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Assessing the Impact of Economic Growth and Water Stress on Per Capita Freshwater Availability: An Econometric Analysis of Algeria (1990 –2020)

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Abstract: The purpose of this study is to determine how economic growth and water stress levels relate to Algeria's per capita renewable freshwater availability between 1990 and 2020, applying the Autoregressive Distributed Lag (ARDL) model. The study found that in the near term, a 1-unit rise in economic growth results in a decrease of 0.00016 units in per capita renewable freshwater resources. In the long run, freshwater availability per capita declines by 1.22 units for every 1-unit increase in water stress levels. Additionally, per capita renewable freshwater resources decrease by 0.01 units for every 1-unit increase in per capita GDP. This ongoing decline in freshwater availability emphasizes how urgently governments must give water resource management top priority and look into alternate water sources.

Keywords: Water Stress; Economic Growth; Per Capita Freshwater Availability; ARDL.

1. Introduction

To achieve high economic growth rates, successful policies must be followed, especially with climate change and its resulting effects, as natural resources are primarily affected by these changes, particularly water resources, which are a key driver of development. Therefore, the United Nations has been compelled to adopt urgent strategies to preserve this resource. According to the United Nations 2024 report on water resource development under the theme "Water for Prosperity and Peace" (United Nations, 2024), the water crisis is considered a threat to global peace, with rising water stress levels increasing the risk of regional conflicts In addition, four out of five individuals without access to basic drinking water services live in rural areas, 2.2 billion people lack access to safely regulated drinking water, and over 14 billion people worldwide have been affected by the global drought issue. The fact that 3.5 billion people do not have access to properly managed sanitation is also concerning. The rapid urban population expansion has created challenges for cities and

municipalities. According to the report, $114 billion would have to be spent every year by 2030 to guarantee that everyone has access to sanitary facilities and safe drinking water. In light of this situation, which requires international efforts to achieve the desired goals and preserve the environment, solutions must be found for countries that heavily depend on the industrial sector as a major pollutant. There must be a balance between increasing economic growth rates and preserving natural resources before it is too late.

Southern Europe has been significantly affected by the impacts of climate change. Water reserves are expected to decline due to reduced precipitation, and surface water temperatures are projected to rise by 1.5°C (Salles, 2022). Algeria, as one of the countries negatively affected by climate change, has suffered from droughts for many years, adversely impacting its water resources, which are a crucial driver of the economy and a vital resource for life.

1.1. Research Problematic:

Algeria, like other countries, seeks to achieve water security in the face of climate change and its negative impacts, particularly on the Southern Mediterranean region. This is done through implementing policies aimed at balancing supply and demand, as well as ensuring the availability of water resources for both the population and economic sectors to drive economic growth to satisfactory levels. This, in turn, leads to increased competition between these sectors, resulting in water stress on this resource. Such competition between various sectors may affect per capita freshwater availability. Therefore, the following research problem can be formulated:

How do economic growth and water stress levels impact per capita freshwater availability in Algeria during the period 1990-2020?

Accordingly, the following sub-questions can be asked:

How do water stress levels affect per capita freshwater availability in Algeria?

Does economic growth impact per capita freshwater availability in Algeria?

1.2. Study Hypothesis:

To answer the main problem and its elements, a main hypothesis was adopted, stating that:

- An increase in water stress levels due to heightened competition between sectors corresponds with a decrease in per capita freshwater availability.

- An increase in the economic growth rate generally improves the standard of living, which in turn leads to an increase in per capita freshwater availability.

1.3. Research Aims:

The study's objective is to provide light on Algeria's water stress levels and economic growth, particularly in light of the country's high susceptibility to the effects of climate change. It also seeks to evaluate the yearly freshwater availability per capita and contrast it with the outcomes concerning water stress and economic growth.

1.4. Methodology:

The descriptive technique was used to examine data pertinent to the study's indicators based on the topic's nature and the research question. Furthermore, an econometric method was used by building a model to illustrate how economic growth and water stress levels affected Algeria's per capita freshwater availability between 1990 and 2020.

2. Literature review:

Regarding previous studies, we have selected the following studies related to our research topic, as follows:

- A 2007 study by Lucas Menzel et al. looks at the relationship between social factors, climate change, and economic growth and water availability and water stress. The study looked at how socioeconomic variables and climatic change impact freshwater resource allocation, water demand, and the emergence of water stress on a worldwide scale. According to the findings, population growth, economic development, and increased water consumption efficiency have a bigger influence on water stress than climate change. By 2050, a discernible rise in water stress is anticipated, with regional variations in water stress levels between scenarios. Rising water withdrawals are mostly to blame for this increase in water stress, but climate change-related increases in water supply are to blame for a decrease in water stress (Menzel et al., 2007).

-Study by Meriem Naimi-Ait-Aoudia and Ewa Berezowska-Azzagaa (2014) on the carrying capacity of Algeria's home water consumption per person. The research evaluated Algeria's water supply capacity while taking into account home water consumption levels that are globally recognized. It considered water inputs, which may differ greatly depending on whether a year is rainy or dry. The study found that in the current operational environment, the water supply system, which relies on desalination, surface water, and groundwater, is particularly vulnerable to drought. It suggested using current irrigation methods in conjunction with treated water for both industrial and agricultural uses (Naimi-Ait-Aoudia & Berezowska-Azzag, 2014), to reallocate freshwater for domestic use. The study also suggested that reducing domestic water demand could be significantly achieved through changing water consumption patterns and implementing modern rainwater harvesting.

-Study by Distefano and Kelly. (2017) titled " Are we in deep water? Water Scarcity and Its Limits on Economic Growth" examined the potential existence of water constraints on economic growth and how water shortage is affected by climate change. According to the study, water shortage is a worldwide problem that is influenced by both social and environmental factors, such as population and climate. This is true regardless of the degree of economic growth. Short-term economic factors (GDP, efficiency, and trade) might affect water extraction; significant effects are anticipated in China and India around 2025. (Distefano & Kelly, 2017).

-Study by Ömer Esen, et al (2020) on the Eurozone's water stress threshold consequences of economic expansion. This study empirically tested the environmental Kuznets curve hypothesis using a country's water stress as a measure of the strain on its renewable water resources. The threshold regression model used in the study was based on a sample of nine European countries between 1995 and 2013. The results clearly showed that there is a threshold, over which the environmental constraints brought on by the expansion of renewable water resources rise, but below which growth in per capita GDP has no statistically significant impact on water stress (Ömer Esen et al., 2020).

-Study by Monica Laura Zlati et al. (2024) on how the 27 EU member states socioeconomic development is affected by the water security index. With an emphasis on how water security affects the EU-27's social and economic development from 2000 to 2022, the study addressed environmental security within the framework of sustainable development (Monica Laura Zlati et al, 2024). The Kruskal-Wallis test and structural equation modeling techniques were used to evaluate regional disparities and ascertain how water security policies affected social and economic metrics. The results showed a strong relationship between population density, pollution levels, and water quality management costs, with greater population densities and pollution levels translating into higher expenses.

3. Theoretical framework of the study:

Climate change has become a central topic of discussion regarding water resources and the associated risks, placing it at the heart of the issue. According to experts, Algeria will experience a decrease in rainfall ranging from 5% to 13% and an increase in temperatures between 0.6 to 1.1 degrees Celsius. Algeria, an arid nation, will see frequent floods and droughts in the near future, and the strain of both population and economic expansion will cause its water demands to quadruple. (mohamed & Khalil, 2015).

3.1. Economic Growth:

Economic growth, which is seen as a reflection of political actions, reflects a society's economic, living, and welfare standards. Development is a topic that many economists have tackled from different angles.

3.1.1. Economic Growth Definition:

Economic growth is the pace at which a nation's output rises over a certain time period, taking into account any adjustments to its production capacity, whether they be increases or losses. An increase in Gross Domestic Product (GDP) is primarily attributed to the enhanced ability to utilize production capacities and the extent of their use. Moreover, real increases in GDP result from several factors, such as improving the quality and quantity of available resources, incorporating advanced technological methods in production stages, and increasing or better directing capital investment (Boukfetane, 2022).

3.1.2. Economic Growth Determinants:

There are several factors through which economic growth can be determined. Based on its concept, we find some key determinants such as natural resources, technology, capital, and human resources.

A-Natural Resources: Natural resources represent essential inputs for the industrial sector, as production relies on resources of various sizes and types to achieve the set economic goals.

B-Human Resources: Human resources are fundamental to these determinants, as they ensure optimal use of different resources and achieve high productivity. Some countries lacking in natural resources have achieved respectable growth rates due to the quality of their human resources.

C-Technological Development: Technology significantly contributes to raising growth rates by reducing production costs or increasing quantities. Technology is also a benchmark for comparing developed and underdeveloped countries.

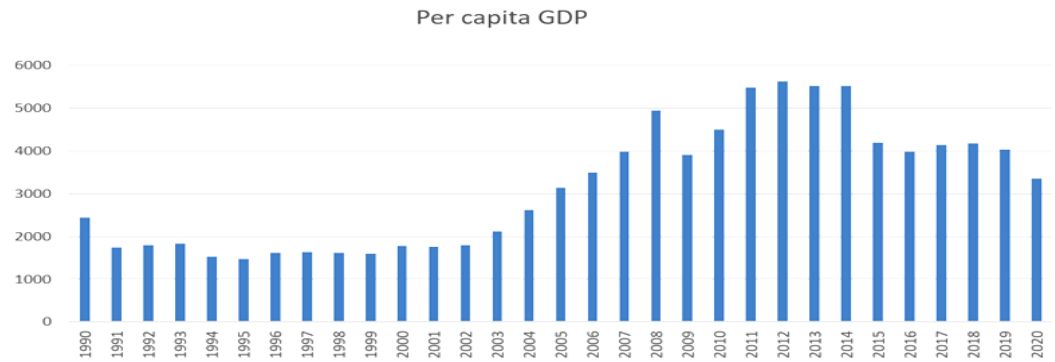
D-Capital: Capital represents the total investments, infrastructure, and equipment that an economy possesses at a specific time. It can be increased through savings that are directed towards investment, which in turn increases output and income, thus enhancing the capital formation capability within the economy. It can also be increased through internal and external borrowing and foreign aid (Merdassi, 2018)

3.1.3. Measuring Economic Growth:

Of the various measures of economic growth, the Gross Domestic Product (GDP) is the most important. GDP measures the market value of all finished goods and services produced in a country over a specific time period. Per capita GDP, which is calculated by dividing

GDP by the population size, is another important figure (Ben Seddik Z, 2023). It can be used as a gauge of people's well-being, as it reflects how easily they can access money, goods, and services.

Figure 1: Evolution of Gross Domestic Product Per Capita in Algeria from 1990 to 2020 in Current US Dollars.



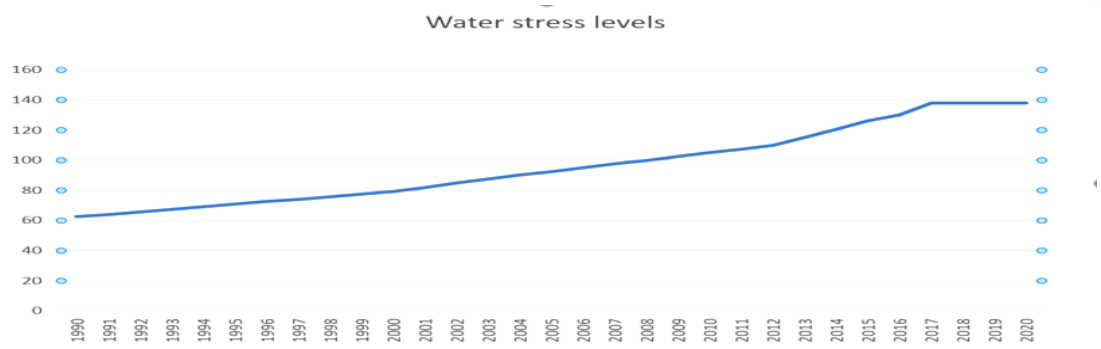
Source: prepared by the researchers using information from the World Bank database

From the graph, we observe the instability of per capita Gross Domestic Product, where increases and decreases are noted. This is primarily due to the Algerian economy's dependence on oil exports, which explains the fluctuations that are associated with oil revenues according to global prices.

3.2. Water Stress Level:

Countries strive to achieve water security through various policies, focusing on protecting water resources and ensuring their sustainability, while having the ability to develop these water sources to meet future needs (Ben Guida S, & Harakat S, 2020). This indicator, also referred to as "water withdrawal intensity" accounts for the demands of multiple industries, including forestry, manufacturing, services, and agriculture, and calculates the volume of freshwater withdrawals as a percentage of all renewable water resources that are available. With the use of this indicator, we can determine how much freshwater is under pressure as a result of withdrawals relative to all accessible resources. Additionally, it evaluates the progress made toward attaining Sustainable Development Goal 6.4, which calls for increasing the efficiency of water use in all sectors and ensuring sustainable water withdrawals by 2030. (https://www.fao.org, 2024). Water stress, or water withdrawal intensity, reflects the pressure exerted on water resources by withdrawals relative to the total available renewable water resources.

Figure 2: Evolution of Water Stress Levels in Algeria from 1990 to 2020.



Source: prepared by the researchers using information from the World Bank database

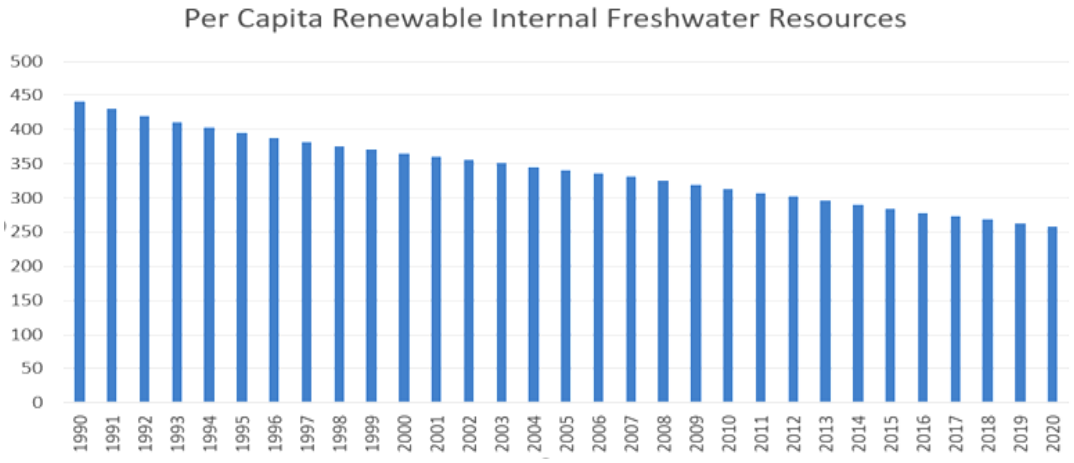
From the graph, we observe an increase in water withdrawal intensity until it stabilized from 2017 to 2020, which explains the intensity of water withdrawals in relation to available water, placing Algeria under water stress.

3.3. Per Capita Renewable Freshwater Resources:

By dividing the amount of water that is accessible by the entire population (Slimani, 2017). This measure assesses the annual percentage of freshwater resources that are renewable per person. Based on estimates, Algeria's water requirements would rise by 25% by 2025, or around 27 billion cubic meters, which means that the problem of water shortage will require more attention (Moussaoui, 2018).

According to the World Bank, per capita renewable freshwater availability is used to assess a country's ability to meet its water needs in agriculture, industry, and domestic consumption. A per capita availability of less than 500 cubic meters per year is considered an indicator of absolute water scarcity. In the GCC countries, it is less than 100 cubic meters, requiring innovative strategies like desalination and water reuse. In North, South, and West Africa, per capita availability is less than 700 cubic meters per year, posing significant challenges in meeting the growing population's water needs.

Figure 3: Evolution of Per Capita Renewable Internal Freshwater Resources in Algeria from 1990 to 2020



Source: prepared by the researchers using information from the World Bank database (https://data.albankaldawli.org, 2024)

It is evident from the graph that there has been a continuous decline in per capita renewable freshwater availability from 1990 to 2020, which calls for urgent solutions, especially in light of the drought affecting Mediterranean regions due to the impacts of climate change.

4. Practical framework:

4.1. Variables and Data Sources:

This study utilized annual data consisting of 31 observations for the period 1990-2020 for the Algerian economy. The study period was chosen based on World Bank statistics, and a thorough explanation of the variables, their symbols, and measurement units is given in Table 1.

Table 1: Definitions of Variables and Data Sources

Variables	Acronyms	Definitions	Source
GDP Per capita	GDPPC	Gross Domestic Product Per capita (in current US dollars) is calculated by dividing the whole GDP by the population at the halfway point of the year	World Bank
Water Stress Levels	LWS	Water Stress Level (%): Freshwater withdrawal as a percentage of available freshwater resources	World Bank
Per Capita Renewable Freshwater Resources	WPC	Per capita renewable internal freshwater resources (cubic meters) for the year	World Bank

Source: Prepared by the researchers based on the World Bank Database

After defining the study variables, an econometric model will be constructed to analyze the impact of water stress levels and economic growth on per capita renewable freshwater resources in Algeria during the study period. The proposed model is represented by the following equation:

$$WPC = f(GDPPC, LWS)$$

4.2. Study Tool:

To find the answers to the study's questions, we built an econometric model utilizing the Autoregressive Distributed Lag (ARDL) model. The ARDL model is one econometric model that can handle non-stationary time series. This model's ability to integrate variables of different orders is one of its main characteristics (Pesaran, et al. (2001), Pesaran explains that the Bound Test in the ARDL framework can be used regardless of whether the variables are integrated of order one I (1), stationary at levels I (0), or a combination of both. The sole criterion is that the variables not be integrated of order two I (2) (Zakraoui, S & Ratia M, 2024) The ARDL model used in this study to analyze the short-term and long-term effects of the proposed independent variables on annual freshwater withdrawals is presented as follows:

$$\Delta WPC_t = a_0 + \sum_{i=1}^{p} a_{1i}\Delta WPC_{t-i} + \sum_{i=0}^{q_1} a_{2i}\Delta GDPPC_{t-i} + \sum_{i=0}^{q_2} a_{3i}\Delta LWS_{t-i} + b_1 WPC_{t-i} + b_2 GDPPC_{t-i} + b_3 LWS_{t-i} + \varepsilon_t$$

Where:

Δ: presents first-order differences;

p: Lag period for the dependent variable;

q1, q2: Lag periods for the independent variables;

b_1, b_2, b_3: Long-term relationship coefficients;

α_{1i}, α_{2i}, α_{3i}: Short-term relationship coefficients;

α_0: Represents the constant term;

ε_t: The stochastic error term.

To assess the presence of a cointegration relationship among the study variables, the bounds testing approach will be employed. This test is based on the following hypotheses:

$H_0: b_1 = b_2 = b_3 = 0$, $H_1: b_1 \neq b_2 \neq b_3 \neq 0$

First, the Augmented Dickey-Fuller (ADF) test is used to check whether unit roots (if any) are present for all variables. The ADF test makes use of three models:

-Without constant: $\Delta \boldsymbol{Y_t} = \gamma\, \boldsymbol{Y_{t-1}} + \sum_{j=1}^{p} \boldsymbol{\varphi_j} \Delta \boldsymbol{Y_{t-j}} + \boldsymbol{\varepsilon_t}$

-With constant: $\Delta \boldsymbol{Y_t} = \boldsymbol{\alpha} + \gamma\, \boldsymbol{Y_{t-1}} + \sum_{j=1}^{p} \boldsymbol{\varphi_j} \Delta \boldsymbol{Y_{t-j}} + \boldsymbol{\varepsilon_t}$

-Including a constant and time trend: $\Delta \boldsymbol{Y_t} = \boldsymbol{\alpha} + \boldsymbol{\beta t} + \gamma\, \boldsymbol{Y_{t-1}} + \sum_{j=1}^{p} \boldsymbol{\varphi_j} \Delta \boldsymbol{Y_{t-j}} + \boldsymbol{\varepsilon_t}$

The null hypothesis for the unit root test is H0: $\gamma = 0$, while the alternative hypothesis is H1: $\gamma < 0$. The critical parameters for the t-statistic to estimate γ\gamma are determined by simulation. In recent years, the ARDL model has been frequently employed as a technique to study cointegration connections among economic variables assuming the variables are stable in their initial differences or levels, where there are the greatest delays between the explanatory and dependent variables. Finally, the Bound Test for Cointegration by Pesaran use Conditional Error Correction (CEC) to test for cointegration once the long-term connection between the explanatory components and the dependent variable has been calculated. The F-statistic, on which this test is based, has constraints at I (1) and I (0). (Fernandes, Jorge, & Maria Rosa, 2021).

4.3. Results and discussion:

Prior to estimating the model, the statistical technique needs figuring out the time series integration levels. Unit root tests are one of the most important methods for assessing the stationarity of these series since they might yield erroneous results if they are not used. The Augmented Dickey-Fuller (ADF) test will be used for this. The accompanying table shows that the variables GDPPC and LWS are integrated of order I (1), whilst the variable WPC is stationary at level I (0).

Table 2: Level of Integration of Time Series

Serie	GDPPC	LWS	WPC
Level of Integration	I (1)	I (1)	I (0)

Source: Based on the output of EViews 12.

Appendix 01 details the process of selecting the optimal lag length for the ARDL model. This involved estimating the model with the maximum number of lags to preserve the maximum amount of information. The Akaike Information Criterion (AIC) was employed to determine the best-fitting model, which was identified as ARDL (3,3,4).

We will utilize the Bound Test with the F-Statistic to ascertain whether a cointegration link exists among the variables under inquiry after confirming that none of them are integrated of order I (2). The calculated F-value of 5.30 is more than the upper bound of the critical values at both the 5% and 10% significance levels. As a result, we confirm that there is a cointegration relationship between the research variables and reject the null hypothesis at these levels.

Table 3:Results of the Bound Test

Fisher Statistic	Value (5,30)	Numbers of Variables (03)	The Decision
Critical Values of the Bounds			
Tabulated Values	I (0)	I (1)	At the 5% and 10% significance levels, we accept the hypothesis that the research variables have a cointegration relationship.
10%	2.84	3.62	
5%	3.47	4.33	
1%	4.94	6.02	

Source: Based on the output of EViews 12.

The dependability of the results will be determined by evaluating the model's performance and quality, as well as its independence from econometric issues, once the long-term relationship between the study variables has been established. The results of the diagnostic tests are compiled in the following table.

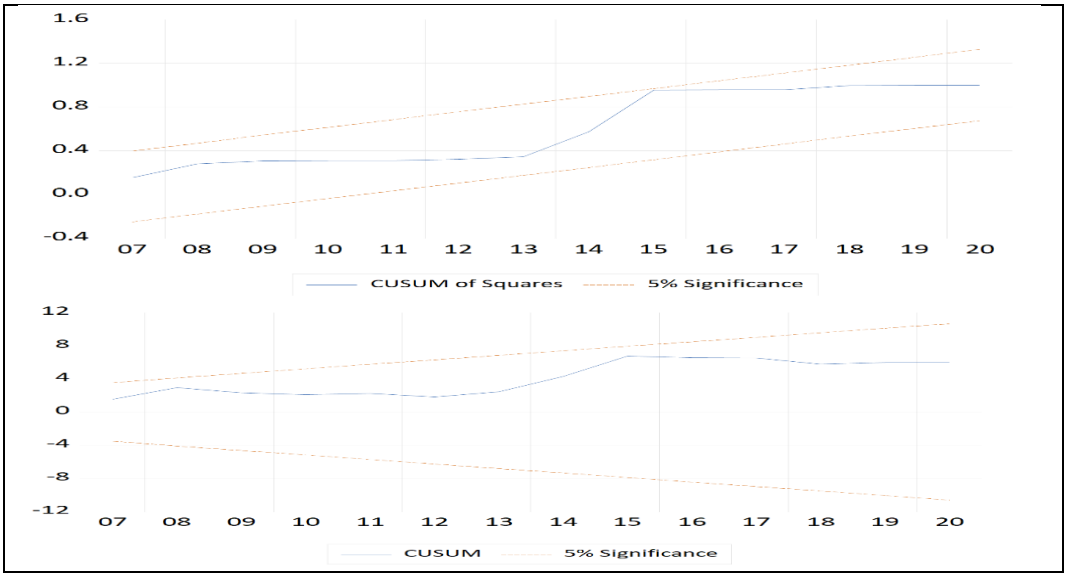
Table 4: Results of the Model Diagnostic Tests

Statistical Test	**Godfrey-Breusch Serial Correlation LM Test**	**Heteroskedasticity -Breusch Test Godfrey-Pagan**	**Bera - Jarque test normality**	**RESET Ramsey (Fisher)**
Test Hypothesis	Autocorrelation Test of Residuals	Heteroscedasticity Test of Residuals	Normality Test of Residuals	Model Spécifications Test
Value (Probability)	0.99(0.39)	0.77(0.66)	1.54(0.46)	0.40(0.53)

Source: Based on the output of EViews 12.

According to the findings in the table above, there is no issue of serial autocorrelation with the model. This result is supported by the Breusch-Godfrey test for residual independence, as the p-value for the Fisher statistic is 0.39, which is greater than 5%. Since there is no autocorrelation between the residuals, we accept the null hypothesis. (Boris, et al., 2024). Regarding the issue of heteroscedasticity in the model, the proposed ARDL model was found to be homoscedastic based on the Breusch-Pagan-Godfrey test. The Fisher statistic's p-value is 0.66, which is greater than 5%. The normality test of the residuals shows that they are normally distributed, as indicated by the p-value of the Jarque-Bera statistic, which is 0.46, greater than 5%. Additionally, the Ramsey RESET test indicates that the model is not misspecified, as the p-value for the Fisher statistic is 0.53, which is also greater than 5%. Therefore, the absence of econometric issues guarantees the accuracy of the model's output.

Figure 4: Results of the Structural Stability Test of the Model Parameters.



Source: Based on the output of EViews 12.

Figure 04's graphical depiction of the Cumulative Sum (CUSUM) and Cumulative Sum

of Squares (CUSUM of squares) test results provides additional evidence, the statistical values fall within the required boundaries. This indicates that the model has not experienced any structural alterations and confirms the stability and consistency between the short- and long-term outcomes. Based on the results of several procedures and tests, such as the stability tests, which revealed a long-term association between the variables, we will apply the ARDL approach to assess the relationship both in the short and long term.

Table 5: Results of the ARDL Model Estimation

Short-term Model Coefficients			
Variable	Parameter	T-Statistic	Probability
D(GDPPC)	-0.00016	-3.03	0.0089
D(LWS)	-0.0096	-0.52	0.61
COINTEQ(1-)	-0.08	-5.07	0.0002
Long-term Model Coefficients			
GDPPC	-0.01	-9.63	0.000
LWS	-1.22	-17.65	0.000

Source: Based on the output of EViews 12.

According to the findings in the above table, there is a statistically significant inverse association (p-value of 0.0089) between Algeria's GDP per capita (GDPPC) and per capita renewable freshwater resources (WPC) in the near run (at time t). WPC decreases by 0.00016 units for every 1 unit rise in GDPPC. Similarly, although WPC is adversely affected by the water stress level (LWS), as the p-value is higher than 0.05, this impact is not statistically significant. The error correction process in accordance with econometric theory is confirmed by the very statistically significant (p = 0.0002) and negative adjustment coefficient, CointEq (-1). This confirms that the variables have a cointegration connection, The coefficient value of -0.08 indicates that deviations from short-term imbalances are corrected at a rate of 8% annually, suggesting a relatively slow adjustment from short-term fluctuations to long-term equilibrium. The following equation represents the long-term economic link between the explanatory and dependent variables:

$$WPC = 430.3480-1.2264*LWS - 0.014* GDPPC$$

The results in Table 05 indicate that GDP per capita (GDPPC) has a significant negative impact on per capita renewable freshwater resources (WPC) in Algeria over the long term, with statistical significance. A 1-unit increase in GDPPC leads to a 0.01-unit reduction in WPC. Similarly, a 1-unit rise in the water stress level (LWS) results in a 1.22-unit decrease in WPC. The decline in WPC is more strongly linked to increases in water stress than to GDP growth, likely due to the significant water consumption by key economic sectors, particularly agriculture and industry, which drive intensive water withdrawals. Despite the economic growth typically associated with improved living standards, per capita renewable freshwater resources continue to decline, made worse by overuse of water resources and droughts brought on by climate change.

5. Conclusion:

Water is a vital component of economic growth across a number of industries, including industry and agriculture, with the goal of promoting and advancing economic development. On the other hand, overuse of this resource may cause it to run out. It is noteworthy that, according to World Bank data, the per capita share of renewable freshwater resources fell from 440.74 cubic meters in 1990 to 258.83 cubic meters in 2020. Using the ARDL model, the study examined how per capita renewable freshwater resources in Algeria were affected by water stress levels and economic growth between 1980 and 2020. The findings of the econometric analysis showed that:

• In the near run, per capita GDP has a negative impact on per capita renewable freshwater resources; for every 1 unit rise in GDP, there is a corresponding 0.00016 units loss in per capita renewable freshwater resources. Water stress levels have a short-term negative impact on per capita renewable freshwater resources, although this effect is not statistically significant.

• In the long run, per capita renewable freshwater resources are significantly impacted negatively by both water stress levels and GDP per capita, with the following outcomes:

- There is a 1.22-unit drop in per capita renewable freshwater supplies associated with every 1-unit increase in water stress levels.

- There is a 0.01-unit drop in per capita renewable freshwater resources for every 1-unit growth in GDP.

In conclusion, the study recommends the need to preserve freshwater resources, especially in light of climate changes that have caused more than a decade of drought. It also suggests exploring new water sources, particularly for the agricultural sector, which consumes large quantities of water, in addition to giving significant importance to water issues in policy-making.

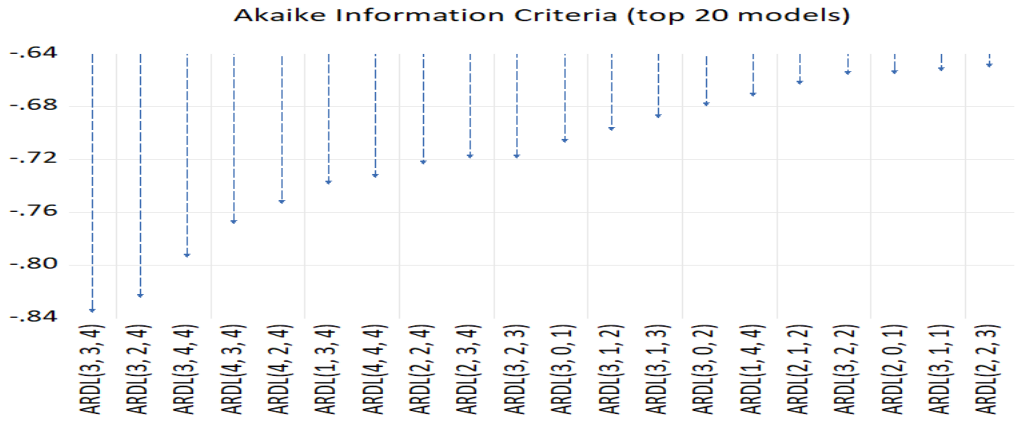
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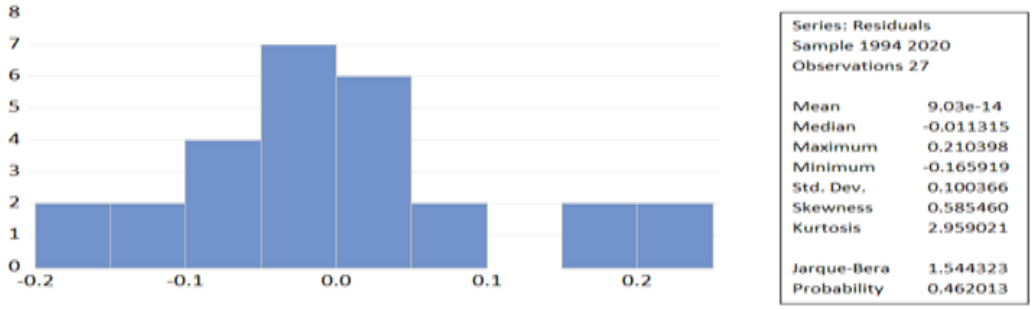
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7.Appendices:

Appendix 1: Results of Lag Selection for the ARDL Model



Appendix 2: Diagnostic Results of ARDL Model Tests



Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: WPC WPC(-1) WPC(-2) WPC(-3) LWS LWS(-1) LWS(-2) LWS(-3) GDPPC GDPPC(-1) GDPPC(-2) GDPPC(-3) GDPPC(-4) C

	Value	df	Probability
t-statistic	0.637562	13	0.5348
F-statistic	0.406486	(1, 13)	0.5348
Likelihood ratio	0.831309	1	0.3619

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.772153	Prob. F(12,14)	0.6698
Obs*R-squared	10.75300	Prob. Chi-Square(12)	0.5502
Scaled explained SS	2.831831	Prob. Chi-Square(12)	0.9966

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.993408	Prob. F(2,12)	0.3988
Obs*R-squared	3.835329	Prob. Chi-Square(2)	0.1469

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