008**
2,555	4,307	0,438	**65**	**7,30**	11,23	**2009**
2,625	4,425	0,375	**66**	**7,50**	11,36	**2010**
2,736	4,484	0,38	**68**	**7,60**	11,18	**2011**
2,808	4,602	0,39	**69**	**7,80**	11,30	**2012**
2,87	5,084	0,328	**73**	**8,20**	11,23	**2013**
2,924	5,504	0,172	**76**	**8,60**	11,32	**2014**
2,97	5,94	0,09	**80**	**09**	11,25	**2015**
3,128	5,888	0,184	**82**	**9,20**	11,22	**2016**
3,332	6,272	0,196	**87**	**9,80**	11,26	**2017**
3,332	6,272	0,196	**87**	**9,80**	11,26	**2018**
3,332	6,272	0,196	**87**	**9,80**	11,26	**2019**
3,332	6,272	0,196	**87**	**9,80**	11,26	**2020**

Source: prepared by the researcher based on: (THE WORLD & BANK, Annual freshwater withdrawals, agriculture (% of total freshwater withdrawal), 2021), (THE WORLD & BANK, Annual freshwater withdrawals, domestic (% of total freshwater withdrawal), 2021), (THE WORLD & BANK, Annual freshwater withdrawals, industry (% of total freshwater withdrawal), 2022)