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Economic Analysis of Sugarcane Production in Egypt

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ABSTRACT

Sugarcane is considered one of the important strategic crops for some countries that cultivate it for sugar production. The problem lies in the fluctuation of sugarcane production alongside the continuous increase in sugar consumption. Therefore, an analytical study was conducted on the economics of sugarcane production considering the rising production costs.

This research aims to study the economics of sugarcane production in Egypt during the period (2005-2022) by analyzing total production, costs, and net return per acre, as well as identifying the relative importance of the sugarcane-producing governorates in Egypt. In addition, it examines the relative importance of cost components associated with sugarcane cultivation.

Among the key findings, it was shown that total cultivated area, total revenue per Feddan, and net return have all followed a generally increasing trend, with statistically significant annual growth at the 0.01 significance level. Meanwhile, both productivity and total production have followed a generally decreasing trend, with this decrease also statistically significant at the 0.01 level.

The relative importance of average cost items for sugarcane production across governorates is distributed among wages and production inputs. Labor wages, chemical fertilizer costs, and machinery costs represent the highest shares of production costs in the governorates of Minya, Sohag, Qena, Luxor, and Aswan, with variations from one governorate to another.

The most important sugarcane-producing governorates were Minya, Sohag, Qena, Luxor, and Aswan.

The study recommends working on increasing the yield per feddan by developing high-yielding sugarcane varieties.

INTRODUCTION

Sugarcane is a crop that supports a wide range of industries, including sugar production as the primary industry, as well as molasses and blackstrap (molasses syrup) production. In addition, it serves as a by-products and raw material for secondary industries such as molasses-based products, alcohols, yeast, fertilizers, paper pulp, particle board, and green fodder for livestock feed.

Sugarcane also plays an important role to provide employment opportunities due to the numerous agricultural operations it requires many of which cannot be mechanized and thus depends heavily on manual labor. Moreover, there is a large industrial and commercial sector associated with sugar production.

In Egypt, sugarcane is cultivated specifically for sugar production. While local production was sufficient to meet domestic demand until recently, the country now faces a growing deficit as production fails to keep pace with the steady increase in consumption related to increase population growth. This has led the government to import large quantities of sugar in an effort to bridge the gap between production and consumption. Consequently, sugar has become one of the main imported commodities, consuming a significant portion of Egypt's foreign currency reserves and placing additional pressure on the balance of agricultural trade and payments.This situation highlights the urgent need to focus on this crop, improve its productivity, and increase its sugar content in order to reduce reliance on imports and strengthen national food security.

Research Problem:

The core problem of the study lies in the fluctuation of sugarcane production alongside the continuous increase in sugar consumption, due to the insufficiency of domestic production in meeting the growing consumption needs. This fluctuation, combined with rising consumption levels, has led to instability in local sugar prices. These factors necessitate an analytical study of the economics of sugarcane production, especially considering that it is one of the main sources of sugar production in Egypt. Furthermore, the high production costs have resulted in a significant number of farmers abandoning sugarcane cultivation.

Research Objective:

The general objective of this research is to study the economics of sugarcane production in Egypt. Specifically, it aims to examine the production of sugarcane by analyzing its production capacity, which includes the development some agricultural and economic indicators such as the cultivated area, yield per acre, total production, production costs, and net return per acre.

The study also seeks to identify the relative importance of the main sugarcane-producing

governorates in Egypt. Additionally, it aims to analyze the relative importance of sugarcane production cost components, distributed across different agricultural operations, and to assess the cost structure in terms of labor and input expenses during the period (2018-2022).

Methodology and Source of Data:

The study relies on both descriptive and quantitative economic analysis methods. General time trend equations and various economic indicators were used to achieve the research objectives. The study is based on secondary data obtained from various sources, including the Ministry of Agriculture and Land Reclamation and its affiliated entities such as the Economic Affairs Sector and the Sugar Crops Council, in addition to relevant studies and research related to the subject of the study.

RESULTS AND DISCUSSION

First: Development of Production and Economic Indicators of Sugarcane Crop During the Period (2005–2022):

1. Development of Sugarcane Cultivated Area in Egypt:

In recent years, increasing attention has been given to sugarcane cultivation in Egypt for sugar production, due to the growing gap between local production and consumption. As a result, sugarcane has become a primary crop for bridging this gap.

From the analysis of the indicators in Table (1), it is evident that the total cultivated area of sugarcane in Egypt during the study period (2005–2022) ranged between a minimum of approximately 316.71 thousand feddans in 2009 and a maximum of around 342.4 thousand feddans in 2021, with an annual average of about 328.1 thousand feddans.

Using the general time trend equation to examine the development of the total cultivated area during the period (2005–2022), Equation (1) in Table (2) shows that the cultivated area followed a statistically significant increasing trend at the 0.01 significance level, with an annual increase of about 680 feddans, representing roughly 0.21% of the annual average (328.1 thousand feddans). The coefficient of determination (R^2) was about 0.35, indicating that 35% of the variation in the total cultivated area is explained by time-related factors. The overall model was statistically significant based on the calculated F-value.

Table 1: Development of Cultivated Area, Productivity, and Total Production of Sugarcane at the National Level During the Period (2005–2022).

Years	Area	Productivity	Production
	10^3 Feddan	**tons/feddan**	**10^3 tons**
2005	321.38	50.77	16317
2006	326.88	50.96	16656
2007	335.06	50.78	17014
2008	323.59	50.9	16470
2009	316.71	48.88	15482
2010	320.33	49.04	15709
2011	325.50	48.43	15765
2012	325.74	47.74	15550
2013	329.15	47.94	15780
First period average	**324.9**	**49.49**	**16082.8**
2014	332.03	48.35	16055
2015	328.12	48.47	15903
2016	325.91	47.32	15422
2017	326.24	47.15	15382
2018	327.42	48.33	15823
2019	329.19	46.59	15336
2020	336.14	47.18	15860
2021	342.38	46.61	15959
2022	333.24	46.71	15565
Second period average	**331.2**	**47.41**	**15700.7**
The difference between the two averages	**-2.47****	**4.01****	**1.88**
Average	**328.06**	**48.45**	**15892**

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economics, Agricultural Statistics Bulletin, Various Issues.

Table 2: General Time Trend Equations for the Development of Cultivated Area, Yield per Feddan, and Total Production of Sugarcane in Egypt During the Period (2005–2022)

Area: (Thousand Feddans) , Yield: (Ton/Feddan) , Total Production: (Thousand Tons).

N	Dependent Variable	Estimated equation	R^2	F	Annual Rate of Change
1	Cultivated Area	$\hat{Y}_i = 321.59 + 0.68\ X_i$ $(128.4)^{**}\ \ (2.94)^{**}$	0.35	$^{*}8.66$	0.21
2	Productivity	$\hat{Y}_i = 50.9 - 0.26\ X_i$ $(159.7)^{**}\ \ (-8.75)^{**}$	0.83	76.6^{*}	0.54
3	Total Production	$\hat{Y}_i = 16385.1 - 51.94\ X_i$ $(87.3)^{**}\ \ (-2.99)^{**}$	0.36	8.97^{*}	0.33

Y: refers to the cultivated area, yield, and total production of sugarcane during the period (2005–2022).
Xi: time variable where i= (1,2, 3,….18)
(R^2) : Coefficient of determination, (F): Model significance value
An asterisk (*) indicates the significance of the coefficient at the 0.05 level of significance, while double asterisks (**) indicate significance at the 0.01 level of significance.
Source: Collected and calculated from the data in Table (1) of the study.

Additionally, a T-test was conducted to compare the average cultivated area of sugarcane during the two periods: (2005–2013) and (2014–2022). The results showed a statistically significant increase in the second period, with an average of 331.2 thousand feddans, compared to 324.9 thousand feddans in the first period, significant at the 0.01 level.

2. Development of Sugarcane Yield per Feddan in Egypt:

From the data in Table (1), it is clear that the yield per feddan during the study period (2005–2022) ranged between a minimum of approximately 46.59 tons/feddan in 2019 and a maximum of about 50.96 tons/feddan in 2006, with an annual average of around 48.45 tons/feddan throughout the study period.

The general time trend equation for the development of sugarcane yield in Egypt, shown in equation (2) of Table (2), indicates that the yield per feddan exhibited a statistically significant decreasing annual trend at the 0.01 level of significance, amounting to approximately 0.26 tons/feddan per year. This decrease represents about 0.54% of the average yield of around 48.45 tons/feddan.

The coefficient of determination (R^2) was approximately 0.83, meaning that 83% of the changes in sugarcane yield per feddan in Egypt can be attributed to factors reflected by the time variable. The calculated F-value of about 76.6 suggests that the model used is appropriate and the data set under study fits well.

A T-test comparing the average yield per feddan for sugarcane between the two periods (2005-2013) and (2014-2022) showed a significant decrease in yield during the second period, reaching about 47.41 tons/feddan compared to the first period's average of about 49.49 tons/feddan, at the 0.01 significance level.

3. Development of Total Sugarcane Production in Egypt:

Data from Table (1) show that total production ranged between a minimum of approximately 15,336 thousand tons in 2019 and a maximum of about 17,014.21 thousand tons in 2007, with an annual average of around 15,892 thousand tons during the period (2005–2022).

Studying the general time trend equation for total sugarcane production, equation (3) in Table (2) indicates that total production exhibited a statistically significant decreasing trend of about 51.94 thousand tons per year at the 0.01 significance level. This decrease represents approximately 0.33% of the average total production of around 15,892 thousand tons.

The coefficient of determination (R^2) was approximately 0.36, meaning that 36% of the variation in total sugarcane production can be attributed to factors reflected by the time variable. The calculated F-value of about 8.97 indicates that the model used is appropriate and that the data fit the study well.

A T-test comparing the average total production of sugarcane between the two periods (2005-2013) and (2014-2022) showed a non-significant decrease in production during the second period, reaching 15,700.7 thousand tons compared to the first period's average of 16,082.8 thousand tons, at the 0.05 significance level.

4. Development of Total Revenue from Sugarcane Production in Egypt:

Table (3) shows that the average total revenue per acre from sugarcane during the study period (2005-2022) amounted to approximately 22,804 Egyptian pounds per acre. It ranged between a minimum of about 8,129 pounds per acre in 2005 and a maximum of about 56,047 pounds per acre in 2022, representing an increase of approximately 47,918 pounds, or about 589.5% of the total revenue

in 2005.

Studying the general trend of total revenue per feddan from sugarcane at the national level during the period (2005–2022), Table (4) shows the statistical estimation results of the parameters of the general trend equation for total revenue per acre during that period. Equation (1) indicates that total revenue per feddan followed a generally increasing trend with a statistically significant annual increase of 2,326 pounds, representing about 10.2% of the average, which was approximately 22,804 pounds.

The coefficient of determination (R^2) indicates that about 88% of the changes in total revenue per feddan from sugarcane at the national level are attributed to factors reflected by the passage of time. The calculated F-value of approximately 118.8 confirms that the model used is appropriate and that the data suit the study well.

5. Development of Total Production Costs for Sugarcane in Egypt:

According to the data presented in Table (3), the average total production cost per feddan of sugarcane amounted to approximately 11,482.8 Egyptian pounds.

This average ranged from a minimum of about 4,302 pounds per acre in 2005 to a maximum of about 29,707 pounds per acre in 2022, reflecting an increase of about 25,405 pounds—approximately 591% of the total production cost in 2005.

Analyzing the general trend of total costs per acre of sugarcane production in Egypt during the period (2005–2022), Table (4) presents the statistical estimation results of the parameters for the general trend equation. Equation (2) shows that total production costs per feddan followed a generally increasing trend, with a statistically significant annual increase of 1,252.4 pounds at the 0.01 significance level. This increase represents approximately 10.9% of the average total cost, which is about 11,483 pounds.

The coefficient of determination (R^2) indicates that around 85% of the changes in total production costs per acre at the national level are due to factors associated with the time variable. The calculated F-value of approximately 87.8 confirms the appropriateness of the model used and the relevance of the data to the study.

6. Development of Net Return from Sugarcane in Egypt:

Table (4) indicates that the average net return from sugarcane during the study period (2005–2022) was about EGP 11,321.1 per feddan. This average ranged between a minimum of approximately EGP 3,827 per feddan in 2005 and a maximum of around EGP 26,340 per feddan in 2022—an increase of about EGP 22,513, representing roughly 588.3% of the 2005 net return.

An analysis of the general trend in the development of net return per feddan of sugarcane across Egypt during the period (2005–2022) shows, as presented in Table (4), the results of the statistical estimation of the general trend equation.

Table 3: Development of the Average Costs, Total Revenue, and Net Return per Feddan for Sugarcane Crop during the Period (2005–2022) (Unit: EGP/Feddan)

Years	Total Revenue	Total Costs	Net Return
2005	8129	4302	3827
2006	8673	4412	4261
2007	9250	5348	3902
2008	10189	5640	4549
2009	11468	6031	5437
2010	13863	6606	7257
2011	16242	6691	9551
2012	17205	7755	9450
2013	17290	7590	9700
2014	19353	8591	10762
2015	19392	8736	10656
2016	29346	13451	15895
2017	33956	14579	19377
2018	34795	18348	16447
2019	33543	17678	15865
2020	33972	18903	15069
2021	37757	22322	15435
2022	56047	29707	26340
Average	22804	11483	11321

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economics, Agricultural Statistics Bulletin, various issues.

Table 4: General Time Trend Equations for Total Revenue, Total Costs, Net Return per Feddan, Farm Price, Cost per Feddan, and Rent for Sugarcane in Egypt During the Period (2005–2022)

N	Depend Variable	The equation	R^2	F	Annual rate of change
1	Total Revenue	$Y_1 = 706.99 + 2325.99X_i$ (0.31) (10.9) **	0.88	(118.77)	10.2
2	Total Costs	Y_2=-415.03 +1252.4 X_i (-0.29) (9.4) **	0.85	(87.82)	10.9
3	Net Return	Y_3 =1122.01+1073.59 X_i (0.92) (9.5) **	0.85	(90.33)	9.5

Y: refers to the cultivated area, yield, and total production of sugarcane during the period (2005–2022).
Xi: time variable where i=(1,2, 3,….18)
(R^2) : Coefficient of determination, (F): Model significance value
An asterisk (*) indicates the significance of the coefficient at the 0.05 level of significance, while double asterisks (**) indicate significance at the 0.01 level of significance.
Source: Compiled and calculated from the data in Table (3) of the study.

According to Equation (3), the net return per feddan followed a generally increasing trend, with a statistically significant annual increase of EGP 1,073.6, representing approximately 9.5% of the average value of EGP 11,321. Additionally, the coefficient of determination (R^2) indicates that about 85% of the variation in net return is attributed to time-related factors. The model was found to be statistically significant at the 0.01 level.

Second: Geographical Distribution of Sugarcane Production in Egypt

Sugarcane is cultivated in Upper Egypt across five main producing governorates: Minya, Sohag, Qena, Luxor, and Aswan. In these governorates, sugarcane is grown for the purposes of sugar manufacturing, molasses production, other by-products, and fresh consumption. Meanwhile, in the remaining governorates and the Delta region, sugarcane is cultivated exclusively for fresh consumption.

The cultivated area of sugarcane varies from one governorate to another. The following presents the geographical distribution of the cultivated area, productivity, and total production of sugarcane during the period (2018–2022).

1. Geographical Distribution of Sugarcane Cultivated Area in Egypt:

Table (5) shows that the cultivated area of sugarcane is concentrated in Upper Egypt governorates, with an average of about 293 thousand feddans, representing approximately 87.81% of the national average cultivated area of 333.67 thousand feddans during the period (2018–2022). This is followed by Middle Egypt governorates with an average of about 39.67 thousand feddans, representing around 11.89% of the total, while the Delta (Lower Egypt) governorates ranked last with an average of only 1.02 thousand feddans, accounting for about 0.30% of the national average.

The same table also indicates that the most important sugarcane-producing governorates are Qena, Aswan, Luxor, Minya, and Sohag, with average cultivated areas of approximately 119.51, 89.97, 66.39, 37.05, and 16.05 thousand feddans, respectively. These represent about 35.82%, 26.96%, 19.9%, 11.1%, and 4.81% of the national average in the same order. Collectively, these five governorates account for approximately 279,852 feddans, representing about 98.6% of the national average cultivated area during the studied period.

2. Geographical Distribution of Sugarcane Yield per Feddan in Egypt:

As shown in Table (5), the average sugarcane yield per feddan during the study period was approximately 47.08 tons/feddan. Upper Egypt governorates ranked first, with an average yield of about 48.08 tons/feddan, representing approximately 102.1% of the national average. They were followed by the Middle Egypt governorates, with an average yield of around 40 tons/feddan, accounting for about 84.91% of the national average. The Delta (Lower Egypt) governorates ranked last, with an average yield of approximately 37.5 tons/feddan, representing about 79.6% of the national average during the same period.

The same table also indicates that the top governorates in terms of yield per feddan were Aswan, Qena, Luxor, Sohag, Kafr El-Sheikh, and Minya, with average yields of approximately 48.81, 48.76, 46.97, 44.65, 41.02, and 40.21 tons/feddan, respectively, over the study period.

3. The geographical distribution of sugarcane production in Egypt:

Data from Table (5) indicates that sugarcane production in Egypt is concentrated in the Upper Egypt governorates, with an average production of approximately 14,084.3 thousand tons, representing about 89.7% of the total average national production during the period (2018-2022), which amounted to around 15,708.7 thousand tons.

Table 5: Geographical Distribution and Relative Importance of the Average Cultivated Area, Yield per Feddan, and Total Production of Sugarcane in Egypt during the Period (2018–2022)

Governorate	Area (acres)	%	Productivity (tons/acre)	%	Production (tons)	%
Beheira	23	0.01	11.09	23.6	644.6	0.0
Gharbia	399.8	0.12	15.67	33.3	15610.0	0.1
Kafr El Sheikh	82.2	0.02	41.02	87.1	3399.4	0.0
Dakahlia	262.8	0.08	38.79	82.4	10193.8	0.1
Damietta	2.4	0.00	15.83	33.6	62.4	0.0
Sharqia	19.8	0.01	28.66	60.9	683.0	0.0
Qalyubia	226.2	0.07	34.28	72.8	7713.0	0.0
Local Lower Egypt	1016.2	0.30	37.48	79.6	38306.2	0.2
Giza	2075.8	0.62	39.23	83.3	80853.8	0.5
Beni Suef	409.4	0.12	31.05	66.0	12631.4	0.1
Fayoum	140.2	0.04	13.64	29.0	3371.0	0.0
Minya	37045.8	11.10	40.21	85.4	1489110.8	9.5
Central Egypt	39671.2	11.89	39.98	84.9	1585967.0	10.1
Assiut	1066	0.32	32.61	69.3	34912.0	0.2
Sohag	16045.6	4.81	44.65	94.8	716729.2	4.6
Qena	119512	35.82	48.76	103.6	5827242.0	37.1
Luxor	66392.4	19.90	46.97	99.7	3118515.6	19.9
Aswan	89967.2	26.96	48.81	103.7	4386876.2	27.9
Upper Egypt	292983	87.81	48.08	102.1	14084275.0	89.7
Total within the Valley	333670.6	100	47.08	100	15708548.2	100
Total	333675	100	47.08	100	15708672.8	100

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economics, Agricultural Statistics Bulletin, various issues.

This is followed by the Middle Egypt governorates, with an average production of about 1,586 thousand tons, representing approximately 10.1% of the total national production during the same period. The Nile Delta governorates ranked last, with an average production of about 38.31 thousand tons, accounting for around 0.24% of the total national production.

The same table shows that the main governorates producing sugarcane on the old lands are Qena, Aswan, Luxor, Minya, and Sohag, with average productions of approximately 5,827.2, 4,386.9, 3,118.5, 1,489.1, and 716.7 thousand tons respectively. These represent about 37.1%, 27.93%, 19.9%, 9.5%, and 4.56% of the total national average production, respectively. The production from these five governorates totals about 15,538.5 thousand tons, representing approximately 98.92% of the total national average production during the studied period.

Third: The Relative Importance of Cost Items for Sugarcane Crop during the Period (2018-2022):

The relative importance of the average cost items for the sugarcane crop is studied, distributed over agricultural operations and production wages and supplies during the average period (2018-2022).

1- The Relative Importance of the Average Cost Items for the Sugarcane Crop Distributed over Agricultural Operations During the Average Period (2018-2022):

Table (6) illustrates the relative importance of the average cost items for the sugarcane crop. The average cost of land preparation for sugarcane was 563.8 EGP per feddan, representing about 2.64% of the total average costs including rent during the average period (2018-2022). The minimum was about 419 EGP/feddan in 2019, and the maximum reached around 851 EGP/feddan in 2022.

The average cost of seeds was 1874.4 EGP/feddan, accounting for approximately 8.76% of the total average costs including rent during the studied period, with a minimum of about 1813 EGP/feddan in 2021 and a maximum of around 2032 EGP/feddan in 2018.

The average cost of irrigation was 2880.6 EGP/feddan, representing about 13.47% of the total average costs including rent during the average period (2018-2022).

The average cost of fertilizers reached 2985.2 EGP/feddan, accounting for about 13.96% of the total average costs including rent during the studied period.

Table 6: Relative Importance of Average Cost Items for the Sugarcane Crop Distributed Over Agricultural Operations During the Average Period (2018-2022)

Unit: Egyptian pounds

Year	Land Preparation	Seeds	Irrigation	Fertilizer	Land Maintenance	Harvest and gathering	Crop Transportation	General Expenses	Total Costs	Rent	Total Costs, including Rent
2018	434	2032	2309	2222	539	1414	941	1582	11473	6875	18348
2019	419	1822	2295	1813	544	1512	947	1496	10848	6830	17678
2020	494	1821	2667	2096	783	1537	1001	1664	12063	6840	18903
2021	621	1813	3007	3863	945	1879	1238	2139	15505	6817	22322
2022	851	1884	4125	4932	1288	2251	1812	2743	19886	9821	29707
Average	564	1874	2881	2985	820	1719	1188	1925	13955	7437	21392
%	2.64	8.76	13.47	13.96	3.83	8.03	5.55	9.00	65.24	34.7	100

Source: Collected and calculated from the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economics, Agricultural Costs and Net Return Statistics Bulletin, various issues.

Table 7: Relative Importance of the Average Cost Items for the Sugarcane Crop at the Governorate Level Distributed over Agricultural Operations during the Period (2018-2022)

Value: in Egyptian Pounds (EPG)

Operations / Governorates	Minya	Middle Egypt Average	Sohag	Qena	Luxor	Aswan	Upper Egypt Average	General Average	%
Land Preparation for Planting	307.6	307.6	316	757.2	663.2	386	595.4	563.8	2.64
Seeds and Planting	1143.4	1143.4	1499.4	2142.4	2245.2	1619.6	1965.6	1874.4	8.76
Irrigation	2567.6	2567.6	2816.6	3080.2	3266	2478.6	2921.4	2880.6	13.47
Fertilization	3213.2	3213.2	2980.6	2926.8	2889.2	3045.2	2958	2985.2	13.96
Agricultural Services	906.8	906.8	831.4	771.6	904	783	808.8	819.8	3.83
Harvesting	1822	1822	1854.4	1648.4	1626.8	1810.2	1705.4	1718.6	8.03
Crop Transportation	1174.8	1174.8	1150	1098.2	1358	1194.6	1190	1187.8	5.55
General Expenses	1781.4	1781.4	1831.4	1988	2072.6	1810.8	1943.2	1924.8	9.00
Total Costs Excluding Rent	12916.8	12916.8	13279.8	14412.8	15025	13128	14087.8	13955	65.24
Rent	10000	10000	8000	7600	7000	6400	7107.4	7436.6	34.76
Total Costs Including Rent	22916.8	22916.8	21279.8	22012.8	22025	19528	21195.2	21391.6	100

Source: Collected and calculated from the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economics, Agricultural Costs and Net Returns Statistics Bulletin, various issues.

Following that, the average cost of land servicing was approximately 819.8 EGP/feddan, about 3.83% during the same period.

The harvesting and cutting stage cost averaged 1718.6 EGP/feddan, representing about 8.03% during the average period (2018-2022).

Next, the transportation of the crop averaged 1187.8 EGP/feddan, about 5.55%.

The final stage, general expenses, averaged 1924.8 EGP/feddan, representing around 9.00% of the total average costs including rent during the average period (2018-2022).

Meanwhile, the average costs during the studied period reached 13,955 EGP/feddan, accounting for about 65.24%, while rent averaged 7,436.6 EGP/feddan, representing about 34.76% of the total average costs including rent during the average period (2018-2022).

2- Relative Importance of Average Cost Items for Sugarcane Crop at the Governorate Level Distributed over Agricultural Operations during the Period (2018-2022):

As shown in Table (7), the relative importance of the average cost items for sugarcane at the governorate level distributed over agricultural operations during the period (2018-2022) indicates that the average total costs excluding rent for the governorates of Middle Egypt reached about 12,916.8 EGP/feddan, while the average total costs including rent reached about 22,916.8 EGP/feddan. The average total costs excluding rent for the governorates of Upper Egypt amounted to 14,087.8 EGP/feddan, while the average total costs including rent reached 21,195.2 EGP/feddan during the studied period.

The overall average cost for the fertilizer operation was 2,985.2 EGP/feddan, representing about 13.96% of the average total costs. Next came the irrigation operation with an average cost of 2,880.6 EGP/feddan, representing approximately 13.47% of the average total costs. The cost for seeds and planting averaged 1,874.4 EGP/feddan, representing about 8.76% of the average total costs for sugarcane during the period (2018-2022).

Harvesting came next with an average cost of 1,718.6 EGP/feddan, representing about 8.03% of the total costs, which averaged 13,955 EGP/feddan or 65.24% during the same period.

Studying the relative importance of cost items in the producing governorates during the period (2018-2022) reveals the following:

Minya Governorate: Fertilization costs averaged about 3,213 EGP/feddan, representing 14% of the total costs. This was followed by irrigation and harvesting, with average costs of 2,567.6 EGP/feddan and 1,822 EGP/feddan, respectively, accounting for about 11.2% and 8.0% of the total costs

Sohag Governorate: Fertilization costs averaged around 2,980.6 EGP/feddan, also about 14% of total costs, followed by irrigation and harvesting at 2,816.6 EGP/feddan and 1,854.4 EGP/feddan, representing 13.2% and 8.7%, respectively.

Qena Governorate: Irrigation costs averaged 3,080.2 EGP/feddan (14% of total costs), followed by fertilization and seeds & planting at 2,926.8 EGP/feddan and 2,142.4 EGP/feddan, representing 13.3% and 9.7%, respectively.

Luxor Governorate: Irrigation costs averaged 3,266 EGP/feddan (14.8% of total costs), followed by fertilization and seeds & planting at 2,889.2 EGP/feddan and 2,245.2 EGP/feddan, representing 13.1% and 10.2%, respectively.

Aswan Governorate: Irrigation costs averaged 3,045.2 EGP/feddan (15.6% of total costs), followed by fertilization and harvesting at 2,478.6 EGP/feddan and 1,810.2 EGP/feddan, accounting for 12.7% and 9.3%, respectively.

3. Relative Importance of Average Cost Items for Sugarcane Crop Distributed on Wages and Production Inputs During the Period (2018-2022):

Table (8) shows the relative importance of average cost items for the sugarcane crop distributed on wages and production inputs during the period (2018-2022).

Table 8: Relative Importance of Average Cost Items for Sugarcane Crop Distributed on Wages and Production Inputs During the Period (2018-2022)

Value: in Egyptian Pounds (EPG)

Year	Worker Wages	Machinery Wages	Seed Price	Price of organic fertilizer	Price of chemical fertilizes	General Expenses	Total Costs
2018	5054	1515	1583	352	1387	1582	11473
2019	5058	1354	1481	354	1105	1496	10848
2020	4685	2756	1253	0	1705	1664	12063
2021	5712	2867	1336	0	3451	2139	15505
2022	6706	4704	1411	0	4322	2743	19886
Average	5443	2639	1413	141	2394	1925	13955
%	39.00	18.91	10.12	1.01	17.16	13.79	100

Source: Compiled and calculated from the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economics, Agricultural Cost and Net Return Statistics Bulletin, various issues.

Table 9: Relative Importance of Average Cost Items for Sugarcane Crop at the Governorate Level Distributed over Wages and Production Inputs during the Period (2018-2022)

Value: in Egyptian Pounds (EPG)

Items / Governorates	Minya	Middle Egypt Average	Sohag	Qena	Luxor	Aswan	Upper Egypt Average	Overall Average	%
Labor wages	5531.2	5531.2	5128.6	5343.4	5541	5523.8	5434	5443	39.0
Machinery wages	1917.8	1917.8	2604.8	2938.6	3413.8	1984.8	2728.6	2639.2	18.9
Price of seeds	910	910	1150.8	1636.2	1577.2	1252.6	1476.4	1412.8	10.1
Price of organic fertilizer	130.2	130.2	98	143.2	166.4	130.2	142.4	141.2	1.0
Price of chemical fertilizer	2646.2	2646.2	2466.2	2363.6	2254	2426	2363.2	2394	17.2
General expenses	1781.4	1781.4	1831.6	1988	2072.6	1810.8	1943.2	1924.8	13.8
Total costs excluding rent	12916.8	12916.8	13280	14413	15025	13128.2	14087.8	13955	100.0

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economics, Agricultural Cost and Net Return Statistics Bulletin, various issues.

It is evident that the average labor wages amounted to about 5,443 EGP/feddan, representing approximately 39.00% of the average total costs during the studied period. The wages for machinery followed, with an average of about 2,639 EGP/feddan, accounting for 18.91% of the average total costs. The cost of seeds averaged 1,413 EGP/feddan, representing about 10.12%. The cost of chemical fertilizers and organic fertilizers was about 2,394 EGP/feddan and 141 EGP/feddan, respectively, constituting 17.16% and 1.01% of the average total costs. Data from the same table indicate that the average total cost amounted to 13,955 EGP/feddan during the period (2018-2022).

4- Relative Importance of Average Cost Items for Sugarcane Crop at the Governorate Level Distributed over Wages and Production Inputs during the Period (2018-2022):

Table (9) illustrates the relative importance of the average cost items for the sugarcane crop at the governorate level distributed over wages and production inputs during the period (2018-2022). It was found that the average labor wages in the Central and Upper Egypt governorates reached 5443 EGP/feddan, representing about 39.0% during the average period (2018-2022). Meanwhile, the average machinery wages in the same governorates amounted to approximately 2639.2 EGP/feddan, representing 18.9% during the studied period. The average cost of seeds in the Central and Upper Egypt governorates was about 1412.8 EGP/feddan, representing 10.1% of the total costs during the same period.

The table also shows that the cost of chemical fertilizer and organic manure in the average of Upper and Central Egypt governorates reached around 2394 EGP/feddan and 141.2 EGP/feddan respectively, representing 17.2% and 1.0% during the studied period. The average costs excluding rent amounted to about 13,955 EGP/feddan during the average period (2018-2022).

Data from the same table indicate that the relative importance of cost items at the governorate level distributed over wages and production inputs during the period (2018-2022) shows that labor wages, chemical fertilizer cost, and machinery wages represent the highest proportions in the cost items in Minya, Sohag, Qena, Luxor, and Aswan governorates, with variations among them.

In light of the results reached, the study recommends the following:

1- Working on increasing the yield per feddan by developing high-yielding varieties of sugarcane.
2- Reducing the cultivation of low-yield sugarcane varieties and focusing on good varieties that also provide a high extraction rate and are resistant to insects and pests.
3- Providing production requirements at prices suitable for farmers' capabilities.
4- Using modern technologies to increase yield per feddan and to rationalize irrigation water for sugarcane crops, including the use of improved surface irrigation methods.

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الملخص العربي

التحليل الاقتصادي لإنتاج قصب السكر في مصر

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يعتبر محصول قصب السكر من المحاصيل الاستراتيجية الهامة لبعض الدول التي تزرعه بغرض إنتاج السكر. وقد تمثلت المشكلة في تذبذب إنتاج قصب السكر مع الزيادة المستمرة في الكميات المستهلكة من السكر، ومن ثم تم إجراء دراسة تحليلية لاقتصاديات إنتاج محصول قصب السكر مع ارتفاع نسبة تكاليف الإنتاج.

ويهدف البحث إلى دراسة اقتصاديات انتاج قصب السكر في مصر خلال الفترة (٢٠٠٥ –٢٠٢٢) ، من خلال دراسة الإنتاج الكلى والتكاليف وصافي عائد الفدان والتعرف على الأهمية النسبية للمحافظات المنتجة له بمصر. بالإضافة إلي دراسة الأهمية النسبية لبنود التكاليف لمحصول قصب السكر.

ومن اهم النتائج تبين ان كلا من إجمالي المساحة المزروعة والايرادات الكلية للفدان وصافي العائد قد أخذت اتجاهاً عاماً متزايداً بمقدار سنوي معنوي إحصائيا عند مستوى معنوية ٠.٠١، وان كلا من الإنتاجية والإنتاج الكلي قد اخذت اتجاها عاما متناقصا وقد ثبتت المعنوية الإحصائية لهذا التناقص عند مستوى معنوية٠.٠١.

وتبين ان الأهمية النسبية لمتوسط بنود التكاليف لمحصول قصب السكر على مستوى المحافظات موزعة علي أجور ومستلزمات إنتاج تبين أن أجور العمال، ثمن السماد الكيماوي، أجور الآلات تمثل أعلي نسب في بنود الكاليف في كل من محافظات المنيا، سوهاج، قنا، الأقصر، أسوان مع اختلافها من محافظه لأخري. وكانت اهم المحافظات المنتجة له محافظة المنيا وسوهاج، وقنا، والاقصر، وأسوان.

ويوصي البحث بالعمل علي زيادة الإنتاجية الفدانية عن طريق استنباط أصناف عالية الإنتاجية من قصب السكر.

الكلمات المفتاحية : قصب السكر – إنتاج قصب السكر– بنود التكاليف– صافي العائد.