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Standard Economic Study for Analyzing the Production Costs of Wheat and Yellow Corn Crops in Iraq for the Period (2017-2021)

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Abstract. Studying production costs is significant for any productive facility. Costs represent the total payments that are paid as prices of production factors services during a certain period. They are of the determining factors that influence any productive process for they affect the donum productivity, alternative uses of production elements, and net profit. The research problem is the increase production costs of main grain crops in Iraq, notably wheat and yellow corn, which in turn decreases their rate of return. The cause of this increase is the inefficiency of using agricultural resources. This study uses descriptive and quantitive statistical analysis methods including averages, percentages, and standard figures in order to evaluate the impact of each of cost factors individually. The research aims at studying the development of area, production, Donum productivity, and changes in production costs of wheat and yellow corn in Iraq between 2017-2021 . It also aims at studying the relation between productive resources costs and the increase in the Donum production costs for each crop individually in order to find out the influence of each cost item on this increase. The statistical analysis of the period from 2017 to 2021 reveals that the Donum productivity costs generally went upward with an increase of approximately 140,000 and 268,000 Iraqi dinars for wheat and yellow corn respectively. This increase represents 46 % and 54% of the total production costs in the base year (2017). This increase mainly resulted from the increase of labor wages, seeds and fertilizers prices, and irrigation costs for wheat and from the increase of labor wages, seeds prices, and petty cash for yellow corn.

Keywords. Agricultural production, Yellow Corn, Wheat.

1. Introduction

In recent years, the economic importance of major grain crops in Iraq and the world has increased due to growing demand and high prices, especially for wheat and yellow corn, which are used for daily consumption by humans and animals. Iraq's wheat production decreased in 2022 by around three million tons due to various factors, including drought and water scarcity crisis. Previously, Iraq had been relatively self-sufficient in wheat production for the years 2019, 2020, and 2021, with an average

production of approximately 4.5 million tons. On the other hand, yellow corn production in 2022 reached around 500,000 tons, an increase of 122,000 tons compared to 2021. This increase was attributed to ample rainfall during the autumn season for cultivating this crop, according to data from the Iraqi Ministry of Agriculture.

Production costs are fundamental in agricultural economic policy planning. The term "production costs" generally refers to the total estimated or incurred costs associated with using production inputs during a specific period of time. These costs include factors such as labor wages, raw material costs, building rent, fuel, and other expenses related to production inputs.

Knowing these costs is crucial because they determine the volume and price at which products can be sold. Cost analysis also helps assess the production efficiency of an establishment, which depends on increasing resource productivity. Efficiency refers to the optimal use of resources to maximize output of goods and services. It represents the relationship between inputs and outputs. Therefore, it represents the ratio between the achieved output and the resources utilized, Economic theory indicates that the most productive farm size is the size that achieves the lowest possible production cost and the highest net return per unit produced [1].

Resource costs play a significant role in determining the net return per donum and the optimal production volume. By combining production inputs in certain proportions to achieve the largest possible output, increasing resource productivity leads to an increase in the productivity rate of the production unit. Consequently, it boosts agricultural income, national income, and agricultural investments due to higher returns on these investments. This, in turn, reflects on the potential to enhance the overall welfare of society. On the other hand, increasing the productivity efficiency of the resource unit leads to a reduction in the average cost of the production unit, resulting in lower prices at the local level and increased competitiveness in foreign markets. Thus, it provides a greater amount of foreign currency, which is essential for comprehensive development in the country [2].

Given the above, studying the items of production costs is of great importance. It helps identify the factors responsible for increasing productivity efficiency and ultimately minimizing the overall average cost per donum.

1.1. The Research Problem

Economic development derives its components from the optimal utilization of resources. The flow of production and the real average income in any society depend on the available productive resources on one hand and how they are utilized on the other hand. Economic theory suggests that the most efficient farm size is the one that achieves the lowest possible production cost and the highest net return per production unit [3].

The research problem arises from the fact that the production of some major grain crops in Iraq faces a continuous increase in production costs, resulting in a decline in their economic return.

This is caused by farmers' inability to make use of the productive resources efficiently. This leads to using these resources in alternative purposes of lower cost and higher profits. This in turn enlarges the food gap of these crops and obliges the government to bear the huge financial burden of import [4].

1.2. Research Objective

This research aims at studying the relation between the costs of productivity resources used in cultivating the study crops and the average increase in the Donum productivity costs of each crop, with the purpose of assessing the role of each item in this increase. Thereby, the factors of higher impact which impose additional burdens on farmers and hinder the economic efficiency of resources used in these crops production in spite of their high prices are determined.. The research also aims to study the most important production indicators in terms of cultivated area, production, and per-area productivity of the study crops during the period (2017-2021).

1.3. Research Methodology

The study relied on analyzing the data and presenting the results using descriptive statistical methods, such as tabular presentation of data, percentages, and averages. Additionally, quantitative statistical analysis was used, employing standard numbers as an analytical tool suitable for the nature of the

research. It can isolate the impact of the cost of each component in the production process of the study crops on one hand and highlight the effect of these changes, whether in absolute or relative values, on the other hand.

2. Data Sources

The research primarily relied on secondary data from sources such as the Iraqi Ministry of Agriculture , Planning and Monitoring Department, Agricultural Statistics and Labor Force Division, as well as data from the Arab Organization for Agricultural Development, specifically the agricultural data and statistics related to Iraq and the research topic.

3. Results and Discussion

3.1. Firstly: The Development of the Area, Production, and Productivity of Wheat and Yellow Corn Crops in Iraq During the Period (2017-2021)

Due to the low rate of wheat yield in Iraq compared to what agricultural production in the world has achieved and the high prices of its supply on the global market, the situation will get worse in the coming years due to population growth. Therefore, working to raise productivity rates per donum per unit area becomes a central goal for development programs and increasing production to reach the stage of self-sufficiency [5].

The study of the economic reality of wheat and yellow corn crops in Iraq during the period (2017-2021), in terms of cultivated area, per-area yield, and total production, provides some important indicators for policymakers in allocating and reusing resources more efficiently. This part of the research will examine these indicators as follows:

3.1.1. The Development of the Cultivated Area, Production, and Productivity of Wheat in Iraq

From the analysis of the data in Table 1, it is evident that the cultivated area of wheat in Iraq during the study period ranged from a minimum of about 3,154 thousand donum in 2018, which represents a record increase of about 74.81% compared to 2017. The maximum cultivated area reached about 9,464 thousand donums in 2021, representing about 224.48% increase compared to 2017, the average annual total cultivated area was about 6,348 thousand donums during that period.

Regarding the average yield per donum of wheat in Iraq, the data in Table 1 showed that it ranged from a minimum of 447 kg in 2021, which represents a record increase of about 54.2% compared to 2017, to a maximum of 728 kg in 2020, which represents about 103.13% increase compared to 2017. The average annual productivity reached about 651 kg during the study period.

Table (1) on the overall wheat production in Iraq during the study period, which ranged from a minimum of about 2,178 thousand tons in 2018, representing a record number of about 73.22% compared to 2017, to a maximum of about 6,238 thousand tons in 2020, representing about 209.74% compared to 2017. The average annual total production was about 3,993.6 thousand tons during the period (2017-2021).

Table 1. Development of Area, Production, and Productivity of Wheat in Iraq for the Period (2017-2021). (Base Year 2017 = 100).

Year	Area A thousand per donum	Index number of area	Average production Kg/ donum	Index number of average production	Production Thousand tons	Index number of production
2017	4216	100.00	705.5	100.00	2974.4	100.00
2018	3154	74.81	690.5	97.90	2178	73.22
2019	6331	150.17	686.1	97.25	4344	146.10
2020	8574	203.40	727.6	103.13	6238.4	209.74
2021	9464	224.48	447.3	63.40	4233.3	142.32
Average	6347.8		651.4		3993.6	

Source: Compiled and calculated from data from the Iraqi Ministry of Planning - Central Statistical Organization - Agricultural Statistics Directorate.

3.1.2. Development of Cultivated Area, Production, and Productivity of Yellow Corn

From studying the data in Table (2) it is evident that the cultivated area of yellow corn in Iraq during the study period ranged from a minimum of about 56 thousand donums in 2018, representing a record number of about 25.1% compared to 2017, to a maximum of about 515.2 thousand donums in 2019, representing about 231.24% compared to 2017. The average annual total cultivated area was about 305 thousand donums during that period.

As for the average productivity per donum of yellow corn in Iraq, the data from Table (2) shows that it ranged from a minimum of about 682.3 kilograms in 2019, representing a record number of about 82.05% compared to 2017, to a maximum of about 1,361 kilograms In 2018, representing about 163.8% compared to 2017. The average annual total productivity was about 1,011.6 kilograms during the study period.

Referring to the data in Table (2) on the development of total yellow corn production in Iraq during the study period, it ranged from a minimum of about 76 thousand tons in 2018, representing about 41.02% compared to 2017, to a maximum of about 419.4 thousand tons in 2020, representing about 226.34% compared to 2017. The average annual total production was about 281.32 thousand tons during (2017-2021).

Table 2. Development of Area, Production, and Productivity of Yellow Corn in Iraq for the Period (2017-2021) (Base Year 2017 = 100).

Year	Area A thousand per donum	Index number of area	Average production Kg/ donum	Index number of average production	Production Thousand tons	Index number of production
2017	222.80	100.00	831.60	100.00	185.30	100.00
2018	55.84	25.10	1361.00	163.80	76.00	41.02
2019	515.20	231.24	682.3	82.05	351.52	189.70
2020	405.44	182	1034.30	124.38	419.40	226.34
2021	325.90	146.28	1148.80	138.14	374.40	202.10
Average	305.04		1011.6		281.32	

Source: Collected and calculated from data from the Iraqi Ministry of Planning - Central Statistical Organization - Agricultural Statistics Directorate.

3.2. Secondly: Analysis of the Cost Items of Wheat Production

Wheat is one of the most important crops in Iraq and many other countries, both in terms of quantity and nutritional value. The local production in 2019 reached about 4.75 million tons, which means it has reached the stage of self-sufficiency in this important crop. Iraq's annual demand for wheat is approximately 4.2 million tons according to the Ministry of Agriculture data.

To meet the food demands resulting from Iraq's growing population, enhancing productivity per donum becomes imperative. This necessitates improving the efficiency of various elements involved in the agricultural process, which is closely tied to analyzing production costs. Production costs encompass the expenses associated with utilizing agricultural production factors such as land, labor, capital, and other elements, ultimately determining the per-donum costs of cultivating a specific crop within a given year. These costs constitute a complex economic phenomenon, reflecting the cumulative expenses incurred in achieving productivity on a per-donum basis.

The production cost function represents the physical relationship between the total production costs and the quantity of production factors that combined to produce the desired commodity for a specific production unit and time period [6].

Based on the above, the different specific costs per donum (independent variables) of wheat production can be represented as a function of the total costs involved in the production process of this crop, as shown in Table (3), and mathematically expressed by the following equation:

$$C = f(I, A, S, M, N, P, H, T, E)$$

Where:

C : Total production costs of wheat. *I* : Human labor wages for wheat.

A : Value of mechanized labor wages for wheat. *S* : Fuel cost for wheat.

M : Seed cost for wheat. *N* : Chemical fertilizer cost for wheat.
P : Pesticide cost for wheat. *H* : Irrigation water cost for wheat.
T : Miscellaneous expenses for wheat. *E* : Land rent for wheat.

The impact of each item (variable) of these costs and its responsibility for the changes that occur in the production costs per donum of wheat is measured by comparing the year 2021 with the base year 2017. Then, the results are analyzed using the standard numbers through the use of Equation (1):

$$IC=(\sum C_1) / (\sum C_0)\times 100 \quad (1)$$

Where:
C_0 is the production costs per donum of wheat in the base year 2017.
C_1 is the production costs per donum of wheat in the comparison year 2021.
IC represents the simple cumulative standard number of production costs per donum of wheat in the comparison year (2021) relative to the base year (2017).

Table 3. Cost items of wheat production per donum in Iraq for the period (2017-2021).

Code	Cost items	Production cost items/ (1000) dinars					The average period is in 1000 dinars
		2017	2018	2019	2020	2021	
I	Wages and human labour	75	75	90	95	110	89
A	Wages and automated work	90	100	100	110	120	104
S	Fuel price	12	12	12	15	15	13.2
M	The price of seeds	25	25	40	40	40	34
N	The price of chemical fertilizer	37.8	37.8	44.8	55	55	46.1
P	The price of pesticides	4	5	5	5	5	4.8
H	The price of irrigation water	4	4	7.5	10	20	9.1
T	Incidental expenses	50	55	55	55	62	55.4
E	Rent of acres of land	4.5	4.5	5	10	15	7.8
	total summation	302.3	318.3	359.3	395	442	363.4

Source: - Arab Organization for Agricultural Development - Agricultural data and statistics for Iraq.
-Iraqi Ministry of Agriculture- Planning and Monitoring Department - Agricultural Statistics and Labor Force Department - Unpublished data.

According to the data in Table (3), the total average production costs during the study period (2017-2021) amounted to approximately 363,000 dinars. The overall average for these costs for wheat in 2017 was around 302,000 dinars. The value of machinery labor costs ranked first among the cost items, amounting to approximately 90,000 dinars, accounting for about 30% of the total production costs for this crop in that year. It was followed by human labor costs amounting to about 75,000 dinars, representing about 25%. Then, there were miscellaneous expenses, fertilizer cost, seed cost, fuel cost, land rent per- donum, pesticide cost, and irrigation cost, with values of approximately 50,000, 37,800, 25,000, 12,000, 4,500, 4,000, and 4,000 dinars, respectively, accounting for approximately 16.5%, 12.5%, 8.3%, 4%, 1.5%, 1.3%, and 1.3% of the total production costs per-donum for wheat in Iraq, respectively, in order.

From the indicators in Table (3), it can be observed that the per- donum production costs for wheat in Iraq can be classified into cost items for the base year and cost items for the comparison year. Equation (1) takes the following form, as shown in Equation (2), which illustrates the comparison of per- donum cost items for the base and comparison years:

$$IC = \frac{C_1}{C_0} = \frac{\sum \quad (CI_1+CA_1+CS_1+CM_1+CN_1+CP_1+CH_1+CT_1+CE_1)}{\sum \quad (CI_0+CA_0+CS_0+CM_0+CN_0+CP_0+CH_0+CT_0+CE_0)} \quad (2)$$

CI_1, CI_0: Human labor costs expended in producing per- donum for the base year and comparison year, respectively.
CA_1, CA_0: Machinery labor costs expended in producing per- donum for the base year and comparison year, respectively.

CS_1, CS_0: Fuel costs expended in producing per donum for the base year and comparison year, respectively.
CM_1, CM_0: Seed costs expended in producing per- donum for the base year and comparison year, respectively.
CN_1, CN_0: Fertilizer costs expended in producing per- donum for the base year and comparison year, respectively.
CP_1, CP_0: Pesticide costs expended in producing per- donum for the base year and comparison year, respectively.
CH_1, CH_0CH0: Irrigation costs expended in producing per- donum for the base year and comparison year, respectively.
CT_1, CT_0: Miscellaneous expenses expended in producing per- donum for the base year and comparison year, respectively.
CE_1, CE_0: Land rent costs expended in producing per- donum for the base year and comparison year, respectively.
To clarify the responsibility of each cost item for per- donum wheat production costs in Iraq, Equation (2) will be compensated in different cost items to demonstrate the impact of each item individually. Each time a specific cost item is changed, while keeping the other items fixed, a relative number (the benchmark number) will be obtained, indicating the responsibility of that item for the changes in per-donum production costs between the base and comparison years of the study, as shown in the following equations.

3.2.1. Impact of Human Labor Costs Item
The impact of human labor costs for the comparison year is shown by its value in the numerator of the equation instead of its value in the base year.

$$I_{CL} = \frac{\sum \quad (CI_1+CA_0+CS_0+CM_0+CN_0+CP_0+CH_0+CT_0+CE_0)}{\sum \quad (CI_0+CA_0+CS_0+CM_0+CN_0+CP_0+CH_0+CT_0+CE_0)} \tag{3}$$

Where (CI_1) represents the benchmark number for costs when changing the value of the human labor costs item.

$$I_{CL} = \frac{110 + 90 + 12 + 25 + 37.8 + 4 + 4 + 50 + 4.5}{75+90+12+25+37.8+4+4+50+4.5}$$

$$I_{CL} = 1.116$$

3.2.2. Effect of the Automated Labor Wages Item
This point refers to the impact of the automated labor wages item on the production costs of wheat for the comparative year, through its apparent value in the denominator of the equation instead of its value in the base year.

$$I_{CA} = \frac{\sum \quad (CI_1+CA_1+CS_0+CM_0+CN_0+CP_0+CH_0+CT_0+CE_0)}{\sum \quad (CI_1+CA_0+CS_0+CM_0+CN_0+CP_0+CH_0+CT_0+CE_0)} \tag{4}$$

Where: I_{CA}: Represents the benchmark cost when changing the value of the automated labor wages item.

$$I_{CA} = \frac{110 + 120 + 12 + 25 + 37.8 + 4 + 4 + 50 + 4.5}{110+90+12+25+37.8+4+4+50+4.5}$$

$$I_{CA} = 1.090$$

3.2.3. Effect of the Fuel Cost Item
This point refers to the impact of the fuel cost item on the production costs of wheat for the comparative year, through its apparent value in the denominator of the equation instead of its value in the base year.

$$I_{CS} = \frac{\sum (CI_1+CA_1+CS_1+CM_0+CN_0+CP_0+CH_0+CT_0+CE_0)}{\sum (CI_1+CA_1+CS_0+CM_0+CN_0+CP_0+CH_0+CT_0+CE_0)} \quad (5)$$

Where: I_{CS}: Represents the benchmark cost when changing the value of the fuel cost item.

$$I_{CS} = \frac{110 + 120 + 15 + 25 + 37.8 + 4 + 4 + 50 + 4.5}{110+120+12+25+37.8+4+4+50+4.5}$$

$$I_{CS} = 1.010$$

3.2.4. Effect of the Seed Cost Item

This point refers to the impact of the seed cost item on the production costs of wheat for the comparative year, through its apparent value in the denominator of the equation instead of its value in the base year.

$$I_{CM} = \frac{\sum (CI_1+CA_1+CS_1+CM_1+CN_0+CP_0+CH_0+CT_0+CE_0)}{\sum (CI_1+CA_1+CS_1+CM_0+CN_0+CP_0+CH_0+CT_0+CE_0)} \quad (6)$$

Where: I_{CM}: Represents the benchmark cost when changing the value of the seed cost item.

$$I_{CM} = \frac{110 + 120 + 15 + 40 + 37.8 + 4 + 4 + 50 + 4.5}{110+120+15+25+37.8+4+4+50+4.5}$$

$$I_{CM} = 1.041$$

3.2.5. Effect of the Chemical Fertilizer Cost Item

This point refers to the impact of the chemical fertilizer cost item on the production costs of wheat for the comparative year, through its apparent value in the denominator of the equation instead of its value in the base year.

$$I_{CN} = \frac{\sum (CI_1+CA_1+CS_1+CM_1+CN_1+CP_0+CH_0+CT_0+CE_0)}{\sum (CI_1+CA_1+CS_1+CM_1+CN_0+CP_0+CH_0+CT_0+CE_0)} \quad (7)$$

Where: I_{CN}: Represents the benchmark cost when changing the value of the chemical fertilizer cost item.

$$I_{CN} = \frac{110 + 120 + 15 + 40 +55 + 4 + 4 + 50 + 4.5}{110+120+15+40+37.8+4+4+50+4.5}$$

$$I_{CN} = 1.045$$

3.2.6. Effect of the Pesticide Cost Item

This point refers to the impact of the pesticide cost item on the production costs of wheat for the comparative year, through its apparent value in the denominator of the equation instead of its value in the base year.

$$I_{CP} = \frac{\sum (CI_1+CA_1+CS_1+CM_1+CN_1+CP_1+CH_0+CT_0+CE_0)}{\sum (CI_1+CA_1+CS_1+CM_1+CN_1+CP_0+CH_0+CT_0+CE_0)} \quad (8)$$

Where: I_{CP}: Represents the benchmark cost when changing the value of the pesticide cost item.

$$I_{CP} = \frac{110 + 120 + 15 + 40 +55 + 5 + 4 + 50 + 4.5}{110+120+15+40+55+4+4+50+4.5}$$

$$I_{CP} = 1.002$$

3.2.7. Effect of the Irrigation Water Cost Item

This point refers to the impact of the irrigation water cost item on the production costs of wheat for the comparative year, through its apparent value in the denominator of the equation instead of its value in the base year.

$$I_{CH} = \frac{\sum (CI_1+CA_1+CS_1+CM_1+CN_1+CP_1+CH_1+CT_0+CE_0)}{\sum (CI_1+CA_1+CS_1+CM_1+CN_1+CP_1+CH_0+CT_0+CE_0)} \quad (9)$$

Where: I_{CH}: Represents the benchmark cost when changing the value of the irrigation water cost item.

$$I_{CH} = \frac{110 + 120 + 15 + 40 + 55 + 5 + 20 + 50 + 4.5}{110+120+15+40+55+5+4+50+4.5}$$

$$I_{CH} = 1.041$$

3.2.8. Effect of the Miscellaneous Expenses Cost Item

This point refers to the impact of the miscellaneous expenses cost item on the production costs of wheat for the comparative year, through its apparent value in the denominator of the equation instead of its value in the base year.

$$I_{CT} = \frac{\sum (CI_1+CA_1+CS_1+CM_1+CN_1+CP_1+CH_1+CT_1+CE_0)}{\sum (CI_1+CA_1+CS_1+CM_1+CN_1+CP_1+CH_1+CT_0+CE_0)} \quad (10)$$

Where: I_{CT}: Represents the benchmark cost when changing the value of the miscellaneous expenses cost item.

$$I_{CT} = \frac{110 + 120 + 15 + 40 + 55 + 5 + 20 + 62 + 4.5}{110+120+15+40+55+5+20+50+4.5}$$

$$I_{CT} = 1.031$$

3.2.9. Effect of the Land Rent Cost Item

This point refers to the impact of the land rent cost item on the production costs of wheat for the comparative year, through its apparent value in the denominator of the equation instead of its value in the base year.

$$I_{CE} = \frac{\sum (CI_1+CA_1+CS_1+CM_1+CN_1+CP_1+CH_1+CT_1+CE_1)}{\sum (CI_1+CA_1+CS_1+CM_1+CN_1+CP_1+CH_1+CT_1+CE_0)} \quad (11)$$

Where: I_{CE}: Represents the benchmark cost when changing the value of the land rent cost item.

$$I_{CE} = \frac{110 + 120 + 15 + 40 + 55 + 5 + 20 + 62 + 15}{110+120+15+40+55+5+20+62+4.5}$$

$$I_{CE} = 1.024$$

By summarizing the results of equations (3 to 11), the results shown in Table (4) were obtained. These results indicate that the total production costs per- donum of wheat in Iraq increased by about 140,000 dinars, or 46%, in 2021 compared to the base year in 2017. We note that this increase in total production costs per- donum was distributed according to the items as follows: 35, 30, 17.2, 16, 15, 12, 10.5, 3, 1 thousand dinars for human labor, automated labor, chemical fertilizer cost, irrigation cost, seed cost, miscellaneous expenses, land rent, fuel cost, and pesticide cost, respectively. These percentages accounted for approximately 25%, 21.4%, 12%, 11.4%, 10.7%, 8.6%, 7.5%, 2%, and 0.7% of the total increase, respectively, in the order mentioned.

Table 4. Comparison of cost items and their impact on the total costs per- donum of wheat crop in Iraq between the base year and the comparative year (2017-2021).

No.	Cost items	Calculated values of costs (thousand dinars)	Index No.	Absolute change (thousand dinars)	Change in items %
1	I_c Cost in the base year	302.21	-	-	
2	I_{CI} The effect of human labor wages on total costs.	337.3	1.120	35	25%
3	I_{CA} The effect of automated labor wages on total costs.	367.3	1.090	30	21.4%
4	I_{CS} The effect of fuel price on total costs	370.3	1.010	3	2.2%
5	I_{CM} The effect of the price of seeds on total costs.	385.3	1.041	15	10.7%
6	I_{CN} The effect of the price of	402.5	1.045	17.2	12.3%

No.	Cost items	Calculated values of costs (thousand dinars)	Index No.	Absolute change (thousand dinars)	Change in items %
	chemical fertilizer on total costs.				
7	I_{CP} The effect of the price of pesticides on total costs.	403.5	1.002	1	0.72%
8	I_{CH} The effect of the price of irrigation water on total costs.	419.5	1.041	16	11.5%
9	I_{CT} The effect of the price of incidental expenses on total costs.	431.5	1.031	12	8.6%
10	I_{CE} The effect of land rent on total costs.	442	1.024	10.5	7.5%
Total		-	1.04	139.7	100 %

Source: Based on the data in Table 3.

It is evident from the indicators shown in Table (4) that increasing the economic productivity efficiency of the wheat crop can affect the total production costs per- donum of wheat, as well as the impact of each item individually. Specifically, the items related to human labor wages, automated labor wages, chemical fertilizer cost, and irrigation cost.

3.3. Thirdly: Analysis of the Cost Items of the Yellow Corn Crop

Yellow corn is a widely cultivated crop worldwide. It is directly and indirectly consumed by humans and used as animal feed. It is also used in various industries such as oils, starch, and paper. The importance of the crop globally is highlighted by the global trends in extracting fuel from yellow corn kernels [7].

The different per- donum production costs (independent variables) of the yellow corn crop can be represented as a function of the total cost items involved in the production process, as shown in Table (5), and mathematically expressed by the following equation:

$$C = f(I, A, S, M, N, P, H, T, E)$$

Where:
C : Total production costs of the yellow corn crop.
I : Value of human labor wages for the yellow corn crop.
A : Value of automated labor wages for the yellow corn crop.
S : Fuel cost for the yellow corn crop.
M : Seed cost for the yellow corn crop.
N: Chemical fertilizer cost for the yellow corn crop.
P : Pesticide cost for the yellow corn crop.
H: Irrigation water cost for the yellow corn crop.
T : Miscellaneous expenses for the yellow corn crop.
E : Land rent for the yellow corn crop.

Table 5. Comparison of cost items and their impact on the total costs per- donum of the yellow corn Crop in Iraq between the base year and the comparative year (2017-2021).

Code	Cost items	Production cost items/ (1000) dinars					The average period is in 1000 dinars
		2017	2018	2019	2020	2021	
I	Wages and human labour	150	150	160	175	200	167
A	Wages and automated work	125	125	140	160	175	145
S	Fuel price	30	30	45	50	55	42
M	The price of seeds	35	42	50	60	75	52.4
N	The price of chemical fertilizer	50	50	65	75	75	63
P	The price of pesticides	8	10	10	12	14	10.8

Code	Cost items	Production cost items/ (1000) dinars					The average period is in 1000 dinars
		2017	2018	2019	2020	2021	
H	The price of irrigation water	15	15	18	20	30	19.6
T	Incidental expenses	75	75	100	125	125	100
E	Rent of acres of land	8	10	10	15	15	11.6
	Total	496	507	598	692	764	611.4

Source: - Ministry of Agriculture/ Planning and Monitoring Department - Agricultural Statistics and Labor Force Department - Unpublished data.
- Arab Organization for Agricultural Development - Agricultural data and statistics for Iraq. Development.

Table (5) reveals that the average total production costs during the study period (2017-2021) amounted to approximately 496 thousand dinars. As for the average total cost for yellow corn in 2017, it amounted to around 496 thousand dinars. The value of labor wages topped the list of costs, amounting to approximately 150 thousand dinars, accounting for about 30.2% of the total production costs for this crop in that year. It was followed by machinery labor costs, amounting to approximately 125 thousand dinars, accounting for about 25.2%. Then came the miscellaneous expenses, fertilizer cost, seed cost, fuel cost, irrigation cost, pesticide cost, and land rent, amounting to approximately 75, 50, 35, 30, 15, 8, 8 thousand dinars, respectively, with percentages of approximately 15%, 10%, 7%, 6%, 3%, 1.6%, 1.6% of the total production costs per donum of yellow corn in Iraq, in order.

By applying equation (2) to the different cost items per donum of yellow corn in Iraq, to determine the impact of each item on the total costs, the values in equations (3-11) were replaced with the indices given in Table (5).

The data and results recorded in Table (6) were obtained, indicating that the total production costs per donum of yellow corn in Iraq increased by approximately 268 thousand dinars or 54% in 2021 compared to the base year of 2017. It is noteworthy that this increase in total production costs per-donum was distributed among the items as follows: 50, 50, 50, 40, 25.25, 15.2, 7, 6 thousand dinars for labor wages, machinery labor, miscellaneous expenses, seed cost, fuel cost, chemical fertilizer cost, irrigation water cost, land rent, and pesticide cost, respectively. These amounts accounted for approximately 18.7%, 18.7%, 18.7%, 15%, 9.3%, 9.3%, 5.7%, 2.6%, 2.2% of the increase, in that order.

Table 6. Comparison of Cost Items and their Impact on Total Costs per Donum of Yellow Corn in Iraq between the Base Year and Comparison Year (2017-2021).

No.	Cost items	Calculated values of costs (thousand dinars)	Index No.	Absolute change (thousand dinars)	Change in items %
1	I_c Cost in the base year.	**496**	-	-	
2	I_{CI} The effect of human labor wages on total costs.	546	1.101	50	18.7%
3	I_{CA} The effect of automated labor wages on total costs.	596	1.092	50	18.7 %
4	I_{CS} The effect of fuel price on total costs.	621	1.042	25	9.2 %
5	I_{CM} The effect of the price of seeds on total costs.	661	1.064	40	15 %
6	I_{CN} The effect of the price of chemical fertilizer on total costs.	686	1.038	25	9.3 %
7	I_{CP} The effect of the price of pesticides on total costs.	692	1.009	6	2.2 %
8	I_{CH} The effect of the price of irrigation water on total costs.	707	1.022	15	5.6 %
9	I_{CT} The effect of the price of incidental expenses on total costs.	757	1.071	50	18.7 %

No.	Cost items	Calculated values of costs (thousand dinars)	Index No.	Absolute change (thousand dinars)	Change in items %
10	I_{CE} The effect of land rent on total costs.	764	1.009	7	2.6 %
Total		-	1.23	268	100%

Source: Calculated from the data in Table number (5).

Through the indicators shown in Table (6), it is evident that increasing the economic efficiency of producing this crop can impact the total production costs per cultivated area of yellow corn on one hand, as well as the impact of each item individually on the other hand, specifically the items related to human labor wages, automated labor wages, miscellaneous expenses, and seed cost.

Conclusion

- Developing new varieties with high productivity that help increase the productivity of the study crops and fill the nutritional gap.
- Providing production requirements according to farmers' needs at reasonable price.
- Using modern agricultural technology to contribute to increasing the productivity of the study crops.
- Establishing a pricing and marketing policy that takes into account the interests of producers in ensuring that they obtain a profitable profit margin.
- Giving a greater role to agricultural extension in order to urge farmers to use modern scientific methods and according to the scheduled dates for planting, fertilizing and harvesting.

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