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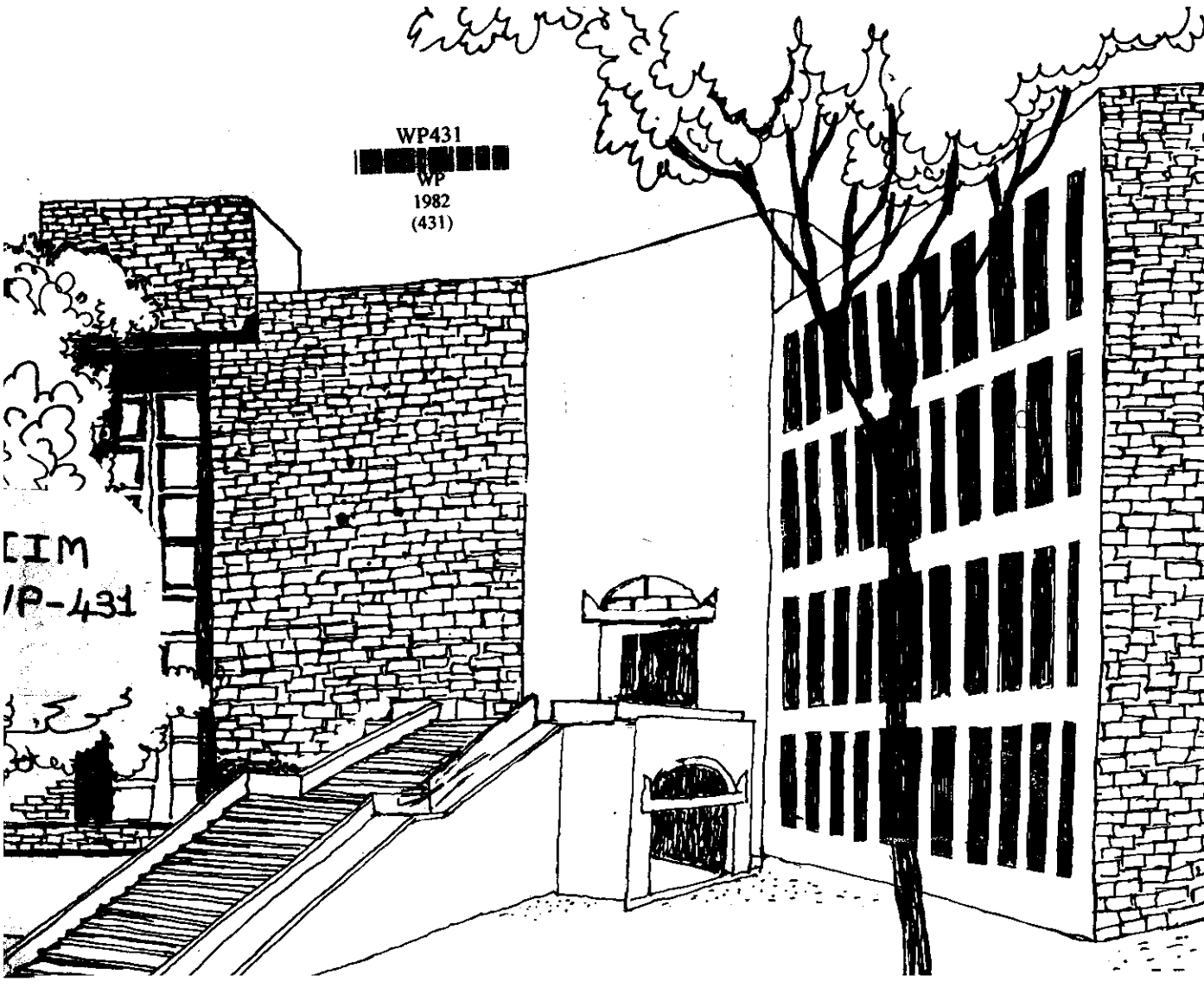

PROCESSING OF SUGARBEET IN INDIA

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PROCESSING OF SUGARBEET FOR SUGAR

1. INTRODUCTION

1.1 Sugar Industry in India

The total number of sugar factories in India has increased from 174 in 1960-61 to 302 in 1979-80. Another 44 factories were under construction (Table 1). A little less than 50 per cent of the total factories were under cooperative sector. Private sector was not much less important and owned about 40 per cent of the total factories. The remaining 11 per cent were in the public sector. Further, a large proportion of factories under eraction were in the cooperative sector.

It could be seen from Table 1 that private sector dominated in Uttar Pradesh and Bihar and the cooperative sector in Gujarat, Maharashtra and Haryana. Elsewhere, both cooperative and private sectors were equally important. Lately, public sector has taken initiative in Andhra Pradesh, Tamil Nadu and Punjab as revealed from the number of factories under construction.

1.2 Growth in Cane Crushed and Sugar Produced

Table 2 provides the growth rates in sugarcane crushed and sugar produced in different states between 1960-61 and 1979-80. The period was divided into two sub-periods of 1960-61 to 1969-70 and 1970-71 to 1979-80, and the growth rates for the two sub-periods as well as for the entire period were estimated separately for the individual states.

Table 1 : Sectorwise, Statewise Distribution of Sugar Factories in India (1979-80)

	Existing				Under erection				Total sugar factories			
	Co-op.	Private	Govt.	Total	Co-op.	Private	Govt.	Total	Co-op.	Private	Govt.	Total
	Number of Factories											
Bihar	-	27	3	30	-	-	-	-	-	27	3	30
Uttar Pradesh	15	62	11	88	6	1	-	7	21	63	11	95
Punjab	4	2	-	6	-	-	2	2	4	2	2	8
Haryana	4	1	-	5	-	-	-	-	4	1	-	5
Rajasthan	1	1	1	3	-	-	-	-	1	1	1	3
Gujarat	13	-	-	13	2	-	-	2	15	-	-	15
Maharashtra	60	10	-	70	9	-	-	9	69	10	-	79
Karnataka	11	8	2	21	5	-	1	6	16	8	3	27
Andhra Pradesh	13	10	4	27	6	-	4	10	19	10	8	37
Tamil Nadu	9	10	1	20	1	-	4	5	10	10	5	25
All India	137	140	25	302	30	1	13	44	167	141	38	346

Source: Compiled from Jain, N.S. (Ed.), Cooperative Sugar Directory and Handbook, 1979, National Federation of cooperative Sugar Factories Ltd., New Delhi, p. 163.

Table 2 : Compound Growth Rates in Cane Crushed and Sugar Produced in Different States in India between 1960-61 and 1979-80

States	Growth rates of cane crushed			Growth rates of sugar production		
	1960-61 to 1969-70	1970-71 to 1979-80	1960-61 to 1979-80	1960-61 to 1969-70	1970-71 to 1979-80	1960-61 to 1979-80
A. South Zone						
Andhra Pradesh	6.445	1.451	2.938	5.289	-1.880	2.597
Gujarat	13.427	13.185	13.692	11.886	13.480	13.355
Karnataka	5.367	8.347	8.763	4.932	7.538	8.209
Maharashtra	8.868	8.246	8.343	7.707	7.913	7.711
Tamil Nadu	13.961	3.339	7.275	11.733	3.283	6.931
B. North Zone						
Bihar	-2.844	-0.480	-1.834	-2.829	-0.297	-2.132
Haryana	2.128	4.811	4.537	1.762	4.979	4.639
Punjab	7.576	6.760	5.888	6.600	8.582	6.519
Rajasthan	-1.231	8.704	4.804	-6.135	9.619	6.534
Uttar Pradesh	-1.585	1.776	1.324	-2.752	2.080	1.288
All India	3.437	4.727	4.227	2.926	4.800	4.190

In 'sixties the growth in cane crushed was found to be positive for southern and western states, but was negative for northern states except for Punjab and Haryana. In 'seventies, the growth rates for southern states except Karnataka, western states; and Punjab in North had decreased. This decline was substantial for Andhra Pradesh and Tamil Nadu. In case of Karnataka in South and Haryana in North, the growth rates in cane actually crushed improved substantially. In case of Rajasthan and Uttar Pradesh also recorded growth in cane crushed was tremendous. Bihar has also showed some improvement in the 'seventies when its negative growth was reduced to less than 0.5 per cent. On the whole, the improvements were remarkable for western states. The growth rates for the entire period were highest for southern and western states except for Karnataka and were positive but low for northern states except for Bihar where the growth was negative.

The pattern of growth in sugar production was in line with the growth in cane crushed for the obvious reasons. The improvements in growth of sugar production between the two periods were larger except in Gujarat where in 'seventies the growth rate in sugar production went down to negative. In case of Karnataka, Maharashtra and Punjab, though the growth rates in cane crushed in 'seventies had declined marginally, the growth rates in sugar production had improved. This implied improvements in recovery of sugar. The overall growth

rates were higher for sugar production than for cane crushed in Punjab and Rajasthan only. This indicated that the decline in growth rates in cane crushed was more to be compensated by improvements in sugar recovery. The average recovery of sugar from sugarcane in different states as compared to overall average recovery in India in different years could be observed from Table 2a. The table shows that the recovery remained almost stagnant over the reference period. In case of Punjab, however, during past few years a substantial improvement in sugar recovery from cane was recorded. A marginal improvement in recovery was also observed in Rajasthan. Elsewhere, the recovery showed a decline between the two points i.e., 1960-61 and 1978-79.

1.3 Problems of Sugar Industry

Table 2b shows that there was a substantial growth in the number of sugar factories in India between 1960-61 and 1979-80. The cane crushed per factory, however, was decreased substantially. In other words, the supply of cane to the sugar factories did not increase and hence under utilization of available crushing capacity has been a serious problem. Though for the states of Gujarat, Tamil Nadu, and Maharashtra cane crushed per factory increased between 1960-61 and 1979-80, in Maharashtra it fell down from the previous highest level of 1975-76. The fall was more pronounced in Karnataka. The per factory lowest quantity processed was in Rajasthan followed by Bihar, Punjab, Andhra Pradesh and Uttar Pradesh in order. Thus, under-utilization was more common in the Northern zone and was particularly serious

Table 2a: Average Recovery of Sugar from Sugarcane in India (1960-61 to 1978-79)

STATES	1960-61	1965-66	1970-71	1975-76	1978-79
			Per cent		
Andhra Pradesh	9.46	9.36	10.22	9.91	9.05
Karnataka	10.14	10.24	10.57	10.62	10.12
Tamil Nadu	9.01	8.47	8.99	9.14	8.52
Gujarat	10.76	10.26	10.23	10.70	10.14
Maharashtra	11.64	11.36	11.28	11.26	10.95
Bihar	9.21	9.32	9.01	9.06	8.86
Uttar Pradesh	9.53	9.46	9.16	9.54	9.28
Rajasthan	9.19	8.90	9.23	9.13	9.55
Punjab	8.78	8.54	8.57	8.83	9.43
Haryana	9.01	8.61	8.69	9.28	8.69
All India	9.74	9.70	9.79	9.83	9.78

Source : 1. Gothoskar, S.M., "National Policy on Sugar: Stable cane prices is the key (Part I)", The Times of India, May 6, 1982, Ahmedabad, p. 10

2. Cooperative Sugar Directory and Year Book, 1979, National Fedration of Cooperative Sugar Factories Ltd., New Delhi, pp. 447-449.

Table 2b : Quantity of Cane Crushed per Sugar Factory in India: 1960-61 to 1979-80

(Cane Crushed in '000 tonne/ per unit)

Sl. No.	States	1960-61	1965-66	1970-71	1975-76	1979-80
1.	Andhra Pradesh	175.73(11)	167.84(19)	145.33(18)	164.5 (20)	86.26(27)
2.	Gujarat	129.50(2)	178.33(3)	117.29(7)	134.38(8)	161.15(13)
3.	Karnataka	1189.00(1)	165.78(9)	176.00(11)	231.47(19)	129.05(21)
4.	Tamil Nadu	162.50(8)	193.43(14)	221.67(15)	123.06(16)	203.90(20)
5.	Maharashtra	166.48(27)	214.72(32)	228.02(41)	259.29(55)	187.86(78)
6.	Bihar	149.21(28)	137.24(29)	120.30(27)	72.26(27)	60.20(30)
7.	Haryana	293.67(3)	329.00(3)	317.33(3)	384.33(3)	195.40(5)
8.	Punjab	163.67(3)	174.40(5)	93.50(6)	160.50(6)	85.83(6)
9.	Rajasthan	98.50(2)	102.50(2)	48.33(3)	11.33(3)	38.67(3)
10.	Uttar Pradesh	201.93(71)	203.94(71)	199.76(71)	158.73(77)	116.00(88)
11.	All India	178.28(174)	182.56(200)	177.70(215)	166.19(252)	129.30(302)

Note: Figures within parentheses refer to total number of sugar factories.

in Bihar and UP which together accounted for about 40 per cent of the sugar factories in the country. In these states almost all the factories were operated below the national average of 165 working days. Even after considering the normal season at 150 days, the factories in East Uttar Pradesh were operated at 37 per cent of the capacity over the period of 11 years ending 1979-80. The sugar factories in Bihar were reported to have utilized only 48 per cent of the capacity over the same period. The average crushing period in East Uttar Pradesh was 11 days against 89 days in Bihar during the period under reference. In Maharashtra the installed capacity of sugar units increased from about 8 million tonnes to 20 million tonnes between 1969 and 1980. At the same time the quantity of cane crushed per day of installed capacity dropped from 195 tonnes in 1969-70 to 113 tonnes in 1979-80.

Currently there were 113 factories in India which did not utilize their rated capacity to the optimum level due to inadequate supply of quality cane. Of these under-utilized factories, 37 were in Bihar. That is, over 50 per cent of the total under-utilized factories were located in this region alone.

Another reason for under-utilization of the available capacity was diversion of sugarcane to gur and khandsari units. Of the total sugarcane available in the country only about 30 per cent was processed in sugar factories. Another 60 per cent went to khandsari units and the remaining 10 per cent was used for miscellaneous purposes (Table 2c). Even after considering the record production year 1981-82 for sugarcane

Table 2c: Utilisation of Sugarcane for Different Purposes (1960-61 to 1979-80)

Use of Cane	1960-61	1965-66	1970-71	1975-76	1979-80
			Million tonnes		
i) Sugar	31	36	38	42	39
ii) Gur or Khandsari	65	73	73	82	74
iii) Others	14	15	15	17	15
Total	110	124	126	141	128

Source : 1. Cooperative Sugar Directory and Year Book, 1979, National Fedration of Cooperatives Sugar Factories Ltd, New Delhi, p. 25.

2. The Economic Times, September 30, 1980.

the available cane for sugar manufacture was about 45 million tonnes against the installed capacity of 80 million tonnes. That is, only 75 per cent of the requirement of the sugar factories were met even in the bumper cane crop year.

The pattern of cane utilization in India has not only resulted in low supplies to sugar factories but also caused loss of extractable sugar, as recovery in khandsari units was grossely low. In 1980-81 alone we lost about 1.2 million tonnes of sugar due to diversion of cane to khandsari and commercial gur. The problem was more serious in relatively scarcity years because these units took away the quality cane on a marginal premium. In the years of excessive supply again these units benefit in paying lower price to the producers. These benefits to khandsari units accure mainly because of absolutely no public control on them and they were not liable to pay purchase tax on cane, were not subjected to contribution to the levy sugar, and enjoyed the freedom to sell their production at any time in the open market.

Sickness of sugar factories in recent years have been on the rise This was more in East Uttar Pradesh and Bihar where they run even below the breakeven capacity. Because of the poor supply of cane in their area, they encroach neighbouring factory's areas. Under the guidelines of licencing new capacity in the sugar industry in the sixth plan, the minimum distance between an existing sugar factory and a purposed new one has been reduced from 50 kms to 30 kms. However, in practice even

the stipulated minimum distance of 30 kms between the two sugar units has not been adhered to and a new sugar unit has been permitted within a distance of less than 9 kms from an existing one with a double cane crushing capacity compared to be standard capacity of 1,250 tonnes per day. Such a discreminatory licencing policy also resulted in under-utilization of sugar factories. For example, in Maharashtra licencing new cooperative sugar factories in close vicinity of long established private sugar factories, has resulted in under-utilization of capacity in the private sector units. Resultantly, all the 10 joint stock units which were known for efficiency in Maharashtra were rendered sick. At the same time, 35 out of 55 working cooperative sugar factories were reported to have gone sick. Moreover, it was noted that in 1953 sugar factories in Maharashtra used to get 90 per cent of their supplies of cane from within a distance of 15 kms, which has currently declined to loss than 30 per cent and major share of cane supplied is arranged even from the distances of over 40 kms.

Financial mismanagement, and neglect of proper maintenance and replacement of old and wornout items of plant and machinery were other reasons for spreading sickness amongst the sugar factories in India. A committee appointed by the Government of Maharashtra for studying the problems of sick factories in the state also pointed out that inadequate supply of cane was one of the causes of sickness of cooperative sugar factories. It could be mentioned that during the bumper crop seasons sugar factories do not accept all the cane made available to them. The situation arises because of (i) the factories assess area and yield of

cane for registered growers, (ii) the attractive price for cane encouraged the growers particularly the nonregistered ones to bring more area under this crop for which factory was not responsible to absorb, (iii) shortage of some essential supplies and power cuts during the season, (iv) continuing or extending cane crushing season beyond April is not economical for sugar factories.

Similarly, the khandsari units do not accept cane beyond their requirements. Thus, even under the assured availability of essential items of consumable store and less frequent power cuts, the underutilisation of the sugar units results during bumper crop years. In this regard an equilibrium between demand and supply of cane under sugar manufacturing (organized sector) and the gur and khandsari (unorganized sector) may be necessary by treating them under the same set of policies.

Even under large quantum of supplies the sugar factory would not prefer to continue its cane crushing season beyond April. However, early crushing season could be started from October to December. While cane harvested during early period was entirely utilised for gur and khandsari. It has been found that in North India, early crushing of cane for sugar production is economically feasable despite its low yield and low sugar recovery during this period. It was also argued that late crushing is more disadvantageous to the nation than early crushing on account of sugar forgone alone.

The expansion of crushing season of the sugar factories will not only make more sugar available but also lead to low cost of sugar production per unit and more employment as well. Another alternative could be to adopt a new crop of sugarbeet which would be processed after the cane processing is completed in March. This crop diffused fastly in most countries having temprate climate and presently it contributes over 50 per cent of the total sugar production in the world. More recently efforts have been to extend this crop to the sub-tropical areas. In India, efforts in this direction started in early 'seventies when Ganganagar Sugar Mill, Sri Ganganagar started processing this raw material for sugar production in 1971-72. The present attempt is aimed at to examine and to understand the experience of this mill in the processing of beet for sugar.

2. Sugarbeet Processing at Ganganagar Sugar Mills

2.1 Historical Review

The processing of beet in India started with the trials of beet cultivation on commercial scale in the factory areas of selected sugar factories between 1964-1971. The results of these trials are shown as under:

Year	Name of the factory	Area sown (hectares)	Yield/hectare (tonnes)	Average sugar in roots (%)
1964-65	M/s Saraswati Sugar Mills Ltd., Yamunanagar (Haryana)	2.5	45.2	13.0
1965-66	- do -	9.0	27.0	15.5
1966-67	The Janta Coop. Sugar Mills Bhogpur (Punjab)	25.0	41.0	14.2
1967-68	Ganganagar Sugar Mills Sri Ganganagar (Rajasthan)	26.0	32.5	14.5
1969-70	Dhaurala Sugar Works Dhaurala (UP)	20.0	12.4	14.3
1970-71	- do -	23.0	18.7	14.3

Source: GOI, Report of the committee on Incentives for the Development of Beet Sugar Industry in India, Department of Food, Ministry of Agriculture, February 1975 (Mimeo).

As indicated in the table, all these factories processed small quantities of beet for one to two years. The results were encouraging especially in Punjab, Haryana (yield in 1965-66 was very low) and

Rajasthan. However, the quantities processed were vary little and the processing was not on large scale. The capacity of the pilot diffuser units was 25 tonnes per day. Another mill, the Phaltan Sugar Works Ltd., Salcharwadi (Maharashtra) installed a diffuser plant in 1968 for juice extraction for sugarcane and processed beet along-with cane. Similarly, Charotar Sahkair Khand Udyog Ltd., Petlad, (Gujarat) and M/s Kesar Sugar Works, Behari (MP) also processed small quantities of beet successfully.

Encouraged by the results achieved in the manufacturing of sugar from beet at different places, the Ganganagar Sugar Mills, Sri Ganganagar, installed in 1970 a sugarcane-cum sugarbeet diffusion plant with a processing capacity of 1000 tonnes of cane and 650 tonnes of beet per day with an additional investment of over Rs. 10 million.

The factory had to face many troubles. The eraction of beet diffusion plant which was scheduled to be completed by the mid of March 1971 was delayed and was commissioned only on June 20, 1971. But soon it was closed down because of a major breakdown in the bucket elevator. Apart from these technical problems, the inadequate supply of beet owing to lack of irrigation in the district and distrubances from Indo-Pak war was another serious difficulty in that year. The plant also faced difficulties in matching capacities of various machines of the unit. Therefore, the working was not satisfactory in the beginning but after 1973-74 the factory worked very well. The performance of the factory in beet processing is depicted in Table 3. The table indicated

Table 3 : Performance of Sugarbeet Processing Ganganagar Sugar Mill Ltd., 1970-71 to 1979-80

Years	Starting date of beet process-ing	Duration of the season (days)	Per cent of time lost on total available processing time	Sugarbeet processed (tonnes)	Recovery of sugar (per cent)	Production of Molas-ses (per cent)	Production of pulp (per cent)
1970-71	29th May	5	NA	195	4.33	8.48	NA
1971-72	4th April	14	NA	2751	6.36	4.65	NA
1972-73	16th April	35	33.9	11199	8.57	5.84	37.86
1973-74	5th April	30	31.8	9475	10.20	5.34	36.09
1974-75	24th April	19	35.0	5616	9.78	4.46	38.50
1975-76	15th April	47	13.3	24211	10.61	5.65	48.65
1976-77	3rd April	64	15.5	32823	9.78	4.41	52.33
1977-78	13th April	69	21.2	32752	9.10	5.63	53.61
1978-79	19th April	38	9.0	19103	11.32	4.19	58.67
1979-80	26th March	36	33.0	13106	11.10	3.78	52.15

Source : Office of the Chief Executive Officer, The Ganganagar Sugar Mill Ltd., Sri Ganganagar, Rajasthan.

that the supply of beet was not stablised and during 1978-79 and 1979-80, the beet processing season was limited to less than 40 days and in 1979-80 about one third of the working days were lost mainly because of this factor. The recovery of sugar, however, had crossed 11 per cent during these years. Only in two of the ten years of working of this unit, beet processing was carried through in June i.e., in 1976-77 and 1977-78. That was perhaps the reason for low recovery of sugar in these years.

The total beet diffused in 1970-71 was 658 tonnes, out of which 195 tonnes of beet was utilized for manufacture of sugar and 463 tonnes of beet for production of rectified spirit. The production of rectified spirit was reported at 19389 LP liters with a recovery of 4.03 per cent of sugarbeet for this purpose. The maximum quantity of beet processed was 32.82 thousand tonnes in 1976-77 and it has come down to only 13.11 thousand tonnes in 1979-80 against the available capacity of 39.00 thousand tonnes in 60 days. This had its impact on the economics of beet processing in a cane processing unit.

2.2 Cane vs Beet Processing

Three alternatives available in processing of cane and beet, the two raw materials for sugar production, are processing of cane alone, beet alone, and cane and beet in the same unit. Processing of beet was quite different from processing of cane especially in the initial stages. Similarly while cane juice was clarified by sulphitation or carbonation. The latter was used for beet juice clarification as it

could not stand sulphitation. As different processes needed different equipment and machinery, introduction of beet processing to cane processing factory requires additional investment. The economics of such a modification depends on the additional net revenue the new system generates by way of reduction in per unit production costs on total sugar. Before going into the details of additional investment and economics of sugar production under the new system we would like to briefly explaine the processing of cane and beet separately to indicate the differences and similarities of the two.

2.2.1 Cane Processing

As mentioned earlier a second hand plant from Java was purchased in mid thirties and installed at Sri Ganganagar in 1945. The four mills of which the plant consisted of were manufactured in 1905. There were 14 rollers driven by three Rider out-of-valve four engines (two, 300 HP each and the other two, 250 HP each). The dimensions of the mill and the speed of the rollers were very low. The rotendum was preceded by two sets of knives each driven by 150 HP motor.

The bagasse, a by-product from milling unit was used as fuel for the boilers. The factory followed double sulphitation process for cane juice clarification. The juice was manually weighed in tanks of three tonnes capacity. The juice was heated in four vertical heaters and one vapour line juice heater. The juice was treated in batch type tanks and clarified in a clarifier. The sulpher furnace was of batch type. One of the two air compressors were electric driven and

the other one steam driven. The mud was filtered by plate and frame presses. The juice was concentrated in quadruple effect evaporators. There were five pans provided with multijet condensers. There were 13 crystalisers and 32 centrifugals. Sugar was dried in grass hopper type driers, graded, bagged and stacked in godowns. The latter two operations were carried out mannualy.

The steam was generated with five Bascock Willcox boilers, four of which were cap type. There was a provision to fire bagasse, fuelwood, coal and furnace oil. Of the three engine driven sets of power bagasse plant, only two worked to supply about 375 KVA. In addition, the plant got power supply from a grid (800 KVA for the cane period and 1100 KVA for beet period). The higher needs of beet for power were, mainly, because beet processing did not yield bagasse.

2.2.2 Processing of Sugarbeet

The processing of beet started with its delivery in the mill. The produce was washed in two beet silos (water tanks) of 300 tonnes capacity each equiped with seven water jets for fluming of beet. The roots were pumped to the overhead flume provided with leaf catcher and stone catcher for removing leaves and stones respectively. The beet was washed and sand was automatically discharged. The roots were then sliced and cossetts of desired dimensions were made. The cossetts were weighed and carried to the diffuser with a capacity of 650 tonnes of beet roots per day. The juice was extracted through diffusion process. The pulp

juice and water going to the diffuser were heated with heat exchangers. The pulp was separated and de-watered.

The beet juice was clarified by double carbonation process in four tanks of 85 hectoliters each for first carbonation and in another one of the same size for second carbonation. The juice was filtered in the usual plate and frame presses. The juice was then concentrated in two quadraple effect evaporators and passed on in five pans with multijet condensers. The concentrated juice was then crystalised at centrifugal station. Sugar was then dried, graded, bagged and stored in godowns for disposal.

2.2.3 Additions and Alterations for Beet Processing

From the discussion on processing of cane and beet, it has become quite clear that for a cane processing unit to take up beet processing would require investment in equipment and machinery for initial processing of beet and for alteration of sulphitation to double carbonation. However, carbonation could itself be an addition for beet while sulphitation remains for cane as in case of Ganganagar Sugar Mills. In what follows is the list of additions and alterations in machinery, equipment and other structures for a cane processing unit to take up beet processing also.

<u>List of Additional Equipment and Machinery for Beet Processing</u> in a Cane Processing Factory.

A. Additional Investment Items:

i) Water Service Pump

ii) Fluming Water Pump.

iii) Beet silos (water tanks fitted with water jets for fluming beet).

iv) Beet Pump for pumping beet to overhead flume.

v) Overhead Flume for conveying of beet.

vi) Leaf and Weed catcher.

vii) Stone catcher.

viii) Beet washer complete with nuematically controlled sand dischargers, programme controller and other accessories.

ix) Waste water chockless Pump Beet Waster for delivering the waste water in kutcha tank outside the factory.

x) Bucket elevator complete with supporting structure, triplase chain and chain wheel for feeding the slicer hopper.

xi) Beet slicer.

xii) Knife sharpening station consisting of knife edge grinder and with bushing machine for straightening the edge of the knives driven by AC electric motor. It also includes preliminary and final knife sharpening automatic machines for sharpening the knife.

xiii) Rubber Belt Conveyor ('G' 'E'), for conveying the beet c cossettes.

xiv) Beet weighing machine for weighment of beet cossettes and pulp.

xv) Diffuser.

xvi) Screw conveyor for conveying the pulp to pulp press.

xvii) Pulp press.

xviii) Rubber Beet conveyor for conveying the pulp from press to vehicles.

xix) Ward Leonard for drive of two diffuser scrolls.

xx) Air Compressor Ingersol Rand for supplying the dry air to the control instruments of diffuser, beet slicer and beet washer.

xxi) Diffuser Juice Pumps.

xxii) Pulp Juice Pumps.

xxiii) Water pump for pumping water to the diffuser.

xxiv) Heat Exchanger for heating pulp juice and water going to the diffuser.

B. Equipment for Switch over from Sulphitation to Carbonation

i) Prelimer.

ii) Liming Tank.

iii) Chockless pumps for pumping juice from main liming tank to heaters.

iv) Carbonation Tanks for first and second carbonation.

v) Lime Kiln.

C. In addition to these investment items extension and development staff for beet would be required. These requirements, however, could be met with the cane extension and development staff who would be responsibile for beet cultivation also. The seasonal staff employed for cane may be retained till the beet season is over.

3. Sugarbeet Sugar System

The sugarbeet sugar system comprised of the following five subsystems, namely,

a) Procurement of sugarbeet

b) Processing of sugarbeet

c) Disposal of output and

d) Public Intervensions

At Ganganagar Sugar Mills, since sugarcane and sugarbeet were processed in the same unit, the cane sugar and the beet sugar have paralell systems. In this section we discuss both the sugar systems under the above mentioned subsystems. The raw material production system at farm level has, however, been covered here in a separate volume[1].

3.1 Procurement of Raw Material

Two major raw materials for sugar production at Ganganagar Sugar Mills were sugarcane and sugarbeet. In case of sugarbeet, it was received only from the gate area whereas sugarcane was also accepted from outside gate area. In the two cases therefore, the procurement system varied as discussed below:

Sugarbeet, the raw material for beet sugar, was ready for harvesting from Mid-March to Mid-May. In practice, however, the harvesting begin sometimes in April and terminated in May and even in first week of June in some years. The time of harvesing, infact, depended on the date of sowing, availability of last irrigation and the constraints of the farmer. The mill distributed seed to the perspective growers on cash or as a part of kind loan arranged through the mill from Rajasthan Bank Ltd. The mill kept the record of sowing dates and beet area sown by individual farmers in the selected villages. This staff of the mill, according to the date of sowing visited the beet fields to assess the time for harvesting the crop and issued the delivery slips to individual growers. While issueing these slips

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[1] See, Gurdev Singh and Amar Guleria. "Cultivation of Sugarbeet in India", Working Paper No. 427, Indian Institute of Management, Ahmedabad, June, 1982.

the staff considered the daily beet requirements of the factory. Another consideration in deciding about the date of harvesting beet on individual farms was the availability of irrigation because the crop requires pre-harvest irrigation. The farmers under the contract bring their produce (beetroots) to the mill on a given date. In fact because sugarbeet had no other alternative use, the farmers had to sell the entire production to the mill. The price paid was fixed on the basis of the support price fixed for sugarcane for the area. It was Rs. 3 higher than the sugarcane price for 8.5 per cent recovery. In case of beet, however, distinction was made for varying recovery. All the costs of transportation and unloading at the mill were borne by the growers. For the year 1979-80 a price of Rs. 16/- per quintal of net weight of roots was paid to the growers. This price, however, was raised to Rs. 25/- per quintal in 1980-81.

At the factory the produce from individual growers was received in order of the token issued to them on the arrival of consignment in the factory yard on carts, trolleys, and trucks. The roots were weighed and unloaded near or in the water tanks. Since the roots, in many cases, were not clean and free of soil, etc., a deduction was applied for unwanted leaves, green parts, dirt and dust, etc. This deduction was calculated on the basis of a sample of six roots, three picked by the farmer and another three by the mill personnels from each lot. The net weight of roots and their value was recorded and a card indicating these items was issued to the growers. These card were encashed by the individuals from the cashiers in the

accounts section of the mill. It takes about a weeks' time to get the payments because the mill had to check the individual accounts for any dues against them. Such dues were adjusted from the sale proceeds.

In case of sugarcane, two systems of procurement anddelivery prevailed. From within the gate area, the farmers brought their produce to deliver at the mill on the terms identical to sugarbeet procurement. In case of outgate supply, the mill takes care of the transportation and unloading at the factory through contractors. The contractors get a commission of Rs. 3.20 per tonne for their services including freight. The produce was weighed on the farm and payments to the farmers were made by the contractors at the rate of fixed cane price less their commission. The contractor get the payment for the cane brought to the mill at the fixed price (Rs. 130 per tonne in 1979-80).

The arrangements were working well except some of the beet growers reported their dissatisfaction with the issuing of delivery slips to which, sometimes, they could not stick for specific reasons and it was difficult to get new slips for more appropriate dates. Though this was reported for both cane and beet, it was mere serious for beet because of its relatively mere perishable nature. Secondly some of the farmers were not at all happy with the deductions but were helpless because beet had no other use.

3.2 Processing of Raw Material

As pointed earlier processing of cane and beet were different at the initial stage of their conversion into sugar. In the case of sugarcane, the canes were cut into sets by two sets of knives. These sets were carried to the rollers for crushing in a conveyor belt. The bagasse was separated, dried and used as fuel for boilers. The juice was collected in a tank from where it was pumped to the sulphitation tanks. After the sulphitation the juice was filtered and treated with SO_2 once again, heated and filtered. In the process, molasses and press mud were separated and pure juice was concentrated and pumped to the crystalizers in the centrigugal station. The crystals were dried with glass hopper type driers, graded and bagged.

In case of sugarbeet, the roots were pushed from the water tank to overhead flume fitted with leaf weed catcher and stone catcher. Roots were then washed and carried to the diffuser plant. The beet slicer makes the slices and then slices were converted into cossettes which were weighed and boiled with steam heated water to extract sugar. The pulp was separated and dewatered. The juice was treated with CO_2 for first carbonation in the carbonation tanks. The molasses were separated and the carbonated juice was filtered before the second carbonation. The clarified juice was filtered again. It was steam heated to certain concentration and was pumped to the crystaliser in the centrigugal section. The crystals were dried with grass hopper type driers, graded, bagged and stacked in the godowns. This ended the processing of beet.

The processing of beet was different from cane as the juice extraction was through diffusion and in case of cane it was simple crushing. The other difference was that in case of cane sulphitation was adopted for juice clarification and double carbonation for clarification of beet juice. In case of sugarcane we got bagasse as a by-product which was used as fuel in the boilers. We also got press mud and molasses as by products. While press mud was sold as organic mannure, molasses were a source of alcohal, etc. In case of beet, however, we got pulp and molasses as by-products. Since pulp could not be used as fuel, beet processing would require extraneous fuel for boilers. On the other hand pulp mixed with other ingredients such as molasses forms a good animal feed. Beet molasses were used in the manufacture of vitamin B and fetches good price. However, the requirements of the industry were limited and whole of beet molasses were not used for this purpose except during 1979-80.

Shortage of raw material especially sugarcane was felt even during a relatively good year of 1981-82. Though the cane was available accross the state boundary from Punjab where it was surplus, it was not accepted because of state policy. Cane was not accepted even from the local growers who were not registered with the mill. In case of beet also the capacity utlisation was very low especialy during past few years mainly because of inadequacy or raw material. The area sown under beet was not adequate to feed the mill. The producers irrespective of its economics were hasitant to grow beet because of marketing difficulties. Power failures were very frequent resulting into heavy lossess and poor recovery.

3.3 Disposal of Output

Four products were obtained from processing of cane and beet in Ganganagar Sugar Mills at Sri Ganganagar. These were, the main output of sugar and by-products of beet pulp, press mud (cane) and molasses (cane and beet). In case of sugar dual price policy prevailed. A part of sugar output (65%) was levy sugar which was acquired by the government for distribution through public distribution arrangements. The price paid for this sugar was fixed in advance. The free sale sugar (35%) was sold through open bid auction at the mill premises. The monthly release of sugar under both the arrangements was, however, directed by the central government covering monthwise release of levy and free sale sugar alongwith free sale price. In case of beet molasses a part of it was purchased by a pharmeceutical company at a price of Rs. 1500 per tonne in 1979-80. The remaining beet molasses and the entire quantity of cane molasses were sold at a fixed rate of Rs. 60 per tonne in that year. The sale of molasses was under the control of Excise Department. The beet molasses mixed with cane molasses were also used for the manufacture of alcohal. The dewatered beet pulp was sold to the feed industry. The press mud from cane processing was sold to the farmers as organic mannure.

3.4 Public Intervention

Sugar industry is well known for public interventions. The intervention starts with the cane support price. The factories had to give the minimum price for cane on the basis of sugar recovery. At the second stage, a part of sugar produced both from cane and beet was levy sugar procured by the government at a fixed price (significantly lower than market price). Further levy sugar to be handed over to the public distribution as directed by the government from time to time. It was 65 per cent of the sugar produced. The remaining 35 per cent was sold in free market again under the directions of the government. While levy price was fixed in advance for the sugar year, free sale qunatity was sold at market price i.e., through bidding by the wholesalers who were intimated in advance by the mill about the date, time and quantity of sugar to be sold. The price and distribution of molassess were also controlled. The alcohal produced from molasses was also a controlled item. There was however, no control on beet pulp and press mud disposal. Similarly no control existed for bagasse disposal.

4. Economics of Sugar Production

4.1 Different Situations

The economics of sugar production at Ganganagar Sugar Mills was worked out and compared among cane sugar, beet sugar and total sugar. Further we examined the economics of sugar production as if only cane/ beet was processed. Therefore, in all five sugar production alternatives were identified for costing.

4.2 Costing and Costs

Since Ganganagar Sugar Mills processed both sugar cane and sugarbeet and had integrated processing of molasses into industrial alcohal, various costs, especially fixed costs, were to be allocated between sugar unit and distillery unit and sugar costs further between cane sugar and beet sugar*. Similarly some by-products were processed into other products which needs to be evaluated. To do so we have used the existing norms wherever available and logic where it was possible. Before going into the details of these processes however, we would like to list various items of costs.

The costs of sugar manufacture could be examined under two heads, namely, variable costs and fixed costs. Variable costs included raw materials of sugarcane and sugarbeet; other supplies such as filter cloth, lubricants, lime, sulpher and other chemicals; fuel (coal, furnace oil, firewood and bagasse); power; packing; seasonal and off-seasonal labour; repairs and maintenance; and interest on working capital. The fixed costs consisted of depreciation on land, building, and machinery and equipment; administrative overheads (salaries, allowances, bonus, gratuity, etc.) and other overheads.

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*The objective of this study was not to make the sugar production system economically viable through vertical integration of processing by-products, but to examine if sugar production could be cheaper and economically viable with the processing of beet in a cane processing unit or a new unit.

While variable costs were direct costs and were easier to compute except interest on working capital, fixed costs were more complex. These were first allocated between sugar and distillery units. In many cases separate accounts for depreciation for two units were available. Others were allocated on the basis of their use for the two units. Similarily fixed costs of the sugar unit were allocated between cane and beet on certain criteria. Various assumption were made to arrive at a reasonably acceptable decomposition of fixed costs. In what follows is the method used in allocating the fixed costs of sugar manufacturing between cane sugar and beet sugar. This was carried out for all the five situations referred above.

Since the mill kept separate records for cane sugar and beet sugar for raw materials of sugarcane and sugarbeet purchases, and other supplies filter cloth, hassion cloth, lime, sulpher, washing soda, caustic soda and other chemicals, these costs were directly taken from the records of the mill. Furnace oil and fire wood were used only for beet and bagasse only for cane. Therefore, their respective costs were added to beet and cane accounts. The costs on coal were allocated on residual basis. That is, bagasse, furnace oil and firewood were converted into coal equivalent and the total coal quantity so arrived was allocated between the two on the basis of the ratio of the actual working days. The quantities of firewood and furnace oil coal and bagasse coal were respectively deducted from total coal for beet and cane processing. The value of these coal quantities were respectively added to the value of firewood and furnace oil for beet and to bagasse for cane. Similarly,

total power used for sugar manufactured was allocated on the basis of working days and power requirements of two processes (power requirements of beet were higher than cane). The seasonal labour, however, was allocated on the basis of ratio of the seasons. Since off-seasonal labour requirements were more for sugarcane because of outgate deliveries, twenty per cent of off-seasonal labour was reserved for cane and the remaining was allocated on the basis of seasons.

The problem arose in the allocation of seasonal and off-seasonal maintenance and repair costs. It was solved as follows. Assuming the repairs and maintenance costs were proportionate to the value of the equipment and machinery, buildings and masonry work, we needed the allocation of these investment items between the two sugars to be used as weights for our decomposition of costs in reference. It was assumed that the total investment in cane sugar factory had two components, namely, a component exclusively used in cane processing and the other component used in cane as well as in beet processing. Because we did not have itemwise valuation of the machinery we decided to divide the total investment into two equal parts for two referred components. The common component for cane and beet processing was further allocated between cane and beet in the ratio of seasons. In other words 84.07 per cent of the investment in cane sugar factory was allocated to cane and the remaining 15.93 per cent to beet to which the investment in diffuser etc., was added. In case of masonry work since major part of it was due to beet silos, 90 per cent of it was added to beet and the remaining 10 per cent to cane. On the other hand tin sheds were

mainly for cane milling unit and hence 90 per cent of the investment in sheds was allocated to cane. Fire equipment, transportation equipment/railway sidings, costs were allocated on the basis of the seasons. The allocation of investment in weighing bridges was made on the basis of the quantities of raw materials. All these values were added separately for two systems to arrive at a ratio which was used in the allocation of repairs and maintenance costs.

Another problem confronted in the allocation of costs was in working out the interest on working capital. Since sugar produced was not sold immediately, the mill required working capital to pay the variable costs. The interest on working capital was only on the part which was not recovered from sales during a period. We decided to take a month as a period for this purpose. Any amount of working capital not recovered by sales was charged at 15 per cent per annum rate of interest The interest amount alongwith the balance of uncovered working capital was considered as balance carried forward and added to the working capital for the month. The monthly working capital was arrived at by dividing the total working captial by number of months the factory was operated during the season. In the begining of beet processing the allocation of returns from sales were aportioned in the ratio of unsold cane sugar and beet sugar. This ratio was kept till working capital for cane and beet were recovered subject to total quantity of cane and beet sugars.

In case of fixed costs, for the allocation of depreciation the method followed was of ratio of investments computed earlier in cane/beet processing was made the basis. For personnel associated with both cane and beet, their overhead costs were allocated in the ratio of seasons whereas elsewhere total costs were considered in the respective accounts.

Coming to the exclusive cane sugar and exclusive beet sugar processing plants, various overheads costs were examined and allocated according to the need for such investments. In these cases the sum of totals exceeded the total costs because some of the items were needed for both the processing plants and hence double counted. For instance, while entire sugar factory machinery was considered for cane processing, 50 per cent of it was used for beet processing which was accounted again in beet and was added to the investment in diffuser and other auxillaries. In case of masonry work, tin sheds, etc., no part of which was common between cane and beet were allocated in the proportion discussed earlier. In case of railway sidings, weighing bridges, etc., total investment was considered for both the systems. All these values were added together and used as a basis for arriving at an allocation of depreciation, and maintenance and repair costs for exclusive beet and cane processing units. Variable costs for cane and beet remained same as in case of combined processing unit except labour and interest on working capital which changed due to labour costs and returns from sale of sugar after manufacturing.

4.3 Economics of Sugar Production

Table 4 gives the economics of sugar production under different assumptions. It was observed that cane crushing capacity was utilised only by 25.5 per cent compared to 33.6 per cent of beet processing capacity on the basis of 150 days and 60 days cane and beet seasons respectively. In other words the available processing capacities were grossly under utilised. The cane crushing was started only on the last day of December in 1979-80. It continued for 77 days. However, 26 per cent of these available days were lost because of break downs, power cuts, shortage of raw material- cane supply, etc. In case of beet the factory worked for only 36 days with a loss of 28 per cent of available time because of the above reasons. The low utilisation of overall capacity again was due to inadequate supply of materials.

The sugar content in beet was higher than cane by about 2.5 percnetage points. However, the recovery was higher only by 2 percentage points. In other words more sugar available was lost in case of beet irrespective of the more efficient diffusion process used for its extraction. Apart from technical reasons which must have lowered the efficiency in beet processing, frequent power cuts and break downs of old cane sugar factory could be responsible for this loss.

Coming to the costs a substantial part of total costs were variable costs. Further raw material alone accounted for about 50 per cent of variable costs for the combined sugar as well as for exclusive cane sugar and about 35 per cent for exclusive beet sugar. The cost structure

Table 4 : Costs and Returns from Sugar Manufacturing Under Different Systems at Ganganagar Sugar Mills (1979-80)

Particulars	Exclusive cane	Exclusive beet	Cane + Beet combined
I. General information			
i) Capacity (tonnes/day)	1000	650	1000 + 650
ii) Normal season	150	60	210
iii) Date of starting season	31-12-79	16-3-80	31-12-79
iv) No. of days operated	77	36	121
v) Actual working days	57	26	83
vi) Cane/beet processed (tonnes)	38257	13106	38257 + 13106
vii) Average sugar content (%)	11.7	14.3	-
viii) Average sugar recovery (%)	9.1	11.1	-
ix) Sugar produced (tonnes)	3470	1455	4925
x) Pulp (tonnes)	-	8145	8145
xi) Bagasse (tonnes)	11634	-	11634
xii) Molasses (tonnes)	1817	496	2313
xiii) Press mud (tonnes)	729	-	729
II. Costs		Rs. '000	
A. Variable Costs			
i) Raw material	5259.9	2096.9	7356.8
ii) Other supplies & consumable stores	204.7	167.4	372.1
iii) Fuel	1077.9	1370.7	2448.6
iv) Power	247.4	115.7	363.1
v) Wages	1918.8	1176.2	2354.2
vi) Repairs & maintenance	728.3	466.3	716.8
vii) Packing	321.3	134.7	456.0
viii) Interest on working capital	287.4	176.0	381.7
Total	10045.7	5703.9	14449.2

Contd....

Table 4 Continued

Particulars	Exclusive Cane	Exclusive Beet	Cane + Beet combined
B. Fixed Costs			
i) Depreciation	273.4	713.8	783.6
ii) Administrative Costs	3282.0	2461.5	3282.0
iii) Other overheads	801.7	601.3	801.7
Total	4357.1	3776.6	4867.4
C. Total Costs	14432.9	9489.5	19316.6
III Returns			
i) Sugar	10140.7	4252.3	14393.0
ii) By-products	632.9	890.3	1523.2
Total	10773.6	5142.6	15916.2
Net returns	- 3629.3	- 4337.9	- 3400.4

IV Break up of costs between cane sugar and beet sugar in the cane-cum-beet processing unit

	Cane Sugar	Beet Sugar	Cane + Beet sugar
A. Variable Costs			
1. Which changed due to allocation			
i) Labour wages	1682.9	671.3	2354.2
ii) Repair and maintenance	488.8	228.0	716.8
iii) Interest on working capital	252.9	128.8	381.7
2. Which did not change due to allocation	7111.1	3885.4	10996.5
3. Total variable costs	9535.7	4913.5	14449.2

Contd....

Table 4 Continued

Particulars	Cane sugar	Beet sugar	Cane + Beet sugar
B. Fixed Costs			
i) Depreciation	207.7	575.9	783.6
ii) Administrative overheads	2236.4	1045.7	3282.0
iii) Other overheads	546.3	255.4	801.7
Total	2990.4	1877.0	4867.4
C. Total Costs	12526.1	6790.5	19316.6

of manufacturing sugar under different systems as shown in Table 4 indicates that processing sugarbeet alone was most expensive, and cane and beet processing together was least costly. The combination brought down the manufacturing costs by about five per cent of the cane sugar and about 40 per cent of the beet sugar produced separately. At the face of it exclusive sugarbeet processing was not desirable.

Because of large additional investments made for beet processing and shorter processing period the sugar manufactured from beet was low and hence the overhead costs of depreciation and administration were almost double the overhead costs of cane sugar manufactured in an exculsive cane processing mill. Even the variable costs for beet processing were significantly higher irrespective of lower raw material costs (due to high recovery of sugar from beet). This was primarily due to higher fuel and wage costs which were significantly higher for beet sugar. Because beet processing does not yield bagasse, the fuel needs of beet processing were met from extraneous sources including costly furnace oil. Wages paid especially to off-seasonal labour were relatively higher because of shorter processing season. Similarly repair and maintenance costs for beet plant were higher because of large investment made in diffuser. Similarly interest on working capital was higher because of its larger working capital needs.

On the whole at the present level of cane and beet processing the costs exceeded the price received from output (main and by-products). Whether through operational efficiency or price incentives, etc., it

was possible to make some of the situations remunerative, need to be examined. In what follows, therefore, is the break even analysis in terms of quantity of sugar price.

4.4 Breakeven Analysis

Table 5 shows the breakeven values of different variables under different systems. It was found that breakeven quantities of sugar production for all the three situations was not feasible because it was much higher than the capacity of the units. On the other hand the weighed price of levy and free sale sugar at existing level of processing activity under all the situations comes to be significantly higher than current price of sugar. It was, however, possible to produce sugar at the given price-cost relationship if the factories run at 80 per cnet of the capacity. However, it would be difficult for the factory to survive in the long run. Assuming 80 per cent capacity utilisation, the breakeven price for sugar was still marginally higher for exclusive cane unit, and cane and beet combined unit. In case of exculsive beet unit the breakeven price for sugar remains quite high. This was so even if 100 per cent capacity was utilised. In case of cane and beet combined plant of the breakeven price of sugar was less than the existing sugar price (weighed). At 80 per cent utilisation of the capacity, the factory was able to pay little higher price for the raw material. However, in 1980-81 the price paid for cane of 8.5% recovery was Rs. 220/- per tonne. In other words, the remote chances of this factory to come out of red are lost.

Table 5: Breakeven Analysis for Different Sugar Production Alternatives at Ganganagar Sugar Mills (1979-80)

Particulars	Cane alone	Beet alone	Cane + Beet together
I. Existing Situations			
i) Raw material processed (tonnes)	38257	13106	38257 + 13106
ii) Sugar produced (tonnes)	3470	1455	4925
iii) Price of raw material (Rs./tonne)	130	160	130 and 160
iv) Weighed sugar price (Rs./tonne)	2922.40	2922.40	2922.40
v) Fixed costs (Rs.000)	4357	3777	4867
vi) Variable costs (Rs. 000)	10046	5704	14449
vii) Raw material costs (Rs. 000)	5260	2097	7357
viii) Total returns (Rs. 000)	10774	5143	15916
ix) Returns from by-products	633	890	1523
II. Breakeven Values			
i) Sugar production (tonnes)	20771	*	11925
ii) Sugar price (Rs./tonnes)			
- At existing capacity utilisation	3969	5904	3613
- At 80% capacity utilisation	3112	4398	2954
- At 100% capacity utilisation	3032	4180	2896
iii) Maximum cane price at 80% capacity utilisation (Rs./tonne)	149	*	136**

*Not computable

**Computed beet price was assumed Rs. 30 per tonne higher than the cane price.

4.5 Investment Analysis

Investment analysis was carried out to examine the economic viability of new investments to be made and for already made investments. In our case the investment in beet processing machinery and equipment was already made. So we thought of carrying out investment anlaysis for this additional investment. However, because the data over past many years had shown that the sugar unit could not make any profits; acted as a constraint for such analysis. The increase in sugarcane and sugarbeet prices in 1980-81 had further made sugar processing unrenumerative and hence the idea of investment analysis was dropped.

5. Findings and Implications

The analysis of the growth in sugar production and the difficulties the sugar industry faced in India indicated that under-utilisation of available cane crushing capacity was the major problem responsible for the so poor performance of this industry. The problem was more serious in the important sugar producing states of Bihar and Uttar Pradesh. A large number of sugar factories in these states have gone financially sick. Many of them were working at below the breakeven. Ganganagar Sugar Mills, Sri Ganganagar in Rajasthan was a similar case. Even the introduction of beet processing could not help to get this unit out of red.

The factory worked only for about half the normal season. Further about 25 per cent of the working days were lost in 1979-80. Even during the relatively better year of 1980-81 the processing of cane was stopped

in the beginning of March. Similar was the situation in case of beet. Inadequacy of raw material supply was the major reason for shorter processing season. Occasional breakdowns and power cuts were the other reasons for low utilisation of capacity. The old cane factory machinery also resulted into higher repair and maintenance costs in addition to loss of sugar due to breakdowns.

In fact, introduction of beet processing in a cane processing unit involved large additional investment in diffuser and hence gains from spread of overheads over longer processing season were almost neutralised by the overheads due to these investment.

Though for the past two years the prices paid for cane and beet were sufficiently remunerative, their production and supply to the mill lagged far behind the capacity. This had happened irrespective of enough extension staff available with all necessary facilities of transport, etc. As mentioned earlier, the cane crushing in 1981-82 was to be stopped in the first week of March for want of cane. At the same time overstaffing had certainly increased the overheads.

The economic analysis of processing of sugar from cane and beet indicated that none of the alternative sugar production systems, namely, cane sugar alone, beet sugar alone, cane and beet sugar together were economically viable as net returns were negative in all the three cases. It was also observed that not only fixed costs per unit of sugar produced were high because of under-utilisation of capacity, but variable costs were also high, mainly because of fuel

costs for beet and high wage bill both for cane and beet. As a result, even breakeven analysis led no where. If, however, the capacity utilisation is improved to over 80 per cent and sugar prices are increased marginally, the factory could run at no profit no loss for cane alone and for cane and beet together. The analysis pointed out that introduction of beet lowered the sugar production costs even though no system was economically sound. As the cane beet sugar system required additional investment, the investment analysis would have been useful. Since the net incremental returns were very low and it was not possible to recover the investment over the economic life of the investment even at zero rate of discount the investment analysis was not carried out.

The implications of the findings, therefore, are very straight forward. That is, under the given circumstance introduction of beet processing was not at all desirable in the factories such as the Ganganagar Sugar Mills both on the basis of cost analysis and investment analysis. The economic superioity of sugarbeet at farm level did not change the situation. In fact, irrespective of its superiority, the factory could not manage to get adequate supply of beet even at a very renumerative price of Rs. 250 per tonne of beet roots in 1980-81. The farmers were reluctant to cultivate beet because it was most expensive and because of the risk in timely disposal. What was required the better management of raw material assembly at the mill such that its disposal costs to the growers are minimised.

Another point against beet cultivation was its irrigation requirements irrespective of additional irrigation made available for beet cultivation, the farmers were not satisfied with the quantum of this water.

On the other hand since to safeguard the interest of beet growers and of the sugar consumers, we could neither recommend a cut in raw material price paid to farmer nor we could increase sugar prices. The only possibility was reducing costs through improved efficiency in organization and operations. This efficiency included utilisation of capacity as well as operational efficiency.

It has therefore, become amply clear that sugar production in Ganganagar Sugar Mill even from cane was not economical mainly because of inadequate supply of raw material. The situation arose because sugarcane did not have comparative advantage over other crop such as wheat and hence the farmers were not ready to expand area under cane irrespective of good price offered to them recently. The fate of beet did not seem to be different as it has added problem of larger irrigation requirements.

At other places, especially, in North, one has to examine the economics of processing of this crop under certain assumptions. Also the introduction of beet replaces some other crop(s), one has to look into the economics of this crop vs. crops replaced in accepting/rejecting this crop for sugar production. For economic analysis both farm and factory level analysis would be necessary.