Original Research Article

Growth and instability analysis of sugar exports from India

ABSTRACT

Aims: To work out growth trends and instability in export of sugar and jaggery from India
Place and Duration of Study: Department of Agricultural Economics, Junagadh Agricultural University (between June 2018 and July 2020).
Methodology: The present study focused on analyzing the growth and instability in sugar and jaggery export quantity, value and unit value as well for the period from 1996-97 to 2005-06. Exponential growth model and Cuddy-Della index used for growth and instability analysis, respectively.
Results: Results found that the export of sugar from India increased annually at the remarkable growth rate of 17.42, 23.44 and 5.13 per cent for quantity, value and unit value, respectively during 1996-97 to 2018-19. Besides, jaggery export also revealed similar trend. However, the export of sugar and jaggery remained highly unstable due to low productions in the scarcity years.
Conclusion: Sugar and jaggery export have vast potential for further expansion with improving quality as per the needs of importing countries. Jaggery is one of the most nutritive foods; its domestic consumption needs to be encouraged, which will help to boost sugarcane farm income.

Keywords: [Sugar, growth rate, instability analysis, jaggery, export}

1. INTRODUCTION

Sugarcane (*Saccharum officinarum L*.) occupies very prominent position on the agricultural map of India. It provides employment to over a million people directly or indirectly besides contributing significantly to the national exchequer. Modern sugarcane varieties that are cultivated for sugar production are complex interspecific hybrids between the species *Saccharum officinarum* and *S. spontaneum* with contributions from *S. robustum*, *S. barberi* and *S. sinensis*, and related grass genera such as Miscanthus, Erianthus and Narenga. The cultivated canes belongs to two main groups (a) thin, hardy North Indian types *S. barberi* and the Chinese *S. sinensis*, and (b) thick, juicy noble canes *S. officinarum*, which is highly priced cane cultivated in India because of high sugar content (DSD 2013).

Sugar industry is such an industry located in rural areas which provides opportunities for the uplifting of rural masses. Sugarcane and sugar beet are the two main crops which contribute approximately 80 and 20 per cent, respectively to the total sugar production in world. (CACP, 2018).On an average 275 lakh farmers engaged in sugarcane cultivation and around 5 lakh workers directly employed in sugar mills (Anon., 2019), having annual turnover of about one lakh crores. The sugar industry also plays a leading role in global market as India being the second largest producer and the largest consumer of sugar. The growth and instability analysis of sugar export from India as traded in international market, is of strategic importance to maintain stability in the domestic sugar prices despite the cyclicality in production. A closer look into the growth and instability analysis of sugar exports from India will help the policy makers to remove bottlenecks in the present policy framework and to develop an overall improved policy for reviving the state's agriculture.

2. MATERIAL AND METHODS

2.1 EXPONENTIAL GROWTH MODEL

The compound growth rate is obtained by fitting a straight line to the logarithms of the data and estimating the slope of the line (Acharya *et al.,* 2012). In the present study, the compound growth rate was calculated using the following formula.

Compound growth rate

The compound growth rates (CGRs) of sugar exports was calculated by using the exponential function of the following specification:

$$\mathbf{Y_t = ab^t u_t} \qquad \mathbf{(1)}$$

Where,

Y_t = Dependent variable(export quantity/ export value, of sugar and Jaggery in the year 't', *etc.*)

t = Time variable in years taking the value of 1, 2, 3,...,n

a = Intercept;

b = Regression coefficient (1+r)

r = Compound growth rate

u_t = Error term

For the purpose of estimation, the equation was expressed in logarithmic form.

$$\mathbf{Log\ Y_t = Log\ a + t\ log\ b + log\ e} \qquad \mathbf{(2)}$$

The value of log b in equation (2) was computed using the formula,

$$\mathbf{Log\ b} = \frac{(\sum \mathbf{t\ Log\ Y} - (\sum \mathbf{t}.\sum \mathbf{Log\ Y}\ /\mathbf{N}))}{\sum \mathbf{t^2} - \left(\frac{\sum \mathbf{t^2}}{\mathbf{N}}\right)} \qquad \mathbf{(3)}$$

Where,

N = Number of years.

Subsequently, the compound growth rate (%) was computed using the formulation,

Compound growth rate (r) = [(Antilog of log b) -1] *100 (4)

Student 't' test was used to determine the significance of the growth rates obtained for which the following formulation was employed,

$$\mathbf{t = Log\ b / SE\ (Log\ b)} \qquad \mathbf{(5)}$$

$$\mathbf{SE} = \sqrt{\frac{\sum(\mathbf{Y}-\bar{\mathbf{Y}})^2 - \mathbf{Log\ b} * (\sum(\mathbf{Y}*\mathbf{t}) - \sum(\mathbf{Y})*\bar{\mathbf{t}})}{(\mathbf{N}-\mathbf{2})\sum(\mathbf{t}-\bar{\mathbf{t}})^2}} \mathbf{(6)}$$

The calculated 't' values, from equation (5), was compared with the table't' values and the significance was tested at 1, 5 and 10 per centlevels.

2.2 INSTABILITY ANALYSIS

Instability is the one of the important decision parameter in development dynamics, more so in the context of agriculture production.

Cuddy-Della index is most commonly used measures of instability of time series data and is universally acceptable. The original formulation of the index is given as follows:

Instability index (Ix) = CV$\sqrt{(1-\bar{R}^2)}$

CV(%) = S/ $\bar{X}$ *100

Where,

Ix = Instability index;

CV = Coefficient of variation;

$\bar{R}^2$ = Coefficient of multiple determination;

$\bar{X}$ = Mean value;

S = Standard deviation.

3. RESULTS AND DISCUSSION

3.1 EXPORT-IMPORT SCENARIO:

Sugarcane as such is neither exported nor imported, however the sugar which is a main produce of sugarcane crop is exported and imported as per the Government policies. The total export of sugar during 2010-11 was17.34 lakh tonnes worth Rs. 5473 crores and import about 10.35 lakh tonnes valued to Rs. 2790 crores during the same year (Table 1).The domestic demand of sugar in India was rotating around 210 lakh tonnes annually in 2010-11, increased to around 260 lakh tonnes in 2018-19, whereas, the production of sugar estimated around 327.50 lakh tonnes.

India is 4th largest exporter of sugar and has the potential and advantage in export of sugar to sugar deficit countries in the Middle East and East Africa. India is by and large self-sufficient in sugar production to meet the domestic consumption demand. However, in the years of scarcity sugarcane production declined drastically due to lack of irrigations, which compel to import of sugar in India in next year. Except, the scarcity years, India earns sizable foreign revenue from sugar export.

Table 1: Export import earning balance of sugar in India

Year	Sugar export from India			Sugar import in India			Balance
	Quantity (000' tonnes)	Value (Rs. Crore)	Unit value (Rs/kg)	Quantity (000' tonnes)	Value (Rs. Crore)	Unit value (Rs/kg)	Value (Rs. Crore)
1995-96	434	597	13.75	151	216	14.33	381
2000-01	339	431	12.72	30.4	31	10.23	400
2005-06	321	569	17.72	558.8	652	11.66	- 83
2010-11	1734	5473	31.56	1035	2790	26.96	2683
2011-12	2749	8767	31.89	100	314	31.47	8453
2012-13	2794	8577	30.70	1122	3094	27.57	5482
2013-14	2478	7179	28.97	881	2287	25.96	4892
2014-15	1955	5329	27.25	1539	3668	23.84	1661

2015-16	3844	9825	25.56	1943	4038	20.78	5787
2016-17	2544	8660	34.04	2146	6869	32.80	1791
2017-18	1758	5226	29.73	2403	6036	25.12	- 810
2018-19	3988	9518	23.87	1491	3175	21.30	6343

Source: *DES, 2020.*

3.2 GROWTH RATES OF SUGAR AND JAGGERY EXPORT FROM INDIA

Results of Growth rates of sugar export (Quantity, value and unit value) presented in Table 2. In all periods the growth rates of sugar export quantity and export value were highly significant, *i.e.* significant at 1 per cent level. Besides, growth rates of sugar unit value were highly significant in Post-WTO period and overall period, but it noticed stagnant in Trans-WTO period. The estimated growth rate of sugar export quantity, export value and unit price results reveals that in overall period (1996-97 to 2018-19) the sugar export increased significantly at a remarkable rate of 17.42 per cent per annum. Besides, export value, too was increased at a very high rate of 23.44 per cent per annum. However, in comparison to quantity and value, the export unit value increased at a moderate rate of 5.13 per cent per annum. This indicates that from last two and half decades, *i.e.* after the establishment of WTO, India's sugar export has been accelerated. Adhikari and Sekhon (2014) reported similar results for basmati rice export from India during 1995-96 to 2012-13. Besides, Devi (2018) also noticed similar results for fresh mango and mango pulp export from India.

In Trans-WTO period, the sugar export and export value increased at the remarkable rate of 19.14 and 19.37 per cent per annum, respectively. But, in Trans-WTO period, unit value was increased non-significantly by the rate of 0.19 per cent per annum. The stagnant export unit value might be due to increased competition in this period as more countries have been involved in exports. Swaminathan *et al*. (2018) revealed similar results regarding marine products exports from India. In Trans-WTO period, the export unit prices of marine produced remained stable during world-wise competition. In case of maize export from India, Geetha and Srivastava (2018) also noticed similar results for export unit value of maize in Post-WTO period.

In Post-WTO period, the sugar export increased at the moderate rate of 7.31 per cent per annum. While, export value was increased at a high rate of 13.09 per cent per annum. However, in comparison to quantity and value, the export unit value was increased significantly at the moderate rate of 5.39 per cent per annum in Post-WTO period. This analysis of sugar export from India from last two and half decades revealed that India has vast potentiality for sugar export. Even in increased competition conditions, India's sugar export quantity increased considerably and unit value also improved sufficiently in recent years.

Table 2: Growth rates of sugar export from India

Periods	Sugar export	Quantity (000' tonnes)	Value (Rs. Crores)	Unit value (Rs./Kg)
Trans-WTO period (1996-97 to 2005-06)	**Mean**	595.4	700.5	13.1
	CGR (%)	19.14***	19.37***	0.19
	SE	1.81	1.72	0.17
Post-WTO period (2006-07 to 2018-19)	**Mean**	2580.8	6281.1	25.2
	CGR (%)	7.31***	13.09***	5.39***
	SE	1.20	1.12	0.28
Over all period (1996-97 to 2018-19)	**Mean**	1717.6	3854.8	20.2
	CGR (%)	17.42***	23.44***	5.13***
	SE	1.44	1.37	0.25

Note: *1. *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively.*
2. CGR – Compound Growth Rate and SE – Standard Error.

The estimated growth rate of jaggery export quantity, export value and unit price were presented in Table 3 reveals that in overall period (1996-97 to 2018-19), the jaggery export and export value increased significantly at a remarkable rate of 9.22 and 17.12 per cent per annum, respectively. However, the export unit value increased at a moderate rate (7.29 %).

Table 3: Growth rates of jaggery export from India

Periods	Jaggery export	Quantity (000' tonnes)	Value (Rs. Crores)	Unit value (Rs/kg)

Trans-WTO period (1996-97 to 2005-06)	**Mean**	151.8	205.8	16.2
	CGR (%)	10.10***	13.83***	3.38***
	SE	1.35	1.14	0.31
Post-WTO period (2006-07 to 2018-19)	**Mean**	652.2	1641.3	35.8
	CGR (%)	-11.15***	-0.68	11.78***
	SE	0.76	0.58	0.25
Over all period (1996-97 to 2018-19)	**Mean**	434.6	1017.1	27.3
	CGR (%)	9.22***	17.18***	7.29***
	SE	1.20	0.99	0.30

Note: *1. *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively.*
2. CGR – Compound Growth Rate and SE – Standard Error

In Trans-WTO period, quite similar results were found as in overall period. In Post-WTO period, the jaggery export decreased at the rate of -11.15 per cent per annum. Besides, export value was also decreased non-significantly, at rate of -0.68 per cent per annum. Whereas, unit value was increased at a very high rate of 11.78 per cent per annum in Post-WTO period. This indicates that due to poor monsoon in the years 2012-13, 2014-15 and 2015-16, the sugarcane production was decreased in the country. Which lead to low production of jaggery, ultimately resulted in low export. However, export demand was more as the export unit price was increased remarkably. This reveals that India has vast potentiality for jaggery export, too.

3.3 INSTABILITY OF SUGAR AND JAGGERY EXPORT FROM INDIA

Results of instability analysis of sugar and jaggery export (Quantity, value and unit value) have been presented in Table 4. During overall period *i. e.* from 1996-97 to 2018-19, high instability was recorded in case of export quantity of sugar (62.03%) and jaggery (134.74%), respectively. Similarly in case of export value of sugar and jaggery, high instability of 49.08 and 82.49 per cent were found, respectively. Whereas, sugar and jaggery export unit value indicated medium instability of about 24.46 per cent and 25.61 per cent, respectively. Gajavali (2019) also stated similar results for her study of growth and instability of castor oil export by India during the period of 1986-87 to 2017-18.

In Trans-WTO period, very high instability was recorded in case of export quantity of sugar and jaggery about 105.99 and 83.57 per cent, respectively. Whereas, sugar export value also showed high instability (95.58%) during Trans-WTO period. However, as compared to export quantity and export value, medium instability (17.12%) was reported in unit value of sugar in Trans-WTO period. In case of jaggery, export value (66.87%) and unit price (32.35%) also showed high instability during Trans-WTO period. But, as compared to export quantity and export value, unit value of jaggery was quite stable in Trans-WTO period. Adhikari and Sekhon (2014) also noticed similar very high instability in case of basmati rice export quantity and export value during Pre and Post-WTO period from 1980-81 to 2012-13. Besides, Adhikari *et al.* (2016) also reported similar results in case of rice export from India in Post-WTO period. In Post-WTO period, the quantity and value of sugar jaggery exported showed high instability. Whereas, medium (24.40%) and low instability (13.38%) was recorded in unit value of sugar and jaggery in Post-WTO period, respectively. Geetha and Srivastava (2018) found the similar results in their study of growth and instability of maize exports from India from the period 1981 to 2016. They also stated the reasons for high instability might be inconsistent domestic production, consumption and international demand.

Table 4: Instability of sugar and jaggery export from India

Particulars		**Sugar export**			**Jaggery export**		
		Quantity	**Value**	**Unit value**	**Quantity**	**Value**	**Unit value**
Trans-WTO period	**CV (%)**	104.52	95.47	16.10	79.79	66.05	33.44
	CDV (%)	105.99	95.58	17.12^	83.57	66.87	32.35
Post-WTO period	**CV (%)**	47.13	44.98	27.63	107.17	56.23	38.49
	CDV(%)	49.40	39.28	24.40	92.11	57.51^	13.38
Overall period	**CV (%)**	81.89	91.86	41.07	133.53	98.39	53.61
	CDV (%)	62.03	49.08	24.46	134.74	82.49	25.16

Note:*CV- Coefficient of Variation (%), CDV – Cuddy Della Valle Index (%), ^- Non* significant

4. CONCLUSION

As per the availability of the data the export performance and instability of sugar and jaggery from India were carried out from the year 1996-97 to 2018-19, which in turn, split into three periods *viz.,* trans-WTO Period-I (1996-97 to 2005-06), Post-WTO Period-II (2006-07 to 2018-19) and overall Period-III (1996-97 to 2018-19). The required data was collected from Directorate of Agriculture, Government of Gujarat, Gandhinagar, Department of Agricultural Economics, JAU, Junagadh and Directorate General of Commercial Intelligence and Statistics, Government of India, and other public sources. The compound growth rates were worked out for quantity, besides, value and unit value of sugar and jaggery export. For the estimation of instability in sugar and jaggery export, Cuddy Della Valle index for each period was calculated.

The results of growth rate of sugar export revealed that there were significantly higher growth rates in quantity and value of sugar exported from India during overall period(1996-97 to 2018-19). In Post WTO period, growth rates of sugar export quantity and value were decreased as compared to Trans-WTO period and overall period. The highest growth rate in unit value was recorded in Post-WTO period *i. e.,* 5.39 per cent. Whereas, in case sugar export value, the highest growth rate was recorded in overall period (1996-97 to 2018-19)about 23.44 per cent. The highest growth rate in export quantity was recorded in Trans-WTO period about 19.14 per cent per annum. Moreover, as compared to quantity and unit price, export value showed higher growth rate in all periods.

In case of Jaggery export, the highest growth rate in jaggery export quantity of about 10.10 percent was recorded in Trans-WTO period. Whereas, the highest growth rate in jaggery export value of about 17.18 per cent was recorded in overall period. Moreover, the highest growth rate in unit price of jaggery export was recorded during Post-WTO period. While, in Post-WTO Period, jaggery export quantity and value were decreasing at the rate of -11.15 and -0.68 per cent, respectively.

Instability analysis of sugar export revealed the highest instability in sugar export quantity and value of about 106 and 96 per cent in Trans-WTO period. Whereas, the highest instability in unit price was recorded in overall about 24.46 per cent. Sugar export quantity and value had shown high instability in all periods, whereas, unit value showed medium instability in all periods. In case of Instability analysis of jaggery export revealed that the highest instability in sugar export quantity and value of about 135 and 82.49 per cent recorded in overall period. Whereas, the highest instability in unit price was recorded in Trans-WTO period about 32.35 per cent. Jaggery export quantity and value had shown high instability in all periods, whereas, unit value showed medium instability in all periods except Trans-WTO period.

India achieved remarkable growth rate in export of sugar and jaggery and it has vast potential for further expansion with improving quality as per the needs of importing countries. Jaggery is one of the most nutritive foods; its domestic consumption needs to be encouraged, which will help to boost sugarcane farm income.

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