AN ECONOMIC STUDY TO MEASURE THE IMPACT OF CLIMATE CHANGE ON WHEAT PRODUCTION IN IRAQ FOR THE PERIOD (2000-2022)

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Received:24/3/2024 Accepted:5/5/2024 Published:30/9/2024

ABSTRACT

The study aimed to identify the basic climatic factors that significantly affect wheat production during the period from 2000 to 2022 to draw up a clear agricultural policy to confront these changes. Statistical tests were conducted to ensure the existence of a balanced long-term relationship between the impact of climate changes on wheat production in Iraq using the ARDL model to clarify the correlation between the dependent variable (production) and the independent variables temperature, rainfall, and relative humidity. And wind speed. The research reached several conclusions, the most important of which is that 99% of the observed fluctuations in the dependent variable can be attributed to the explanatory variables included in the model. The remaining 1% of fluctuations are due to other variables not included in the model and are absorbed by the random variable. The results showed a positive and significant relationship between average rainfall and wheat yield and a significant inverse relationship between temperature, relative humidity, and average wind speed on wheat crops. The study suggested the necessity of cultivating high-yielding varieties that are resistant to climate change and suitable for the Iraqi environment, making optimal use of water resources, and developing economic policies that consider adaptation to climate change. In addition, she stressed the importance of investing in renewable energy sources that can support agricultural activities, mitigate the effects of climate change, and enhance crop productivity.

Keywords: Wheat production, ARDL model, climate changes.

INTRODUCTION:

Climate change is one of the fundamental challenges affecting food security by affecting crop productivity, leading to a lower self-sufficiency rate, higher food prices, and increased imports (Abdel Hamid ,2023). Climate is defined as the basic characteristics of the weather condition in a particular country (Noman, and Al-Samarra, 2008; Jackson, S. T, 2023)The United Nations Convention on Climate Change has defined it as a direct or indirect result of human activity (Mustafa, 2019; Al-Hamouli, 2021). Due to increasing human demand and rapid economic growth, these changes will affect the entire biosphere, often negatively (Mohammad et al., 2021; Abdel Aziz and Fathi, 2006). The reason behind climate change is that natural resources are not being exploited properly (Ahmed,2018). Among them is the problem of desertification, which causes a decline in agricultural production and affects productivity while increasing costs (Ali et al.,2021; Al-Lami et al.,202). Therefore, climate change is no longer just studies and predictions but has become clear and measurable, especially in the agricultural sector, given its danger (AL-Badri and Al-Tamimi,2023). Because agricultural production activities are the most sensitive and affected by climate change (Abdullah and Radwi, 2023), abnormal climate changes cause crops to become infected with diseases (Al-Sabhany and Al-Jubouri, 2021). Climate change adaptation efforts in developing countries are still in the early stages of development. It seeks to help adapt to and confront the effects of climate change to mitigate them as much as possible to preserve the safety

of the environment and the health of society (Al-Halafi and Al-Azzawi, 2022; Al-Quran, 2014). Therefore, improving the level of the economic performance of farms is an important goal pursued by economic systems (Al-Badri and Muhammad,2016), as biotechnology is necessary to enhance agricultural production and develop high-yielding varieties and seeds resistant to salinity, drought, and diseases (Fakhri et al., 2023; Al-Jubouri, 2022). Therefore, it is necessary to enhance food security, increase agricultural productivity, and reduce poverty, especially in poor communities (Ali et al., 2023). The wheat crop represents the basis of global agricultural and food production, as evidenced by the quantities produced, consumed, and traded globally (Jisam et al., 2021; Mahmoud and Hussein,2023). Hence, it has become necessary to study climate changes and know their direct and indirect effects on wheat revenues, given the increasing need to formulate an agricultural policy to improve resource use efficiency considering the current climate conditions (Amin, 2022).
Moreover, it contributes to reducing greenhouse gas emissions. The most important problem facing the agricultural sector is that it is more sensitive to and affected by climate change. The research aims to measure and analyze the impact of climate change on production, and the basic variables that will be highlighted are temperature, rain, wind speed, and relative humidity. The study assumes the significant impact of climate change on wheat production, identifies the positive and negative effects of these variables, and develops strategies to confront these changes.

THE FIRST SECTION: RESEARCH METHODOLOGY

- **Research problem:**
  The agricultural sector is one of the most sensitive sectors to climate change. Despite the importance of climate change and its various impacts, there are no specific estimates to simulate the impact of climate change on the agricultural sector and determine the impact of changes in Temperature, Humidity, Rain, and Wind. It is expected that the agricultural sector will be affected by the climate in general and agricultural crops in particular.
- **Research Importance**: The importance of studying climate change is because the agricultural sector is the most sensitive to these variables, especially at the present time due to high temperatures and lack of rain.
- **Research objectives:** Measure and analyze the impact of climate changes on wheat production in Iraq (2000-2022).
  Research hypothesis: The study assumes the significant impact of positive and negative climate changes on wheat production in Iraq.
- Research limitations: The research data covers the period from 2000-2022.
- **Data collection methods**: The theoretical aspect is that Arabic and foreign books are available in university libraries and other official institutions.
- **The practical aspect**: The practical aspect relied on primary sources to obtain data and information related to the research topic and choose to accept or reject the hypotheses.
- **Approved statistical methods**: We relied on statistical methods appropriate to the nature of the data and to test and treat hypotheses. The research data was analyzed using the ARDL model using (12 EViews) program.

THE SECOND TOPIC: THEORETICAL ASPECT

The Ricardo approach was used to evaluate the impact of climate conditions on net revenues. Data for this analysis were obtained from the Ministry of Agriculture (The Iraqi Ministry of Agriculture and its formations). The ARDL model will be used to derive net revenues for a period extending from 2000 to 2022(Pesaran, et al.,2001)

1. **ARDL Model**: Most economic series data show a noticeable trend over time and lack stability. Therefore, estimating this series using traditional regression models can give misleading results. The

research relied on the use of statistical analysis and econometrics tools, employing the Autoregressive Distributed Lag (ARDL) approach. (Nouri and Al-Hayali, 2019; Al-Wasti Al-Atabi, 2023). Through three methods:

1. **Model description stage**: The standard model is built, and its variables are identified. (Jihad and Abdullah,2021).

   - NR: The dependent variable is wheat revenues at the Iraq level, tons/thousand dinars.
   - LNX1: represents the annual rainfall rate (mm/year).
   - LNX2: represents the average annual temperature (°C).
   - LNX3: represents the annual humidity rate (%).
   - LNX4: represents the average annual wind speed (km/h).

2. **Methodology of analysis and estimation of model parameters**.
   At this stage, the model parameters are estimated. Suppose that both the dependent and independent variables in the current year (1) are affected by their values in past years (t-1). In this case, these variables will be included in the model, and accordingly, we will have a dynamic, kinetic model; in such a case, we will deal with time-delay models. The best example is Pesaran Shin and Smith's lagged or distributed regression model (Al-Bayati and Al-Dulaimi,2022).

3. **Model testing phase:** This phase consists of several steps, the most important of which are:
   - **Unit root test for variable data**: Subjecting variables to stationary testing is essential because they include behavioral variables with significant random trends that make the time series unstable. Therefore, the more famous extended Dickey-Folar test was used to test series invariance (Harvey, 1990; Anani, 1992).
   - **Determine the optimal slowdown period through the VAR model**: In this step, the optimal slowdown periods for the variables are determined by using the Vector Auto Regression model, as there is a set of standards that are used to determine the optimal slowdown period: the AIC standard and the Schwarz SC standard (Hammadi, 2012).
   - **Bounds test for co-integration:** In this step, the parametric methodology is tested for the purpose of ascertaining whether there is a long-run relationship between the variables. To test the validity of the existence of a long-term relationship between the dependent variable and the independent variables, the (F) statistic was calculated according to the following hypotheses. The null hypothesis (Ho) states that there is no long-term balanced relationship between the research variables, and the alternative hypothesis (1H) states that there is no long-term balanced relationship between the research variables (Dagher and Farhan ,2017).
   - **Estimating the ARDL model:** Parameter estimation using a lag-distributed autoregressive model (Al-Hashemi and Bakr, 2023)
   - Final exams: Goodness-of-performance tests are used to ensure that the estimated model performs well before adopting it. We will perform the following range of diagnostic tests:

- **Testing the normal distribution of errors or residuals generated from the estimated model**: One of the basic considerations upon which the construction and estimation of the model are based is the normal distribution of the residuals generated from the estimated model, and one of the most important tests is the Jarque-Bera test. If the statistical value of the test is at a significance level greater than (5%), we will accept the null hypothesis. Thus, the probability distribution of the residuals will be a normal distribution and vice versa (Sheikh,2011; Issa, 2022).

- **Testing the problem of autocorrelation in residual values**: One of the most important tests used for the purpose of testing the problem of autocorrelation between residual values is the Breusch-Pagan test, as the null hypothesis for this test states that the residuals are not autocorrelated over time, while the alternative hypothesis states Otherwise (Breusch and Pagan 1980).

- **Testing the problem of heterogeneity of variance in the values of the residuals:** To detect the presence of the problem of heterogeneity of variance, the Breusch-Pagan and Godfrey test is performed. The null hypothesis for this test states that the variance of the estimated model residuals is heterogeneous, while the alternative hypothesis states that. If the statistical value of the test is at a significance level greater than (5%), we will accept the null hypothesis, and thus the residuals will have a homogeneous variance. However, the statistical value of the test is at a significance level of less than (5%). In that case, we will reject the null hypothesis and accept the alternative hypothesis, which states that the variance of the residuals is not homogeneous (Abdel Hamid, 2016; Bakhit, 2012).

2. The Ricardian model:

The Ricardian approach uses agricultural surveys or country-level data to analyze the relationship between agricultural capabilities, land value, and climate variables, such as rainfall, temperature, relative humidity, and wind speed (Rizkallah, 2020). Its purpose is to correct for any significant biases in the production function. (ECLAC, 2011) Mendelsohn et al. used net revenues and land values to represent farm income. By directly estimating net revenues, this approach considers the direct impacts of climate change on different crop yields, indirect substitution of other inputs and potential adaptation to other climatic conditions, which is reflected in costs. This model assumes that markets are functioning correctly, allowing the economic effects of climate change to be measured on the monetary value of different activities (Mendelsohn and Shaw,1994). A vital feature of the Ricardian model is its ability to incorporate adjustments made by farmers to adapt to climate change to maximize profits by changing crop mixes, planting, and harvesting dates, and various other agricultural practices.

Farmers' response is reflected in costs, causing economic damage to net revenues. Therefore, the overall calculation of the fees or benefits of adaptation should be reflected in the dependent variable, net revenue, or land value, not productivity (Darwin, 1999). Another advantage of this model is that it is cost-effective, as it may be relatively easy to collect secondary data on cross-sectional sites based on climatic, productivity and socio-economic factors. The main criticism of this model is that it needs to consider price changes. Mendelsohn believes that the assumption of price stability is justified because it does not pose a serious problem when using the model. Another weakness of the Ricardian model is that it must rely on controlled experiments on the farm. Farmers' responses vary across different lands not only due to climatic factors but also due to many social and economic conditions. The model rarely fully includes these non-climatic factors (World Bank,2007). To overcome the criticisms directed at the Ricardian model as one of the models of the econometric approach, (Zaied, 2013) believes that using the econometric method allows for estimating the correct relationship between climate change and agricultural production and productivity. The micro database uses econometric techniques to depict reality accurately by exploring accurate, not empirical, data.

THE THIRD TOPIC:THE PRACTICAL ASPECT

the first step: unit root tests for the study variables

Table1.unit root results

Augmented Dickey- Fuller Test						
Variables	At Level			At First Difference		
	With Constant	With Constant & Trend	Without Constant & Trend	With Constant	With Constant & Trend	Without Constant & Trend
LNY	-0.50071	-0.998855	0.005881	-1.532887	1.532186-	-1.477309
t-State	-3.15908	- 4.101692	0.662212	-5.059785	-4.898414	-5.115747
Prob	0.0366**	0.0208 **	0.8508	0.0007***	0.0045***	0.0000***
Ln(x1)	-0.89938	- 0.900704	-0.015544	-2.692956	-2.692691	-2.691892

t-State	-4.01921	-3.927758	-0.364344	-5.027395	-4.858706	-5.179828
Prob	0.0058***	0.0282**	0.5397	0.0008***	0.0054***	0.0000***
Ln(X2)	-0.91057	-1.289654	0.000411	-1.840600	-1.840612	-1.833395
t-State	-4.13117	-4.059753	0.123380	-5.103159	- 4.951740	-5.230011
Prob	0.0045***	0.0226**	0.7115	0.0006***	0.0041***	0.0000***
Ln(X3)	-0.70291	-0.910275	0.000729	-1.421314	-3.591529	-1.414433
t-State	-3.46102	-3.930600	0.242935	-6.664052	-4.350811	-6.843327
Prob	0.0195**	0.0281**	0.7469	0.0000***	0.0151**	0.0000***
Ln(X4)	-1.00010	-1.464777	-0.000540	-1.727452	-1.728959	-1.722222
t-State	-4.62857	-6.942110	-0.487373	-10.78126	-10.55549	-10.98688
Prob	0.0015***	0.0001***	0.4925	0.0000***	0.0000***	0.0000***

Source: Ministry of Transport/General Authority for Meteorology, Ministry of Planning/Central Bureau of Statistics
Source: Prepared by the researcher based on Eviews 12 program

a: (*) Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant.

Table (1) above shows the unit root test for the climate model variables in Iraq, as the first part of the table refers to the test results at the Level (At Level). In contrast, the second part relates to the results when taking the first difference (At First Differences), as it becomes clear to us that the variables independent and dependent variables all stabilized after taking their first difference, which means accepting the null hypothesis, which indicates that these variables contain a unit root, so the (ARDL) model can be applied.

THE SECOND STEP: determine the optimal lag periods, Table (2) displays the ideal lag periods selected for the variables using the VAR model. The selection is based on the AIC criterion, and it ensures that the model is free from the issue of autocorrelation between the residuals. In this case, the optimal lag period is (0).

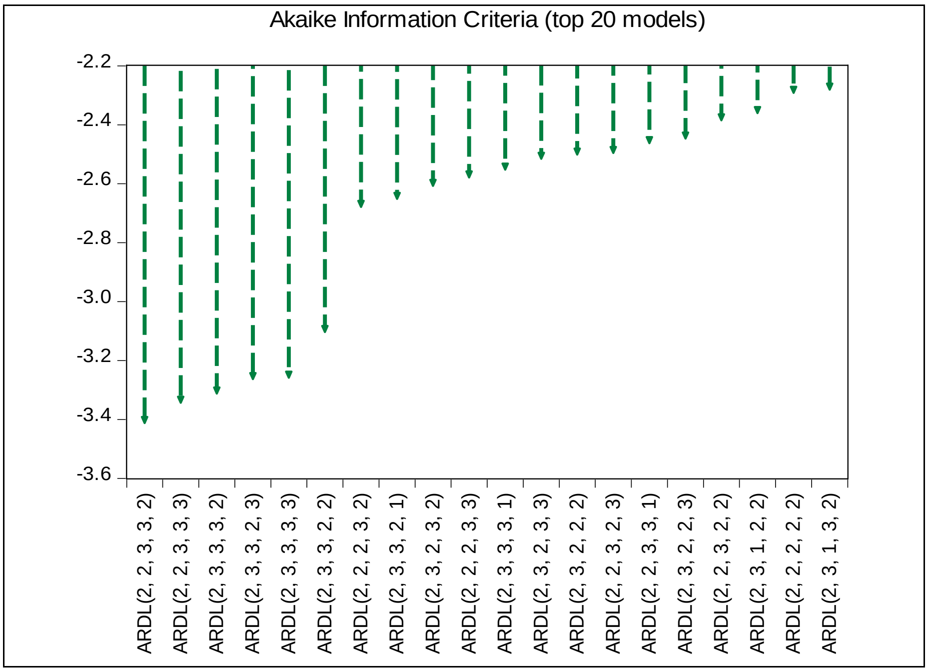
Table 2. Optimal lag periods for the climate model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	**119.7537**	**NA**	**1.23e-11**	**-10.92892**	**-10.68022**	**-10.87495**
1	137.5774	25.46243	2.65e-11	-10.24546	-8.753289	-9.921624
2	202.2194	61.5638*	9.98e-13*	-14.02089*	-11.28524*	-13.4271*

program2Source: Prepared by the researcher based on Eviews1

Hence, the model selection will be based on the autoregressive lag time lag (ARDL) methodology, where the lag length that yields the minimum value for this criterion is identified. Figure (1) below illustrates this based on the Akaike Information Criterion (AIC) test.

Figure1. shows the results of the slowdown (periods according to the Akaike Criterion (AIC) method for the climate model).



Source: Prepared by the researcher based on Eviews12 program

THIRD: COINTEGRATION TEST: Table (3) displays the use of the marginal test method for identifying co-integration among the variables in the model. The results indicate that the computed (F) value is 53.72588, which exceeds the maximum value at the 1% significance level at both lower bounds. A greater value of this shows the rejection of the null hypothesis and the acceptance of the alternative hypothesis, which asserts the presence of co-integration, i.e., a long-term link between wheat revenues and all independent factors (climatic variables).

Table 3. Results of the co- integration test using the bounds test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Signif.**	**`I(0)**	**I(1)**
F-statistic	**53.72588**	**10%**	**2.2**	**3.09**
K	**4**	**5%**	**2.56**	**3.49**
		2.5%	**2.88**	**3.87**
		1%	**3.29**	**4.37**

Source: Prepared by the researcher based on Eviews12 program

STEP FOUR: estimate and analyze the long- and short-run results and the error correction parameter:

FIRST: The immediate outcomes of the relationship, the short-term

After confirming the existence of an equilibrium relationship between the independent variables and the dependent variable, Table (4) illustrates the estimation results of the short-term function with its lag periods, as the ARDL model is highly sensitive to lag periods.

Upon testing the goodness of fit (R^2), the coefficient of determination R^2 was found to be approximately 0.99. This means that 99% of the variations in the dependent variable are due to the explanatory variables (climate changes) present in the model, while 1% is due to other variables not included in the model and whose effect is absorbed by the random variable. It is worth noting that the parameter values in the logarithmic model represent partial elasticities.

The average rainfall showed a value of (0.047), indicating a positive and significant response at the 10% level. This aligns with logic, as it illustrates a direct relationship between rainfall rate and wheat production, meaning that a 1% increase in rainfall rate will lead to a 4.7% increase in wheat production. This is because wheat requires amounts of rainfall for germination and crop growth, especially at the early growth stages during the required irrigation times.

There is an inverse and significant relationship between average temperatures and wheat production, indicating that a 1% increase in average temperatures will lead to a 5.42% decrease in wheat production. This is logical since increased temperatures at the beginning of the plant's lifecycle accelerate the crop's growth process, causing it to transition from one stage to another more quickly, which subsequently affects the grain's specific weight.

There is an inverse and significant relationship between average relative humidity and wheat production, indicating that a 1% increase in humidity will lead to a 2.74% decrease in wheat production. This is because increased humidity raises the likelihood of crop diseases and rot.

There is also an inverse and significant relationship between wind speed rate and wheat production, indicating that a 1% increase in wind speed will lead to a 13.28% decrease in wheat production. This result is logical, as higher wind speeds cause the plants to lodge.

Second: evaluating the capabilities of the unrestricted error correction model (ardl-ecm) : Table 4 indicates that the error correction factor (Coint Eq) determines the rate at which short-run variables adjust to long-run variables. The factor must be negative and statistically significant to prove the existence of a long-term association between the variables in the function analyzed. Table 4 shows that the error correction factor (ECM) has a negative value of 0.70.5, statistically significant at a significance level of less than 1%. This indicates that about 29.5% of short-term errors are automatically corrected to achieve long-term equilibrium. This value confirms the validity of the.

Table 4. Results of estimating the model using the ARDL method short-run equation

ARDL Error Correction Regression				
Dependent Variable: D(LNY)				
Selected Model: ARDL(2, 2, 3, 3, 2)				
Case 2: Restricted Constant and No Trend				
Sample: 2000 2022				
Included observations: 20				
ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNY (-1))	0.611572	0.036198	16.89532	0.0005
D(LNX1)	0.047288	0.020314	2.327864	0.1023
D(LNX1(-1))	1.386999	0.039448	35.16012	0.0001
D(LNX2)	-5.428806	0.258145	-21.03006	0.0002
D(LNX2(-1))	3.153521	0.209876	15.02564	0.0006
D(LNX2(-2))	1.313293	0.212877	6.169242	0.0086
D(LNX3)	-2.740329	0.184391	-14.86152	0.0007
D(LNX3(-1))	-4.275014	0.247862	-17.24756	0.0004
D(LNX3(-2))	1.045836	0.157109	6.656771	0.0069
D(LNX4)	-13.28666	0.837686	-15.86114	0.0005
D(LNX4(-1))	3.089133	0.561185	5.504661	0.0118
CointEq(-1)*	-0.705403	0.024059	-29.31918	0.0001
R-squared	0.996578	Mean dependent var		0.003274
Adjusted R-squared	0.991873	S.D. dependent var		0.331350
S.E. of regression	0.029871	Akaike info criterion		-3.900177
Sum squared resid	0.007138	Schwarz criterion		-3.302738
Log likelihood	51.00177	Hannan-Quinn criter.		-3.783551
Durbin-Watson stat	2.488000			

Source: Prepared by the researcher based on Eviews 12 program

Third: long-term results of the relationship: Table (5) shows There is a significant and inverse relationship between rainfall rate and wheat production, indicating that a 1% increase in average rainfall will lead to a 1.68% decrease in production. This is because increased rainfall during the latter stages of the plant's lifecycle, when it no longer needs irrigation, causes rot and crop damage, which is logically consistent. There is a significant and inverse relationship between average temperatures and wheat production, aligning with the short-term impact results. There is a significant and direct relationship between humidity rate and wheat production at a 1% significance level, meaning that a 1% increase in average humidity will lead to a 7.58% increase in wheat production. This result contradicts the short-term impact result. There is a significant and inverse relationship between wind speed rate and wheat production at a 1% significance level, meaning that a 1% increase in wind speed will lead to a 32.16% decrease in wheat production. This result aligns with the short-term impact results.

Table 5. Results of estimation the long-run equation

Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNX1	-1.689554	0.422402	-3.999873	0.0280
LNX2	-8.625633	3.815895	-2.260448	0.1089
LNX3	7.586391	1.232223	6.156672	0.0086
LNX4	-32.16041	5.948117	-5.406822	0.0124
C	99.08174	26.74375	3.704856	0.0342
EC = LNY - (-1.6896*LNX1 -8.6256*LNX2 + 7.5864*LNX3 -32.1604*LNX4 + 99.0817)				

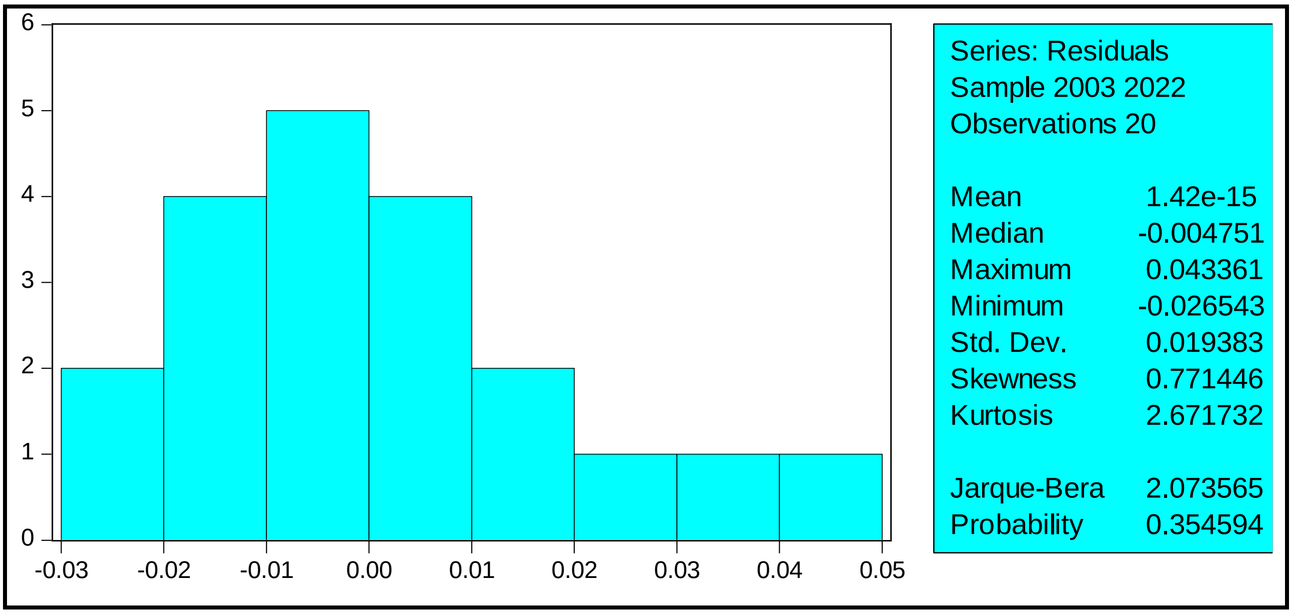
Source: Prepared by the researcher based on Eviews 12 progra

STEP The Five: ARDL MODEL TESTS: -The diagnostic tests listed below are the standard criteria used to evaluate the efficiency of the research model.

1. typical quality tests:

- Testing the normal distribution of random errors : The figure (2) below demonstrates that the Jarque- Bera test confirmed the fulfillment of the requirement of a normal distribution of the residuals, with a probability value of 0.35 and a significance level exceeding 5%. Thus, we conclude that the null hypothesis is valid, indicating that the random errors in the calculated model follow a normal distribution.

Figure2.of the residual distribution test



Source: Prepared by the researcher based on Eviews12 program

- Testing the problem of autocorrelation between the residuals: The following table (6) demonstrates that the model successfully meets the standard criteria. The text refers to the Breusch-Godfrey serial correlation (LM) test. The Lagrange multiplier test for autocorrelation indicates that the model is not affected by autocorrelation, with a probability of 0.45. Therefore, we can confidently accept the null hypothesis that the model is free from the issue of autocorrelation.

Table 6. LM test Results Non- Stationarity of variance test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.953972	Prob. F(2,1)	0.4514
Obs*R-squared	15.92497	Prob. Chi-Square (2)	0.0003

Source: Prepared by the researcher based on Eviews 12 program

- **Testing the problem of non-constancy of contrast:** Table 7 indicates that the model successfully passes the Breusch-Pagan-Godfrey heterogeneity test and ARCH test, demonstrating that it does not exhibit non-stationarity of variance. This is supported by the probability value (0.9862-0.8752), which exceeds the threshold of 0.05, enabling acceptance of the null hypothesis. There is no issue with the instability of contrast.

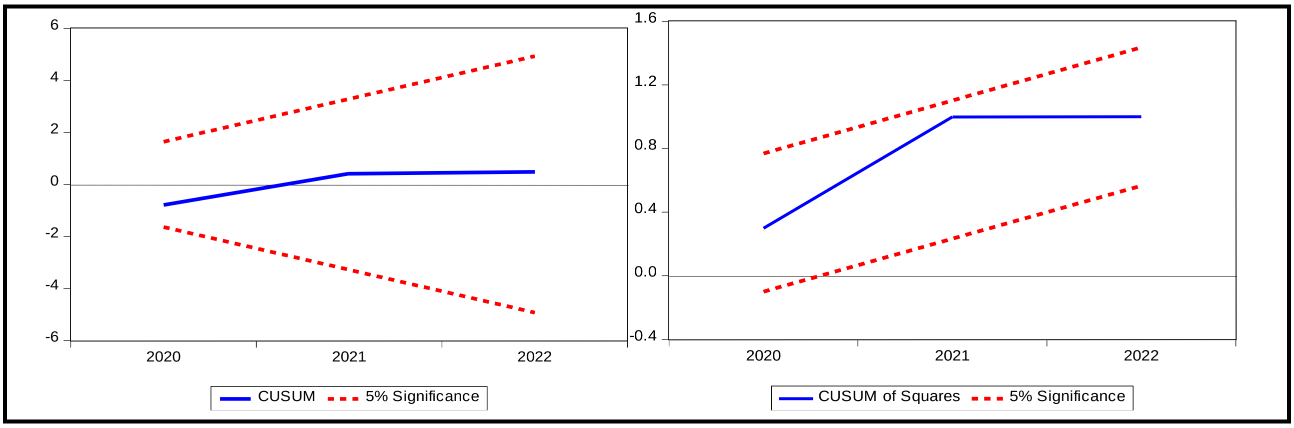
Table7. Results of non-stationary test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.206313	Prob. F(16,3)	0.9862
Obs*R-squared	10.47771	Prob. Chi-Square (16)	0.8405
Scaled explained SS	0.197054	Prob. Chi-Square(16)	1.0000
Heteroskedasticity Test: ARCH			
F-statistic	0.025407	Prob. F(1,17)	0.8752
Obs*R-squared	0.028353	Prob. Chi-Square (1)	0.8663

Source: Prepared by the researcher based on Eviews 12 program

secondly: testing the stability of the estimated model It is clear from Figure (3) that the estimated coefficients of the model used are stable, which confirms the presence of stability between the study variables and consistency in the model in the long and short term, as the model fell within the critical limits at a 5% significance level (Al-Khafaji,2018: Attia, 2005).

Figure 3. The cumulative sum of the successive remainders (CUSUM) and the cumulative sum of the squares of the successive remainders (CUSUMSQ)



Source: Prepared by the researcher based on the Eviews12 program

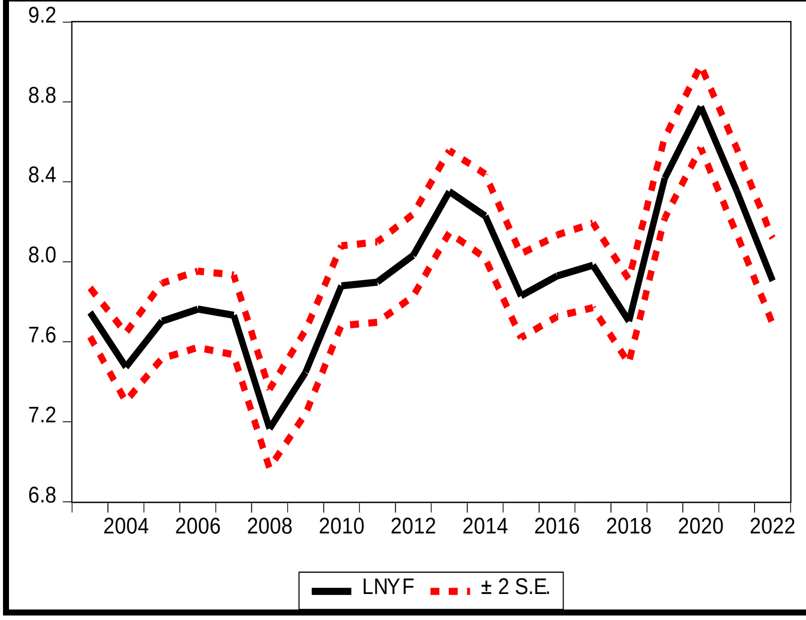
Third: Testing the predictive performance of the error correction limit model:

- It is clear from the figure (4) below:

- The Thiel coefficient (T) has a value of 0.0016, which is lower than the accurate value and in near proximity to zero.
- The bias ratio, denoted as BP, has a value of 0.000596, which is smaller than the right value and approaching zero.

- The variance ratio (VP) attained a value of 0.028171, which is lower than the correct value and near zero.
- The variance ratio, denoted as CP, attained a value of 0.971232, which falls below the correct value.

Figure 4. shows the actual and estimated values of the climate model.



Forecast: LNYF	
Actual: LNY	
Forecast sample: 2000 2022	
Adjusted sample: 2003 2022	
Included observations: 20	
Root Mean Squared Error	0.026395
Mean Absolute Error	0.021962
Mean Abs. Percent Error	0.277834
Theil Inequality Coefficient	0.001665
Bias Proportion	0.000596
Variance Proportion	0.028171
Covariance Proportion	0.971232
Theil U2 Coefficient	0.082371
Symmetric MAPE	0.277853

Source: Prepared by the researcher based on Eviews12 program

Consequently, the estimated climate model in Iraq has a high degree of predictive capacity across the study period, meaning that the model's output may be trusted for analysis, policy assessment. and other applications. and predictions in the future.

SECTION FOUR: CONCLUSIONS AND RECOMMENDATIONS

- Conclusion:

1. Increased rainfall rates significantly impact wheat revenues in the short term. In contrast, in the long term, there is an inverse and significant relationship between the impact on revenues due to climate change and reduced rainfall rates.
2. The temperature variable has a positive significance in affecting wheat revenues in the short term. In contrast, in the long term, there is an inverse and significant relationship in the impact on revenues due to high average temperatures.
3. an inverse and significant relationship to the relative humidity variable affects wheat revenues in the short term. In contrast, in the long term, there is a positive and significant relationship in affecting revenues, as the wheat crop is a winter crop, and the varieties that adapt to the climate are grown.
4. There is an inverse and significant relationship to the wind speed variable in affecting wheat revenues in the short term and similar in the long term in affecting revenues.

- Recommendations:

1. Implementing innovative agricultural techniques and systems to address the challenges posed by climate change.
2. Learn from the experiences of other nations in effectively adjusting to the consequences of climate change and implementing their strategies concerning climate-smart agriculture, sustainable agriculture, and the green economy due to their influence on food security and environmental preservation. The environment.

3. Formulate a concise plan to counteract and adjust to the impacts of climate change, particularly the escalation of temperatures, and guarantee that clean technology significantly reduces ecologically harmful emissions.
4. Modifying the timing of planting to accommodate altered weather conditions
5. Creating novel cultivars that exhibit resilience to elevated temperatures, salinity, and drought, which are the predominant environmental conditions in response to climate change.

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