Economic and Social Dimensions of Sugar Crop Cultivation in Egypt: A Comparative Analysis of Sugarcane and Sugar Beet Production

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Abstract

This study examines the economic and social implications of reducing the agricultural area devoted to sugarcane cultivation, expanding sugar beet cultivation, and exploring alternative cropping structures to meet Egypt's sugar production targets over the past decade. The research focuses on governorates with concentrated sugarcane cultivation in Upper and Middle Egypt, specifically Aswan and Qena (representing Upper Egypt) and Minya (representing Middle Egypt).

The economic analysis utilizes partial budget analysis to assess the added value of sugarcane and sugar beet, identify alternative crop compositions, and evaluate water yield efficiency for each. The social study is based on farmer surveys to understand their perspectives on replacing sugarcane with sugar beet, motivations for sugar beet cultivation, challenges faced by sugarcane farmers, and the feasibility of reducing sugarcane cultivation in these regions.

The findings indicate that while sugar beet has a similar sugar productivity per cubic meter of water compared to sugarcane, its return per cubic meter of water is 13.69% higher. However, transitioning to sugar beet cultivation in Upper Egypt faces significant challenges related to farmers' preferences, socio-economic factors, and technical constraints, such as the need for locally produced beet seeds. The study concludes that sugar beet expansion should be concentrated in Lower Egypt and newly reclaimed lands, while maintaining the stability of sugarcane cultivation in Upper Egypt to ensure socio-economic balance and agricultural sustainability.

Keywords: *Irrigation Efficiency, Farmers' Preferences, Cultivation Challenges, Economic Sustainability, Alternative Cropping Patterns*

INTRODUCTION

Egypt suffers from a gap between the production and consumption of sugar amounting to about 1100 thousand tons of sugar which increases by about 70 thousand tons per year as a direct result of population increase. There is a need to establish a sugar's factory every three years to meet this demand and to keep the current gap (Al-Sharbini, 2024). Therefore, Egypt adopts expansion strategy in cultivation of sugar crops for sugar industry. The production strategy of sugar in Egypt (as in the whole world) is based on two crops; sugarcane in the hot zone and sugar beets in cold temperate zone.

As the sugarcane has a high water consumption, it is required to look for other alternatives to save water and to obtain the necessary sugar amount to meet the population needs. The alternative is to expand the cultivation of sugar beet of lower water consumption compared with sugarcane. In the same time this replacement is associated with many economic and social problems in the short and long terms. The problem is how to secure the replacement of sugarcane by sugar beet and to ensure the achievement of the social

dimension and economy of farmers of sugarcane and sugar beet as well as the income of workers and sugar factories.

This research is an attempt to answer specific questions, how and where you can implement this replacement without negative impacts on farmers and workers in the field of sugarcane? Or in other words, is there a reason for this replacement, whether partially or entirely? What are the technical, economic and social drivers for this change or replacement?

The study objective in its economic part is to use partial analysis method to define the added value of sugarcane and sugar beet. Also, to determine the alternative crops and the total return per unit of water for each. Concerning the social part, the objective is to use field interview method in three governorates: Minia, Qena and Aswan (the three governorates produce nearly 91% of sugarcane in Egypt) mainly to recognize farmers' response about replacing sugarcane by sugar beet. (Figure 1) shows the map of main provinces cultivating sugarcane and sugar beet in Egypt.

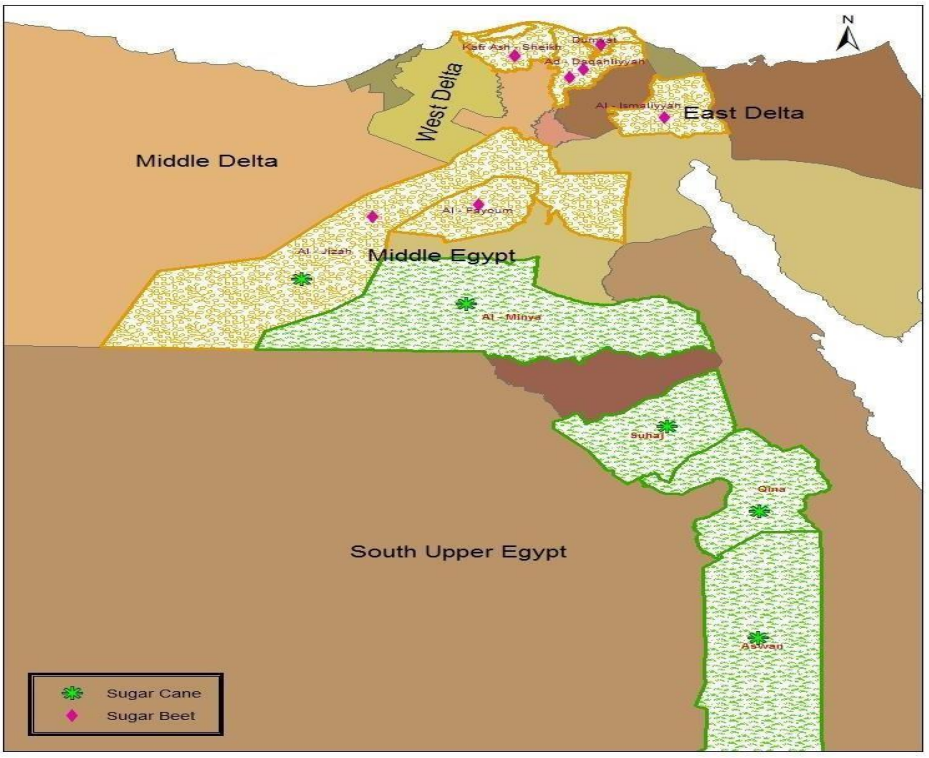

Figure (1) Provinces cultivating sugarcane and sugar beet in Egypt

METHODOLOGY

This study aims to highlight the economic and social dimensions arising from the replacement of sugarcane by sugar beet, through exposure to a range of sub-factors as follows:

- *The economic importance of the sugar crops in Egypt and indicators of self-sufficiency.*
- *The economics of the production of sugarcane and sugar beet in terms of yield per unit water.*
- *Motives preference for cultivation of sugarcane.*
- *Problems facing farmers of sugarcane.*
- *Possibility of reducing sugarcane cultivated area.*
- *Alternative crop compositions in case of reduction of the sugarcane area.*
- *Use of economic analysis technique to compare the economic effects of replacing sugarcane by sugar beet besides applying some statistical parameters.*

Use of a questionnaire to identify farmers' response towards replacing sugarcane by sugar beet.

STATISTICS OF PRODUCTION AND CONSUMPTION OF SUGAR IN EGYPT

Egypt was self-sufficient in the production of its need of sugar until the beginning of the seventies of the last century, where sugar consumption was less than the total sugar production. The degree of self-sufficiency reached 118% in 1972. However, the picture changed later and Egypt turned into a country that imports about 35% of its needs of sugar. This is mainly due to population increase along with changing consumption patterns as a result of changes in social and economic multiple. Table (1) shows the development of production and consumption of sugar in Egypt and the situation of self-sufficiency during the period from 1972 to 2022. It is clear that:

The beginning of the gap period between production and consumption of sugar in Egypt occurred after the war in 1973 associated with the economic reforms, the subsequent increase in the income of numerous groups of people with changing dietary patterns, and increased consumption in addition to the rapid increase in population. The population increased from 69.648 million in 2005 to 102.879 million in 2022. The maximum gap occurred in 2020 during COVID-19. In 2005 self-sufficiency reached of 61.5 %. About the consumption of sugar per capita reached about 30.5 kg/year after COVID-19 Pandemic had been finished in 2021.

Sugar production increased from 1497 million tons in 2005 to 2650 million tons in 2022, an increase of about 1.153 million tons, with increasing rate of 77%. In the same year 2022 the self Sufficiency increased to 91.3%. Sugar consumption increased from 1.115 million tons in 1980 to 3.25 million tons in 2020, an increase of about 2.135 million tons i.e. 191.5% increase. The per capita consumption rate increased from 26.5 kg/ year in 1980 to 32.5 kg/ year in 2020.

The ratio of self-sufficiency ratio varied during the period 1980- 2020. By 2008 it was 61.7%, increased to 72.8% in 2019 and by 2020 dropped to 70.2% due to the distractions related to Covid-19 pandemic.
Adding sweeteners of hi-fructose and honey Glucose produced in 2018 (about 225 thousand tons of sugar equivalent) to the total sugar production, the consumption becomes 2.387 million tons and the self-sufficiency in 2018 is about 72.3%.

Table (1) Production and consumption of sugar and the ratio of self-sufficiency in Egypt from 2005 to 2022

Year	Population * (million)	From Sugarcane	From Sugar beet	Total Sugar production (thousand tons)	Importance of sugar beet/total sugar	Total sugar consumed (thousand tons)	Gap (thousand tons)	Consumption Rate per capita (kg / year)	Self-Sufficiency (%)
1972	30.180	593	-	593	0	501	0	16.6	118.4
2005	69.648	1048	449	1497	29.99	2432	935	33	61.5
2008	74.439	1075	507	1582	32.05	2564	982	33.0	61.7
2012	81.567	1001	1004	1997	50.28	2860	896	34.0	69.1
2018	96.279	915	1248	2163	57.70	3300	892	33.4	70.8
2019	98.101	930	1528	2460	62.11	3375	812	33.8	75.2
2020	99.843	865	1417	2282	62.09	3335	1053	32.8	68.4
2021	101.464	876	1836	2712	67.70	3153	441	30.5	86.0
2022	102.879	900	1750	2650	66.04	2902	691	35.7	91.3

Year for the production and consumption of sugar in Egypt (where self-sufficiency ratio stood at 118.4%)
Council of Sugar crops and sugar production in Egypt and the world (different annual reports)
** According to population annual book. 2023. ("Central Agency for Public Mobilization and Statistics," n.d.)*
Total of population is an actual number based on natural increasing & the age structure based on census 2017.

COSTS AND RETURNS

COSTS AND RETURN OF SUGARCANE

The total cost during the summer season (2021/2022) was about LE 29707/feddan (1 feddan = 0.42 hectare). The estimated fixed costs were about LE 9821 /feddan, which represent about 33.06% of the total cost. The average variable costs of various agricultural operations were about 19886 LE/feddan accounted for about 6 9.94% of the total cost. Detailed costs are provided in Table (2).

The average production per feddan was about 46.706 tons, therefore, the average production costs per ton is equal to 636.04 LE /ton. The total return was about 56047 LE /feddan, i.e. the average return is equal to 1200 LE /ton. The estimated net return was about LE 26340/feddan, as shown in Table (2).

Costs and return of sugar beet

The total cost during the period (2021/2022) was about LE 13708/ feddan. The estimated fixed costs were about LE 2864/ feddan per period, which represent about 20.89% of the total cost. The average variable costs of various agricultural operations were about LE 10844/ feddan, which represent about 79.11% of the total cost. Detailed costs are provided in Table (2).

The average production per feddan was about 24.508 ton, therefore, the average production costs per ton is LE 599.4/ton. The total return about LE 23598/ feddan, i.e. the average total return is LE 963/ ton. The estimated net return was about LE 9890/feddan as shown in Table (2).

Table (2) Average production costs and net returns per feddan for sugarcane and sugar beet during (2021-2022)

Terms and costs of production	Sugarcane		Sugar Beet	
	Avg.	**%**	**Avg.**	**%**
Variable costs				
Prepare Land for planting	851	2.86	1116	8.14
Seeds & Cultivation	1884	6.34	914	6.67
Irrigation	4125	13.89	1223	8.92
Fertilizer	4932	16.60	2428	17.71
Services	1288	4.34	1134	8.27
Pests' Resistance	--	0.00	763	5.57
Harvesting and breaking	2251	7.58	1520	11.09
Transportation and Shipping	1812	6.10	943	6.88
Other expenses	2743	9.23	803	5.86
Total Variable Costs Without Rent	**19886**	66.94	**10844**	79.11
Fixed costs				
Rent (LE/Feddan)	9821	33.06	2864	20.89
Total Costs	**29707**	**100**	**13708**	**100**
Production and Return				
Average productivity (tons/feddan)	46.706		24.508	

Average productivity of straw crop (tons/feddan)	-		19.61	
Average price for main crop (LE/ ton)	1200		870	
Average price for straw crop (LE/ton)	-		116	
Return of the main crop (LE/ feddan)	56047		21322	
Return of straw crop (LE/ feddan)	----		2275	
The total return (LE/ feddan)	**56047**		**23598**	
Net return (LE/ feddan)	**26340**		**9890**	
Water requirements (m ^{3}/feddan)	10973		3860	
Water productivity (LE /1000 m^3)	**2400**		**2562**	

Source: Economic Affairs Sector of the Ministry of Agriculture and Land Reclamation. Bulletin of Statistical Cost Production and Net Return. Part (1,2). Year 2022.

WATER REQUIREMENTS FOR SUGARCANE AND SUGAR BEET

Figure (2) and table (3) depict the evolution of water requirements of sugarcane and sugar beet, according to the area cultivated by each in the period from 1982 to 2022. It is obvious that there is an increase in water requirements of sugar beet comparing with that of sugarcane. This is due to the increased area of sugar beet from 16.9 thousand feddans in 1982 to 484.53 thousand feddans in 2022, an increase of 6.3% over 2021. While the increase in area of sugarcane during the same period is only 13.6%. The water requirements of sugarcane were amounted to 3525.59 million cubic meters and that of sugar beet were amounted to 2057.5 million cubic meters through in 2022 (Mehanna, et al., 2020)

Generally, the water use of sugarcane is larger than that for sugar beet although the increase in sugar beet cultivated area than the sugarcane. This is due to the high-water requirements of sugarcane than sugar beet (water requirements of sugarcane exceeds that of sugar beet by three times).

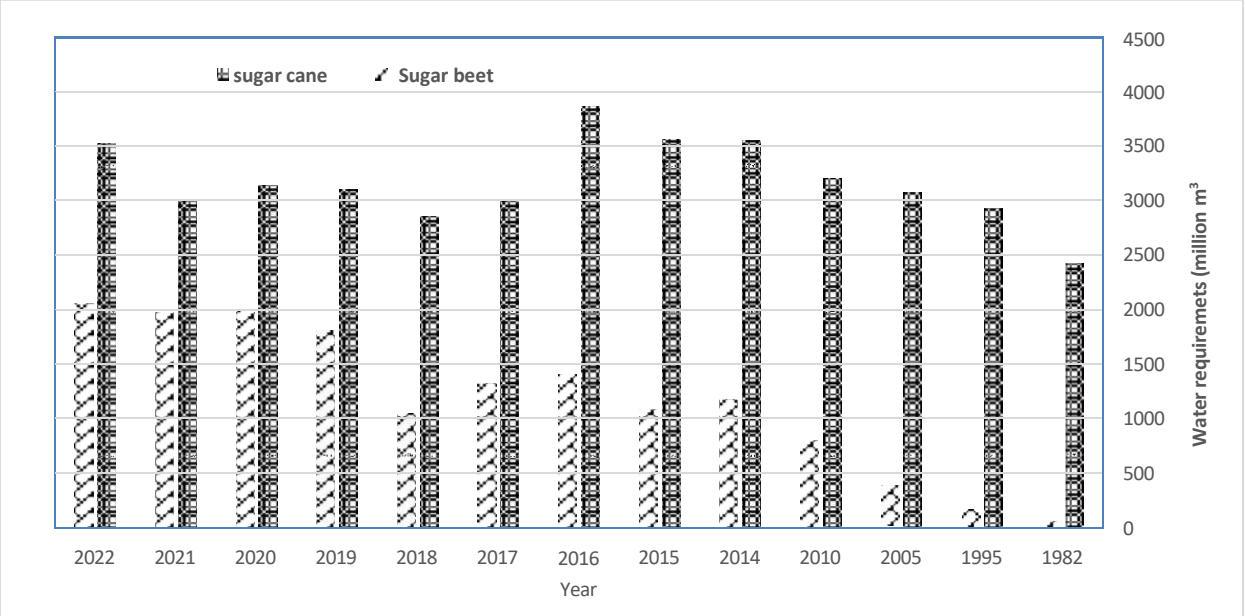

Figure (2) Water requirements of sugarcane and sugar beet in the period 1982-2022 in Egypt

Table (3) Cultivated area and water requirements of sugarcane and sugar beet in the period 1982-2022

	Sugarcane				Sugar Beet			
Year	Area (1000) feddan	Total increase %	Annual increase %	Water Req. Million m^3	Area (1000) feddan	Total increase %	Annual increase %	Water Req. Million m^3
1982	254.0	0	0.0	2425.20	16.90	0	0.0	55.78
1995	287.2	13.07	13.1	2926.50	47.40	180	180.5	165.30
2005	322.0	26.77	12.1	3068.7	167.30	890	253.0	380.27
2010	316.7	24.69	-1.6	3205.42	357.7	2017	113.8	798.74
2014	321.4	26.54	1.5	3546.13	480.28	2742	34.3	1172.36
2015	325.6	28.19	1.3	3558.05	450.08	2563	-6.3	1083.79
2016	321.8	26.69	-1.2	3861.96	545.21	3126	21.1	1402.28
2017	280.1	10.28	-13.0	2994.03	485.73	2774	-10.9	1319.52
2018	280.3	10.35	0.1	2848.67	360	2030	-25.9	1044.68
2019	282.6	11.26	0.8	3100.81	468.7	2673	30.2	1808.81
2020	300.96	18.49	6.5	3138.36	363.22	2049	-22.5	1998.21
2021	287.51	13.19	-4.5	2998.73	455.94	2598	25.5	1970.67
2022	326.72	28.63	13.6	3525.59	484.53	2767	6.3	2057.50

Source: Economic Affairs Sector of the Ministry of Agriculture and Land Reclamation. Bulletin of Agricultural Statistical, Part (1, 2). Year 2023.

RETURN PER UNIT OF WATER

Water productivity of sugarcane (LE/ m^3)

The irrigation water productivity of sugarcane during the period (20218-2022) was about 4.25 kg of cane/ m3 water. The amount of sugar was about 0.330 kg/ m3 water. The total return and cost per feddan were about LE 56047 and LE 29707 respectively i.e. the net return per feddan is about LE 26340. Therefore, the return of unit water is about LE 2.40 / m3 water.

Water productivity of sugar beet (LE/ m^3)

The irrigation water productivity of sugar beet during the period (2021-2022) was amounted 6.35 kg of beet/ m^3 water. The amount of sugar was about 0.70 kg/ m^3 water. The total return and cost per feddan were about LE 23597 and LE 13707 respectively i.e. the net return per feddan is about LE 9890 Therefore, the return of water unit is about LE 2.562 / m^3 water

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The above analysis reveals that the sugar productivity per m3 of water for the sugar beet is nearly that of the sugarcane. Also, the return per m3 of water of sugar beet is more than that of sugarcane by 6.75%.

SOCIAL DIMENSIONS OF THE POLICY OF REDUCING THE SUGARCANE AREA

The social study depended on a questionnaire conducted in the three governorates Minia, Qena and Aswan. Ninety farms were chosen as sample for each governorate i.e. the total sample size is 270 farms.

Motives preference of sugarcane cultivation

The cultivation of sugarcane has received considerable favorable preference from the farmers in the three governorates because this crop is in line with their experiences, suitability for cultivation regarding environmental conditions (weather, soil and water) and high yield of this crop compared with other crops. Meanwhile it is associated with the sugar factories existing nearby agriculture lands which make it easier for

marketing the products.

All farmers in the study sample in Aswan governorate prefer sugarcane cultivation. The same is valid for more than 90% of the farmers of the study sample in Minia and Qena governorates. Table (4) lists the motives preference for the majority of the farmers in the three governorates in this study. The table provides the reasons for choosing the cultivation of sugarcane according to their relative importance.

Table (4) Motives for choosing cultivation of sugarcane according to the study sample and their relative importance

Serial	Preference for sugarcane	Minia	Qena	Aswan
		٪		
1	high yield	46	48	26
2	Suitable environmental conditions (heat and thirst tolerance, and suitable soil)	6	21	30
3	Ease of service and supervision	27	17	14
4	Provide down payment to farmers (availability of cash money)	-	9	12
5	The abundance of irrigation water	10	1	1
6	Ease of Marketing (sugar mills)	-	-	16
7	An abundance of manpower and production requirements	7	1	1
8	Resistance to pests	4	3	-

Source: Calculated from data questionnaires

Expansion in sugar beet and decrease in sugarcane cultivated areas

The field study investigated farmer's views concerning the possibility of cultivation sugar beet in Upper Egypt as shown in Table (5). The majority of farmers do not think it is possible to cultivate sugar beet. The main reasons are lack of experience of farmers and the unsuitable climatic conditions.

Table (5) **Farmers views (%) concerning the possibility of cultivation sugar beet in Upper Egypt**

	Minia	Qena	Aswan	Average
Can be planted	3	9	1	4
Cannot be planted	97	91	99	96

**Source: Calculated from data questionnaires*

Recently few experiments show possibility of success of cultivation of sugar beet in Upper Egypt. However, these experiments have not prevail yet and there is a need for continuing research and studies in this field.

Alternative crops to replace sugarcane

The field study tackled the alternative crops that could replace the sugarcane in Upper Egypt as follows:

In Minia Governorate, the alternative crops are corn, barley, cotton and vegetables, respectively. In Qena and Aswan governorates the alternative crops are grains, legumes, cotton and vegetables, respectively. Table (6) provides the production costs, net value added and return per unit of water of these crops. Table (7) contains the net value added per feddan and return per unit of irrigation water for the proposed alternative crops. Figure (3) shows the net values per feddan while figure (4) shows the returns per unit of water.

Table (6) Production cost, value added and return per unit of water for sugarcane, sugar beet and alternative crops during the period (2019-2020)

Crop	*Water Requirements (m^3/fed)*	*Total Return (LE / fed)*	*Total Cost (LE / fed)*	*Net Return (LE/ fed)*	*Return per unit of water (LE/ 1000 m^3)*
Sugarcane	*10532*	*33279*	*18792*	*19826*	*1882*
Sugar beet	*3225*	*17020*	*11248*	*5772*	*1790*
Alfalfa	*2350*	*11708*	*4855*	*6853*	*2916*
Alfalfa permanent	*2795*	*24392*	*7576*	*16816*	*6016*
Wheat	*2431*	*15063*	*11069*	*3994*	*1643*
Beans	*2600*	*18296*	*10445*	*7850*	*3019*
Winter vegetables	*2437*	*29167*	*10146*	*19021*	*7805*
Cotton	*4303*	*23817*	*14737*	*9080*	*2110*
Maize	*4511*	*9263*	*3664*	*5599*	*1241*

**Source: Calculated from data questionnaires*

Table (7) Water requirements, value added and return per unit of water for the proposed alternative cropping patterns of sugarcane during the period (2019-2020)

2019			
Alternative cropping pattern	Water Requirements (m^3/ fed)	Value added (LE/ fed)	Return per unit of water (LE/ 1000 m^3)
(Sugar beet + maize)	3868	5685.5	2053
(Sugar beet + cotton)	3764	7426	2305
(Cotton + alfalfa)	3327	7967	2065
(Alfalfa + maze)	3431	6226	1141
(Maize +wheat)	3471	4796.5	858
(Maize+ broad beans)	3556	6725	1095
(Maize + vegetables)	3474	12310	2735
2020			
(Sugar beet + maize)	9405	19305	2053
(Sugar beet + cotton)	9142	21073	2305
(Cotton + alfalfa)	7716	15933	2065
(Alfalfa + maze)	7979	9104	1141
(Maize +wheat)	7684	6593	858
(Maize+ broad beans)	7383	8083	1095
(Maize + vegetables)	7778	21272	2735

*Source: Calculated from data questionnaires

PROBLEMS FACING FARMERS OF SUGARCANE

The results of the field study showed that there are several problems facing sugarcane farmers which can be divided into two groups. The first group is the problems related to production of sugarcane, while the second group is related to marketing of the crop. The relative importance of the problems is provided in Table 8.

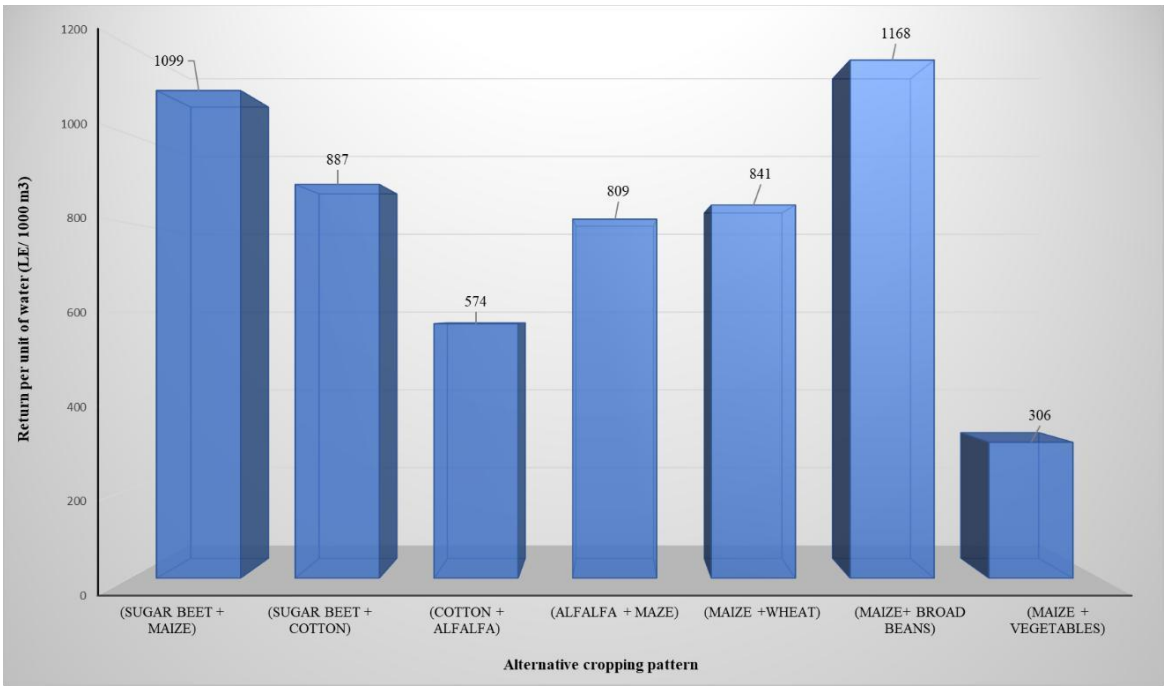

Figure (3) V**alue** added **of alternative crop compositions**

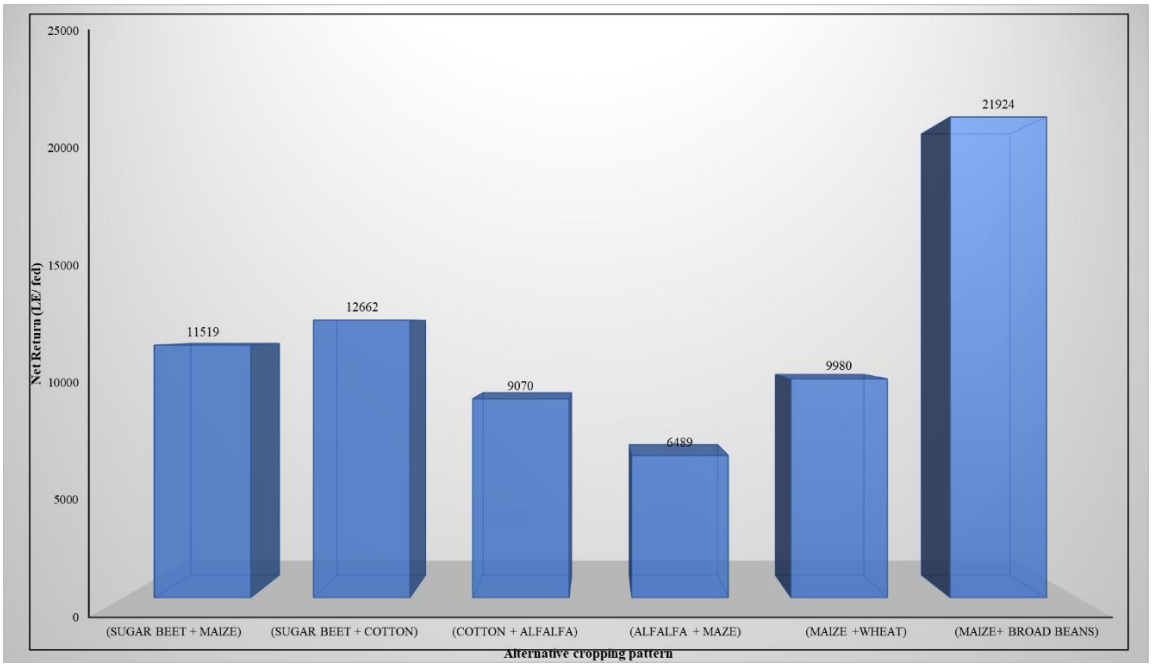

Figure (4) **Water productivity for alternative cropping patterns**

Sugarcane production problems represent about 69% of the total problems which face farmers. The most important problem is insufficient quota of chemical fertilizer distributed by Agricultural Cooperatives, forcing farmers to buy the necessary remaining quantity from the open market with nearly double price. Following are the lack of employee during harvest periods (break) and transportation; injury by insightful and high cost of pesticides; insufficient irrigation water for areas adjacent to the ends of the canals; and the absence of agricultural guiding. Other problems are spread of weeds; no change of species for a long time resulting in productivity degradation; high cost for lifting irrigation water; and spread of rats.

Marketing problems represent about 30% of the total problems facing farmers. The most important of these problems are high transport cost and poor road conditions; the inadequacy of the purchase price which is

determined by sugar companies; sugar companies interfering in cane cutting timing; and high interest rate on loans. Farmers who don't have problems do not exceed 1% of the sample size.

Table (8) Problems facing farmers of sugarcane according to their relative importance

Problem	*Minia*	*Qena*	*Aswan*	*Average*
	٪			
Insufficient chemical fertilizers quota and high price of fertilizers in open market	*3*	*38*	*37*	*26*
Transportation and roads bad conditions	*15*	*3*	*20.6*	*13*
Inadequacy purchase price of sugarcane	*19*	*7*	*7*	*11*
Un suitable security conditions	*28.5*	*-*	*-*	*9*
Lack of employee	*5*	*16*	*6*	*9*
Limited and high cost of pesticides especially for insightful	*13*	*3*	*7*	*8*
Insufficient irrigation water	*-*	*16*	*4.7*	*7*
No agriculture guidance	*5*	*7*	*3.5*	*5*
Multiple price payments	*2*	*1.5*	*6*	*3*
Weeds	*-*	*6*	*3*	*3*
Sugar companies interfere in cane cutting timing	*6*	*0.5*	*1.2*	*2.5*
Non variable species leading to deterioration of product	*1*	*1.5*	*-*	*1*
Cost of lifting irrigation water	*-*	*-*	*2.4*	*1*
Spread of rats	*0.5*	*-*	*0.5*	*0.3*
High interest rates on loans	*-*	*-*	*0.5*	*0.2*
No problem	*2*	*0.5*	*0.6*	*1*

POSSIBILITY OF SUGARCANE AREA REDUCTION

The targeted water strategy of the Ministry of Water Resources and Irrigation is to reduce areas of high-water requirements crops. This includes the area of sugarcane so that it would not exceed 200 thousand feddans per year.

Table (9) provides farmers response regarding the possibility of reducing the cultivated sugarcane area. The highest percentage approval is in Qena governorate (72%) followed by Minia governorate (60%) while the highest refusal is in Aswan governorate (92%). Table (10) provides the reasons for farmers refusing to reduce the area cultivated by sugarcane. The more frequent reasons are appropriate return (average of 37%); ease of service and high expertise of cultivation (average of 29%); and suitable environmental (heat and thirst bearing) conditions for cultivation (average 24%). Other reasons are ease of marketing and availability of loans prior to cultivation (average 5% each).

Table (9) Possibility of reducing sugarcane cultivated area

Farmers opinion about possibility of reducing sugarcane area	**Minia**	**Qena**	**Aswan**	**Average**
	٪			
Agree	60	72	6	46
Refuse	37	21	92	50
Nothing	3	7	2	4

*Source: Calculated from data questionnaires

***Table** (10) Reasons of farmers refusing to reduce the area cultivated by Sugarcane*

Reason	Minia	Qena	Aswan	Average
	٪			
Appropriate return	46	35	31	37
Ease of service and high expertise of cultivation	46	35	5	29
Suitable environmental conditions for cultivation (heat and thirst bearing)	8	24	40	24
Ease of marketing	-	-	16	5
Availability of loans prior to cultivation	-	6	8	5

*Source: Calculated from data questionnaires

It is worth to mention that the above reasons have different priorities in each governorate. For Minia and Qena governorates the appropriate return and the ease of service are the dominant reasons, while the suitable environmental conditions is the dominant reason followed by the appropriate return in Aswan governorate.

EGYPTIAN STRATEGY FOR SUGAR CROPS PRODUCTION

This strategy adopts providing the raw material in terms of quantity and quality either sugarcane or sugar beet for operation of existing factories on full capacity to produce about 2.16 million tons of sugar annually, compared to the production of about 2.46 million tons (in 2019). However, still there is a gap between production and consumption and this gap is widening every year due to population increase. Therefore, the strategy also targeted the following three pillars:

Achieve horizontal expansion of the area of sugar beet, especially in the new reclaimed lands to fulfill the capacity of existing sugar factories and its future expansions. Meanwhile, to fulfill the duties of the proposed new sugar factories (it is proposal to establish 3-5 new factories by 2019).

Achieve vertical expansion to increase the productivity of sugar crops (sugarcane and sugar beet) as to reach 60 tons /feddan of cane and about 30 tons /feddan of beet. Cultivation of outstanding species and up scaling all the agricultural operations starting from preparing land for planting and ending with packing the products for transportation to sugar factories.

Expand corn cultivation in the new lands to provide raw material necessary for the production of sweeteners from hi-fructose syrup (liquid sugar), where corn is grown after sugar beet allowing new agriculture turns.
In addition to the above three pillars, the following issues should be realized:

Rationalize sugar consumption rate to reach the healthy rates (about 24 kg /capita /year) instead of the existing rate (30-32) knowing that the global average rate is 20 kg /capita /year.
Alleviate manufacturing efficiency to the optimal rates.
Import raw sugar only and refine it locally.

Face the challenges that hinder the achievement of this strategy, the forefront of which are land, water, populations increase and price policy.

FUTURE STRATEGY VISION FOR THE CULTIVATION OF SUGARCANE IN EGYPT

Sugarcane is one of the crops that pose stress on soil in addition to its high-water needs. One of the main components of Egypt's water strategy is rationalization of water used in irrigation. It depends on reducing area of crops with high water consumption of which rice and sugarcane. Also, direct the saved irrigation water to be used for cultivation of alternative crops with high yield per unit of water. Therefore, it is proposed to limit the area for cultivation of sugarcane to 200 thousand feddans in the governorates that have sugar factories i.e. Minia, Sohag, Qena and Aswan. Meanwhile, work to raise the productivity of sugarcane up to

about 60 tons per feddan through the establishment of new species of sugarcane to replace the current species that lead to deterioration of productivity as a result of long-time cultivation. Aspects of this strategy also depends on the expansion of sugar beet cultivation (200-250) thousand feddans in the Northern Delta region and some of the new reclaimed lands

During this change the social dimensions of the farmers must be taken into consideration. Cultivation of sugarcane provides stability to farmers for a long time economically and socially. Most of the farmers who refuse reducing sugarcane area have their reasons such as their long experience in cultivation, service and operations of sugarcane in addition to the appropriate economic return for them. In addition, sugarcane is one of the crops that suit the special high-temperature harsh environmental conditions in summer

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Development of irrigation networks at the levels of transmission, distribution and also at the field level is very important for the rationalization of water use and to improve the water quality as well. Also, to improve land reeds due to the deterioration of large land areas of Upper Egypt as a result of turning the irrigation system to the permanent one after the establishment of the High Aswan Dam. As there is no available fund to cover the land with tile drainage this led to high ground water levels and affect soil characteristics resulting in decrease of productivity.

Finally sugar factories must commit to implement the plan of cane fracture and supply which leads to regular performance of agriculture operations especially irrigation during the months of April to May. In addition to reconsidering the price per ton of cane supplied to sugar factories in the light of increasing costs and the actual annual yield of the crop to become appropriate for farmers.

Recommendations

1. *Expand cultivation of sugar beet, especially in the new reclaimed areas.*
2. *Vertical expansion of sugary crops to increase productivity with the cultivation of high-yield species that can withstand dominant environmental conditions.*
3. *Introduce modern farming methods in the production of sugar crops and maximize the role of agricultural research.*
4. *Reduce crop losses during harvest, packing, transport and trading.*
5. *Raise the efficiency of existing factories in extracting the juice and sugar refining. Alleviate capacity of some sugarcane factories through development and rehabilitation plans in order to accommodate early dates for all cane production so as not to harm production of next season.*
6. *Establish new factories for producing sugar from sugar beet.*
7. *Expand the use of by-products of sugar like molasses, baggas and beet pulp to maximize the value added.*
8. *Set up a fund box to support the prices of sugar to meet the fluctuations that occur in the global su gar prices.*
9. *Perform media awareness campaigns to rationalize the use of sugar to reach the levels recommend ed by the World Health Organization.*

CONCLUSION

The study concludes that transitioning from sugarcane to sugar beet cultivation in Egypt offers significant opportunities to enhance water productivity and promote sustainable sugar production. While sugar beet provides higher returns and efficiency in water use, the transition is hindered by challenges such as farmer resistance, technical barriers, and unsuitable climatic conditions in Upper Egypt. To achieve a balanced transition, targeted interventions are required, including investments in farmer education, development of locally adapted sugar beet varieties, and infrastructural improvements. Expanding sugar beet in Lower Egypt and reclaimed lands, while maintaining sugarcane cultivation in suitable regions of Upper Egypt, can balance economic stability with sustainability goals. Further research should explore long-term technical feasibility and assess socio-economic impacts of alternative cropping patterns on rural livelihoods.

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