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A study of cost benefit analysis of by-products manufactured by select sugar industries in Maharashtra

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Abstract
Sugar industry produces certain by products. The important by products are molasses, bagasse, which is used for production of chemicals and alcohol. Bagasse is utilized as a fuel in the boilers and also used as a raw material in the paper industry, press mud also mixed with another residual output of the distillery viz. spent wash and used as biomanure. A sugar mill can thus have multiple streams of revenue. Maharashtra sugar industries are one of the most notable and large scale sugar manufacturing sector in the country. Maharashtra sugar industry has been contributing nearly 40% of India's, total sugar production. The pace of growth of sugar manufacturing has been massive over the past few years. The latest sugar statistics of sugar production in Maharashtra indicates that state is doing better than the other states in the country. The sugar industry in Maharashtra is highly popular in the co-operative sector, as farmers own a portion in the sugar factories. Co-operative sugar factories are backbone of the sugar industry of Maharashtra. These sugar industries had been a spectacular growth owing to the different conductive in the state. Sugarcane is one of the chief crops manufactured in Maharashtra so that most of sugar industries been setup over the years in the state.

Keywords: sugar industries, molasses, bagasse

Introduction
Today the financial position of sugar industries is getting affected due to continuous fluctuations in sugar prices, rising prices of necessary raw materials such as chemicals, jute bags, sulphur, parts of machinery, increased cost of harvesting transportation and power. Irregular supply of electricity and water is another issue and it also affecting the financial position of sugar mills. All such expenditures lead to increase in the cost of production, as a result of which there is a decline in the profit margin of the sugar industries. Paying higher cane prices to the cane growers after meeting above expenditure is not possible just by selling the sugar. For survival in competition, high price for sugar cane has to be given and for this purpose, advance loan has to be taken from a bank which depends on total quantity of produce. And this advance also depends upon the price of sugar. Because of these factors the sugar industry is affected adversely and is not able to match its revenue expenditure to sale realization. To give more sugarcane price, some expenditures of current year are differed to next year which affects the economic condition of factory.

It is clear that number of financial problems is faced by the sugar industries. There are number of negative factor which badly affects the financial health of the sugar mill viz., high taxes and increased input expenditure, fluctuation in the sugar price as it depends on world demand and supply, farmer's demand for higher cane prices and other such issues. In the present situation, it is not possible to overcome the above problems. Sugar is the only sector where multiple by products can be produced. For example, instead of selling the baggage, it can be used for generation of electricity. It is more beneficial to the sugar mills and to the society. All the sugar factories should established by-products manufacturing plants to fetch more profits. This is the only solution for improving the financial position. Co-generation, ethanol, spirit, bio-compost, biogas, chemical, industrial alcohols are the multiple by-products that can be manufactured by sugar industries to fetch additional income.

Literature Review
Lokhande M.A. (2005) [1] revealed in his article, in the era of globalization, sugar industry needs more competitive edge which can be given by way of modernization, enhancing productivity, and manufacturing excellent quality sugar at competitive prices. Projects based on bagasse and molasses should be initiated. Ethanol, alcohol, and paper projects have tremendous scope for development in India. In future, 10-15% ethanol may be allowed to be blended with petrol. Bagasse based power generation projects installed adjacent to each sugar factory would fulfill need of power.

Adya Prasad Pandey (2007) [2] revealed that in the sugar industry several by-products especially bagasse and molasses are found. At one time bagasse was used as fuel, which sugar factories did not know what to do with the accumulating molasses, a health hazards. Small cottage industries may be established for disposing these by-products in a positive way for preparing paper, cardboards, alcohol, fertilizers, cattle field etc. Apart from its manufacturing process of sugar also needs certain modification so that yield may be improved.

A.S. Mahadik (1991) [3] analyzed the economics of molasses based By-products of co-operative sugar factories in Kolhapur, Satara, Sangli and Sholapur districts of Maharashtra State, during the period from 1975 to 1989. The study revealed that the bagasse and molasses constitute the main By-products of sugar industry and the utilization of the By-products affects the processing cost of the sugar. The study concluded with a suggestion that every sugar factory must utilize their By-products effectively to reduce the total cost of the sugar.

A.M. Gurav (2003) [4] produced his research work on "A Study of Cost and Productivity of cooperative sugar factories in Kolhapur District". In this context, he has examined financial

position of sugar factories under study and evaluated cost of production excluding cane price and including cane price. Researcher analyzed productivity performance and identified different areas for cost reduction. Author emphasized necessity of atomization and computerization for reduction of manpower and inventory cost.

R K Research Report (2008) [5] concludes that the sugar industry is a major supplier of by-products like molasses for alcohol, ethanol and chemical industries, bagasse for paper industry. Indian sugar industry is dominated by the cooperative sector, which accounts for more than 55 percent in terms of the number of factories, installed. Maharashtra and Uttar Pradesh alone accounting for 60 percent of Indian's total sugar production.

Rangrajan committee (5th October 2012) [6] revealed that sugar sectors issues about cane reservation area and bonding minimum distance criterion, price of sugarcane levy sugar obligation regulated release of free sale sugar Trade policy for sugar, Regulation relating to by-products and other issues such as jute packaging materials and recommended that rationalization of sugarcane pricing and liberalization of sugar trade need to be introduced over a two to three year period, in a calibrated two recommendation of the committee namely, removal of levy sugar obligation from the sugar season 2012-13 and deregulation of release mechanism for non-levy sugar.

Statement of the Problem

In the early stage of the industry disposal of these products could be accomplished by burning the bagasse in boiler furnace, using filter cake in the fields but the disposal of molasses posed problems and as such these were considered as undesirable industrial wastes creating environmental disturbance. Many factories had to encounter difficulties in disposing of the surplus bagasse. In the past few decades however, thanks to the sustained efforts of research workers and technologists considerable progress has been achieved in the proper use of these by-products for manufacture of number of items of industrial significance. Particularly in the last two decades profitable utilization of the by-products of sugar manufacture assumed great importance in view of vast potential they offer in the manufacture of various useful products like paper, ethanol etc. besides the generation of electricity.

Objective of Study

1. To understand the by-products of the co-operative sugar factories.
2. To study the cost structure of by-products of selected co-operative sugar factories.
3. To evaluate the cost-benefit of by-products of co-operative sugar industries.

Research Methodology

Research methodology is the description, explanation and justification of the various methods of conducting research. Methodology is a system of methods and rules to collection and analysis of data. It provides the starting points for choosing an approach made up of theories, ideas, concepts and definition of the topic.

Data Collection

The concern study was depending on secondary data. The data has been collected through sugar factory annual reports, reference books, journals, magazines, articles published in various types of conference proceeding, websites and other sources related with subject. The interpretation and analysis of data was based on statistical tools and techniques.

By-products of Sugar Industry

The by-products of the sugar industry are bagasse (30 to 35%), molasses (4 to 5%), press mud (2 to 4%), leaves and tops (25 to 35%) and boiler ash (0.3%). The cost of sugar continues to be high due to the neglect of the profitable utilization of the by-products. If the by-products are used the cost of production of the sugar may go down by about 20%. The development of sugar cane 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 utilizing the by-products. Some of these countries produce alcohol as main product and sugar as by-product.

Molasses

Molasses is a residue of sugar industry and obtained after the sucrose has been crystallized and centrifuged from evaporated cane juice. Molasses contain sucrose, invert sugar, salt and the entire alkali soluble non sugar ingredient. 50 Kg. molasses is obtained from crushing of 1 M.T. cane (i.e. 5 percent). Molasses are used in different by-product as a raw material. Rectified spirit, country liquor, fuel oil use as a raw material. Molasses can be sold in the market or it is used in production of above by-products. The situation of selected co-operative sugar factory is given below.

Present average selling price of molasses = Basic price per M.T. + Excise duty per M.T. + VAT (20 percent on Basic) = i.e. 4,000 + Rs. 772.50 + Rs. 800 + Rs. 5,572.50 per M.T. However, excise duty is collected by central government and VAT is collected by the sugar factory and then deposited to government accounts. At the time of selling of molasses excise duty and VAT is collected by the sugar factory and then deposited to government accounts. Hence, the amounts of such taxes are not considered wile calculation of molasses selling price.

If the factory utilizes its 100 percent crushing capacity, average molasses production would be 1,00,000 kg. (2,500 M.T. × 4% average recovery per day) i.e.100 M.T. per day. If this molasses is sold by the sugar factory in the market it can fetch a big amount. The detailed calculation is given below. Average collection from molasses per day = 100 M.T. × Rs. 4000 per M.T. = Rs. 4.00 lakh per day.

Table 1: Production and selling of molasses

Year	Kopargaon Co-operative Sugar Industries Ltd.			Sanjivani Co-operative Sugar Industries Ltd.		
	Production M.T. (excluding own consumption by the factory)	Average Selling price (Rs. per M.T.)	Total Selling prices Rs. In Lakh.	Production M.T. (excluding own consumption by the factory)	Average Selling price (Rs. per M.T.)	Total Selling prices Rs. In Lakh.
2003-04	14,231	4,000	569.24	13,438	4,000	537.52
2004-05	6,076	4,000	243.04	8,100	4,000	324.00
2005-06	25,746	4,000	1029.84	22,223	4,000	888.92
2006-07	31,220	4,000	1248.80	25,948	4,000	1,037.92
2007-08	32,011	4,000	1280.44	24,861	4,000	994.44
2008-09	20,531	4,000	821.24	20,368	4,000	814.72
2009-10	29,806	4,000	1192.24	25,306	4,000	1,012.24
2010-11	34,300	4,000	1372.00	26,199	4,000	1,047.96
2011-12	32,291	4,000	1291.64	23,010	4,000	920.40
2012-13	30,408	4,000	1216.32	15,172	4,000	606.88

***Source*:** - compiled from annual reports of Kopargaon & Sanjivani Co-operative sugar Factory from 2003-04 to 2012-13

From the table no. 1 reveals that the production and selling prices of molasses of Samartha sugar and Sanjivani Sugar. Average selling price has been taken of molasses for the study in each year. The production of molasses depends on the sugarcane crushed. Hence, the figures production of molasses has been changed every year. Though the production of molasses in the year 2004-05 was lowest, the total selling price of molasses was highest in 2010-11 due to highest production of molasses.

Distillery

In India the use of alcohol was as a drink from early stages. The process of making alcohol, termination and distillation is available since Vedic time.

The first distillery in the country was set up at Cawnpore (Kanpur) in 1805 by Carew and Co. Ltd. for manufacture of rum for the army. Molasses is the raw material of distillery. It also called as sugar industry is mother industry of distillery.

Rectified Spirit of Kopargaon Distillery

The capacity of Kopargaon distillery is 40,500 liter per day. It uses the molasses produced during the production of sugar as raw material. Kopargaon distillery manufacture rectified spirit and country liquor. It works 300 day in a year. As mentioned earlier, during the crushing capacity of Kopargaon sugar is 3000 TCD. It produces 150 M.T. molasses per day. As maintained above 1 M.T. gives 270 liter of rectified spirit therefore, total rectified spirit produce by Kopargaon distillery is 150 M.T. × 270 liter = 40500 liter per day. The selling price of rectified spirit fluctuates and is determined by the force of demand and supply in the market. Average income (excluding cost of production) from the rectified spirit is Rs. 12.75 per liter. Hence Kopargaon can earn 40,500 liter × Rs. 12.75/ liter = Rs. 5.16 lakh per day profit.

Table 2: Benefit cost of Rectified Spirit of Kopargaon Co-operative Sugar Factory

Year	Production of rectified spirit (liters)	If it sold in the market		Production cost per liter	Total cost of production Rs. Lakh	Net Profit (Rs. In lakh)	Net Profit (%)
		Per liter	Total selling price Rs. lakh				
	1	2	1×2=3	4	1×4=5	3-5=6	6×100/3
2003-04	12467000	17.10	2131.85	13.47	1679.30	452.55	21.23
2004-05	12123000	24.90	3018.62	18.35	2224.57	794.05	26.30
2005-06	10775000	27.19	2929.72	19.22	2070.95	858.76	29.31
2006-07	9899000	24.59	2434.16	17.81	1763.01	671.15	27.57
2007-08	10583000	25.40	2688.08	14.61	1546.17	1141.90	42.48
2008-09	5543370	27.41	1519.44	19.71	1092.59	426.85	28.09
2009-10	8047620	43.14	3471.74	22.61	1819.56	1652.18	47.59
2010-11	9261000	31.16	2885.73	20.19	1869.79	1015.94	35.21
2011-12	8718570	34.58	3014.88	21.95	1913.72	1101.16	36.52
2012-13	8210160	38.63	3171.58	29.70	2438.41	733.17	30.88

***Source*:** - compiled from annual reports of Kopargaon sugar from 2003-04 to 2012-13

** Total production of rectified spirit = (Rectified spirit + impure alcohol + extra neutral alcohol)*

It can be depicted from table no. 2 by using molasses as raw material; rectified sprit is the finished product. However, its production is fluctuating because production is depending on availability of molasses. Overall per liter cost of rectified spirit was showing increasing trend, only except same years. During the period of 10 years cost of rectified spirit was increase by 120.48 percent. It is also concluded that, if Kopargaon sugar factory sales is total molasses in the market during the period 2012-13, then factory was received Rs. 12.61 crore. However, through processing, it is converted in rectified spirit and selling price was 31.72 crore. The profit after conversion of 30.88 percent more. In case of Kopargaon sugar production of rectified spirit is always profitable it is shows that, there was more amount received by factory for e.g. in the year 2012-13 selling price of molasses Rs. 12.61 crore. But Rs. 12.61 crore already paid to the sugar factory. It means Rs. 12.61 crore + Rs. 9.79 crore = 22.04 crore received by the factory this amount was 77.64 percent more than selling price of molasses.

Rectified Spirit of Sanjivani Distillery

Sanjivani distillery has a capacity of 75,000 liter/day which is highest of all the factories under study. It produces rectified

spirit, country liquor and chemicals by using molasses produce by Sanjivani sugar factory. Like other factories under study, working days of Sanjivani is also 300 days for production of by-products.

Table 3: Benefit cost of Rectified Spirit of Sanjivani Co-operative Sugar Factory

Year	Production of rectified spirit (liters)	If it sold in the market		Product-ion cost per liter	Total cost of production Rs. Lakh	Net Profit (Rs. In lakh)	Net Profit (%)
		Per liter	Total selling price Rs. lakh				
	1	2	1×2=3	4	1×4=5	3-5=6	6×100/3
2003-04	25639208	24.22	6209.81	13.47	3745.88	2463.92	39.67
2004-05	12627921	29.20	3687.35	18.35	1844.93	1842.41	49.96
2005-06	16780686	30.65	5143.28	19.22	2451.65	2691.62	52.33
2006-07	21963773	30.17	6626.47	17.81	3208.90	3417.56	51.57
2007-08	27891547	31.03	8654.74	14.61	4074.95	4579.79	52.91
2008-09	5499360	29.30	1611.31	20.71	1138.91	472.4	29.32
2009-10	6832620	43.14	2947.59	22.61	1544.85	1402.74	47.59
2010-11	7073730	31.16	2204.17	20.19	1428.18	775.99	35.21
2011-12	6212700	52.45	3258.56	40.58	2521.11	737.45	22.63
2012-13	4096440	64.72	2651.21	48.12	1971.20	680.01	25.65

***Source*:** - compiled from annual reports of Sanjivani sugar from 2003-04 to 2012-13

(Sanjivani does not sell rectified spirit in the market every year, but utilize it for further processing. Hence cost of production and selling price are taken as it is as in case of Kopargaon as the figures for Sanjivani were not available)

From above table no.3 shows that per liter cost of rectified spirit was showing trend, only except of 2010-11. During the period of 10 years cost of rectified spirit was increase by 56.96 percent. It is also concluded that, if Sanjivani sugar factory sales its total molasses in the market during the period 2012-13, then factory was received Rs. 6.06 crore. However, though processing, it is converted in rectified spirit and selling price was 26.51 crore. The profit after conversion of 25.65 percent more. In case of Sanjivani sugar production of rectified spirit is always profitable. It is show that, there was more amount received by factory for e.g. in the year 2012-13 selling price of molasses Rs.6.06 crore + Rs. 6.80 crore = 12.86 crore received by the factory. This amount was 112.21 percent of molasses.

Country Liquor

Rectified spirit is further processed to produce country liquor; 2.22 liter of country liquor is produced from 1 liter rectified spirit.

Country Liquor of Kopargaon Distillery

As seen in the previous calculation, Kopargaon distillery produces an average 40, 500 liter of rectified spirit per day. If 1 liter rectified spirit gives 2.22 liter of country liquor, 40,500 liter rectified spirit will give (40,500 × 2.22) = 89,910 liter of country liquor per day. Profit earned by selling country liquor (after deduction cost of production) is Rs. 6.60 per liter. Therefore total profit that Kopargaon distillery can earn by selling country liquor would be 89910 × 6.60 = Rs. 5.9 lakh per day.

Table 4: Economics of Country Liquor of Kopargaon Co-operative Sugar Factory

Year	Country liquor Productio-n (liters)	Per liter	Total selling prices (Rs. Lakh)	Product-ion cost per liter	Total Cost of Producti-on Lakh	Net Profit (Rs. In lakh)	Net Profit (%)
	1	2	1×2=3	4	1×4=5	3-5=6	6×100/3
2003-04	18553000	24.22	4493.53	21.36	3962.92	530.61	11.80
2004-05	20934000	29.20	6112.72	28.96	6062.48	50.24	0.82
2005-06	23884000	30.65	7320.44	28.73	6861.87	458.57	6.26
2006-07	27767000	30.17	8377.30	26.92	7474.87	902.42	10.77
2007-08	31576000	31.03	9798.03	26.59	8396.05	1401.97	14.31
2008-09	12306282	33.02	4063.53	28.67	3528.21	535.32	13.18
2009-10	17865716	36.31	6487.04	31.79	5679.51	807.53	12.45
2010-11	20559420	36.63	7530.91	30.40	6250.06	1280.85	17.01
2011-12	19355225	38.94	7536.92	34.54	6685.29	851.63	11.30
2012-13	18226555	41.35	7536.68	34.84	6350.13	1186.55	15.74

***Source*:** - compiled from annual reports of Kopargaon sugar from 2003-04 to 2012-13

Above table no. 4.22 shows that the production of country liquor varies with the use of rectified spirit throughout the study period. Kopargaon has not only utilized its own rectified spirit but had purchased spirit from market making country liquor. The highest profit was earned in 2010-11, where production was highest. Selling price of molasses has always remained less than the net profit earned from the sale of country liquor and rectified spirit. This shows that production of finished products proves more beneficial than the sale of molasses. The profit so earned can be diverted towards sugar factory. This will help the sugar factory to serve adequately the interest of the farmers in terms of payment of cane price and development of the area concerned.

Country Liquor of Sanjivani Distillery

In Sanjivani distillery, rectified spirit is used in the production of chemicals, country liquor and fusil oil. However, maximum quantity of rectified spirit is used in the production of country

liquor. As seen earlier, Sanjivani distillery produces 270 liters of rectified spirit from 1 M.T. molasses. It produces (128 × 270) 34,560 liters of spirit / day.

1 liter rectified spirit gives 2.22 liter of country liquor; hence, Sanjivani distillery produces (34,560 × 2.22) 76,723.2 liters of country liquor each day. The sale of country liquor earns (76,723.2 × 6.60) Rs. 5.06 lakh per day (excluding cost of production).

Table 5: Economics of country liquor of Sanjivani Co-operative Sugar Factory

Year	Country liquor Production (liters)	Per liter	Total selling prices (Rs. Lakh)	Production cost per liter	Total Cost of Production Lakh	Net Profit (Rs. In lakh)	Net Profit (%)
	1	2	1×2=3	4	1×4=5	3-5=6	6×100/3
2003-04	13971722	24.22	3383.95	21.36	1881.99	399.59	11.80
2004-05	16938182	29.20	4945.94	28.96	3108.15	40.65	0.82
2005-06	22363054	30.65	6854.27	28.73	4298.17	429.37	6.26
2006-07	22950254	30.17	6924.09	26.92	4087.44	745.88	10.77
2007-08	23623068	31.03	7330.23	26.59	3451.33	1048.86	14.30
2008-09	12208579	32.81	4005.63	27.67	3378.11	627.52	15.67
2009-10	15168416	35.73	5419.68	30.88	4684.00	735.67	13.57
2010-11	15703681	36.34	5706.71	29.40	4616.88	108.84	19.10
2011-12	13792194	39.21	5407.92	35.54	4901.74	506.17	9.36
2012-13	9094097	41.8	3817.70	34.84	3168.38	64.32	17.01

***Source*:** - compiled from annual reports of Sanjivani sugar from 2003-04 to 2012-13

Above table no. 5 shows the details about the production of country liquor and net profit earned by Sanjivani distillery. The highest profit was earned in 2010-11, where production was highest. Production of country liquor varies with the use of rectified spirit. Throughout the study period, Sanjivani has utilized its own rectified spirit by fluctuating trends. The profit earned can be diverted towards sugar factory this will help the sugar factory to serve adequately the interest of the farmers in term of payment of cane price and make up the accumulated losses of sugar.

Bagasse

Bagasse is a fibrous residue of the cane stalk left after crushing and extraction of juice. Bagasse production is seasonal so it must be stored over the period when production is stopped. In processing of one M.T. sugarcane produce 300 kg. bagasse. Production of bagasse is depending on fiber in sugarcane. Generally 30 percent fibers are in sugarcane. There are various options in case of bagasse (a) it can be selling in the market (b) use for production of paper and (c) used for co-generation. In Maharashtra, paper mills as a by-products were not successful. Paper mills were closed, due to financial problems in the market; bagasse can be used for co-generation. In the first stage, researcher calculated the economic situation, when bagasse sold in the market. Co-generation is the next option.

*Present selling price of bagasse = basic price Rs. 2500 per M.T. and VAT 5 percent.

About 40 percent bagasse of crushing capacity is use for sugar factory for its processing purpose i.e. 3000 TCD × 40 percent = 1200 tonnes steam (one kg. bagasse = two kg. steam) it means 600 tonnes of bagasse is used per day this ratio is depend on boiler pressure and steam temperature. This ratio is generally used for 21 kg. boiler.

Table 6: Production and selling of bagasse

Year	Kopargaon Co-operative Sugar Industries Ltd.			Sanjivani Co-operative Sugar Industries Ltd.		
	Production M.T. (excluding own consumption by the factory)	As per current Market Prices (Rs. per M.T.)	Total Selling prices Rs. In Lakh.	Production M.T. (excluding own consumption by the factory)	As per current Market Prices (Rs. per M.T.)	Total Selling prices Rs. In Lakh.
2003-04	99,176	660	654.56	1,07,239	660	707.77
2004-05	49,851	848	422.73	58,263	848	494.07
2005-06	1,65,535	450	744.90	1,49,872	450	674.42
2006-07	1,89,955	292	554.66	1,75,991	292	513.89
2007-08	1,94,536	1,191	2,316.92	1,80,435	1,191	2,148.98
2008-09	1,28,722	1,191	1,533.08	1,07,369	1,191	1,278.76
2009-10	1.01,380	1,538	1,559.22	95,496	1,538	1,468.72
2010-11	1,43,023	875	1,251.45	1,35,474	1,274	1,725.93
2011-12	1,67,530	1,400	2,345.42	1,50,246	1,114	1,673.74
2012-13	1,35,991	1,700	2,311.84	1,44,800	1,181	1,710.08

***Source*:** - compiled from annual reports of Kopargaon & Sanjivani Co-operative sugar Factory from 2003-04 to 2012-13

It can be depicted from above table no. 6 production of bagasse depends upon the quantity of sugar cane crushed. The fluctuating trend in bagasse production is seen throughout the study period. Initially during 2008-09 and 2009-10, the price of bagasse per M.T. was quite high, but in 2010-11 there was a sudden fall in the price which reduced the total amount earned though there was a highest production of bagasse during the year. The highest price per M.T. has been realized during the year 2012-13

Bio- Gas

The spent wash is very toxic and harmful to aquatic life and Cattle. Due to high concentrations of inorganic matter, it cannot be used as irrigation water on land. Very bad smell is

emitted by decomposition of spent was causing atmospheric pollution. The problem faced by distilleries is to treat the spent wash efficiently and effectively and save the local population from health hazards. The process of bio-digestion of treatment problem and during the course also produces a valuable by product Bio-gas. The bio-gas produced during the anaerobic fermentation of spent wash is valuable fuel for distillery boilers. There are a number of different technologies available for bio-digestion of spent wash.

The following table gives the details of bio-gas generated; spent wash proceeds and bagasse save by Kopargaon and Sanjivani biogas plant.

Table 7: Working of Bio-gas

Year	Kopargaon Co-operative Sugar Industries Ltd.			Sanjivani Co-operative Sugar Industries Ltd.		
	Spent wash processed (NM^3)	Bio- gas generation (NM^3)	Bagasse saved in M.T.	Spent wash processed (NM^3)	Bio- gas generation (NM^3)	Bagasse saved in M.T.
2003-04	53706	2023000	5183	530523	17507253	37885
2004-05	39264	1479000	3789	260403	8593298	18595
2005-06	92971	3502000	8972	332956	10987614	23777
2006-07	105157	3961000	10148	366412	12091664	26166
2007-08	106059	3995000	10235	335996	11087907	23994
2008-09	99746	3757185	9626	235172	7760697	16794
2009-10	43673	1437280	3683	152319	5026538	10282
2010-11	45499	1603060	3847	135254	4463402	10550
2011-12	43010	1465985	3665	164976	54444215	128686
2012-13	39723	1495252	3738	186562	6156569	14551

***Source*:** - compiled from annual reports of Kopargaon sugar from 2003-04 to 2012-13.

It can be shows from table no. 7 that each year, considerable amount of biogas has been produced with the help of spent wash. Generation and use of biogas in sugar mills help to save the bagasse which otherwise would have been used in the progress of production. Bagasse, thus saved can be used in processing of ethanol which can generate additional income. Quantity of biogas generated fluctuates with the quantity of spent wash processed. Generation of biogas helps to save the bagasse which diverted for further processing in distillery and co-generation.

Sugar factory and their by-product unit profit and losses

Production of by-product helps in generation of additional income that can help the sugar mills to make up the accumulated losses. The following table gives the details about the income generated by sugar mills under study.

Table 8: Comparison between of sugar factory and their by-product unit profit and losses (Rs. In Lakh)

Year	Kopargaon Co-operative Sugar Factory			Sanjivani Co-operative Sugar Factory		
	Sugar	By-product	Total	Sugar	By-product	Total
2008-09	10450	1465.88	-585.00	141.90	1264.04	-152.17
2009-10	290.87	1536.55	-294.12	-1786.24	792.73	-1634.07
2010-11	312.74	2557.47	18.62	490.25	1978.31	-735.30
2011-12	23.49	2034.79	42.11	411.74	33.27.31	227.91
2012-13	83.27	3346.27	125.38	330.38	3093.02	6.81

***Source*:** - compiled from annual reports of Kopargaon sugar from 2008-09 to 2012-13.

From the table no. 8 reveals the comparison between of sugar factory and their by-product unit profit and losses. The selling price of sugar has kept fluctuating throughout the study period and also due to seasonal nature of sugar industry, the industry has been running into the losses. Processing of by-products has led to earning of profits which have been diverted towards the sugar factory as a result of which the factories have been able to make up their losses and earn profit. Kopargaon and Sanjivani have recovered their losses and are in a profitable position today. The profit earned can be diverted towards sugar factory. This will help to the sugar factory to serve adequately the interest of the farmers in terms of payment of cane price and development of the area concerned.

Conclusion

Molasses and bagasse was a residue left after crushing sugarcane. Hence, production of molasses cannot be increased or decreased be sugar mills. It ultimately depends on the quantity of sugarcane. Establishment of by-product plant improves the financial health of sugar industry. The loss of sugar mills recovered through profit of by-products. Ethanol, country liquor, co-generation, bio-gas were the best example of by-products. Co-generation was useful for reduction in power shortage and sugar industries indirectly health socio-economic development of the state. Production of ethanol reduced the import of oil and useful for enhancement of the financial health of sugar industry. But this issue not seriously taken by Central Government. There was no any long term policy determined by the State and Central Government.

Suggestions

1. Sugar industries must set up processing plants for molasses and bagasse as the processed products help to generate more profits than can be diverted towards making up of the losses and for further expansion and modernization.
2. Input cost of sugarcane is continuously increases but as per inflation sugarcane price is not increased accordingly. Hence, it is necessary to produce various by-products.
3. Sugar industries must set up processing plants for molasses and bagasse as the processed products help to generate more profits than can be diverted towards making up of the losses and for further expansion and modernization.

References

1. Lokhande MA. A Study of Indian Sugar Industry in Post Reforms Era, Cooperative perspective, 2005; 40(10):7-12.
2. Pandey AP. sugaring the profit pill of co-operative movement; Bombay, Deccan Herald. 2007.
3. Mahadik AS. Economics of Molasses Based By-Products of Co - Operative Sugar Factories In Kolhapur, Satara, Sangli and Solapur District. Ph.D. thesis submitted to Shivaji University. Kolhapur. 1991.
4. Gurav AM. A Study of Cost and Productivity of Cooperative Sugar Factories in Kolhapur District, Ph.D. Thesis, Shivaji University, unpublished thesis. 2003.
5. Research RK. ÉDGE, Sugar Industry Report. 2008.
6. Rangrajan Committee C. Government of India, New Delhi. 2012.