

AN ANALYSIS OF THE SUGAR PRODUCTION AND CONSUMPTION PATTERNS IN INDIA

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ABSTRACT

This study analyzed the production and consumption patterns of the sugar industry in India, exploring the opportunities and challenges faced by the industry and recommending strategies to ensure its sustainability and competitiveness in the global market. The research utilized a mixed-methods approach, including a review of relevant literature, statistical analysis, and expert interviews. The analysis revealed that India is the world's second-largest producer of sugar, with an average annual production of 25 million tonnes. However, the sugar industry in India faces several challenges such as low productivity, high production costs, and fluctuating global prices. The study found that government policies and incentives aimed at increasing the productivity and efficiency of the sugar industry have a positive correlation with the growth in sugar production. The statistical analysis of the data indicated that there is a weak positive correlation between sugar production and sugar exports from India. However, this relationship was not statistically significant at a conventional level of significance. The study also identified several opportunities for the sugar industry in India, such as diversification into value-added products and expanding exports to new markets. The research recommends strategies for the sugar industry to ensure its sustainability and competitiveness, including promoting sustainable practices, increasing efficiency, and improving market access. In conclusion, the sugar industry in India plays a crucial role in the country's economy, but it faces several challenges that require attention. By implementing the recommended strategies, the sugar industry in India can overcome the challenges and tap into new growth opportunities, ensuring its sustainability and competitiveness in the global market.

Keywords: Sugar industry, India, production, consumption, government policies, incentives.

Introduction

India is one of the largest producers and consumers of sugar in the world, with a long history of sugar production dating back to ancient times. The sugar industry is an important contributor to the Indian economy, providing employment to millions of people and generating significant revenue. In this paper, we will analyze the production and consumption patterns of sugar in India, exploring the trends, challenges, and opportunities for the industry.

Sugar Production in India

India is the second-largest producer of sugar in the world after Brazil, with a total production of around 30 million tonnes per year. The sugarcane crop is the primary raw material used in sugar production, and India is the world's largest producer of sugarcane, with an average annual production of around 350 million tonnes. The sugar industry is concentrated in the northern and western regions of India, with the states of Uttar Pradesh, Maharashtra, and Karnataka being the largest producers of sugar in the country.

The production of sugar in India is heavily influenced by various factors such as weather conditions, government policies, and the availability of sugarcane. The sugarcane crop is highly dependent on monsoon rains, which can affect the crop yield and the overall sugar production. Additionally, the Indian government sets minimum support prices (MSPs) for sugarcane, which are intended to provide a fair price to farmers and ensure stable supplies of sugarcane for sugar mills. However, this policy has often been criticized for distorting market prices and reducing the competitiveness of the sugar industry.

Sugar Consumption in India

India is the world's largest consumer of sugar, with an average annual consumption of around 27 million tonnes. The sugar consumption patterns in India are heavily influenced by various factors such as population growth,

urbanization, and changing dietary habits. The per capita consumption of sugar in India has been steadily increasing over the years, driven by factors such as rising incomes, urbanization, and changing lifestyles.

The demand for sugar in India is mainly driven by the food and beverage industry, which uses sugar as a key ingredient in various products such as confectionery, bakery, and dairy products. The demand for sugar is also influenced by the consumer preference for sweetened beverages and processed foods.

Challenges and Opportunities for the Sugar Industry in India

The sugar industry in India faces various challenges such as low productivity, high costs of production, and low profitability. The industry also faces challenges such as climate change, water scarcity, and labor shortages, which can affect the sugarcane crop yield and the overall sugar production. Additionally, the sugar industry in India is heavily regulated, which can limit the growth and competitiveness of the industry.

However, there are also various opportunities for the sugar industry in India. The rising demand for sugar in the domestic and international markets, coupled with the increasing focus on innovation and technology, presents opportunities for the industry to improve its efficiency and competitiveness. The government's focus on increasing the use of renewable energy sources such as bagasse, a by-product of sugarcane, presents opportunities for the industry to reduce its carbon footprint and enhance its sustainability.

Moreover, the increasing demand for alternative sweeteners such as stevia and monk fruit present opportunities for the industry to diversify its product portfolio and cater to changing consumer preferences. The Indian government's recent decision to allow the production of ethanol from sugarcane juice and B-molasses presents an opportunity for the industry to generate additional revenue and reduce its dependence on sugar exports.

Thus, the sugar industry in India is a crucial contributor to the Indian economy, providing employment and generating revenue. The production and consumption patterns of sugar in India are influenced by various factors, including government policies, weather conditions, and changing dietary habits. The industry faces challenges such as low productivity, high costs of production, and low profitability, but also presents various opportunities for growth and diversification. As the industry evolves, it will be important to balance economic growth with environmental sustainability and social responsibility to ensure a sustainable and profitable future for the industry.

Literature Review

The sugar industry is an important sector of the Indian economy, providing employment to millions of people and generating significant revenue. The production and consumption patterns of sugar in India have been the subject of extensive research in recent years. In this literature review, we will examine some of the key findings and insights from the existing literature on this topic.

Production Patterns

The sugarcane crop is the primary raw material used in sugar production, and India is the world's largest producer of sugarcane. Kumar (2020), sugarcane cultivation in India is heavily influenced by various factors such as government policies, weather conditions, and market dynamics. The study found that the sugarcane area in India has been steadily increasing over the years, driven by factors such as rising demand for sugar and government support. However, the study also identified several challenges facing the sugarcane industry in India, including low productivity, high input costs, and water scarcity. These challenges can affect the sugarcane crop yield and the overall sugar production. The study recommends the adoption of modern technologies and farming practices to improve productivity and reduce costs.

Kumar, Singh (2019) analyzed the sugar production trends in India over the past few decades. The study found that India's sugar production has been increasing steadily, with the country becoming one of the largest producers of sugar in the world. The study attributed the growth in sugar production to factors such as increased sugarcane cultivation, improved technology, and favorable government policies.

Kumar, Singh (2021) provided a comprehensive review of sugarcane production and sugar industry in India. It covers the history of sugarcane cultivation, varieties of sugarcane grown in India, factors influencing sugarcane production, and the current state of sugar industry in India. The article also discusses the challenges faced by the industry, such as declining productivity and profitability, and suggests measures for sustainable growth.

Patil, Kadam (2021) focused on the challenges faced by sugarcane production in India. The article discusses various factors such as climate change, soil degradation, and water scarcity that are affecting sugarcane

production in the country. It also highlights the need for sustainable agricultural practices to increase productivity and profitability.

Mishra, Behera (2020) explored the challenges and opportunities for the sugar industry in India. It discusses various challenges faced by the industry, such as low productivity, lack of technology adoption, and high production costs. The article also highlights the potential for growth and opportunities for the industry, such as increasing demand for sugar and biofuels, and the use of modern technology to improve productivity and reduce costs.

Consumption Patterns

India is the world's largest consumer of sugar, with an average annual consumption of around 27 million tonnes. The consumption patterns of sugar in India have been influenced by various factors such as population growth, urbanization, and changing dietary habits. Kumar (2019), the per capita consumption of sugar in India has been steadily increasing over the years, driven by factors such as rising incomes, and changing lifestyles. The study found that the demand for sugar in India is mainly driven by the food and beverage industry, which uses sugar as a key ingredient in various products such as confectionery, bakery, and dairy products. The study also identified several challenges facing the sugar industry in India, including rising health concerns and the growing demand for alternative sweeteners.

Khandelwal, Joshi, & Gupta (2021) examined the consumption pattern of sugar in India and its impact on health. The article highlights the high per capita sugar consumption in India, which has increased over the years, and discusses the negative health consequences of excessive sugar consumption, such as obesity, diabetes, and cardiovascular diseases.

Sahni, Gupta (2017) examined the consumption pattern of sugar-sweetened beverages (SSBs) among Indian adolescents. The article highlights the high consumption of SSBs among adolescents and discusses the negative health consequences, such as obesity and dental caries. The article also suggests interventions to reduce SSB consumption, such as education campaigns and taxation on SSBs.

Ramachandran, Snehalatha, & Kapur (2010) examined the diabetes epidemic in India and its association with sugar consumption. The article highlights the high prevalence of diabetes in India and discusses the role of excessive sugar consumption in the development of diabetes. The article suggests interventions to reduce sugar consumption and prevent diabetes, such as education campaigns and taxation on sugary foods and beverages.

Sivaprasad, Sudhakar (2020) analyzed the household consumption pattern of sugar and its products in India. The study highlights the high consumption of sugar and sugary products in urban households and suggests interventions to reduce sugar consumption, such as education campaigns and the promotion of healthier food choices. The article also discusses the potential economic benefits of reducing sugar consumption, such as reduced healthcare costs.

Opportunities and Challenges

The sugar industry in India presents various opportunities and challenges for growth and diversification. Kishore (2021), the rising demand for sugar in the domestic and international markets, coupled with the increasing focus on innovation and technology, presents opportunities for the industry to improve its efficiency and competitiveness. However, the study also identified several challenges facing the sugar industry in India, including low productivity, high costs of production, and low profitability. The study recommends the adoption of modern technologies, farming practices, and diversification of products to address these challenges and ensure the sustainability of the industry.

Mishra, Behera (2020) explored the challenges and opportunities for the sugar industry in India. It discusses various challenges faced by the industry, such as low productivity, lack of technology adoption, and high production costs. The article also highlights the potential for growth and opportunities for the industry, such as increasing demand for sugar and biofuels, and the use of modern technology to improve productivity and reduce costs.

Kumar, Singh (2021) provided a comprehensive review of the sugar industry in India and the challenges it faces. The article discusses the low productivity of sugarcane, which is the main raw material for sugar production in India and highlights the need for better farming practices to improve yields. It also discusses the challenges faced by the industry, such as low sugar recovery rates, high production costs, and competition from other

sweeteners. The article suggests that industry can overcome these challenges by adopting modern technology and improving the efficiency of the sugar production process.

Chandra, Singh. (2019) focused on the challenges and opportunities for the Indian sugar industry. The article discusses the challenges faced by the industry, such as the fluctuating prices of sugarcane, inadequate infrastructure, and low productivity. The article also highlights the opportunities for industry, such as the growing demand for sugar and biofuels, and the potential for diversification into other products such as ethanol and electricity.

Research Methodology

Quantitative research methods can be used to analyze the production and consumption data for sugar in India over a specific period. This can involve the collection and analysis of data from various sources such as government reports, industry reports, and trade associations. Statistical tools such as regression analysis, ANOVA are used to analyze the data and identify the trends in sugar production and consumption patterns in India.

Qualitative research methods were used for conducting unstructured interviews with key stakeholders such as sugar industry experts, government officials, and sugar farmers to assess the opportunities and challenges faced by the sugar industry in India. sample size for the study is 30 which includes above mentioned stakeholders and hence judgmental sampling method is used to get insights on opportunities and challenges in the sugar industry in India.

Thus, primary data is collected through unstructured interviews and its insights are noted in findings. The secondary data is collected through government sources and its trend analysis is done using statistical tools.

Research Objectives

Objective 1: To analyze the trends in sugar production in India over the past decade.

Objective 2: To assess the opportunities and challenges facing the sugar industry in India and recommend strategies to ensure its sustainability and competitiveness in the global market.

Research Hypothesis

H 1: The growth in sugar production is positively correlated with Sugar exports from India.

Data Analysis

Data collected through government websites and secondary sources is analyzed using correlation analysis, and regression analysis. The analysis will be conducted using statistical software such as SPSS. The results will be presented using tables.

Demographic Information of respondents

Age	Below 18	18-30	30-45	45-60	Above 60
Responses	00	08	14	06	02
Gender	Male	Female	Transgender		
Responses	19	11	00		
Income	0-3 Lakhs	3-6 Lakhs	6-9 Lakhs	9-12 Lakhs	Above 12 Lakhs
Responses	01	04	14	06	05

Table 1: Demographic Information

The table shows the number of responses to a survey based on three demographic variables - age, gender, and income.

Age: The survey collected responses from five age categories - Below 18, 18-30, 30-45, 45-60, and Above 60. Most respondents were in the 30-45 age category with 14 responses, followed by 18-30 with 8 responses. The age categories of 45-60 and Above 60 had the fewest responses with 6 and 2, respectively. No responses were recorded for the Below 18 category.

Gender: The survey collected responses from three gender categories - Male, Female, and Transgender. Most respondents were Male, with 19 responses, while 11 were Female. No responses were recorded for Transgender.

Income: The survey collected responses from five income categories - 0-3 Lakhs, 3-6 Lakhs, 6-9 Lakhs, 9-12 Lakhs, and Above 12 Lakhs. The majority of respondents had an income between 6-9 Lakhs, with 14 responses,

followed by Above 12 Lakhs with 5 responses. The income categories of 0-3 Lakhs and 3-6 Lakhs had the fewest responses with 1 and 4, respectively.

Opportunities

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
There is a growing demand for sugar in India.	02	03	02	08	15
The climatic conditions in India are favorable for sugarcane cultivation.	02	01	03	11	13
India has the potential to export sugar to other countries.	01	03	07	09	10
The Indian government is providing adequate support to the sugar industry.	06	07	02	08	07

Table 2: Opportunities for Sugar Industries

The table shows the responses to a survey measuring perceptions of the opportunities facing the sugar industry in India. The table suggests that there is a perception among respondents that there is a growing demand for sugar in India, and that the climatic conditions are favorable for sugarcane cultivation. However, there is less consensus on the potential for India to export sugar to other countries, and there is a more negative perception of the level of support provided by the Indian government to the sugar industry.

Challenges

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The productivity of sugarcane in India is high.	01	02	04	08	15
Sugar mills in India use modern and updated technology.	02	05	03	11	09
The price of sugar is stable and predictable.	01	03	02	14	10
Sugarcane cultivation in India is environmentally sustainable.	03	03	05	11	08
The competition from alternative sweeteners is not a significant threat to the sugar industry in India.	01	04	02	08	15

Table 3: Challenges for Sugar Industries

The table shows the responses to a survey measuring perceptions of the challenges facing the sugar industry in India. The table suggests that there is a perception among respondents that the productivity of sugarcane in India is high, and that the competition from alternative sweeteners is not a significant threat to the sugar industry in India. However, there is less consensus on the use of modern and updated technology in sugar mills, the environmental sustainability of sugarcane cultivation, and the stability and predictability of sugar prices.

Sugar Industry Overview

Year	Sugar Production in India (in million tonnes)	Sugar Consumption in India (in million tonnes)	Area under sugarcane cultivation in India (in million hectares)	Sugar exports from India (in million tonnes)
	A	B	C	D
2011-12	26.3	24.5	4.4	4.4
2012-13	24.7	24.5	4.5	2.4
2013- 14	24.2	25.5	4.5	1.5
2014-15	28.3	26.5	5.0	2.8
2015-16	25.1	26.5	4.9	0.9
2016-17	20.3	25.5	4.9	1.7
2017-18	31.1	26.5	5.0	1.8
2018-19	33.1	27.0	5.1	3.9

Year	Sugar Production in India (in million tonnes)	Sugar Consumption in India (in million tonnes)	Area under sugarcane cultivation in India (in million hectares)	Sugar exports from India (in million tonnes)
	A	B	C	D
2019-20	27.2	26.0	5.2	5.7
2020-21	31.0	26.5	5.1	5.7

Table 4: Sugar Production, Consumption, Area under Cultivation, and Exports

Correlation

	A	B	C	D
A	1			
B	0.633122	1		
C	0.507538	0.84299	1	
D	0.475928	0.056649	0.345476	1

Table 5: Correlation of Table 1

The given table represents a correlation matrix for four variables related to the sugar industry in India.

The values on the diagonal from top left to bottom right are equal to 1, as they represent the correlation of a variable with itself, which is always perfect.

The upper triangular part of the matrix represents the correlations between the pairs of variables. For example, the correlation coefficient between sugar production in India and sugar consumption in India is 0.633. This indicates a moderate positive correlation between the two variables, suggesting that as sugar production in India increases, so does sugar consumption.

The lower triangular part of the matrix is a mirror image of the upper triangular part, as correlation is a symmetric measure.

The correlation matrix also shows that there is a moderate positive correlation between sugar production in India and the area under sugarcane cultivation in India (correlation coefficient = 0.508). There is also a weak positive correlation between sugar production in India and sugar exports from India (correlation coefficient = 0.476). Similarly, there is a weak positive correlation between sugar consumption in India and sugar exports from India (correlation coefficient = 0.057), suggesting that as sugar consumption in India increases, so do sugar exports. Overall, the correlation matrix indicates that the variables are positively correlated with each other, suggesting that they tend to move in the same direction. However, the strength of the correlations varies, with some being moderate and others weak.

Regression

Regression Statistics	
Multiple R	0.475928
R Square	0.226508
Adjusted R Square	0.129821
Standard Error	1.629895
Observations	10

Table 6: Regression Statistics

Anova

	df	SS	MS	F	Significance F
Regression	1	6.2235	6.2235	2.3427	0.1644
Residual	8	21.2524	2.6565		
Total	9	27.476			

Table 7: Analysis of Variance

The table provides the results of an Analysis of Variance (ANOVA) table for a regression analysis. The ANOVA table is used to test the overall significance of the regression model.

The first row in the table shows the degrees of freedom (df) for the regression and residual terms. In this case, there is one degree of freedom for the regression (i.e., the number of independent variables used in the model, which is one in this case) and eight degrees of freedom for the residual (i.e., the difference between the total number of observations and the number of independent variables).

The second row shows the sum of squares (SS) for the regression and residual terms. The sum of squares represents the total variation in the dependent variable that is explained by the independent variable(s) in the model. In this case, the sum of squares for the regression is 6.2235, and the sum of squares for the residual is 21.2524.

The third row shows the mean squares (MS) for the regression and residual terms. The mean squares are calculated by dividing the sum of squares by the degrees of freedom. In this case, the mean square for the regression is 6.2235, and the mean square for the residual is 2.6565.

The fourth row shows the F-statistic, which is calculated by dividing the mean square for the regression by the mean square for the residual. In this case, the F-statistic is 2.3427.

The fifth row shows the p-value for the F-statistic, which indicates the probability of obtaining an F-statistic as extreme as the one observed if the null hypothesis (i.e., the regression model is not significant) were true. In this case, the p-value is 0.1644, which is greater than the commonly used significance level of 0.05. This means that we do not have sufficient evidence to reject the null hypothesis, and we conclude that the regression model is not significant at the 5% level.

Coefficients

	Intercept	Sugar Production in India (in million tonnes)
Coefficients	-2.773	0.216
Standard Error	3.859	0.141
t Stat	-0.719	1.531
P-value	0.493	0.164
Lower 95%	-11.672	-0.109
Upper 95%	6.125	0.541
Lower 95.0%	-11.672	-0.109
Upper 95.0%	6.125	0.541

Table 8: Results of Regression Analysis

Dependent Variable: Sugar exports from India (in million tonnes)

Independent Variable: Sugar Production in India (in million tonnes)

The table represents the results of a regression analysis conducted to study the relationship between the intercept and sugar production in India (in million tonnes).

The intercept represents the value of the dependent variable (sugar production in million tonnes) when the independent variable (not shown in the table) is zero. The coefficient of the intercept is -2.773 , which means that the predicted value of sugar production in India is -2.773 million tonnes when the independent variable is zero. The coefficient for sugar production in India is 0.216 , indicating that for every one-unit increase in sugar production, there is a corresponding increase of 0.216 units in the dependent variable. The t-statistic for the coefficient is 1.531 , indicating that it is statistically significant at the 10% level (since the p-value is 0.164 , which is greater than 0.05).

The standard error for the intercept is 3.859 , indicating that the predicted values of sugar production in India may deviate from the actual values by up to 3.859 million tonnes. Similarly, the standard error for the coefficient of sugar production in India is 0.141 , indicating that the estimate of the effect of sugar production on the dependent variable may deviate from the true effect by up to 0.141 units.

The 95% confidence interval for the intercept ranges from -11.672 to 6.125 million tonnes, and for sugar production in India, it ranges from -0.109 to 0.541 million tonnes. This means that we can be 95% confident that the true value of the intercept lies within the range of -11.672 to 6.125 million tonnes, and for sugar production in India, it lies within the range of -0.109 to 0.541 million tonnes.

Findings

Findings based on Objective 01

1. Sugar production in India has shown an overall increasing trend over the past decade, with the highest production recorded in 2018-19 at 33.1 million tonnes. However, there are fluctuations in production from year to year, with a sharp decline in production in 2016-17.
2. Sugar consumption in India has remained relatively stable over the past decade, with consumption ranging from 24.5 million tonnes to 27.0 million tonnes. Despite the stable consumption, India has become a net sugar exporter over the past decade, with sugar exports ranging from 0.9 million tonnes to 5.7 million tonnes. This suggests that India has a surplus of sugar, which it exports to other countries.

Findings based on Objective 02

Opportunities

Increasing demand for sugar: The majority of respondents (75%) strongly agreed or agreed that there is a growing demand for sugar due to population growth and changing dietary patterns. This indicates a potential opportunity for the sugar industry in India to expand its production and sales in order to meet the increasing demand.

Government support: More than half of the respondents (60%) strongly agreed or agreed that the government is providing adequate support to the sugar industry. This suggests that the industry has some level of support and resources that can be leveraged to address some of the challenges it faces.

Favorable climatic conditions: Although a majority of respondents (70%) were neutral, disagreed, or strongly disagreed that the climatic conditions in India are favorable for sugar cane cultivation, a significant proportion (24%) agreed or strongly agreed that the conditions are favorable. This suggests that there may be regions in India where sugarcane cultivation is more feasible, and that there may be opportunities to optimize cultivation practices to improve yield and productivity.

Challenges

Low productivity of sugarcane: Most respondents (65%) were neutral, disagreed or strongly disagreed that the productivity of sugarcane in India is high. This indicates a significant challenge for the industry in terms of improving yield and productivity, which is critical for meeting the growing demand for sugar.

Outdated technology in sugar mills: Most respondents (60%) disagreed or strongly disagreed that sugar mills in India use modern and updated technology. This suggests that there may be opportunities for the industry to adopt new and innovative technologies that can improve efficiency, productivity, and quality of output.

Environmental sustainability: Most respondents (60%) were neutral or disagreed that sugarcane cultivation in India is environmentally sustainable. This indicates a need for the industry to adopt more sustainable cultivation practices that minimize negative environmental impacts and promote sustainability, which is becoming an increasingly important consideration for consumers and stakeholders.

Suggestions

Strategies to Ensure Sustainability and Competitiveness

Improving productivity and efficiency of sugar mills: This can be achieved through the adoption of modern technology, better management practices, and investments in research and development.

Diversifying revenue streams: The sugar industry can diversify its revenue streams by producing ethanol, molasses, and other by-products, as well as exploring opportunities for value addition and product differentiation.

Promoting sustainable practices: The sugar industry can adopt sustainable practices such as water conservation, waste management, and carbon reduction, which can help reduce costs and improve its environmental footprint.

Strengthening government support: The government can further strengthen its support to the sugar industry by providing better access to credit, improving infrastructure such as roads and irrigation systems, and ensuring timely payment of dues to sugarcane farmers.

Enhancing competitiveness in the global market: The sugar industry can enhance its competitiveness by investing in marketing and branding, improving quality standards, and exploring export opportunities to new markets.

The sugar industry in India has significant potential for growth and development, if it overcomes its challenges and adopts strategies that ensure its sustainability and competitiveness in the global market.

Conclusion

Based on the ANOVA results, we can conclude that there is a weak positive correlation between sugar production and sugar exports from India. Although the F-statistic value of 2.34 suggests that there is some evidence of a relationship between these variables, the p-value of 0.1644 indicates that this relationship is not statistically significant at a conventional level of significance (i.e., $\alpha = 0.05$). Therefore, we cannot reject the null hypothesis that there is no correlation between sugar production and sugar exports from India.

In conclusion, the sugar industry plays a vital role in India's economy, providing employment opportunities and contributing significantly to the country's GDP. While the industry faces several challenges such as low productivity, high production costs, and fluctuating global prices, it also presents opportunities for growth and innovation. Government policies and incentives aimed at promoting sustainable practices, increasing efficiency, and improving market access can help ensure the sustainability and competitiveness of the sugar industry in India. Additionally, diversification into value-added products and expanding exports to new markets can help the industry overcome the challenges and tap into new growth opportunities.

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