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GOVERNMENT POLICY INITIATIVES AND GROWTH OF SUGAR INDUSTRY IN INDIA

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ABSTRACT :

Sugar industry is an important agro-based industry that impacts rural livelihood of about 50 million sugarcane farmers and around 5 lakh workers directly employed in sugar mills. Employment is also generated in various ancillary activities relating to transport, trade servicing of machinery and supply of agriculture inputs. India is the second largest producer of sugar in the world after Brazil and is also the largest consumer. Today Indian sugar industry's annual output is worth approximately 80,000 crores. Surplus production over domestic consumption in the last three sugar seasons and low exports due to subdued international sugar prices have led to building up of sugar stocks with the mills and low realization from sale of sugar. This has adversely affected the financial health of the mills and resulted in accumulation of cane price arrears.

KEYWORDS : *Indian sugar industry's , financial health , trade servicing of machinery.*

1. INTRODUCTION

Sugarcane as a crop has long back history. Now it has become one of the important cash crops in the world. It is cultivated in tropical and subtropical climate. Brazil, India, China, Thailand, Australia, Cuba with South and Central America are the major sugarcane producers in the world. Asia ranks first in respect of area under sugarcane followed by South America, Central America, and Caribbean countries. Now-a-days sugar industry has an astonishing tradition and place in the world economy. This industry has been emerging as a prominent player in world economy. There are 122 sugar producing countries in the world, out of which 67 countries are making sugar from sugarcane and 55 countries making sugar from beet. Brazil, India, China, United States, Thailand, Australia, Mexico, and Pakistan are the frontrunners in sugar production. Sugar with its byproducts like ethanol, power, alcohol, paper, particle board, industrial chemicals, and bio fertilizers is contributing significantly in driving various industries in the world. Sugar has grown over centuries to be a major commodity in the world market. Brazil and India occupies first and second positions respectively in world sugar production.

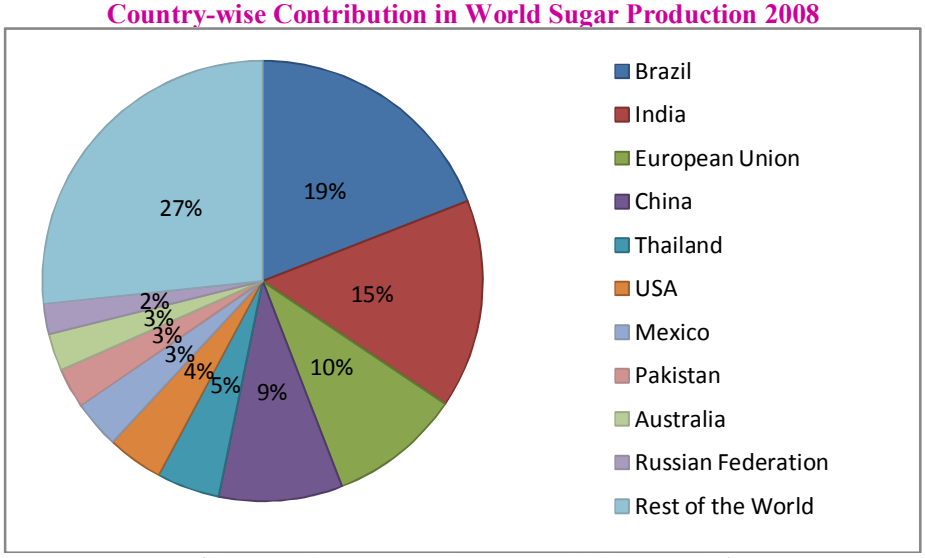
Table 1
Top Ten Sugar Producers in the World in 2008
(In million metric tonnes)

Sr.No	Country	Production
1	Brazil	32.29
2	India	25.94
3	European Union	16.38
4	China	15.40

5	Thailand	7.77
6	USA	6.96
7	Mexico	5.94
8	Pakistan	4.99
9	Australia	4.62
10	Russian Federation	3.79
11	Rest of the World	45.09
	Total	**169.17**

(Source- Cooperative Sugar Jan. 2010 Pp.88)

Graph 1
Country-wise Contribution in World Sugar Production 2008



(Source- Cooperative Sugar, Jan.2010, Page 88)

India is a country with prominent agrarian economy. It has a remarkable tradition of agriculture coupled with agro based industries. Though India is said to have been developing economy, it is still considerably an underdeveloped country. Prominent features of underdeveloped countries are: They are '*agrarian economies'*. Most of the population of such countries is dependent upon agriculture and agro-ancillary activities. Agro raw material and food grains are the major products of such countries. These products contribute extensively in GDP of these countries. Indian economy still has all these features. Naturally, these features initiate agro based industrial culture in India. These agro based industries play a crucial role in economic development of India. Agricultural and allied sector's contribution in India's Gross Domestic Product is 183 US billion dollars which is 17.2% of total (ESI 2009). Agriculture and allied sector provides livelihood to 71% of country's population. Cotton and sugarcane are the major cash crops which support and contribute notably in India's agro economy. Cotton industry is largest agro industry in India followed by sugar industry. Cotton and sugarcane are cultivated on 9.09 mn/ha and 4.50 mn/ha respectively (Agricultural Statistics at a glance, 2008). Hence, growth of agro processing sector has been naturally taken place in India. In this regard, while considering cash crop pattern in Indian agriculture, sugarcane has a prominent place in Indian agrarian economy. Accordingly, it has given birth to sugar industry in India.

It is universally acknowledged that India is the home land of sugarcane and sugar. Sugarcane has been one of the major crops of India since time immemorial. As sugarcane being grown in India since ancient period, producing *'Sugar'* or *'Gur'* from sugarcane is also done from that time (Lallanji, 1964). In India Gur and Khadsari was produced as cottage industry but first industrial effort for making sugar was done by the European and French people in Bihar, Orissa, and United Province since 1791 (Deer, 1949). After the initial gradual beginning of Indian sugar industry, India was considerable exporter of unrefined sugar till 1864.

Consequently, at the outset of the 20th century, i.e. 1902 to 1905, sugar factories at Purtabpur, Marhowarh, Rosa, Puisa, and Barrachakia in North India and Ottur in Bihar were started (Gandhi, 1934).

Initially lots of efforts were made by then British Government for development of the domestic sugar industry. In this regard, in 1922, through a committee report, Government found out feasibility of development of sugar industry in India. Agricultural Advisor of Government of India had also studied potential cane cultivation area. Recommendations of Imperial Council for Agricultural Research, import duty protection given by Sugar Committee in 1929 and passing of Sugar Industry protection Act, 1932 helped domestic sugar industry in rooting down. At the advent of cooperative movement in the country, the farmers in Andhra Pradesh set up cooperative sugar factories in the state, but due to initial teething problems, lack of organizational and managerial ability, the cooperative sugar industry in the country was not flourished and its growth till independence was limited.

Table 2
Growth of Development of Sugar Factories in 1930 to 1950

Year	Area Under Sugarcane Mn/Hactare	Sugarcane production Million Tonnes	No. of Factories	Sugar Production Million Tonnes
1930-31	1.18	36.35	29	0.12
1935-36	16.81	62.18	135	0.93
1940-41	16.17	51.97	148	1.11
1945-46	12.99	47.27	145	0.96
1950-51	17.07	54.82	139	1.10

(Source- Cooperative Sugar Feb. 2010)

After independence, our Government has entered into industrialization and adopted economic planning through five year plans. The sugar industry in India was brought under the control of Government. The industry has experienced extensive growth under protective environment till 1990. At the end of the Seventh Plan, i.e. in the year 1990, cane cultivation in the country had reached to 3.43 million hectare and cane production was over 225 million tonnes. There were 377 sugar industries in the country producing sugar around 11 million tonnes.

At the advent of new economic era, i.e. after 1991, India became the largest sugar producing country in the world. Area under cultivation during this plan crossed 4 million hectare and number of sugar factories reached to 412. In the Ninth Plan, again the industry recorded remarkable hike in all respects. One more important decision taken by the Government in the month of August 1998 was de-licensing of sugar industry in the country. It helped and encouraged in setting up new sugar mills as well as capacity expansion up to 5000 TCD of the existing mills. The industry has witnessed horizontal expansion and with the liberalization of economy, it titled towards the private segment. During the 10th Plan, in the year 2006-07, Indian sugar industry has recorded highest growth in terms of cane cultivation, cane production and sugar production.

Table 3
Development of sugar industry in India during 5 year plans

Plan	Year	Area under Sugarcane Mn/ha	Sugarcane Production Mn/tn	Factories in Operation	Sugar Production Mn/tn
First Plan	1951-56	1.84	58.38	143	1.83
Second Plan	1956-61	2.42	110.01	174	3.02
Third Plan	1961-66	2.84	123.99	200	3.54
Annual Plans	1966-69	2.53	124.68	205	3.55
Fourth Plan	1969-74	2.75	140.80	229	3.94
Fifth Plan	1974-79	3.08	151.66	299	5.84
Annual Plan	1979-80	2.61	128.83	300	3.85

Sixth Plan	1980-85	2.95	170.31	339	6.14
Seventh Plan	1985-90	3.43	225.56	377	10.99
Eighth Plan#	1990-97	4.17	277.56	412	12.90
Ninth Plan	1997-02	4.41	297.20	434	18.52
Tenth Plan	2002-07	5.15	355.52	504	28.36

(Source- Cooperative Sugar February 2010)
'#' – Eighth plan was carried over by 2 years i.e. till 1997
Figures in plan period are of the last year of plan

The Indian sugar industry has now achieved the only singular distinction of being one of the largest producers of white plantation crystal sugar in the world but has also turned out to be a massive enterprise of gigantic dimensions (Nair, 2005). It has spread especially in states like Maharashtra, Uttar Pradesh and Karnataka because of extensive irrigation facilities, construction of dams, water shading programs, etc. The industry contributes 7.5% of total agro product (GOI, 2009).

Table 4
No. of operating factories, cane crushed and sugar produced in different states of India during the year 2008-09

Sr. No	State	No. of Factories in Operation			Cane Crushed (In 000, tonnes)	Sugar Production (In 000, tonnes)
		Coop	Pvt/Pub	Total		
1	Uttar Pradesh	25	107	132	45482	4064
2	Maharashtra	110	37	147	40023	4578
3	Tamil Nadu	15	22	37	16606	1598
4	Karnataka	12	38	50	16104	1654
5	Gujarat	17	1	18	9445	1012
6	Andhra Pradesh	8	27	35	5993	593
7	Uttarakhand	4	6	10	2421	223
8	Harayana	10	5	15	2528	229
9	Bihar	0	9	9	2370	214
10	Punjab	9	7	16	2603	242
11	Madhya Pradesh	3	6	9	581	56
12	West Bengal	0	1	1	29	2
13	Orissa	3	2	5	327	31
14	Chhattisgarh	1	0	1	150	13
15	Rajasthan	0	1	1	42	4
16	Goa	1	0	1	108	9
17	Puducherry	1	0	1	166	17
	All India	**219**	**269**	**488**	**144978**	**14539**

(Source- Compiled data from cooperative sugar, Jan and Feb, 2010)

The industry provides employment to 2 million rural, skilled and unskilled people as well as 5 million cane growers and around same number of indirect labourers depend upon the industry. At present the industry has total investment of 50000 crores and annual turnover of 7000 crores. The industry contributes 2800 crores to the central and state exchequer (ISMA 2009). At present, there are 17 sugar producing states in the country with cumulative 19 million metric tonnes sugarcane crushing capacity. 626 sugar factories (GOI 2009) located throughout the country working as centre for the overall rural development. Sugar industry in India has been playing a crucial role in socio-economic development of rural population. Since last six decades, it has changed the facets of Indian economy and achieved prominent place in Indian economy.

2.GOVERNMENT INITIATIVES FOR THE REVIVAL

The Sugarcane (Control) Order, 1966 stipulates payment of cane price within 14 days of supply, failing which interest at the rate of 15 per cent per annum on amount due for the delayed period beyond 14 days is payable. The powers for enforcing this provision are vested with the State Governments/Union Territories administrations. Further, the Central Government advises the State Governments/Union Territories from time to time to ensure timely payment of cane dues to the farmers and to take action against the defaulting sugar mills.

In order to facilitate clearance of cane price arrears of previous sugar seasons and timely settlement of cane price of current sugar season to sugarcane farmers, the Central Government, on 3 January 2014, had notified a Scheme for Extending Financial Assistance to Sugar Undertakings (SEFASU-2014), envisaging interest-free loans worth Rs. 6,600 crores by bank as additional working capital to sugar mills. Under the scheme, all loans were to be sanctioned by 30 June 2014 and disbursed by 30 September 2014. Out of sanctioned loan amount, loan amounting to Rs. 6,420.09 crores has been disbursed up to 30 September 2014. The beneficiary sugar mills under the scheme had time up to 31 December 2014 to utilize the loan for cane payment arrears.

An additional grant of interest-free loans of Rs. 4,400 crores to factories for settlement of cane dues was announced in June 2014. To encourage sugar factories to export raw sugar, in view of high sugar inventories, a scheme was notified in February 2014, which allows incentives for marketing and promotion services for raw sugar production targeted for export markets for 4 million tonnes during the 2013-14 and the 2014-15 sugar seasons from Sugar Development Fund (SDF). This export incentive has been extended till September 2014. An increased provision for blending of a cane by-product *viz.* Ethanol with petrol from 5 per cent to 10 per cent has also been made. These measures have been announced with a view to raise demand for sugar and sugar products and to increase the liquidity of the sugar mills so that they can clear the cane dues.

3.BENCHMARK FOR COMPETITIVENESS

According to Shri Prakash Naiknavare, the Managing Director of Maharashtra's Cooperative Sugar Federation, 'Minimum 100 tonnes cane output per hectare and minimum 12% sugar recovery' should be the mission target for farmers and millers respectively.

4.GOVERNMENT POLICY ON SUGAR

The sugar industry in India is highly regulated not only at the central level but also at the state whereby the State Government intervene in matters relating to sugarcane production and pricing. The department of food and public distribution monitors and implements various policies of the Government and development of sugar industry. It also takes stock of the indigenous production, internal requirement and allocation of sugar.

In the past, the Government permitted only small sized units of 1,250 TCD and 2,500 TCD. Expansions for 5,000 TCD and above were discouraged. As a result, the industry grew horizontally. In August 1998, the Government of India de-licensed the sugar sector, encouraging entrepreneurs to set up sugar mills at a distance of 25 kilometers away from an existing sugar mill, which at present is further reduced to 15 kilometers.

The de-licensing is applicable not only for the new capacity initiatives but also for expansion of existing capacities.

5.THE MAJOR REGULATIONS IN THE SUGAR SECTOR

The major regulations in the sugar sector are as follows:

The Essential Commodities Act, 1964
Sugar Control Orders, 1943, 1966 and 1999
Sugarcane Control Order, 1966
Sugar Export Promotion Act, 1958
Sugar Cess Act, 1982
Sugar Development Fund Act, 1982
Sugar Packaging Order; Jute Packaging Materials (Compulsory use in Packing Commodities) Acts, 1987

Sugar Wage Board Rules
Molasses Control Order, 1961 and Molasses Decontrol, 1993
Excise and Customs Rules

Besides, sugar factories have to negotiate with state authorities, such as Cane Commissioners and State Food Secretaries, on several issues. The Cane Commissioners of the States decide on the command area to be allotted to each sugar factory. At present new factories can be set up within 15 kilometers of the existing factory.

6 MAJOR RECOMMENDATIONS OF THE MAHAJAN COMMITTEE

In March 1997, the Central Government appointed a high-powered committee headed by former Food Secretary, Mr. B.B. Mahajan, to study regulation on the sugar industry. The Committee submitted its recommendations in April 1998. The major recommendations of the Mahajan Committee are as follows:

1. Phased decontrol of sugar from levy quota system.
2. Government should purchase sugar from open market for Public Distribution System (PDS) supply.
3. Fixed a minimum benchmark of 11.5% sugar content in sugarcane and a recovery rate of 8.5% to improve the quality of Indian sugarcane.
4. Continuing SMP to protect sugarcane growers – but linking of sugarcane prices to sugar content instead of recovery rate.
5. Fixing cane prices (SMP) for zones instead of current practice of state level prices.
6. Setting up of central sugarcane pricing board to determine prices of sugarcane (SMP) for various zones (currently the State Governments are fixing the price).
7. The sugar mills should statutorily be required to pay a minimum of 80% of the sugarcane price in advance and the rest before the end of the sugar season.
8. Continuation of licensing system only for new mills and not for capacity additions.
9. Sugar import may continue to be under open general license.
10. The cane area reserve policies should continue. As per the policy, all cane growers in the reserved area of the mills are required to supply cane to the specified from the reserved area for supply to the mill.
11. No new Khandsari mill should be allowed within the reserved area of a sugar mill.

Certain recommendations like reduction in the levy ratio to zero percent, setting up of a Sugarcane Pricing Board and fixing of an Annual Sugar Export Quota are yet to be implemented.

7 DE-REGULATION OF SUGAR SECTOR

The Central Government considered the recommendations of Dr. C. Rangrajan Committee on de-regulation of sugar sector and decided to do away with levy obligation on sugar mills for sugar produced after September 2012 and dispense with the regulated release mechanism on open market sale of sugar. The de-regulation of the sugar sector is likely to improve the financial health of the sugar mills, increase the cash flow, reduce their inventory cost and also result in timely and better payment of cane price to sugarcane farmers in the country. The recommendations of the Committee relating to Cane Area Reservation, Minimum Distance Criteria and adoption of the Cane Price Formula have been left to the State Governments for adoption and implementation, as considered appropriate by them.

8 CURRENT SCENARIO (SUGAR SEASON 2014-15)

The sugar season 2014-15 has started from October 2014 with a carryover stock of 75 lakh tonnes. The production in new season is estimated to be around 250-255 lakh tonnes. Thus, there will be about 330 lakh tonnes of sugar available as against consumption requirement of 245 lakh tonnes. The cane price arrears of about Rs.5,900 crores of 2013-14 still remain unpaid. Sugar prices are ruling around Rs.2,650 per quintal, much below the cost of production. Meanwhile, the Central Government has increased the FRP by Rs.10 per quintal leading it to Rs.220 per quintal for 2014-15.

In Karnataka, Hon'ble High Court has upheld the notification of the State Government notifying cane price at Rs.2,500 per tonne for 2013-14. The mills have only paid FRP fixed by the Centre at Rs.210 per quintal. The Uttar Pradesh Government has decided to maintain previous year's State Advised Price of Rs.280

per quintal for 2014-15 season, but farmers in Uttar Pradesh are demanding cane price at Rs.350 per quintal, while in Maharashtra, farmers are demanding Rs.2,700 per tonne in current sugar season.

The 2014-15 sugar season has started with a lot of uncertainties as to whether the mills would be able to begin operation due to their grave financial constraints and due to cane pricing policy implemented by State Governments. Mills in all States, including in Uttar Pradesh, Karnataka and Maharashtra, are facing issues relating to cane pricing and payment to the cane farmers.

In order to ensure sustainable good health of the Sector, a revenue sharing formula should be evolved between the sugar mills and the cane farmers in the ratio of their relative cost as per the recommendation of the Rangrajan Committee. As per the Committee recommendations, the ideal value-sharing is 70 per cent for cane growers and 30 per cent for mills including revenue from sugar and its by-products. Few States like Maharashtra and Karnataka have already constituted Sugar Control Board to implement the revenue sharing formula. For successful implementation, cane-growers are to be guaranteed FRP payments, irrespective of the sugar market behaviour. In case the revenue in a particular season warrants higher payments to growers, they should be entitled to a second payment.

4.9 IMPLEMENTATION OF RECOMMENDATIONS OF DR. RANGRAJAN COMMITTEE

Issues	Gist of Recommendations	Action Taken
Cane Area Reservation	Over a period of time States should encourage development of such market-based long-term contractual arrangements and phase out cane reservation area and bonding. In the interim, the current system may continue.	The recommendation has been referred to the concerned State Governments for adoption and implementation as considered appropriate by them.
Minimum Distance Criteria	It is not in the interest of development of sugarcane farmers or the sugar sector and may be dispensed with as and when a state does away with cane reservation area and bonding.	-do-
Sugarcane Price : Revenue Sharing	Based on an analysis of the data available for the by-products (molasses and bagasse/ cogeneration) the revenue-sharing ratio has been estimated to amount to roughly 75 per cent of the *ex*-mill sugar price alone.	-do-
Levy Sugar	Levy sugar may be dispensed with. The states which want to provide sugar under PDS, may henceforth procure it from the market directly according to their requirement and may also fix the issue price. However since currently there is an implicit cross-subsidy on account of the levy, some level of Central support to help states meet the cost to be incurred on this account may be provided	Central Government has abolished levy on sugar produce after 1st October 2012. Procurement for PDS operation is being made from the open market and the Central Government is giving a fixed subsidy @ Rs. 18.50 per Kg. to make sugar available at Retail Issue price of Rs. 13.50 per Kg.

	for a transitory period.	
Regulated Release Mechanism	This mechanism is not serving any useful purpose and may be dispensed with.	Regulated Release Mechanism for open market sale of sugar has been dispensed with.
Trade Policy	As per the committee, Trade Policies on sugar should be stable. Appropriate tariff instruments like a moderate export duty not exceeding 5 per cent ordinarily as opposed to quantitative restrictions should be used to meet domestic requirements of sugar in an economically efficient manner.	No export duty on sugar. Import duty stands at 15 per cent.
By-products	There should be no quantitative or movement restrictions on by-products like molasses and ethanol. The prices of the by-products should be market-determined with no earmarked end-use allocations. There should be no regulatory hurdles preventing sugar mills from selling their surplus power to any consumer.	In order to harness the full socio-economic potential of the sugar sector, State Governments have to take appropriate step to enhance the productivity of sugarcane and the recovery of sugar. In addition, the effective utilization of its by-products, i.e. bagasse, molasses and press-cakes are necessary to make the industry globally competitive. The State Governments have been requested to reconsider the regulatory controls on movement of molasses which can be used for producing ethanol.
*(**Source:** India. M/o Consumer Affairs and Food and Public Distribution, Note of Directorate of Sugar, 2014, pp.10-11)*		

India had been known as the original home of sugarcane and sugar. Mention of sugar has been found in our revered ancient religious texts like Vedas, and also in Ramayana and Mahabharata. Articles also suggest that Indians knew the art of making sugar since fourth century B.C. It is universally acknowledged that India is the homeland of sugarcane and sugar. There are references of sugarcane cultivation, its crushing and preparation of Gur in Atharva Veda as well as Kautaliya's Arthashastra. The scribes of Alexander the Great, who came to India in 327 B.C., recorded that inhabitants chewed a marvelous reed which produced a kind of honey without the help of bees. The Indian religious offerings contain five 'Amrits' (elixirs) like milk, curd, ghee (clarified butter), honey and sugar which indicates how important sugar is not only as an item of consumption but as an item which influences the Indian way of life. It is understood that sugar was initially made in India during fourth and sixth centuries by cutting sugarcane into pieces, crushing the pieces by weight to extract the juice and then boiling it to crystallize. These crystals were called 'Sarkara' meaning gravel in Sanskrit. The word sugar is a derivative of 'Sarkara'. The larger lumps were called Khand from which the

English word 'Candy' is derived. Around 600 A.D., the Chinese Emperor Tsai Hang sent an emissary to Bihar, where sugarcane was cultivated for making sugar, to learn the art of making sugar. Therefore, it is from India that the art of making sugar went to Persia and subsequently to the world over. However, in the eighteenth century, India lost the initiative to the European, American and Oceanic countries, as the sugar industry witnessed the development of new technology. Also Brazil emerged as a major producer of sugar in the world.

Although sugarcane was being grown in India from time immemorial and sugar produced in lumps during fourth century, there was no sugar industry in India. It is said that the first sugar plant in India was established by the French at Aska in Orissa in 1824. Not much is known about this factory except that Late James Fredrick Vivian Minchin maintained it and that it stopped its operation around 1940. However, the first vacuum pan process sugar plant was set up at Saran in Marhowrah in Bihar in 1904. By 1931-32, there were 31 sugar factories in India, all of which were in the private sector. The total production of sugar at that time was only about 1.5 lakh tonnes, whereas the consumption was about 12 lakh tonnes. To meet the domestic demand of sugar, India had to import sugar mainly from Java (Indonesia).

As mentioned above, the advent of modern sugar industry in India dates back to mid 1930's when a few vacuum pan units were established in the sub-tropical belts of Uttar Pradesh and Bihar. However, until the mid 1950's, the sugar industry was almost confined to the states of Uttar Pradesh and Bihar. After late 1950's and early 1960's, the industry dispersed into southern India, western India and other parts of northern India.

Today, India is the largest consumer and second largest producer of sugar in the world (Source: USDA Foreign agricultural Service). The Indian sugar industry is the second largest agro-industry located in the rural India. The Indian sugar industry has a turnover of Rs. 500 billion per annum and it contributes almost Rs. 22.5 billion to the central and state exchequer as tax, cess and excise duty every year (Source: Ministry of Food, Government of India). It is the second largest agro-processing industry in the country after cotton textiles. With 581 installed sugar mills and 453 operating sugar mills in different parts of the country, Indian sugar industry has been a focal point for socio-economic development in the rural areas. These mills are located in 19 states of the country. Around 312 of the total installed mills are in the cooperative sectors, 205 in the private sector and 64 in the public sector (Source: Directorate of Sugar). Out of 453 operating sugar mills in the country, 252 are in the cooperative sector, 134 are in private sector and 67 are in the public sector. Besides, 136 units in the private sector are in various stages of implementation. A few such units are under implementation in the cooperative sector as well. But no new units have been present in the public sector.

The challenges which need to be addressed in order to enhance sugarcane/sugar productivity and sustaining soil health include: continuously decreasing size of land holdings with time and increasing population, shortage of labour for performing various field operations, plateauing of yield and sugar recovery, decline in sugarcane acreage in times to come, cultivation of de-notified sugarcane varieties defending the gains already made, prevailing invasive insect-pests and diseases and weeds affecting productivity and also the upcoming pests, declining factor productivity and tendency of the farmers to quit farming. For improving productivity of sugarcane, bridging the gap between theoretical yield and commercial yield need to be attempted; and for which Krishi Pandits have paved the way. In order to improve sugarcane and sugar production and increase factor productivity in India utmost attention is a need for the profitable sugar cultivation in the small and marginal land holdings. Therefore, all the research and development programs for sugarcane should be formulated and implemented in proper spirit. Adoption of some of the beneficial features of sugarcane agriculture in Brazil may also be very useful in Indian context.

Sugarcane, a multi-product crop with immense potential for diversification, is one of the important cash crops in India, which is grown in nearly 4.5-5 million ha. As per the estimates of the National Commission of Agriculture (1976) and by other agencies, the population of the country is expected to reach 1.5 billion by 2030 A.D. at a compound growth rate of 1.6% per annum. The present level of sugar consumption of 22.6 Kg. is likely to go up by 35 Kg. (including both white sugar and Gur/Jaggery) by 2030 A.D.; and we shall be requiring nearly 52 million tonnes of sweeteners by this time. In recent past, sugarcane has also emerged as an important energy crop yielding electrical power through cogeneration fuel through ethanol. Thus, to meet this demand of sugar as well as the bio-fuel alcohol by 2030, around 520 million tonnes of sugarcane will be needed with an average recovery of 10.75 (312 million tonnes for sugar and 78 million tonnes for alcohol production).

Natural challenges also influence agriculture and affect sugarcane productivity. Challenges arising from biotic stresses, climate change and diminishing water resources have resulted in declining sugarcane productivity and quality as well as its cultivation. Emergence of new insect-pests and diseases has also added to these losses. Emerging diseases like **yellow leaf disease** needs immediate attention and in-depth studies are required in this regard.

In view of the above, the following is being suggested to address these challenges so as to improve factor productivity for sugarcane and sugar, in the national interest, per se.

9.1 LAND HOLDINGS BECOMING SMALLER AND SMALLER:

In India, nearly 85% of the farming families are small holder farm families (small, marginal and sub-marginal); and about 80% of these are marginal (<0.5ha) and sub-marginal (<0.1 to 0.5 ha). Small holders cultivate about 45% of the cultivated lands and produce 50% of total agricultural production. Over 50% of the small holders possess <0.5ha land and their number has been increasing with increasing population; as a result small is getting smaller. In spite of higher productivity levels, such small and fragmented holdings are not economically viable. In sugarcane crop, small and marginal holdings are 75% covering 48.54% of the sugarcane acreage, whereas remaining 25% of the farmers having semi-medium (16.58%), medium (7.46%) and large (1.0%) holdings cultivate the remaining half of the acreage of sugarcane.

Some of the non-monetary inputs to sugarcane agriculture desirable for small and marginal resource poor sugarcane farmers are: use of a locally adapted/recommended high yielding/high sugar/good rationing variety, timely planting, maintaining optimum plant population, zero-till cultivation crop rotation and intercropping, trash mulching (serves as a mulch, reduces water requirement and also adds to soil organic matter, macro and micronutrients after its decomposition), harvesting the crop at ground level (with additional yield, it also ensures better rationing, improves sugar content and also saves cost on stubble shaving before initiating a ratoon crop). Adoption of multiple ratooning saves cost of seed cane and pre-planting operations (seed bed preparation, etc.), and also enhances recovery during early crushing. Use of Low Energy Water Application (LEWA), which is a water and energy efficient pressurized irrigation system suitable for small and marginal farmers, should be promoted.

9.2 SHORTAGE OF LABOUR FOR PERFORMING VARIOUS FIELD OPERATIONS:

On an average, 167-325 man-days are required for performing various field operations for raising and harvesting one hectare of sugarcane crop. Besides, the migration of farm labourer to other areas, the government's National Rural Employment schemes are also adding to labour shortage in a big way. In recent past, the labour charges have also increased in Maharashtra, Gujarat, North Karnataka and Tamil Nadu, leading to Rs. 350-500 per tonne of cane harvested under these circumstances. Mechanization has virtually become need of the hour. It helps in accomplishing cultural operations on time and precise application of critical inputs for enhancing the input-use efficiency.

9.3 PLATEAUING YIELD AND SUGAR RECOVERY:

In India, as a whole, over the last ten years' sugarcane yield on an average remained around 66 t/ha and varied within narrow limits (+2.6; -6.5). Some of the states like Tamil Nadu have, however, recorded cane yields as high as 101 t/ha. Sugar recovery over these years, on an average, remained around 10.27 and varied within narrow limits (+0.21; - 0.24) though some of the sugarcane growing areas in tropics like south Maharashtra (12.17), central Maharashtra (11.14), south Gujarat (10.75) recorded relatively higher recovery (Fig.1). In other sugarcane growing countries of the world, like Australia, Egypt, USA, Colombia, Brazil and Mexico, yield of cane and sugar recoveries are much higher as compared to India. The tonnage and recovery patterns in recent past may be attributed to various factors such as decreasing organic matter in soil, ground water depletion, soil salinity, nutrient imbalance and unfavorable input-output prices.

After the inter-specific hybrids have been developed, some of the varieties, superior for certain traits, have been continuously used for varietal development. These efforts, however, have met with limited gains for increasing the productivity and its sustainability, broadening of the genetic base is necessary. Concerted efforts are needed to extensively utilize the variability in wild species of sugarcane with respect to resistance to a biotic and biotic stresses, yield ratoon ability, etc.

9.4THE SUGARCANE ACREAGE MAY DECLINE IN TIMES TO COME:

With time, use of the arable lands (suitable for agriculture) for non-agricultural purposes is increasing. It is estimated that in U.P. alone, every year around 46000 ha arable land is used for non-agricultural purposes. If this trend continues, in the coming 25 years we may not be able to produce sufficient food for the people in the state. Although over the last 16 years, around 7 lakhs ha of the user and wastelands have been roped in for agricultural purpose. Being less productive, these do not yield even the average productivity. In the year 2025, the population of U.P. alone may touch 245 million and the state may need 51.37 million tonnes of food grains. But, over the last five years, food grain production is hovering only around 43-45 million tonnes. Thus, with increasing urbanization and requirement of land to cope up with food production for the burgeoning population and to meet the sweetener needs, besides improving yield and sucrose contents vertically, we should also look into the sugarcane cultivation on wastelands and improve their biological characteristics so as to cultivate sugarcane. There is no option left except to produce more sugarcane under conditions of diminishing per capita arable land and fast depleting water resources. Hence, we must harness the best in frontier technologies and integrate them with traditional wisdom and thereby launch an eco-technology movement as suggested by the great visionary, Dr. M.S. Swaminathan. In an interview on March 13, 2011, he cited an interesting solution for land a shrinking asset due to housing, roads and other urban activities. In 1967, Shri Morarji Desai, the then Deputy Prime Minister and Finance Minister, GOI, opined that the storage areas for wheat should be built on user lands which are non-productive lands. For urbanization the agriculturally productive lands should not be used and productive farmlands be used exclusively for crop production.

At present, in India, approximately 68.35 million hectare area of the land is lying as wastelands. Out of these, approximately 50% are such non-forest lands which can be made fertile again, if treated properly. A part of these lands could be utilized for increasing sugarcane acreage to meet the increasing sugar and energy (alcohol and cogeneration) needs of burgeoning population.

9.5 CULTIVATION OF DE-NOTIFIED SUGARCANE VARIETIES AND UNAVAILABILITY OF SEED CANE OF IMPROVED VARIETIES:

From time-to-time, state sugarcane departments and sugar mills de-notify sugarcane varieties which do not give the requisite amount of sugar and the sugar mills will not purchase cane of these varieties. Sugarcane farmers are advised to plant new improved varieties instead of these old de-notified varieties. But farmers use these because these give good cane yields and/or the seed cane of improved recommended varieties is not available. For improving sugarcane and sugar production per unit area, cultivation of de-notified varieties should be discouraged and the seed cane of high yielding/high sugar improved varieties suitable to various agro-climatic conditions (released by the Central Varietal Release Committee and various State Varietal Release Committees) should be made adequately available to the sugarcane farmers.

9.6 SUSTAINING THE GAINS ALREADY MADE:

Agriculture has been regarded as the most risky profession in the world since natural actors like temperature, precipitation, hail and thunder-storm, pest epidemics, etc. influence crop yield vis-à-vis economic fate of the farmers. Indian agriculture has long been described as a gamble in the monsoon, but it is also now becoming a gamble in temperature. The challenges arising from advent of a biotic stresses, climate change, marginalization of arable land, diminishing water resources and associated factors need to be faced. Needless to mention that technological gains attained so far have not only to be defended but improvement has also to be ensured to confront challenges of climate change, marginalization of arable land, ever depleting water resources, other biotic stresses, and above all the ever increasing human population.

9.7 PREVAILING INVASIVE INSECT-PESTS AND DISEASES AFFECTING PRODUCTIVITY:

In India, out of 100 pathogens (causing 72 diseases), only 12 are of economic importance. Crop suffers a great loss to the tune of 20%, both in cane yield and quality. Damage due to insect pests is 15-20% losses in tonnage and 0.5-2.5 units in recovery. Emerging new insect pests and diseases may also add to these losses. Emerging diseases, like yellow leaf disease, in many parts of the county and increasing incidence of

white grubs, mealy bugs and grassy shoot disease in western Uttar Pradesh need immediate attention for their effective management including eco-friendly technologies.

Climate change also affects insect pests and diseases. Therefore, surveillance and weather based forecasting of insect-pests and diseases needs greater emphasis. Bio-control has emerged as an important strategy to manage insect pests. Attempts should be made to enhance parasitizing efficiency of parasitoids against major insect-pests for their effective bio-control.

9.8 BRIDGING THE GAP BETWEEN THEORETICAL YIELD AND COMMERCIAL YIELD - KRISHI PANDITS HAVE PAVED THE WAY:

In State Crop Competitions in U.P., in subtropical India, cane yield as high as 138.3 to 281.9 tonnes/ha has been obtained, thus, these Krishi Pandits have paved the way to bridge the gap between theoretical and the yields obtained in field conditions. In the tropics, some of the progressive farmers in Maharashtra have achieved a cane yield of 350 tonnes/ha in *adsali* (18 months) crop. The Jai Research Foundation, Vapi, Gujarat, has obtained a cane yield of 392.5 tonnes/ha in a 12 months' crop. As suggested by Dr. Swaminatan, farm schools should be established in the fields/area of eminent farmers, the Krishi Pandits. They should also be invited to research institutes for sharing their valuable experiences/know-how for improving sugarcane productivity, per se.

9.9 DECLINING FACTOR PRODUCTIVITY:

The factor productivity measures the contribution of knowledge-based inputs (fertilizer and water and how and when to use), i.e. technology in crop production. Kumar and Mittal examined the temporal and spatial variation in Total Factor Productivity Growth (TFPG) for many crops including sugarcane, during 1971-86 and 1986 to 2000. TFPG in western, northern and southern parts of the country is going down, but there is improvement in the eastern parts. However, in the country as a whole, TFP has become negative. The productivity attained during 1980s was not sustained during 1990s. Authors have suggested shifting the production function by improving the technology interventions, judicious use of natural resources and harnessing the biodiversity at the command of breeders.

9.10 TENDENCY OF THE FARMERS TO QUIT FARMING:

The National Sample Survey Organization (Ministry of Statistics and Programmed Implementation), in a situation, Assessment Survey of Farmers (2003) reported that 40% of Indian farmers, given a choice, would "take up some other career". Sugarcane farmers are no way exception to it due to labour shortage, increased labour costs, cost of inputs, untimely payment of cane price by the mills, etc. Cane cultivation has to be made more lucrative and remunerative (timely payment, commercialization of value-added products and sharing of the profit with farmers, etc.). There could be many aspects of it.

9.10.1 INCREASING COST OF SUGARCANE PRODUCTION:

Cost of sugarcane production per hectare in some of the important sugarcane growing states in India in 2006-07 was Rs. 41,193 (in Maharashtra) and Rs. 79,794 (in Tamil Nadu), with added increase in these figures with passage of time. The fair and remunerative cane price (FRP) for 2010-11 has been fixed by the Central Government to be Rs. 13912/Qtl. for 9.5% basic recovery with a premium of Rs. 1.46 for every 0.1% increase in recovery.

9.10.2 SCARCITY OF LABOUR TO PERFORM FARM OPERATION:

The Government's National Rural Employment Scheme has also an important bearing to growing labour shortage in agriculture and forcing many farmers to abandon crop cultivation. Mechanization is the only solution to overcome the scarcity of labour to perform various farm operations. Suggestions outlined like developing equipments for small and marginal farmers and hire-purchase systems for machines could be a plausible solution to effectively address this complex issue.

9.10.3 EASY ACCESS TO FINANCIAL LOANS:

Many farmers fall prey to private money lenders. Therefore, an easy access to financial loans from

banks and other financial institutions is needed for purchasing necessary equipments/implements, seeds of improved varieties, fertilizers, pesticides, etc.

9.10.4 NON-PAYMENT OF DUES TO THE FARMERS BY THE SUGAR MILLS:

The highlights of the U.P. budget for the financial year 2011-12 indicated, "Cent per cent payment of outstanding due till 2nd February 2012 in current crushing season". However, in the season (2010-11), even after the strict directives of the U.P. Government, cane dues of nearly Rs. 745 crores are yet to be paid to sugarcane farmers and recovery certificates have been issued against 12 sugar mills in the state. As per a case pending in the Supreme Court of India, a sum of Rs. 1200 crores for the difference of cane price is to be paid to 4.2 million farmers of U.P. for the crushing seasons 2006-07 and 2007-08. The Honorable Court has ordered the Government sugar mills to pay Rs. 161 cores to sugarcane farmers. Non-payment of dues by the private sugar mills is yet to be decided. As per a recent report, in U.P. alone Rs. 1347 cores of sugarcane price are yet to be paid to sugarcane growers. Needless to mention that the provision of interest payment on the price of sugarcane, if not paid after 14 days of the cane supply to the sugarcane farmers, has been envisaged in the Sugarcane Control Order, 1966, also does not come to the rescue of the sugarcane growers. Thus, provision maintained in its subsequent amendments in 2009 and 2010 may help farmers financially.

9.10.5 ORGANIC SUGARCANE FARMING:

Organic Jaggery/Sugar is in demand in national and international markets and may fetch more money to the farmers making sugarcane farming more lucrative. To achieve this, there is a need to identify organic sugarcane farming zones and make all out efforts to produce internationally acceptable organic Jaggery/Sugar.

9.10.6 PROFIT-SHARING WITH FARMERS OF THE VALUE-ADDED PRODUCTS MADE FROM BY-PRODUCTS OF SUGARCANE PROCESSING:

In India, on an average, processing of 100 tonnes of sugarcane in a factory yields 10.03 tonnes of sugar, 30-34 tonnes of bagasse (of which 22-24 tonnes is used in processing and 8-10 tonnes is saved), 4.46 tonnes of Molasses, 3 tonnes of filter mud (press mud), 120 tonnes of fuel gases and 1500 Kwh of surplus electricity. Besides sucrose, the by-products of processing like bagasse, molasses, press-mud, etc., being rich in carbon compounds and minerals, provide ample opportunity for co-generation of electricity, physical-chemical transformation or microbial fermentation to value added products, like building and structural materials, pharmaceuticals, fermentation or enzyme substrate for production of valuable chemicals, new food/feed products and low calorie sweeteners, energy options (like cogeneration/fuel/bio-diesel, ethanol), medicines, pesticides, etc. Current low sugar prices also prompt us to explore these avenues, thereby making sugarcane agriculture more profitable and sustainable. Most of these are much more expansive as compared to sugar and truly make sugarcane a Kalpavriksha. It is high time to emphasize their commercial production by turning sugar mills into "Sugar, Alcohol, Co-generation and value-added product complexes" and sharing a reasonable part of this profit with sugarcane growers.

9.10.7 AMENITIES PROVIDED BY THE GOVERNMENT TO SUGARCANE CULTIVATORS:

In Uttar Pradesh, Cane Development Department provides following amenities for creating awareness and interest in cultivators in sugarcane farming through:

- District Sector Schemes: improved seed production programme, seed and soil treatment programme, urea spray on ratoon crops, inter-village link-road programme, etc.
- The State Sector Schemes: for spraying pesticides on sugarcane crop for controlling epidemics of insect-pests and diseases, and
- Centrally-Sponsored Macro Management Mode of Agriculture - Sugarcane Development: for field demonstrations, seed multiplication programme, subsidy on purchase of heat-treatment training of the lands, implements for sugarcane cultivation, training of the farmers, soil testing, preparation of bio-fertilizer and vermin-compost for the farmers belonging to scheduled caste/tribe of Ambedkar villages for Samatamulak Development (for membership of Ganna Samiti, field demonstrations, free cane seed and its transport and free extension and training).

9.10.8 OTHER MEASURES:

i. Instead of being sold, government-owned sugar mills should be expanded and all out efforts should be made to run them effectively.
ii. To stop less weighment of cane supplied, weight of cane of the purchase centers should be revalidated by weighment at the mill gate.
iii. To prevent post-harvest sugar losses, sugar mills should be entrusted with the maturity-wise harvest of sugarcane fields and the current punchy (indent) system be abolished.

9.11 WHAT CAN WE LEARN FROM BRAZIL – THE TOP SUGAR AND ALCOHOL PRODUCER AND EXPORTER IN THE WORLD:

Brazil cultivated sugarcane in 8.03 million ha (in 2010-11) producing 625 million tonnes of cane with a productivity level of 77.8 t/ha. It utilizes 44% of cane for sugar production, 55% for alcohol production and 1% for beverage production. In 2010-11, its sugar and alcohol productions were 38.7 million tonnes (recovery of 14.09%) and 27.7 billion liters. It earmarked 28.0 million tonnes of sugar (72.35% of production and over 62% of world export) and 5.5 billion liters of alcohol (9.3% of production) for export.

Brazil is the top-most sugar and alcohol producer and exporter in the world. At the same time, the cost of production of sugar (Rs. 12.85/kg) and alcohol (Rs. 16.50) are lowest in the world. This success is attributed to:

i) Planting and harvesting of sugarcane is done by the sugar mills themselves.
ii) Most of the sugarcane planting and harvesting are mechanized.
iii) Multi-ratooning (plant crop + five rations).
iv) Brazil has large sugar/alcohol plants with crushing capacity of over 8385 TCD (in 2003). Now it must be still higher as mills with higher capacity are erected.
v) Payment of cane is done on the quality basis.
vi) Breeding programmes to develop sugarcane varieties as per the conditions prevailing in various parts of Brazil.

The sugarcane research in Brazil focuses on developing high yielding sugar-rich varieties with less of fibre, greater resistance to a biotic and biotic stresses, less demanding on soil fertility and expanding the number of multi-ratoons. Besides, to increase the cane acreage, Brazil plans to bring in wastelands into sugarcane cultivation.

For improving the productivity of sugarcane and ensuring the sugar supply, research strategy should be pro-nature and pro-small farmer oriented. New technologies are needed to enhance productivity per unit of land, time and water to overcome the prevailing technological fatigue. Soil health enhancement and balanced fertilization, especially the micronutrient component, hold the promise to raise the productivity of Jaggery/Gur and value-added products. Organic Gur/Jaggery seems to be a lucrative option. Such efforts will especially augment the profitability of small and marginal sugarcane farmers. For dissemination of technology and mitigation of the problems of sugar farmers, there is a need to strengthen the linkages among the sugar factories, farmers and Krishi Vigyan Kendras (KVKs). Relevant training programs should also be chalked out for all the stakeholders. Adoption of profit-proven and high-yielding technologies will help in enhancing TFPG and ensuring increased sugar supply to cater to the needs of burgeoning population in the times to come. Adoption of some of the positive features of sugarcane cultivation followed in Brazil may also help in improving sugarcane cultivation, reducing cost of production and improving recovery as well as increasing sugarcane acreage, also contribute significantly to economic growth.

About 50 million sugarcane farmers and a large number of agricultural labourers are involved in sugarcane cultivation and ancillary activities, constituting 7.5% of the rural population. Besides, the industry provides employment to about 2 million skilled and semi-skilled workers and others mostly from the rural areas. The sugar industry comprises two major segments viz. the registered sugar factories in the organized sector and the small-scale manufacturers of traditional sweeteners like Gur and Khandsari in the unorganized sector. The latter is considered to be a rural industry and enjoys much greater freedom than sugar mills.

In the early 1930s, nearly two-thirds of sugarcane production was utilized for production of these alternate sweeteners. However, with better standard of living and higher incomes, the Gur and Khandsari

sectors being in the small-scale sector, these two sectors are completely free from controls and taxes that are applicable to the sugar-sector.

India's sugar season or sugar year is from October to September of the next year and the cane-crushing season, which usually lasts for an average of 200 days, is from November to May.

Cooperative sugar mills have traditionally dominated the Indian sugar market, although their importance has gradually waned. The cooperative sugar factories, which accounted for almost 70% of the total sugar production in the late 1980s, contributed nearly 60% of the total sugar production in the country in 1999-2000. The fall in their share has largely been due to the gradual deregulation of the domestic sugar market by the Government. Due to the high level of controls, the private players stayed away from sugar industry till the late nineties. But now the cooperative sugar factories are struggling and nearly half of them are making losses. The size of sugar mills in India is small by international standards. In late 1990s, the average mill size was less than 2,000 tonnes crushed per day (TCD). However, a minimum of 2,500 TCD standard has been imposed for new mills, and incentives have been created to encourage expansion up to 5,000 TCD.

In 2004-05, about 60 percent of the sugar mills were in the cooperative sectors, 25 percent in the private sector and 15 percent in the public sector. Also in 2004-05, the average capacity of the sugar mill was around 3,540 TCD, much lesser than the average capacity of mills in Brazil, Thailand and Australia, where the average capacity is more than 10,000 TCD. In India there are only a few mills of this capacity. A few of them have the capacity of more than 30,000 TCD as well.

The industry not only generates power for its own requirement but surplus power for export to the grid based on by-product bagasse. It also produces ethyl alcohol, which is used for industrial and potable uses, and can also be used to manufacture Ethanol, an ecology friendly and renewable fuel for blending with petrol.

The Government de-licensed the sugar sector in August 1998, thereby removing the restrictions on existing capacity as well as on establishment of new units, with the only stipulation that a minimum distance of 15 Kms would continue to be observed between an existing sugar mill and a new mill. The number of factories in the private sector has increased by more than 15 percent, which shows the corporatization of sugar production. But majority of the industry is still fragmented with more than 50 percent of the industry represented by the cooperatives. Maharashtra has been the most enterprising of the states in starting new factories that increased from 102 in 2004-05 to 142 in 2005-06.

REFERENCES:

1. Anon, Uttar Pradesh Ganna Vikas Vibhag Dwara Ganna Kisano Ko Di Jane Wali Suvidhain, Ganna Vikas Vibhag, U.P., Lucknow, 2005-06, (Folder) (in Hindi)
2. Anon Energy, Chapter 11 in India 2011: A Reference Annual, Publication Division, Ministry of information & Broadcasting, New Delhi, 2011 pp. 274-313.
3. Baviskar, B.S., (1980) - "The Politics of Development: Sugar Cooperatives in Rural Maharashtra", (Oxford University Press, Mumbai)
4. District Industries Centre (Belgaum), Government of Karnataka and KLS' Institute of Management Education and Research, Belgaum, "Vision 2006-2010, A perspective plan for Belgaum district", page 3, 9 and 10
5. Duttamajumder, S. K.; Sharma, A. K. and Prakash, B., Vision 2030, Indian institute of sugarcane Research, Lucknow (ICAR), 2011, pp. 28.
6. George, P.S., 1988 – 'Dilemma of Cost of Cultivation in Kerala', Economical & Political Weekly, Vol.23, No.39, Sept., pp.A129-A132
7. Ghosh, Anjan D., and Majumdar, Sabyasachi – 'Sugar Industry – Recent Trends and Outlook', I.C.R.A. rating feature, Aug. 2006
8. Jennefer Nyberg:-and trade division/Food and Agriculture Organization of the united nations
9. K.P.M.G. Report, 'The Indian Sugar Industry – Sector Roadmap, 2017', June 2007
10. Khekale, N.R., (1999) - "Pressure Politics in Maharashtra" (Mumbai: Himalaya Publishing House)
11. Mashram, J. R. and Mohan, S., Overview of bagasse based co-generation program in India co-op. sugar, 2010, 41(5): 33.37
12. Mrs. R. Jaya, Cooperative Sugar Nov,- 2012

13. Nair, N.V. – 'The Challenges and Opportunities in Sugarcane Agriculture', Cooperative Sugar, 2011, 42(5), 43-52
14. Prasad, Rama M.V. – 'Indian Sugar Industry: An Erratic Trader on the World Market', Facts for You, Jan. 2004, pp.22-29
15. Pruthi, S. – 'History of Sugar Industry in India', Reliance Publishing House, New Delhi, 1995, pp.70-71
16. Ramaiah, N. A. - Production of ethanol from cane A profitable process and economics. Co-op. Sugar, 2008, 39(1): 15-41
17. Report of the Indian Sugar Committee, 1920, Simla, 1921, pp.408-462
18. Sharma, M.P.; Singh, A.K. and Singh, Jashjant, 2009 – 'Newly Development Machineries for Sugarcane Cultivation', Indian Sugar, Vol.13, No.4, pp.23-28
19. Shrivastava, Ashok K.; Soloman, S.; Srivastava Arun K.; Kumar, Rajesh – 'Cooperative Sugar'
20. Singh, R.B. - The smallholder farmer-beautiful but weak. NAAS news, 2011, 11(2): 1-2
21. Sinha, Ram Vichar – 'Sugar Industry in India', Deep & Deep Publication, New Delhi, 1988, pp.177
22. Srivastava, A.K.; Ghosh, A.K. and Agnihotri, V.P. – 'Sugarcane Ratoons', I.B.H. and Oxford, New Delhi, 1992, pp.182
23. Srivastava, A.K.; Shahi, H.N. and Agnihotri, V.P. – 'Ripening of Sugarcane and its Management of Improving Sugar Production', Indian Institute of Sugarcane Research, Lucknow, 2000, pp.310
24. Sugar Statistics, Cooperative Sugar, Vol.43, No.1, Sept. 2011, pp.72-76
25. Sugar Statistics, Vasantdada Sugar Institute Bulletin, July 2010, Vol.10, Issue 8
26. Swaminathan, M.S. - Overcoming Land, Water Shortage, The Hindu Survey Of Indian Agriculture, 2008, pp. 10-17
27. www.sugarindustry.com
28. Yadav, R. L. - Economics of sugarcane Farming in India, Lambert Academic Publishing, Saabrucken, Germany, 2010, pp. 281
29. http://coopsugar.org/
30. http://www.fao.org/docrep/003/s8850e/s8850E03.htm
31. http://www.indianmirror.com/imdian-industries/sugar.htm
32. http://www.indianmirror.com/indian-industries/sugar.html
33. http://www.mahasugarfed.org/