Evaluation of the Agricultural Reality of the Industrial Yellow Corn Crop in the Iraqi Province of Kirkuk

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Abstract. The agricultural sector is considered one of the important and vital economic sectors in any country due to its role in providing food, clothing, employment opportunities for the population, and the supply of raw materials needed for industries. In Iraq, this sector is the largest non-oil economic sector and contributes significantly to the Gross Domestic Product (GDP). Yellow maize (corn) is one of the main economic crops in Iraq. This study evaluates the agricultural situation of yellow maize crop in Kirkuk Governorate. The statistical data pertaining to the crop, including cultivated areas, production, productivity, and crop prices, were assessed descriptively through the calculation of arithmetic averages, percentages, growth rates, and graphical representations. During the study period from 2000 to 2021, approximately 23,000 to 237,000 tons of yellow corn were produced in Kirkuk province, Iraq. This crop was cultivated over an area ranging from 10,000 to 39,000 hectares of cultivated land during various years within the mentioned period. The average contribution of the yellow corn cultivation area in Kirkuk to the total cultivated areas of yellow corn in Iraq was approximately 19%. This study examines the average contribution of yellow corn production in Kirkuk Governorate to the overall yellow corn production in Iraq, which stands at approximately 24%. The contribution of yellow corn production in the region has exhibited considerable fluctuations over the years, with the highest contribution recorded in 2018 at 71.1%, and the lowest in 2006 at 6.3%. These fluctuations can be attributed to insufficient support for yellow corn cultivation, as well as the impact of various factors, including environmental, human, technological, political, and economic elements. The average corn crop yield in Kirkuk Governorate was estimated at around 3904 kg/ha. Notably, the highest yield was achieved in 2013, reaching 7592 kg/ha, while the lowest yield was recorded in 2014 at 1092 kg/ha, primarily due to challenging conditions faced by the region during that year. The annual growth rates for cultivated area, production, productivity, and price demonstrated positive rates, with values of 9.2%, 7.4%, 4.6%, and 6.7%, respectively. This indicates an increase of 9.2%, 7.4%, 4.6%, and 6.7% in the cultivated area, production, productivity, and price of yellow corn in Kirkuk Governorate, respectively. However, these positive rates were insufficient to meet the rising local demand for yellow corn. İn this study, recommendations were made to establish agricultural plans and policies for this crop, as well as to open multiple marketing channels in the Kirkuk province, particularly during the harvesting season. These measures aim to alleviate the burdens on farmers and protect them in order to mitigate the decline in the cultivation of this important crop. Furthermore, additional research is proposed, focusing on aspects related to the crop, such as price and marketing studies, to develop productive and pricing policies that can address the existing deterioration in the production of this crop. Increasing the purchasing price of this crop and providing prior disclosure of the

price before the production season for yellow corn is suggested to incentivize farmers to engage in its cultivation. Additionally, granting more agricultural loans is recommended to enhance the production of this strategic crop and activate the role of agricultural guidance in the province. This would facilitate the transfer of modern agricultural techniques and provide clarification to farmers on their implementation.

Keywords. Agriculture, Yellow Corn, Cultivated Area, Production, Prices.

1. Introduction

The agricultural sector is one of the vital and essential sectors in any country's economy due to its provision of food, clothing, employment opportunities for the population, and raw materials for industries. In Iraq, this sector is the largest non-oil economic sector, contributing approximately 25% of the country's workforce and 5% of the Gross Domestic Product (GDP). Therefore, comprehensive development in the country is unimaginable without accompanying progress in the agricultural sector. In the field of food security, in particular, this sector faces challenges in balancing the demand for food with its supply due to fluctuations in domestic production and an increase in population, among other factors, including a decline in average per capita income.

Yellow corn is one of the main economic crops in Iraq and ranks fourth after wheat, rice, and barley. The cultivated area of yellow corn fluctuates from year to year due to competition with other summer crops such as cotton and potatoes [1]. Yellow corn is widely distributed worldwide and is consumed directly or indirectly by humans. It is also used to produce flour mixed with wheat flour at a ratio of 5-15% for bread-making. Additionally, its seeds are used in starch production due to their high carbohydrate content (70-80%) and in oil production, as they contain approximately 4% of a liquid oil known for its nutritional and health benefits. Moreover, yellow corn is used as green or dry fodder, while its stalks are used in the paper industry [2].

The economic value of corn is increasing day by day. The corn kernel contains approximately 70% starch, 10% protein, and 5% fats. Out of the total corn produced globally, 70% is used for animal feed, 25% for human consumption, and 5% for industrial purposes as a raw material. To increase both the yield and quality of corn per unit area, it is essential to distribute different varieties in production and encourage farmers to use high-quality seeds [3].

Plant production holds significant economic importance in overall agricultural output. The expansion of other agricultural crops led to significant fluctuations in local grain production in Iraq during the mid-1990s, following the country's fulfillment of a large portion of its grain needs through the "Oil-for-Food" program with the United Nations in 1996. Additionally, the shift away from compulsory agriculture, as well as the drought conditions that affected the region, including Iraq, in the late 1990s, also contributed to these fluctuations [4]. Production plays a key role in economic studies as it represents the creation or addition of value to existing capital. Agricultural production, in particular, plays a major and crucial role in any country's economy because it is directly linked to human life and is a source of economic activity [5]. Grain cultivation is widespread in most regions of Iraq, with its concentration varying from one area to another based on environmental and climatic conditions [6].

1.1. Research Problem

The production of yellow corn faces several challenges and problems due to weak agricultural policies. This has led to a decline in cultivated areas and production quantities, as well as an increase in production costs. When production costs are consistently high, farmers find it difficult to achieve the desired profits, and some may gradually abandon cultivating the crop. This negatively impacts the economic capacity of farmers and weakens their ability to achieve economic sustainability in the agricultural sector.

1.2. Research Aim

The study aims to determine the cultivated areas, production volume, productivity, and prices of the yellow corn crop for the period 2000-2021 through a descriptive analysis of the cultivation status of yellow corn in Kirkuk Governorate.

1.3. Research Importance

The importance of studying the yellow corn crop can be seen from both nutritional and industrial perspectives. It is considered one of the major economic crops as it represents a significant source of agricultural income, ranking second after wheat, barley, and rice crops. Its industrial significance lies in its use in starch production and oil extraction. Therefore, this crop is of great importance in all countries around the world, including Iraq.

1.4. Research Hypothesis

The fluctuation of cultivated areas and the decrease in the yield and productivity of the yellow corn crop in some years in Kirkuk Governorate may have effects not only related to price factors. It is influenced by competition with other crops, irrigation techniques, fluctuations in natural and climatic conditions, technological factors, and political and economic factors, all of which play a significant role in this regard.

2. Materials and Method

The data was obtained from official sources, including the Iraqi Ministry of Agriculture - Planning and Monitoring Department - Agricultural Statistics Department, and the Ministry of Planning and Development Cooperation - Central Agency for Statistics and Information Technology - Planning and Monitoring Department - Agricultural Statistics Department - Agricultural Product Prices.

The study's methodology relies on the descriptive approach, which involves using simple statistical descriptive methods such as averages, percentages, growth rates, and charts for cultivated areas, production, productivity, and prices.

2.1. Descriptive and Graphic Analysis of the Reality of Yellow Corn Cultivation in Kirkuk Governorate

The policy of Iraq's production and its focus on cultivating cereal crops was an attempt to resist economic sanctions in the 1990s by resorting to a mandatory crop cultivation policy and increasing purchase prices by the state. Yellow corn is one of the strategic grain crops, which is essential for human and animal nutrition. Despite the cultivated areas in Iraq, the crop still falls below the required level. The average area of yellow corn cultivation in Iraq during the study period was about 118,000 hectares. There have been significant fluctuations in the cultivated areas, with the highest value being 184,000 hectares in 2004 and the lowest value being 55,000 hectares in 2017. The average corn production in Iraq was 343,000 tons. Due to the expansion of cultivated areas in some years of the study, there was an increase in production, reaching the highest levels of 473,000 tons in 2019 and 419,000 tons in 2020. The lowest production level reached 63,000 tons in 2018 and 170,000 tons in 2000.

According to data provided by the FAO, in 2021, 1,063,286 tons of corn were imported [7]. This quantity exceeds the domestic production in the same year and during the targeted study period, indicating a deficit in local production. The average productivity of yellow corn crop was 3,000 kg/hectare, and during the period from 2000 to 2021, the highest productivity of yellow corn crop was 4,595 kg/hectare in 2021, while the lowest productivity was 2,235 kg/hectare in 2000, as shown in Table (1).

During the period from 2000 to 2021, approximately 23,000 to 237,000 tons of yellow corn were produced in Kirkuk province. This crop was cultivated on an area ranging from 10,000 to 39,000 hectares of farmland during different years of the mentioned period. Table (1) illustrates the lack of a sustainable policy for expanding yellow corn cultivation, leading to fluctuations in the cultivated areas over several years.

The contribution of yellow corn cultivation in Kirkuk to the total corn cultivation in Iraq averaged around 18.8%, with the highest contribution being 57.1% in 2018 and the lowest being 6.9% in 2006. Despite a decrease in prices during 2019, 2020, and 2021, the production increased in the years 2012, 2013, 2019, 2020, and 2021. This increase in production is likely attributed to the use of improved seeds and modern irrigation techniques. The average production during the period from 2000 to 2021 was approximately 80,000 tons, with the highest production of 237,000 tons in 2021 and the lowest of 23,000 tons in 2000.

Furthermore, the average contribution of yellow corn production in Kirkuk to the total corn production in Iraq was about 23.9%, with the highest contribution being 71.1% in 2018 and the lowest being 6.3% in 2006. This fluctuation in production is due to insufficient support for yellow corn production and the influence of various factors, including geographical, human, technological, political, and economic factors.

Some years during the study period witnessed political and economic events that affected various sectors, including agriculture. Between 2000 and 2021, the average yield of yellow corn in Kirkuk province was 3,904 kilograms per hectare. In 2013, the highest yield was recorded at 7,592 kilograms per hectare, while the lowest yield was in 2014 at 1,092 kilograms per hectare, attributed to challenging conditions in the province during that year.

The production fluctuations in Kirkuk city from year to year cause instability in the agricultural reality of the crop. However, according to Table (1), it is evident that the lands cultivated with yellow corn and their production in Kirkuk province contributed more than half of the total cultivated lands and overall production in Iraq in some years. This is likely due to the expansion of cultivating this crop and an increase in productivity due to higher prices in certain years, as the price is an essential motivating factor for farmers who aim primarily for profit. Additionally, Kirkuk province is characterized by vast agricultural lands, especially in the district of Hawija, and is also abundant in water resources. Thanks to technological advancements and the use of high-yield seeds, farmers can achieve greater success in this field.

Table 1. Cultivated area, production and productivity of yellow corn crop in Iraq and Kirkuk, and the relative importance of area and production for Kirkuk Governorate for the period (2000-2021).

	Iraq			Kirkuk				
Years	Area Cultivated With Yellow Corn (ha)	Total Production of Yellow Corn (Tons)	Yield Of Yellow Corn kg/ha	Area Cultivated With Yellow Corn (ha)	Relative Importance %	Total Production of Yellow Corn (Tons)	Relative Importance %	Yield of Yellow Corn (kg/ha)
2000	76185	170255	2235	10194	13.4	23073	13.6	2263
2001	98541	231825	2353	16425	16.7	40003	17.3	2435
2002	183990	578630	3145	27121	14.7	79599	13.8	2935
2003	90995	235715	2590	11841	13.0	29260	12.4	2471
2004	184940	415971	2249	20982	11.3	43794	10.5	2087
2005	173390	401082	2313	14564	8.4	30729	7.7	2110
2006	164429	399038	2427	11343	6.9	25139	6.3	2216
2007	155102	384471	2479	12817	8.3	27094	7.1	2114
2008	122573	287955	2349	12045	9.8	25663	8.9	2131
2009	114130	238113	2086	15435	13.5	34883	14.6	2260
2010	116958	266699	2280	24052	20.6	58714	22	2441
2011	129591	335710	2591	18803	14.5	48048	14.3	2555
2012	151361	503389	3326	30638	20.2	172371	34.2	5626
2013	199530	831345	4167	35573	17.8	270067	32.5	7592
2014	127582	325389	2550	33067	25.9	36101	11.1	1092
2015	57260	182340	3184	11430	20	55400	30.4	4847
2016	75992	259546	3415	10162	13.4	68362	26.3	6727
2017	55703	185291	3326	8102	14.5	45323	24.5	5594
2018	13959	63307	4535	7972	57.1	44988	71.1	5643
2019	128790	473064	3673	27864	21.6	203060	42.9	7288
2020	101357	419345	4137	23711	23.4	174648	41.6	7366

	Iraq			Kirkuk				
Years	Area Cultivated With Yellow Corn (ha)	Total Production of Yellow Corn (Tons)	Yield Of Yellow Corn kg/ha	Area Cultivated With Yellow Corn (ha)	Relative Importance %	Total Production of Yellow Corn (Tons)	Relative Importance %	Yield of Yellow Corn (kg/ha)
2021	81477	374400	4595	39087	48	237939	63.6	6087
Average	118356	343767	3000	19238	18.8	80648	23.9	3904

Source: Republic of Iraq - Ministry of Agriculture - Department of Planning and Follow-up - Department of Agricultural Statistics [8].

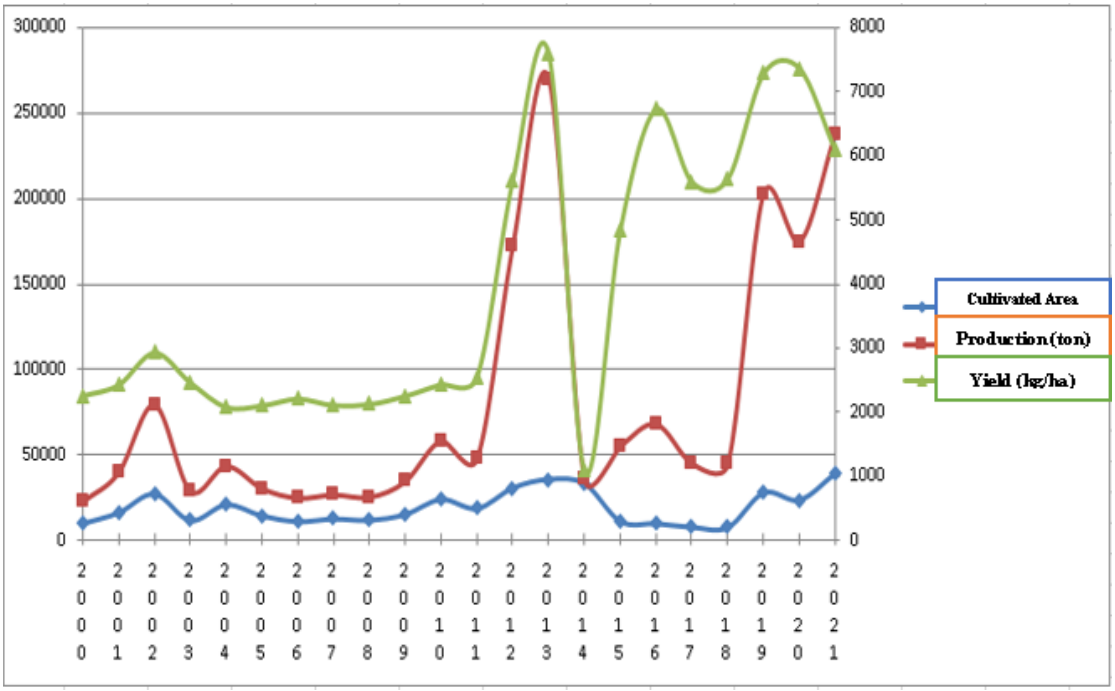

Figure 1. Shows the development of the cultivated areas, production and productivity of the yellow corn crop in Kirkuk Governorate for the period (2000-2021).

Prices are considered one of the most important economic indicators in all countries, regardless of their economic and social systems. They are used in various fields within the national economy, such as domestic and international trade transactions, resource allocation among different sectors, and the formulation of long-term economic policies. Additionally, prices play a crucial role in shaping the patterns and trends of international trade, and both developing and manufacturing countries alike rely on prices and their fluctuations to determine the economic distribution of their various investments [9].

Current prices refer to the prevailing prices in the market at the present time, and they fluctuate based on the impact of inflation. Current prices are measured using price indices. Due to changing prices each year, the number of price indices for different years also varies. In an inflationary environment, the numbers in the indices increase as prices continuously rise. In economies where the state heavily intervenes in markets, prices are set by the government. The main purpose of the state is to protect consumers and control the policy of pricing inputs in production, as well as protecting farmers by setting base prices and providing fair and appropriate wages, and so on. In this way, the state seeks to distribute income and achieve social balance to prevent the loss of welfare resulting from the instability of producers and input suppliers, which is particularly weak in the practices of setting floor prices, and ensure economic development. Price floor practices can be applied to achieve the mentioned objectives. In applying a base price, prices are set above market prices to protect the workforce from production factors and aim to ensure stable production of goods and services that are considered basic needs of society by producers. The phenomenon of pricing based on market prices has an increasing impact on the general level of prices in the economy [10].

The main problem facing developing countries is ensuring economic development by changing their current economic structures. Economic development, in this context, refers to the continuous transformation of the economic structure. When production increases and the economy grows in these countries, there is an increase in demand and changes in its structure. However, obstacles arising in this process prevent an increase in supply to meet the demand in sectors where it is increasing. Changes in the quantity and structure of demand lead to rapid population growth, accelerated urbanization with development, changes in individual consumption, and increasing preferences due to rising incomes. The reason for the lack of increased supply to meet the increased demand is attributed to the relative stability of production factors, a shortage of qualified labor, weak infrastructure, a lack of widely spread technological knowledge, traditional economic thinking and conservative attitudes, and restrictions imposed on import capacity. Table (2) illustrates the current prices of the yellow corn crop for the period (2000-2021).

The average price of the yellow corn crop per ton reached 457,000 dinars. The lowest price was 219,000 dinars in 2000 and 211,000 dinars in 2001. Then the price began to increase until it reached its highest value of 700,000 dinars in 2015. After that, there was a sharp decline in the last three years, but in recent years, there has been a good increase in the price of corn.

Despite the price increase in some years, the cultivated areas of this product remain small and have decreased significantly in recent years. The study attributes this to the political, economic, and social conditions. Additionally, the increase in prices was not sufficient to cover the production costs of the crop. Graph (2) illustrates the development of yellow corn crop prices for the period from 2000 - 2021.

Table 2. Shows the prices of the yellow corn crop in Iraq for the period (2000-2021).

Years	Price (dinar / ton)
2000	219000
2001	211000
2002	240000
2003	250000
2004	270000
2005	288000
2006	332000
2007	372000
2008	515000
2009	594000
2010	612000
2011	640000
2012	646000
2013	653000
2014	689350
2015	700000
2016	602000
2017	587000
2018	557000
2019	350000
2020	363000
2021	370000
Average	457289

Source: Republic of Iraq - Ministry of Planning and Development Cooperation - Department of Planning and Follow-up - Prices of agricultural products.

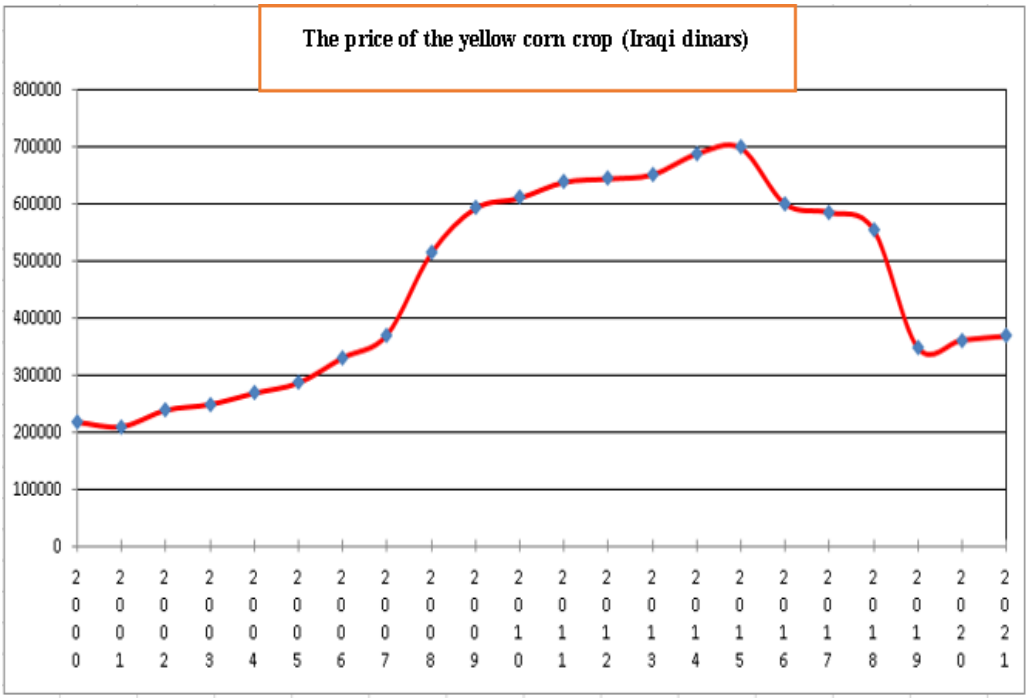

Figure 2. Shows the price development of the yellow corn crop in Iraq for the period (2000-2021).

2.2. The Annual Growth Rate and the Standard Number of Variation for the Cultivated Area, Production, Productivity and Price of the Yellow Corn Crop in Kirkuk Governorate for the Period (2000-2021)

The growth rates and standard coefficients of variation for the area, production, productivity, and price of yellow corn crop in Kirkuk governorate have been extracted for the period (2000-2021) using simple linear regression after taking the natural logarithm of each of the cultivated area, production, productivity, and price along with the time factor, as follows.

$$\ln Area = b0 + bTime$$

$$\ln Production = b0 + bTime$$

$$\ln Yield = b0 + bTime$$

$$\ln Price = b0 + bTime$$

In economic research, it is essential to calculate growth rates, especially in agricultural production, as it serves as a vital indicator of the success of agricultural policies. Understanding the general trend of this sector and predicting it is crucial for evaluating the policies being implemented. Growth rates are influenced by key factors such as the area cultivated, production, productivity, and prices. Calculating the growth rates of these variables helps determine which ones have the most significant impact.

The annual growth rate for the cultivated area and production has been positive, reaching values of 9.2% and 7.4% respectively. Similarly, the growth rate for productivity also showed a positive value of 4.6%. Additionally, the annual growth rate for prices recorded a positive value of 6.7%. In other words, there has been an increase of 9.2%, 7.4%, 4.6%, and 6.7% in the cultivated area, production, productivity, and the price of yellow corn in Kirkuk Governorate, respectively. Table (3) demonstrates that the area, production, productivity, and price have been positively affected by economic measures and agricultural policies implemented during the studied period.

As for the standard deviation of the cultivated area, production, productivity, and price, the values reached 35.1%, 26.8%, 17.4%, and 22.5% respectively. When comparing the standard deviation, we find that the cultivated area and production were more stable than the price and productivity.

Table 3. Shows the annual growth rates and the standard number of variation for the cultivated area, production, productivity and price of the yellow corn crop in Kirkuk Governorate for the period (2000-2021).

Variables	Growth Rates	Standard Number of Covariance
Cultivated Area	9.2	35.1
Production	7.4	26.8
Productivity	4.6	17.4
Yellow Corn Price	6.7	22.5

Estimates were calculated by the researcher based on the data of Tables No. (1) and No. (2), where the annual growth rate is a time parameter and the standard number of variance is the standard error in the estimated regression equation.

Conclusions

- Despite recording positive growth rates for the total cultivated area, overall production, productivity, and price, reflecting the development of yellow corn cultivation in Kirkuk Governorate due to the government's supportive policies to encourage farmers to increase their cultivation of this crop, this growth was not sufficient to meet the increasing local demand for yellow corn.
- It was observed that the cultivated lands and production of yellow corn in Kirkuk Governorate contribute to more than half of the total cultivated lands and overall production in Iraq in some years.
- Fluctuations in production from year to year have caused disruptions in the agricultural reality of the corn crop in Kirkuk provinces. These fluctuations have negatively affected agricultural productivity and market balance, leading to significant challenges for farmers and investors in the agricultural sector.
- Yellow corn cultivation in Kirkuk Governorate faces several challenges that affect its productivity and contribution to the overall corn production in the country. The study revealed that the percentage contribution of yellow corn production to the total corn production in Iraq was the lowest in 2006 at 6.3%. This can be attributed to various factors such as natural, climatic, and technological conditions, in addition to political and economic factors, which support the research hypothesis.
- The lowest level of crop productivity was recorded in 2014, reaching 1092 kg/ha, due to the challenging conditions experienced in the province during that year. These conditions can be described as exceptional challenges that affected the region, leading to a decline in agricultural productivity for the crop.
- Despite the continuous increase in prices of yellow corn crop in most study years, sufficient progress has not been achieved in terms of cultivated areas, total production, and productivity of this crop at the provincial level.

Recommendations

- Support from the government for farmers by providing the necessary supplies for this crop and reducing the cost of acquiring them through cooperative prices, especially for seeds, fertilizers, tools, and agricultural machinery. Additionally, efforts should be made to develop high-yield crop varieties suitable for the region's conditions, as high input costs may lead farmers to switch to more competitive crops.
- Strengthen government support for farmers by providing essential supplies for this crop and reducing the costs of obtaining them through cooperative pricing. This support includes lowering seed and fertilizer prices, as well as providing agricultural tools and equipment at affordable prices. The government should also focus on developing high-yield crop varieties suitable for the region. Rising agricultural input costs negatively impact local crop production.

- Implement agricultural plans and policies for this crop and establish multiple marketing channels in Kirkuk Governorate, particularly during harvest, to ease the burden on farmers and encourage them to continue cultivating this important crop.
- The researcher recommends conducting further studies related to the crop, such as studies on pricing and marketing, to develop production and pricing policies that address the decline in production of this crop.
- Increase the purchase price of this crop and provide prior disclosure of the price before the production season of yellow corn to incentivize farmers to grow it.
- Grant more agricultural loans to support the development of this strategic crop and activate the role of agricultural guidance in the governorate to introduce modern farming methods and clarify them to farmers.

References

[1] Dahla, Raad Eidan Ubaid., (2008). "Economic Analysis of Production Functions and Costs of Yellow Corn Crop in Wasit Governorate (A Field Study)" - PhD Thesis - College of Agriculture - University of Baghdad.
[2] Ali, Mohammed Jassim., (2008). "Estimation of Economies of Scale and Economics of Yellow Corn Crop (Applied Model: Babil Governorate)" - Master's Thesis - College of Agriculture - University of Baghdad.
[3] Sencar, Ö., 1988. The Effects of Sowing Frequency and Nitrogen in Corn Cultivation. C.U. Tokat Faculty of Agriculture Publications, 6. Scientific Research and Reviews. (3) Turkey.
[4] Dahsh, Fadel Jawad., (2008). "The Potential Effects of Iraq's Accession to the World Trade Organization in the Agricultural Sector" - PhD Thesis - College of Management and Economics - University of Baghdad.
[5] Al-Dahri, Abdulwahab Mitro., (1987). "Agricultural Economy" - Ministry of Higher Education and Scientific Research - University of Baghdad.
[6] Al-Wasiti, Rajaa Ta'meh., (2003). "Evaluation of Agricultural Price Policies for Basic Grain Crops in Iraq for the Period (1970-2000)" - PhD Thesis presented to the College of Agriculture - University of Baghdad.
[7] FAO, 2021. Statistics. Http:/Www.Fao.Org
[8] Republic of Iraq, Ministry of Agriculture., (2021). Planning and Monitoring Department, Agricultural Statistics (2000-2021).
[9] Republic of Iraq, Ministry of Planning and Development Cooperation., (2021). Central Statistical Organization, Planning and Monitoring Department, Agricultural Product Prices (2000-2021).
[10] Republic of Iraq, Central Prices Agency., (1985). "Price Policy: Realities and Future Requirements" - Baghdad.