

A Future Vision of the Possibility of Reducing Sugar Gap in the Light of the Current World Situation

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Abstract: Findings indicate that total sugar production in Egypt has been increasing at a statistically significant rate of 35.86 thousand tons representing 3.8% of the period's average (1990-2007), whilst total sugar consumption has been increasing at a statistically significant rate of 42.84 thousand tons representing 2.4% of the same period's average. Investigating world sugar markets indicate that Brazil is the main sugar exporter to Egypt where Egypt's imports from Brazil accounted for 79.7% of the total sugar imports during the period 2001-2005. However, in the light of utilizing sugarcane in producing biofuel, world sugar supply tends to decline thus sugar prices tend to increase, which is bound to affect Egypt's agricultural trade balance as a sugar-importing country. that the main factors affecting sugar consumption in Egypt include the number of population, sugar imports, sugar production, average consumer price, and real individual income. The best scenario is the one that involve reducing per capita consumption to 24 kg/year, where sugar consumption is forecasted to reach 1990.80 and 2144.70 thousand tons in 2012 and 2017 respectively, based on which self-sufficiency in sugar has been forecasted to reach 113% and 122% in the two years respectively. In addition, the study stressed the importance of rationalizing per capita sugar consumption to reach world per capita level estimated at 24 kg/year, expanding sugar beet production in New Lands, and raising sugar plants' efficiency to full capacity.

Key words: Egypt and the World, sugar production, sugar consumption, sugar imports, sugar exports, per capita sugar consumption, self-sufficiency rate, forecasts for 2012 and 2017.

INTRODUCTION

Sugar is one of the important sources of energy necessary for human life. It is also one of the strategic commodities. It ranks second in importance after wheat at the level of the world. In addition, it represents a major source of income in countries which economies depend on sugarcane production. Average global production of sugar reached around 127.28 million tons during the period (2001-2005), of which sugarcane accounted for 79%, and sugar beet accounted for 21%. It is worth noting that both types of sugar are produced in about 120 countries around the world. Brazil, Thailand, Cuba, France, Germany, Australia are the most important sugar-exported countries, where their exports constitute about 59% of total world sugar exports estimated at 44,436 million tons in average during the period (2000-2004). As regards imports, Russia, the United States of America, China, Japan, Korea, and the United Kingdom are considered the main importers of sugar at the level of the world, where the volume of their imports totaled to 12.59 million tons, representing an average of 30.7% of the total world imports for the same period. Egypt's policy

to raise the rate of self-sufficiency, which reached about 67.5% in 2007, depends on the horizontal expansion in sugar beet cultivation and selecting the high-yielding varieties of sugarcane. It should be noted that average per capita sugar consumption in Egypt is estimated at 34 kg/annum compared to the world average per capita sugar consumption estimated at 24 kg/annum. As regards domestic production, the volume of raw sugar has been estimated at 1757 thousand tons in 2007, of which sugarcane and sugar beet accounted for 61.20% and 38.80% respectively.

Regarding the study Problem, self-sufficiency in sugar has been following a gradually declining trend in recent years, where it declined from 77.80% in 2001 to 67.50% in 2007 due to the increase in average per capita consumption and the increase in population, which both led to doubling the amount of sugar imports from 400 thousand in 2001 tons to 843 thousand tons in 2007. Such huge increase in domestic consumption constitutes a burden on the agricultural trade balance. Moreover, the increased global demand for sugar, both for human consumption and biofuel production (as in Brazil), in addition to the fact that some countries reduced sugarcane acreage, resulted in

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lower sugar supplies and higher international prices, thus a considerable burden on sugar-importing countries.

This research aims at shedding the light on the current situation of sugar in Egypt and the world, identifying the most important economic variables affecting domestic sugar consumption and predicting the volumes of domestic production and consumption in order to explore the possibility of reducing sugar gap, thus reduces the volume of sugar imports.

Methodology and Sources of Data: The research applied descriptive and statistical analysis methods, particularly simple linear regression equations and multiple regression in both the linear and double-log forms. The research is based on secondary and primary data collected from different sources, in addition to data published in the economic bulletins issued by the Ministry of Agriculture and Land Reclamation, Sugar Crops Council, Food and Agriculture Organization of the United Nations, and online data published on the internet by the Central Agency for Public Mobilization and Statistics (CAPMAS).

Global Sugar Situation: Sugar is considered a strategic commodity for most of the world countries, either in terms of production, consumption, exports, or imports. Sugar is extracted from both sugarcane and sugar beet crops in about 120 countries. World countries can be divided into^[4]:

- Net sugar consuming countries such as most of the Arab World countries.
- Sugar producing and consuming countries such as India, China, and the United States of America.
- Sugar producing and exporting countries such as Brazil and the European Union.
- Sugar producing, consuming, and importing countries such as Egypt.

Global Sugar Production: Data in Table (1) indicate that only three countries have control over 45% of the global sugar production, these are Brazil, India and China, which average sugar production amounted to 38.90, 27.00, and 10.00 million tons representing 23.34%, 16.20%, and 6.04% respectively during the period 2001-2005. World sugar production comes from two sources; these are sugarcane and sugar beet. Sugarcane production is concentrated in Brazil, India, China, and Thailand, which average production accounted for 61.18% of the world total sugar production. Brazil ranked first with average production of sugarcane estimated at 38.90 million tons representing 29.50% of the world average production

estimated at 131.88 million tons during the period 2001-2005 as illustrated in the table. India, China, and Thailand followed with average production estimated at 27.00, 8.81, and 5.97 million tons representing 20.29%, 6.68%, and 4.52% of the world average sugarcane production respectively.

As for beet sugar production, its contribution to the total amount of sugar produced in recent years has been increasing where it is being widely grown in many of the world countries. France ranked first with average beet sugar production estimated at 4.34 million tons representing 12.49% of the world average production estimated at 34.75 million tons during the period 2001-2005. The USA, Germany, and Russia followed with average production estimated at 3.67, 3.65, and 2.65 million tons representing 10.57%, 10.50%, and 7.63% of the world average beet sugar production respectively. It should be noted that the whole volume of sugar produced in the European Union comes from sugar beet⁽³⁾.

Global Sugar Consumption: Table (2) indicates that India ranked first in terms of the relative importance of sugar consumption at the level of the world. Its average sugar consumption has been estimated at 23.50 million tons representing about 21% of the world average consumption estimated at 112.30 million tons during the period 2001-2005. China and Brazil followed with average consumption estimated at 8.20 and 7.58 million tons representing about 7.30% and 6.75% of the world average sugar consumption during the same period. India is considered the world's largest cane sugar consumer. Its average consumption of cane sugar has been estimated at 23.48 million tons representing 26.80% of the world average cane sugar consumption estimated at 87.60 million tons during the period 2001-2005. While the Russian Federation ranked as the world's first beet sugar consumer with average estimated at 2.4 million tons representing about 9.7% of the world average beet sugar consumption during the same period as illustrated in Table (2).

From what proceeded, it can be inferred that average consumption of cane sugar represented around 87% of the world average consumption of sugar, whereas average beet sugar consumption represented around 22% of the world average consumption of sugar during the period 2001-2005. Such finding shows the significance of beet sugar contribution to satisfying the global demand for sugar consumption.

Global Sugar Trade:

Global Sugar Exports: Data in Table (3) indicate that the volume of world sugar exports increased from 29.925 million tons in 1990 to 51.801 million tons in

Table 1: Relative Importance of Sugar-Producing Companies during the Period 2001-2005.

Country	Total Production		Sugarcane		Sugar Beet	
	Volume	% of World Total	Volume	% of World Total	Volume	% of World Total
Brazil	38.9	23.34	38.9	29.49	-	-
India	27.00	16.2	27.00	20.49	-	-
China	10.06	6.04	8.81	6.68	1.25	3.58
USA	6.059	3.95	2.92	2.21	3.67	10.57
Thailand	0.97	3.58	5.97	4.52	-	-
Pakistan	4.89	2.93	4.89	3.71	-	-
Mexico	4.63	2.78	4.63	3.51	-	-
France	4.34	2.6	-	-	4.34	12.49
Colombia	3.74	2.24	3.74	2.84	-	-
Australia	3.43	2.06	3.43	2.61	-	-
Cuba	-	-	2.49	1.88	-	-
Germany	-	-	-	-	3.65	10.5
Russia	-	-	-	-	2.65	7.63
Ukraine	-	-	-	-	2.16	6.2
Turkey	-	-	-	-	2.01	5.79
Poland	-	-	-	-	1.75	5.03
Italy	-	-	-	-	1.5	4.31
UK	-	-	-	-	1.28	3.68

Source: Food and Agricultural organization (FAO) Production Yearbook, different issues^[4].

2004, which is an increase of 73.12%. The estimated general regression equation for the volume of world sugar exports for the period 2001-2004 is presented as follows:

$$\hat{Y}_t = 25.697 + 1.459 X_t \quad (9.764)$$

$R^2 = 0.94, \quad R^2 = 0.88, \quad F = 95.33$

Where:

\hat{Y}_t is the estimated volume of world sugar exports in million tons in year.
 X_t is the time variable in years, where $t = 1, 2, 3, \dots, 15$.

The figure between brackets is the calculated t value.

The equation indicates that world sugar exports have been increasing at a statistically significantly annual rate of 1.46 million tons representing

approximately 3.5% of the average volume of exports estimated at 37.37 million tons during the studied period.

Table (3) also indicates that world price of sugar exports has been fluctuating during the period 1990-2004 where it declined from US\$ 455.53/ton in 1990 to US\$ 298.80/ton in 1993, then further declined to US\$ 218.50/ton in 2004. The estimated general regression equation for world sugar export price is presented as follows:

$$\hat{Y}_t = 406.357 + 13.218 X_t \quad (6.245)$$

$R^2 = 0.87, \quad R^2 = 0.75, \quad F = 39.33$

Where:

\hat{Y}_t is the estimated average price of world sugar exports in US\$/ton in year t .
 X_t is the time variable in years, where $t = 1, 2, 3, \dots, 15$.

Table 2: The Relative Importance of the World Sugar-Consuming Countries during the Period (2001-2005).

Country	Total Sugar Consumption Quantity Consumed (million tons)	% of World Total Consumption	Cane Sugar Consumption Quantity Consumed (million tons)	% of World Total Cane Sugar Consumption	Serf Sugar Consumption Quantity Consumed (million tons)	% of World Total Beet Sugar Consumption
India	23.34	20.91	23.48	26.8	-	-
China	8.2	7.3	8.2	9.37	-	-
Brazil	7.58	6.75	7.58	8.66	-	-
Russian Federation	6.51	5.8	4.11	4.69	2.4	9.73
USA	6.2	5.52	4.04	4.6	2.16	8.76
Pakistan	3.37	3.00	3.37	3.84	-	-
Mexico	3.1	2.76	3.1	3.54	-	-
Indonesia	2.94	2.62	2.94	3.36	-	-
Germany	2.26	2.01	2.04	2.33	2.26	9.17
Thailand	2.04	1.82	-	-	-	-
Colombia	-	-	1.61	1.84	-	-
Ukraine	-	-	-	-	1.65	6.68
France	-	-	-	-	1.61	6.51
Turkey	-	-	-	-	1.51	6.11
Italy	-	-	-	-	1.30	5.28
Poland	-	-	-	-	1.23	4.98

Source: Food and Agriculture organization (F.A.O) production year book, different issues^[4].

Table 3: World Sugar Exports and Imports during the Period 1990-2004.

Year	World Sugar Exports		World Sugar Imports	
	Volume of Exports (million tons)	Export Price (US\$/ton)	Volume of Imports (million tons)	Import Price (US\$/ton)
1990	29.925	455.53	29.076	534.23
1991	29.560	355.42	27.942	380.38
1992	31.494	336.62	30.364	375.00
1993	28.698	298.8	37.899	342.15
1994	28.994	327.29	27.643	363.18
1995	33.191	368.86	29.366	419.19
1996	36.952	345.247	34.319	399.689
1997	37.883	322.658	34.788	370.772
1998	39.072	305.015	36.201	347.199
1999	42.644	235.27	39.731	271.57
2000	40.069	221.48	36.033	262.59
2001	42.681	249.00	40.096	279.34
2002	45.619	220.22	38.895	257.92
2003	42.003	249.5	40.50	270.81
2004	51.807	218.55	48.50	242.84

Source: Food and agriculture organization (FAO), Trade, Year book^[4]

The figure between brackets is the calculated t value.

The equation indicates that sugar export price has been declining at a statistically significantly annual rate of US\$ 13.22/ton representing approximately 4.39% of the average price of sugar exports estimated at US\$ 300.63/ton during the studied period.

Global Sugar Imports: Data in Table (3) indicate that the volume of world sugar imports increased from 29.076 million tons in 1990 to 48.825 million tons in 2004, which is an increase of 66.90%. The estimated general regression equation for the volume of world sugar imports during the period 2001-2004 is presented as follows:

$$\hat{Y}_t = 24.662 + 1.2 X_t$$

(8.583)

$R^2 = 0.92, \quad R^2 = 0.85, \quad F = 73.67$

Where:

\hat{Y}_t is the estimated volume of world sugar imports in million tons in year t.
 X_t is the time variable in years, where t = 1, 2, 3,, 15.

The figure between brackets is the calculated t value.

The equation indicates that the volume of sugar imports has been increasing at a statistically significantly annual rate of 1.27 million tons representing approximately 3.6% of the average volume of sugar imports estimated at 34.82 million tons during the period 1990-2004.

Table (3) also indicates that world price of sugar imports has been declining over the period 1990-2004 where it declined from US\$ 534.26/ton in 1990 to US\$ 242.84/ton in 2004, which is about 54.50% decline. The estimated general regression equation for world sugar imports price is presented as follows:

$$\hat{Y}_t = 460.655 + 14.941 X_t$$

(5.782)

$R^2 = 0.85, \quad R^2 = 0.72, \quad F = 33.43$

Where:

\hat{Y}_t is the estimated average price of world sugar imports in US\$ /ton in year t.
 X_t is the time variable in years, where t = 1, 2, 3,, 15.

The figure between brackets is the calculated t value.

The equation indicates that sugar import price has been declining at a statistically significantly annual rate of US\$ 14.90/ton representing approximately 4.37% of the average price of sugar imports estimated at US\$ 341.26/ton during the studied period. Such finding can be attributed to the support granted by the EU to sugar exporters, which resulted in reducing the price of world sugar imports, and to the global changes and international agreements in recent years^[8].

Movements in World Prices of Sugar: Sugar is one of the commodities which trading in the world market is subject to stock market prices. Sugar prices are affected by many global variables such as the size of global stock, global production, and the nature of international agreements between exporting and importing countries. Perhaps the most important causes affecting the world price of sugar is the conflicting policies in some of the sugar-producing and exporting countries such as:

- Some countries tend to reduce sugarcane acreage owing to the fact that it requires large quantities of irrigation water.
- Some exporting countries encourage sugar exports through providing financial support to dispose of the accumulated stock, which results in lower world price.
- Directing raw sugarcane towards industries other than the sugar industry such as bio-fuel production, as in Brazil, to use it as car fuel, which resulted in reducing the global supply and stock of sugar, and soaring its world price.

Major World Exporters and Importers of Sugar: Sugar is considered a major export crop for some countries which economies depend primarily on sugarcane. Brazil, Thailand, Australia, and France are the world's major sugar-exporting markets where their average exports amounted to 11.69, 4.30, 3.38, and 3.20 million tons respectively, which accounted for 50% of the average world sugar exports estimated at 44.44 million tons during the period 2000-2004. As regards sugar-importing markets, Russia, USA, China, and Korea are considered the world's major sugar-importing markets where their average imports amounted to 4.84, 1.57, 1.55, and 1.53 million tons respectively representing 27.27% of the average world sugar imports estimated at 34.80 million tons during the period 2000-2004.

Sugar Crops Production in Egypt: Egypt's sugar industry relies on two main sugar crops; these are

Table 4: Sugarcane and Sugar Beet Acreage, Production, and Yield during the Period 1985-2006.

Year	Sugarcane			Sugar Beet		
	Area '000 Feddan	Production '000 tons	Yield '000 Feddan/tons	Area '000 Feddan	Production '000 tons	Yield '000 Feddan/tons
1985	250	9684	38.7	41	578	14.2
1986	262	10832	41.4	37	607	16.2
1987	268	10795	40.3	42	724	17.6
1988	275	11213	40.7	42	726	17.4
1989	274	11144	40.6	40	685	17.2
1990	263	11095	42.2	34	575	16.9
1991	267	11624	43.5	49	1106	22.4
1992	271	11708	43.2	38	744	19.3
1993	278	12412	44.6	40	495	19.9
1994	301	13822	45.9	42	825	19.5
1995	306	14105	46.00	50	920	18.4
1996	300	13908	46.5	51	842	16.6
1997	291	13726	47.2	64	1143	17.9
1998	291	14353	49.2	104	1951	18.8
1999	307	15254	49.7	128	2560	19.9
2000	319	15706	49.2	136	2890	21.3
2001	312	15572	49.9	143	1858	20.00
2002	323	16017	49.5	154	3168	20.6
2003	327	16245	49.6	131	2692	20.5
2004	322	16230	50.00	141	2860	20.3
2005	321.38	16317	50.80	167	3429	20.6
2006	326.81	16604	50.81	186	3905	21.1
Average	293.42	1356.09	45.48	84.45	1762.86	18.92

Source: Ministry of Agriculture and Land Reclamation, the Central Agency for Agricultural Economics, Agricultural Economics Bulletin, Different Issues^[5].

sugarcane crop cultivated in upper Egypt governorates, and sugar beet crop cultivated in lower Egypt governorates.

Sugarcane: Sugarcane domestic production depends on both the cultivated area and productivity. It is noted from Table (4) that sugarcane acreage has been fluctuating over the period 1985-2006 where it reached a minimum of 250 thousand feddan in 1985 and a maximum of 326.81 thousand feddan in 2006, which is about 31% increase compared to 1985. Moreover, sugarcane productivity increased from 38.80 tons/feddan in 1985 to 50.80 tons/feddan approximately in 2006, which is about 31.30% increase in productivity. Such increase has been reflected on total production

that increased from 9684 thousand tons in 1985 to some 16604 thousand tons in 2006, which is an increase of 71.46%. Such finding indicates that the large increase in total production during that period can be explained by the increase in both acreage and productivity.

The estimated general regression equations for sugarcane acreage, yield, and total production are presented as follows:

$$\hat{Y}_t = 238.78 + 3.839 X_t \quad (1)$$

(10.769)

$R^2 = 0.87, \quad F = 115.96$

$$\hat{Y}_{2t} = 39.03 + 0.596 X_t \quad (2)$$

(18.66)

R²= 0.90, F = 348.098

$$\hat{Y}_{3t} = 9693.75 + 334.899X_t \quad (3)$$

(21.91)

R²= 0.96, F = 443.45

Where:

\hat{Y}_{1t} is the estimated sugarcane acreage in thousand feddans in year t.

\hat{Y}_{2t} is the estimated sugarcane yield in year t, in tons/feddan.

\hat{Y}_{3t} is the estimated sugarcane total production in thousand tons, in year t. X_t is the time variable, where t= 1,2,3, 22

The figure between brackets is the calculated t value.

Equations 1, 2, and 3 indicate that sugarcane acreage, yield, and total production have been increasing at statistically significant annual rates of 3.839 thousand feddans, 0.596 tons/feddan, and 334.899 thousand tons respectively during the period 1 985-2006.

Sugar Beet: Sugar beet acreage increased drastically from 41 thousand tons in 1985 to 186 thousand tons in 2006, which is an increase of 353.60%. Moreover, sugar beet yield increased from 14.20 tons/feddan in 1985 to 21 thousand tons in 2006, which is an increase of 48.60%. Such increase in yield resulted in increasing total sugar beet production from 578 thousand tons in 1985 to around 3905 thousand tons in 2006, which is a drastic increase of 575%.

The estimated general regression equations for sugar beet acreage, yield, and total production are presented as follows:

$$\hat{Y}_{1t} = 5.026+ 7.067 X_t \quad (4)$$

(10.479)

R²= 0.85, F = 109.804

$$\hat{Y}_{2t} = 14.725 + 0.326 X_t \quad (5)$$

(4.47)

R²= 0.50, F = 19.98

$$\hat{Y}_{3t} = 143.00 + 153.079X_t \quad (6)$$

(9.263)

R²= 0. 81, F = 85.806

Where:

\hat{Y}_{1t} is the estimated sugar beet acreage in thousand feddans in year t.

\hat{Y}_{2t} is the estimated sugar beet yield in tons/feddan in year t.

\hat{Y}_{3t} is the estimated sugar beet total productions in thousand tons year t.

X_t is the time variable, where t = 1, 2, 3, .. , 22.

The figure between brackets is the calculated t value.

Equations 4, 5, and 6 indicate that sugar beet acreage, yield, and total production have been increasing at statistically significant annual rates of 7.067 thousand feddans, 0.326 tons/feddan, and 153.079 thousand tons respectively during the period 1985-2006.

Sugar Consumption in Egypt: Egypt is one of the countries which sugar consumption surpasses domestic sugar production, a situation that can be attributed to the increase in population growth rate that reached about 1.96% during the period 1985-2007, in addition to the increase in per capita average consumption that reached 34kg/annum approximately, which is higher than the world's average per capita consumption estimated at 24kg/ annum. El-Agroudy explained that such higher per capita sugar consumption in Egypt is due to the fact that sugar is considered a complementary good for tea, which consumption in Egypt exceeds the consumption rates in tea-producing countries^[2].

Table (5) shows that domestic total sugar consumption increased from 1440 thousand tons in 1985 to around 2600 thousand tons in 2007, which is an increase of 80.50%. The estimated general regression equation for domestic sugar consumption is presented as follows:

$$\hat{Y}_t = 1266.11 + 42.839 X_t \quad (7.17)$$

(7.17)

R²= 0.71, F = 51.41

\hat{Y}_t is the estimated total sugar consumption in thousand tons in year t.

X_t is the time variable in years, where t = 1,2,3, . . . 23.

Table 5: Total and Per Capita Consumption, Food Gap, and the Rate of Self-sufficiency in Sugar in Egypt during the Period 1985-2007.

Year	Population (million)	Sugar Production ('000 tons)	Total Consumption ('000 tons)	Gap ('000 tons)	Average Per Capita Consumption kg/year	Self-Sufficiency %
1985	48.3	830	1440	610	29.8	57.6
1986	49.5	881	1470	589	29.7	60.0
1987	50.7	926	1500	574	29.6	61.7
1988	51.7	891	1576	685	30.4	51.5
1989	53.1	871	1492	621	28.1	58.4
1990	54.3	895	1792	897	33.0	50.0
1991	55.5	982	1716	734	30.9	57.2
1992	56.7	991	1534	543	27.1	64.6
1993	57.9	1005	1505	500	26.0	66.7
1994	59.1	1099	1550	451	26.2	71.0
1995	60.3	1131	1586	455	26.3	71.3
1996	61.5	1124	1574	450	25.6	71.4
1997	62.7	1131	1570	439	25.0	72.0
1998	63.9	1167	1600	433	25.0	72.9
1999	64.3	1243	1678	435	26.1	74.0
2000	65.5	1393	1800	407	27.5	77.4
2001	66.9	1406	1806	400	27.0	77.8
2002	68.3	1373	2000	627	29.93	68.6
2003	69.5	1285	2100	815	30.2	61.2
2004	70.7	1370	2200	831	32.0	62.3
2005	71.90	1479	2370	873	33.0	63.2
2006	73.10	1575	2485	910	34.0	63.4
2007	77.00	1757	2600	843	34.0	67.5
Average	61.41	1165.43	1780.174		28.97	

Source: Ministry of Agriculture and Land Reclamation, Sugar Crops Council, Annual Report on Sugar Crops and Sugar Production in Egypt, 2006^[6].

The figure between brackets is the calculated t value.

The estimated equation indicates that sugar consumption has been increasing by a statistically significant annual rate of 42,839 thousand tons, and an annual increase estimated at 2.4% of the average annual consumption that amounted to about 1780,174 thousand/tons during the period 1985-2007. Such increase in consumption can be explained by the increase in population, and the increase in average per capita sugar consumption resulting from the increase in consumers purchasing power, and the increased

consumption of sweets, beverages, and juices.

Egypt's Sugar Imports: To close the gap between domestic sugar production and consumption, Egypt imports different forms of sugar including refined cane sugar, cane sugar without added flavoring for the purpose of refining, and raw cane sugar without added flavoring for non-refining purposes, in addition to importing different forms of beet sugar such as refined beet sugar, raw beet sugar without added flavoring for the purpose of refining, and beet sugar without added flavoring for non-refining purposes.

Table 6: Major Sugar-Exporting Countries to Egypt during the period Vly 2004-2007.

Country	Cane Sugar		Beet Sugar		Total Sugar	
	Quantity (’000 tons)	Value L.E. Million	Quantity (’000 tons)	Value L.E. Million	Quantity (’000 tons)	Value L.E. Million
Brazil	974.67	1669.4	201.26	304.32	1175.93	1973.72
Ireland	99.01	129.03	0.115	0.167	99.12	129.2
European Union	11.97	16.25	36.70	58.29	48.667	74.54
Argentina	36.19	48.72	1.02	1.52	37.21	49.94
Guatemala	27.00	40.06	-	-	27.0	40.06
United Kingdom	10.83	2.41	8.20	11.78	19.03	14.20
Southwest Africa	4.46	4.46	0.542	0.138	5.002	4.60
USA	10.00	25.88	-	-	10.00	25.88
Uruguay	9.301	10.79	-	-	9.30	10.79
Saudi Arabia	-	-	5.13	5.76	5.13	5.76
China	34.91	0.357	0.454	0.914	35.36	1.27
France	0.021	0.047	1.09	1.72	1.111	1.77
Germany	1.10	1.55	0.021	0.069	1.12	1.62
Italy	-	-	0.551	0.738	0.552	738.2
Lebanon	0.179	0.427	-	-	0.179	427.02
Ukraine	-	-	0.044	0.072	0.044	71.7
Mauricio	-	-	0.042	0.014	0.0420	0.140

Source: <http://www.capmas.sov.eg>

Table 7: Forecasting Sugar Production and Consumption in Egypt in 2012 and 2017.

Scenario	2012	2017		Production "000 tons"	Consumption "000 tons"	Self-sufficiency %
	Production "000 tons"	Consumption "000 tons"	Self-sufficiency %			
Scenario 1	2046.75	2679.28	76.39	2384.29	2732.51	87.26
Scenario 2	2046.75	2546.56	80.37	2384.286	2597.16	91.80
Scenario 3	2251.42	2927.33	76.91	2622.72	3295.89	79.57
Scenario 4	2251.42	2679.28	84.00	2622.72	2732.51	95.9
Scenario 5	2251.42	1990.8	113.09	2622.72	2144.69	122.29

Egypt's total sugar imports has been estimated at 1474.80 thousand tons during the period 2004-2007. Major sugar-exporting countries to Egypt include Brazil, Ireland, the European Union, and Argentina. Table (6) indicates that Egypt's sugar imports from these countries amounted to 1175.90, 99.12, 48.67, and 37.21 thousand tons representing 79.73%, 6.72%, 3.30%, and 2.50% of Egypt's total sugar imports respectively, which means that Brazil is the major sugar exporter to Egypt. However, in the light of utilizing sugarcane in biofuel production, the

quantities of sugar available for exports are expected to decline, thus sugar prices in the world market are expected to rise.

Sugar Gap in Egypt: Sugar gap started to occur in Egypt after the 1973 War as a consequence of applying the open-door economic policy, the increasing population, and the changes in food consumption patterns. As clear from Table (7), self-sufficiency reached 50% in 1990, which is the lowest level during the period 1985-2007. Despite the efforts exerted by

the government of Egypt, which succeeded in raising annual sugar production by 36 thousand tons during the period 1985-2007, the annual rate of increase in consumption reached about 43 thousand tons during the same period.

Such finding can be explained by the increase in average per capita sugar consumption from 29.80kg/annum in 1985 to 34kg/annum in 2007, and the annual increase in population estimated at 1.96 million over the studied period.

Comparing domestic sugar consumption to domestic production reveals that sugar gap has been fluctuation over the period 1985-2007, where it reached a minimum of 400 thousand tons in 2001 and a maximum of 843 thousand tons in 2007. The government of Egypt resorts to sugar imports to close this gap, which places Egypt among sugar-importing countries. Therefore, it is necessary to predict the future size of sugar gap and design policies to balance between production and consumption in order to reduce the quantities of sugar imports to the minimum possible levels to face the global changes.

Factors Affecting Sugar Consumption in Egypt:

Studies conducted to investigate consumption indicate that the quantity consumed of a commodity is influenced by the number of population, the price of that commodity, real individual income, and the production and imports of that commodity. The logic of economic theory states that the quantity consumed of a commodity is a direct function of the number of population, individual income level, the volume of imports of the commodity, and total production of the commodity, i.e., consumption is expected to increase as these variables increase, and vice versa. Moreover, a study that was conducted indicated the existence of a direct relationship between consumption and both imports and domestic production.

Sugar consumption equation for Egypt during the period 1990-2007 has been estimated using total sugar consumption (y), population in million (X₁), total sugar production in thousand tons (X₂), sugar imports in thousand tons (X₃), average price in piaster/kg (X₄), and real individual income in L.E/year (X₅). The following is the estimated linear multiple regression equation:

$$\hat{Y}_t = 29.352 + 0.934 X_{1t} + 1.27X_{2t} + 1.22X_{3t} - 0.1X_{4t} + 0.046X_{5t}$$

(8.12) (10.522) (5.614) (3.008) (0.989)

R² = 0.98, F=283.429

The estimated equation indicates that the main factors significantly affecting sugar consumption are the number of population, sugar production, sugar imports, and average consumer price, which signs comply to the logic of economic theory.

The calculated F value indicates that the estimated equation is statistically significant, whereas R² indicates that 98% of the changes in the annual volume of consumption is due to the changes in the previously mentioned variables.

Moreover, the estimated coefficients indicate that an increase in population by one million results in 0.93 thousand tons increase in sugar consumption; an increase in sugar production by one thousand tons results in 1.27 thousand tons increase in sugar consumption; an increase in the volume of imports by one thousand tons results in 1.12 thousand tons increase in sugar consumption; an increase in consumer price by one piaster/kg results in 0.1 thousand ton reduction in sugar consumption; and finally, an increase in real individual income by one pound results in 0.046 thousand tons increase in sugar consumption, statistically insignificant.

Another trial to estimate the equation using the double-log regression equation gave the following equation:

$$\hat{Y}_t = 0.434 - 1.206 \log X_{1t} + 1.352 \log X_{2t} + 1.068 \log X_{3t} - 0.115 \log X_{4t} + 0.088 \log X_{5t}$$

(8.366) (10.235) (22.878) (4.05) (1.0801)

R² = 0.98, F=294.12

This equation proved to be the most efficient form of estimation where the level of significance increased for all variables, and the changes in the number of population, sugar production, sugar imports, consumer price, and real individual income explain 98% of the changes in sugar consumption in Egypt. In addition, the obtained signs comply to the logic of economic theory.

An important characteristic of the double-log form is that the coefficient of variation directly expresses the elasticity. The estimated coefficients indicate that a 10% increase in the number of population, production, and imports leads to increasing sugar consumption in Egypt by 12.06%, 13.52%, and 10.68% respectively. In addition, consumer price coefficient indicates that a 10% increase in sugar price results in reducing sugar consumption by 1.15%. The price elasticity of demand estimated at 0.115 and the income elasticity of demand estimated at 0.088 reveal that sugar is a necessary commodity with low income elasticity of demand.

Outlook of Sugar Production and Consumption in Egypt: A study^[2] indicated that the increase in self-sufficiency can be predicted via predicting the future increase in sugarcane and sugar beet production. And, in the light of the predicted volumes of production and consumption, future sugar gap can be predicted, thus proper economic policies can be drawn accordingly. The predicted volumes of production and consumption for the years 2012 and 2017 have been estimated using the following equation 2:

$$v = x (1+r)^n$$

Where:

- v = the predicted volume of sugar consumption.
- x = the current volume of sugar consumption (in 2007)
- n = number of prediction years
- r = sugar consumption growth rate

The volumes of production and consumption were predicted for the years 2012 and 2017 assuming that both of them increase annually according to the estimated annual changes, while holding average per capita share constant at 34 kg/annum. Based on that, sugar production and consumption are predicted to reach 2046.75 and 2927.33 thousand tons respectively, and self-sufficiency rate is predicted to reach 69.9% for the year 2012, whereas for the year 2017 sugar production and consumption are predicted to reach 2384.29 and 3295.89 thousand tons respectively, and self-sufficiency rate is predicted to reach 72.40%.

To attain the best possible solution for increasing self-sufficiency rate and reducing the sugar gap, the following scenarios for sugar production and consumption have been predicted:

First Scenario: Average per capita sugar consumption is assumed to decline by 5% to reach 32.70 kg/annum.

Second Scenario: Average per capita sugar consumption is assumed to decline to reach 30.60 kg/annum.

Third Scenario: Sugar beet acreage is assumed to increase by 10 thousand feddans, which produces 205 thousand tons. This means that production can be increased by 10%, keeping average per capita consumption constant at 34kg/annum.

Fourth Scenario: Production is assumed to increase by 10%, whereas average per capita consumption is reduced by 5% to reach 32.70 kg/annum.

Fifth Scenario: Average per capita sugar consumption is assumed to decline to reach the world average per capita consumption level estimated at 24kg/annum.

It can be inferred that the last scenario is the best, where increasing sugar beet acreage is expected to increase total production of sugar to 2251.42 thousand tons and reduce average per capita consumption to the world per capita's level. In addition, this scenario is predicted to increase self-sufficiency rate to 113% in 2012 and 122% in 2017 as illustrated in Table (7).

This means that we can achieve self-sufficiency in sugar and export direct the increase in production. This objective can be realized through expanding sugar beet cultivation in New Lands, developing high yielding varieties, and rationalizing per capita sugar consumption by arranging health awareness campaigns for consumers to illustrate the need to rationalize the quantities consumed of sugar and the danger of increasing sugar consumption on human health, where sugar is one of the white poisons that threatens human life. Such campaigns can be conducted in schools, universities, and via different types of communication media. In addition, linking the quantity of consumed sugar to ration cards can help limit sugar consumption.

Conclusion: Sugar ranks second after wheat as a strategic commodity at the world level and is the main source of income for many countries. This study investigates the low level of self-sufficiency in sugar in Egypt that reached 67.50% as a result of increased per capita sugar consumption, which reached about 34 kg/annum. Such increased consumption resulted in increasing sugar imports to some 843 thousand tons in 2007, which represents a burden on Egypt's agricultural trade balance.

The study aimed to shed the light on the current situation of sugar in Egypt and the world, and the main economic variables affecting sugar consumption, in addition to forecasting the volumes of sugar production and consumption in 2012 and 2017. To achieve these objectives, the researcher applied both descriptive and statistical analysis methods, and relied on secondary data and previous studies.

Findings indicate that world's average per capita consumption during the period 2001-2005 has been estimated at 166.63 million tons, and both Brazil and India controlled over 45% of the world sugar production during that period. In addition, Brazil ranked first in cane sugar production, which accounted for 29.50% of the world total sugar production, whilst France ranked first in beet sugar production that accounted for 12.5% of the world average production during the studied period. As regards consumption, India ranked first by accounting for 21% of the world's average cane sugar consumption, whilst Russia ranked

first in beet sugar consumption that accounted for 9.7% of the world's average consumption during the studied period. The study also found that Brazil, Thailand, Australia, and France are the main sugar exporters, where their average exports accounted for 50% of the world's average exports during the period 2001-2004, whilst Russia, USA, China, and Korea are the main sugar importers, where their average imports accounted for 27.27% of the world average imports during the same period.

The study indicate that total sugar production in Egypt has been increasing at a statistically significant annual rate of 35.86 thousand tons representing 3.8% of the studied period's average (1990-2007), and sugar consumption has been increasing at a statistically significant annual rate of 42.84 thousand tons representing 2.4% of the period's average.

Moreover, the study indicates that Brazil is the main sugar exporter to Egypt, where the quantities of sugar imported from Brazil represented 79.70% of Egypt's total sugar imports during the period 2001-2005. However, Brazil's utilization of sugarcane in bio-fuel production is expected to reduce the world supply of sugar, which in turn is expected to raise the world prices of sugar.

The study found that population number, sugar imports, sugar production, average consumer sugar price, and real individual income are the main variables affecting sugar consumption in Egypt, where their signs complied to the logic of the economic theory.

In addition, studying the five assumed scenarios for sugar forecasts indicate that the best scenario is the one that leads to reducing average per capita consumption to 24 kg/year, where sugar consumption is estimated to reach 1990.80 and 2144.70 thousand tons and self-sufficiency is expected to reach 113% and 122% in 2012 and 2017 respectively.

The study emphasizes reducing sugar consumption in Egypt to reach the world's level estimated at 24 kg/year and recommends increasing the price per ton of sugar supplied to sugar refining factories, encouraging investments in establishing sugar refining factories, expanding sugar cultivations in New Lands, raising the operation efficiency of sugar refining factories to full capacity, and importing and refining raw sugar to lower the cost of white sugar imports.

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