An economic study of the most important factors affecting rice production in Iraq for the period (2004-2024).

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abstract :-

Rice is considered one of the main crop with economic and nutritional importance world in terms of production and consumption , ranking second after wheat , the study was conducted based on (ARDL) model using the Eviews software , This research studied the most important factors affecting rice production in Iraq for the period (2004-2024). The research aims to identify and measure the economic and agricultural factors affecting rice production, estimate the production function for rice in Iraq, and study the reality of rice production in Iraq. The research reached several conclusions, the most important of which were: In the short term, the coefficient of the independent variable Area (\text{X}_1) was positive, which means there is a direct relationship between the area and rice production, i.e., an increase in area will lead to an increase in production. This variable was significant at a 5% probability level, which is economically logical. In the long term, the significance of this variable is confirmed at a 5% probability level. The parameter of the independent variable Local Price (\text{X}_2) was positive in the short term, which means there is a direct relationship between the local price and rice production, as an increase in the local price leads to an increase in rice production. This variable was significant at a 5% probability level. In the long term, it is significant at a 5% level due to the influence of other factors that have a greater impact on rice production in the long run. The parameter of the independent variable Water Imports (\text{X}_3) was positive, indicating a direct relationship between water imports and production, meaning that as water imports increase, production increases. This variable was significant at a 5% probability level, and this result is consistent with general economic logic. In the long term, however, the significance of this variable was not confirmed at a 5% level. The coefficient of the independent variable Competing Crop Price (Wheat) (\text{X}_4) was negative in the short term, meaning there is an inverse relationship between the competing crop price and rice production. This implies that a percentage increase in the competing price leads to a decrease in rice production. This variable was significant at a 5% probability level, and this result is economically logical. In the long term, this variable is significant at a 5% level. The study recommends introducing new, high-yielding, drought- and salinity-tolerant varieties to increase domestic production, taking measures to develop agricultural production of rice by developing an integrated scientific-economic plan to achieve farming that relies on modern scientific methods aimed at increasing production and improving its quality, and working on land reclamation by implementing an efficient drainage system that relies on main and secondary drains and improving irrigation methods by using lined canals and

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providing water at the appropriate times and in the correct quantities. The state must seriously and decisively consider developing and increasing the production of this important crop to reduce the large volume of imports that leads to the depletion of the country's hard currency and its transfer abroad. Therefore, the state must consider how to increase the cultivation of this crop and provide serious support to farmers to increase its production.

Introduction:-

Rice is one of the most important field crops in the world , especially in southeast Asian countries , which top the list of rice – producing and exporting nations in lraq the agricultural sector is considered one of the essential sectors as it supplies the population with the majority of their food needs and provides the industrial sector with a large portion of its raw material Rice production in Iraq experienced a singnificant decline in 2018 reaching 18196 due to drought as the cultivated areas were severely reduced comared to previous years amounting to 21702 with afocuc on only a limited number of varieties this highlights the need for an economic study of the factors affecting rice production in order to contribute to improving production efficiency .

Research Problem:- Rice production in Iraq suffers from a clear fluctuation in the quantities produced and a decrease in productivity per unit area compared to the global average. Despite the efforts made to increase the production of grain crops, especially rice, the total production of both is still insufficient to meet increasing consumption needs, especially since the self-sufficiency rate for each is low, leading to a widening food gap, in addition to population growth and increasing demand for food.

Research Hypothesis:- The research hypothesizes that several factors affect rice production, such as (area, local price, water inflows, price of the competing crop (wheat)), and the impact of these factors on rice is positive, except for the price of the competing crop (wheat), which shows a negative impact.

Research Objectives:- 1- To identify and measure the economic and agricultural factors affecting rice production. 2- To estimate the production function for rice in Iraq. 3- To study the reality of rice production in Iraq for the period 2004-2024.

Research Methodology:- The descriptive method will be used to study and analyze the economic factors affecting production, and the quantitative method will use the econometric analysis approach by applying the multiple regression model to analyze the relationship between production and a number of independent variables (area, local price, water inflows, price of the competing crop). Statistical analysis will be performed using EViews software.

Data Sources:- Ministry of Agriculture, Planning and Follow-up Department, Agricultural Statistics Records.

The Economic and Econometric Theoretical Framework Concept of Production: - Agricultural production includes everything produced from plant and animal products, and production results from the various activities that involve the inputs through which we obtain production. The production process refers to all activities that lead to the creation of utility for agricultural products [1].

Factors Affecting Production: - There are many factors that affect production, enabling agriculture to meet population needs. These factors significantly impact the agricultural sector, and the most important factors are [2]: **1- Soil:** It is an important factor affecting agricultural production. Good soil rich in elements and nutrients for plants leads to high productivity, whereas soil lacking in elements results in low production. **2- Water Resources:** It is one of the most important factors affecting production and is indispensable in agriculture, having a direct impact on farming. The abundance or scarcity of water is a major obstacle to agricultural expansion, whether horizontal or vertical. **3- Agricultural Inputs: -** Agricultural inputs include seeds, fertilizers, and pesticides, and these inputs are necessary and important for agricultural production.

Time Series Concept: Time series refer to the absence of a general upward or downward trend in a phenomenon over time, in addition to the presence of seasonal changes, meaning its characteristics do not change with time [3]. Statistically, time series are defined "as a series of random variables," and their mathematical expression is as follows [4]:

$Y = f(t)$ If there are other factors (other explanatory variables) besides the time variable that affect the studied phenomenon, we use the following mathematical relationship:

$Y = f(t, X_1, X_2, \ldots, X_n)$. **Time series are classified according to their stationarity as follows:** Stationary Time Series: A time series is considered stationary if the following conditions are met [5]: The fluctuation around the mean is constant over time: $E(Y_t) = \mu \ldots\ldots\ldots\ldots(1)$ The variance of the values is constant over time: $\text{Var}(Y_t) = E[(Y_t - \mu)^2] = \sigma^2 \ldots\ldots\ldots\ldots(2)$ The covariance between any two values of the same variable depends only on the time lag (K) between the two values (Y_t and Y_{t-K}) and not on the actual time at which the covariance is calculated: $\text{Cov}(Y_t, Y_{t+K}) = E[(Y_t - \mu)(Y_{t+K} - \mu)] \ldots\ldots\ldots\ldots(3)$, where $\text{Cov}(Y_K) = \text{Cov}(Y_t, Y_{t+K})$ Where μ represents the arithmetic mean, σ^2 represents the variance, and (γ_K) represents the autocovariance coefficient, and all these parameters are constant.

Time Series Stability Tests: There are a number of criteria used to test the stability or stationarity of series. These criteria include: Graphical Time Series Analysis: An initial practical idea of the stability of time series for any variable can be obtained from the graphical representation of the time series. If there is a general downward or upward trend in the series, this indicates a difference between the means of the partial samples of the series as a whole, and thus indicates that the time series is non-stationary. Stability requires that the mean value E[y] remains constant for every time period [7]. **Autocorrelation Function**:- This function is of great importance in highlighting the general characteristics of the time series, as:

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-Explains the existing correlation between observations for different periods. -It is one of the important and simple tests used to verify the stability of time series and takes the following form: Yk: The autocovariance at lag k for a given time series. [8]. **Unit Root Test:** The most important test for the stability of time series is the Unit Root Test. When there is no unit root, the series is stable, and when there is a unit root, the series is unstable. The most important unit root tests are the Phillips-Perron (P.P.) test. [9].

$$\Delta Y_t = \partial Y_{t-1} + \mu_t \quad \ldots\ldots\ldots\ldots(3)$$

$$\Delta Y_t = \beta_1 + \partial Y_{t-1} + \mu_t \quad \ldots\ldots\ldots\ldots(3)$$

$$\Delta Y_t = \beta_1 + \beta_{2\ t} + \partial Y_{t-1} + \mu_t \quad \ldots\ldots\ldots\ldots(3)$$

Equation (1) represents the variable Y_t\Delta without a constant term and without a general trend, i.e., the Random Walk Only equation. Equation (2) includes a constant term (drift), \beta_1, for the series, while Equation (3) includes a constant term and a general trend. t represents time or the general trend variable. In all three cases, the null hypothesis (H_0: b = 0) is chosen if the time series of the variable (Y_t) is a non-stationary series, and we reject the null hypothesis, meaning we accept the alternative hypothesis (H_1: b \neq 0), when the time series of the variable (Y_t) is stationary. It should be noted that the critical values for t differ in each of the previous cases.

Phillips-Perron (PP) Test: This test is based on the same Augmented Dickey-Fuller (ADF) tests and models, but it differs from it in that it takes into account errors with heterogeneous variance through a non-parametric correction of the Augmented Dickey-Fuller (ADF) statistics. It is known that the (ADF) test is based on the hypothesis that the time series is generated by an autoregressive process, while the Phillips-Perron (PP) test is based on a more general assumption, which claims that the time series is generated by an Autoregressive Integrated Moving Average (ARIMA). Therefore, the Phillips-Perron test has better testing power, in addition to being more accurate than the Augmented Dickey-Fuller test, especially when the sample size is small [10]. If the results of the two tests differ and are inconsistent, the results of Phillips-Perron are relied upon because it is more advanced than the Augmented Dickey-Fuller (ADF) test [11].

Cointegration: is defined as the association between two or more time series (X_t, Y_t), such that fluctuations in one cancel out fluctuations in the other in a way that the ratio between their values remains constant over time. This may imply that the time series data may be non-stationary when taken individually, but stationary as a group. Such a long-term relationship between variables is useful in forecasting the value of the dependent variable based on a set of independent variables.

The Autoregressive Distributed Lag (ARDL) Model: model is one of the standard models used in testing for cointegration using the Bounds test. The ARDL model is a combination of two models: the first is the Distributed Lag Model, and the second is the Autoregressive Model [12].

Reality of Rice Production in Iraq for the Period (2004-2024). Rice production is a fundamental pillar for food and economic security in Iraq, supporting societal stability through its role in feeding the population, providing employment opportunities, and achieving sustainable agricultural development. The state seeks to enhance the economic importance of rice by increasing local production and reducing reliance on imports, which contributes to achieving self-sufficiency, supporting the national balance of payments, and stimulating the rural economy.

Area: The area of land cultivated with rice in Iraq varies from year to year depending on several factors, the most important of which are water availability, agricultural policies, rainfall levels, and the availability of seeds and fertilizers. The average area reached (334,222.28), the highest value reached (511,366) in (2019), and the lowest value reached (21,702) in (2018).

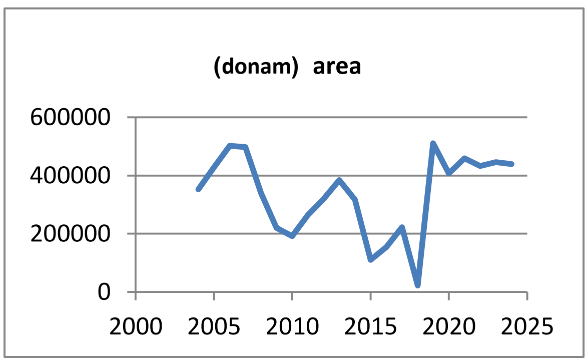

Figure (1) Rice area in Iraq.

Production:- Rice production in Iraq faces significant challenges, including water scarcity resulting from climate change and water policies, declining irrigation efficiency, and the weak adoption of modern agricultural technologies. Nevertheless, relevant authorities and agricultural researchers are seeking to improve rice production by developing drought-resistant varieties, increasing water use efficiency, developing agricultural extension programs, and adopting modern irrigation methods. The average production reached (332,021.66), the highest value reached (574,705) in (2019), and the lowest value reached (18,196) in (2018).

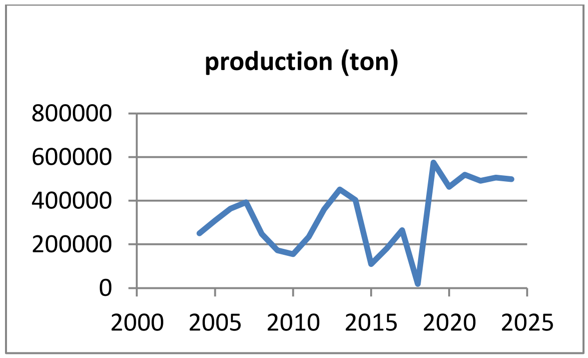

Figure (2) Rice Production in Iraq

Productivity: Productivity increases if the appropriate conditions and factors for increased production are available, but in the event of drought, productivity declines due to the reduction of cultivated areas and the decrease in grain quality. The average productivity reached (964.38), the highest value reached (1197) in the year (2017), and the lowest value reached (711) in the year (2004).

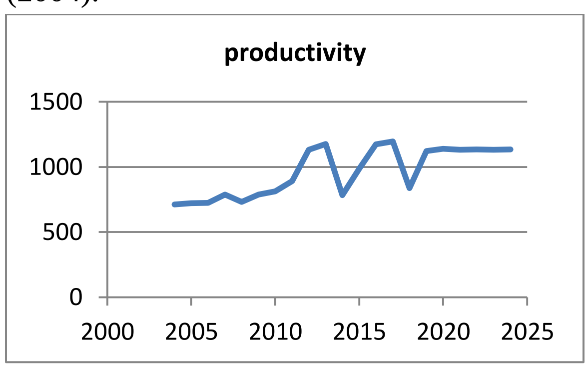

Figure (3) Rice Productivity in Iraq

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Table (1): Area, Production, and Productivity of Rice in Iraq for the Period (2004–2024).

Year	Area (Dunum)	Production (Tons)	Productivity
2004	351,793	250,275	711
2005	428,243	308,660	721
2006	502,565	363,338	723
2007	497,365	392,803	789
2008	339,043	248,157	731
2009	219,735	173,074	787
2010	191,895	155,829	812
2011	263,810	235,118	891
2012	318,767	361,339	1133
2013	383,824	451,849	1177
2014	317,249	403,028	783
2015	110,434	109,209	988
2016	154,247	181,320	1175
2017	222,096	265,852	1197
2018	21,702	18,196	838
2019	511,366	574,705	1123
2020	406,862	464,159	1140
2021	459,114	519,432	1131
2022	432,988	491,795	1135
2023	446,051	505,613	1133
2024	439,519	498,704	1134
Average	334,222.28	332,021.66	964.38
Maximum Value	511,366	574,705	1,197
Minimum Value	21,702	18,196	711

Results and Discussion

Y=f(X1,X2,X3,X4)

Y = Rice Production (tons)

X1 = Area cultivated with rice (decares)

X2 = Local price of rice (Dinar/ton)

X3 = Water inflows to the Tigris and Euphrates rivers (billion m3)

X4 = Price of a competing crop (Wheat) ()

First: Time Series Graphs: Before testing the time series, it must be represented graphically against time to determine the nature and type of this series. If this curve shows a general upward or downward trend, it indicates that its average changes over time, meaning the time series is unstable, as shown in Figure (4) the graph of the variables as a linear function. The variable (X1) was stable at the level, which indicated that the time series for the two variables are integrated at the zero order I(0), while the other variables (Y, X1, X2, X3, X4) stabilized upon taking their first difference and that they are integrated at order I(1).

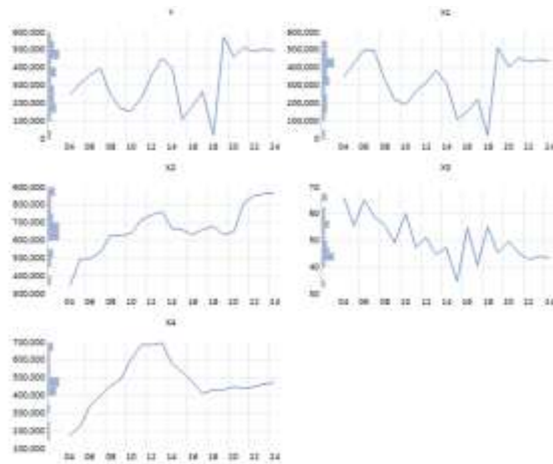

Figure (4) Graphical method for detecting the stability of the time series of the variables used at the level.

Source: Prepared by the researcher based on the outputs of the (Eviews 12) program

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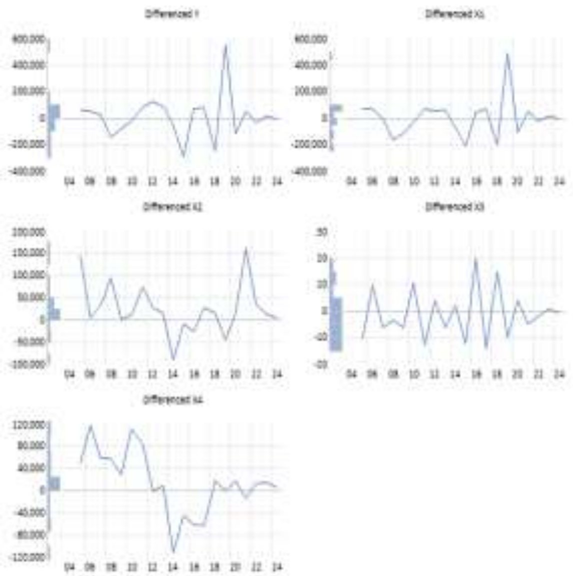

Figure (5): Graphical Method for Detecting the Stationarity of the Time Series for the Variables Used at the First Difference.
Source: Prepared by the researcher based on the outputs of the (Eviews 12) program

Secondly: Unit Root Test for Time Series Stability of Variables Using the Phillips-Perron (PP) Method. The unit root test aims to examine the time series properties of each variable in the function under study, confirm the stability of economic time series, and determine the order of integration for each variable. Table (2) and Phillips-Perron (PP) show the variables of the function under study. The results from Table () using the (PP) test indicate that the time series of variable (X3) is stationary at the level, at a significance level of (10%). As for variables (X4, X3, X2, X1, Y) of the function under study, they became stationary at the first difference I(1), at significance levels of (10%) and (5%). From the above, we observe that the variables differ in their degree of stationarity, which requires us to remember that the Ordinary Least Squares (OLS) method cannot be used as long as the studied variables have different orders of integration. Furthermore, the (OLS) method assumes that the variables have the same order of integration (i.e., they are stationary at the level). To avoid misleading results that can be obtained using the (OLS) method, it was necessary to search for another method suitable for the differing degrees of stationarity among the variables used in the model. Therefore, the models will be estimated according to the Autoregressive Distributed Lag (ARDL) model.

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Table (2) Unit Root Test for Time Series Stability of Variables Using the (PP) Method.

UNIT ROOT TEST RESULTS TABLE (PP)						
At Level		Y	X1	X2	X3	X4
With Constant	t-Statistic	-2.6463	-2.5018	-2.2200	-3.6569	-2.4012
	Prob.	0.1007	0.1298	0.2057	0.0138	0.1538
		n0	n0	n0	**	n0
With Constant & Trend	t-Statistic	-3.0561	-2.4187	-2.5688	-5.6389	-2.0867
	Prob.	0.1427	0.3598	0.2960	0.0010	0.5216
		n0	n0	n0	***	n0
Without Constant & Trend	t-Statistic	-0.4000	-0.5819	1.4592	-1.5919	0.0734
	Prob.	0.5266	0.4525	0.9588	0.1029	0.6947
		n0	n0	n0	n0	n0
At First Difference		d(Y)	d(X1)	d(X2)	d(X3)	d(X4)
With Constant	t-Statistic	-6.2660	-5.8367	-4.4318	-15.4755	-2.0583
	Prob.	0.0001	0.0002	0.0029	0.0000	0.2619
		***	***	***	***	n0
With Constant & Trend	t-Statistic	-6.4110	-6.1879	-4.2194	-16.8775	-2.4526
	Prob.	0.0003	0.0004	0.0182	0.0001	0.3444
		***	***	**	***	n0
Without Constant & Trend	t-Statistic	-6.4004	-6.0092	-4.1478	-13.6908	-2.0909
	Prob.	0.0000	0.0000	0.0003	0.0001	0.0381
		***	***	***	***	**
(*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant						

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There are several criteria used in determining the optimal lag periods for the Autoregressive Distributed Lag (ARDL) model, the most important of which are the AIC criterion (Akaike Information Criterion), the SIC criterion (Schwarz Information Criterion), and the HQ criterion (Hannan-Quinn criterion). It is shown through these criteria in Table (3) that the best lag period that can be used in the ARDL model is (1)

Table (3) Determining Optimal Lag Periods.

Source: Prepared by the researcher based on the outputs of the (Eviews 12) prog

VAR Lag Order Selection Criteria						
VAR Lag Order Selection Criteria Endogenous variables: Y X1 X2 X3 X4 Exogenous variables: C Date: 11/18/25 Time: 21:10 Sample: 2004 2024 Included observations: 20						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1085.664	NA	1.60e+41	109.0664	109.3153	109.1149
1	-1007.901	108.8673*	9.00e+38*	103.7901*	105.2837*	104.0817*

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Third: Standard and economic estimation of the effect of the study variables on the rice production rate in Iraq for the period (2004-2024). The model of the effect of rice production variables is estimated through the Error Correction Model and Autoregressive Distributed Lag (ARDL) in the following steps: 1- Preliminary estimation of the Autoregressive Distributed Lag (ARDL) model for the effect of the study variables on the rate of agricultural exposure in Iraq for the period (2004-2023). After confirming the time series stability of the variables by using stability tests for the variables of the influencing factors and the dependent variable (rice production), we conduct the preliminary estimation of the Autoregressive Distributed Lag (ARDL) model using the statistical software Eviews12. We observe from Table (4) that the value of the Adjusted R-squared is (0.91), meaning that the independent variables included in the estimated model explain about (98%) of the changes in the dependent variable. This indicates that the explanatory factors have the greatest impact on the function, while the unexplained (2%) is attributable to variables not included in the model, and their effect is absorbed by the random variable. The calculated F-test value is (161.32) with a significance level of (0.000), which is less than (0.05) and even less than (0.01). This means that the estimated model is significant as a whole and can be relied upon for future planning and forecasting.

Table (4) Preliminary estimation of the Autoregressive Distributed Lag (ARDL) model.

Dependent Variable: Y				
Method: ARDL				
Date: 11/18/25 Time: 21:15				
Sample (adjusted): 2004 2024				
Included observations: 20 after adjustments				
Maximum dependent lags: 1 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (1 lag, automatic): X1 X2 X3 X4				
Fixed				

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regressors: C				
Number of models evalulated: 16				
Selected Model: ARDL(1, 1, 0, 0, 1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Y(-1)	0.535917	0.131077	4.088557	0.0015
X1	1.147899	0.040527	28.32423	0.0000
X1(-1)	-0.651867	0.138178	-4.717583	0.0005
X2	0.185119	0.077355	2.393113	0.0339
X3	1620.117	1050.460	1.542294	0.1490
X4	-0.316682	0.129667	-2.442275	0.0310
X4(-1)	0.434379	0.122476	3.546635	0.0040
C	-262935.8	80208.11	-3.278169	0.0066
R-squared	0.989485	Mean dependent var		336109.0
Adjusted R-squared	0.983352	S.D. dependent var		156948.3
S.E. of regression	20250.77	Akaike info criterion		22.95895
Sum squared resid	4.92E+09	Schwarz criterion		23.35724
Log likelihood	-221.5895	Hannan-Quinn criter.		23.03670
F-statistic	161.3226	Durbin-Watson stat		1.625487
		Prob(F-statistic)		0.000000

Source: Prepared by the researcher based on the outputs of the EViews 12 program

Co-integration test using the bounds testing approach for the effect of study variables on rice production in Iraq for the period (2004-2024). To ensure the existence of co-integration, which indicates the long-term equilibrium relationship between the factors affecting rice production, the co-integration test will be performed using the bounds testing approach on the agricultural exposure model. This test relies on the F-Statistic, where we reject the null hypothesis (H_0: b=0) stating no co-integration among the model variables, in favor of the alternative hypothesis (H_1: b \neq 0) stating the existence of co-integration among the variables. Table (5) shows that the calculated F-statistic value reached (5.16), which is greater than the critical F-value at both bounds (the lower and upper bounds). This means we reject the null hypothesis (H_0: b=0) and accept the alternative hypothesis (H_1: b \neq 0), indicating the existence of a long-term equilibrium relationship (co-integration) between the variables of the rice production model.

Table (5) Co-integration test using the bounds testing approach.

Null Hypothesis: No levels relationship	F-Bounds Test			
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.161140		Asymptotic: n=1000	
K	4	10%	2.2	3.09
		5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Source: Prepared by the researcher based on the outputs of the EViews 12 program.

Fourth: Estimation and interpretation of the short-run and long-run relationship model according to the (ARDL) model for the impact of study variables on rice production in Iraq for the period (2004-2024).

From Table (6), we observe that in the short run, the coefficient of the independent variable Area (X_1) reached (1.147899), which indicates a direct relationship between area and rice production. That is, a 1% increase in area will lead to a 1.14% increase in production. This variable was significant at the 5% probability level, and this is economically logical. In the long run, this variable is also significant at the 5% probability level. It was shown that the coefficient of the independent variable Local Price (X_2) reached (0.185119) in the short run, which indicates a direct relationship between local price and rice production. An increase of 1% in the local price leads to a 0.185% increase in rice production. This variable was significant at the 5% probability level. In the long run, it is also significant at the 5% level, because there are other factors that have a greater impact on rice production in the long run. It was shown that the coefficient of the independent variable Water Imports (X_3) was positive, and its value reached (1620.117). This indicates a direct relationship between water imports and production, meaning that a 1% increase in water imports leads to a 1620.117% increase in production. This variable was significant at the 5% probability level, and this result is consistent with general economic logic. In the long run, this variable was not significant at the 5% level. It was shown that the coefficient of the independent variable Price of Competing Crop (Wheat) (X_4) was negative and its value reached (-0.316682) in the short run, which indicates an inverse relationship between the price of the competing crop and rice production. This means that a 1% increase in the competing price leads to a decrease in rice production by (-0.316682%). This variable was significant at the 5% probability level, and this result is economically logical. In the long run, this variable is also significant at the 5% level.

Table (6) Estimation and interpretation of the short-run and long-run relationship model according to the (ARDL) model.

Conditional Error Correction Regression				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-262935.8	80208.11	-3.278169	0.0066
Y(-1)*	-0.464083	0.131077	-3.540527	0.0041
X1(-1)	0.496031	0.130051	3.814114	0.0025
X2**	0.185119	0.077355	2.393113	0.0339
X3**	1620.117	1050.460	1.542294	0.1490
X4(-1)	0.117697	0.049008	2.401613	0.0334
D(X1)	1.147899	0.040527	28.32423	0.0000
D(X4)	-0.316682	0.129667	-2.442275	0.0310
Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
X1	1.068842	0.104492	10.22898	0.0000
X2	0.398892	0.137009	2.911421	0.0130
X3	3491.008	2708.980	1.288680	0.2218
X4	0.253613	0.134932	1.879564	0.0847
C	566570.7-	220776.9	2.566259-	0.0247
EC = Y - (1.0688*X1 + 0.3989*X2 + 3491.0084*X3 + 0.2536*X4 - 566570.7199)				

Source: Prepared by the researcher based on the outputs of the EViews 12 program.

It is clear from Table (7) that the error correction coefficient was (-0.464) and significant at the (1\%) level. Thus, it satisfied the necessary and sufficient condition, which means that short-run disequilibrium in rice production can be corrected towards the long-run equilibrium relationship. = 1/0.464 = \text{ECM}, meaning it takes eleven years and nine months to return to the equilibrium state.

Table (7) Error Correction Coefficient for the ARDL Model.

ARDL Error Correction Regression				
Dependent Variable: D(Y)				
Selected Model: ARDL(1, 1, 0, 0, 1)				
Case 2: Restricted Constant and No Trend				
Date: 11/18/25 Time: 21:50				
Sample: 2004 2024				
Included observations: 20				
ECM Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(X1)	1.147899	0.026552	43.23168	0.0000
D(X4)	-0.316682	0.081459	-3.887639	0.0022
CointEq(-1)*	-0.464083	0.070067	-6.623419	0.0000
R-squared	0.991050	Mean dependent var		12421.45
Adjusted R-squared	0.989997	S.D. dependent var		170111.6
S.E. of regression	17014.05	Akaike info criterion		22.45895
Sum squared resid	4.92E+09	Schwarz criterion		22.60831
Log likelihood	-221.5895	Hannan-Quinn criter.		22.48810
Durbin-Watson stat	1.625487			

Source: Prepared by the researcher based on the outputs of the EViews 12 program

Fifth: Diagnostic Tests for the Impact of Rice Production Variables in Iraq for the Period (2004-2024). After obtaining the short-run and long-run relationship for the impact of rice production variables using the (ARDL) model, we will then evaluate the study model to determine the efficiency of the model used through diagnostic tests. Table (8) shows through the (Breusch-Godfrey Serial Correlation LM) test that the model does not suffer from the problem of serial correlation, as the F-statistic value was (0.263953) at a probability level of (0.7732), which is a probability level greater than (5%), allowing us to accept the null hypothesis stating the absence of a serial correlation problem among the residuals. Through the (ARCH) Heteroskedasticity Test, it was found that the model does not suffer from the problem of heteroskedasticity, as the F-statistic value was (1.312285) at a probability level of (0.3238), which is a probability level greater than (5%), allowing us to accept the null hypothesis stating the absence of a heteroskedasticity problem. Through the (Ramsey reset test), it is evident that the F-statistic value was (0.167874) at a probability level of (0.6899), which is a probability level greater than (5%).

Thus, this model is acceptable, and we can accept the null hypothesis that the model does not suffer from the problem of functional form misspecification. The (JB) test was used to confirm the normal distribution of the residuals, as shown in Figure (6); the regression equation is normally distributed; the (JB) value was 0.326, which is a probability level greater than 5%. Therefore, we accept the null hypothesis that the model residuals are normally distributed.

Table (8) Diagnostic Tests.

Breusch-Godfrey Serial Correlation LM Test:					
F-statistic		**0.263953**	**Prob. F(2,10)**		**0.7732**
Obs*R-squared		**1.002868**	**Prob. Chi-Square(2)**		**0.6057**
Heteroskedasticity Test: Breusch-Pagan-Godfrey					
F-statistic		**1.312285**	**Prob.) F(7,12**		**0.3238**
Obs*R-squared		**8.671760**	**Prob. Chi-Square(7)**		**0.2771**
Ramsey RESET Test , Equation: UNTITLED					
	Value	**Df**			**Probability**
t-statistic	**0.409725**	**11**			**0.6899**
F-statistic	**0.167874**	**(1, 11)**			**0.6899**

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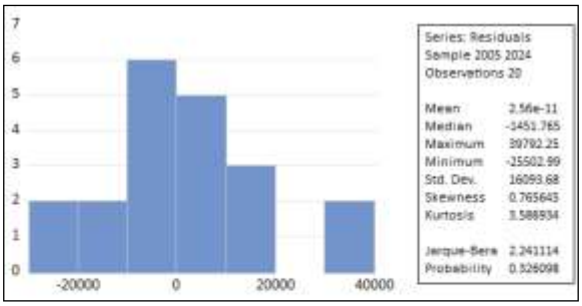
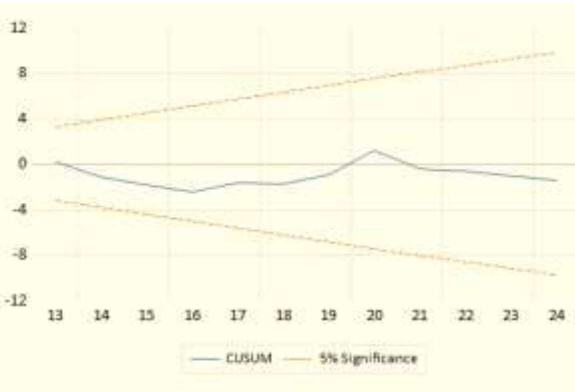


Figure (6) Normality test of residuals (Jarque-Bera). Source: Prepared by the researcher based on the outputs of the EViews 12 program

Sixth: Stability test of the estimated model using the CUSUM Squares and CUSUM tests for the effect of rice production in Iraq for the period (2004-2024). The structural stability test for the estimated (ARDL) model for the short- and long-run relationship, using the Cumulative Sum of Residuals (CUSUM) test, as well as the Cumulative Sum of Squared Residuals (CUSUM Squares) test, is considered one of the most important tests in this field because they clarify two important things: confirming the absence of any structural changes in the data used in the study, and the extent of the consistency and stability of the short-run parameters with the long-run parameters. Such tests are always associated with the Autoregressive Distributed Lag (ARDL) model. If the graph for both tests falls within the critical bounds at the (5%) level, it means that all estimated parameters are stable and



there are no structural changes in them. Figure (5) shows the Cumulative Sum of Residuals, where the graph falls within the critical bounds at the (5%) significance level, indicating no structural changes and consistency between the long-run and short-run parameters. It was evident from the Cumulative Sum of Squared Residuals (CUSUM Sq) that the parameters were stable over the period under study, but they went outside the critical bounds at the (5%) level in (2020) and (2021). This indicates the occurrence of structural changes in the aspect of rice production due to most of the commercial outlets exiting the control of the Iraqi government.

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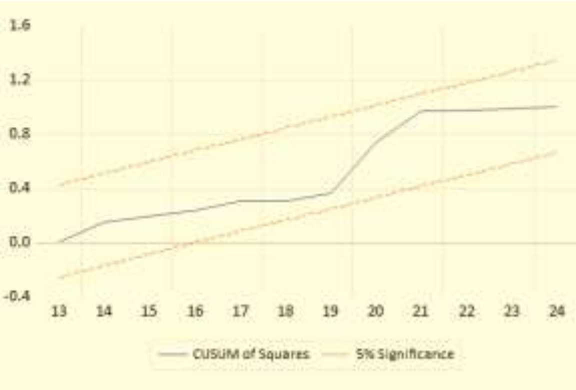

Figure (7) Model Stability Test using CUSUM and CUSUM Squares tests for the rice production function in Iraq for the period (2004-2024).

Source: Prepared by the researcher based on the outputs of the Eviews12 program.

Conclusions:

1- In the short run, the coefficient of the independent variable Area (X_1) was positive, which indicates a direct relationship between area and rice production. This means that an increase in area will lead to an increase in production, and this variable was significant at a 5% probability level. This is economically logical. In the long run, this variable remains significant at a 5% probability level.

2- The parameter of the independent variable Local Price (X_2) was positive in the short run, indicating a direct relationship between the local price and rice production, meaning that an increase in the local price leads to an increase in rice production. This variable was significant at a 5% probability level. In the long run, it is significant at 5% because of the existence of other factors that have a greater impact on rice production in the long run.

3- The parameter of the independent variable Water Imports (X_3) was positive, indicating a direct relationship between water imports and production. This means that an increase in water imports leads to an increase in production, and this variable was significant at a 5% probability level. This result is consistent with general economic logic. In the long run, this variable was not significant at the 5% level.

4- The coefficient of the independent variable Competing Crop Price (Wheat) (X_4) was negative in the short run, indicating an inverse relationship between the competing crop price and rice production. This means that a percentage increase in the competing price leads to a decrease in rice production, and this variable was significant at a 5% probability level. This result is economically logical. In the long run, this variable remains significant at the 5% level.

Recommendations:

1- Introduce new high-yielding, drought- and salinity-tolerant varieties to increase local production.

2- Take measures to develop the agricultural production of rice by developing an integrated scientific and economic plan to achieve cultivation that relies on modern scientific methods aimed at increasing production and improving its quality, and working on land reclamation by implementing an efficient drainage system based on main and secondary drains and improving irrigation methods using lined canals and providing water at the appropriate times and in the correct quantities.

3- The state must seriously and decisively consider developing and increasing the production of this important crop in order to reduce the large-scale importation process, which leads to the depletion of the country's hard currency and its transfer abroad. Therefore, the state must consider how to increase the cultivation of this crop and provide serious support to farmers to increase its production.

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