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An Analysis of the Performance of Sugar Beet Broduction and Processing in Egypt: Insights From Delta Sugar Company

Ali Fouad[1] ,Victor Shaker[2]

[1]Professor Emeritus, Department of Agricultural Economics, Faculty of Agriculture, Cairo University, Egypt
[2] Associate Professor, Department of Agricultural Economics, Faculty of Agriculture, Cairo University, Egypt
Correspondence: Victor.Shaker@agr.cu.edu.eg

تحليل أداء إنتاج وتصنيع بنجر السكر في مصر: دراسة حالة شركة الدلتا للسكر

على فؤاد[1] ، فيكتور شاكر[2]

[1] استاذ متفرغ بقسم الاقتصاد الزراعى، كلية الزراعة، جامعة القاهرة، مصر
[2] استاذ مساعد بقسم الاقتصاد الزراعى، كلية الزراعة، جامعة القاهرة، مصر
المراسلة: Victor.Shaker@agr.cu.edu.eg

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Abstract

The Egyptian government is expanding sugar beet cultivation and increasing the number of factories due to challenges in the sugarcane sector. Integrating supply response, partial equilibrium, and linear programming models provides a comprehensive understanding of market behavior. These models collectively offer insights into farmers' decision-making, market efficiency, welfare distribution, and resource optimization at the firm level. The results indicate that the rise in sugar beet production is primarily driven by an expansion in the cultivated area, while feddanic productivity has remained stable. Additionally, sugar beet producers exhibit risk-averse behavior, requiring an average of 7.3 months to decide whether to cultivate the crop in the future. Furthermore, price controls distort market signals, leading to inefficient resource allocation and declining consumer welfare. The case study of Delta Sugar Company underscores key operational and financial factors necessary for ensuring the long-term sustainability of Egypt's sugar beet sector. Boosting Egypt's sugar beet industry requires improving agricultural efficiency, workforce development, and financial policies while adopting cost-reflective pricing and targeted subsidies to enhance sustainability and market competitiveness. Future research should focus on optimizing the value chain and analyzing market efficiency in Egypt's sugar beet industry to enhance competitiveness, pricing mechanisms, and policy effectiveness.

Keywords*:* Sugar beet, supply response model, partial equilibrium model, linear programming, Egyptian economy

Introduction

Sugar beet and sugarcane are well-known sources of sugar and serve as primary feedstocks for efficient biofuel production (Babu & Adeyeye, 2024). Globally, sugar beet is the second most important sugar crop after sugarcane, accounting for 12.5% of the total global sugar crop area and 38% of total global sugar production. In Egypt, however, sugar beet is considered the most essential and strategic industrial crop (Kenawy & Nagib, 2024). Rather than competing with sugarcane, it serves as a complementary crop (Khalil et al., 2022; MALR, 2018). Additionally, sugar beet is used as a fodder crop and a raw material for various industrial applications (Usmani et al., 2022).

Egypt’s sugarcane sector faces several challenges that farmers and other agricultural stakeholders must address. First, sugarcane is a water-intensive crop, posing a significant issue in a water-scarce country like Egypt (Ibrahim & Khalil, 2021). Second, continuous monocropping depletes soil fertility and reduces productivity (Pang et al., 2021). Third, the crop is highly susceptible to various pests and diseases, leading to damage, productivity losses, and increased production costs (Wada, 2024). Fourth, sugarcane cultivation is labor-intensive, requiring skilled workers and generating additional costs (Rohit et al., 2015). Finally, the plant’s size, farm layout, and the availability of suitable harvesting equipment make the transition from manual to mechanical harvesting challenging (Abdel-Mawla, 2014).

Given these challenges, there is an urgent need to expand sugar beet production areas and manufacturing capacities, as sugar beet requires less irrigation water and is a viable alternative to sugarcane (Ameen, 2024). Additionally, sugar beet cultivation can improve water efficiency and allow the allocation of resources to other high-value crops (Ibrahim & Khalil, 2021; Seadh et al., 2024).

Comparably, sugar beet is vulnerable to climate change effects, including temperature extremes, droughts, and irregular weather patterns, which reduce crop yields and quality (Ferweez et al., 2022). Additionally, shareholder profitability can be adversely affected by market inefficiencies, price fluctuations, and distortions (Arezki et al., 2020). Moreover, the sector exhibits low adoption of modern agricultural technologies, precision farming methods, and mechanization, reducing production efficiency, lower productivity, and higher costs (Salem et al., 2024). Furthermore, inadequate processing, transportation, storage, and market access infrastructure contribute to inefficiencies, post-harvest losses, and supply chain disruptions (Abdelwahab et al., 2022). Although Egypt has made progress in technological advancements and policy reforms for sugar beet production, it still lags behind major producers in Europe and North America in terms of modern agricultural practices, regulatory frameworks, and market sophistication.

Sugar beet has the potential to be cultivated in newly reclaimed lands due to its adaptability to various climatic conditions and lower irrigation water requirements (MALR, 2018). Unlike traditional agriculture, which prioritizes high output, sugar beet production emphasizes yield quality over quantity (El-Zayat, 2021). The crop is typically harvested between mid-February and mid-June and transported directly to factories for efficient processing (El-Syiad et al., 2016). It is preferred over wheat due to its shorter growing season, higher profitability, and lower risk under contract farming. However, while contract farming ensures stability, it may also limit farmers' bargaining power.

Given the challenges facing the sugar beet sector, a comprehensive understanding of the factors influencing its competitiveness is crucial. Unlike previous studies that employed a single-method approach, this study adopts a multi-model approach by integrating supply response analysis, partial equilibrium modeling, and linear programming. This allows for a holistic analysis of the interactions between production, market forces, and processing efficiency. The findings serve as a basis for policy recommendations to support decision-making for farmers and industry stakeholders.

The remainder of this paper is structured as follows: Section 2 presents the literature review, ensuring that the research design, techniques, and analysis are informed by established knowledge and theories. Section 3 introduces the methodologies that form the foundation for the results and discussion. Section 4 presents the results along with their interpretations. Finally, Section 5 concludes the study by integrating key findings and policy implications.

Overview of the Sugar Beet Sector

Sugar beet production in Egypt dates back to the early twentieth century. It has become a key component of the country's agricultural landscape, particularly in the Nile Delta and other suitable regions.

A recent study by Khalil et al. (2022) highlights that the number of automatic working hours in laser leveling is one of the most critical factors affecting sugar beet production. This finding underscores the importance of technological advancements, horizontal expansion into new lands, and contract farming. Notably, technologies such as laser leveling can enhance farm-gate prices by improving productivity, reducing costs, enhancing crop quality, and increasing market competitiveness. Therefore, subsidies for laser leveling equipment and field preparation could encourage adoption, optimize resource utilization, and align with government objectives for sustainable agriculture and increased farm profitability.

The rising price of sugar beet has driven increased industrial demand, prompting more farmers to cultivate the crop and leading to establishing additional sugar mills (USDA, 2023). The sugar industry significantly contributes to Gross Domestic Product (GDP) and is a crucial source of foreign exchange earnings. However, due to high domestic consumption for both personal and industrial purposes, more than 20% of Egypt's sugar supply is imported (Chernova et al., 2024). Egyptians' strong preference for sugar has also led to a nutritional gap (Elsayed, 2023). Ensuring the resilience of the sugar industry is essential for maintaining economic and food security, as it directly affects the income of over 500,000 families (Chernova et al., 2024).

According to Ahmed (2018), farm-gate prices and cultivated area (with a one-year lag) are the most significant factors influencing sugar beet supply. These variables determine farmers' production decisions, market participation, and overall supply responsiveness. Monitoring and understanding these factors are essential for maintaining long-term supply chain stability, market equilibrium, and industrial development.

Using the Policy Analysis Matrix (PAM) to examine the impact of agricultural policies on sugar beet production, Bahloul (2019) found that farmers received no input subsidies and were taxed on beet production. Nevertheless, Egypt holds a comparative advantage in sugar beet production, largely due to its favorable agro-climatic conditions. This advantage could be further strengthened through efficient water management, a skilled labor force, and the implementation of sustainable agricultural practices.

Elshatla (2024) analyzed the impact of agricultural policies on sugar manufacturing using the Partial Equilibrium Model (PEM). The study revealed that sugar manufacturers were subject to implicit taxes, which, in turn, led to increased domestic prices, effectively imposing additional costs on consumers. As a result, production surpluses were recorded, while consumers experienced losses. Although the efficiency analysis indicated economic gains at the production level, consumption-related losses resulted in an overall net economic loss at the societal level. Additionally, government revenue benefited from the absence of consumer subsidies, while rising imports had a negative impact on foreign exchange reserves.

By examining the sugar beet value chain, Abdelwahab et al. (2022) found that farmers' ability to add value was limited by a significant increase in production costs relative to farm gate revenue. However, profitability tends to rise with the value added by each actor in the supply chain. A case study of Delta Sugar Company in Egypt showed that producers captured the highest share of value added (33.4%), followed by factories (12.4%), packing companies (7.46%), retailers (5.3%), and wholesalers (5%). Strategic policy interventions, market incentives, and technological advancements should be considered to optimize production efficiency, improve farmer livelihoods, and ensure market access.

The sustainability of the sugar industry depends on the interaction of technical, environmental, socio-economic, and geographical factors (Aguilar-Rivera, 2019). According to Egypt’s Sustainable Agricultural Development Strategy 2030, sugar production is projected to reach 3.5 million tons through horizontal expansion, increasing the cultivation area to 800,000 feddans (Hashem, 2020).

In summary, the sustainability and growth of Egypt's sugar beet industry depend on a combination of technological advancements, policy reforms, and market efficiency. Adopting modern techniques such as laser leveling can significantly enhance productivity, reduce costs, and improve competitiveness. While rising sugar beet prices have driven industrial demand and expanded cultivation, structural challenges remain, including input taxation, high domestic consumption, and reliance on imports. Policy analysis highlights the need for targeted subsidies, efficient water management, and market-driven pricing mechanisms to ensure long-term stability. Additionally, optimizing the value chain through strategic interventions can enhance farmer profitability and industry resilience. Aligning with Egypt's Sustainable Agricultural Development Strategy 2030, future efforts should focus on expanding cultivated areas, improving resource utilization, and fostering a balanced market structure to secure economic and food security.

Methodology and Data Sources

This research integrates supply response, partial equilibrium, and linear programming models to provide a comprehensive analysis with a case study of Delta Sugar Company. The first model identifies factors influencing farmers' production decisions, while the second evaluates market dynamics. Through the case study, the third model assesses processing efficiency. The goal is to provide evidence-based recommendations for policymakers, farmers, and industry stakeholders to enhance productivity, ensure market stability, and improve the competitiveness of Egypt's sugar beet sector.

The data used in this study consist of two main types: primary data from Delta Sugar Company (2018–2020) and secondary data from the Ministry of Agriculture and Land Reclamation, the World Bank, the Federal Reserve Economic Data (FRED), the Central Agency for Public

Mobilization and Statistics (CAPMAS), the Central Bank of Egypt (CBE), and relevant reports covering the period from 2005 to 2021. The data are analyzed from different perspectives using both qualitative and quantitative methods.

Supply Response Analysis

Supply response models are widely used to capture the dynamic behavior of producers when adjusting output levels. In practice, the Newlove model, which forecasts farmers' reactions based on price expectations and partial area adjustments, applies across various economic frameworks dealing with supply responses in agricultural commodities. A variation of this model (Ahmad & Mahmood, 1994) was selected for testing within a risk framework.

Risk is measured using several surrogate variables, including price variance, dummy variables, and expectational factors. Incorporating risk is particularly important, as the agricultural sector operates within a competitive framework where price and yield variability significantly influence farmers' production decisions (Hazen & Scandizzo, 1974; Just, 1974).

The supply response model equations are as follows:

$$\mathbf{A_t = a + b_1\, A_{t-1} + b_2\, P_{t-1}} \quad (1)$$

$$\mathbf{A_t = a + b_1\, A_{t-1} + b_2\, P_{t-1} + b3\, K_t} \quad (2)$$

$$\mathbf{K_t = (P_{t-1} - 0.33\,(P_{t-2}+P_{t-3}+P_{t-4}))^2 \,/\, (0.33\,(P_{t-2}+P_{t-3}+P_{t-4})} \quad (3)$$

Where:

- $\mathbf{A_t}$: actual Area under cultivation at time t,
- $\mathbf{P_{t-1}}$: one-year lagged farm gate price,
- $\mathbf{P_{t-2}}$: two-year lagged farm gate price,
- $\mathbf{P_{t-3}}$: three-year lagged farm gate price,
- $\mathbf{P_{t-4}}$: four-year lagged farm gate price,
- $\mathbf{K_t}$: price risk variable at time t,
- **a**: constant,
- $\mathbf{b_i}$: regression coefficients.

Supply response models provide valuable insights into how producers adjust output levels in response to economic conditions. If risk aversion significantly influences optimal supply behavior, then any policy aimed at reducing risk aversion would, in turn, impact optimal supply decisions and subsequently affect suppliers' incomes.

Partial Equilibrium Analysis

Partial equilibrium is the technical term for demand and supply analysis. It examines a single market at a time while ignoring potential cross-market interactions. These models can be used to forecast changes in key economic variables, such as prices, trade volume, revenue, and economic efficiency indicators (Tsakok, 1990).

For this study, the analysis period was divided into three phases: 2005–2010, 2011–2015, and 2016–2021. This segmentation allows for monitoring changes resulting from significant political, economic, and social events that characterized these periods. Additionally, the model incorporates government price-setting as an exogenous factor rather than relying on a market-clearing mechanism.

The equations for the partial equilibrium model are presented as follows:

Table (1)

Equations for the Partial Equilibrium Model

Net Economic Loss in Production	**NELp**	$= 0.5\ (Q_w - Q_d)\ (P_b - P_p)$	(1)
Net Economic Loss in Consumption	**NELc**	$= 0.5\ (C_w - C_d)\ (P_C - P_b)$	(2)
Net Economic Loss	**NEL**	$NEL = NEL_P + NEL_C$	(3)
Change in Producer Surplus	**WG_p**	$= Q_d(Pp - P_b) - NEL_P$	(4)
Change in Consumer Surplus	**WGc**	$= C_d\ (Pb - P_C) - NEL_C$	(5)
Change in Foreign Exchange Earnings	**ΔFE**	$= - P_b\ (Q_w - Q_d + C_d - C_W)$	(6)
Change in Government Revenue	**ΔGR**	$= - NEL - WG_p - WG_c$	(7)
Net Effect	**NET**	= GR + PS +Cs = -(NELP + NELC)	(8)

Where:

Retail Price (consumer)	P_c	Quantity of production at border price	Q_w
Producer Price (Producer)	P_p	Quantity of production at farm-gate price	Q_d
Border price	P_b	Quantity of consumption at border price	C_w
		Quantity of consumption at domestic price	C_d

Source: Tsakok, 1990.

Linear programming

Linear programming is an algebraic technique that uses linear equations to determine the optimal solution (maximum or minimum) to a mathematical problem, given finite resources and a well-defined optimization goal. The general modeling process follows three main steps: (1) identifying the problem, (2) prescribing a solution, and (3) continuously refining the optimal solution by updating parameters and adjusting the problem structure. Constraints in the model account for contractual acreage limits, factory processing capacity, and transportation logistics provided by the company. Feedback loops exist among these steps, ensuring adjustments are made based on changing conditions (Arsham, 2014).

The mathematical representation of the model adopted in this research is as follows:

Table (2)

Mathematical Representation of the Model

Max $Z = -4.756X_1-0.080X_2-0.155X-0.17X_3-.800X_4-4.500X_5- X_6+14X_8+23X_9$		(1)
Subject to		
$X_1 \leq 103$	Area	(2)
$55X_1-X_2 \leq 0$	Labor supply	(3)
$4X_1-X \leq 0$	Irrigation water supply	(4)
$4.756X_1+0.080X_2-X_3+0.155X+0.8X_4+ 4.500X_5+X_6 \leq 0$	Capital supply	(5)
$X_4=1957;$	Maximum sugar beet production	(6)
$-19X_1+7.0X_4 \leq 0$	Sugar beet delivered to the factory	(7)
$-X_4+ X_5 \leq 0$	Sugar supply	(8)
$-X_5+X_6 \leq 0$	Sugar Distribution to wholesale companies	(9)
$-X_6+X_8+X_9 \leq 0$	Sugar sales at retail level	(10)
$X_8 \leq 184.5$	Maximum limit for subsidized sugar	(11)
$X_9 \leq 95$	Maximum limit for extra sugar	(12)

Where:

Z	objective function (maximizing net return)
X_1	sugar Beet Area Supplied to Delta Sugar factory (000 feddans)
X_2	human labor for the production and harvesting of sugar beet (000 people)
X	irrigation water used to grow sugar beet (000 m^3)
X_3	capital used in the cultivation and manufacture of sugar beet (000 EGP)

X_4	Sugar beet Supplied to the Factory (000 Tons)
X_5	sugar produced in the factory (000 Tons)
X_6	Sugar distribution by wholesale Companies (000 Tons)
X_8	sugar subsidized at retail level (000 Tons)
X_9	extra sugar at retail level (000 Tons)

Source: Prepared by author.

Shadow prices, also known as dual prices, represent the change in the optimal objective function value per unit change on the right-hand side of a constraint. Simply put, they indicate the marginal value of relaxing or tightening a constraint within a linear programming model.

Results and Discussion

Production and economic status of sugar beet crops

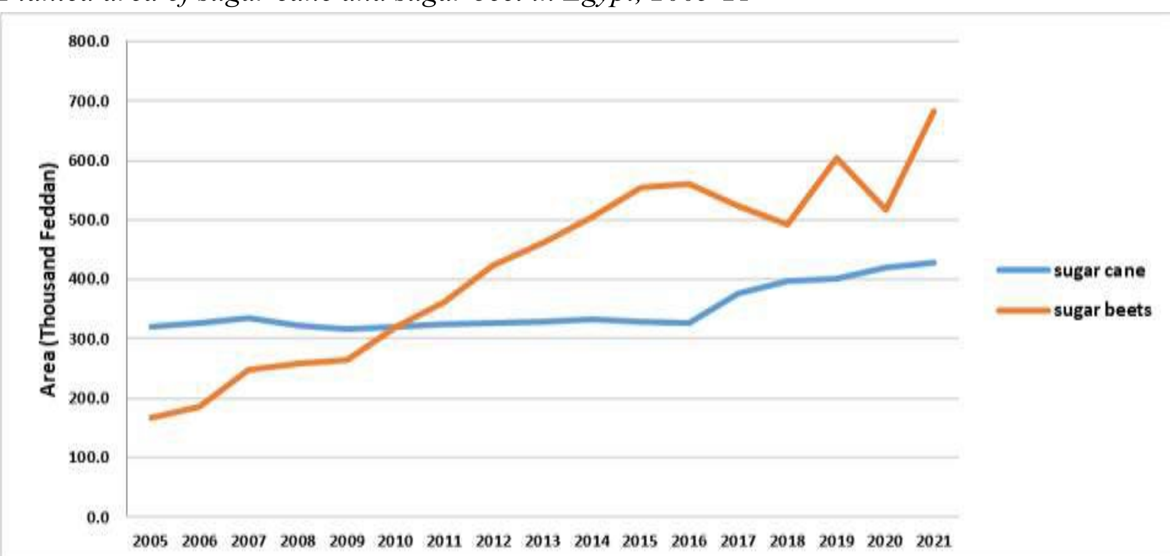
Sugar beet is a winter crop, but its seeds are not produced in Egypt due to unsuitable weather conditions. The crop is cultivated in several governorates, including Kafr El-Sheikh, Dakahlia, Gharbia, Beheira, Sharkia, Minya, Assiut, Beni Suef, and Faiyum. Figure 1 shows that sugar beet cultivation expanded significantly, increasing from 167.4 thousand feddans in 2005 to 682.4 thousand feddans in 2021, marking a 307% increase. The crop accounted for 34% of the total sugar crop area in 2005 and 61.88% in 2021.

Regarding feddanic productivity, yields remained relatively stagnant between 2005 and 2011, increasing slightly from 20.5 tons in 2005 to 20.8 tons in 2011. However, total production rose from 3.43 million tons in 2005 to 14.9 million tons in 2021, representing a 334% increase. The lack of productivity growth between 2005 and 2011 may be attributed to technological limitations, soil conditions, and input constraints.

Table 3 indicates that the annual growth rates for sugar beet area, productivity, and production between 2005 and 2021 averaged 7.81%, -0.08%, and 7.73%, respectively. This suggests that the increase in total production was primarily driven by horizontal expansion into new agricultural areas as part of national development projects.

Figure 1

Planted area of sugar cane and sugar beet in Egypt, 2005-21



Source: Table A1 in Appendix.

Table 3

Annual growth rates of the production indicators of sugar beet, 2005-21

Variable	Unit	Annual Growth Rate	Standard Error	F - Statistic	R^2
Area	000 feddan	7.81*	0.007	96.32*	0.85
Productivity	Ton	-	0.001	0.18	0.053
Production	000 ton	7.73*	0.008	76.29*	0.82
Variable costs	EGP/feddan	12.73*	0.002	2277.68*	0.99
Fixed costs	EGP/feddan	11.01*	0.006	260.94*	0.94
Total Costs	EGP/feddan	12.13*	0.002	2502.80*	0.99
Net income	EGP/feddan	4.65*	0.015	8.740*	0.32
Farm-gate price	EGP/feddan	9.20*	0.007	148.1*	0.9

**Significant at 5% level*

The annual growth rate was calculated using the Semi-Log Form.

Source: Tables A1 & A2 in Appendix.

Regarding production costs per feddan, variable costs increased from approximately EGP 1,085 in 2005 to EGP 7,585.1 in 2021, marking a 599% increase. Similarly, fixed costs rose from EGP 771 in 2005 to EGP 3,736 in 2021, an increase of 384%. As a result, total costs per feddan increased from EGP 1,856 in 2005 to EGP 11,321 in 2021, representing a 609% increase.

Meanwhile, the farm gate price per ton rose from EGP 120 in 2005 to EGP 625 in 2021, reflecting a 420% increase. These trends impacted net profit per feddan, which increased from EGP 604 in 2005 to EGP 1,672.8 in 2021, marking a 191% increase (Appendix A2). The annual growth rate of total costs was approximately 12.13%, while farm-gate prices grew at 9.2% annually. Consequently, net profit increased at a lower rate of 4.65% per year (Table 3).

The preliminary descriptive analysis of sugar beet production indicates that production volume primarily depends on the cultivated area. However, input prices have risen faster than farm gate prices, leading to a negative net effect, which serves as a crucial predictor of farmers' future production decisions.

To analyze the key drivers of sugar beet production and farmers' supply decisions, Table 4 presents the estimation results of the restricted supply response model (Equation 1) with an adjusted coefficient of determination (adj. R^2) of 87%.

The analysis reveals that:

- A 1,000-feddan increase in the one-year lagged sugar beet area leads to a current-year allocation increase of 0.48 thousand feddans.
- A one-pound increase in the one-year lagged farm-gate price per ton motivates farmers to expand the cultivated area by 0.187 thousand feddans.
- The partial adjustment coefficient (γ) is 0.52, suggesting that farmers take approximately 6.32 months to make decisions about future sugar beet cultivation.

Table 4

Supply response results for sugar beet, 2005-21

Model	Parameters	Standard Error	F - statistic	Adjusted R^2
The Restricted Model				
Constant	84.67*	38.36	56.82*	0.87
A_{t-1}	0.48*	0.199		
P_{t-1}	0.47*	0.187		
The partial adjustment coefficient (ג)	0.52			
The Unrestricted Model				
Constant	90.97	45.39	37.14*	0.87
A_{t-1}	0.40	0.23		
P_{t-1}	0.53*	0.21		
Price risk coefficient	-0.72	0.72		
The partial adjustment coefficient (ג)	0.60			

**Significant at 5% level*

Sources:

- Tables A1 & A2 in Appendix.
- Ahmad M., Mahmood F.,1994. incorporating risk in supply response (case of wheat in Pakistan)- workshop on food and agricultural policy analysis – INP, Cairo.

Turning to the unrestricted model (Equation 2) with a coefficient of determination (R^2) of 87%, the results in Table 4 indicate that:

- A 1,000-feddan increase in the one-year lagged sugar beet area leads to a current-year allocation increase of 0.40 thousand feddans.
- A one-pound increase in the one-year lagged farm-gate price per ton motivates farmers to expand the cultivated area by 0.53 thousand feddans.
- The price risk coefficient suggests that farmers are risk-averse.
- The partial adjustment coefficient (γ) is approximately 0.60, indicating that farmers take about 7.3 months to decide on future sugar beet cultivation.

The difference in adjustment periods between the restricted and unrestricted models may be attributed to price risk effects. Understanding the adjustment period is crucial for policymakers, as it helps anticipate the time required for markets to respond to policy interventions or external shocks.

Applying a standard supply response model based on perfect competition may not fully capture the dynamics of Egypt's sugar beet sector due to heavy government involvement and the contract farming system. Key limitations include government-set farm gate prices, where the government determines prices before planting, influencing supply incentives and reducing farmers' responsiveness to price fluctuations, and the contract farming system, in which farmers enter into pre-agreed contracts specifying acreage, price, and quality standards, thereby limiting the role of free-market price mechanisms.

Given these factors, rather than assuming perfect competition, it may be more appropriate to consider a quasi-planned supply model, where farmers respond primarily to contract availability rather than price alone.

Sugar beet processing

There are eight public sugar beet factories in Egypt, with Al-Sharqiya Sugar Factory beginning production in 2019. Table 5 and Figure 2 illustrate the distribution of sugar beet growing areas delivered to factories for the 2020 juice season, totaling 517 thousand feddans. Among the factories, Delta Sugar Factory accounted for 20.47%, Daqahlia Sugar Factory for 20.26%, Faiyum Sugar Factory for 14.14%, and Nile Sugar Factory for 11.34%, while the remaining factories collectively accounted for 33.79% of the total cultivated area.

Table 5

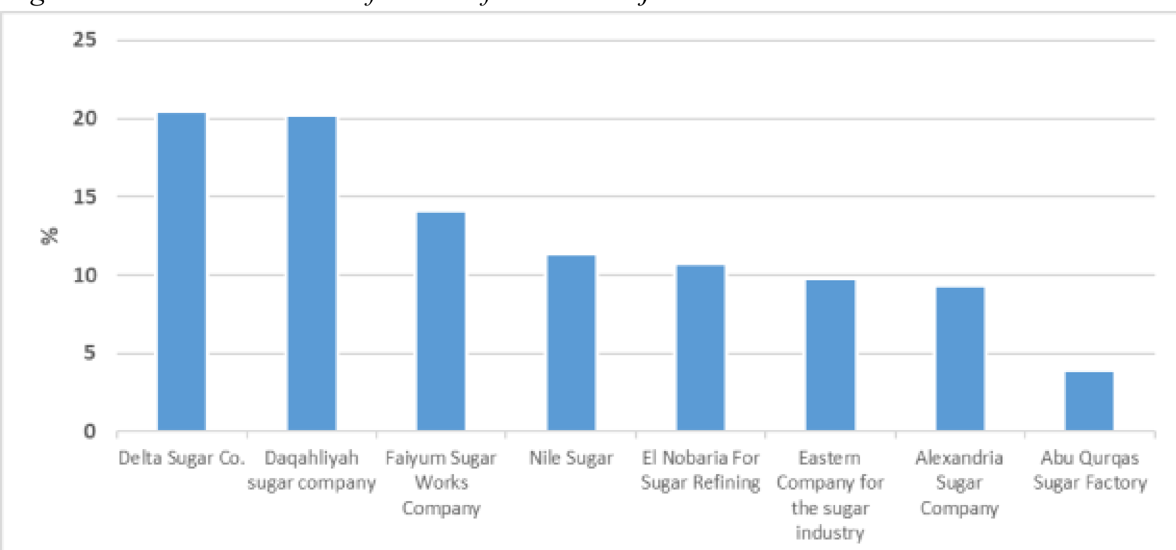
Sugar beet areas allocated to factories for the 2020 juice **season**

Marketing channel	Area supplied. (000feddans)	%
Delta Sugar Co.	105.8	20.47
Daqahlia sugar company	104.8	20.26
Faiyum Sugar Works Company	73.1	14.14
Nile Sugar	58.6	11.34
Nobaria Sugar Industry and Refining Company	55.6	10.75
Eastern Company for the Sugar Industry (Noran)	50.5	9.78
Alexandria Sugar Company	48.3	9.34
Abu Qurqas Sugar Factory	20.3	3.92
Total	**517.0**	**100**

Source: Ministry of Agriculture and Land Reclamation - Sugar Crops Council, 2020.

Figure 2

Sugar beet areas allocated to factories for the 2020 juice season



Source: Table (5)

Table 6 and Figure 3 present the geographical distribution of sugar factory production by governorate from 2018 to 2020. Alexandria was the top contributor, producing 369.5 thousand tons, which accounted for 28.7% of total beet sugar production (1.28 million tons). Dakahlia ranked second with 294.6 thousand tons (22.9%), followed by Kafr El-Sheikh with 279.7 thousand tons (21.7%). Faiyum, Nobaria, and Sharkia contributed 169.9, 142.5, and 30 thousand tons, representing 13.2%, 11.1%, and 2.3%, respectively, of total beet sugar production.

The Herfindahl-Hirschman Index (HHI), a widely used measure of market concentration, indicates that the beet sugar market is moderately concentrated. This suggests that no single company dominates the market or exerts significant control that could disadvantage smaller players.

Table 6

Geographical distribution of beet sugar processors, 2018-20

Governorate	Factory[1]	Average (Thousand ton)	%	Herfindahl-Hirschman Index [2]
Dakahlia	Dakahlia	294.6	21.8	474.87
Kafr El-Sheikh	Delta	279.7	20.7	428.05
Alexandria	Nile	199.6	14.8	217.99
	Alexandria	169.7	12.6	157.57
Faiyum	Faiyum	169.9	12.6	157.94
Nobaria	Nobaria	142.5	10.5	111.11
Minya	Abu Qurqas	65.9	4.9	23.76
Sharkia	Eastern Company for the Sugar Industry (Noran)	30	2.2	4.92
Total		**1351.9**	**100.0**	**1576.22**

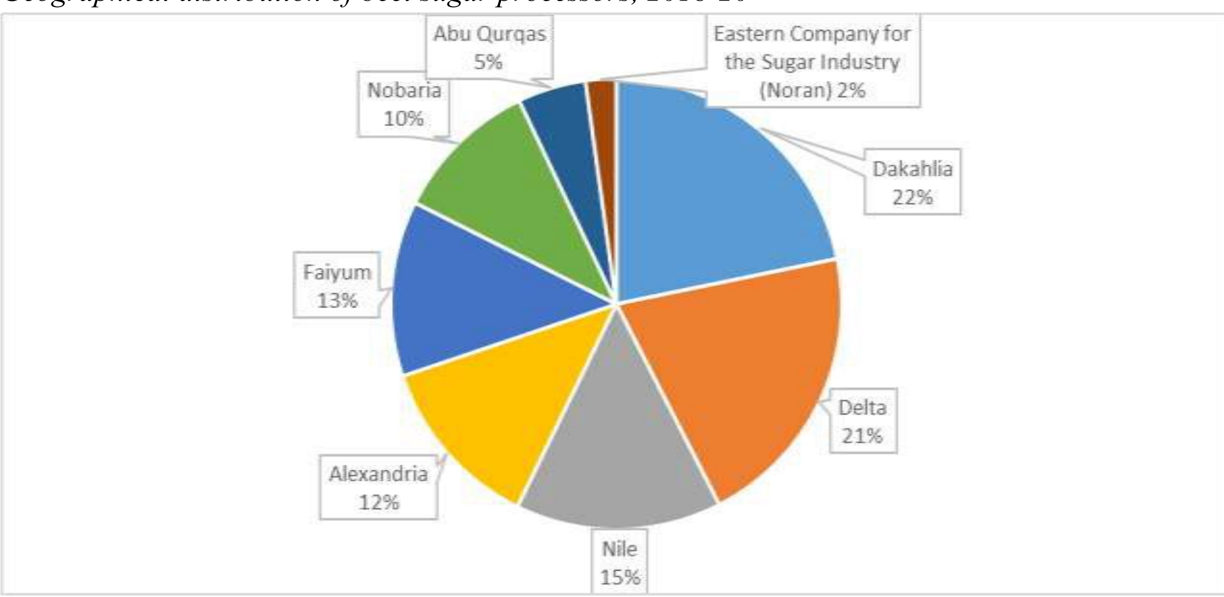
Herfindahl-Hirschman Index (HHI) is calculated by squaring each factory's market share and then summing the resulting numbers.

Source:

- The data is collected and computed from the Ministry of Agriculture and Land Reclamation, Sugar Crops Council, Annual Report Bulletin, various issues.
- Bade & Parkin (2008).

Figure 3

Geographical distribution of beet sugar processors, 2018-20



Source: Table (6)

According to the Sugar Crops Research Institute (ARC), Nile Factory has the highest operating efficiency at 150.5%, with approximately 169 operating days and a total intake of 1,505 thousand tons of sugar beet. In contrast, Nobaria Factory has the lowest operating efficiency at 107.5%, with 138 operating days and 1,075 thousand tons of sugar beet received. Al-Sharqiya Factory, which only recently began beet sugar production, received 638 thousand tons of sugar beet in 2019, with an operational efficiency of 42.5% and 91 operating days.

Table 7 illustrates the increasing proportion of sugar extracted from sugar beet compared to sugar cane between 2005 and 2021. From 2005 to 2010, beet sugar accounted for 37.2%, and cane sugar accounted for 62.8% of total sugar production (1,668.5 thousand tons). In 2011–2015, the proportion shifted to 52.7% beet sugar and 47.3% cane sugar, with total production reaching 2,102.4 thousand tons. By 2016–2021, beet sugar accounted for 61.5%, while cane sugar dropped to 38.5% of total production (2,357 thousand tons).

Table 7

Extraction of sugar from sugar beet and sugar cane, 2005-21

Period	Sugar beet (Ton)	%	Sugar cane (Ton)	%	Total
2005-2010	621.2	37.2	1047.3	62.8	1668.5
2011-2015	1107.8	52.7	994.6	47.3	2102.4
2016-2021	1450.2	61.5	906.8	38.5	2357.0

Source: Ministry of Agriculture and Land Reclamation - Sugar Crops Council, various issues.

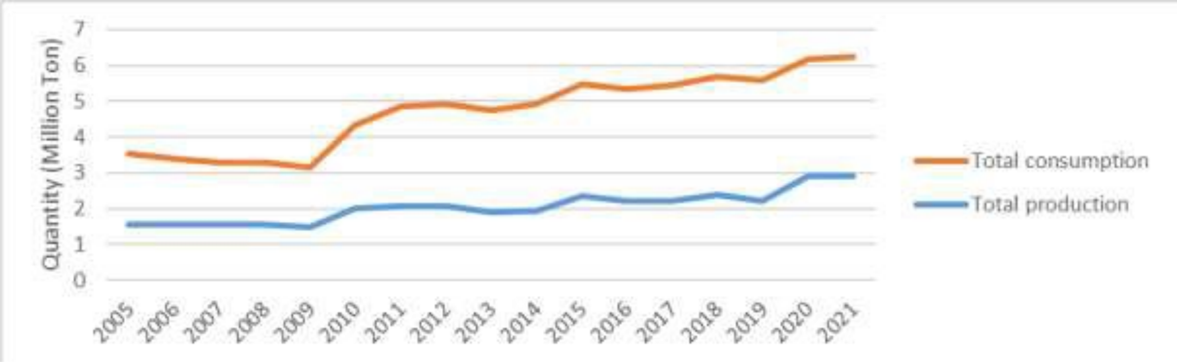
These trends reflect state-led initiatives to promote beet sugar production in response to water scarcity and rising sugar demand. While imports are expected to remain unchanged, domestic production is anticipated to increase to meet growing consumption needs.

Sugar consumption

Figure 4 shows that domestic sugar consumption increased by 73.6%, rising from 1.99 million tons in 2005 to 3.30 million tons in 2021. Meanwhile, domestic sugar production grew by 87%, increasing from 1.55 million tons in 2005 to 2.9 million tons in 2021. Despite this growth, imports remained relatively stable, filling the supply gap with 0.44 million tons in 2005 and 0.45 million tons in 2021. Self-sufficiency reached its highest level in 2020 (89.8%) and its lowest in 2013 (66.15%). Additionally, per capita sugar consumption rose by 21.4%, from 25.2 kg in 2005 to 30.6 kg in 2021.

Figure 4

Sugar production and consumption, 2005-21



Source: Table A4 in Appendix.

Considering the development of sugar sector indicators, Table 8 shows that domestic sugar consumption grew at an annual rate of 4.66%, outpacing production growth, which increased by 3.9% per year from 2005 to 2021. As a result, sugar imports expanded at an annual growth rate of 7.14% to fill the supply gap. Additionally, per capita sugar consumption increased by 2.87% annually, reinforcing the notion that Egyptians have a strong preference for sugar.

Table 8

Annual growth rates of sugar sector indicators, 2005-21

Variable	Measurement Unit	Annual Growth Rate	Standard Error	F-Test	Adjusted R^2
Total production	Million Ton	3.9*	0.004	84.45*	0.84
Total Consumption	Million Ton	4.66*	0.006	59.25*	0.78
Imports	Million Ton	7.14*	0.027	6.63*	0.56
Self-sufficiency	%	-0.77	0.009	1.74	0.04
Per capita consumption	Kilogram	2.87*	0.007	16.11*	0.48

**Significant at 5% level*

The annual growth rate was calculated using the semi-Log Form.

Source: Table A4 in Appendix.

Table 9 presents the partial equilibrium results for Egypt's sugar beet sector across three periods: 2005–2010, 2011–2015, and 2016–2021.

- Net Economic Loss in Production (NELp) and Consumption (NELc): Both indicators increased significantly over time, indicating rising inefficiencies in both production and consumption. NELp rose from EGP 0.2 million (2005–2010) to EG 2.0 million P (2016–2021), reflecting growing production-related inefficiencies. Similarly, NELc surged from EGP 1.6 million to EGP 14.8 million, highlighting worsening consumer inefficiencies. Consequently, the total economic loss (NEL) followed an upward trajectory, increasing from EGP 1.7 million to EGP 16.8 million, suggesting declining efficiency in the sugar beet sector, potentially due to policy distortions or market inefficiencies.

- Producer surplus (WGp) increased from EGP 1.7 million to EGP 11.0 million, indicating growing producer benefits over time. However, consumer surplus (WGc) remained negative, deteriorating from EGP -1.3 million to EGP -12.6 million, signifying increasing consumer welfare losses.

- Foreign Exchange Losses: The sector experienced growing foreign exchange losses, rising from EGP -24.5 million (2005–2010) to EGP -33.6 million (2016–2021). This suggests a worsening trade balance, likely due to increased import dependency to bridge the sugar supply gap.

- Government revenue losses deepened over time, increasing from EGP -4.6 million to EGP -8.6 million. This may be attributed to subsidies distributed through government outlets in response to rising sugar prices.

- The net economic impact remained negative across all periods, worsening from EGP -1.7 million (2005–2010) to EGP -3.2 million (2016–2021). This indicates that the sugar beet sector has consistently imposed a net economic burden on the economy.

Table 9

Partial Equilibrium results for sugar beet sector, 2005-21

(EGP Million)

Period	NELp	NELc	NEL	WGp	WGc	ΔFE	ΔGR	NET
2005-10	0.2	1.6	1.7	1.7	-1.3	-24.5	-4.6	-1.7
2011-15	0.1	6.4	6.5	4.7	-5.7	-29.9	-6.4	-2.4
2016-21	2.0	14.8	16.8	11.0	-12.6	-33.6	-8.6	-3.2

NELp*: Net Economic Loss in Production,* ***NELc****: Net Economic Loss in Consumption,* ***NEL****: Net Economic Loss,* $\boldsymbol{WG_p}$ *: Change in Producer Surplus,* ***WGc****: Change in Consumer Surplus,* ***ΔFE****: Change in Foreign Exchange Earnings,* ***ΔGR*** *: Change in Government Revenue,* ***NET****: Net Effect.*

Source: Tables A2, A4, and A5 in Appendix.

In a nutshell, the results reveal increasing inefficiencies and losses in Egypt's sugar beet sector over time. While producers benefited from the rising surplus, consumers and the government faced growing financial losses. The rising net economic loss and deteriorating trade balance suggest the need for policy interventions to improve efficiency, reduce distortions, and enhance sectoral performance.

Sugar market analysis (Delta Sugar Company Case)

Considering the case study of Delta Sugar Company for the period 2018–2020, the research focuses on the production and processing of sugar beet supplied to the factory, which then markets sugar to final consumers. With a maximum production capacity of 300,000 tons and an operating rate of 84.4%, the factory produced an average of 367 thousand tons of sugar, processing 2,001.9 thousand tons of sugar beets at an 18% sweetness extraction rate. On average, 66.2% of the total sugar produced was allocated to the holding company, while the remaining 33.8% was distributed to private companies.

To maximize net returns on sugar beet production, processing, and marketing during this period, the results of the linear programming model (Table 10) indicate that the average net profit from sugar beet cultivation and processing was EGP 195.27 thousand. Sugar beet was cultivated on 103 thousand feddans, requiring 5,665,000 workers and 412 thousand cubic meters of irrigation water. Additionally, with an 84.4% operating capacity, the factory received 1,957 thousand tons of sugar beet.

Since producing one ton of sugar requires seven tons of sugar beet, over 279 thousand tons of sugar were produced. The total capital required for sugar beet cultivation, processing, and marketing amounted to EGP 3,908.3 thousand. Wholesale distribution companies received the entire production and sold 184.5 thousand tons (66.1% of total production) at a subsidized price of EGP 14 thousand per ton and 95.5 thousand tons (33.9%) at a market price of EGP 23 thousand per ton.

Table 10

Linear programing results for growing and manufacturing sugar beet in Delta Sugar Company, 2018-20.

Indicators	Unit of Measurement	Value
Net profit	000 EGP	**195.27**
Cultivated Area	000 feddan	**103**
Human Labor	000 people	**5665**
Irrigation Water	000 m^3	**412**
Capital for production and manufacturing	000 EGP	**3908.3**
Production supplied to the factory	000 ton	**1957**
Sugar production	000 ton	**279**
Sugar distributed by wholesale company	000 ton	**279**
Sugar distributed by retail companies at the subsidized price	000 ton	**184.5**
Sugar distributed by retail companies at the retail price	000 ton	**95.5**

Source: Authors' calculations using lingo (19) software**.**

A comparison of market and shadow prices, as shown in Table 11, suggests the presence of implicit taxes of approximately 15%, as the market wage rate is lower than the shadow price. This indicates that workers are paid less than their actual economic contribution, effectively imposing a tax on labor. While lower wages benefit employers by reducing production costs, they may also discourage skill development and labor productivity in the long run. In rural areas, where farming and sugar production dominate, these low wages are likely linked to contract farming constraints and weak labor bargaining power.

Similarly, capital is subject to an implicit tax of 6%, as its market rate is lower than its corresponding shadow price. This suggests that firms and farmers face investment constraints due to artificially low capital costs, limiting access to adequate funding. Additionally, financial institutions may struggle to charge interest rates that reflect the real cost of capital, potentially leading to credit shortages and inefficient capital allocation.

Table 11

Shadow and market prices of sugar beet cultivation and manufacturing in Delta Sugar Company, 2018-20

Input	Value	Market price	Shadow price	Subsidy/Tax*

Agricultural labor wage	EGP	80	93.6	0.85
Interest rate	%	17	18. 1	0.94
Irrigation water cost	EGP/ 000 m3	155	170	0.91
supplied sugar beet price	EGP/ton	800	481	1.66
Factory gate price of sugar	EGP/ton	4500	5265	0.85
Wholesale company distribution cost	EGP/ton	1000	6435	0.15
Subsidized sugar price	000 EGP/ton	14	7.56	1.85
Extra sugar price	000 EGP/ton	23	16.56	1.38

**If the coefficient value is more than one, it means implicit subsidies, and if it is less than one, it means implicit taxes.*

Source: Authors' calculations using lingo (19) software**.**

Regarding irrigation water, its market cost—which includes expenses for labor, pumps, and diesel—is lower than its shadow price, indicating an implicit tax of 9%. This indication suggests that the true economic value of water exceeds what farmers actually pay, potentially leading to inefficient water use.

A significant market distortion is also evident in sugar beet pricing. Farmers receive EGP 800 per ton, whereas the shadow price—the true economic value—is only EGP 481 per ton, meaning the market price is 66% higher than its actual economic worth. This implicit subsidy suggests that the government is setting prices that obscure the real costs borne by farmers. If sugar beet prices were more aligned with market conditions, farmers might choose to cultivate alternative, more profitable crops. However, due to contract farming and limited bargaining power, they continue supplying sugar beet despite potentially lower returns.

At the factory gate, the market price of sugar is lower than its shadow price, implying an implicit tax of 15%. This is likely due to government-controlled pricing, which reduces factory profitability while ensuring affordable sugar for wholesalers and consumers.

At the wholesale level, the price of distributing a ton of sugar is approximately 85% lower than its shadow price, revealing another implicit tax. This price indicates that wholesale distributors purchase sugar at a significantly reduced price, likely due to government intervention aimed at stabilizing supply chains.

Conversely, the retail price of subsidized sugar is 85% higher than its shadow price, suggesting an implicit subsidy. This indicates that subsidized sugar is sold at a price exceeding its true economic cost, benefiting either the government or distributors. While consumers still receive subsidies, the pricing structure suggests an inefficient distribution of benefits.

Furthermore, the retail price of non-subsidized sugar is 38% higher than its shadow price, also indicating an implicit subsidy. This suggests that the government or retailers may use higher market prices to offset losses from subsidized sugar sales.

Conclusion

The sugar beet sector in Egypt has witnessed substantial expansion, with cultivated areas increasing by 307% and total production by 334% from 2005 to 2021. However, this growth has been primarily driven by horizontal expansion rather than productivity improvements. Rising input costs have outpaced farm-gate price increases, leading to slower net profit growth for farmers.

Supply response models indicate that farmers' production decisions are influenced by previous-year acreage and prices, with an adjustment period of 6–7 months. Price risk aversion also affects land allocation decisions.

Economic analysis reveals the need for policy interventions to improve efficiency. Despite increased production and a rising share of sugar beet in total sugar output, the sector remains vulnerable to policy misshaping and rising costs. Addressing these challenges is crucial for ensuring long-term sustainability and competitiveness.

Based on these findings, several recommendations are provided to assist policymakers in making informed and practical decisions. They may be summarized as follows:

1. Enhancing Agricultural and Processing Efficiency

- Instruct farmers to supply beets promptly to factories to maintain sweetness and qualify for price incentives.
- Work with all stakeholders to introduce new sugar beet varieties and establish new processing factories.
- Adopt innovative technologies and practices, promote research and development, and adhere to sustainability certifications to improve economic welfare and sustainability.

2. Strengthening Labor and Workforce Development

- Invest in vocational training programs and technical education to help workers justify higher wages and enhance economic efficiency.
- Strengthen rural labor unions or cooperative agreements to empower farmers and agricultural workers in wage negotiations.
- Organize capacity-building workshops, educational seminars, and knowledge exchange platforms to enhance the skills and expertise of agricultural stakeholders.

3. Reforming Financial and Investment Policies

- Gradually align market interest rates with the shadow price of capital to improve investment efficiency.
- Restructure financial support systems by implementing targeted credit programs instead of across-the-board low rates to ensure efficient capital allocation.

4. Improving Market and Pricing Mechanisms

- Gradually shift toward cost-reflective pricing at all levels (factory, wholesale, and retail) to enhance market efficiency.
- Implement targeted cash transfers or food vouchers as alternatives to direct sugar price subsidies to reduce inefficiencies.
- Introduce progressive subsidy reductions to allow gradual price alignment without negatively affecting low-income consumers.
- Establish a more balanced pricing structure by aligning both subsidized and extra sugar prices closer to the shadow price.

By implementing these recommendations, Egypt's sugar beet sector can enhance productivity, improve labor conditions, optimize investment, and create a more sustainable and efficient market.

Future research should prioritize optimizing the sugar beet value chain and evaluating market efficiency in Egypt to improve competitiveness, refine pricing mechanisms, and enhance policy effectiveness.

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Appendix

Table A1

Production of sugar crops in Egypt, 2015-21

Year	Sugar Cane			Sugar beet			Total Area
	Area	Productivity	Production	Area	Productivity	Production	
	Thousand feddan	ton	Million Ton	Thousand feddan	Ton/feddan	Million Ton	Thousand feddan
2005	321.4	50.8	16.3	167.4	20.5	3.43	488.8
2006	326.8	51.0	16.7	186.5	20.9	3.90	513.3
2007	335.2	50.8	17.0	248.4	22.0	5.46	583.6
2008	323.6	50.9	16.5	257.7	19.9	5.13	581.3
2009	316.7	48.9	15.5	264.6	20.2	5.33	581.3
2010	320.3	49.0	15.7	320.3	24.5	7.84	640.6
2011	325.5	48.4	15.8	361.9	20.7	7.49	687.4
2012	326.0	47.7	15.6	423.8	21.5	9.13	749.8
2013	329.2	47.9	15.8	460.5	21.8	10.04	789.7
2014	332.0	48.4	16.1	504.3	21.9	11.04	836.3
2015	328.1	48.5	15.9	554.9	21.6	11.98	883
2016	325.9	47.4	15.4	559.7	20.0	11.21	885.6
2017	376.0	50.0	18.8	523.4	20.8	10.86	899.4
2018	397.0	51.4	20.4	492.7	21.1	10.38	889.7
2019	401.0	50.0	20.1	605.3	20.2	12.24	1006.3
2020	419.0	49.6	20.8	518.0	19.9	10.29	937
2021	428.0	51.6	22.1	682.8	20.8	14.19	1110.8

Source: Compiled and calculated from Ministry of Agriculture and Land Reclamation data, Sugary Crops Board, Annual Report Bulletin, Various issues.

Table A2

Feddanic net profit of Sugar Beet in Egypt, 2005- 2021

Year	Variable costs	Fixed costs	Total costs	Farm price	Net Profit
	EGP /Feddan	EGP /Feddan	EGP /Feddan	EGP /ton	EGP /ton
2005	1085	771	1856	120	604.0
2006	1115	771	1886	172	1717.4
2007	1196	763	1959	188	2173.2
2008	1422	946	2368	231	2233.5
2009	1555	1142	2697	317	3693.7
2010	1787	1216	3003	263	2343.8
2011	2079	1378	3457	355	3888.0
2012	2354	1738	4092	363.5	3737.8
2013	2651	1742	4393	386.7	4040.9
2014	3012	1857	4869	370.1	3236.2
2015	3459	1857	5316	378.5	2855.8
2016	3597	3256	6853	379.4	746.4
2017	4069	3325	7394	534	3686.5
2018	5290	3323	8613	600	4023.0
2019	5765	3310	9075	625	3568.8
2020	6931	3330	10261	625	2151.5
2021	7585.1	3736	11321	625	1672.8

Source: Ministry of Agriculture and Land Rehabilitation. Economic Affairs Sector. Agricultural Economy Bulletins. Miscellaneous Preparation

Table A3

Self-sufficiency of sugar in Egypt, 2005-2021

Year	Sugar production		Total production	Total consumption	Imports	Self-sufficiency	Average per capita
	Sugar cane	Sugar beet					
	million tons	million tons	million tons	million tons	million tons	(%)	(Kg)
2005	1.05	0.45	1.55	1.99	0.44	77.9	25.2
2006	1.07	0.50	1.55	1.86	0.31	83.3	23.1
2007	1.08	0.68	1.55	1.74	0.19	89.1	21.2
2008	1.08	0.51	1.55	1.74	0.19	89.1	20.8
2009	1.01	0.60	1.48	1.67	0.19	88.6	19.5
2010	1.00	0.99	1.99	2.36	0.37	84.3	27.0
2011	0.99	0.91	2.06	2.80	0.74	73.6	33.6
2012	1.00	1.00	2.06	2.86	0.8	72.0	34.0
2013	0.94	1.00	1.89	2.86	0.97	66.1	34.0
2014	1.02	1.27	1.92	3.00	1.08	64.0	34.0
2015	1.03	1.35	2.37	3.10	0.73	76.5	33.0
2016	0.93	1.35	2.20	3.16	0.96	69.6	33.0
2017	0.67	1.49	2.23	3.23	1	69.0	33.1
2018	0.82	1.45	2.38	3.30	0.92	72.1	33.4
2019	0.89	1.38	2.22	3.38	1.16	65.7	33.9
2020	0.87	1.42	92.2	25.3	0.33	89.8	32.0
2021	0.88	1.84	9.2	53.3	0.45	86.6	30.6

Source: Compiled and calculated from Ministry of Agriculture and Land Reclamation data, Sugary Crops Board, Annual Report Bulletin, Various issues

Table A4

Equivalent price of beet sugar in Egypt, 2005-2021

Year	world price of Sugar[1]	Exchange rate[2]	Factory gate price[3]	Distribution margins[4]	Consumer price index[5]	Population[6]
	¢/lb	EGP/USD	EGP /ton	EGP /ton	%	Million
2005	21.1	5.79	1636.36	354	57.8	79.1
2006	22.1	5.75	2345.45	441	62.2	80.6
2007	20.8	5.79	2563.63	454.5	68.0	82.2
2008	21.3	5.45	3150	471	80.4	83.8
2009	24.3	5.76	4322.72	507	89.9	85.5
2010	31.1	5.67	3586.36	664.5	100.0	87.3
2011	37.6	5.97	4840.90	839.8	110.1	83.4
2012	28.9	6.36	4956.81	985.6	117.9	84
2013	21.2	6.96	5273.18	669.5	129.1	84.2
2014	24.9	7.15	5046.81	714.8	142.1	88.2
2015	24.8	7.55	5161.36	19.4	156.8	93.8
2016	27.6	8.95	5173.63	1004.1	178.4	95.7
2017	27.9	13.00	7281.81	1240.9	231.1	97.6
2018	25.3	18.85	8181.81	1115.8	264.4	98.9
2019	26.1	17.86	8522.72	1080.3	288.6	99.8
2020	27.0	15.73	8522.72	1070.6	303.1	101.7
2021	33.6	17.50	8522.72	1070.6	318.9	109.3

Source:

1.International Monetary Fund. (2024). Global price of sugar (No. 16) [PSUGAUSAUSDQ]. Retrieved from Federal Reserve Bank of St. Louis (FRED): https://fred.stlouisfed.org/series/PSUGAUSAUSDQ

2.Central Bank of Egypt. Statistical bulletin. Various issues.

3.& 4 Data collected and calculated from Ministry of Agriculture and Land Reclamation, Sugary Crops Board, Annual Report Bulletin. Various Issues.

5- World Bank-World Development Indicators.

6- The Central Agency for Public Mobilization and Statistics. Statistical yearbook. Various issues.

Table A5

Border Prices of Sugar Beet Production and Beet Sugar Consumption in Egypt, 2005-2021

(**Quantity**: 000 tons, **Price**: EGP /tons)

Year	Production of sugar beet		Consumption of Sugar		Border Price of Sugar	Farm-gate Price	Consumer Price at local price	The Nominal Protection Coefficient (NPC)
	Production of sugar beets at local price	Production of sugar beet at Border Price	at local price	at Border price				
2005	3429.7	10660.8	596.3	674.2	2479.2	120	2360	1.17
2006	3905.1	9907.1	593.1	817.0	2596.4	172	2940	1.57
2007	5457.6	12691.4	675.6	1008.1	2439.9	188	3030	1.81
2008	5133.4	10492.7	548.1	939.4	2364.5	231	3140	2.26
2009	5334.3	10256.0	499.9	979.4	2884.6	317	3380	2.50
2010	7841.3	18884.9	1228.7	1756.5	3685.7	263	4430	1.69
2011	7486.1	17366.4	1274.3	1894.8	4745.8	355	5540	1.76
2012	9126.0	18655.6	1431.4	2336.5	3829.5	363.5	5740	2.26
2013	10044.3	17825.1	1480.0	2676.0	3002.8	386.7	5420	2.94
2014	11045.6	21916.5	1663.2	2713.0	3664.3	370.1	5790	2.33
2015	11983.0	24141.8	1760.4	2693.6	3863.5	378.5	5880	2.08
2016	11209.2	26008.5	1868.5	2524.6	5137.6	379.4	8300	1.76
2017	10860.9	25817.7	1909.9	2418.6	7542.4	534	14040	1.66
2018	10377.4	27005.5	1951.3	2362.6	9860.6	600	14010	1.40
2019	12247.2	30687.3	1995.7	2490.5	9651.7	625	14030	1.48
2020	10284.1	24391.3	2018.1	2609.2	8793.3	625	14050	1.62
2021	14195.5	41620.3	2256.6	2485.1	12384.2	625	14050	1.15

NPC= Local price/border price reflects implicit subsidy if higher than 1 and implicit taxes if lower than 1

Source:

- annexes (2) (3), (4)
- Central Agency for Public Mobilization and Statistics, Annual Bulletin of Prices for Materials, Food Products and Services (Product - Wholesale - Retail)

Table A6

Linear programing matrix indicators

1. The total cultivated area of sugar beet is 103 thousand feddans, with a cost per feddan of EGP 9,316 and an average yield of 19 tons per feddan.
2. Sugar beet cultivation requires 57 workers per feddan, with a wage of EGP 80 per worker. The capital interest rate is 17%.
3. The water requirement for sugar beet is 4,000 m³ per feddan, at a cost of EGP 155 per 1,000 m³.
4. The supply price of sugar beet is EGP 800 per ton, while the factory gate price is EGP 4,500 per ton. The distribution price of sugar is EGP 1,000 per ton.
5. For retail prices:

   - Subsidized sugar is sold at EGP 14,000 per ton.
   - Non-subsidized (extra) sugar is priced at EGP 23,000 per ton.

Source:

- 1 &2 Ministry of Agriculture and Land Rehabilitation. Economic Affairs Sector. Agricultural Economy Bulletins. Various issues.
- 3. Central Bank of Egypt. Statistical bulletin. Miscellaneous Preparation.
- 4&5 Delta Sugar Company, General Department of Agriculture, unpublished data.

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تحليل أداء إنتاج وتصنيع بنجر السكر في مصر: دراسة حالة شركة الدلتا للسكر

المستخلص

تتبنى الحكومة المصرية استراتيجية التوسع الأفقي في زراعة بنجر السكر وإنشاء مصانع جديدة لتعزيز إنتاجه، في مواجهة التحديات التي تواجه قطاع قصب السكر. ومن أجل تحليل ديناميكيات السوق وتخصيص الموارد بكفاءة في هذا القطاع، اعتمدت الدراسة على نماذج كمية متكاملة تشمل استجابة العرض، والتوازن الجزئي، والبرمجة الخطية، مما يوفر فهما شاملا للسلوك الاقتصادي للمنتجين وهيكل السوق. وأظهرت النتائج أن نمو إنتاج بنجر السكر يرجع أساسا إلى التوسع في المساحة المزروعة، بينما ظلت الإنتاجية الفدانية مستقرة. كما تبين أن منتجي بنجر السكر يتسمون بسلوك كاره للمخاطرة، حيث يستغرقون في المتوسط 7.3 أشهر لاتخاذ قرار بشأن زراعة المحصول مستقبلا. بالإضافة إلى ذلك، فإن سياسات التحكم في الأسعار تؤدي إلى اختلال آليات السوق، مما يساهم في سوء تخصيص الموارد وانخفاض رفاهية المستهلكين. وتبرز دراسة حالة شركة الدلتا للسكر أهمية العوامل التشغيلية والمالية في ضمان استدامة القطاع على المدى الطويل. ولتعزيز نمو صناعة بنجر السكر في مصر، توصي الدراسة بتحسين الكفاءة الإنتاجية، وتطوير رأس المال البشري، وإصلاح السياسات المالية، إلى جانب تبني سياسات تسعير قائمة على التكاليف الحقيقية، وتوجيه الدعم إلى الفئات المستحقة. كما ينبغي أن تركز البحوث المستقبلية على تحسين سلسلة القيمة، وتحليل كفاءة السوق، لتعزيز القدرة التنافسية للقطاع، وتحقيق تسعير أكثر كفاءة، وتعزيز فاعلية السياسات الاقتصادية.

الكلمات الدالة: بنجر السكر، نموذج استجابة الإمداد، نموذج التوازن الجزئي، أسلوب البرمجة الخطية، الاقتصاد المصري