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An Econometric Analysis of the Factors Affecting Sustainable Agricultural Development in Iraq for the period (1990-2020)

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Abstract

Agricultural investments, agricultural capital accumulations and average per capita agricultural product are considered as important factors in raising levels of sustainable agricultural development, and it is important to quantify the relationship among these factors. The study aimed to measure the impact of some factors affecting sustainable agricultural development in Iraq. The variables used in this study are agricultural investment, accumulated agricultural capital and the average per capita agricultural product as independent variables, while sustainable agricultural development represents the dependent variable. The data for these variables are the time series covered the period from 1990 to 2020 obtained from Ministry of Planning - Central Statistical Organization (COS), Statistical Group for the years (1990-2020). The Johansen's cointegration method was used to estimate the long-run equilibrium relationship among the study variables, and the Toda-Yamamato methodology was used to test the causality. The results showed the weak levels of sustainable agricultural development in Iraq during the period (1990-2020), as it did not exceed (0.160), and the reason for this may be due to the failure of most development indicators to keep pace with the increase in population as well as the unstable political and security conditions that faced Iraq during this period. Also, there is a long-run equilibrium relationship among these variables, as an average per capita agricultural product can causes the sustainable agricultural in the long-run, which requires the Ministry of Agricultural to promote the agricultural sector and pay more attention to the agricultural product, which seems to be one of the sources of sustainable agricultural development in the long-run. The research also recommends encouraging agricultural investments and overcoming obstacles towards targeted investments to promote the agricultural sector, especially investment in agricultural land reclamation, encouraging agricultural workers to maintain their work.

Key words: Johansen’s co-integration, Toda-Yamamoto causality, sustainable agricultural development, agricultural investment, agricultural capital accumulation, average per capita agricultural product.

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Introduction

The agricultural sector is one of the most important economic sectors that constitute the economic structure of most countries of the world, whether developed or developing, as the importance of this sector for developed countries is shown through the prominent role it played in advancing the economies of these countries, as the agricultural sector contributed to financing the process of economic development in general and industrial development in particular in most of these countries. As for developing countries, the agricultural sector has a distinctive and important role in the fields of production and employment in most of these countries, in addition to the fact that these countries suffer from the increasing gap between the rates of demand for food and its production equations as a result of the high rates of population growth and the increase in purchasing power in the face of the demand for food, which forced them to resort to importing in large quantities, hence the concentration of efforts in this sector and its development has become a must, and in Iraq there was and still is an urgent need for the role of the state In the development of this vital sector in proportion to its economic importance for the individual and the process of economic development, as Iraq has most of the elements of agricultural production of arable land and water from the Tigris and Euphrates rivers, labor, experts in the field of agriculture and capital, but it suffers from the problem of production failing to meet the population's need for food.

The problem of the research is that there are low indicators of sustainable agricultural development in Iraq during the period (1990-2020), despite the availability of the elements of this development, including agricultural lands with large areas, labor force, financial resources, financial allocations, and others. One of the objectives of the research is to identify the most important factors affecting sustainable agricultural development and measure the impact of these factors. The research is based on the main hypothesis that sustainable agricultural development in Iraq is positively affected by the increase in agricultural investments, agricultural capital accumulations and average per capita agricultural product, and that this effect is based on a long-run equilibrium relationship.

The importance of this research and the reason for choosing this topic comes from the scarcity of research and studies that dealt with statistical and econometric modeling of the factors influencing sustainable agricultural development in Iraq, as there was only one study conducted in Iraq in (2022) to measure sustainable agricultural development during the period (2000-2017), as it used the descriptive and quantitative methods in analyzing agricultural investments, agricultural labor, the cultivated area, and agricultural exports and their impact on sustainable agricultural development in Iraq. The results indicated, using the autoregressive distributed lag (ARDL) methodology, that there is a long-run co-integration relationship between the variables. Agricultural exports had an impact on sustainable agricultural development, while area and employment had no significant impact [1].

Materials and Methods

1. Concept of Sustainable Development

Sustainable development is also defined as a set of standards and areas that meet the needs of society at the present and future using available resources and using them to achieve development in the fields (economic, social and environmental [3]. The concept of sustainable development is at the heart of current concerns and is of interest to a large number of researchers as well as practitioners and government authorities. From the point of view that it is not just a fad but contrary to what is believed it seems possible to put contemporary discussions in expanding the body of ideas that have developed since the period of declining economic growth in industrialized countries, and the concept of sustainable development became famous and established after its publication in the Brundtland Report by the World Commission on Environment and

Development (WCED). Since then, sustainable development has been defined, in its broadest sense, as development that can meet the needs of present generations without threatening the ability of future generations to Meet their own needs [4]. In its 1981 report, the World Conservation Union defined sustainable development "as the constant pursuit of the development of the quality of human life, taking into account the capabilities and potential of the ecosystem that embraces life, in the sense of expanding the choices available to all people in society, and that makes the central goal of development to create an enabling environment, in which everyone can enjoy long, healthy and creative lives" [5]. Sustainable development includes the rapid transformation of the technological base of industrial civilization, where there must be technology capable of saving natural resources, so as to reduce pollution, help stabilize the climate, and accommodate growth in population and economic activity.

2.Concept of Sustainable Agricultural Development

Agricultural development is defined as the process of creating appropriate conditions to meet agricultural requirements, and providing the necessary agricultural capabilities such as the accumulation of knowledge and technology, as well as the distribution of agricultural inputs and outputs [6]. Sustainable agricultural development is also defined by the Food and Agriculture Organization of the United Nations (FAO) as the management and maintenance of the basic natural resource base so that institutions and technologies include human requirements on an ongoing basis for present and future generations [7]. There are other definitions of sustainable agricultural development, which indicate that [8]:

- That development that guarantees the preservation and use of natural resources in the most efficient way possible.
- That development that is economically feasible to ensure reasonable incomes commensurate with agricultural investments.

That development that is environmentally sound in the sense that it preserves the natural environment and does not cause any damage to it.

From all these concepts, it is clear to us that sustainable agricultural development must meet food needs, provide decent job opportunities for current and future generations, or maintain productive capacities and renew the natural resource base whenever possible. The Arab strategy for sustainable agricultural development showed the most important main directions for sustainable agricultural development, including [9]:

1. Paying attention to water as the main determinant of sustainable agricultural development, through improving the efficiency of irrigation water use, developing techniques for using and managing water resources, and water awareness by spreading the culture of rationalizing water use in agriculture.
2. Developing and protecting agricultural lands, horizontal expansion of appropriate agricultural environments and preserving the agricultural environment, coordinating legislation related to limiting urban sprawl and non-agricultural uses, then developing and technical modernization of agriculture by supporting the capabilities of farmers, especially small farmers, to adopt modern technologies, and coordinating efforts to encourage innovation Creativity in the areas of developing priority agricultural technologies, preserving individual property rights, and supporting and developing agricultural research systems.
3. Building professional capacities and developing human resources by paying attention to building the necessary agricultural frameworks and staff to advance the paths of sustainable agricultural development at various levels, upgrading the level of university vocational agricultural education and rehabilitation programs, and verifying the dynamics and appropriateness of education outputs in accordance with the

needs of sustainable agricultural development.

4. Providing an appropriate and stable investment climate for the agricultural sector, and attracting the interest of the private sector to agricultural development activities by preparing a map for promising agricultural investments, implementing promotion programs for the purpose of investment, and providing assistance in preparing these opportunities economically and technically.

3.Goals of Sustainable Agricultural Development

The goals of sustainable agricultural development can be summarized as follows [10]:

1. Securing citizens' food needs.
2. Increasing the contribution of the agricultural sector to the formation of the gross domestic product.
3. Increasing the contribution of the agricultural sector to raising the income level of the population.
4. Securing the requirements of light manufacturing industries.
5. Agricultural development provides a suitable environment for life.

4. Model Specification

In the research model, sustainable agricultural development is a function of both foreign investment and agricultural capital accumulation.

$$Y_t = f(X_{1t}, X_{2t}, X_{3t}) + \varepsilon_t ; \quad t = 1,2,\dots,31 \dots (1)$$

where

Y : Sustainable Agricultural Development (million dinars per capita)

X_1 : agricultural investment (million dinars)

X_2 : agricultural capital accumulation (million dinars)

X_3 : average per capita agricultural product (dinars)

ε : Error term in the model, or what is known as the random variable, that includes all other unmeasured variables and those that are not included in the model (1) and that are believed to affect sustainable agricultural development such as political stability to the country and security stability and others.

5. Johansen's Cointegration Methodology

Granger defines cointegration as that non-stationary processes can contain a stationary linear combination. Granger's cointegration methodology is used to verify the long-run relationship between economic variables. The concept of cointegration is used to describe the long-run relationship between variables. The cointegration technique is used to verify the relationship between time series variables has become very popular since its introduction in the 1990s. The Johansen cointegration test, named after Soren Johansen, is a method of testing the cointegration of a number of time series variables. The most preferred case is when all variables are integrated in the same order. However, it is necessary to emphasize here that this is not always the case, and that even in cases where there is a combination of variables I (0), I (1), and I (2) in the model, cointegration relationships may exist well [11].

Despite the multiplicity of cointegration tests, the Johansen test is superior to it, as it is characterized by its suitability for small-sized samples, and it can be applied in the case of more than two variables in the model, provided that all variables are integrated by the first difference. In order to determine the number of co-integration vectors, this method relied on two tests:

1) **Trace Test:** the null hypothesis states that the number of cointegration vectors is less than or equal to (p), against the alternative hypothesis that the number of cointegration vectors is equal to (r). The test is calculated from the following formula:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{p} Ln\left(1 - \hat{\lambda}_i\right) \dots\dots\dots \quad (2)$$

Where

(T) is the sample size, (r) is the number of cointegration vectors, and $\hat{\lambda}_{r+1}, \dots, \hat{\lambda}_p$ are the (p-r) smallest values of eigenvectors.

2) Max-Eigen Value Test: whose formula is calculated according to the following formula:

$$\lambda_{max}(r, r+1) = -TLn(1 - \hat{\lambda}_{r+1}) \ \dots\dots \ (3)$$

The null hypothesis states that there are (r) of cointegration vectors, is being tested against the alternative hypothesis that there are (r+1) cointegration vectors. If the calculated value of the Likelihood Ratio (LR) is greater than the critical value at a certain significant level, then the null hypothesis is rejected [12].

6. Toda -Yamamoto Causality Test

The analysis of the causal relationship between the model variables is an experimental approach that helps to test the economic relationship between the variables, and that the discovery of the existence of common integration relationships between a group of variables means the existence of causal relationships between these variables either unidirectional or bidirectional. If the values of one variables in a past period affect the values of other variable in the current period, it is said that the first variable causes the second variable, and vice versa [13].

The Granger causality test is a way to examine whether one variable helps predict the other. Granger's traditional causality testing methods should ensure the stationarity of time series data at the level. However, the effectiveness of Granger's causality test is poor if the process of integrating time series is different or unclear. To solve this problem, the Toda-Yamamoto (T-Y) methodology is used, where this test requires the estimation of the autoregressive vector (VAR) of order ($k+d_{max}$) where k represents the optimal lag, and d_{max} is the order of the maximum difference obtained from the unit root test [14].

Based on the research variables, the (T-Y) test depends on the estimation the following equations:

- Sustainable Agricultural Development (Y) formula:

$$Y_t = \alpha_1 + \left(\sum_{j=1}^{k} \beta_{1,j} Y_{t-j} + \sum_{j=k+1}^{d_{max}} \beta_{2,j} Y_{t-j}\right) + \left(\sum_{j=1}^{k} \lambda_{1,j} X_{1,t-j} + \sum_{j=k+1}^{d_{max}} \lambda_{2,j} X_{1,t-j}\right) + \left(\sum_{j=1}^{k} \theta_{1,j} X_{2,t-j} + \sum_{j=k+1}^{d_{max}} \theta_{2,j} X_{2,t-j}\right) + \left(\sum_{j=1}^{k} \delta_{1,j} X_{3,t-j} + \sum_{j=k+1}^{d_{max}} \delta_{2,j} X_{3,t-j}\right) + u_t \qquad (4)$$

- Agricultural Investment (X_1) formula:

$$X_{1,t} = \alpha_2 + \left(\sum_{j=1}^{k} \beta_{1,j} X_{1,t-j} + \sum_{j=k+1}^{d_{max}} \beta_{2,j} X_{1,t-j}\right) + \left(\sum_{j=1}^{k} \lambda_{1,j} Y_{t-j} + \sum_{j=k+1}^{d_{max}} \lambda_{2,j} Y_{t-j}\right) + \left(\sum_{j=1}^{k} \theta_{1,j} X_{2,t-j} + \sum_{j=k+1}^{d_{max}} \theta_{2,j} X_{2,t-j}\right) + \left(\sum_{j=1}^{k} \delta_{1,j} X_{3,t-j} + \sum_{j=k+1}^{d_{max}} \delta_{2,j} X_{3,t-j}\right) + v_t \qquad (5)$$

- Agricultural Capital Accumulation (X_2) formula:

$$X_{2,t} = \alpha_3 + \left(\sum_{j=1}^{k} \beta_{1,j} X_{2,t-j} + \sum_{j=k+1}^{d_{max}} \beta_{2,j} X_{2,t-j}\right) + \left(\sum_{j=1}^{k} \lambda_{1,j} Y_{t-j} + \sum_{j=k+1}^{d_{max}} \lambda_{2,j} Y_{t-j}\right) + \left(\sum_{j=1}^{k} \theta_{1,j} X_{1,t-j} + \sum_{j=k+1}^{d_{max}} \theta_{2,j} X_{1,t-j}\right) + \left(\sum_{j=1}^{k} \delta_{1,j} X_{3,t-j} + \sum_{j=k+1}^{d_{max}} \delta_{2,j} X_{3,t-j}\right) + w_t \qquad (6)$$

- Average per capita agricultural product (X_3) formula:

$$X_{3,t} = \alpha_3 + \left(\sum_{j=1}^{k} \beta_{1,j} X_{3,t-j} + \sum_{j=k+1}^{d_{max}} \beta_{2,j} X_{3,t-j}\right) + \left(\sum_{j=1}^{k} \lambda_{1,j} Y_{t-j} + \sum_{j=k+1}^{d_{max}} \lambda_{2,j} Y_{t-j}\right) + \left(\sum_{j=1}^{k} \theta_{1,j} X_{1,t-j} + \sum_{j=k+1}^{d_{max}} \theta_{2,j} X_{1,t-j}\right) + \left(\sum_{j=1}^{k} \delta_{1,j} X_{2,t-j} + \sum_{j=k+1}^{d_{max}} \delta_{2,j} X_{2,t-j}\right) + z_t \quad (7)$$

Results and Discussion

Data for this research was obtained through the Ministry of Planning - Central Statistical Organization (COS), Statistical Group for the years (1990-2020) covered sustainable agricultural development, agricultural investment, agricultural capital accumulation and average per capita agricultural product through Johansen's co-integration methodology and causality analysis [15].

1. Description of Study Variables

Table (1) presents the most important descriptive statistics for sustainable agricultural development (Y), agricultural investment (**X_1**), agricultural capital accumulation (**X_2**) and average per capita agricultural product (**X_3**).

Table 1. Descriptive statistics of study variables

	Y	**X_1**	**X_2**	**X_3**
Mean	0.159783	4,263	195.4419	177,251
Maximum	0.380294	9,627	776.0000	380,294
Minimum	0.000258	116	10.80000	69,272
Std. Dev.	0.110235	3,546	185.5561	89,345
Growth Rate (average)	48.2%	39.5%	56.7%	5.92%
Observations	31	31	31	31

- **Sustainable Agricultural Development (Y):**

Figure (1) shows that sustainable agricultural development in Iraq has been clearly increasing throughout the study period (1990-2020) with an increasing trend and an average annual growth rate of (48.2%). From table (1), we find that the minimum value of sustainable agricultural development was in (1990) as it did not exceed (258) dinars per capita, while its maximum value reached in (2013) to (380,294) dinars per capita. The average sustainable agricultural development throughout the study period was approximately (159.783) dinars per capita. The large standard deviation of (110.235) dinars per capita indicates the large variation or fluctuations in the values of sustainable agricultural development throughout the study period.

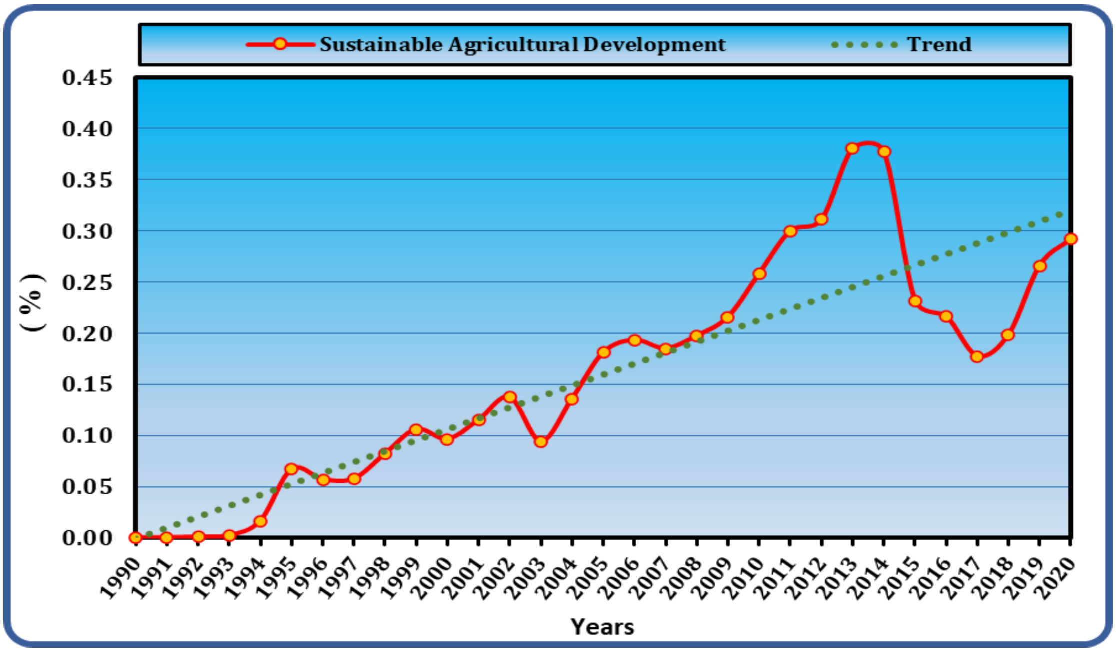

Figure 1. Sustainable agricultural development curve of Iraq during (1990-2020)

- **Agricultural Investment (X_1):**

The concept of investment or (capital formation) represents a prominent position in the ancient and contemporary economic thought for its role in the process of economic development, and investment represents one of the basic activities that are entrusted to the movement of the national economy of any society, and around these activities the economic life revolves, either it grows and thrives, or it shrinks It shrinks according to the changes that occur in these activities due to the interdependence and overlap between them [16]. Figure (2) displays the time series of agricultural investment data in Iraq during (1990-2020).

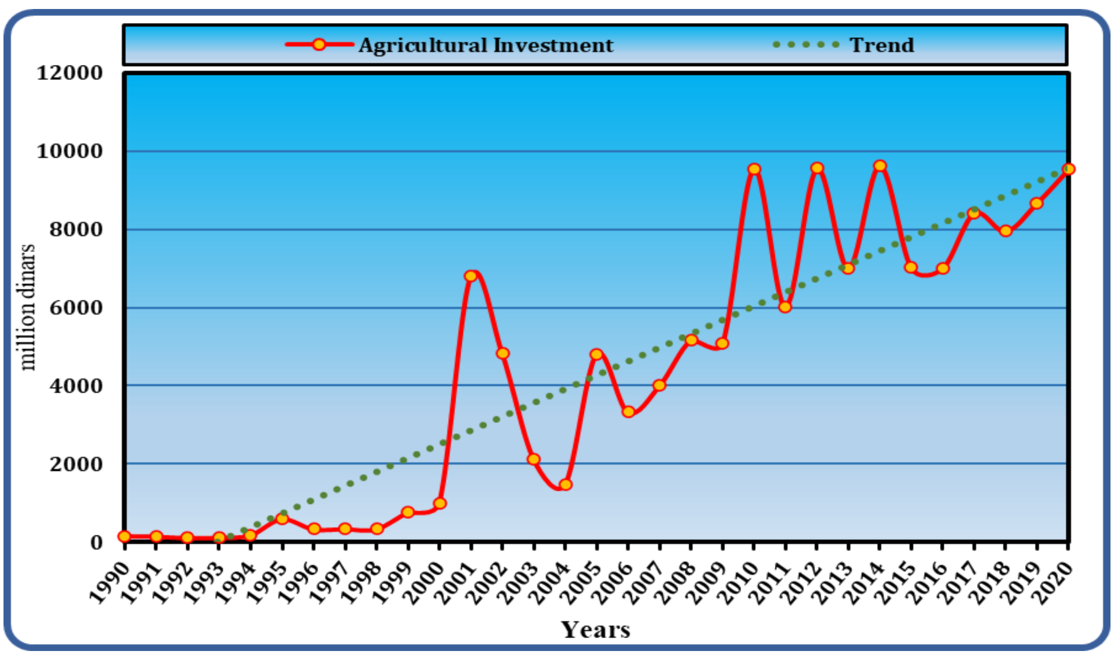

Figure 2. Agricultural investment curve of Iraq during (1990-2020)

Figure (2) shows that the agricultural investment in Iraq was increasing throughout the period of the study, but in a fluctuating manner, as it began to gradually increase from the year (1990) until the year (2000), then it increased significantly in the year (2001) to reach (6,791) million dinars, then it decreased again in the following years. Thus, we find that agricultural investment is unstable throughout the study period, despite the clear increase in its volume. The year (1992) witnessed the lowest value of agricultural investments, as it did not exceed (116) million dinars, while the year (2014) recorded the highest value in agricultural investments (9,627) million dinars. The average agricultural investments throughout the study period is approximately (4,263.13) million dinars. The large standard deviation value of (3,546.474) million dinars indicates the large variation or fluctuations in the values of agricultural investments throughout the study period as a result of the unstable security and political conditions of the country during this period. Despite all of the foregoing, agricultural investments witnessed an average annual growth rate of (39.5%). However, this is not commensurate with the state's capabilities and the availability of ingredients for the development of this sector.

- **Agricultural Capital Accumulation (X_2):**

Formation of fixed capital is that part of the productive capacity in the national economy, such as machinery, transportation means, buildings and constructions of all kinds. The formation of fixed capital is one of the basic indicators of the growth and development of any economic sector because of its connection to the productive capacity and the development process in general. There is no doubt that the structure and nature of investment greatly affects labor productivity, production costs, and the productive flexibility of the national economy. It can be said that the growth of investment in the socialist and private sectors is highly related to the nature of the political and economic conditions prevailing in any country, so we find that the material base of economic development often finds its expression in the size of fixed capital and the amount of its annual growth. Fixed capital estimates represent exceptional importance in the national economy of any country, as the availability of such statistics is a binding necessity in developing and formulating various economic plans in their correct and objective form [16].

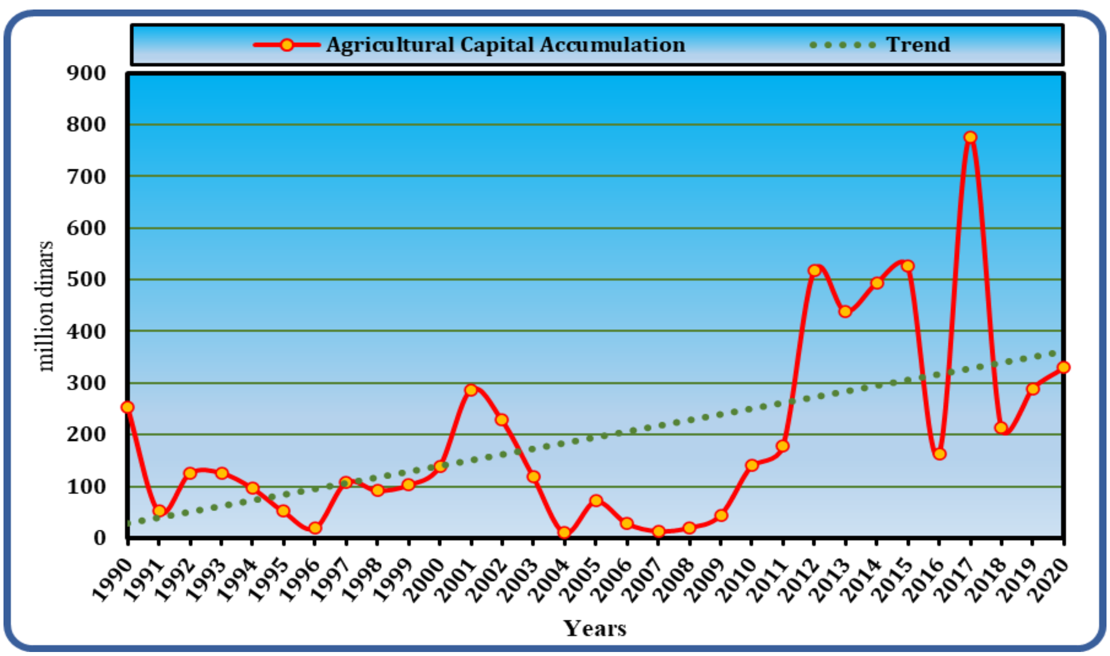

Figure 3. Agricultural capital accumulation curve of Iraq during (1990-2020)

Figure (3) shows that the agricultural capital accumulation in Iraq was fluctuating throughout the period (1990-2020), with a general increasing time trend and an average annual growth rate of (56.7%). The lowest value of agricultural capital accumulation in (2004) was approximately (10.8) million dinars, while the value of accumulated agricultural capital reached its maximum value in (2017) when it amounted to (776) million dinars. The average accumulation of agricultural capital reached during the study period (195.442) million dinars, and this figure is considered very low for a country with the capabilities of Iraq and the availability of the elements of agriculture in it. The need for the agricultural sector to have huge capital, and therefore the need for the state to allocate investments to the agricultural sector, and to provide financial support to the private sector in order to stimulate private activity.

- **Average per capita agricultural product (X_3):**

Figure (4) displays the time series of average per capita agricultural product in Iraq during (1990-2020). It is clear from the figure that the average per capita share of agricultural product was increasing until the year (2003), when the highest value of per capita share in (2013) reached to (380,294) dinars. Due to the bad security conditions that Iraq witnessed in the year (2014) and thereafter, the agricultural product decreased significantly until the year (2018), which is a result of the rise in the real values of agricultural product with the increase in the population size [17]. The average per capita share of agricultural product in Iraq during the study period was (177,251) dinars, with a standard deviation of (89,345) dinars, indicating the presence of clear fluctuations in the indicator. The average annual growth rate of the indicator was (5.92%), indicating slow growth during the study period.

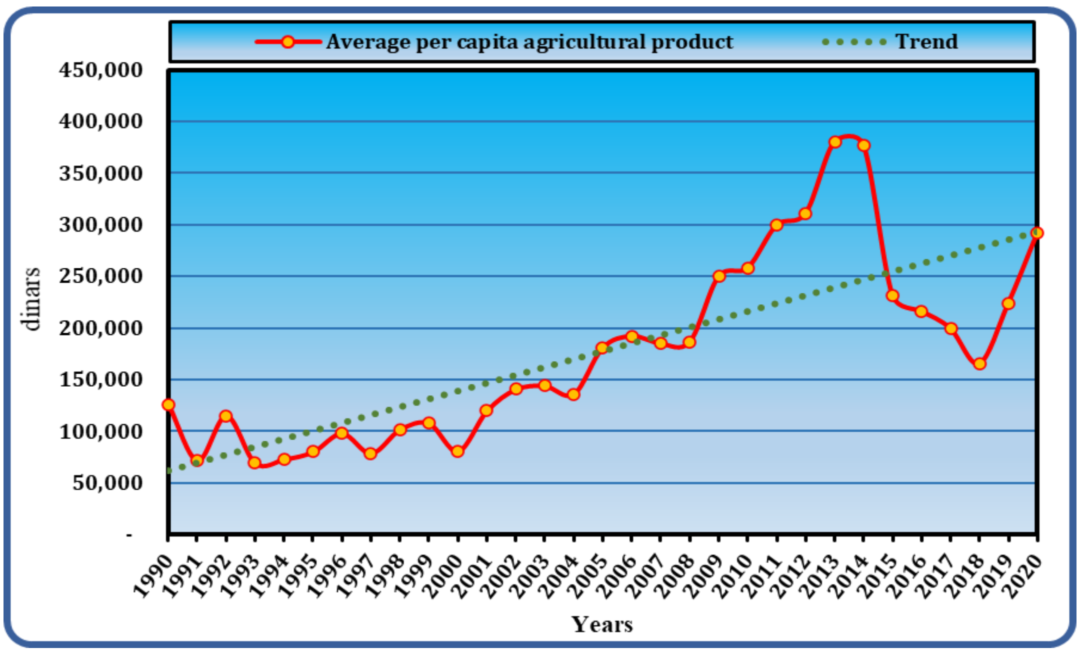

Figure 4. Average per capita agricultural product curve of Iraq during (1990-2020)

2. Stationarity Test

The double logarithmic transformation function (Log-Log) was used by taking the natural log transformation of the dependent and independent variables for several reasons, including that it is the best function that reflects the effect of the independent variables on the dependent variable compared to other types of functions (Linear, Linear-Log, Log-Linear). Also, through the application of the four types of functions, as well as to ensure that the distribution of sustainable agricultural development data is approximated to a normal distribution, and to avoid the problem of residuals variance heterogeneity of the estimated model, as well as the possibility of achieving stationarity in time series to ensure the conditions for using (ARDL) models. Therefore, in the model's estimation, the coefficients of the independent variables (slopes) will be interpreted as elasticities.

Table 2 presents the results of the unit root test or the stationarity of the study variables for Iraq during the period (1990-2020) using Augmented Dickey-Fuller (ADF) test.

Table 2. The results of the unit root test (ADF) for the study variables

	At Level		At first Difference	
	Intercept	Inter. & Trend	Intercept	Inter. & Trend
Log(Y)	-4.9331*** (0.000)	-3.0089$^{n.s}$ (0.146)	-2.9297* (0.054)	-3.7218** (0.037)
$Log(X_1)$	-1.40620$^{n.s}$ (0.566)	-2.3140$^{n.s}$ (0.414)	-6.2972*** (0.000)	-6.2969*** (0.000)
$Log(X_2)$	-2.5566$^{n.s}$ (0.113)	-2.1390$^{n.s}$ (0.116)	-7.7616*** (0.000)	-7.6155*** (0.000)
$Log(X_3)$	-1.0496$^{n.s}$ (0.722)	-2.3774$^{n.s}$ (0.383)	-5.0317*** (0.000)	-4.9379*** (0.002)

*** significant at 1% level
** significant at 5% level
( ) represent P-value
* significant at 10% level
n.s not significant

We note that all the variables were not stationary at the level, but it became stationary at first difference, that is, the degree of integration of each of them is one I (1), and thus the conditions for using Johansen's cointegration is fulfilled.

3. Optimal Lag Selection

After testing for unit root, study uses Johansen's cointegration test to check the long run relationship among the study variables. Before that we need to find the optimal lag length.

Table 3. Optimal lag order for research variables according to the (VAR) analysis

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-717.6265	NA	2.86e+17	51.54475	51.73506	51.60293
1	-680.5058	60.98386*	6.42e+16*	50.03613	50.98771*	50.32704*
2	-668.6409	16.10237	9.33e+16	50.33150	52.04433	50.85513
3	-644.8226	25.51967	6.61e+16	49.77304*	52.24714	50.52940

* denotes the optimal Lag length of the variable
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

It is noted from the table (3) that the optimal lag order is one according to the majority of information criteria (LR, FPE, SC, HQ), based on that, the best lag for the purpose of conducting co-integration and causality analysis between the study variables is one, that is, at time (t-1). To confirm the suitability of the optimal lag one for the study variables, the inverse roots of the autoregressive characteristic polynomial function of are plotted as in figure (4) below.

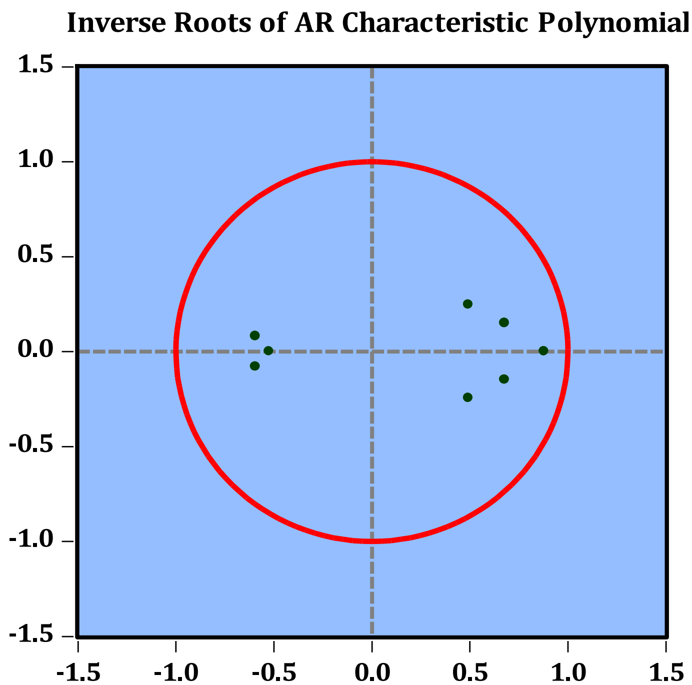

Figure 4. Inverse roots of AR characteristic polynomial function of lag one

Figure (4) shows that the values of all the roots (as absolute values) less than one, meaning that the points representing these roots are located within a circle of radius one. This confirms the validity and quality of all the results that will be obtained by adopting the optimal lag one [18].

4. Co-integration Test

Tables (4) and (5) present the results of the Johansen's cointegration test, we note that the results of the trace and max-eigen tests are identical. In the case of the existence of one cointegration relationship, it rejects the null hypothesis and accepts the alternative hypothesis, based on the two probabilistic values of the two tests, which are less than the level (5%), while we note the acceptance of the hypothesis that states that there is at most two cointegration relationship according to the probability value of the two tests, which respectively are (0.073) and (0.195) greater than (5%). We conclude that the number of long-run relationships between sustainable agricultural development and agricultural investment, agricultural capital accumulation and average per capita agricultural product is two.

Table 4. Trace test for cointegration between study variables

H_o	H_1	Eigen value	Trace Statistic	5% Critical Value	Prob.
$r = 0$ *	$r > 0$	0.728871	95.30962	63.87610	0.000
$r \leq 1$ *	$r > 1$	0.705983	58.76509	42.91525	0.000
$r \leq 2$	$r > 2$	0.413951	24.48981	25.87211	0.073
$r \leq 3$	$r > 3$	0.288432	9.527943	12.51798	0.150

Table 5. Max-Eigen test for cointegration between study variables

H_o	H_1	Eigen value	Max-Eigen Statistic	5% Critical Value	Prob.
$r = 0$ *	$r = 1$	0.728871	36.54454	32.11832	0.013
$r \leq 1$ *	$r = 2$	0.705983	34.27528	25.82321	0.003
$r \leq 2$	$r = 3$	0.413951	14.96187	19.38704	0.195
$r \leq 3$	$r = 4$	0.288432	9.527943	12.51798	0.150

5. Long-run Relationship Estimation

After ascertaining the co-integration relationship between sustainable agricultural development and other variables, the long-run relationship is estimated under autoregressive distributed lag model

Table 6. Results of estimating the long-run relationship between study variables

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\text{Log}(X_{1t})$	0.163694	0.072053	2.27185*	0.042
$\text{Log}(X_{2t})$	-0.033590	0.019073	-1.76113^{ns}	0.103
$\text{Log}(X_{2t})$	0.648675	0.202012	3.21107**	0.007

** significant at 1% level
* significant at 5% level
ns not significant

There is a positive significant impact of the agricultural investment on sustainable agricultural development in the long-run and at (1%) significant level, this means every increase in the agricultural investment by one million dinars offset by an increase in sustainable agricultural development by $0.164 * 1\% = 0.002$. Also, there is a positive significant impact of the average per capita agricultural product on sustainable agricultural development in the long-run and at (1%) significant level, this means every increase in the average per capita agricultural product by one dinar offset by an increase in sustainable agricultural development by $0.649 * 1\% = 0.006$. While the effect of agricultural capital accumulation on sustainable agricultural development in the long term was not significant.

6. Correlations between Study Variables

The results of the correlation among the study variables (table 7) confirm the long-run relationship, as it turns out that if the accumulation of agricultural capital and average per capita agricultural product remains constants at a certain level, sustainable agricultural development will respond by (87%) to any changes in agricultural investment. Also, if agricultural investment and average per capita agricultural product remains constants at a certain level, sustainable agricultural development will respond by (49%) to any changes in the accumulation of agricultural capital. On the other hand, if agricultural investment and accumulation of agricultural capital remains constants at a certain level, sustainable agricultural development will respond by (95%) to any changes in the average per capita agricultural product.

Table 7. Matrix of Pearson correlation coefficients between the model variables

	Y	X_1	X_2	X_3
Y	1.000	0.874**	0.493**	0.951**
X_1		1.000	0.640**	0.826**
X_2			1.000	0.546**
X_3				1.000

** significant at 1% level

7. Causality Analysis

It was found through the results of table (2) that the maximum difference at which the stationarity of the study variables is one, that is, (d_{max}=1), and through table (3) the optimal lag was one, i.e. (k=1), so (k+d_{max}=2) depending on that, the results of the (Toda - Yamamoto) test will be as in table (8).

Table 8. Toda-Yamamoto test results for long-run causality between sustainable agricultural development and other variables

Null Hypothesis:	Chi-sq	Prob.	Direction of Causality
$\text{Log}(Y_t)$ does not Cause $\text{Log}(X_{1t})$	3.1199^{ns}	0.210	Not exist
$\text{Log}(X_{1t})$ does not Cause $\text{Log}(Y_t)$	2.6579^{ns}	0.265	Not exist
$\text{Log}(Y_t)$ does not Cause $\text{Log}(X_{2t})$	2.0427^{ns}	0.360	Not exist
$\text{Log}(X_{2t})$ does not Cause $\text{Log}(Y_t)$	0.1078^{ns}	0.947	Not exist
$\text{Log}(Y_t)$ does not Cause $\text{Log}(X_{3t})$	0.5515^{ns}	0.759	Not exist
$\text{Log}(X_{3t})$ does not Cause $\text{Log}(Y_t)$	6.6276*	0.036	$\text{Log}(X_{3t}) \Rightarrow \text{Log}(Y_t)$

* significant at 5% level
n.s not significant

The results of table (8) indicate only one directional causal relationship from average per capita agricultural product to sustainable agricultural development at the (5%) significance level, meaning that average per capita agricultural product causes the sustainable agricultural development in Iraq in the long-run

Conclusions

The results of the current study showed the weak levels of sustainable agricultural development in Iraq during the period (1990-2020), as it did not exceed (0.160), and the reason for this may be due to the failure of most development indicators to keep pace with the increase in population as well as the unstable political and security conditions that faced Iraq during this period. The study showed that sustainable agricultural development is affected by both agricultural investment and average per capita agricultural product. There is a long-run equilibrium relationship between these variables, average per capita agricultural product causes the sustainable agricultural development in Iraq in the long-run, which requires the Ministry of Agricultural to promote the agricultural sector and pay more attention to the agricultural product, which seems to be one of the sources of sustainable agricultural development in the long-run. The research also recommends encouraging agricultural investments and overcoming obstacles towards targeted investments to promote the agricultural sector, especially investment in agricultural land reclamation, encouraging agricultural workers to maintain their work, preventing migration and going to other jobs.

References

[1] Shukr, A.S. and Obaid, B.H., 2020. Economic Analysis of the Most Important Factors Affecting Sustainable Agricultural Development in Iraq for The Period 2000-2017. Al Kut Journal of Economics and Administrative Sciences, 12(37), 338–362.

[2] Al-Hamdani, B.K., 2020. The extent to which Sustainable Development concepts are included in Social Textbooks for the intermediate stage from the point of view of Social School Teachers, Journal of Humanities, 37(4).

[3] Al-Tamimi, R.R. and Al-Saadi, H.H., 2020. Sustainable Educational Development: Ideas and Studies, Dar Al-Safa for Distribution and Publishing, Amman.

[4] Omrane, A., 2013, Social Entrepreneurship and Sustainable Development: The Role of Business Models. Available at: http://ssrn.com/abstract=2232438.

[5] Al-Haddad, H.M., 2014, The Impact of Total Quality Management on Sustainable Development in Higher Education in Iraq, University of Baghdad, Journal of College of Economic Sciences, Issue of the Joint Scientific Conference.

[6] Delaiglesia, J.R., 2006. Institutional Bottlenecks for Agricultural Development, OECD, Development Centre, p.10.

[7] Al-Ashram, M. 2010. Biodiversity, Sustainable Development and Food (globally and in the Arab world), Center for Arab Unity Studies, Beirut, p. 72.

[8] Zogheib, M. and Zina, K., 2009. Sustainable Agricultural Environment and Genetically Modified Products, Journal of Economic and Administrative Research, Issue 5, Algeria, p. 135.

[9] Arab Organization for Agricultural Development 2005. Arab Agricultural Development Strategy for the Next Two Decades, www.aoad.org/strategy/.

[10] Hussein, S.A., 2018. Sustainable Agricultural Development in Al-Hasakah Governorate (A Geographical Study), University of Duhok, Journal for Humanities and Social Sciences, 21(1), 226-235.

[11] Engle, R.F. and Granger, C.W.J., 1987. Co-integration and Error Correction: Representation, Estimation and Testing, Econometrica: Journal of the Econometric Society, 55(2), 251–276.

[12] Johansen, S. and Juselius, K., 1990. Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money, Oxford Bulletin of Economics and Statistics, 52, 169-210.

[13] Bhaskara, R.B.; Rup, T. and Chaitanya, V.K., 2008. Financial Development and Output Growth Rates: Another Approach, MPRA Papers, 1, 1-39.

[14] Toda, H.Y. and Yamamoto, T., 1995. Statistical Inference in Vector Autoregressions with Possibly İntegrated Processes, Journal of Econometrics, 66(1–2), 225–250.

[15] Ministry of Planning, Central Statistical Organization (COS), Statistical Group for the years (1990-2020).

[16] Zeidan, A.A., 2005. An Economic Study to show the Impact of Agricultural Investment on the Growth of the Agricultural Sector in Iraq for the period 1980-2000, MS.c thesis, College of Agriculture and Forestry, University of Mosul, Iraq.

[17] Abdel-Hussein, A.J., Abd, M.J. & Rahi, W.R. 2023. The global event (agriculture, industry, oil) on the gross domestic growth in Iraq for the period 1990-2020, Warith Scientific Journal, 5, special issue, 157-165.

[18] Nasrullah, M., Rizwanullah, M., Yu, X., Jo, H., Sohail, M. & Liang, L. 2021. An Autoregressive Distributed Lag (ARDL) Method to Study the Effects of Climate Change and Other Factors on Rice Production in Korea, Journal of Water & Climate Change, 12(12), 1-16.

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تحليل اقتصادي قياسي للعوامل المؤثرة على التنمية الزراعية المستدامة في العراق للمدة (1990–2020)

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الملخص

تعتبر الاستثمارات الزراعية، تراكم رأس المال الزراعي ومتوسط نصيب الفرد من الناتج الزراعي عوامل مهمة في رفع مستويات التنمية الزراعية المستدامة، ومن المهم تحديد العلاقة كمياً بين هذه العوامل. هدفت الدراسة إلى قياس تأثير بعض العوامل المؤثرة على التنمية الزراعية المستدامة في العراق. والمتغيرات المستخدمة في هذه الدراسة هي الاستثمار الزراعي، رأس المال الزراعي المتراكم ومتوسط نصيب الفرد من المنتج الزراعي كمتغيرات مستقلة، بينما تمثل التنمية الزراعية المستدامة المتغير التابع. والبيانات الخاصة بهذه المتغيرات هي السلاسل الزمنية التي تغطي الفترة من 1990 إلى 2020 والتي تم الحصول عليها من وزارة التخطيط – الجهاز المركزي للإحصاء، المجموعة الإحصائية للأعوام (1990–2020). تم استخدام طريقة يوهانسن للتكامل المشترك لتقدير العلاقة التوازنية طويلة المدى بين متغيرات الدراسة، كما تم استخدام منهجية تودا–ياماماتو لاختبار العلاقة السببية. وأظهرت النتائج ضعف مستويات التنمية الزراعية المستدامة في العراق خلال الفترة (1990–2020)، حيث لم تتجاوز (0.160)، وقد يعود السبب في ذلك إلى عدم مواكبة معظم مؤشرات التنمية الزيادة السكانية فضلا عن الظروف السياسية والأمنية غير المستقرة التي واجهها العراق خلال هذه الفترة. كما أن هناك علاقة توازنية طويلة المدى بين هذه المتغيرات، حيث أن متوسط نصيب الفرد من المنتج الزراعي يمكن أن يسبب التنمية الزراعية المستدامة على المدى الطويل، الأمر الذي يتطلب من وزارة الزراعة النهوض بالقطاع الزراعي والاهتمام أكثر بالمنتج الزراعي. والذي يبدو أنه أحد مصادر التنمية الزراعية المستدامة على المدى الطويل. كما يوصي البحث بتشجيع الاستثمارات الزراعية وتذليل العقبات أمام الاستثمارات المستهدفة للنهوض بالقطاع الزراعي، وخاصة الاستثمار في استصلاح الأراضي الزراعية، وتشجيع العاملين الزراعيين على الاستمرار في عملهم.

الكلمات المفتاحية: التكامل المشترك لـ جوهانسن، سببية تودا–ياماموتو، التنمية الزراعية المستدامة، الاستثمار الزراعي، رأس المال الزراعي المتراكم، متوسط نصيب الفرد من الناتج الزراعي