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CONTENTS

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INTRODUCTION

REVIEW OF LITERATURE

NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

ACKNOWLEDGMENTS

REFERENCES

APPENDIX/ANNEXURE

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- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

UNPUBLISHED DISSERTATIONS AND THESES

- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

ONLINE RESOURCES

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WEBSITES

- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

A PENTAGON PERFORMANCE SCENARIO OF SUGAR SECTOR IN INDIA

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ABSTRACT

Sugarcane is cultivated in 127 countries in the world. Sugar industry is the second largest organised agro based industry in India. India ranks first with regard to the sugarcane cultivation area followed by Brazil. India is the second largest sugar producer in the world after Brazil, having a share of over 15 percent of the world's sugar production. So far no research was undertaken to make an analytical study of key factors at national level. The key factors like Crushing Capacity of Sugar Mills, Quantum of Cane Crushed, Quantum of Sugar Produced, Rate of Sugar Recovery and Quantum of Molasses Production of entire Indian sugar sector were studied, analysed and compared in this research work. This research is mainly focused on number of sugar mills fall under various slabs of key factors.

KEYWORDS
Crushing, Mills, Molasses, Sugar, Recovery.

INTRODUCTION

After textile industry, sugar industry is the second largest organized agro based industry in India. Reference of sugar and its products are available in Vedas and epics (the oldest written scripts available in India), indicating that the sugar was known to Hindus earlier than to any other race. ***Ikshu*** the term of sugarcane was found in ***Atharva Veda,*** which shows that the Aryans knew the sugar plant. In olden days, the forms of sugar products such as ***Khanda*** (Solid *jaggery*) and ***Sarkara*** (sugar) were used as medicinal compound.

HISTORICAL BACKGROUND

History has shown ample evidences of colonial rulers who had put their maximum efforts to acquire and control the production and distribution of sweetness. The East Indian Company started its venture by setting up of sugar mills at Surat, Arangaon and Machlipatanam in 1640. In 1906 there were 8 sugar mills with a total manpower of 1205 laborers. In 1921, the number of sugar mills increased to 16 and gave employment opportunities to 3348 workers. During 1935-36 there were 137 sugar mills in India and in a decade (1945-46) number shot up to 172 working sugar mills in India.

GLOBAL SUGAR SCENARIO

Sugarcane is cultivated in 127 countries in the world. Most of them are situated in between 35°S and 35°N of the Equator with altitudes ranging from sea level above 700 metres. The major sugar producers are Brazil, Argentina, Peru and Mexico. The highest sugar recovery recorded in Australia. In Asia, the major sugarcane producing countries are India, Indonesia, Philippine and China. During 1994 to 2003 the world sugar production increased by 25 percent. Some of the western countries produce beet sugar. The ratio between cane sugar and beet sugar is 76:24.

INDIAN SUGAR SCENARIO

India is the second largest sugar producer in the world after Brazil, having a share of over 15 percent of the world's sugar production and so far as the area under sugarcane cultivation is concerned, India stands first. In India, sugarcane is cultivated in 4.076 million hectors of land and today, India is not only self-sufficient but also capable to export to the tune of more than 0.81 million MT per annum to more than 38 countries. The countries like Pakistan, Bangladesh and Sri-Lanka are bulk our buyers. Normally, the crushing season beings in Indian from October to May and season prolongs for on an average 120 to 150 days.
There were 553 registered sugar mills in the country but many of them already lost their entity (as on 30th September 2003), unfortunately 496 mills are functioning. The Co-operative sugar sector was looking after 296 factories, 166 mills were in the hands of private people and the rest 34 sugar companies were in the public sector. There were 143 mills in India's sugar bowl, Maharashtra state followed by Uttar Pradesh, 129 mills. The sugar sector generated employment for 40 million farmers in the fields and 0.5 million in factories. Today, Indian farmers are capable to produce a mass quantum of more than 300 million MT of sugarcane per year.

REVIEW OF LITERATURE

In order to support the research process and to understand the research gaps in the chosen research problems, several research articles and sugar India year books were reviewed.
i) ***D.K. Pant*** *et al* (2005), examined various process and also made an attempt to explain the efficient manner of By-products utilization.
ii) ***Ram Vichar Sinha*** (1998) studied the problems of cane marketing and transport, utilization of By-products and policies on sugar economy.
iii) ***S. Pruthi*** (1995) studied the history of sugar, sugar making in ancient and medieval India, during British period and after independence till 1992.

NEED/IMPORTANCE OF THE STUDY

It is observed that all referred studies emphasised either a particular problem of a sugar mill or comparative studies in nature. So far no research was undertaken to make an analytical study of key factors at national level. The key factors like Crushing Capacity of Sugar Mills, Quantum of Cane Crushed, Quantum of Sugars Produced, Rate of Sugar Recovery and Quantum of Molasses Production of entire Indian sugar sector with reference to number of factories agglomerated at different slabs were studied, analysed and compared in this research work.

STATEMENT OF THE PROBLEM

Agriculture has continued to be the backbone of Indian economy and it contributes about 29 percent to GDP. The co-operative sugar sector has accounted a lion's share in terms of the total number of sugar factories as well as the quantum of sugar production in India. The annual sugarcane price paid to the cultivators by the sugar mills amounts to Rs.135,000 millions per year. The annual turnover of the Sugar Sector amounts to Rs. 250,000 millions. The Central Excise Department gets an income of Rs.15,000 millions and the State Governments receive Rs. 10,000 million in the form of various cess. Looking at the significance importance the sugar sector it is the need of the hour is to study the performances of key factors by taking into considering entire India with reference to their concentration at different points.

OBJECTIVES

i) To analyse the Crushing Capacity of Sugar Factories in India.

ii) To study the Quantum of Cane Crushed during the study period.
iii) To study the Quantum of Sugar Produced during the study period.
iv) To analyse the Rate of Sugar Recovery in India.
v) To analyse the Quantum of Molasses Production.

RESEARCH METHODOLOGY

The study is based on **secondary data** published in "SUGAR INDIA" yearbooks of 2005, 2009 and 2011 and Co-operative Sugar Journals; covers performances of five different areas in three sugar seasons in India. The quantum of data includes three years statistical records of 544 factories in **five areas *viz.*, crushing capacity, cane crushed, sugar production, sugar recovery and molasses production.** The sample size covers all 544 sugar mills (cent percent) of entire India during the study period (three financial years 2007-08, 2008-09 and 2009-10), which includes Co-operative factories, Private and Public sector sugar companies. Tabulation analysis is used as tool.

LIMITATIONS OF STUDY

i) Study base on the data published in various sugar yearbooks and sugar journals. The conclusion drown also entirely depends upon the data published in the books and journals.
ii) The conclusion derived from the findings may not be applicable in any other years since the performance of sugar factory may differ from year to year.

RESULTS AND DISCUSSION

I) CRUSHING CAPACITY OF SUGAR MILLS IN INDIA

Crushing Capacity of a sugar factory plays a very important role in the jurisdiction where it is established. The capacity is decided based on the quantity availability of sugarcane at present and in future within the area specified for the sugar factory. In India, the crushing capacity of sugar mills varies from 500 Metrics Ton Per Day (MTPD) to 18,000 MTPD. The available data have been classified into 54 slabs which are based on convenient MTPD capacity installed by the promoters in their respective areas. The tabulated data exposed the following pictures.
(i) The installed crushing capacity of Indian sugar mills observed to have varied from 500 MTPD to 18,000 MTPD.
(ii) Many factories observed to have increased their crushing capacity during the study period from 2007 to 2009 and none of them reduced their crushing capacity.
(iii) About 25 present (165 Mills) of the factories have installed 2,500 MTPD, about 10 percent (44 Mills) have are venturing with 3,500 MTPD capacity, 5 percent (24 Mills) have installed 4,000 MTPD, 9 percent of them (40 Mills) observed to have installed 5,000 MTPD capacity and the rest fall under other slabs.
(iv) Mills who have installed over and above 10,000 MTPD were either in private sector or were public limited companies and none of them in cooperative sector.
(v) The companies who have significantly larger crushing capacity are Bajaj Hindustan Ltd., 12,000 MTPD (Central UP), Balarampur Chini Mills Ltd., 15,000 MTPD (East UP), Bajaj Hindustan Sugar & Industries Ltd., 16,000 MTPD (East UP), Triveni Enginering & Industries Ltd., (West UP) and Renuka Sugar Ltd., Karnataka.
(vi) The mills which have less than 1,250 MTPD capacities were observed to have not performed well because of the increased cost of production due to small scale operation.

II) QUANTUM OF CANE CRUSHED

In India, the quantum of cane supply depends upon three major factors: **(a) Monsoon Factors** - the destiny of farmers and agro-based industries purely depends upon the mercy of monsoon in India. The sugarcane crop depends upon timely and sufficient rainfall, required amount of moisture and absence of the pests and diseases; **(b) Price of Substitutes** - in India, *Gur* and *Khandsari* units are still major source of sweeteners especially in rural India. About 60 to 65 percent of sugarcane produced in the country is utilised for sugar manufacturing, about 21 to 28 percent is utilised for the manufacturing of *Gur* and *Khandsari* and the balance of 11 to 12 percent goes to feeding, chewing, seeding and other uses; and **(c) Statutory Minimum Price** - the Statutory Minimum Price (SMP) is the price fixed by the Central Government below that no sugar factory is allowed to buy sugarcane from the cane growers. Every year the Central Government announces SMP (based on minimum 8.5 percent recovery rate) for sugarcane by notification in the month of September or October, which is to be essentially paid to the sugarcane growers by the sugar mills.
The quantum of cane crushed by the Indian sugar factories have been classified into 39 convenient widths viz., less than 59,999 MT; 60,000 MT to 1,00,000 MT [Lac Metric Ton (LMT)], 1 LMT LMT to1,59,000 LMT; and so on till 19.59 LMT. The tabulated analysis told the following truths.
(i) On an average data indicates that in 2007-08, larger number of the factories observed to have crushed less than 59,000 MT. It may be because of failure of sugarcane production during 2007-08 and later on (2008-09), the situation observed to have improved in quantity crushed indicated bumper crop season and again a fall in 2009-10.
(ii) About 140 mills observed to have sugarcane crushed less than 1.59 LMT during 2009-10.
(iii) Up to 7.59 LMT one can see double digit factories and later on a few factories observed to have crushed more than 7.59 LMT but very surprisingly shifting in crushing quantity is observed varying from year to year, which is an impact of good rain in a particular state or states.
(iv) Following are the new companies, which have crushed more than 15 LMT viz., The Ugar Sugar Karkhana Ltd., Karnataka [>15.6 LMT]; Balrampur Chini Mills Ltd., UP [>16.2 LMT]; Shree Khenvata Sahakari Chand Udyog Mandily Ltd., Gujarat [>16.6 LMT]; Haryana Saraswati Sugar Mills Ltd., [>17 LMT] and Godavari Bio-refinery Ltd., Karnataka [>17.6 LMT]
(v) One company Shree Khedavati Sahakari Khan Udyog Mandily Ltd., South Gujarat observed to have crushed more than 19 LMT during 2007-08 and 2009-10 but could not achieve the target in 2008 [>16.6 LMT].

III) QUANTUM OF SUGAR PRODUCED

Every sugar mill proudly says its performance in terms of white crystallised sugar production. This parameter of performance is accepted universally, however, production performance of any sugar factory totally depends upon the other two variables *viz*., quantum of sugarcane crushed and recovery rate.
In order to analyse the white crystal sugar production performance of the mills during the study period, the data relating to the sugar production have been put in conveniently made 44 slabs *viz.*, less than 0.59 (Lac Quintals) LQS to 0.60 to 1.00 LQS and so on up to 21.60 to 22.00 LQS. The consolidated data analysis revealed the following facts.
(i) The trends of sugarcane production are directly and proportionately move with sugar production since both are interdependent.
(ii) The impact of good and bad rain were clearly visible in the form of bumper and average production of sugar, as stated in the sugarcane production i.e. low production in 2007-09 and an average production in 2009-10.
(iii) Larger number of factories (average) fall under the categories of less than 0.59 LQS, in between 0.69 to 1.00 LQS and 1.01 to 01.59 LQS which indicate larger number of sugar factories in India smaller in size.
(iv) Quantum of production of sugar by the factories significantly varied from one year to another and also observed that the number of factories agglomerated under a particulars slab during the study period shows very large differences.
(v) The factories, which achieved the production target of 13.00 LQS during the 2009-10, could not do best during 2007-08 and 2008-09.
(vi) Major factories, which achieved the target above 17.00 LQS of sugar production were Bannari Ammar Sugar Ltd., Karantaka (2007-08); Sahakari Khand Udyog Mandli Ltd.,Gujarat (2008-07); the Godavari; Bio-refineries Ltd., Gujarat (2009-10); Sheer Khedut Sahakari Khand Udyog Mandli Ltd.,Gujarat (2007-08) and the Godavari Bio-refineries Ltd., (2007-08) Karnataka.

IV) RATE OF SUGAR RECOVERY

Rate of recovery is another important parameter indicates the degree of production performance. The rate of recovery is nothing but the percentage of sugar content extracted from sugarcane. The sugar content in cane differs from region to region and from time to time. The sugar content in sugarcane does not have any correlation with the yield per hectare. High degree of sugar contents fetches a high rate of white crystal sugar return. The input of sugarcane and output of sugar production is measured in term of percentage i.e. **Rate of Recovery**.

The degree of sugar contents in sugarcane depends upon the quality of soil, sugarcane variety and seed, impact of monsoon, pesticides and fertilisers used and cropping pattern. The rate of recovery depends upon percentage of sugar content in cane and also depends upon the efficiency of men and machines in the factory.

No sugar factory can extract cent percent sugar content from sugarcane. A small amount of sugar content goes as normal process loss. After making numerous researches in the sugar extraction methods and processes, the researchers fixed up an allowable maximum normal loss. If any sugar unit maintains its normal loss within the allowable normal losses, such sugar mills are considered as highly efficient mills. The rate of normal loss indicates the degree of efficiency of men and machines in sugar mills.

It is noticed that there is a loss of sugar at all stages right from harvesting to final product, which is a serious economic problem of sugar industry. It is also observed that the overall loss of sugar contents from the point of pre-harvest to till the point of bagging is estimated in between 5 percent to 35 percent.

The quantum of loss depends upon the degree of geographical and technical factors affecting the sugarcane cultivation, transportation and production processes. The **sugar losses** in the sugarcane process have been classified into **(a) Known Losses (Bagasse loss, Filter cake loss and Molasses loss)** and (b) **Unknown Losses or Undetermined Losses,** which cannot be determined directly.

If a factory wants to get higher recovery rate, the material manager must see that the cane must reach the factory premises within eight hours after cutting from the fields. If it is not possible within specified period, the cane juices get converted into fructose rather than sugar and get mixed with molasses.

In order to find out how many mills agglomerated in a particular range, the rate of recovery slabs have been fixed from less than 7.00 to 7.50 and so on by keeping a width of 0.50 percent.

As it is stated, in India Average Recovery Rate (ARR) varies in between 9.50 to 10.00 percent. India achieved a record recovery of 10.48 percent during 1930-31 otherwise most of the time the recovery rate was in between 9.00 to 10.00 percent. With this background, the tabulated data have been analysed and found the following facts.

(i) On an average about 8 factories have shown very poor recovery (Less than 7.00 %) during the study period. It may be due to poor quality of sugarcane, delay in crushing.

(ii) An increasing trend in number of factories is observed from 2009-08 to 2009-10 towards the 11.50 percent recovery.

(iii) About 10 percent of factories fallen under the category of 8.10 to 8.50 percent recovery; about 15 percent of factories fallen under 8.15 to 9.00 percent and about 20 percent of the mills fallen under 9.10 to 9.50 percent category.

(iv) About 15 percent each of the mills fallen under 9.15 to 10.00 percent and 10.10 to 10.50 percent category and just 10 percent each of the mills observed to have fallen under 10.51 to 11.00 percent category; rest above 11.00 percent.

(v) As many as 23 mills have crossed the remarkable recovery rate of 12.51 percent during 2007-08 as compared to 7 mills in 2008-09 and 8 mills in 2009-10.

(vi) About 150 factories observed to have crossed healthy bench mark of 10.00 percent recovery rate during 2009-10.

V) QUANTUM OF MOLASSES PRODUCTION

The by-products of the sugar industries are Bagasses (36%-35%) molasses (4%-5%), press mud (2%-4%) leaves and tops (25%-35%) and boiler ash (0.3%). The cost of sugar continues to be high due to the neglect of the profitable utilisation of the by-products. If the by-products are used the cost of production of the sugar may go down by about 20 percent. The development of sugarcane by-products industries and their ancillaries may push up the profitability of the sugar industry.

The countries like Australia, Brazil, Cuba, Philippines, South Africa and Taiwan have developed numerous industries utilising the by-products. Some of these countries produce alcohol as main product and sugar as by product.

In India, only the factories having 3,500 MT and above capacity, convert their molasses in to sprit, since it is commercially viable to invest in sprit production plants. The bagasses are used to produce electricity. About 50 percent of units produce electricity to fulfill mills requirement when they are in operation.

Molasses is one of the by-products comes out in the form of semi-liquid used to prepare alcohol / ethanol / spirit. Many sugar factories, which have installed 3,500 MTPD and more, get large amount of molasses and have installed ethanol distillation units. The inefficient material management also leads to the production of larger amount of molasses rather than sugar. These units produce spirit product soon after the sugar production season, and keep their labour force in action. Otherwise generally, sugar seasons, get over in between 90-160 days in a year.

In order to find out how many mills agglomerated in a particular range, the ranges of quantum of molasses production have been classified into 18 slabs from less than 0.59 Lac Quintals (LQS), to 0.60 LQS and so on by keeping a width of 0.50 LQS. The analytical study revealed the following facts.

(i) Number of units observed to have increased from 2007-08 to 2008-09 and 2008-09 to 2009-10. An upward trend is clearly visible due to the increase in cane yield year to year.

(ii) More than 50 percent of the factories observed to have produced less than 3.00 Lac Quintals (LQS) of molasses per season.

(iii) The factories which accumulated more than 2.00 LQS molasses have installed distillation units in their factory premises instead of selling molasses to outsiders, who have spirit production units.

FINDINGS

I. CRUSHING CAPACITY

(i) Increasing of crushing capacity from lower level to higher level is observed during study period and not vice versa.

(ii) Many (25%) factories observed to have opted 2,500 MTPD crushing capacity and 10 percent each have installed 3,500 MTPD and 5,000 MTPD.

(iii) Most of the factories who have crushing capacity over and above 10,000 MTPD were either of private sector mills or of public sector mills.

(iv) Crushing capacity depends upon the cane availability within the jurisdiction of the factories.

II. CANE CRUSHED

(i) Larger number of sugar factories observed to have crushed less than 0.60 LMT during 2007-08, which was due to cane crop failure because of rain failure in that year.

(ii) Indian sugar production is fully depends upon the quality and quantity of rainfall except irrigated areas, which is also depends upon rain fall.

(iii) Constant supply of sugarcane irrespective of good or bad rain fall observed in some sugar factories, because of well irrigation. Hence, tube well irrigation also plays a major role in sugar production in India.

(iv) Factories who have crushing capacity over and above 15 LMT observed to have taken care of regular supply of sugarcane by providing irrigation facility, educating farmers and providing required basic materials and tools such as seeds, fertilizer, guidance, etc.

III. SUGAR PRODUCTION

(i) Sugar factories in India do not get sugarcane supply constantly; supply purely depends upon rain and irrigation pattern, which has direct impact on sugar production.

(ii) Cane supply and sugar production have got direct and proportional relationship and slightly affected by the *gur* production and *gur* price.

(iii) Quantum of production observed to have varied from year to year and factory to factory even though every factory has got Jurisdiction of 25 km of cane supply and farmer members.

(iv) Larger number of factories observed to have produced sugar in between 1.00 LQS tO 4.59 LQS.

IV. SUGAR RECOVERY

(i) All India Sugar Recovery Rate observed to have varied from 2.50 percent to 14.00 percent.
(ii) All India Average Recovery Rate fall in between 9.00 to 10.00 percent.
(iii) Factories who have record of less than 7.50 percent are neither able to continue nor able to recover their cost of production; become sick and led to many problems specially payments to farmers.
(iv) Many of the factories who have achieved the target rate of recovery over and above 11.00 percent observed to have not paid proportionately to their farmers as stated in the many research reports.
(v) Indian Average Recovery Rate is lower as compared to Brazil and other advanced countries.
(vi) Though all India Average Recovery Rate is lower as compared to other countries, India exceeds in quantum of production of sugar as compared to sugar bowl of the world - Brazil.

V. MOLASSES PRODUCTION

(i) Increasing trend of number of factories falling under same range is observed in case of molasses production as in the case of cane and sugar production.
(ii) Production of molasses depends upon the other factors *viz.,* amount of sugarcane crushed by the factory and gap between the cane cutting time and the cane crushed time.
(iii) Delay in crushing time leads to more amount of molasses production and lesser quantum of sugar production due to conversion of glucose into fructose due to delay in process.
(iv) Sugar factories who produced more than 2 LQS of molasses have installed their own distilleries, and these units are able to provide employment to their workers throughout the year rather than closing down soon after the season.

RECOMMENDATIONS/SUGGESTIONS

(i) The factories which are having crushing capacity less than 1,000 MTPD and below are advised to enhance their capacity to gain the benefits of large scale operation.

CONCLUSIONS

Indian sugar sector largely depends upon monsoon; politically influenced sugarcane price fixing system; moods of the farmers and mills administrators. The degree of success of Indian sugar sector is depending on joint venture of said stake holders.

SCOPE FOR FURTHER RESEARCH

All six problems and segments can be analysed in detail by interested research scholars in future.

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