Causality Analysis of Sugar Productions and Consumption in Tanzania

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Abstract

Scarcity of resources has regularly caused what is produced to be consumed. Tremendous increase of the rate of sugar production in Tanzania has led to the raise of sugar consumption level the in the country. This study analyze the relationship between the amount of sugar produced (SGP) and sugar consumed (SGC) in Tanzania covering a period of 1977 to 2014. The series data were collected from economic survey data of Tanzania (URT 2012) and Sugar Board of Tanzania (SBT, 2015). The objective of this study was to analyses the causality demand for sugar production and consumption in Tanzania. The focus was to analyze whether there is direction causality from SGP to SGC, from SGC to SGP, bilateral causality or they are independent from each other. Granger Causality analysis was used and the order of integration employed in the Vector Autoregressive (VAR) was estimated by seemingly unrelated technique (SUR).

The findings indicated that there is a two way causality of sugar produced and consumed in Tanzania by 2014. Therefore, in order to improve the livelihood of farmers rural the Government should spend large amount of money expanding local industries and providing subsidy on farm inputs and productions facility that could have income multiplier effect toward local sugarcane producers. Interventions should be done on the sugar import tariffs and duties. The current low importation taxes affect the price of sugar produced in the country as it is very high compare to the price of imported sugar. Moreover more investors should be invited to invest on sugarcane production because the demand is still high.

Key words: Sugar Production, Sugar Consumption, Granger Causality

1.0 Introduction

The prolonged deficit of sugar production in Tanzania since back 1989 is doubtful. Sugar production and consumption by the year 2014 in Tanzania was at 320,000 metric tons and 480,000 metric tons respectively leaving a deficit of about 160,000 metric tons yearly demand (SBT, 2015). Sugar productions has been influenced by several factors including production costs, policy against import permit, cheap imported sugar, inflations or the rise of demand for sugar consumptions in Tanzania. Meanwhile sugar consumption is very high due to the smuggling of the sugar produced from Tanzania caused by high demand of sugar by other neighboring Eastern African countries. The price of sugar produced in Tanzania is lower compare to other neighboring countries led to sporadic price increase in the country. While retailers in Tanzania are directed to sell a kilo of sugar at not more than 1,700/- per Kg, the current sub-whole price stands at between 87,000/- and 11,000/- per 50-kilo bag and the retail price at between 2,300/- and 2,500/- per kilo. In Kenya, a kilo of the item fetches Kshs 210, which at the current exchange rate is 3,570/-.

In Uganda, it is Ugsh. 6,000 (equivalent to 3,400/-) and in Burundi it is Burundi Franc 2000 (about to 3,100/-). (Report from Ministry of Agriculture).However, since the privatization of the sugar local industries and sugar estates plantation in Tanzania, sugar production has consistently increased (Rabobank, 2013).

Consequently, the objective of this study is to analyses the causality relationship between sugar production and consumption in Tanzania and its impacts on agricultural economy.

2.0 Review of Related Literatures
2.1 Sugar Production and Consumption in Tanzania

Sugar production in Tanzania is facilitated by four main producers: the Tanganyika Plantation Company (TPC) located in Kilimanjaro Region; Kilombero Sugar Company Ltd and Mtibwa Sugar Estates both are in Morogoro; and Kagera Sugar Ltd in Kagera region. In 10 years ,the country's sugar production has increased from 112,903 tons in 1995/96 to 263,317 tons in 2005/06. This represents an increase of 134.91 percent. Factory-wise, Kilombero's has increased production by 227.91%, TPC by 80.04% and Mtibwa by 53.13%. Kagera Sugar Ltd which stopped production in 1999/2000 resumed production in October 2004 producing 16,703 tons by end of March 2006.Tanzania's sugar demand was more than 330,000 tons, in year 2010 while its production stood at 250,000 tonnes, creating a deficit of nearly 80,000 tons. The retail cost of sugar has risen to 2,500/= from 1,700/- per kilo in retail outlets.With current projected demand of 501,865 tons, it outstrips current production by about 48%. The country also depends on sugar imports to satisfy domestic requirement (SBT, 2012).

Production theory postulates that, with the availability of input factors may results to output factors. The sugar production industry in Tanzania has some causal factors on the quality and quantity of the sugar product including granting duty free for those importing sugar, high demand comparing to production capacity, and presence of cartels for profit margins and lack of clear irrigation system in the country. Other factors are related to few hours of sunshine which has impact on the availability of sucrose, climatic changes that disturbs the availability of rainfall to estates that do not use irrigation and poor block farming system (SBT, 2012; Sugaronline; 2013 and Rabobank, 2013).

Sugar consumption is very high in Tanzania. Following the demands, it also needs to be transported, though not at enough quantity, to satisfy final consumers. Transport cost influence its prices to the final consumer, moreover there is no fixed prices which is set unless intervened by government officials at local level (SBT, 2013), otherwise producers can set their own price. Import tariffs and duties fixed by the government affects the prices and thus indirectly the effects are transferred to consumers. Population increase at a rate of 3% and annual population grow by 6% which also leads to the increase of per capital consumptions (SBT, 2012 and Rabobank 2013).

Unsecure sugar local market dominated by greedily middleman has been affecting sugar consumption in Tanzania to the extent that they create inadequate availability of sugar in

the country. Moreover, sometimes poor timings in importation of sugar has caused sugar to be overloaded in warehouses. This has affected sugar production for large scale producers. As the result, due to inconveniences, the government licensed unsold sugar to be sold at European Union, Uganda and South Sudan. This is an indication that more sugar can be produced by the firms within the country and the markets are available at local and international level for (SBT, 2013).

Despite the reports issued by SBT, the strategic plans of country's sugar industry expects to largely target export markets by 2016. The SBT expects to implement nine projects see the country tripling its annual sugar production from the current estimate of 300,000 metric tons to 910,000 metric tons by the year 2016.

Several studies have been conducted on the direction of the causal link between economic variables such as FDI and Economic Growth (Kholdy, S. 1995, Ngowi H.P, 2001, Frimpong J.M and Oteng-Abuyie E.F, 2008). According these studies, the characteristics and conditions of a particular country may affect the causal relationship between economic variables of our expectation.

This study developed to find out the causal relationship between sugar production and sugar consumption. The aim of this study is to determine whether the amount of sugar produced within a country is determined by the amount of sugar consumed or sugar consumed in and some exported is determined by sugar produced in Tanzania perspective, and if there is a causal relationship in both direction

2.0 Data

The study used time series data on domestically sugar produced and consumed in Tanzania between 1977 and 2008which which were collected from Tanzania Sugar Board for.

3.0 METHODOLOGY

3.1 Granger Causality Test

Basing on the axioms that the past and the present may cause the future but the future cannot cause the past, and all causal relationship remain invariant over the period of analysis then the Granger Causality Test was used to test these two variables as they were measured on the yearly basis.

The inquiry was directed toward the possibility that time series *Y(t)* causes another *x(t)*, and the direction of causality is determined by Granger Causality Test. The series assumed to have the same time interval and measured at same units. Granger (1969) argues that within a bivariate context, the Granger-type test states that, 'if a variable *x* Granger causes variable *y*, the Mean Square Error (MSE) of a forecast y, based on the past values of both variables is lower than that of a forecast that uses only past values of *y*. Granger test was implemented by running the following regression:

$$\Delta y = \alpha + \sum_{i=1}^{p} \beta_i \Delta Y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta X_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

And testing the joint hypothesis Ho: $\gamma_1 = \gamma_2 = \ldots \gamma_p = 0$; against H_1: $\gamma_1 \neq \gamma_2 \neq \ldots \gamma_p \neq 0$. Granger causality from the y variable to the coincident variable x is established if the null hypothesis of the asymptotic chi-square (X^2) test is rejected. A significant test statistic indicates that the x variable has predictive value for forecasting movements in y over and above the information contained in the latter's past.

3.2 Model Specification

The model is;

$$lnSGC_t = \alpha_0 + \sum_{i=1}^{k+d} \beta_{1i}\, lnSGC_{t-1} + \sum_{i=1}^{k+d} \gamma_{1i}\, lnSGP_t + \mu_{1t} \ldots\ldots\ldots\ldots (2a)$$

$$lnSGP_t = \alpha_0 + \sum_{i=1}^{k+d} \beta_{2i}\, lnSGP_{t-1} + \sum_{i=1}^{k+d} \gamma_{2i}\, lnSGC_t + \mu_{2t} \ldots\ldots\ldots\ldots (2b)$$

Where;

1. $lnSGC_t$ is the natural logarithm of sugar consumption
2. $lnSGP_t$ is the natural logarithm of sugar production
3. K is the optimal lag order, d is the maximal order of integration of the variables in the system and μ_{1t} and μ_{2t} are error terms that are assumed to be white noise.

Equation 2a and 2b postulate that both current SGC and SGP are related to past values of themselves respectively. Basing on examination of causality direction, four cases were derived from the two equations above. These were:

In order to test sugar production influence on sugar consumption, the natural log of sugar consumption were regressed as a function of natural log of sugar production. In order to test sugar consumption influence on sugar production, the natural log of sugar production were regressed as a function of the natural log of sugar consumption.

1. One direction causality from SGP to SGC exists if the estimated coefficients on SGP in equation (2a) are statistically different from zero as a group (i.e. $\Sigma\gamma_{1i} \neq 0$) and the set of estimated coefficients on SGC in equation (2b) is not statistically different from zero (i.e. $\Sigma\gamma_{2i} = 0$).
2. Conversely, one direction causality from SGC to SGP exists if the estimated coefficients on SGP in equation (2a) are not statistically different from zero as a group (i.e. $\Sigma\gamma_{1i} = 0$) and the set of estimated coefficients on SGC in equation (2b) is statistically different from zero (i.e. $\Sigma\gamma_{2i} \neq 0$).
3. Two way, or bilateral causality, is suggested when the sets of SGP and SGC

coefficients are statistically significantly different from zero in both regressions.

4. Finally, independence i.e. neither SGP nor SGC causes one another, is suggested when the sets of SGP and SGC coefficients are not statistically significant in both regressions.

More generally, since the future cannot predict the past, if variable *SGP* (Granger) causes variable *SGC*, then changes in *SGP* should precede changes in *SGC*. Therefore, in a regression of

SGC on other variables (including its own past values), if we include past or lagged values of

SGP and it significantly improves the prediction of *SGC*, then we can say that *SGP* (Granger) causes *SGC*. A similar definition applies if *SGC* (Granger) causes *SGP*.

3.3 Estimation Results
3.3.1 Augmented Dickey Fuller (ADF) unit root test

The tabulated results are shown Table 1.

The four stages were done to estimate the results; the first was to establish the maximum order of integration (*d max*) using Augmented Dickey Fuller (ADF) unit root test for a series stationary on the *SGC* and *SGP* in their natural log-levels. The results shows that, there is unit root on SGC and SGP thus they are not stationary.

3.3.2 Optimal Lag Order (*k*)
In the second stage was to find the optimal lag order by using Akaike Information Criteria (AIC), Schwartz Bayesian Information Criteria (SBIC), Likelihood Ratio (LR), Hannan Quinn Information Criteria (HQIC), and Forecast PredictionError (FPE) criteria to establish and select the optimal lag length of the VAR(k) which is the optimal maximum order of integration. Verbeek (2004) argues that the advantages of considering the components simultaneously include that the VAR (k) model is more parsimonious and includes less lags and that more accurate forecasting.

Table 1: Selection Order Criteria

Sample: 1981 - 2008						Number of obs	=	28	
Lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC	
0	-18.9918				.015356	1.49942	1.52851	1.59457	
1	14.6779	67.339*	4	0.000	.001847*	-.619849*	-.532578*	-.334377*	
2	18.1508	6.9458	4	0.139	.00193	-.582198	-.436746	106411	
3	18.6282	.95485	4	0.917	.002517	-.330586	-.126952	.335516	
4	20.4125	3.5686	4	0.468	.003025	-.172323	.089492	.684094	

Endogenous: Lnconsumed Lnsugar; Exogenous: _cons

Basing on the LR information criteria, FPE information criteria, AIC, HQIC and SBIC they all selects 1 lag. Therefore (1) lag order of VAR model to preserve some degree of freedom for estimation.

3.3.3 Model Estimation (Seemingly Unrelated Regression)

Using the established maximal order of integration and the selected VAR length, the following augmented VAR (1) model was estimated using the SUR technique and the results are in Table 3 below:

$$lnSGC_t = \alpha_0 + \sum_{i=1}^{1} \beta_{1i} \, lnSGC_{t-1} + \sum_{i=1}^{1} \gamma_{1i} \, lnSGP_{t-1} + \mu_{1t} \dots\dots\dots\dots\dots \text{(3a)}$$

$$lnSGP_t = \alpha_0 + \sum_{i=1}^{1} \beta_{2i} \, lnSGP_{t-1} + \sum_{i=1}^{1} \gamma_{2i} \, lnSGC_{t-1} + \mu_{2t} \dots\dots\dots\dots\dots \text{(3b)}$$

Table 2: Seemingly Unrelated Regression (Output 1)

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
LnSGC	32	2	.2495837	0.6999	72.29	0.0000
LnSGP	32	2	.1239209	0.8179	139.20	0.0000

Table 2(b): Seemingly Unrelated Regression (Output 2)

$LnSGC_t$		Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
	$LnSGC_{t-1}$	.7500819	.1323475	5.67	0.000	.4906857	1.009478
	$LnSGP_{t-1}$	.1061007	.1968867	0.54	0.590	-.2797901	.4919916

	_cons	1.717662	1.657872	1.04	0.300	-1.531706	4.967031
$LnSGP_t$	$LnSGP_{t-1}$	.7406869	.0977563	7.58	0.000	.549088	.9322857
	$LnSGC_{t-1}$	.0740586	.0657119	1.13	0.260	-.0547343	.2028516
	_cons	2.146313	.8231506	2.61	0.009	.5329675	3.759658

3.3.4

Testing the Causality

Granger causality analysis was conducted by using the F-test and chi^2 to verify if the coefficients γ_{1i} and γ_{2i} of the lagged variables are significantly different from zero in the respective equations 3(a) and 3(b). The hypotheses results were;

1. $LnSGP_{t-1} \Longrightarrow LnSGC_{t,}$ lags(1)

    Ho; $LnSGP_{t-1}$ does not Granger cause$LnSGC_{t,}$

    $F(1,30) = 32.64728$, Prob> F= 4.17 and;

    $Chi^2(31) = 72.29$, Pro> $Chi^2 = 43.77$

2. $LnSGC_{t-1} \Longrightarrow LnSGP_{t,}$ lags(1)

    Ho; $LnSGC_{t-1}$ does not Granger cause $LnSGP_{t,}$

    $F(1,30) = 62.86428$, Prob> F= 4.17 and;

    $Chi^2(31) = 139.20$, Pro> $Chi^2 = 43.77$

From the above tested hypotheses at 5% level of significance the computed F and Chi^2 statistics revealed that they exceed the critical value of both F and Chi^2. Therefore, null hypothesis was rejected due to the clear evidence that they exist a two way causality from SGP to SGC and from SGC to SGP.

The present study employed a relationship between the SGP and SGC in Tanzania using the annual data from 1977 to 2008. The empirical analysis using augmented Dickey Fuller unit root test revealed that the SGC and SGP were not stationary. On the basis of this the optimal lag order 1, I (1) was obtained from AIC, SBIC, LR, HQIC and FPE. The

lag (1) satisfied the principle of parameter parsimony in the VAR (1) model which used in the SUR estimation technique.

Finally the Granger causality infers that, there was a two way causality of the SGP to SGC and SGC to SGP in Tanzania but Tanzania will remain deficit in Sugar for years (Figure 1).

Results from Granger causality indicated that, sugar production in Tanzania influences its consumption in the same country as fact that, there is a high supply of sugar in the market which affects the changes of its price as a results high demand of sugar from the consumers. Assurance of sugar consumers attracts more sugar importers to participate in supplying sugar as raw material, this is may also be attributed by economic and population growth of the country.

4.0 PRESENTATION AND DISCUSSION OF THE FINDINGS

Descriptive Statistics

From 1977 to 2008 Tanzania industries produced an average of 142,347 tons of sugar annually while consumption stood at 189,830 indicating consumption shortfall of 33%, per capital sugar consumption in the country stands at 7kg per annum. The sugar industry in Tanzania provides direct employment to about 30,000 people and sugar cane out growers' a total about 16,768 acquired secondary employment. These sectors were involves a total of about 81,360 people (SBT, 2012).

The industry also creates substantial indirect employment to people engaged in the wholesale and retail trade in sugar, transport services providers, and people working in social services in the sugar estates townships. Moreover, it provides sugar cane farmers with total earnings of about Tshs 29.4 billion whose benefits spread toover 160,000 people. Sugar production plays a vital role in rural areas in the development and provision of social amenities including schools, hospitals, water supply, townships, and farm roads. (SBT, 2012)

Tanzania exported sugar to EU market under the ACP-EU preferential agreement with prices which are higher than average world market (Magongo, 2008, Garside, 2015). Therefore, there is a potential and reasons for expansion of the sugar industry, as more sugar is needed to meet the domestic consumption and opportunity to export to the neighboring countries. The descriptive statistics of the time series trends of sugar production and consumption is as shown in Figure 1. This study therefore intends to analyze the causality between the domestic production and consumption of sugar in Tanzania.
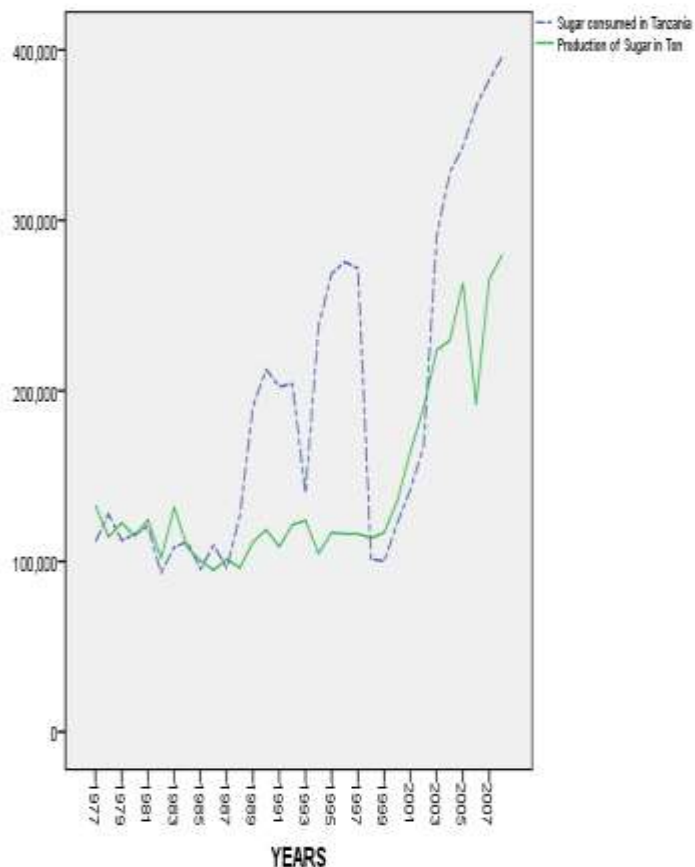
The trends shows that, between 1977 and 1986 domestic sugar production and consumption in Tanzania almost balanced, Sugar production remain almost the same while consumption dramatically increased in 1991 and 1996. From 2001 sugar production and consumption continue to skyrocket. In 2006 sugar production fell dramatically and rise 2007.

Figure 1: Trends of the Sugar Productions and Consumption in Tanzania

5.0 Conclusion and Policy Recommendation

The amount of sugar consumed in Tanzania and neighboring countries has great influence on the production of more sugars from industries and importing. The more is produced l the more the consumption. Henceforth, sugar industries in Tanzania has to produce more sugar so as to compete with the markets demands and price fluctuations caused by imported sugar, which further motives domestic consumption of sugar in the country. However this study suggests the following possible actions to be considered

(a) The country should spend large amount of money on expansion of local industries that could have income multiplier effect toward local sugarcane producers and thus stabilize the economy of the country both on per capita income and value for money, rather than spends much on importing sugar from abroad which have tremendous effects on economy of the country. Current

there is a growing deficit of 150,000 tons of sugar which could be produced locally to fill the gap.

(b) Furthermore, the government should intervene the importation tarrifs and duties for sugar which affects the local sugar industrial operational cost and thus fail compete with the price of sugar imported within the country, sugar should be imported at the time when demand is high and local industries should set price as per cost of productions and not to form a cartel that expands margins of profits while the final consumers in rural areas suffer.

(c) Moreover, more investors should be invited to invest on sugarcane production because the demand is still high and Tanzania is endowed with an area of 94.5 million hectares of arable land of which 44million are classified as suitable for agriculture, and there is a possibility of increasing of demand due to shortage of sweetener in other East African Community partner (Ministry of Agriculture, Garside 2015).

(d) The government should provide subsidy on farm inputs and production facility so as to lower the cost of sugarcane production to farmers. This will allow sugar produced by local industries to be sold at a competitive price with the imported sugar in the local markets. Moreover to stabilize local industries,

the government may impose heavy tax on sugar imports

Therefore the government should ensure sugar market value for the economic growth and improvement of rural livelihood because through fully utilization sugarcane offers production alternatives to food, such as feed, fiber and energy, particularly biofuels (sugar-based ethanol) and/or co-generation of electricity (Nyberg, 2015)

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Annex: Sugar Data Results from Economic Survey of Tanzania 2015

DDUCTION AND CONSUMPTION OF SUGAR

| | Sugar Cane | | | | Sugar | | |
| | | | | | | Consumed[3] | |
	Public ('000 Tons)	Private ('000 Tons)	Total ('000 Tons)	Price[2] (Shs/Ton)	Production Ton	Total Ton	Kg. per person[4]
1977/78	1008	116	1124	95.20	132979	111546	6.69
1978/79	1169	197	1366	96.20	114267	127712	7.42
1979/80	1180	210	1390	101.20	122530	112282	6.34
1980/81	854	193	1047	106.20	114667	115961	6.37
1981/82	1135	203	1338	137.30	124326	120629	6.44
1982/83	1090	113	1203	170.00	101996	93179	4.84
1983/84	1372	160	1532	238.00	131525	108369	5.48
1984/85	1148	105	1253	323.70	108102	111433	5.48
1985/86	1003	104	1107	352.30	100287	95379	4.56
1986/87	991	72	1063	463.00	94815	109462	5.09
1987/88	997	102	1099	600.00	101266	96271	4.35
1988/89	787	91	878	750.00	96227	126771	5.29
1989/90	963	98	1061	1748.45	111236	190750	5.47
1990/91	1068	116	1184	2525.90	118560	212585	5.93
1991/92	967	114	1081	3476.85	108480	202478	6.07
1992/93	1098	273	1371	5267.67	121414	204126	6.11
1993/94	1105	362	1467	6200.00	123949	139829	5.38
1994/95	914	370	1284	8600.00	104624	238424	5.38
1995/96	997	372	1369	8900.00	116810	268910	..
1996/97	951	347	1298	9500.00	116100	275700	5.54
1997/98	808	176	984	10500.00	116100	271790	5.70
1998/99	948	320	1268	12500.00	113622	101272	5.87
1999/00	907	341	1248	12500.00	116927	100127	6.70
2000/01	1050	284	1334	14000.00	135534	122534	10.00
2001/02	1134	389	1523	14700.00	164498	142396	10.10
2002/03	1402	411	1813	15000.00	190120	167300	10.42
2003/04	1672	670	2342	16800.00	223839	290711	10.90
2004/05	1594	752	2346	20568.00	229617	328005	10.90
2005/06	1545	956	2501	22383.00	263317	343292	12.00
2006/07	1430	611	2041	29000.00	192095	366708	12.00
2007/08	1967	799	2766	32767.00	265434	382518	13.00
2008/09	2056	693	2749	32770.51	279850	396113	13.40
2009/10	1972	598	2570	42046.00	263461	398070	13.68
2010/11	2357	661	3019	43865.00	304135	410259	12.00
2011/12	2036	680	2717	48833.00	262679	439307	12.00
Change (%) 10/11-11/12	-0.14	0.03	-0.10	0.11	-0.14	0.07	0.00
Increase (%) 77/78-11/12	1.02	4.86	1.42	506.62	0.96	2.94	0.79

Source: Tanzania Sugar Bord

1 Season is between July and June
2 Price is for sugar cane with 10.5% of Sucrose
3 Includes sugar transported to Zanzibar
4 For Tanzania mainland
.. Not available