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Factors Affecting Sustainable Agriculture in Iraq: Evidence from Employment, CPI, Rents, and Policies

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This research examines the current state of sustainable agricultural development in Iraq and explores its association with various factors. Data were obtained from reputable sources such as the World Bank Database, and econometric tests were used. Utilizing the autoregressive distributed lag model (ARDL), the study analyzes the impact of agricultural employment (EA), consumer price index (CPI), agriculture policies including crop production index (CROP) and arable land (AL), and natural resource rents (NR) on sustainable agricultural development (SDA) in both short and long terms. The results reveal that CROP positively and significantly influences SDA in the short and long run, while CPI and AL also positively affect SDA. Nevertheless, CPI has an insignificant influence in the long run. NR negatively impacts SDA in the short and long run. The study's findings contribute to understanding the role of these factors in promoting sustainable agricultural development in Iraq, suggesting beneficial insights for policymakers and researchers in the environmental and agricultural sectors.

Keywords: Sustainable agricultural development, Consumer price index, agricultural employment, natural resource rents, Iraq

1. Introduction

In response to global climate threats, the international agricultural community emphasized the need for sustainable agricultural developments. Due to the increased demand for production and food, the agro sector globally shifted towards attractive and accessible sources, which raised serious environmental concerns (Stephens et al., 2020). In such context, the agro sectors worldwide are responsible for tackling food insecurity and sustainable observation. Iraq's agriculture sector in this regard is not an exception. The consumer demand in Iraq is increasing annually, provoking the need for more production of food and crops. At this point, the significant potential of sustainable value chain development is noteworthy. Recently, climate change drastically transformed production methods and ways in this region (Shukr, 2023). Adopting different energy alternatives and revising energy consumption plans are clear evidence of the agricultural sector's sustainable development and growth. In the Middle East, the competitiveness in the value chain is pushing Iraq's agricultural sector to align with the national development growth to ensure food security, employment creation, and inclusive growth. It is estimated by the International Trade Centre that agribusiness by 2030 is likely to see growth in the form of additional jobs and employment (Rafique, 2022). Therefore, these sustainable development reforms are a way of hope for the agribusiness of Iraq.

The process of sustainable agricultural development in Iraq is under the impact of various factors, including the availability of resources, governance, employment

opportunities, and agricultural policies. Before planning sustainable development plans, it is necessary to assess the significance of these factors in establishing the proposition for future programs. The researchers in this area investigated sustainability development issues in different contexts. They considered the role of government, policies, infrastructure, resources, and the economic status of the country (Awadh, Al-Mimar, & Yaseen, 2021; Zarei, 2020). Employment in agriculture and resource management is also observed in previous studies (Sulaiman et al., 2019). The primary focus was given to the energy resources, the requirements, and the standards of the current production environment was dealt with critically in the context of countries that are under the influence of geo-political changes (Al-Taiy, Al-Salhi, & Al-Mashadani, 2020; Salman et al., 2020). The current analysis of the agricultural sector in Iraq thus demands a broader perspective on the factors associated with sustainable developments and growth in the respective industry. Moreover, no previous study dealt with these issues collectively in the context of Iraq. This research gap, therefore, needs to be filled by providing an in-depth analysis of the situation.

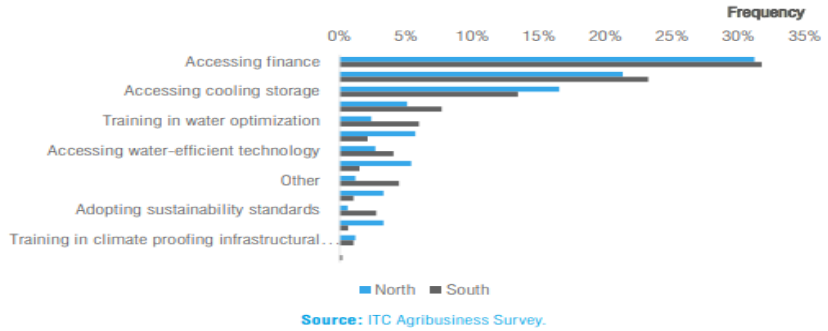

Figure 1. Assistance needed by agrifood SMEs to sustain environmental developments
Source: ICT Agribusiness

The above debate highlighted the significance of conducting a broader research study considering the role of agricultural and non-agricultural factors in determining sustainable development in Iraq's agricultural sector. Thus, the study's primary aim is to examine the current sustainable developments in the agriculture sector of Iraq. The researcher aims to fulfill the following objectives: 1) To study the role of agricultural employment on sustainable agricultural development, 2) To analyze the CPI in association with the sustainable agricultural goals, 3) To study the significance of natural resource rents in sustainable agricultural developments 4) To study the role of agricultural restructure policies on the sustainable agricultural development. The researcher followed a quantitative research method and utilized secondary databases to gather evidence on the respective issues in Iraq. Therefore, the study holds a significant research purpose and will be valuable to contemporary researchers. It also has significant practical implications for environmental and agricultural policymakers. It develops a base for understanding agricultural issues in Iran, which will give constructive future directions to improve sustainable development.

2. Literature Review

2.1. Theoretical Background

The current study aims at investigating the impact of agricultural employment, CPI, natural resources rent and agricultural restructuring policies on sustainable development in agriculture in Iraq. Over the past few decades, sustainable agricultural development has gained immense scholarly attention as it is related to various other critical concerns such as food security, ecological conservation and socio-economic growth (Aliyas, Ismail, & Alhadeedy, 2018). The present study is based on the agricultural transformation theory originally proposed by Ester Boserup. The theory of agricultural transformation is centred around the idea that with the increasing population and subsequently growing demands for food, restructuring the agricultural policies and introducing technological innovation are necessary to boost agricultural productivity. The theory maintains that to meet the global food demand, more farmers should be hired who should adopt modern agricultural strategies (Allen & Ballard, 2001). The present study aims at exploring how natural resource rent, CPI, and agricultural employment impact sustainable agricultural development within the framework of agricultural transformation theory.

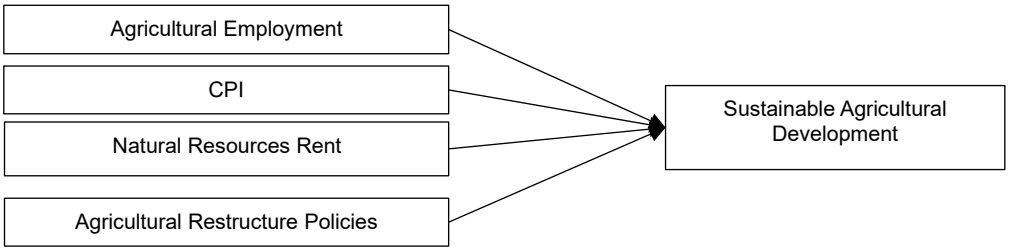

Figure 2.1: Conceptual Framework

2.2. Impact of Agricultural Employment on Sustainable Agricultural Development 334

Agricultural employment can have a significant impact on sustainable agricultural development. A well-managed workforce can enhance agricultural outputs and improve sustainability in this sector. Agricultural employment is a source of livelihood support for people in rural areas. It is a primary factor which decreases poverty and improves lifestyles in rural communities by increasing people's income. Thus, it leads to inclusive agricultural development in rural areas (Harwood, 2020). The agricultural sector has always employed a large portion of the population in Iraq. However, over the decades, agricultural employment has been influenced by political instability and economic crises in the country. Moreover, various international conflicts and lack of access to the latest farming tools have also influenced agricultural employment in Iraq. Agriculture sector in Iraq has the potential to absorb a larger amount of labour than any other industry in the country (Jongerden et al., 2019). Studies have concluded that up to 50% of rural households have their agricultural land. Moreover, almost 7% of households in urban areas of Iraq own their agricultural lands (Beer, 2016). In 2017, 16% of the male population was employed in the agriculture sector which was previously 13% in 2000. On the other hand, the female population in the agriculture sector went from 26% in 2000 to 44% in 2017. However, the agricultural workforce in Iraq mostly consists of the migrant workforce (Jongerden et al., 2019). Alsudani and Al-hiyali (2021) conducted a study to investigate the structure of employment in the agriculture sector of Iraq. The study affirmed that a well-trained workforce is one of the most important factors to achieve agricultural objectives. Agricultural productivity depends on labour productivity. With the advent of agricultural transformation and increasing demands for food, world leaders are introducing strategies to improve workforce productivity and increase agricultural productivity through technological innovations. The study concluded that new policies for effective management of agricultural labour must be implemented which will, in turn, boost agricultural development.

H1: *Agricultural employment has a significant and positive impact on sustainable agricultural development.*

2.3. Impact of Consumer Price Index (CPI) on Sustainable Agricultural Development 369

The Consumer Price Index (CPI) refers to the measurement of the change in prices based on a representative collection of goods and services over a certain amount of time (Topuz, Yazdifar, & Sahadev, 2018). In the agricultural sector, CPI measures the changes that take place in the prices of products and services associated with agriculture. This includes various products like crops, livestock and agro-chemicals and farming tools. CPI reflects the prices of these agricultural products and services which have a direct influence on the farmers, consumers and the agricultural sector (Shrestha, Staab, & Duffield, 2019). CPI in Iraq went from 120.70 points in April to 120.40 points in May 2023 (Economics, 2023). In the context of agriculture, changes in CPI can affect both farmers and consumers. If there is an increase in agricultural productivity due to technological innovations and labour intensification, it can increase food production and subsequently affect the CPI. If the productivity of food surpassed the food demands, it results in a lowering of prices for products, which would be a benefit for the consumers. However, if the food demand increases at a faster rate than food productivity, it would cause an increase in food prices, which would harm food security everywhere. Therefore, sustainable agricultural practices are necessary to maintain food prices and meet food demands (Bai et al., 2021). Moreover, changes in the CPI have a direct influence on the prices of agrochemicals and farming tools. If the prices of agricultural tools increase due to inflation, it affects the production cost as well as the profits of farmers. This can pose a challenge for the farmers in adopting sustainable agricultural practices. Moreover, the primary objective of sustainable development in agriculture is to ensure food security all over the world. However, fluctuations in the prices of food products cause major obstructions in the way to achieving sustainability in the agricultural sector and food security. The CPI has a significant impact on the incomes and lifestyles of the farmers. In times of inflation, farmers find it very difficult to adopt sustainable agriculture practices (Czyżewski, Matuszczak, & Miśkiewicz, 2019). Rising inflation is impeding sustainable agricultural development in Iraq (Salih, 2022).

H2: *The CPI has a significant and negative impact on sustainable agricultural development.*

2.4. Impact of Natural Resource Rent on Sustainable Agricultural Development

Natural resource rent refers to the amount of profit gathered from the use of natural resources such as land, forests and minerals. With the increasing agricultural transformation, the excessive exploitation of natural resources has become a key area of study in the context of sustainable agriculture. One primary goal of sustainable agricultural development is the moderate consumption of natural resources and conservation of ecological resources while improving agricultural productivity to meet global food demands. However, in the conventional models of agriculture, the intensification of agricultural practices has led to over-consumption of natural resources and exploitation of ecological resources. The increasing natural resource consumption is over-burdening the natural environment which can obstruct the achievement of sustainable development in agriculture (Huang, Sadiq, & Chien, 2021). Natural resource rents have played a significant role in improving developing economies (Ibrahim & Ajide, 2021). At the same time, they have raised concerns about the exploitation of natural resources and the subsequent environmental degradation (Ikram et al., 2020). Furthermore, environmental degradation due to Carbon dioxide emission is a major concern in the context of Iraq. Moreover, with the provision of incentives, resource rents

promote more exploitation of the natural environment (Wang, Zhang, & Li, 2023). Studies have shown that natural resource rents promote unsustainable agricultural practices which lead to loss of soil fertility, water contamination and exploitation of the ecosystem (Huang, Sadiq, & Chien, 2021).

H3. *Natural resource rents hurt sustainable agricultural development.*

2.5. Agriculture Restructure Policies and Their Impact on Sustainable Agricultural Development

In the post-war era, the government is Iraq introduced various agricultural restructuring policies. These policies relied on a neoliberal approach which promotes the role of the free market, privatization of the agricultural sector, and minimal state intervention in the agricultural sector. The neoliberal approach focuses on removing any trade barrier in agriculture and allows a free flow of agricultural products at domestic and international levels. Iraq has also introduced free trade policies for the agricultural sector (Jongerden et al., 2019). Past studies have shown that agricultural restructuring policies can have a significant impact on sustainable development in agriculture. Agriculture policies must align with specific goals of sustainable development in agriculture. The policies which promote resource-efficient agricultural practices can increase sustainability in the agriculture sector. Moreover, the introduction of various incentives for the moderate use of natural resources and conservation of the natural environment can help a country in achieving sustainable development in agriculture (Ngoc, Hung, & Pham, 2021). Furthermore, the use of sustainable agricultural technologies should also be introduced in the agricultural policies, it can increase agricultural productivity with minimal exploitation of natural environment and resources. The agriculture sector in Iraq consumes 40% of land and up to 70% of natural resources. Therefore, restructuring agricultural policies is very crucial to achieve sustainable development in agriculture. The government needs to introduce environment-centred agricultural policies which promote minimal use of harmful agrochemicals and diversification of crops to avoid reliance on a single crop. Such practices can enhance agricultural productivity to attain food security and at the same time promote the conservation of natural resources. They cause less harm to the fertility of the soil and promote efficient use of water for irrigation purposes. Moreover, sustainable practices in agriculture will also control desertification of land in Iraq. The 70% of total area in Iraq is covered by desert. Thus, implementation of sustainable agriculture policies can help in conservation of non-renewable resources which can create a natural balance in the consumption of these resources (Aliyas, Ismail, & Alhadeedy, 2018).

H4: *Agricultural restructuring policies have a significant and positive impact on sustainable development in agriculture.*

3. Research Methodology

The present research aims to analyze the role played by agricultural employment, CPI, natural resource rent and agricultural restructuring policies on the sustainable development of agriculture in Iraq. A secondary time-series quantitative research methodology has been selected to meet the research objective. Research methodology is always selected based on the research aims and objectives as the concept of the present research is central towards assessing sustainable development in the agricultural sector of Iraq, so this research design has been selected. The extent of quality and the result's accuracy is highly dependent on the sources from where data is gathered. Therefore, the data regarding the variables involved have been gathered through the world development indicator. According to the website of world development, Indicators ensure access to data along with information regarding the type of indicators available and how they are gathered and can be visualized to assess development trends.

3.1. Variables Description

There are four explanatory variables: agricultural employment, CPI, natural resource rent and agricultural restructuring policies. Sustainable development in agriculture has been estimated as the dependent variable. Data regarding these variables have been collected from WDI within the time duration of 2000-2021.

3.1.1. Consumer Price Index

According to Diewert (1998), the consumer price index is an instrument utilized to measure inflation. It has been used in the present research context to assess the average variation between two periods.

3.1.2. Natural Resource Rent

Natural resource rent is the sum of natural gas rents, oil rents, forest, coal and mineral rents. In the present study, natural resource rents are estimated as the variation between the price of a commodity and the average cost of producing it (Khan et al., 2020).

3.1.3. Agriculture Restructure Policies

Under this agriculture policy, restructure the provision regarding agriculture implements and the latest machinery to the farmers on subsidy. Agricultural employment has been studied as a tillage and soil cultivation factor (Ngoc, Hung, & Pham, 2021). The present research has studied horticultural or agricultural commodities' cultivation, production, harvesting and growing.

3.1.4. Sustainable Development in Agriculture

In the present study, sustainable agricultural development has been studied as the conservation and management of natural resource base and the orientation of institutional and technological change in such a way as to ensure the satisfaction of human needs (Gouda et al., 2018).

3.2 Econometric Model

The researcher has implemented the "autoregressive distributed lag model ARDL" in the present research. According to Bahmani-Oskooee and Ng (2002), ARDL model can be defined as a “parsimonious infinite lag-distributed model”. It is a famous co-integration technique applied widely by researchers.

3.2.1. Linear Regression

The linear regression model is the basic econometric model as it serves as the basis for its required level tests in econometric testing and can be demonstrated through the following equation:

$$Y = \beta X + \varepsilon \quad (1)$$

X&Y represents vectors of observations, ε refers to the "residual vector" that is shown in the model, and β shows the vector that exists between "coefficients of this law and the intercept" (Seber, 2012). β can be observed by using the "ordinary least square method", which minimizes the "sum of squares of the residuals". The equation constructed for the measurement of β using OLS is as follows:

$$\hat{\beta} = (X^T X^1)^{-1} X^1 Y \quad (2)$$

3.2.2 Model Specifications

For estimating the long and short-run associations among variables of a study, the CS-ARDL model is preferred. Through this model, robust estimations can be generated along with efficient regressors compared to other data analysis techniques. CS-ARDL model also deals with the CSD "Cross-sectional dependence" and SH "Slope heterogeneity". This model can be shown through the following equation:

$$\Delta SDA = \vartheta_i + \sum_{I=1}^{p} \vartheta_i I \Delta SDA_{i,t} + \sum_{I=1}^{p} \vartheta_i I \Delta Z_{s,i,t-1} + \sum_{I=1}^{1} \vartheta_i I \Delta \bar{A}C_{i,t-1} + \varepsilon_{i,t}$$

SDA represents the sustainable development of agriculture, which is the dependent variable in this research; AC represents the different cross-sections, and Z represents the control and independent variables.

3.3.3. Unit Root Test

Unit root test is applied to assess the integration level of the variables. The null hypothesis of the unit root test supports that the unit root is present and the data is non-stationary. Conversely, the alternative hypothesis declares the absence of unit root and the presence of stationarity.

$$\Delta y_{i,t} = a_i + \rho y_{i,t} - 1 + \sum_{J=1}^{pi} a_J \Delta y_{i,t-J} + \varepsilon_{i,t}$$

4. Results

4.1 Descriptive Statistics

The normality of the variables is assessed using the Jarque-Bera test. With p-values greater than 0.05, SDA, AL, CROP, EA and NR follow a normal distribution, while CPI does not follow a normal distribution.

Table 1: Descriptive Statistics

	SDA	AL	CPI	CROP	EA	NR
Mean	5.217196	20.28621	10.60322	118.8867	24.03536	47.71791
Median	4.929408	20.41737	4.978962	123.7300	24.15543	46.97211
Maximum	8.562672	21.46924	53.23096	158.2400	27.58526	65.31850
Minimum	2.815818	18.07423	-10.06749	72.50000	20.05735	27.41701
Std. Dev.	1.594552	1.047183	15.42864	25.65365	2.748806	9.863784
Skewness	0.631030	-0.494909	1.338564	-0.488054	-0.075404	0.070909
Kurtosis	2.648281	2.052372	4.082468	2.387715	1.461651	2.717598
Jarque-Bera	1.501938	1.643021	7.296403	1.161718	2.090603	0.087380
Probability	0.471909	0.439767	0.026038	0.559417	0.351586	0.957251
Sum	109.5611	426.0105	222.6676	2496.620	504.7425	1002.076
Sum Sq. Dev.	50.85193	21.93183	4760.860	13162.20	151.1187	1945.885
Observations	21	21	21	21	21	21

"SDA= Sustainable agriculture development, AL= Arable land, CPI= Consumer price index, CROP= crop production index, EA= Employment in agriculture, NR= Natural resource rents"

Secondly, the researcher assessed the stationarity and integration order of the variables, as displayed in the table below. The unit root analysis is carried out with a critical threshold of 5% and a null hypothesis stating the non-stationarity of the variable. The results of the level stationarity test indicate that CPI, CROP and NR variables are stationary. All variables are stationary in the first difference.

Table 2: Unit Root Analysis

	I(0)	I(1)
SDA	-1.652478	-4.264223**
AL	-1.860033	-4.189438**
CPI	-4.022886**	-4.414524**
CROP	-4.930593**	-3.336792*
EA	-1.680206	-3.027451*
NR	-4.375085*	-4.263034**

"SDA= Sustainable agriculture development, AL= Arable land, CPI= Consumer price index, CROP= crop production index, EA= Employment in agriculture, NR= Natural resource rents"

The bounds test is employed to confirm the presence of long-term cointegration relationships. The results of the ARDL Bounds test in Table 3 reveal that the F-statistical value of 19.92 exceeds the upper bounds at critical level thresholds of 1%, 2.5%, 5%, and 10%. As a result, we reject the null hypothesis, indicating the presence of long-term cointegration relations.

Table 3: ARDL Bound Test

Test Statistic	Value	k
F-statistic	19.92684	5
	Critical Value Bounds	
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

The results of ARDL estimation are displayed in Table 6, where it can be seen that the previous value of SDA does not have a significant impact on SDA with a p-value of 0.1370. Employment in agriculture positively influences SDA with a p-value of 0.0002, indicating that the impact is significant at a 1% significance level. CPI was presumed to negatively influence SDA; however, the

results showed that CPI positively and significantly affects SDA with a p-value of 0.0169. Similarly, CROP has a positive impact on SDA. With a p-value below 0.01, the positive association between CROP and SDA is significant. AL positively impacts SDA in Iraq with a β of 0.36. The association between AL and SDA is significant at a 5% significance level. The present study presumed that NR negatively impacts SDA, which is supported by the results in Table 4. NR has a negative and significant influence on SDA, with a p-value of 0.0216. However, lagged value of NR does not significantly impact SDA.

Table 4: ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
SDA(-1)	0.229952	0.144279	1.593800	0.1370
EA	0.578257	0.108259	5.341402	0.0002
CPI	0.028854	0.010407	2.772552	0.0169
CROP	0.021165	0.004150	5.100175	0.0003
AL	0.360410	0.136568	2.639054	0.0216
NR	-0.100507	0.018823	-5.339678	0.0002
NR(-1)	-0.024849	0.018577	-1.337654	0.2058
C	-13.91874	4.105627	-3.390162	0.0054
R-squared	0.953024	Mean dependent var		5.246318
Adjusted R-squared	0.925622	S.D. dependent var		1.630236
S.E. of regression	0.444605	Akaike info criterion		1.505912
Sum squared resid	2.372080	Schwarz criterion		1.904205
Log likelihood	-7.059121	Hannan-Quinn criter.		1.583663
F-statistic	34.77861	Durbin-Watson stat		1.780115
Prob(F-statistic)	0.000000			

*Note: p-values and any subsequent tests do not account for model selection.

"SDA= Sustainable agriculture development, AL= Arable land, CPI= Consumer price index, CROP= crop production index, EA= Employment in agriculture, NR= Natural resource rents"

Concerning long-term association, it can be noted that all the explanatory variables have the same signs of coefficients. NR negatively and significantly influences SDA in the long run, with a p-value of 0.012. Similarly, CROP has a significant influence on SDA. Nevertheless, AL and EA do not significantly impact SDA in the long run, as the p-value exceeded 0.05.

Table 5: Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AL	0.251082	0.398410	0.630211	0.5930
CPI	0.074542	0.036337	2.051402	0.1767
CROP	0.043430	0.004230	10.267103	0.0094
EA	0.496025	0.208102	2.383571	0.1400
NR	-0.179257	0.019945	-8.987498	0.0122
C	-8.533900	12.908543	-0.661105	0.5765

"AL= Arable land, CPI= Consumer price index, CROP= crop production index, EA= Employment in agriculture, NR= Natural resource rents"

Table 6 depicts the short-term results. AL's present value positively influences SDA; however, the impact is insignificant, with a p-value of 0.32. At t-1, AL negatively influences SDA; the association is insignificant, similar to the previous result. CPI positively and significantly impacts SDA, whereas the lagged value of CPI negatively and insignificantly influences SDA. With a p-value of 0.0067, CROP significantly and positively impacts SDA in the short run. Similar to the long-run association, EA does not significantly influence SDA in the short run while NR negatively and significantly influences SDA.

Table 6: Cointegration Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AL)	0.320000	0.246784	1.296680	0.3242
D(AL(-1))	-0.433725	0.188921	-2.295803	0.1486
D(CPI)	0.045866	0.010412	4.405216	0.0479
D(CPI(-1))	-0.018078	0.016452	-1.098842	0.3864
D(CROP)	0.027268	0.002238	12.182726	0.0067
D(CROP(-1))	-0.011897	0.009138	-1.301907	0.3227
D(EA)	0.838716	0.519501	1.614466	0.2478
D(EA(-1))	0.747166	0.157976	4.729628	0.0419
D(NR)	-0.107651	0.016305	-6.602361	0.0222
D(NR(-1))	0.044638	0.019408	2.299960	0.1482
CointEq(-1)	-0.909289	0.195323	-4.655319	0.0432

"AL= Arable land, CPI= Consumer price index, CROP= crop production index, EA= Employment in agriculture, NR= Natural resource rents"

Figure 2 illustrates the distribution of the residuals. Firstly, the histogram appears to have a bell-shaped curve; the small JB value of 0.230 and probability of 0.887 indicate that the error terms are normally distributed.

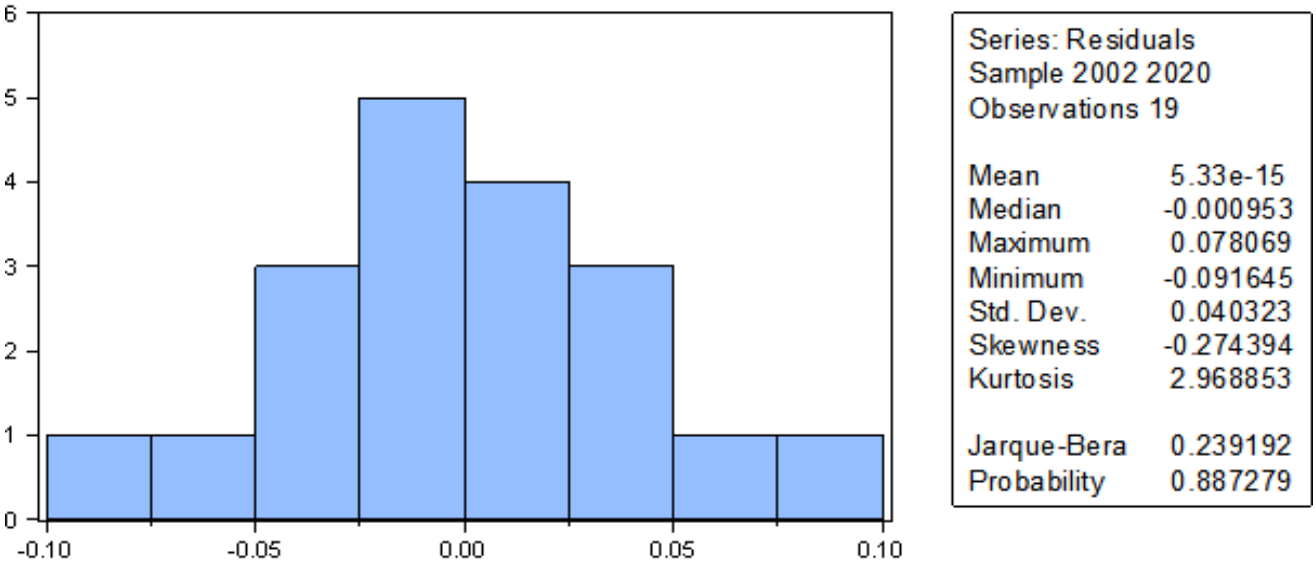

Figure 2: Regression Standardization Residuals

Autocorrelation is tested using the LM test, as shown in Table 7. The results showed that the null hypothesis is rejected at the significant level of 5%, indicating that autocorrelation is not present among residuals.

Table 7: Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.904017	Prob. F(1,1)	0.3992
Obs*R-squared	12.45734	Prob. Chi-Square(1)	0.0004

The p-values are higher than the significance level of 0.05 in Table 8. As a result, we do not reject the null hypothesis and can infer that residuals are homoscedastic.

Table 8: Heteroskedasticity Test

F-statistic	3.241182	Prob. F(1,16)	0.0907
Obs*R-squared	3.032105	Prob. Chi-Square(1)	0.0816

Considering the structural changes in the economy of Iraq, it is probable that the macroeconomic series might experience one or multiple structural breaks. The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests are employed to assess the stability of both short-run and long-run coefficients. Figures 3 and 4 depict the test statistics, falling within the critical bounds of 5% significance. This suggests that the estimated parameters remain stable over the period indicated.

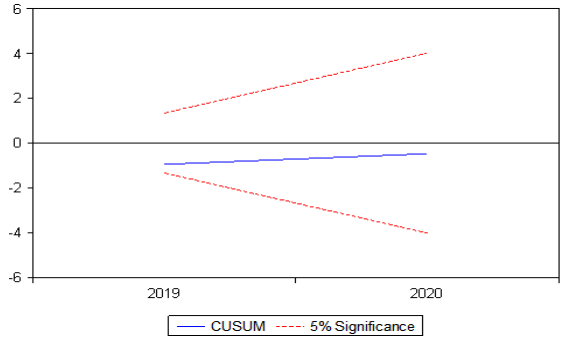

Figure 3: Plot of CUSUM

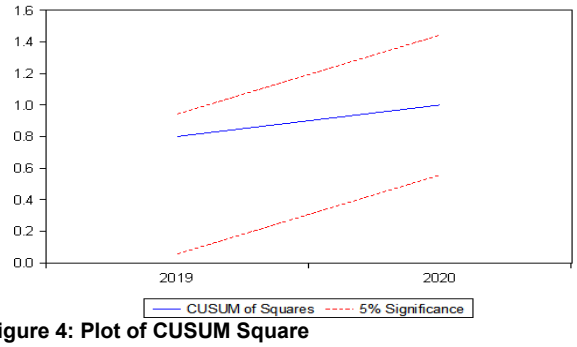

Figure 4: Plot of CUSUM Square

5. Discussion

In the contemporary era, validated experts have reported a significant increase in demand for agricultural products which is predicted to increase in 2050 by 70% (Kumawat, Razdan, & Saharan, 2022). The significant growth in human population and increasing depletion of non-renewable energy sources tend to enhance agricultural production in a sustainable manner. In this accordance, sustainable agricultural development caught the attention of many experts and researchers. Grounding on the gap from previous studies, this paper tends to explore sustainable agricultural development within the context of Iraq. Accordingly, the impact of employment in agriculture (EA), consumer price index (CPI), crop production index (CROP), arable land (AL), and natural resources (NA) has been examined on sustainable agricultural development (SDA). The section of the literature review assists the formulation of associations among the selected variables, and overviewing these associations, four hypotheses were formulated, which are comprehensively discussed below. As per the results of the study, the impact of selected variables on SDA has been examined in short and long runs.

The first association formulated by this study indicates that EA exerts a positive and significant impact on SDA. As per the results of the study, EA positively impacts SDA, but its impact is not significant in the shorter and longer run. It implies that with the efficiency of employment in agriculture, sustainable agricultural practices have not significantly increased. Indicating an insignificant impact, the respected hypothesis of the study has been rejected. In contrast to it, the studies of Edeme et al. (2020) in existing literature indicate that agricultural productivity is significantly associated with employment in agriculture however, this impact is dependent on the infrastructure that supports agricultural practices. The contrast in results indicates the error of data in this study.

The second association of the study indicates that CPI is positively and significantly associated with SDA. As per the results of the study, the positive impact of CPI has been indicated, but in the longer run, this impact is insignificant. The achieved results demonstrate that with an efficient consumer price index, sustainable agricultural development can be enhanced, but this impact becomes insignificant in the longer run. The studies of Mahmoud (2015) support this result as it highlights that CPI is significantly linked with the GDP of the country. Following the link, the respective researcher believes that an increase in CDI can be used to address the issues of weak agriculture. This, in turn, can potentially enhance sustainable agricultural development. The next association of this study highlights that CROP is positively and significantly associated with SDA. The results of the study indicate that CROP significantly and positively impacts SDA in both the shorter and longer run. The respected hypothesis thus has been accepted. It implies that an increase in the index of crop production can remarkably pave the path of sustainable agricultural development. However, this outcome is not supported by previous studies as Omodero (2021) highlights that the food production index is positively linked with poverty reduction (a significant dimension of SDA) however, the agricultural output index is negatively associated with a reduction in poverty. The negative impact on the reduction of poverty indicates a negative impact on SDA. Likewise, Sarkodie and Owusu (2017) also highlight that a 1% increase in crop production indicates 0.52% carbon emission. As per the results, carbon emission is negatively associated with SDA as sustainable practices

do not allow carbon emission. Accordingly, the difference in results of this study from previous studies indicates mismanagement of relevant data.

The further association of this study indicates that AL is positively and significantly associated with SDA. As per the results of the study, AL positively impacts SDA in the short run, while this impact is not significant in the long run. This implies that AL can potentially enhance SDA however, this impact is no longer. The studies of Naderi and Danesh-Shahraki (2013) have yielded similar results as it indicates that limitation in AL adversely impacts agricultural development, which highlights that the efficiency in AL is positively linked with SDA. Tian et al. (2021) also highlight the shortage of AL threatened sustainable agricultural practices, which indicates the positive association of AL with SDA. Subsequently, this outcome of the study is validated.

Moreover, this study has highlighted that NR is positively and significantly associated with SDA. However, as per the results, a negative association of NR has been indicated with SDA. The outcomes are validated as Chopra et al. (2022) also indicate a negative association between NR and agricultural productivity. However, Pant and Hambly-Odame (2009) state that the approach to NR and SDA is a significant conceptual tool. The author further suggests innovation in NR to increase its impact on SDA.

5.1 Conclusion

The aim of this study is to examine sustainable agricultural development in Iraq by exploring the impact of significant factors. In this accordance, the impact of EA, CPI, CROP, AL, and NR on SDA has been evaluated. The data has been collected using the medium of secondary data collection thus, reputable resources like research articles from respective journals, data from the World Bank Database, from the official website of the agricultural sector, and from econometric tests were utilized. Based on analysis by ARDL, the following results have been generated:

- EA positively impacts SDA in the shorter and longer run however, this impact is insignificant.
- CPI positively impacts SDA however, this impact is insignificant in the longer run.
- CROP positively and significantly impacts SDA in both the longer and shorter run.
- AL positively impacts SDA in the shorter run, while in the longer run, this impact is insignificant.
- NR negatively impacts SDA in the longer and shorter run.

5.2 Theoretical and Practical Implications

This study has remarkable implications as, on the theoretical level, this paper expands the literature related to SDA. Following the increased importance of SDA in present times, further exploration of it has been done by examining the numerous variables. In this accordance, the perspective related to SDA had further developed on theoretical grounds. Moreover, on the basis of the gaps in existing literature, this study offers significant outcomes for scholars and experts.

The contribution of this study is also remarkable on practical grounds, as by indicating the impact of selected variables, the outcome of this study indicates which variables are significantly associated with SDA. On the basis of these outcomes, sustainable practices have been enhanced by practitioners in the agricultural sector. Furthermore, these outcomes have significant implications for policy-makers as it assists them in drawing policies for SDA while considering the significant factors outlined by this study.

5.3 Limitations and future research indications

Despite its significant contribution to existing literature, this study has some limitations that can pave the path for future researchers.

- At first, this study observe a contextual limitation as data has been collected only within the context of the agricultural sector in Iraq. Future studies can collect data from multiple other locations to increase the generalizability of the outcomes.
- At second, this study follows the secondary form of data collection, which restricts the reliable outcomes of this study. Future studies can conduct primary data collection from practitioners, managers, and employees working in the agricultural sector to view their perspectives related to the determinants of SDA.
- At third, this study was limited to its determinants as the contemporary innovative practices related to SDA have not been examined. To efficiently expand the topic, future studies can examine the impact of other factors like innovativeness, smart technology, AI, and machine learning on SDA.

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