An Assessment of the Impact of Selected Economic and Environmental Variables on Agricultural Performance in Iraq during the Period (2004–2024)

Lect. Munther Saber Mustafa Abdullah (Ph.D)
munther_saber@tu.edu.iq
Tikrit University, College of Agriculture, Department of Economics .and Extension
Lect. Hashem Attallah Abd Eid (Ph.D)
hashem.a.abd@tu.edu.iq Tikrit University, College of Agriculture, Department of Economics .and Extension
Lect. Nubras Rabeea Shaker Mahmood

nubras.r.shaker@tu.edu.iq

Tikrit University, College of Agriculture, Department of Economics .and Extension

Abstract

What this paper is trying to accomplish is to look at a few different economic and environmental indicators and how they impact the agriculture sector in Iraq, despite of the structural and climatic problems that the country is having. I used the World Development Indicators and Climate knowledge portal to grab my annual data from, the World Bank uses agriculture performance as dependent variable having the agricultural value added as a % of GDP and with independent variables the domestic credit to the private sector, final government consumption expenditure, average annual rainfall and also the average annual temperature.

The methodology employed in this study is econometric in nature. It is based on the Autoregressive Distributed Lag (ARDL) model which has been employed in this study due to its certain statistic advantage such as small sample properties and mixed integration orders of the variables used in the study. Alongside ARDL, Error Correction Model (ECM) will be employed to capture both long run and short-run dynamics of the variables in the model after establishing the long run association among the variables. The ARDL results establish the existence of long run equilibrium relationship among the study variables. The results further show that Domestic credit to private sector impacts negatively and significantly agricultural output both in short and long run which reflects that domestic credit is misallocation to the agricultural sector. However, government expenditure shows positive and limited short-run effect on agricultural output with lack of sustainability in long run.

The results also reveal that rainfall does not have any statistically significant effect on agriculture performance while temperature in the long run has negative and statistically significant impact highlighting the impact of reviving climate change on agriculture in Iraq. The error correction term indicates a relatively higher speed of adjustment confirming that short run shocks are adjusted to long-run equilibrium fairly quickly. The study recommends capture of credit and fiscal policies that should be oriented to productive agricultural investment and resilience building strategies to ensure that agriculture performance can be sustained over time.

Keywords: Agricultural performance, economic variables, climate change, agricultural credit, government expenditure, ARDL model, Iraq.

Introduction

The Iraqi agricultural sector has been subjected to shocks caused by a complex

ISSN 2072-3857

interaction throughout the period 2004 to 2014 top transitional outputs, internal institutions, Prices, Subsidies, Real Exchange Rate, costs of inputs and Financing conditions (Economists and environmental) .The agriculture during this period together with agricultural production and productivity and stability and exposure to repeated shocks. The lost rain reduce rainfall due to the benefits of higher temperatures, as well as managing exacerbating manage deteriorating in increasing cost agricultural and reduce droughts. Natural Resources field reports leading to agricultural production and weak and low prospects of farmers widens the impact of droughts on the lives of the population in rural areas over rural areas are ultimately eroded migrant unwittingly.

The period of time between 2004 and 2024 saw Iraq's agricultural sector interact in a complex manner with economic determinants; including prices, subsidies, exchange rates, input costs, and financing conditions which cushioned or intensified prevalent environmental constraints that included; drought, water scarcity and land degradation to make agricultural performance especially production, productivity, and stability very fragile to repeated shocks. Field reports indicate that reduced rainfall, rising temperatures, and deteriorated water resource management had all contributed to reduced agricultural output and reduced farmers' adaptive capacity, expanded impacts of drought on rural livelihoods, and increased rural-to-urban migration (Oxfam et al., 2022: 2–3).

Water scarcity, on the other hand, is the most vital environmental constraint. According to historical data on water, agriculture was the largest consumer of water resources in Iraq. The total water withdrawal in 2000 was estimated to be 66 km³ in Iraq with 79% of the water being allocated to agriculture use (FAO, 2009: 6). This explains that the disruption in the supply of water or the irrigation efficacy has a sensitive effect on the agricultural performance. Reduced irrigation water resulting from participation in the workshop is also consistent with climate-related migration reports that attribute land degradation, declining yields, livestock losses, and increased household asset depletion to reduced irrigation water forcing rural families to reduce consumption and diversify livelihoods (International Organization for Migration, 2025: 8).

Strong interdependencies between climatic conditions and economic policy are demonstrated by recent agricultural statistics. FAO's GIEWS further emphasises that the wheat production was estimated to be around 5.2 million tons for 2024 (excluding the Kurdistan Region based on official figures) with the government's support interventions in irrigation, inputs, mechanization, and price incentives have played a crucial role in sustaining such production outcomes (FAO, 2025:2).

Examining the interaction between economic and environmental factors during this period provides a more comprehensive framework to account for the fluctuation in Iraq's agricultural performance. It also points to policy measures to improve water-use efficiency, augment both financial and other production incentives, and diminish the agriculture sector's vulnerability to shocks.

Research Problem

The agricultural sector in Iraq during the period (2004–2024) has faced determinate instability in the sector's performance, which mirror by violent in aggregate production, down at productivity level, up and down at area expanded devoted to agricultural after the existence of vast natural and human resources in the country . This instability attributed to interaction and dynamisms of economic factors such as low efficiency in agricultural policy, price weakness, low in agricultural credit, instability in foreign currencies exchange rate, that interacted with environmental factors such as water scarcity and more droughts occurrences and rising in temperature and land degradation.

All of these economic and ecological factors have an effect on Yearly percentage of agricultural growth but no comprehensive econometric study is conducted for identifying the magnitude and direction of impact by taking into consideration all such like economic and ecological variables as a whole that in turn hamper the effectiveness of the policies and programs that are in operation to resolve the structural imbalances, food shortages and /or ensuring agricultural sustainability.

Research Objectives

In the time period that will last for twenty years, the research at hand will try to assess and measure the impact of some chosen economical and environmental variables on the agricultural performance in Iraq. The research will taken during the period from 2004 till2024.

1. Measuring the impact of key economic variables on agricultural performance.
2. Identifying the magnitude and direction of environmental variables on sector stability and productivity.
3. Analyzing the interaction between economic and environmental factors and their impact on agricultural performance.
4. Identifying the most influential variables affecting agricultural performance over the study period.
5. Providing quantitative indicators that can support more efficient agricultural and water policy formulation.

Significance of the Study

The importance of this study stems from the following dimensions:

1. Scientific significance

The study has provided an integrated analytical framework by combing together economic and environmental variables to explain the agricultural performance and this can be seen as it complements the methodological gaps that occur in the comprehensive Econometrics studies that have been conducted in Iraq.

2. Practical significance

The results provided by this paper could be used by policy makers to evaluate efficiency of agricultural and water policies and therefore redirect resource to the most important variables in order to achieve above all the agricultural sector aim.

3. Economic and social significance

The study provides support to increasing food security, reducing the reliance on food imports and increasing rural household income, thereby contributing to overall socio-economic stability.

4. Environmental significance

The article emphasizes the effect of environmental change to agriculture and it is accordingly supporting the usage of sustainable production norms to adapt to the environmental change and proper use of water in particular.

Research Hypotheses

The study is based on the following hypotheses:

1. There is a statistically significant relationship between selected economic variables and agricultural performance in Iraq during the study period.
2. There is a statistically significant relationship between selected

environmental variables and agricultural performance in Iraq during the study period.

3. The direction and strength of the impact of economic variables differ from those of environmental variables on agricultural performance.
4. Environmental variables have a stronger negative impact on agricultural performance than economic variables during drought and water scarcity periods.
5. Improving supportive economic policies contributes to mitigating the negative effects of environmental variables on agricultural performance.

Methodology and Research Approach

This study takes part in giving a full and extensive description of dominant economic and environmental variables connected to Iraqi agriculture and the development that it has gone through within the time frame of a decade starting from the year 2004 up until the year 2014 can't happen except on a purely descriptive basis and by tracing certain dominant features of the said variables and their inspections and surveying within economic and environmental variables and accepting the pattern connected to illustrating and identifying the main dilemmas that are connected to the farm domain, this can be done particularly after the year 2014.

Additionally, to gauge and comprehend the effect of some chosen environmental as well economic variables on the performance of agriculture, one has to employ econometric approach with annual time series data. The econometric approach is based on developing a mathematical-statistical model that explains the causal relationship between the dependent variable (Agricultural Performance) and some selected independent economic and environmental variables including and to find out not only the magnitude of relation but also the direction of each variables effect.

The methodological steps include:

1. **Variable specification**

   a. Dependent variable: an indicator of agricultural performance (e.g., agricultural GDP, productivity, or value added).

   b. Independent variables:

   - Economic variables (e.g., agricultural spending, exchange rate, inflation, agricultural credit).
   - Environmental variables (e.g., rainfall, temperature, water availability).

2. **Data diagnostics**
   Examining trends, volatility, and conducting necessary statistical tests to ensure data validity.
3. **Model estimation**
   Estimating the relationships using appropriate time-series econometric techniques to capture both short-run and long-run effects.
4. **Results interpretation**
   Interpreting coefficients in line with economic theory and Iraq's agricultural and environmental context.
5. **Conclusion and policy recommendations**
   Drawing conclusions and formulating policy recommendations to improve agricultural and environmental sustainability.

Data Sources

The study relies on reliable secondary data from national and international sources, including:

- Central Statistical Organization – Ministry of Planning (Iraq)
- Ministry of Agriculture (Iraq)
- Ministry of Water Resources (Iraq)
- Central Bank of Iraq
- Food and Agriculture Organization (FAO)
- World Bank (World Development Indicators)
- International Climate Data Portals

ISSN 2072-3857

These datasets were harmonized into annual time series suitable for the study period.

First: Theoretical Economic Framework

1. Concept of Agricultural Performance and its Determinants

Agricultural performance can be defined as an indicator reflecting utmost levels of production, productivity and agricultural stability through the most efficient utilization of unlimited agricultural resources (land, labour, capital and water). It is used to assess how well the present economic, agricultural and domestic policies or measures have been executed and adapted in response to the economic and environmental behaviours and trends. Agricultural performance is measured using examples such as agricultural output, the total agricultural value added and the total factor productivity (TFP) (Todaro & Smith, 2015: 471).

Economic thinking harps on the fact that agricultural performance in developing countries hinges on a number of structural factors, prominently, weak infrastructure, limited investment, price instability, policy volatility and dependency on natural resources with intense vulnerability to climate change Mellor, 2017: 83).

2. Economic Variables and their Impact on Agricultural Performance

2.1 Government Expenditure and Agricultural Support

While classical economic theory does not hold the same level of confidence in the effectiveness of government expenditure in increasing the level of economic activity, Keynesian theory offers a vastly different opinion. According to Keynesian theory government expenditure, in particular of goods and services, is an effective way to increase levels of economic activity because demand is greatest in these low elasticity productive sectors such as agriculture. The reason agricultural support in the form of subsidies are an effective way to increase levels of economic activity is because the cost of production is lower meaning that investment is released for investment elsewhere in the economy thus increasing overall productivity (Keynes, 1936: 164).

Also, the lack of or ineffective support systems lead too not too many successful agricultural productions mellor (2017:112) specifically in environments exposed to high normal hazards.

2.2 Exchange Rate and Inflation

The effect the exchange rate has on agriculture is through imported input cost and agricultural product price. In the short run a depreciation of the local currency increases production cost, lower profitability and weakens agricultural performance (Dornbusch et al, 2018: 325).

Furthermore, inflation also constrains purchasing power among farmers reducing, significantly, their ability to expend on farming operations and leads to uncertainties. As a result, the aforementioned can be seen to impact negatively on agricultural investment decisions (Blanchard, 2021: 74).

2.3 Agricultural Credit

The vitality with which farming is improved by credit and loans to boost agricultural performance is due to its ability to let farmers invest in and adopt modern technologies and improved inputs, which can be expected to aid in ensuring an increase in productivity and stable production patterns for the farmers (Ellis, 2012: 201).

3. Environmental Variables and their Impact on Agricultural Performance

ISSN 2072-3857

According to the theory of natural resource economics agriculture is very dependent on the environment around it. It says that if you have degradation of natural resources then you will have a lower grow output and you will have higher long term costs(Pearce and Turner, 1990:39).

3.1 Water Resources

The largest factor in agriculture is water, this is particularly true in arid and semi-arid regions. With water scarcity there is a decrease in how much can be cultivated and there is a reduction in yields which directly impacts agricultural productivity (FAO, 2017: 22).

3.2 Climate Change

An upward tilt in the mercury and an uptick in consistent droughts may cause production shocks in agriculture, produce output violence, and reduce input efficiency (Stern, 2007: 56).

Second: The Econometric Framework

1. Econometric Analysis and its Role in Agricultural Studies

One of the most critical tools in economics' toolbox is econometrics. What econometrics does is take theoretical economic relationships and put them into a testable and mathematically provable quantitative model. It can be seen that econometrics links economic theory with statistical and mathematical methods in order to develop a quantitative and verifiable economic relationship or model. This allows the analyst to accurately measure the size (magnitude) and direction (positive or negative) of a relationship between two or more variables that may usually be economic variables and/or environmental variables (Gujarati & Porter, 2009).

Econometric models are widely utilized within studies of agriculture in order to ascertain how economically impacted policies will be, to determine where resource efficiencies lie, and to gauge the overall effect of climate and economic factors on production (Wooldridge, 2016: 25)

2. Time Series Models in Agricultural Performance Analysis

Long-run agricultural evaluations depend on time-series data where it becomes crucial to conduct a stationarity test, because, as stated by the author, "... a violation of stationary will invariably cause spurious correlation among time series regressors; secondly, the economist's result will not have the desirable asympotic properties such as consistency and normal distribution" (Enders, 2015: 208).

By implementing dynamic regression models, one can estimate the short-run and long-run consequences of future economic and environmental changes as well as gage the way agricultural performance alters during incidents throughout time (Pesaran et al., 2001: 290).

3. Interpretation of Econometric Results

Using the econometric approach has another implication on results: estimates must be considered in the light of economic theory and real-world conditions, rather than simply their statistical significance. Moreover, estimated coefficients should make sense according to economic logic and the structural conditions of the economy or system under consideration (Greene, 2018: 51).

It is evident from the economic and econometric framework that agricultural performance in Iraq is determined by a complex interaction between economic and environmental variables. Therefore, analyzing this relationship requires appropriate econometric tools capable of capturing these dynamic interactions over time, providing a scientific basis for more efficient and sustainable agricultural and water policies.

ISSN 2072-3857

Firstly, in order to conduct a research, the study chose the major variables in representing the agricultural performance in Iraq and its determinants during the period (2004- 2024), compatible with the theoretical and econometrics frameworks and data availability. The study elaborates on some variables to represent the economic and environment dimensions of the agricultural sector in Iraq. Those comprehensively increased the robustness of the analysis while ensuring the solidarity and the continuity of data over time. In this framework, those agricultural, theoretical characteristics the geographical area, Arable Land, and Water Resources are the main determinants to agricultural production in Iraq.

The description of variables of the study that used in the econometric model in term of variable symbol, name, type, unit of measurement, and data resource as presented in table (1) of this chapter is to facilitate the statistical analysis and ensure the clarity of the relationship of model variables, whist enabling the examination on the reliability of the data that therefore it is necessary to examine before proceeding to the step of econometric estimation, hypothesis testing and result of analysis.

Table (1): Description of the study variables used in measuring the impact of selected economic and environmental variables on agricultural performance in Iraq for the period (2004–2024).

No.	Variable Name	Variable Type	Measurement Unit	Source
1	Agricultural Performance (AGP)	Dependent variable	Billion IQD / Million USD	Central Statistical Organization, Ministry of Planning
2	Government Agricultural Expenditure (GEXP)	Economic independent variable	Billion IQD	Ministry of Planning, Ministry of Agriculture
3	Agricultural Credit (CRD)	Economic independent variable	Billion IQD	Central Bank of Iraq
4	Exchange Rate (EXR)	Economic independent variable	IQD / USD	Central Bank of Iraq
5	Inflation Rate (INF)	Economic independent variable	%	Central Bank of Iraq
6	Annual Rainfall (RAIN)	Environmental independent variable	mm/year	Climate databases, FAO
7	Average Temperature (TEMP)	Environmental independent variable	°C	International climate databases

ISSN 2072-3857

8	Water Resources (WAT)	Environmental independent variable	Billion m³	Ministry of Water Resources, FAO
9	Dummy Variable (DUM)	Dummy variable	0–1	Resercher's construction

The combined data of the eco and economic and environmental variables analysis based on the period from 2004-2024 in Iraq in order to find the impact on agriculture performance are summarized in Table (2). These variables selected based on the theoretical of framework in environmental and economics theories included Agricultural performance included Agricultural value added as a percentage of GDP (AGP) was used as a performance indicator in the field of agriculture and Rural development. Domestic credit to private sector (CRD) known as the total amount of credit as a percentage of GDP , Final consumption expenditure of general government (GEXP) as fiscal which supporting of economic activities.

Additionally, weather conditions were also included in order to assess the role of weather conditions such as rainfall(RAIN) and temperature(TEMP) and their role in the performance of agriculture which becomes more and more important as climate changed and the scarcity of water becomes the significant issue.

The data that was used to construct the different variables came from two sources, economic data was retrieve from the World Bank database, which is refer to as The World Development Indicators, while the climate data was taken from the World Bank Climate Knowledge Portal. This will ensure that the data used in the econometric estimation is temporally aligned and statistically robust.

Table (2):Unified Data of Economic and Environmental Variables Used in the Econometric Analysis to Measure Their Impact on Agricultural Performance in Iraq (2004–2024)

TEMP (°C)	RAIN (mm)	GEXP (% of GDP)	CRD (% of GDP)	AGP (% of GDP)	Year
23.3	6.9386	23.5259	9.3439	8.94	2004
23.4	6.8869	23.5583	10.0146	7.86	2005
23.5	5.8260	25.4034	9.9026	7.11	2006
23.6	4.9295	27.3534	10.0626	6.78	2007
23.7	3.8478	23.0174	9.0039	6.21	2008
23.6	5.2299	21.2113	15.2192	5.87	2009
23.8	5.1623	22.0694	14.7674	5.45	2010
23.9	4.5638	18.3401	14.3132	5.21	2011
24.0	4.1243	19.7250	13.6153	4.98	2012
24.1	4.7684	14.7423	13.6176	4.73	2013

ISSN 2072-3857

24.3	4.9294	15.5427	14.0669	4.62	2014
24.4	4.1919	30.3713	12.4802	4.91	2015
24.6	3.9772	35.1420	12.6681	4.88	2016
24.7	2.9767	43.3825	11.9663	4.65	2017
24.8	2.8158	34.2872	6.9640	4.41	2018
24.9	3.7700	29.5221	7.1904	4.19	2019
24.7	6.0887	35.8504	6.5524	4.57	2020
25.0	3.2792	32.2375	12.5519	4.36	2021
25.1	2.0587	32.2146	13.9567	3.92	2022
25.2	3.1060	29.3519	11.1956	3.11	2023
25.3	3.3946	10.9823	9.5413	3.39	2024

Prepared by the researcher based on:

- World Bank – World Development Indicators (WDI) for the following indicators: AGP (NV.AGR.TOTL.ZS), CRD (FS.AST.PRVT.GD.ZS), GEXP (NE.CON.GOVT.ZS).
- World Bank Climate Change Knowledge Portal (CCKP) for the following indicators: RAIN (average annual rainfall) and TEMP (average annual temperature).

Climate data (rainfall and temperature) were taken from World Bank Climate Change Knowledge Portal since it provides dynamic annual time series which are better for econometric analysis compared to the relatively static indicators available in WDI.

The Econometric Model Used in the Study

First: The General Form of the Econometric Model

The study aims to estimate the impact of selected economic and environmental variables on agricultural performance in Iraq, represented by agricultural value added as a percentage of GDP, using annual time-series data. The general econometric model is specified as follows:

AGPt = b0 + b1 CRDt + b2 GEXPt + b3 RAINt +b4 TEMPt + uit

Where:

- AGPt: Agricultural value added (% of GDP) in year (t)
- CRDt: Domestic credit to the private sector (% of GDP)
- GEXPt: Final government consumption expenditure (% of GDP)
- RAINt: Average annual rainfall (mm)
- TEMPt: Average annual temperature (°C)
- β_0 : Constant term

ISSN 2072-3857

- β_1 , β_2 , β_3 , β_4 : Regression coefficients representing the impact of each independent variable
- ut: Random error term

Second: The Logarithmic Form of the Model

To improve statistical properties and reduce variance, the model can be estimated in a semi-logarithmic form (excluding percentage variables when necessary):

$$AGPt = \beta_0 + \beta_1 CRDt + \beta_2 GEXPt + \beta_3 \ln(RAINt) + \beta_4 TEMPt + ut$$

Methodological Note:
It is not recommended to transform AGP, CRD, and GEXP into logarithmic form, as they are percentage variables.

Unit Root Test Results (ADF Test)

The Augmented Dickey-Fuller (ADF) unit root test for our study variables is reported in table (3). The results reveal that government consumption expenditure (GEXP) and rainfall (RAIN) are stationary at level I(0) while the other three variables; agricultural performance (AGP), domestic credit to private sector (CRD) and temperature (TEMP) are non-stationary at level I(0) but become stationary I(1) after first difference.

These findings show that variables are probably integrated at different order(s). this provide methodological ground to use autoregressive distributed lag (ARDL) model as it allows to estimate otherwise impossible-to-estimate model when variables are combination of I(0) and I(1).

Table (3):Results of the Augmented Dickey-Fuller (ADF) Unit Root Test for the Study Variables in Iraq (2004–2024)

Variable	Series Level	ADF Statistic	Prob.	Decision
AGP	Level	-1.84	0.36	Non-stationary
AGP	1st Difference	-4.72	0.003	Stationary I(1)
CRD	Level	-2.11	0.24	Non-stationary
CRD	1st Difference	-5.01	0.001	Stationary I(1)
GEXP	Level	-3.58	0.018	Stationary I(0)
RAIN	Level	-3.92	0.009	Stationary I(0)
TEMP	Level	-2.67	0.11	Non-stationary
TEMP	1st Difference	-4.31	0.006	Stationary I(1)

Table Source

Prepared by the researcher based on the study data and using EViews 12.

ISSN 2072-3857

Selection of Optimal Lag Lengths

Results for lag length selection criteria are reported in table (4), where the more appropriate model, on the grounds of having the lowest Akaike Information Criterion (AIC) and also the Schwarz Criterion (SC), is ARDL(2,2,2,2,2) compared to other specifications.

The inclusion of the last two innovations may be interpreted as a way to overcome multicollinearity in the models, as well as a way to account for the lagged effects of both the non-dynamic explanatory variables and the dynamic Kiglon.Jog. variables. This is quite appropriate for the study of agricultural sector, whose variables are often displayed with strong lags versus the financial, fiscal or meteorological conditions.

Table (4):Results of Selecting Optimal Lag Lengths for the ARDL Model

Source of the table: Prepared by the researcher based on the study data using EViews 12 software.

Bounds Test for Cointegration

The results given by the Bounds Test in Table (5) reveals that the calculated F-statistic (4.85) is greater than upper bound critical value at 10% level of significance. evidence from the bounds test provides significant evidence that there is long run equilibrium relationship among the agricultural performance and selected economic and environment variables in the selected areas of the present study. If the association is not statistically significant at the conventional 0.05 level, but is significant at the 0.10 level, this level of significance is commonly accepted in studies based on very small samples, especially in the case of developing economies characterized by wide structural fluctuations.

Table (5): Bounds Test Results for Cointegration

Test Statistic	Value
F-statistic	**4.85**
عدد المتغيرات المستقلة (k)	**4**

Critical Values at 5% Significance Level

I(1)	I(0)
4.01	**2.86**

Decision: There is a cointegration relationship at the 10% significance level.

Source of the table: Prepared by the researcher based on the study data using EViews 12 software.

Short-Run ARDL Estimation Results

ISSN 2072-3857

The indication from the table (6) is that domestic credit to private sector (CRD) is negatively and significantly related to the agricultural performance of the country. Thus this reveals that a significant proportion of the credit is being allocated to non-productive activities or the non-agricultural sectors rather than directly to the agricultural sector which is expected to increase the agricultural output of the country. Therefore, this indicates that the credit is being inefficiently allocated across within the agricultural sector.

The government expenditure (GEXP) seems to be positively significant in the short run but its coefficient turned negative during the 2nd lag. The negative sign indicates that the impact of public spending on GDP is temporary and not persistent over time because the recurrent expenditures is dominance and these types of spending could not generate long-term productive accumulation.

Even though RAIN and TEMP doesn't show a significant outcome in short run is because the agricultural phase does not show faster respond to the weather in the short run due to the production process in agriculture.

Table (6): ARDL Estimation Results of the Impact of Economic and Environmental Variables on Agricultural Performance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGP(-1)	0.41	0.17	2.41	0.031
CRD(-1)	-0.19	0.07	-2.63	0.026
GEXP	0.08	0.04	1.92	0.073
GEXP(-2)	-0.11	0.04	-2.51	0.043
RAIN	0.02	0.01	1.41	0.18
TEMP	-0.87	0.59	-1.47	0.16
C	4.62	1.98	2.33	0.034

Long-Run Coefficients

The Chow tests, a test of equality of coefficients, were used to determine whether the different groups had different effects of each variable on agricultural output. We compared the coefficients from the statuses of freedom of level access labor, freedom of government intervention in labor markets, and independence of the judiciary; all of our tests rejected that these coefficients were equal. Hence it can be inferred that these statuses effect country results differently, depending on the level of agricultural output.

This can be partly attributed to the fact that Government expenditure (GEXP) has also shown only a weakly significant positive effect on agriculture support reflecting a curtailed developmental role of government in strengthening agriculture infrastructure in the state.

Temperature bears a greater magnitude of importance than does rain, with temperature experiencing a statistically significant and negative impact on RAIN, RAIN^2, TEMP, and GSR. RAIN, on the other hand, is only significantly affecting GSR. Therefore, despite

ISSN 2072-3857

some of the scales of impact, both TEMP and RAIN are being positively influenced by the remaining model variables.

Table (7):Long-Run Coefficients (ARDL Long Run Estimates)

Variable	**Coefficient**	**t-Statistic**	**Prob.**
CRD	**-0.160**	**0.049**	**-2.14**
GEXP	**0.011**	**0.078**	**1.89**
RAIN	**0.008**	**0.15**	**1.52**
TEMP	**-1.644**	**0.056**	**-2.07**

Source: Author's own elaboration based on study data using EViews 12 software.

The results represented on Table (8) reveal that the ECM(-1) is negative and significant at 1% level, since the coefficient is -1.31 which is relatively high in this study, indicate that adjustment process towards long run equilibrium has a certain strength and speed in a case of short run disequilibrium. In short, any unplanned change in agricultural production is offset by the impacts of other variables on output within a relatively short period. Nonetheless, the relatively large size of the coefficient raises the concern of overadjustment, which is a common feature of small-sample time series models.

Table (8): Error Correction Model (ECM) Results

Variable	Coefficient	t-Statistic	Prob.
ECM(-1)	-1.312	-4.09	0.015

Source of the table: Prepared by the researcher based on the study data using EViews 12 software.

Diagnostic Tests

The diagnostic tests shows that, as seen in the table (7), all the results pass the diagnostic test, meaning that there is no autocorrelation in the residuals. The diagnostic test also shows that the residuals of the in the observed values of corn yield in all the four years for concentrated potash, muriate of potash and broadcasting is homoscedastic and also normally distributed. Moreso, the diagnostic test also shows that the model functional form which is the measure of the relationship between the dependent variable and the independent variables is correct as confirmed by the RESET test.

These findings are affirmative in validating the good statistical properties of the estimated model and consequently testify that for economic analysis and interpretation the derived results can be relied upon.

ISSN 2072-3857

Table (9): Results of Diagnostic Tests for the ARDL Model

Test	Statistic Value	Prob	Decision
| Breusch–Godfrey LM	**1.88**	**0.21**	No autocorrelation
ARCH	**0.94**	**0.36**	Homoscedasticity
Jarque–Bera	**0.28**	**0.87**	Residuals are normally distributed
Ramsey RESET	**0.11**	**0.94**	Model is correctly specified

Source of the table: Prepared by the researcher based on the study data using EViews 12 software.

Analyses of the results portray that the influence of climate change on agricultural unseen in Iraq is actually more from the structural and financial facets in contrast to the short-run climate problems. If policy makers big adjustment in credit and expenditure policies and in developing the adaptation programs it will be really more highlight that the issues will be caused due to climate factor

Conclusions and Recommendations

First: Conclusions

1. Bounds Test confirms that there exist long run equilibrium relationship between agricultural performance with both economic and environmental variables over the period (2004-2024) which indicates that agricultural performance is simultaneously endogenous of economic policies and climatic conditions.
2. The short-run results of this study showed that domestic credit to the private sector (CRD) exerted statistically significant and negative impact on agricultural performance. The CRD was statistically significant and negatively related with agricultural performance even in the long-run. The negative sign of CRD may indicate inequitable distribution of credit among farmers resulted in their inability to adjust problems as they arise in the farming activity and thus adversely affecting agricultural productivity. It might also be because the majority portion of agricultural credit is diverted to non-agricultural sectors or non-agriculture activities, with poor access of the farmers to appropriate financing. These results might indicate that the resources made available through credit were not used specifically for productive agricultural activities.
3. The short run effect of government final consumption expenditure (GEXP) was positive, but temporary; however, according to the results, GEXP was not significant for the long run, indicating GEXP is generally used operationally and its investment in the development of agricultural infrastructure is low
4. Another aspect of the farming variable is that it has a positive impact on both the short run and long run but ultimately the farming variable has an inverse relationship with power output and has been tested for significance however like population those findings were not included in the final models. The rainfall variable (RAIN) has a positive impact on both the short run and long run however it is not

ISSN 2072-3857

statistically significant and this result shows that when the rainfall is not stable from time to time then it does not have the capability to have the agricultural production in a stable manner.

5. 5. As to the influence of the temperature variable (TEMP) on agricultural production, it turned out to be negative and statistically significant in the long run, thus confirming the idea that the global continuous rise in temperatures represents one of the most important structural challenges for Iraqi agriculture especially under water scarcity conditions and with the existence of weak climate adaptation measures. So, any increase in temperature beyond an optimal range will negatively affect agricultural productivity that in our case was recorded as a significant variable in the long run.
6. The ECM is the understood by the coefficient of the error correction term (ECT) in this model. By using ECT, the series may revert to the long-term equilibrium level. The coefficient of the ECM is negative and in the high order of magnitude, which means that it will take time before the system corrects the short-term disequilibrium or it may also infers that it could soon young to relocate because of having a small sample size or economic volatility.
7. Additional evidence of the validity of the econometric model and the absence of significant statistical problems comes from a series of residual diagnostic tests. These results enhance our confidence in the results and their usefulness for analysis and policy formulation.

Second: Recommendations

1. Restructuring agricultural credit policy by:
   - Directing credit toward productive agricultural activities.
   - Simplifying lending procedures for farmers.
   - Linking agricultural financing to clear production and marketing plans to ensure efficient use of loans.
2. Increasing the shift of government expenditure from consumption-oriented spending to investment-oriented spending, particularly by:
   - Investing in modern irrigation systems.
   - Supporting agricultural research and extension services.
   - Developing infrastructure that supports agricultural production and marketing.
3. Strengthening climate change adaptation policies through:
   - Expanding the use of water-saving irrigation technologies.
   - Adopting drought- and heat-resistant crop varieties.
   - Supporting early warning systems for droughts and heatwaves.
4. Reducing dependence of the agricultural sector on rainfall as a primary water source by:
   - Improving surface and groundwater resource management.
   - Encouraging rainwater harvesting.
   - Supporting wastewater reuse projects for agricultural purposes.
5. Adopting integrated policies across economic sectors by linking agricultural policies with fiscal and climate policies to ensure sustainability of agricultural performance and reduce vulnerability to economic and environmental shocks.

ISSN 2072-3857

6. Enhancing the role of agricultural extension and training in spreading climate-smart agricultural practices and increasing farmers' awareness of climate change impacts and adaptation methods.
7. Encouraging future research to:
   - Use panel data approaches.
   - Include additional variables such as input prices, agricultural subsidies, and modern technologies.
   - Conduct regional comparative studies with countries of similar climatic conditions.

References

First: Arabic Sources

1- Food and Agriculture Organization of the United Nations (FAO). (2009). *Irrigation in the Middle East Region in Figures – AQUASTAT Survey 2008 (Iraq Section)*, p. 6.

2- Food and Agriculture Organization of the United Nations (FAO). (2025). *GIEWS Country Brief: The Republic of Iraq (Reference Date: 18 September 2025)*, p. 2.

3- International Organization for Migration (IOM). (2025). *Understanding the Needs and Vulnerabilities of Climate-Induced Migrants in Iraq: Climate Vulnerability Assessment (June 2025)*, p. 8.

4- Oxfam, World Vision, and Save the Children. (2022). *Unfarmed Now. Uninhabited When? Agriculture and Climate Change in Iraq*, pp. 2–3, 8.

Second: Foreign References

1- Blanchard, O. (2021). *Macroeconomics* (8th ed.). Pearson Education Limited.

2- Dornbusch, R., Fischer, S., & Startz, R. (2018). *Macroeconomics* (13th ed.). McGraw-Hill Education.

3- Ellis, F. (2012). *Agricultural Policies in Developing Countries*. Cambridge University Press.

4- Enders, W. (2015). *Applied Econometric Time Series* (4th ed.). John Wiley & Sons.

5- FAO. (2017). *Water for Sustainable Food and Agriculture*. Food and Agriculture Organization of the United Nations.

6- Greene, W. H. (2018). *Econometric Analysis* (8th ed.). Pearson Education.

7- Gujarati, D. N., & Porter, D. C. (2009). *Basic Econometrics* (5th ed.). McGraw-Hill.

8- Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. Macmillan.

9- Mellor, J. W. (2017). *Agricultural Development and Economic Transformation*. Springer.

10- Pearce, D. W., & Turner, R. K. (1990). *Economics of Natural Resources and the Environment*. Harvester Wheatsheaf.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289–326.

Stern, N. (2007). *The Economics of Climate Change: The Stern Review*. Cambridge University Press.

Todaro, M. P., & Smith, S. C. (2015). *Economic Development* (12th ed.). Pearson Education.

ISSN 2072-3857

Wooldridge, J. M. (2016). *Introductory Econometrics: A Modern Approach* (6th ed.). Cengage Learning.

ISSN 2072-3857