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Production of strategic summer agricultural crops in Iraq and the factors affecting them for the period (2004-2021) and future forecasts for the volume of their production until the year (2031)

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Abstract : These crops suffer from fluctuations in production quantities, cultivated areas, and average yield productivity during the period (2004-2021). The analytical descriptive method and the standard method for measuring production volume and estimating the production functions of strategic summer agricultural crops in Iraq for the period (2004-2021) and future predictions for the volume of production of those crops, as this research dealt with two axes, the first axis included the reality of the production of strategic summer agricultural crops in Iraq and the factors influencing them for the period (2004-2021), while the second axis dealt with estimating and measuring the functions of producing summer strategic agricultural crops in Iraq for the period (2004-2021) and its future forecasts for the period (2022-2023), By using the standard model (Eveiws12) for a set of tests, during which the researcher dealt with a quarterly series of (24) observations, based on official data and statistics issued by the relevant ministries, where he used a set of standard methods and was the most important. The stability test (Extended Dickey-Fuller test, Phillips-Peron test), the cointegration test of the error correction model, and the autoregressive distributed delay (ARDL) model test. Therefore, the results of this axis were the existence of a relationship between the production quantities of strategic summer agricultural crops and the variables affecting them, As for future predictions, the study showed that the quantities of rice production are trending downward, while the yellow corn crop is trending towards an increase, which necessitated focusing on recommendations, the most important of which are: If we want to increase the volume of crop production, we have to control and control these factors now and in the future, as well as state support for farms. From providing agricultural production requirements and manufacturing them locally and preventing their import from abroad, and using modern and advanced methods of agricultural machinery and equipment, which would raise the production of summer strategic agricultural crops.

Introduction: The production of summer strategic agricultural crops (sweet rice and yellow corn) is of great importance to the countries of the world as a major source of food for the population, as well as the employment of society in the agricultural sector represented by the labour force, whether they work in agriculture or who live in the countryside, as well as the economic profitability it provides for any country, However, the lack of food for the community will lead to problems, whether in the past, present or even the future, in addition to increasing imports in order to meet the population's food needs.

The importance of the research: The production of summer strategic agricultural crops is of great importance as it is one of the main sources of food through what is provided by these crops to humans in terms of food and a necessary source of raw materials for the industrial sector. These crops also depend on economic and natural conditions and on the factors that contribute significantly to determining its growth In order to obtain food and its current and future importance.

Research problem: The research problem is summarized in the following question:
Is the production of summer strategic agricultural crops (salt and yellow corn) not enough to meet the local need, which leads to dependence on imports to fill the shortfall in this need?

Research hypothesis: The research stems from the hypothesis that the production of strategic summer agricultural crops in Iraq will be affected by many current and future factors or variables.

research aims:

The study aims to:
1- Standing on the reality of the production of strategic summer agricultural crops in Iraq for the period (2004-2021)
2- Clarifying the factors affecting the production of strategic summer agricultural crops
3- Estimate the quantities of production of these crops until the year (2031).

search limits:
Temporal limits: The research deals with the production of strategic summer agricultural crops in Iraq for the period (2004-2021) and future forecasts for its production until the year (2031).
Spatial boundaries: The study includes the production of strategic summer agricultural crops (salab, yellow corn) in Iraq.

Research Structure: First / the reality of the production of strategic summer agricultural crops (salab, yellow corn) and the factors affecting them in Iraq for the period (2004-2021)
Second/ estimating and measuring the functions of the production of strategic summer agricultural crops in Iraq for the period (2004-2021) and their future predictions for the period (2022-2031)

The first axis: the reality of the production of strategic summer agricultural crops (stems, yellow corn) and the factors affecting them in Iraq for the period (2004-2021)
The first requirement / the development of turnip production: the turnip crop occupies the first place among the summer agricultural crops in Iraq, and as a result of the importance of this crop, its cultivation has faced many difficulties due to the fluctuation in the quantities of its production, the cultivated areas and the average yield [(1)] ، The rice crop is also one of the strategic agricultural crops, which occupies the second place among the global grain crops in terms of cultivated areas, which can be cultivated in most parts of the world due to the availability of natural conditions suitable for its growth in terms of rain, temperature and soil. As for its cultivation historically and at the global level, Some researchers say that the rice crop dates back to 3000 BC in China [(2)]،We will discuss the following:
1- The amount of production: It is noted from Table (1) that the amount of production witnessed a fluctuation in the rice crop, and the fluctuation continued from the year (2004) until the year (2021).
2 Cultivated area: It is noted from Table No. (1) the cultivated area witnessed fluctuation from the year (2004) to the year (2021) due to the dryness of the agricultural land, the reduction of the water share, and the decision to prevent its cultivation as a result of the scarcity of water and the lack of rainfall.
3- Average Yield Productivity: The average yield of the canola crop also fluctuated due to water scarcity and lack of rain.[(3)]
The second requirement / the development of the yellow corn crop: the yellow corn crop is one of the strategic agricultural crops, which ranks third at the global level after wheat and rice crops in terms of cultivated areas and production. Africa At the local level, the yellow maize crop ranks fourth after the strategic agricultural crops, wheat, rice and barley،[(4)] Yellow corn is an important grain crop with multiple uses in food and fodder and its application in industry [(5)] ،And we will discuss the following:
1- **The amount of production:** It is noted by those who found (1) that the quantities of the yellow corn crop production in Iraq for the period (2004-2021) fluctuated due to agricultural migration, the security situation, and the decline in the water share.
2- **Cultivated area**: Table No. (1) shows a variation in the cultivated area of maize crop. The reason for this fluctuation is due to the decline in rainfall rates in Iraq during the season, and the insufficient water share of this crop in Iraq.
3**- Average yield:** The average yield of yellow corn also fluctuated due to the desertification of many agricultural lands and the security situation in some governorates, as well as agricultural migration.[(6)]

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Table (1) Production, cultivated area and average yield of rice crop in Iraq for the period (2004-2021)

average yield (Kg/dunum)	production quantity (one hundred tons)	cultivated area (One hundred acres)	the year
711	2503	3518	**2004**
721	3087	4282	**2005**
723	3633	5026	**2006**
790	3928	4974	**2007**
732	2482	3390	**2008**
788	1731	2197	**2009**
812	1558	1919	**2010**
891	2351	2638	**2011**
1134	3613	3188	**2012**
1177	4518	3838	**2013**
1270	4030	3172	**2014**
989	1092	1104	**2015**
1176	1813	1542	**2016**
1197	2659	2221	**2017**
838	182	217	**2018**
1124	5747	5114	**2019**
1141	4642	4069	**2020**
1098	4225	3849	**2021**

Source: From the work of the researcher, based on data, Republic of Iraq, Ministry of Planning - Central Statistical Organization, Directorate of Agricultural Statistics, reports on the production of straw, in Iraq, except for the Kurdistan region for the years (2004-2021)

Table (2) Production, cultivated area and average yield of yellow corn crop in Iraq for the period (2004-2021)

average yield (Kg/dunum)	production quantity (one hundred tons)	cultivated area (One hundred acres)	the year
562	4160	7398	**2004**
578	4011	6949	**2005**
607	3990	6577	**2006**
620	3845	6204	**2007**
587	2880	4903	**2008**
522	2381	4565	**2009**
570	2667	4678	**2010**
648	3357	5184	**2011**
831	5034	6058	**2012**
1042	8313	7981	**2013**
765	2893	3781	**2014**
796	1823	2290	**2015**
854	2595	3040	**2016**
832	1853	2228	**2017**
1134	633	558	**2018**
918	4732	5152	**2019**
1034	4193	4054	**2020**
1149	3744	3259	**2021**

Source: From the work of the researcher based on data, Republic of Iraq, Ministry of Planning - Central Statistical Organization, Directorate of Agricultural Statistics, reports on production of yellow maize in Iraq except for the Kurdistan region for the years (2004-2021)

Figure (1) Production, cultivated area and average

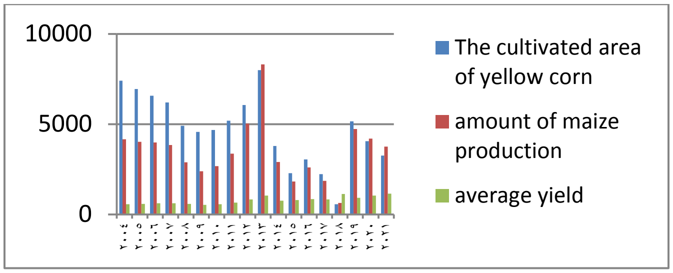
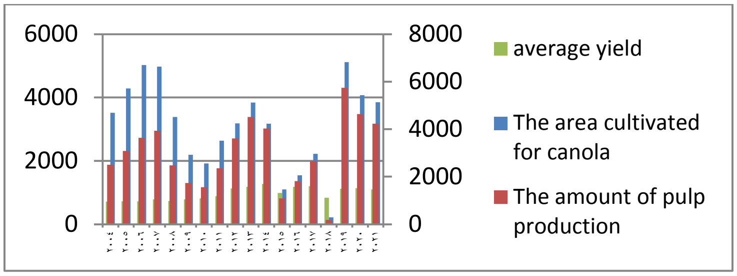


Figure (2) Production, cultivated area and average



yield of the rice crop in Iraq for the period (2004-2021) yield of yellow corn crop in Iraq for the period (2004-2021)

Source: from the researcher's work based on the data of Table (1) ا

The third requirement: the most important factors influencing the production of strategic summer agricultural crops (rice and yellow corn) in Iraq for the period (2004-2021)

1- Prices: Prices represent one of the factors affecting the economy of any country, and price is considered a factor that directs the market economy, and agricultural prices for crops are characterized by fluctuation and instability agricultural[(7)]

2- Population growth: From Table (3), the discrepancy in the population numbers in Iraq is noted, and the size of the population plays a major role in the quantities of these two crops. An increase in the population will increase the demand for agricultural crops as a result of the demand for food, which causes a decline in the production of the two crops.[(8)]

3- Temperature: Summer agricultural crops are more tolerant of high temperatures than winter crops, and the difference and variation in temperature during the agricultural season may affect the production of the two crops, which exposes the crops to damages resulting from this temperature variation and then affects crop production.

4- Humidity: It is noted that the annual humidity rates fluctuate in Iraq, and that humidity is one of the factors that affect agricultural production, including agricultural crops (rice and maize), and its rise will lead to water evaporation, which will increase the loss and waste of water, which means an increase in the water need for the crop and then Impact on crop production[(9)]

5- **The waters of the Tigris and Euphrates Rivers**: The fluctuation in the waters of the Tigris and Euphrates Rivers, in turn, has an effect on the crops of rice and maize, because the two crops have special conditions in their cultivation, which makes them affected by the water factor for their cultivation, being one of the crops that are grown in the

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([7]) Widad Ali Zagheir Al-Manshdawi, The Reality of Agricultural Investment in Iraq in Light of the Evolution of the Domestic Demand Structure for Agricultural Crops, University of Baghdad, College of Administration and Economics, PhD thesis, 2016, p. 18

([8]) Abbas Trad Sajit, Shakir Musir Al-Zamili, Evaluation of the Efficiency of Grain Crops for Nutritional Needs in Wasit Governorate, Wasit University, College of Education for Human Sciences, Volume (1), Issue (32), 2018, p.1

([9]) Wafaa Ajeel Mohan Al-Badiri, Climate Requirements for Cultivating the Yellow Maize Crop in Al-Qadisiyah Governorate, Journal of Geographical Research (University of Maysan), Volume (27), without a year, p. 285

summer, and thus as a result of the scarcity of water in the Tigris and Euphrates rivers. effect on the production of the two crops[10]

6- Chemical Fertilizers: It is noted from Table No. (3) the discrepancy in the quantities of fertilizers used, but the use of chemical fertilizers for these two crops in Iraq is less than the scientific use, but reliance on importing chemical fertilizers, which may not be among the good brands globally in terms of nutritional content and therefore effect on both crops[11]

7- Tractors: Agricultural mechanization, such as tractors, plays a major role in agricultural operations, and its use will increase crop production (rice and maize) and reduce costs. The use of this agricultural mechanization, which has advantages, would save time and effort for the farmer, which leads to the success of agricultural work.[12]

8- Harvesters: The harvest crop requires agricultural mechanization such as harvesters, but there is a widespread shortage of harvesters in Iraq, which leads to a decline in the production of this crop. Therefore, harvesters are among the factors affecting the harvest (), and as for yellow corn, harvesters are also considered factors affecting the yellow corn crop. Agricultural production requires the provision of harvesters through what is needed from the harvesting process, and this requires available agricultural mechanization, which is the harvesters to harvest the agricultural crop, and then it will increase the production of yellow corn[13]

9- Cultivated area, quantity of production, and average yield: Each of the cultivated area, quantity of production, as well as the average yield of the two crops of rice (rice) and maize are among the factors that affect their productivity.

10- Agricultural labour: It is noted from Table No. (3) the discrepancy in the agricultural labour force. The crops of rice and yellow corn are among the crops that require an abundance of agricultural labor, and this in turn has an impact on the production of the two crops.[14]

Table (3) Factors affecting the production of rapeseed and yellow corn crops in Iraq for the period (2004-2021)

agricultural labor force	combines	tractors	Fertilisers	Tigris and Euphrates rivers	Humidity	temperatures	population	Purchase price of yellow corn	Purchase prices	the year
1229.00	6155	63717	661.23	64.96	101.7	177.1	27139	210	350	2004
1266.00	6205	64427	661.23	54.65	42	143.8	27963	230	450	2005
1304.00	6265	64676	661.23	67.55	138	192.7	28810	270	650	2006
1343.00	8366	72775	661.23	56.42	125	194.9	29682	300	750	2007
1443.00	8366	72775	661.23	32.70	130	186.6	31895	310	900	2008
1452.00	8402	72814	661.23	32.11	131	185.8	31664	350	900	2009
1467.00	4966	73194	661.23	50.12	165	198.5	32490	400	700	2010
1461.00	5111	73585	661.23	47.57	170	180.4	33338	400	700	2011

([10]) Rahman Jamil Saad, Maher Nasser Abdullah, Industrial agricultural crops and their role in industrial development in Al-Muthanna Governorate, Uruk Journal of Human Sciences, Volume Fourteen, Issue Four, 2021, p. 2811

Widad Ali Zughair Al-Manshdawi, previous source, p. 140 ([11])

([12]) Manaf Muhammad al-Sudani, Dalal Hassan Kazem, Spatial analysis of agricultural mechanization and its spatial relationship to the cultivation of grain crops in Maysan Governorate, Journal of Geographical Research (University of Baghdad), Issue (26), 2022, p. 281

([13]) Tahseen Hadi Rameed, Raad Rahim Hammoud, Human factors and their impact on the cultivation and production of yellow corn crop in Diyala Governorate, Diyala Journal for Human Research, Issue Ninety-one, 2022, p. 101

([14]) Rahman Jamil Saad, Maher Nasser Abdullah, previous source, p. 2812

1504.00	5291	75493	661.23	49.11	174	187.9	34208	400	700	2012
1558.00	5300	75534	661.23	56.02	141	128.4	35096	440	750	2013
1583.00	5343	75547	661.23	37.25	43	48.9	36005	400	750	2014
1623.20	6806	73898	661.23	35.34	81	104.8	35213	310	900	2015
1664.42	352	1546	102.54	54.75	78	103.2	36169	340	900	2016
1644.32	352	1574	154.60	40.69	75	147.1	37140	350	900	2017
1666.91	141	910	167.42	33.20	51	194.8	38124	350	900	2018
1668.77	194	660	278.399	93.51	146	147.3	39128	350	900	2019
1806.00	194	661	116.97	49.67	95	92.5	40150	350	950	2020
1713.89	176.3	743.7	187.60	31.24	120	195.9	41190	250	950	2021

Source: From the researcher's work, based on the Ministry of Planning, Ministry of Transport, Ministry of Water Resources, Ministry of Trade, Arab Organization for Agricultural Development

The second axis: estimating and measuring the functions of the production of strategic summer agricultural crops in Iraq for the period (2004-2021) and their future predictions for the period (2022-2031)

The first requirement: description and formulation of the standard model:

First, the function model of the rice crop production in Iraq:

A- model variables:

1- **Independent Variables:** It includes eleven variables and is divided into seasonal (quarterly) data, which are:

- The cultivated area is denoted by the symbol X1.
- The average yield is denoted by the symbol X2.
- - Purchase prices and symbolized by the symbol X3.
- - Population number, denoted by the symbol X4.
- The average annual temperature is symbolized by the symbol X5.
- - The average relative humidity is denoted by the symbol 6X
- The waters of the Tigris and Euphrates rivers, symbolized by the symbol X7.
- - Chemical fertilizers and symbolized by the symbol X8.
- - Tractors and symbolized by the symbol X9.
- Harvesters, denoted by the symbol X10.
- - Agricultural labor force and symbolized by the symbol X11

2- **Dependent Variables :** It includes the variable quantity of pulp production and is symbolized by the symbol Y3

3- **Random Vriabels** : They are real random variables that include other factors that did not appear in the model but affect the dependent variables and are denoted by the symbol U3

B- The theoretical relationship between the variables of the model: in order to determine the nature of the relationship between the variables of the model and to indicate the effect of the independent variables on the amount of rice production in Iraq. The ARDL model was used, and the double logarithmic formula was the best estimation formula. The general form of the model consists of the following equation:

$$\Delta\gamma_3 = \alpha. + \sum \beta_1 \Delta y_{t-i} + \sum \theta_i \Delta X_{t-i} + \lambda_2 X_{t-i} + \eta_t$$

Where: Y3: represents the logarithm of the production quantity of pulp, ■(α_0): represents the intersection limit vector (fixed term) ∅_(i ,): represents the short-term coefficients

λ_i: represents the long-run coefficients, η_t: represents the random variable

According to economic theory and economic literature, the natural relationship between the amount of rice production and the cultivated area is a direct relationship, as well as other independent variables. It is expected that the value of the parameters will be positive.

Second: Maize production function model in Iraq:

The model variables:

1-Independent Variables : It includes eleven variables and is divided into seasonal (quarterly) data, which are:

- The cultivated area is denoted by the symbol X1.
- The average yield is denoted by the symbol X2.
- - Purchase prices and symbolized by the symbol X3.
- - Population number, denoted by the symbol X4.
- The average annual temperature is symbolized by the symbol X5.
- - The average relative humidity is denoted by the symbol 6X
- The waters of the Tigris and Euphrates rivers, symbolized by the symbol X7.
- - Chemical fertilizers and its symbol is X8.
- - Tractors and symbolized by the symbol X9.
- Harvesters, denoted by the symbol X10.
- - Agricultural labor force and symbolized by the symbol X11

2- **Dependent Variables :** It includes the variable quantity of maize production and is symbolized by the symbol Y4

3- **Random Vriabels :**They are real random variables that include other factors that did not appear in the model but affect the dependent variables and are denoted by the symbol U4

B- The theoretical relationship between the model variables: to determine the nature of the relationship between the model variables and to indicate the impact of the independent variables on the amount of corn crop production in Iraq. The ARDL model was used, and the double logarithmic formula was the best estimation formula. The general form of the model consists of the following equation:

$$\Delta\gamma_4 = \alpha. + \sum\beta_1 \Delta y_{t-i} + \sum\theta_i \Delta X_{t-i} + \lambda_2 X_{t-i} + \eta_t$$

Where: Y4: represents the logarithm of the amount of corn production, ■(α_0): represents the intersection limit vector (fixed term) ∅_(i ,): represents the short-run coefficients, λ_i: represents the long-run coefficients, η_t: represents the random variable

According to economic theory and economic literature, the natural relationship between the amount of maize production and the cultivated area is a direct relationship, as well as other independent variables. It is expected that the value of the parameters will be positive.

The second requirement is estimating the functions of producing strategic agricultural crops in Iraq for the period (2004-2021).

First: the first model is to estimate the function of the rice crop production in Iraq:

A- matrix of multiple correlation coefficients between variables:

Table (4) shows the matrix of multiple correlation coefficients between variables. We find through the table that there is a positive correlation of varying strength between the amount of rice production, Y3, and between the cultivated area X1, average yield X2, population X4, humidity rate X6, the water of the Tigris and Euphrates X7, and the labour force X11. The highest positive correlation strength was with the cultivated area with a strength of 87%, and the lowest correlation with the labour force, as the correlation coefficient reached about 11%..while the correlation was negative between the amount of pulp production and between purchase prices X3, the annual rate of heat X5, chemical fertilizers X8, tractors X9, and harvesters X10, as they were higher A negative correlation is with the annual rate of temperature, and the least strong correlation is with purchase prices, 0.09%. As for the association of other variables with each other, they were uneven in strength and direction

Table No. (4) Matrix of correlation coefficients between the variables of the third model of the rice crop for the period (2004-2021)

X11	X10	X9	X8	X7	X6	X5	X4	X3	X2	X1	Y3	
1.000	-0.146	-0.109	-0.053	0.538	0.233	-0.224	0.212	-0.010	0.421	0.872	1.000	Y3
0.872	0.168	0.113	0.200	0.595	0.276	0.045	-0.221	-0.290	-0.050	1.000	0.872	X1
0.421	-0.582	-0.418	-0.484	-0.006	-0.123	-0.627	0.758	0.473	1.000	-0.050	0.421	X2
-0.010	-0.439	-0.522	-0.584	-0.359	-0.015	-0.160	0.780	1.000	0.473	-0.290	-0.010	X3
0.212	-0.794	-0.717	-0.752	-0.182	-0.109	-0.319	1.000	0.780	0.758	-0.221	0.212	X4
-0.224	0.199	0.115	0.185	0.002	0.563	1.000	-0.319	-0.160	-0.627	0.045	-0.224	X5

0.233	0.229	0.303	0.324	0.302	1.000	0.563	-0.109	-0.015	-0.123	0.276	0.233	X6
0.538	-0.127	-0.100	0.007	1.000	0.302	0.002	-0.182	-0.358	-0.006	0.595	0.538	X7
-0.053	0.928	0.982	1.000	0.007	0.324	0.185	-0.752	-0.584	-0.484	0.200	-0.053	X8
-0.109	0.932	1.000	0.982	-0.100	0.303	0.115	-0.717	-0.522	-0.418	0.113	-0.109	X9
-0.146	1.000	0.932	0.928	-0.127	0.229	0.199	-0.794	-0.439	-0.582	0.168	-0.146	X10
0.116	-0.754	-0.693	-0.758	-0.221	-0.173	-0.437	0.970	0.824	0.760	-0.315	0.116	X11

Source: The researcher's work based on the results of the Eveiws12 program

B- Unit root tests for the variables of the third model of the pulp crop

1- Dickie Fuller Expanded Test ADF: Table (5) shows the results of the ADF test for the variables of the third model at the level of significance 1%, 5% and 10%, and we note that the dependent variable the amount of pulp production (Y3) was static at the level with a categorical and a time trend and a level of significance 5%. The same applies to purchase prices X3 and the water of the Tigris and Euphrates rivers X7, which means that it is an inhabitant of class (I ~ 0). As for the variables X1, the cultivated area X2and the average yield did not achieve stillness at the level, but it stabilized after taking the first difference for it at all levels of significance and in the case of a constant presence only, as the probability value of these tests was less than 0.05 m. Which means it is an I~1 static. This confirms the acceptance of the null hypothesis, that is, the absence of a unit root for these variables, and they enjoy rest. As for the variables from (X4-X11), they are identical to the results of what came in the third model, so we chose not to repeat the results. The integral variables of degree (I~0) and I~1) will be confined.

Table No. (5) The results of the ADF dormancy test for the variables of the third model of the rice crop

					At Level	
X7	X3	X2	X1	Y3		
-3.0740	-2.8916	-1.8779	-2.5964	-5.1167	t-Statistic	With Constant
0.0522	***0.0671***	***0.3337***	***0.1128***	***0.0014***	***Prob.***	
*	*	n0	n0	***		
-3.6051	-4.6757	-2.6852	-2.5693	-4.7809	t-Statistic	With Constant & Trend
0.0620	***0.0122***	***0.2532***	***0.2959***	***0.0103***	***Prob.***	
*	**	n0	n0	**		
-0.4945	1.0384	0.2211	-0.8846	-0.9018	t-Statistic	Without Constant & Trend
0.4846	***0.9138***	***0.7382***	***0.3183***	***0.3112***	***Prob.***	
n0	n0	n0	n0	n0		
				At First Difference		
d(X4)	d(X3)	d(X2)	d(X1)	d(Y3)		
-5.9071	-2.8311	-5.6879	-3.1835	-3.5308	t-Statistic	With Constant
0.0003	***0.0761***	***0.0004***	***0.0449***	***0.0248***	***Prob.***	
***	*	***	**	**		
-6.6838	-2.8749	-5.5369	-3.8651	-3.6270	t-Statistic	With Constant & Trend
0.0004	***0.1948***	***0.0023***	***0.0474***	***0.0678***	***Prob.***	
***	n0	***	**	*		
-6.1768	-2.7443	-5.6687	-3.4621	-3.7077	t-Statistic	Without Constant & Trend
0.0000	***0.0094***	***0.0000***	***0.0022***	***0.0013***	***Prob.***	
***	***	***	***	***		

Source: The researcher's work based on the results of the Eveiws12 program

2-Phillips –Perron Test : To be more sure and to enhance the results of static, the PP test will be performed on the time series of the variables, as shown in Table (6). We note from the results of the above table that the results of the PP test are identical to the results of the ADF test.

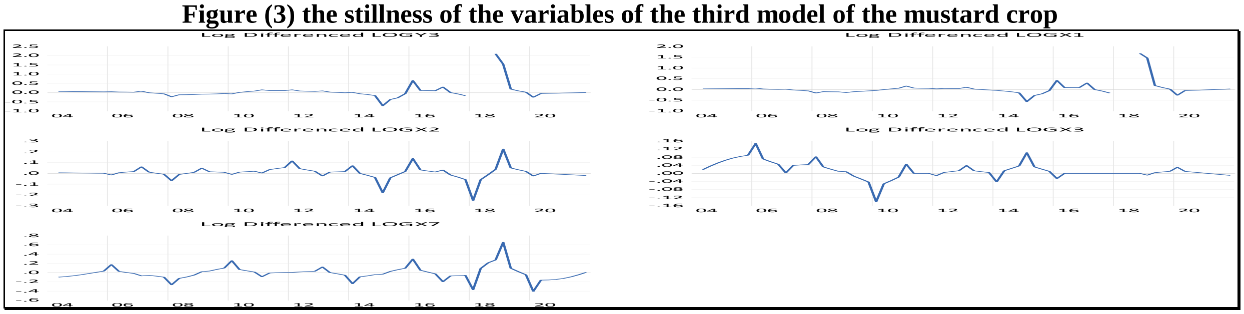
The rest of the variables can be illustrated as stated in Figure (3).

Table No. (6) the results of the PP test for dormancy for the variables of the third model of the rice crop

					At Level	
X7	X3	X2	X1	Y3		
-5.9863	-2.8916	-1.7634	-2.5964	-3.1555	t-Statistic	With Constant
0.0002	***0.0671***	***0.3843***	***0.1128***	***0.0412***	***Prob.***	
***	*	n0	n0	**		
-5.6507	-2.6451	-2.6852	-2.5693	-3.1127	t-Statistic	With Constant & Trend
0.0016	***0.2674***	***0.2532***	***0.2959***	***0.1345***	***Prob.***	
***	n0	n0	n0	n0		
-1.1477	0.8440	0.9975	-0.7153	-0.6541	t-Statistic	Without Constant & Trend
0.2183	***0.8838***	***0.9081***	***0.3917***	***0.4188***	***Prob.***	
n0	n0	n0	n0	n0		
					At First Difference	
d(X4)	d(X3)	d(X2)	d(X1)	d(Y3)		
-11.0944	-2.8311	-6.9393	-5.4221	-6.5357	t-Statistic	With Constant
0.0000	***0.0761***	***0.0000***	***0.0006***	***0.0001***	***Prob.***	
***	*	***	***	***		
-10.1530	-2.8749	-8.9317	-8.5602	-9.4990	t-Statistic	With Constant & Trend
0.0000	***0.1948***	***0.0000***	***0.0000***	***0.0000***	***Prob.***	
***	n0	***	***	***		
-10.6367	-2.6938	-5.8459	-5.6318	-6.7595	t-Statistic	Without Constant & Trend
0.0000	***0.0105***	***0.0000***	***0.0000***	***0.0000***	***Prob.***	
***	**	***	***	***		

Source: The researcher's work based on the results of the Eveiws12 program

Figure (3) the stillness of the variables of the third model of the mustard crop



Source: The researcher's work based on the results of the Eveiws12 program

Third: cointegration test: : According to the results of static tests, which showed that the variables were not static at the same rank, but some were static at the level and others at the first difference, so the Johanson test cannot be used because the condition of the variables static at the same rank is not available, and the Bounds Test will be used within the ARDL model to test cointegration and to reveal the existence of a long-term equilibrium relationship between the variables. One of the conditions for applying this test is the possibility of testing with the similarity of the degree of integration of the variables or their difference, provided that there is no static variable at the second difference. Table (7) indicates the results of the co-integration test by applying the Bounds test. We note from the above table that the value of the calculated F-statistic value of 59.9744 was greater than the upper limits of the tabular statistical value and at all levels of significance, which means rejecting the null hypothesis and accepting the alternative hypothesis, which means the existence of a short and long-term equilibrium relationship between the variables of the model.

Table (7) Bounds test for cointegration of rice crop

	Null Hypothesis: No levels relationship		F-Bounds Test	
I(1)	I(0)	Signif.	Value	Test Statistic

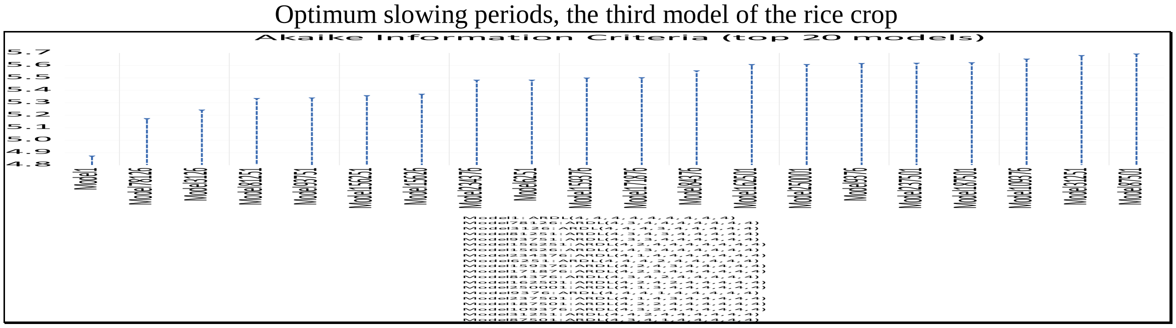
	Asymptotic: n=1000			
2.85	1.85	10%	59.9744	F-statistic
3.15	2.11	5%	8	K
3.42	2.33	2.5%		
3.77	2.62	1%		
	Finite Sample: n=70		68	Actual Sample Size
-1	-1	10%		
-1	-1	5%		
-1	-1	1%		

Source: The researcher's work based on the results of the Eveiws12 program

Fourth: Model Estimation ARDL: Co-integration was tested according to the (ARDL) methodology through the Bound Test method developed by Pesaran et al (2001), where Autoregressive models (AR) and distributed lag time models were combined. The estimated (ARDL) model is based on the independent variables represented by the cultivated area X1, average yield X2, purchase prices X3, population X4, average annual temperatures X5, the water of the Tigris and Euphrates rivers X7, chemical fertilizers X8, labour force X11, and the quantity of rice production Y3 as a dependent variable. The time lag time is (4, 4, 4, 4, 4, 4, 4, 4, 4), respectively, based on the values of (Akaike) (AIC), which gives the lowest value for this criterion and is determined automatically by the program, as shown in the figure (4)

Figure (4)

Optimum slowing periods, the third model of the rice crop



Source: The researcher's work based on the results of the Eveiws12 program

Table (8) shows the results of the ARDL model test for the function of barley production. It is clear from the statistical tests of the model the significance of these tests and the quality of the model estimated through the modified (R2) of (0.94), meaning that the independent variables explain about 94% of the changes in the amount of wheat production and 6% is Other variables not included in the model. In addition to the value of (F - Statistic) which amounted to (541614.4) and at a statistically significant level (0.0000). The value of D.W was about 1.8, which is a value close to 2, so we accept the null hypothesis (H0), that is, there is no problem of autocorrelation to the error limit in the estimator model.

Table (8) the results of the ARDL model for the production of rice crop

		Dependent Variable: LOGY3		
Maximum dependent lags: 4 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (4 lags, automatic): LOGX1 LOGX2 LOGX3 LOGX4				
	LOGX5 LOGX7 LOGX8 LOGX11			
Selected Model: ARDL(4, 4, 4, 4, 4, 4, 4, 4, 4)				
3017.118	Mean dependent var		0.949999	R-squared
1461.645	S.D. dependent var		0.939997	Adjusted R-squared
4.870222	Akaike info criterion		2.450800	S.E. of regression
6.339013	Schwarz criterion		138.1476	Sum squared resid
5.452202	Hannan-Quinn criter.		-120.5875	Log likelihood
1.851904	Durbin-Watson stat		541614.4	F-statistic
			0.000000	Prob(F-statistic)
*Note: p-values and any subsequent tests do not account for model				
		selection.		

Source: The researcher's work based on the results of the Eveiws12 program

Fifth: ECM error correction model according to the ARDL methodology: Table (9) shows the results of estimating the impact of production factors on the amount of pulp production. We note that the error correction coefficient is negative and significant, meaning that it met the acceptance conditions. Where its value was about (-0.889618), which reflects the existence of a long-term equilibrium relationship between the amount of pulp production on the one hand and the independent variables on the other hand. That is, about 88% of the errors in the short term can be corrected and re-adapted in the long term, meaning that the time required to return to the long-term equilibrium is about 1.133, or about a season and several days, to enhance the quantity of production and return it to the long-term equilibrium position. This confirms the acceptance of the alternative hypothesis, which states that there is an equilibrium relationship in the short term.

Table (9) The results of the ECM model for the production of rice crop

ARDL Error Correction Regression				
Dependent Variable: D(LOGY3)				
Selected Model: ARDL(4, 4, 4, 4, 4, 4, 4, 4, 4)				
ECM Regression				
Case 2: Restricted Constant and No Trend				
0.0000	-91.36449	0.009737	-0.889618	CointEq(-1)*
21.92923	Mean dependent var		0.949996	R-squared
680.2699	S.D. dependent var		0.939991	Adjusted R-squared
4.605516	Akaike info criterion		2.077766	S.E. of regression
5.780549	Schwarz criterion		138.1476	Sum squared resid
5.071100	Hannan-Quinn criter.		-120.5875	Log likelihood
			1.851904	Durbin-Watson stat
* p-value incompatible with t-Bounds distribution.				

Source: The researcher's work based on the results of the Eveiws12 program

As for the long-term parameters in their logarithmic form and as illustrated by the equation below, they indicate that the most important factors positively affecting the production of pulp are the annual rate of heat X5, the average yield X2, the labour force X11, the cultivated area X1, then finally comes the number of population X4, where the elasticity of production indicates that the increase of these factors by 1 % leads to an increase in the amount of production by (3.77, 2.8, 1.07, 1.008), respectively, meaning that there is a significant effect of temperatures because the crop is summer and needs high temperatures, and there is an increase in yield and the effect of the cultivated area and the increase in population on the production of pulp.As for the rest of the factors, it had a negative impact on the quantity of production, such as the water of the Euphrates and Dahleh, purchase prices, and chemical fertilizers, as the flexibility towards these factors was (-12.7, -0.65, and -0.20), respectively. The response rate was about (-334.9, -30.1, -149.14), respectively, and all variables were significant, as the probability value was less than 0.05.

LOGY3 = (1.0088*LOGX1 + 2.8076*LOGX2 -0.6563*LOGX3 + 0.0408 *LOGX4 + 3.7728*LOGX5 -12.0741*LOGX7 -0.2096*LOGX8 + 1.0710 *LOGX11 - 5190.5816)

Sixth: Diagnostic tests of the model

1- The autocorrelation problem test: The results showed that the estimated model is free from the autocorrelation problem in terms of the LM test, as the value of Prob. Chi - square (0.1007) as shown in Table (10) which is greater than (0.05), i.e. we accept the null hypothesis which states that the residuals are not self-correlated.

Table (10) LM test for cane crop

	Breusch-Godfrey Serial Correlation LM Test:		
Null hypothesis: No serial correlation at up to 2 lags			
0.0806	Prob. F(2,21)	2.845798	F-statistic
0.1007	Prob. Chi-Square(2)	14.50002	Obs*R-squared

Source: The researcher's work based on the results of the Eveiws12 program

2- Instability of variance homogeneity: To ensure that the residuals do not suffer from the problem of instability of variance, we find that the value of Prob. Chi - square for the ARCH test, it amounted to (0.1889), which is greater than

5%. Accordingly, we accept the null hypothesis that the residuals are homogeneous and that they do not contain the problem of incompatibility and contrast smoothing.

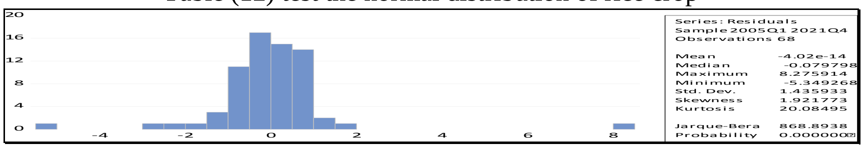
Table (11) Breusch test for grape yield

		Heteroskedasticity Test: ARCH		
0.1945	Prob. F(1,65)	1.718772	F-statistic
0.1889	Prob. Chi-Square(1)	1.726017	Obs*R-squared

Source: The researcher's work based on the results of the Eveiws12 program

3- Normal distribution: We note from Table (12) that the probability value of the Jarque-era test was less than 5%, which means that the variables do not follow the normal distribution.

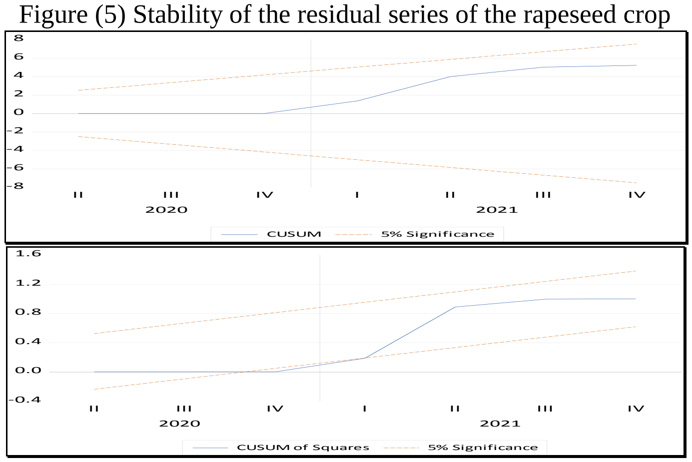
Table (12) test the normal distribution of rice crop



Source: The researcher's work based on the results of the Eveiws12 program

4- Stability of the Residual Series: We notice from Figure (5) that the cumulative sum of squares test (CUSUM) and the cumulative sum of squares test (SUSUMSQ) that they fall within the limits of stability, which means the stability of the residuals and thus the quality of the results of the ARDL model

Figure (5) Stability of the residual series of the rapeseed crop



Source: The researcher's work based on the results of the Eveiws12 program

Second: The fourth model for estimating the yellow maize production function in Iraq for the period (2004-2021)

1Matrix of multiple correlation coefficients between variables: Table (13) shows the matrix of multiple correlation coefficients between variables. Through the table, we find that there is a positive correlation of varying strength between the amount of yellow corn production Y4 and between the cultivated area X1, average yield X2, purchase prices X3, humidity rate X6, water of the Tigris and Euphrates X7, chemical fertilizers X8, tractors X9 and harvesters X10. The highest positive correlation strength was with the cultivated area with a strength of 80%, and the lowest correlation with harvesters, as the correlation coefficient was about 12%..while the correlation was negative between the quantity of maize production and between each of the population X4 and the annual rate of heat X5 and the labor force X11, as it was higher A negative correlation is with the labor force (-14%), and the least strong correlation is with the annual average temperature (-0.6%). As for the association of other variables with each other, they were uneven in strength and direction.

Table No. (13) Matrix of correlation coefficients between the variables of the fourth model for the yellow corn crop for the period (2004-2021)

X11	X10	X9	X8	X7	X6	X5	X4	X3	X2	X1	Y4	
-0.1448	0.1219	0.2359	0.2594	0.5038	0.4235	-0.0681	-0.0882	0.1734	0.1460	0.8019	1.0000	Y4
-0.677	0.5292	0.5656	0.6187	0.5456	0.4404	0.1604	-0.634	-0.114	-0.433	1.0000	0.8019	X1
0.8056	-0.763	-0.678	-0.699	-0.098	-0.177	-0.213	0.8587	0.2310	1.0000	-0.433	0.1460	X2
0.4297	-0.111	0.1104	0.0126	-0.084	0.2907	-0.269	0.3807	1.0000	0.2310	-0.114	0.1734	X3

0.9697	-0.794	-0.716	-0.752	-0.182	-0.108	-0.319	1.0000	0.3807	0.8587	-0.634	-0.088	X4
-0.436	0.1991	0.1148	0.1854	0.0021	0.5625	1.0000	-0.319	-0.269	-0.213	0.1604	-0.068	X5
-0.172	0.2286	0.3033	0.3239	0.3024	1.0000	0.5625	-0.108	0.2907	-0.177	0.4404	0.4235	X6
-0.220	-0.126	-0.099	0.0072	1.0000	0.3024	0.0021	-0.182	-0.084	-0.098	0.5456	0.5038	X7
-0.757	0.9280	0.9824	1.0000	0.0072	0.3239	0.1854	-0.752	0.0126	-0.699	0.6187	0.2594	X8
-0.693	0.9323	1.0000	0.9824	-0.099	0.3033	0.1148	-0.716	0.1104	-0.678	0.5656	0.2359	X9
-0.754	1.0000	0.9323	0.9280	-0.126	0.2286	0.1991	-0.794	-0.111	-0.763	0.5292	0.1219	X10
1.0000	-0.754	-0.693	-0.757	-0.220	-0.172	-0.436	0.9697	0.4297	0.8056	-0.677	-0.144	X11

Source: The researcher's work based on the results of the Eveiws12 program

Second: Unit root tests for the variables of the fourth model of corn crop

2- The expanded Dickie Fuller test ADF: Table (14) shows the results of the ADF test for the variables of the fourth model at the level of significance 1%, 5% and 10%, and we note that the dependent variable, the amount of yellow corn production (Y4), was not static at the level, but it has stabilized after Taking the first difference to him at all levels of morale. The same is the case with the variable cultivated area X1 and purchase prices X3, which means that it is static of degree (I~1).As for the variables, the average yield X2 achieved repose at the level and at all levels of significance, where the probability value of these tests was less than 0.05. Which means it is static of degree I~0). This confirms the acceptance of the null hypothesis, that is, the absence of a unit root for these variables, and they enjoy rest. As for the variables from (X4-X11), they are identical to the results of what came in the first model, so we chose not to repeat the results. The integral variables of degree (I~0) and I~1) will be confined.

Table No. (14) ADF dormancy test results for the fourth model variables of maize crop

				At Level	
X3	X2	X1	Y4		
-1.9318	-1.0427	-2.2358	-2.9235	t-Statistic	With Constant
0.3111	***0.7126***	***0.2019***	***0.1633***	***Prob.***	
n0	n0	n0	n0		
-0.8308	-4.1223	-2.8656	-2.8299	t-Statistic	With Constant & Trend
0.9413	***0.0296***	***0.1960***	***0.2066***	***Prob.***	
n0	**	n0	n0		
-0.0904	0.7207	-1.3165	-1.1112	t-Statistic	Without Constant & Trend
0.6380	***0.8610***	***0.1665***	***0.2309***	***Prob.***	
n0	n0	n0	n0		
				At First Difference	
d(X3)	d(X2)	d(X1)	d(Y4)		
-2.3288	-4.4019	-4.6550	-4.5027	t-Statistic	With Constant
0.1755	***0.0056***	***0.0025***	***0.0033***	***Prob.***	
n0	***	***	***		
-3.5024	-4.3082	-4.5179	-4.3517	t-Statistic	With Constant & Trend
0.0758	***0.0241***	***0.0130***	***0.0173***	***Prob.***	
*	**	**	**		
-2.5071	-5.1029	-4.7250	-4.6607	t-Statistic	Without Constant & Trend
0.0159	***0.0001***	***0.0001***	***0.0001***	***Prob.***	
**	***	***	***		

Source: The researcher's work based on the results of the Eveiws12 program

3- Phillips –Perron Test :To be more sure and to enhance the results of static, the PP test will be performed on the time series of the variables, as shown in Table (15). We note from the results of the above table that the results of the PP test are identical to the results of the ADF test. The rest of the variables can be illustrated as stated in Figure (6).

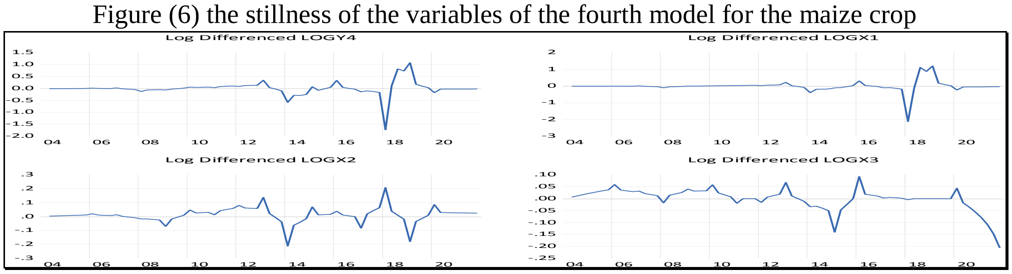
Table No. (15) The results of the PP dormancy test for the fourth model variables for the yellow corn crop

				At Level	
X3	X2	X1	Y4		
-1.9600	-0.7163	-2.1509	-2.8386	t-Statistic	With Constant
0.2997	***0.8168***	***0.2292***	***0.1738***	***Prob.***	
n0	n0	n0	n0		
0.4625	-3.2840	-2.7711	-2.7276	t-Statistic	With Constant & Trend
0.9979	***0.0023***	***0.2247***	***0.2388***	***Prob.***	
n0	**	n0	n0		
-0.0904	2.6006	-1.4922	-0.8439	t-Statistic	Without Constant

					& Trend
0.6380	***0.9956***	***0.1230***	***0.3356***	***Prob.***	
n0	n0	n0	n0		
				At First Difference	
d(X3)	d(X2)	d(X1)	d(Y4)		
-2.2131	-7.7698	-7.1487	-7.0089	t-Statistic	With Constant
0.2093	***0.0000***	***0.0000***	***0.0000***	***Prob.***	
n0	***	***	***		
-3.4347	-8.4881	-7.9138	-6.8030	t-Statistic	With Constant & Trend
0.0820	***0.0000***	***0.0001***	***0.0003***	***Prob.***	
*	***	***	***		
-2.4097	-5.1967	-5.8777	-7.3691	t-Statistic	Without Constant & Trend
0.0197	***0.0000***	***0.0000***	***0.0000***	***Prob.***	
**	***	***	***		

Source: The researcher's work based on the results of the Eveiws12 program

Figure (6) the stillness of the variables of the fourth model for the maize crop



Source: The researcher's work based on the results of the Eveiws12 program

Third: cointegration test: According to the results of static tests, which showed that the variables were not static at the same rank, but some were static at the level and others at the first difference, so the Johanson test cannot be used because the condition of the variables static at the same rank is not available, and the Bounds Test will be used within the ARDL model to test Joint integration and the detection of a long-term equilibrium relationship between the variables. One of the conditions for applying this test is the possibility of testing with the similarity or difference of the degree of integration of the variables, provided that there is no static variable at the second difference. Table (16) indicates the results of the co-integration test by applying the Bounds test. We notice from the above table that the value of the calculated F-statistic value of 24.14047 was greater than the upper limits of the tabular statistical value and at all levels of significance, which means rejecting the null hypothesis and accepting the alternative hypothesis, which means the existence of a short and long-term equilibrium relationship between the variables of the model.

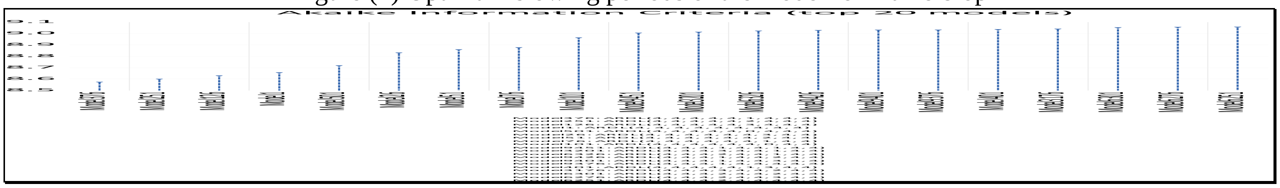
Table (16) Bounds test for cointegration of maize crop

	Null Hypothesis: No levels relationship		F-Bounds Test	
I(1)	I(0)	Signif.	Value	Test Statistic
	Asymptotic: n=1000			
2.85	1.85	10%	24.14047	F-statistic
3.15	2.11	5%	8	K
3.42	2.33	2.5%		
3.77	2.62	1%		
	Finite Sample: n=70		68	Actual Sample Size
-1	-1	10%		
-1	-1	5%		
-1	-1	1%		

Source: The researcher's work based on the results of the Eveiws12 program

Fourth: Estimating the ARDL model: The co-integration was tested according to the (ARDL) methodology through the Bound Test method developed by Pesaran et al (2001), as the Autoregressive model (AR) and period models were combined. distributed slowdown. The estimated (ARDL) model is based on the independent variables represented by the cultivated area X1, average yields X2, purchase prices X3, population X4, average annual temperatures X5, the water of the Tigris and Euphrates rivers X7, chemical fertilizers X8, labor force X11, and the amount of maize production Y4 as a dependent variable. The time lag time is (4, 4, 4, 4, 4, 1, 4, 4, 4), respectively, based on the values of (Akaike) (AIC), which gives the lowest value for this criterion and is determined automatically by the program, as shown in the figure (7)

Figure (7) Optimum slowing periods of the model for maize crop



Source: The researcher's work based on the results of the Eveiws12 program

Table (17) shows the results of the ARDL model test for the maize production function. It is clear from the statistical tests of the model the significance of these tests and the quality of the model estimated through the modified (R2) of (0.91), meaning that the independent variables explain about 91% of the changes in the amount of wheat production and 9% It is due to other variables not included in the model. In addition to the value of (F - Statistic) which amounted to (19785.55) and at a statistically significant level (0.0000). The value of D.W was about 1.9, which is a value close to 2, so we accept the null hypothesis (H0), that is, there is no problem of autocorrelation to the error limit in the estimator model.

table (17) results of the ARDL model for maize production

		Dependent Variable: LOGY4		
			Method: ARDL	
Dynamic regressors (4 lags, automatic): LOGX1 LOGX2 LOGX3 LOGX4				
	LOGX5 LOGX7 LOGX8 LOGX11			
Selected Model: ARDL(4, 4, 4, 4, 4, 1, 4, 4, 4)				
3467.294	Mean dependent var		0.919968	R-squared
1687.863	S.D. dependent var		0.909917	Adjusted R-squared
8.572578	Akaike info criterion		15.33916	S.E. of regression
9.943451	Schwarz criterion		6117.536	Sum squared resid
9.115760	Hannan-Quinn criter.		-249.4677	Log likelihood
1.989412	Durbin-Watson stat		19785.55	F-statistic
			0.000000	Prob(F-statistic)
*Note: p-values and any subsequent tests do not account for model				
		selection.		

Source: The researcher's work based on the results of the Eveiws12 program

Fifth: Error Correction Model (ECM) according to the ARDL methodology: Table (18) shows the results of estimating the impact of production factors on the amount of maize production. We note that the error correction coefficient is negative and significant, meaning that it met the acceptance conditions. Where its value amounted to about (-0.611682), which reflects the existence of a long-term equilibrium relationship between the amount of maize production on the one hand, and the independent variables on the other hand. That is, about 61% of the errors in the short term can be corrected and re-adapted in the long term, meaning that the time required to return to the long-term equilibrium is about 1.634, or about a season and a half and several days, to enhance the quantity of production and return it to the long-term equilibrium position. This confirms the acceptance of the alternative hypothesis, which states that there is an equilibrium relationship in the short term.

Table (18) ECM model results for maize production

Null hypothesis: No serial correlation at up to 2 lags

0.0659	Prob. F(2,24)	3.052562	F-statistic
0.0810	Prob. Chi-Square(2)	13.78996	Obs*R-squared

0.0000	18.02686	0.144877	-0.611682	CointEq(-1)*
-7.188419	Mean dependent var		0.919818	R-squared
708.1603	S.D. dependent var		0.909651	Adjusted R-squared
8.307872	Akaike info criterion		13.22069	S.E. of regression
9.384986	Schwarz criterion		6117.536	Sum squared resid
8.734658	Hannan-Quinn criter.		-249.4677	Log likelihood
			1.989412	Durbin-Watson stat
* p-value incompatible with t-Bounds distribution.				

Source: The researcher's work based on the results of the Eveiws12 program

As for the long-term parameters in their logarithmic form and as illustrated by the equation below, they indicate that the most important factors positively affecting the production of maize are the average yield X2 and purchase prices X3, as we note that the production elasticities of these factors are high, as an increase of these factors by 1% leads to an increase in the amount of production by (4.41% and 3.35%), respectively. Then comes, with a small effect, the cultivated area X1, the water of the Tigris and Euphrates X7, and chemical fertilizers X8, with a response rate of (0.82, 0.70, and 0.64%), respectively, and finally comes the population X4, where resilience indicates that it does not exceed 1%, which is a very weak effect. Its effect was negative, but less than 1% on the amount of production, the annual average of temperature and labor force, as the flexibility towards these factors was (-0.11 and -0.13), respectively, and all variables were significant, as the probability value was less than 0.05.

$$LOGY4 = (0.8270*LOGX1 + 4.4194*LOGX2 + 3.3559*LOGX3 + 0.0678 *LOGX4 -0.1119*LOGX5 + 0.7037*LOGX7 + 0.6480*LOGX8 -0.1337 *LOGX11 - 7437.7064)$$

Sixth: Diagnostic tests of the model;

1- The autocorrelation problem test: The results showed that the estimated model is free from the autocorrelation problem in terms of the LM test, as the value of Prob. Chi - square (0.0810) as shown in Table (19) which is greater than (0.05), i.e. we accept the null hypothesis which states that the residuals are not self-correlated**.**

Table (19) LM test for maize crop

Source: The researcher's work based on the results of the Eveiws12 program

Null hypothesis: No serial correlation at up to 2 lags

0.0659	Prob. F(2,24)	3.052562	F-statistic
0.0810	Prob. Chi-Square(2)	13.78996	Obs*R-squared

Source: The researcher's work based on the results of the Eveiws12 program

Table (20) Breusch test for maize yield

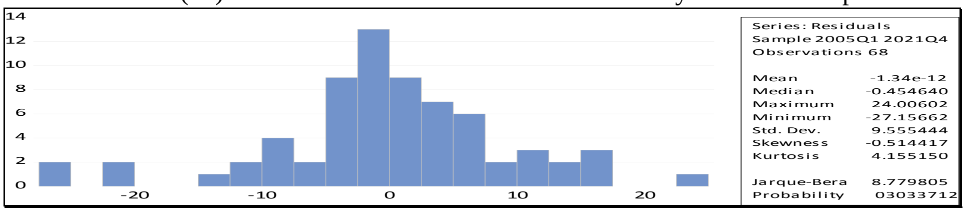
		Heteroskedasticity Test: ARCH	
0.0146	Prob. F(1,65)	6.299437	F-statistic
0.1150	Prob. Chi-Square(1)	5.919574	Obs*R-squared

Source: The researcher's work based on the results of the Eveiws12 program

2- Instability of variance homogeneity: To ensure that the residuals do not suffer from the problem of instability of variance, we find that the value of Prob. Chi - square for the ARCH test, it reached (0.1150), which is greater than 5%, and accordingly we accept the null hypothesis that the residuals are homogeneous and that they do not contain the problem of inhomogeneity of variance.

3- Normal distribution: We note from Table (21) that the probability value of the Jarque-era test was (0.303), which is greater than 5%, which means that the random variable follows a normal distribution and there is no problem

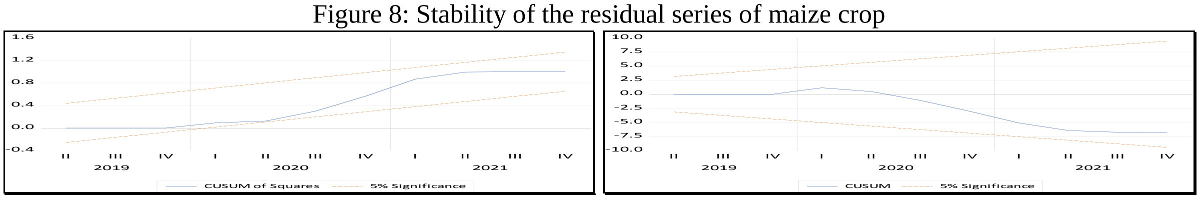
Table (21) shows the normal distribution test for the yellow corn crop



Source: The researcher's work based on the results of the Eveiws12 program

4- Stability of Residual Series: We notice from Figure (8) that the cumulative sum of residuals test (CUSUM) and the cumulative sum of squares residuals test (SUSUMSQ) fall within the limits of stability, which means the stability of the residuals and thus the quality of the results of the ARDL model.

Figure 8: Stability of the residual series of maize crop



Source: The researcher's work based on the results of the Eveiws12 program

The third requirement: future forecasts for the production of strategic agricultural crops in Iraq for the period (2022-2031)

1- Forecasting the function of pulp production for the period (2022-2031): We note table (22), which shows that there is a general trend for the production of pulp during the expected period, heading towards a decline, at a compound annual growth rate of about (-1.2%).

2- Forecast of the maize production function for the period (2022-2031): We note table (23), which shows that there is a general trend for the production of maize during the expected period, heading towards an increase, at a compound annual growth rate of about (7.66%).

Table (23) The expected production quantity of the yellow corn crop for the period (2022-2031)

Table (22) The expected amount of rice production for the period (202

Production amount of maize (thousand tons)	the years	Production amount of maize (thousand tons)	the years	The amount of pulp production (thousands of tons)	the years	The amount of pulp production (thousands of tons)	the years
591.54	2027Q1	1559.3	2022Q1	1000.74	2027Q1	1562.422	2022Q1
733.42	2027Q2	1483.7	2022Q2	1006.12	2027Q2	1493.498	2022Q2
879.43	2027Q3	1403.3	2022Q3	1010.509	2027Q3	1421.742	2022Q3
1029.6	2027Q4	1318.1	2022Q4	1013.677	2027Q4	1351.084	2022Q4
1184.3	2028Q1	1228.7	2023Q1	1015.504	2028Q1	1283.619	2023Q1
1343.3	2028Q2	1135.6	2023Q2	1015.965	2028Q2	1221.517	2023Q2
1506.9	2028Q3	1039.6	2023Q3	1015.118	2028Q3	1165.924	2023Q3
1675.1	2028Q4	941.08	2023Q4	1013.083	2028Q4	1117.64	2023Q4
1848.0	2029Q1	840.09	2024Q1	1010.033	2029Q1	1076.951	2024Q1
2025.7	2029Q2	736.70	2024Q2	1006.167	2029Q2	1043.836	2024Q2
2208.2	2029Q3	630.86	2024Q3	1001.704	2029Q3	1017.981	2024Q3
2395.7	2029Q4	522.46	2024Q4	996.8606	2029Q4	998.8731	2024Q4
2588.1	2030Q1	411.36	2025Q1	991.8454	2030Q1	985.8355	2025Q1
2785.7	2030Q2	297.44	2025Q2	986.8449	2030Q2	978.085	2025Q2
2988.4	2030Q3	180.55	2025Q3	982.0188	2030Q3	974.7687	2025Q3
3196.3	2030Q4	60.549	2025Q4	977.4945	2030Q4	975.0048	2025Q4
3409.7	2031Q1	62.718	2026Q1	973.3656	2031Q1	977.918	2026Q1
3628.4	2031Q2	189.40	2026Q2	969.6915	2031Q2	982.672	2026Q2
3852.7	2031Q3	319.67	2026Q3	966.4995	2031Q3	988.4967	2026Q3
29941.6	2031Q4	453.67	2026Q4	963.7877	2031Q4	994.7113	2026Q4

7.66%	compound annual growth rate	-1.2^%	compound annual growth rate

Source: The researcher's work based on the results of the Eveiws12 program

conclusions

1- The production of strategic agricultural crops in Iraq has been affected by many factors, whether by increase or decrease, which are natural, economic and technological factors.

2- The production of summer strategic agricultural crops has fluctuated, and the rapeseed crop ranked first, followed by the yellow corn crop.

3- The results indicate that there is a significant relationship between the independent variables (cultivated area, average yield, purchase prices, population, average annual temperature, rainfall, chemical fertilizers, agricultural labour force, water of the Tigris and Euphrates rivers) and the dependent variable (production quantities).

4- Through future predictions for the production of strategic agricultural crops, the results showed that the quantities of rice production tended to decline, with an annual growth rate of -1.2%.

Recommendations

1- The need to control and control the factors that affected the production of strategic agricultural crops, whether they are present or in the future

2- Increasing state support for summer strategic agricultural crops because they are linked to food security and sustainable development to ensure that the actual need for food commodities from these crops is met in line with the population increase.

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