CHAPTER - II

REVIEW OF LITERATURE

INTRODUCTION:

In this chapter, the researcher has given some of literature reviews relating to the study which are classified into four parts. i.e. i) Review of journal articles ii) Review of books iii) Review of thesis and iv) Review of reports. The purpose of presenting the details of the previous studies is to prepare the relevant background about the study. Through this, the researcher would be able to state the findings of the previous study on the topic being researched by other researchers. Many researchers have studied the different aspects of sugar industry with respect to growth, productivity, export, employment potential and the problems associated with those aspects at regional as well as national level. Here are some of the earlier studies, which have focused their attention on the economic problems of the sugar industry.

Anekar R. B. ¹(1964), discussed various aspects of co-operative sugar factories in his thesis titled, "Economic Survey of the Co-operative Sugar Factories in Maharashtra". He included 20 co-operative sugar factories in his study. The size of sugar factories, their capital structure, cost structure, marketing methods and labour practice are the major factors that was discussed by him. He stated that sugar factories have greatly influenced the social structure of the State and have provided a number of economic and occupational opportunities to the people in the vicinity. He has compared practices in co-operative sugar factories with those of joint stock companies.

Kamat G. S.\(^2\) (1965), in his doctoral dissertation entitled, “Management of Co-operative Sugar Factories in Maharashtra” has discussed four major aspects of co-operative sugar factories namely production, financial structure, management and labour. He argued that, if co-operative sugar factories are to become successful they must begin from managing cultivation of sugarcane by farmers. Based on the leading production, the performance of 14 co-operative sugar factories in Maharashtra had paid regard to the principles of good financial management and also to the principles of co-operation and successfully reconciled them. They have conferred many benefits on the cultivators in an unorthodox manner. There is a need to develop cost consciousness among managers in co-operative sugar factories. There is also a need to have a new look to the administration of finance.

The Board of Directors of co-operative sugar factories work in a peculiar way of solving grievances of individual members and interfering in the functioning of the subordinates. Development of democratic control in co-operative industrial structure is a complex process. It is necessary to develop staff relationships of a typically co-operative character because it resembles to the personnel practices in the private sector.

Beaver.W.H.\(^3\) (1966), in his study on financial ratio stated that “Failure is defined as the inability of a firm to meet its financial obligations as they nature”. He compared the financial ratio of a sample of 79 firms that failed with the financial ratios of a sample of 79 non – failed firm for the same period of time – for each failed


firm, a non–failed firm operating in the same industry and of comparable size was selected. For both the samples, Beaver examined for, period of five year prior to the point of failure for the failed firms and conducted three types of analysis to determine the predictive power of financial ratios:

i) a comparison of mean values,

ii) a dichotomous classification analysis and

iii) an analysis of likelihood ratios.

His analysis suggested that many of the ratios employed by him showed the power to signal an impending failure. The ratio of failed firms differs significantly from those of the non–failed firms. Further, they deteriorated sharply during the five years prior to failure.

Horrigan\(^4\) (1968), in his study on financial ratio analysis stated that “From a negative view point the most striking aspect of ratio analysis is the absence of an explicit” theoretical structure under the dominant approach of pragmatically empiricism”, the user ratio is required to rely upon the authority of an author’s experience. As a result the subject of ratio analysis is replete with untested assertion about which ratios should be used and what their proper levels should be”.

Shirodkar S. L. \(^5\) (1969), developed a hypothesis that the co-operative sugar factories in Kolhapur district have provided stability to the agricultural income by reasonable and guaranteed price. With a view to achieve the development of backward regions, he has suggested the establishment of sugar factories in backward


regions. He has also studied the problems of sugar industry in respect of availability of raw materials, finance and organization of the factory.

Vimal Raghavachari \(^6\) (1973), has analysed the role of Government in the development of sugar factories in respect of licensing, location of financing. Thereby, the State and Central Governments tried on the one hand, help and on the other hand, control of sugar industry. In their opinion sugar industry is of great social and economic importance. Therefore, it has to play vital role in moulding the society and the economy of the nation.

Gupta L.C. \(^7\) (1979), in an extensive study done with Indian data, attempting to distinguish sick and non - sick companies on the basis of financial ratios. He employed the criterion of ‘Percentage Classification Error’ to judge the predictive power of financial ratios.

Baviskar B. S \(^8\) (1980) made an extensive and intensive study of Kisan Co-operative Sugar Factory, Kopargaon. He has discussed the criteria of measuring success of co-operative sugar factories. On the basis of these determinates, he has evaluated the success of the said factory. Emergence of co-operative sugar factories has brought an important change in the life style of people in rural Maharashtra. Co-operative sugar factories have also brought a change in the character and style of politics in rural Maharashtra.

\(^7\) Gupta L.C., Financial Ratios as Forewaring Indicators of Sickness, ICICI Bombay, 1979. p 18
Jain N. S \(^9\) (1980) has studied the functions of local planning agencies that can be taken up by co-operative sugar factories. His conclusion is that the area of the co-operative sugar factory did not develop considering to the growth in irrigation facilities, agricultural development and generation of employment opportunities in the area. The modern techniques of regional planning have been employed much more and could have been achieved on all these fronts.

Tupe S. D \(^{10}\) (1980), has discussed the effect of sugar factory on various aspects of rural life, like the agriculture, the economy of agriculturists, life of agricultural labour, economic conditions of factory workers and the change brought about in the rural area by the spread effects of the sugar factory. His finding is that the development of agriculture depends upon the development of agro-based industries in the region. Sugar factory functions as a growth centre in rural area and centrifugal and centripetal forces created by its wide development in the region. Establishment of sugar factory though had a favourable effect on economic conditions of agriculturists. It also had an adverse effect of those of the agricultural labourers indicating the fruits of development grabbed by haves, having not been expelled from those.

Belkaoui \(^{11}\) (1983) made an interesting study conducted in 1983, analysed bond ratings for an estimation sample of 266 industrial bonds, all with a rating at B or above by standard and poor’s in 1981. He employed a linear multiple discriminate analysis model in which the following nine independent variables were considered:


\(^{10}\) Tupe S. D., The Impact of Sugar Factories on Regional Economy, A case study, Ph. D thesis, University of Poona, 1980.

\(^{11}\) Ahmed Belkaoui, Industrial Bonds and, the Rating Process, West Port CT: Quorum Books 1983, pp 21-22
1. Total assets,
2. Total debt,
3. Long term debt – total invested capital
4. Current assets/ current Liabilities
5. Fixed charge coverage ratio
6. Five – year cash flow dividend by five years sum of capital expenditure,

Kharche R. M ¹²(1985) studied sugar factories under the caption, "Co-operative Sugar Factories in Maharashtra - A Critical Study”. He selected five sugar factories on the basis of representative sampling method from the five districts of Marathwada. Low recovery of sugar, excess expenditure on staff and under utilisation of capacity are the problems that sugar co-operative faces. They face shortage of sugarcane causing heavy losses. Managements of sugar factories do not take adequate steps to generate internal sources of funds and also control expenditure on staff. It is necessary that sugar factories should take steps to increase per hectare yield of sugarcane. Government should adopt policy of licensing new co-operative sugar factories in backward region where potential of sugarcane production exists.

Mishra K. K ¹³(1985) prepared the study "Sickness in Indian Sugar Industry". He collected data on cost, realisations of profitability of factories from each of the sixteen zones. He pinpointed four factors as basic causes of sickness, a) Lack of availability of good quality cane from reasonable distance from factories. b) High cost of conversion, c) Pricing of sugarcane and d) Pricing of sugar. proper sugarcane management, timely repairs and maintenance of plant and machinery, control on cost

of conversion, maintenance of disparity between the returns obtained by growers from sugarcane and other competing crops, adequate provisions for inclusion of interest cost, minimum bonus and return on investment in determining price of levy sugar can save many factories from falling sick.

Rakesh Chandra Sharma\textsuperscript{14} (1985) in his study, “Financial reporting in public Enterprises”, examined the external reporting practices of Union Government enterprises incorporated under the Companies Act. The study analysed the contents of the annual reports and trends in 107 Public enterprises and 200 private enterprises. The study measured and tested the extent of corporate disclosure with the help of co-efficient of correlation. The study attempted to ascertain the present state of social reporting by the corporate sector. The study revealed that irrespective of sectoral differences, the quality of reporting in terms of timeliness, adequacy and objectivity was not satisfactory.

Foster.G\textsuperscript{15} (1986) in his study on financial analysis stated that, “It is the process of identifying financial strengths and weakness of the firm by properly establishing relationships between the items of the balance sheet and profit and loss account. Financial analysis can be undertaken by management of the firm, on by parties outside the firm viz., owners, creditors, investors and others.

Jayalakshmi.M\textsuperscript{16} (1987-88) in her research, “A study on the Financial statement analysis of PRICOL diagnosed the financial position and performance of premier investments and controls limited company with the help of Liquidity,

profitability and solvency ratios, and suggested to reduce the amount locked excessively in the form of current assets”.

Nikam G. A 17(1988) selected nine sugar factories from different districts of Maharashtra to analyse their cost structure, cost components, total cost, trends of changes in cost, financial strength and profitability. Most of the sugar factories have narrow capital base. Even compared to networth of the factories the share capital was very little and therefore the sugar mills had to rely upon borrowed capital. Proportion of general expenditure and administrative expenses were much higher as compared to that in private sugar factories.

Potdar S. D 18(1988) presented a case study and concluded that the sugar factory under study has provided a number of infrastructural facilities to the cane grower farmers. Irrigation, roads, transportation, seeds, fertilizers and technical services were major among them. The factory, by developing and utilising by-products has added strength. Using the tool of break-even analysis he has analysed the cost structure of the factory. He stated that labour relations were co-operative.

Pramod Kumar 19(1988) in his study titled, “Analysis of financial statement”, analysed how the financial statement will prove to be helpful to the various parties such of the shareholders, financial institutions and other creators and the employees.

Sinha R. V 20(1988) has analysed the cost of cultivating sugarcane. Transportation and marketing of sugarcane are the major problems that cane farmer

faces. Sinha has also dismissed technical performance of sugar factories. Cost structure has been analysed to find out components of cost and their appropriative utilisation of by-products. Labour relations are the additional factors discussed by him. In his consideration there is a need to develop a consistent, programmatic sugar policy by the Government.


Hilage V. M 22(1989) in his Ph.D. dissertation, "Performance of sugar co-operatives - A critical Study of two co-operative sugar factories", in which operational performance, oriented performance and development oriented performance are the three aspects discussed in detail. He is of the view that the performance of sugar factories can be improved by developing sugarcane in scientific manner, providing greater facilities of lift irrigation, paying, proper attention to harvesting, speedier and timely transportation of sugarcane and controlling diseases and pests.

Saher R.K 23(1990) in his article, “Analysis of Corporate Profitability and Multivariate Approach”, mentioned that among all the techniques used in financial statement analysis, ratio analysis is the most powerful tool of financial analysis But there is no International Standard for Financial ratios against which the results can be compared. A single profitability ratio in itself does not convey much of the sense. But at the same time, several ratios are used. They may yield different conclusions for the

same firm. So they attempted to measure the composite profitability of a firm by a single index indeed there by facilitating ease of comparison and ranking.

Joshi C. J 24(1991) has studied finances of all the eleven co-operative sugar factories in Kolhapur district. Using the ratio analysis, and working capital structure as tools of analysis, he has ranked the factories in Kolhapur district. He selected seventeen ratios from liquidity, solvency, efficiency and profitability groups. To find out the style of day to day using of money at their disposal he employed the tool of working capital management. Financial performance of sugar factories did not rest conspicuously on operationally related factors. Performance results are mostly the products of attitude, policies, practices and wisdom of factory and bosses.

Mr. Rustagi. R.P 25(1991) in his book titled “Financial Management Theory, Concepts and Problems” added that the complete figures given in the financial statements are to be dissected into simple and valuable elements and significant relationships are established between the elements of the same statement. This process of dissection, establishing relationship, interpretation to understand the working and financial position of a firm constitute the analysis of financial statements.

Tamiloli R.L. 26(1991) in his study title, “Financial analysis for identification of business has examined the growth in different aspects such as capital employed, fixed assets, working capital, business operations and social contribution.

Michael Ferrantino, Gary D. Ferrier, and Carl B. Linvill 27(1995) told that, “Frontier cost and production functions are used to examine the effects of ownership

on intra firm differences in technical, cost, and allocative efficiency in the Indian sugar processing industry. Co-operatives are found to be as or more efficient than their counter parts. The results suggest that technical and coordination economies of vertical integration provide important advantages for the co-operative form of organization. They also find that seasonal labor is over utilized and permanent labor is underutilized related to their cost-minimizing proportions. This is possibly a second-best solution in light of employment regulations.”

Indrasena Reddy and Someshwar Rao 28(1996) conducted a study on working capital management in HCL. They used seven ratios and statement of changes in working capital and concluded that the company’s working capital management is not up to the expected level. It needs to be improved by effective utilization and control of current assets.

Kulkarni P.V.and Sathya Prasad B.G.29 (1999) in his book stated that to evaluate the financial condition and the purpose of a firm the financial analyst needs certain yardsticks. The yardstick frequently used is a ratio or an index relating two pieces of financial data to each other. Not only those who manage a company but also the shareholders and creditors are interested in knowing about the financial position and / an earning capacity of the concern”.

Sumit K. Lodhia (1999) concludes that, “That accountants have the potential
to play a crucial role in environmental management and reporting, through their
managerial, performance measurement and evaluation, auditing and reporting skills.
An in-depth study is undertaken to review the environmental accounting practice of
the only public company in Fiji that discloses environmental information in its
corporate annual report. The results indicate that environmental accounting in the Fiji
Sugar Corporation (FSC) focuses on legitimising the environmentally sensitive nature
of the company's operations rather than being an attempt to extend stewardship to the
stakeholders that may be affected by the company's operations. There is also evidence
of only limited involvement of accountants in the environmental management
strategies of the FSC. The findings suggest that voluntary attempts at environmental
accounting may not necessarily lead to an improvement in the quality of life for
everyone. Hence, it is envisaged that the accountants' skills can be utilised more
effectively in environmental matters if appropriate legislation and standards are used
to provide a regulatory framework for environmental accounting.”

Abhijit V. Banerjee, Kaivan D. Munshi, Dilip Mookherjee and Debraj Ray
(2001) told that, “Their paper presents a theory of rent seeking within farmer co-
operatives in which inequality of asset ownership affects relative control rights of
different groups of members. The two key assumptions are constraints on lump-sum

30 Sumit K. Lodhia: Australian National University (ANU) - Faculty of Economics & Commerce,
Journal of Pacific Studies - Banking, Finance and Accounting Special Issue, Environmental
Accounting in Fiji: An Extended Case Study of the Fiji Sugar Corporation, November 1999. Vol. 23,
No. 2, pp. 283-309.
31 Abhijit V. Banerjee, Kaivan D. Munshi, Dilip Mookherjee, Debraj Ray, Inequality, Massachusetts
Institute of Technology (MIT) - Department of Economics, Control Rights and Rent Seeking: Sugar
transfers from poorer members and disproportionate control rights wielded by wealthier members. Transfers of rents to the latter are achieved by depressing prices paid for inputs supplied by members and diverting resulting retained earnings. The theory predicts that increased heterogeneity of landholdings in the local area causes increased inefficiency by inducing a lower input price and a lower level of installed crushing capacity. Predictions concerning the effect of the distribution of local landownership on sugarcane price, capacity levels, and participation rates of different classes of farmers are confirmed by data from nearly 100 sugar co-operatives in the Indian state of Maharashtra over the period 1971-93.”

Sahu\textsuperscript{32} (2002) investigated the usefulness of current and quick ratios and builds a model involving those ratios to determine whether liquidity management process in Indian paper industry is effective or not. He concluded that most of the paper producing companies in India have been caught in a vicious down cycle facing a threat to their viability.

Won W. Koo \textsuperscript{33}(2002) told that, “The impacts of alternative trade liberalization policies in the United States and the European Union (EU) on the U.S. sugar industry. A global sugar policy simulation model was used for this analysis. The study results indicate that the U.S. sugar industry may be able to survive if both the United States and the EU liberalize their sugar trade. However, if only the United States eliminates its sugar programs, all U.S. sugar-producing regions would be threatened.”


Maheshwari S.N. (2003) pointed that, comparative balance sheet as on two or more different dates can be used for comparing assets and liabilities and findings out any increase or decrease in those items. Thus, while in a single balance sheet the emphasis is on present position. It is on change in the comparative balance sheet. Such balance sheet is very useful in studying the trends in an enterprise.

Chakraborty (2004) stated that the conventional method of measuring liquidity would not be sufficient to cover this extended view of liquidity and new framework must be developed to cover analysis of amount and trend of internal cash flow; which is the better proposition to focus on a firm’s liquidity position than those and flexibility backed by Net Liquid Balance (NLB) of Shulman and Cox and concluded that this is definitely a better approach to measure liquidity over the conventional method of ratio analysis.

Reddy and Patkar (2004) studied the size and its components and liquidity management in factoring companies. They also studied the correlation between liquidity and profitability of factoring companies. They concluded that the sundry debtors and amount due to creditors are the major components of current assets and current liabilities respectively in determining the size of the working capital.

34 Maheshwari S.N., Financial Management, Sultan Chand & Sons Delhi 2003
Subhes C. Bhattacharyya and Dang Ngoc Quoc Thang ³⁷(2004), The Cogeneration Potential of the Sugar Industry in Vietnam, tells that, “Vietnam produces about 15 million tons of sugarcane per year and about five m.t. of bagasse. There is the potential for cogeneration using bagasse, which can also help overcome power shortages in the country. This paper analyses the potential for cogeneration from the sugar industry in Vietnam under three different scenarios and finds that between 100 and 300 megawatts of power-generating capacity could be supported by the bagasse generated from sugar mills, depending on the technology considered for sugar mills and cogeneration and the possibility of renovation of the existing mills. The paper also assesses the expense of cogeneration and finds it to be a cost-effective option for all types of sugar mill. It is found that the cost savings from cogeneration would more than offset the cost of introducing cogeneration in sugar mills with inefficient cane processing technologies. Sugar mills with modern technologies would have a significant amount of excess power and most of these plants would break-even if they sold excess power at around 4.5 cents per kilowatt hour. The break-even cost and the average production cost are sensitive to the investment cost assumptions. The paper thus suggests that cogeneration from the sugar industry is an attractive option for investors in existing mills or new sugar mills alike.”

Cheryl S. DeVuyst and Cheryl J. Wachenheim ³⁸(2005) state that, “Biotechnology affords new risks and opportunities for food processing firms. This

decision case involves a co-operative that is considered whether to allow members to grow sugar beet varieties that are genetically enhanced for herbicide tolerance. Sugar beet farmer-members of American Crystal Sugar Company support the use of Genetically Enhanced (GE) varieties. However, there are risks for the co-operative, especially related to market acceptability of sugar and by-products. The co-operative competitive environment is analyzed as a part of the decision-making process. The key decision turns on how approving the use of genetically enhanced sugarbeet varieties would impact the co-operative, its partners and competitors, and participants throughout the marketing channel."

Parimala S. 39(2005) observed that, “The study was undertaken to analyse the financial performance is to fulfill the objective of the study, selected profitability ratio, financial ratio and turnover ratios were calculated and inferences drawn. The study of research reveals that the effort should be taken to the company trend in the profits.”

Vanitha G. 40(2005) concluded that, financial statement analysis is one of the factors, which provides fast information. But in real business experience, we can give suggestions to improve the performance of business concern but not able to provide any concrete or solutions to the business concern, because the possibility of changes and other factors are highly responsible for judging the financial and operational efficiency and performance of the business concern, particularly in banking Industries.

Christopher Stevens \(^{41}\)(2006) identifies that, “Many of the changes to developed country trade policy that affect developing countries do not fit neatly into the category of 'liberalisation' yet they are frequently assessed as if they did. The recent changes to the EU's regimes for production and imports of sugar fall into this group: both production and trade policies were highly distorted before the change and will remain so after it, but the distribution of the effects of these distortions will be altered. This will affect three of the six Development Cooperation Ireland programme countries in Africa: Mozambique, Tanzania and Zambia. Returns from sugar exports to the EU will be less than otherwise would have been. How much lower depends critically on how the sugar market develops after 2009.”

Peter Bogetoft and Kristoffer Boye \(^{42}\)(2007) told that, “The reform of the EU sugar regime involves significant price reductions for sugar and sugar beet. We examine whether the Danish Sugar Industry can maintain production and profit levels by reallocating production from less to more efficient farmers. The impact of alternative reallocation mechanisms is estimated using a DEA model of sugar beet production, together with information about processing capacity at the three Danish plants, beet transportation costs and alternative crop options. The analysis shows that the present allocation is far from efficient. With the new reform fully implemented and the quota efficiently reallocated, actual production will fall by only 25 percent, although profit will be substantially lower.”

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\(^{41}\) Christopher Stevens, University of Sussex - Institute of Development Studies, Why Unwinding Preferences is Not the Same as Liberalisation: The Case of Sugar, IIIS Discussion Paper No. 137, April 2006.

Ruthann B. Swanson (2007) defines that, “Oatmeal and chocolate chip cookies were prepared using a non-sucrose sweetener blend (dextrose/acesulfame-K) and/or prune puree to replace 50% of the sugar and/or fat, respectively, following manufacturers recommendations. Similar effects of modification were found for both cookie types. Specific gravity (P<0.05) and water activity (P<0.05) increased with modification; cookie spread (P<0.05) decreased. Probing (P<0.05) revealed that the increase in hardness and chewiness associated with fat reduction was moderated to some extent when coupled with sugar reduction. Sensory assessments of texture using the Consumer Profile Ballot reflected the instrumental textural assessment. There were few significant sensory differences between the full-fat/full-sugar control oatmeal cookie and either modified oatmeal cookie. In chocolate chip cookies, sensory results (P<0.05) suggest an increase in off-flavours and bitterness, and a decrease in sweet and buttery attributes with modification. Panellists indicated that all formulations of each cookie type were acceptable with ratings above mid-point on the scale for flavour and texture acceptability. Total fat reduction was 32% and 45% in the oatmeal and chocolate chip cookies respectively. Caloric reductions were 14.15% in the modified oatmeal cookies, and 12.13% in the modified chocolate chip cookies.”

Ryan Vinelli Benjamin N. (2009), Sugar Taxes Aren’t Sweet: The Case against Taxes on Sugar -Based Drinks told that, “Everyday there is a new call by politicians and scholars to place taxes on sugar -based drinks. Sodas, energy drinks, sports drinks, and some juices are increasingly linked as a cause for the obesity


44 Ryan Vinelli: Benjamin N., Cardozo School of Law, Sugar Taxes aren’t Sweet: The Case against Taxes on Sugar -Based Drinks, May 26, 2009
epidemic. It is thought that a tax will dissuade individuals from drinking these highly caloric beverages. In addition the revenue collected could be used to help offset the negative health externalities generated by their consumption. A tax of this nature is the textbook definition of a Pigouvian tax. However, a Pigouvian tax on sugary drinks would be ineffective at combating obesity for four reasons: it would be under-inclusive; the tax would be too small to adequately deter consumers; tax revenues will decline while the associated health costs will rise; and this tax would be highly regressive.”

Hongli Feng and Chad Hart45, (2010) Willingness to Pay for Surplus Sugar in the United States told that, “Sugar supply is managed in the United States to support minimum prices set by law. The 2008 farm bill contains the sugar-to-ethanol program to sell surplus sugar to ethanol producers and a program that allows bids from sugar processors. The sugar program is required to run at no net cost to taxpayers. Bids for surplus sugar are analyzed under various scenarios. Sugar processors will outbid ethanol producers given current ethanol prices. At present, surplus sugar bids will not exceed the minimum prices, and the sugar-to-ethanol program will not be able to help the Government achieve no net program costs.”

Amarender A. Reddy 46(2011), Sugar and Cane Pricing in India, told that, “Sugar and cane prices in India are highly regulated as a result free market prices in India are showing rising trend with high volatility. There is a possibility of long run shortage of sugar in international markets due to diversion of cane to produce ethanol

and also reduction of domestic support as committed under WTO regime. Suppressed Minimum Support Price (MSP), stagnation in productivity of cane, obsolete technologies and low capacity utilization hindered long-term perspective. To balance small-scale farming, economies of scale in mills, there is a need for reducing cost of production and processing of cane. A formula based Fair and Remunerative Price (FRP) is suggested for cane to take into account both cost of production and international price realities along with complete freeing of sugar prices. Further, for better price discovery in domestic markets de-control of sugar prices should be accompanied by re-introduction of future market to reduce price volatility.”

In addition, Indian literature provides enough evidence of availability of sugarcane in the ancient period. Sugarcane plant and its juice were remarkably mentioned in the medicinal works of Caraka and Susruta.

In the Jatakas, there is a reference for pressing of sugarcane in machines. The occupation of cane pressing and the machine used in the process are specifically mentioned. The sugarcane press and allied machines were known by the name of mahajanta (mahayantra or kolluka) (compare with vernacular word kolhu). "Vyavahara Bhasya” refers to sheds where such pressing machines were installed. India early evolved the technique of manufacturing sugar. The Arthasastra includes the manufacture of sugar from cane juice in a list of works called Simbanika.

Caraka, in his medicinal work states that ksudra guda is formed by evaporating the juice of sugarcane down to a quarter, a third or half of the original volume. Guda is a purified product and contain few impurities. Even more refined are matsyandika, khanda and sarkara, each of which is purer than the preceding one.

Caraka notes the medicinal properties of these four types, which are in fact four stages in the process of manufacturing granulated sugar. Susruta mentions phanita, guda, masyandika, khanda and sarkara, these being in order of purity. The Arthasastra, under kasra refers to phanita, guda, masyandika, khanda and sarkara.

From early Buddhist works, it seems that sugarcane was a common crop and sugarcane juice, a popular object of consumption. Sugarcane fields greeted the eyes of a traveler wherever he went.\textsuperscript{48}

Kautilya notices it in the list of principal crops cultivated. But, he remarks sugarcane the least profitable of crops, for it is subject to various evils and requires much care and expenditure.

Manu\textsuperscript{49} at one place says that garlic and sugarcane grow in the same fashion as seeds. Probably what Manu means is that these two crops are not normally propagated by sowing seeds but are grown from off-shoots.

In ancient works, Iskuda and Iksumati \textsuperscript{50} occur as the names of two rivers. These names indicate that the Indians had a knowledge of soil that best suited for sugarcane cultivation and recognised that the soil was irrigated by certain rivers that was very suitable for the crop.

Describing a sylvan village on the outskirts of the Vindhya forests of Harsacarita\textsuperscript{51} gives a graphic picture of a sugarcane field, this refers to the cultivation

\textsuperscript{50}Rama S.R.I., 70.3, II.68.17, Panini, IV 2.86, VIII, 2.9, Bhagavata Purana, V. 10.1 Visnu Purana, II 13.53.
of sugarcane plants in enclosures, to the harm done to them by antelopes and rabbits, and to the careful tending needed for the crop. Advanced knowledge of sugarcane cultivation is clear from the classification of the plants into several types, differing according to their qualities. Caraka mentions two varieties paundraka and vamsaka. The Amarakosa, though by name mentioning only the pundra and kantara types, implies many others also in the word adayah. Ksiravamin, the commentator, names some of these. But Susruta mentions twelve varieties- paundraka, bhiruka, vamsaka, sataporake, tapaseksu, kasteksu, sucipatraka, naipala, dirghapatra, nilapora and kosakrt.\(^{52}\)

In the Vedic period, thus it seems that, though the Aryans were acquainted with sugarcane, they had not acquired the knowledge of manufacturing sugar from its juice. On the basis of the reference to the word in the early Buddhist literature, one can assign the beginning of sugar manufacturing in Aryan India to somewhere about the 8th century B.C assuming some necessary antecedent period for the knowledge to grow.\(^{53}\)

In 399 A.D., the Chinese Buddhist pilgrim Fa-Hien entered India to the east of the Indus and he writes, "As you go forward from the mountain, the plants, trees and roots are all different from those in the land of the of ban except the bamboo, the pomegranate and the sugarcane".\(^{54}\) Three hundred years later, he was followed by the Hiuen-Tsang who travelled in 629 AD observed, "They feed themselves generally on

\(^{52}\) Jadavji Trikumji Acharya, Ed. N.S.P., 1915, Sutra, 45,pp 138-139.


\(^{54}\) http://mpra.ub.uni-muenchen.de/6065/
cakes of parched gram, which they mix with milk, cream, butter, solid sugar and mustard oil.

The juice of grapes and sugarcane is the food of the Khatriyas. The fermented product of grains is of Vaisyas. The Brahmans drink the juice of grapes which differs completely from that of distilled from wine".55

Cunningham56 wrote, "Gandhara of Swat (Peshwar) also produces much sugarcane of which they make stone honey". He mentioned that, "Punjab (Pounatch)57 produces much sugarcane but no grapes". Regarding Kosambhi located on Jumuna thirty miles above Allahabad, he wrote "This place harvests a large quantity of rice and some sugarcane."58

56 Ancient Geography of India, ed. Majumdar, Calcutta, 1924, p. 55.
57 Ibid. p 187.