"This research manuscript..... a first flower
in my life is affectionately dedicated
to my loving parents and sister 'KUSUM'
who are the continuous source of
inspiration for me in every
walk of life....."

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ECONOMICS OF SIZE AND RETURNS TO SCALE IN CO-OPERATIVE SUGAR FACTORIES IN MAHARASHTRA

A Thesis submitted to the

MAHATMA PHULE KRISHI VIDYAPEETH

(AGRICULTURAL UNIVERSITY)

RAHURI, District : Ahmednagar, (Maharashtra State)

in partial fulfilment of the requirements for the degree of

Master of Science (Agriculture)

in

Agricultural Economics

By

Arjun Uttamrao Kawade

B. Sc. (Agri.) First Class

DEPARTMENT OF AGRICULTURAL ECONOMICS

Post-Graduate School, Rahuri

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CHAPTER I

INTRODUCTION

Development of agriculture occupies an important place in the country like India where nearly half the national income is contributed by agriculture and over 70 per cent of its population is directly dependent on agriculture. Among the various strategies advocated by the planners, leading economists and scientists for the speedy development of agriculture, establishment of agro-based industries has gained important position, particularly, during the post-independence period. It is maintained that the establishment of agro-based industries helps the development of agriculture in two ways. Firstly, they are supposed to utilize output of agriculture commodities as raw material in producing intermediate and final products that consumers demand for ready consumption. Secondly, they supply various forms of inputs needed for enhancing agricultural production.

1.2 Sugar Industry and the Co-operatives :

Sugar industry is one of such agro-based industries which utilizes agricultural produce, i.e., sugarcane and beet, as raw material for the production of sugar and other related products. It is often said that India is the home of sugar. The Indian sugar industry has made tremendous progress during the post-indepence period and presently, it is the third largest industry in the country next only to iron-steel and textile industry.

In the year 1975-76, the Indian sugar industry had under its fold 253 sugar factories. It has provided employment to more than a quarter million people including a large number of technicians and highly skilled persons. The industry contributes Rs. 200 crores annually to the central and State revenue by way of taxes. The Fiscal contributions of the industry to the exchequers of the Central and State Governments by way of excise duty, cane cess and income tax is estimated at about Rs.1,500 million per year. It also disburses each year Rs.400 crores to the cane growers as against purchase of cane. The sugar industry has also demonstrated a remarkable ability to modernise agriculture, to transform rural society, and to bring prosperity to the country side. Consequently it occupies a place of pride as an instrument of rural reconstruction and development. According to late Shri.Jawaharlal Nehru, the growth and prosperity of the rural side is the only way to have development and to make a nation prosperous and this is followed in the case of sugar industry. This has been possible only because of establishment of a large number of private and co-operative sugar factories in various states. More particularly, the establishment of co-operative sugar factories in India has enabled the country in becoming not only self-sufficient in sugar requirement, but also a net exporter of sugar in the world market. In 1975-76, about 9.25 lakh tonnes of sugar worth Rs.452 cores was exported as against 2.5 lakh tonnes valued at Rs. 42 crores exported in 1973-74. The phenomenal rise in the export of sugar is, in a way, a reflection of the dynamic growth of the industry.

The progress of the Indian sugar industry during the post-independence period has been the result of the widespread expansion in the area under sugarcane cultivation and establishment of sugar factories particularly in co-operative sector in some of the northern and southern states in the country.

1.3 Variation in the Installed Capacities of the Co-operative Sugar Factories :

Among the various sugar producing states in India, Maharashtra occupies an unique position in the sugar production for the reason that relatively large quantity of sugar is manufactured by the co-operative sugar factories. During the year 1975-76, out of the 55 sugar factories , 45 sugar factories were in co-operative sector. These sugar factories have got different crushing capacities ranging from 800 tonnes to 5,000 tonnes of sugarcane per day.

1.4 Economies and Diseconomies of Scale in Co-operative Sugar Factories :

The variation in the crushing capacities of the co-operative sugar units in Maharashtra has got significant economic importance. As the size of plant and the scale of operation become larger, certain economies of scale are usually realized. After adjusting all inputs optimally, the unit cost of production can be reduced by increasing size of the plant. The possibility of specialization and division of labour and use of latest technology leading to reduction in the unit cost of production, are facilitated by the expanded plant size. One should not however, forget that expanded plant size is also subjected to diseconomies of scale. Limitations on efficient management of the business, many a times, make the control and co-ordination of a wide range of activities like production, transportation, finance, sales, etc. difficult. Besides this, as the industry depends on supply of sugarcane for its raw material requirement, the limited supply of sugarcane usually leads to underutilization of capacity and increase in the per unit cost of production. The profitability and returns to capital investment are affected to a greater extent if the capacity is not put to its maximum possible use.

The co-operative sugar industry in Maharashtra therefore, witnesses both economies and diseconomies of scale. Some of the sugar factories are at advantage in keeping the unit cost of production relatively at a low level. At the same time there are some factories which, because of several reasons, experience the problems of underutilization of installed capacity, as well as, diseconomies of scale.

1.5 Problem of the Study :

In view of the fact that the size of the co-operative sugar factories varies considerably and there exists economies as well as diseconomies of scale, it is imperative on the part of the planners, co-operators and economists to determine empirically the most optimum size of the plant within the framework of the existing situation. An attempt is therefore, made to study the "economics of size and returns to scale in co-operative sugar factories in Maharashtra State".

1.6 Hypotheses of the Study :

It has been hypothesised that

(1) there exists economies of scale in co-operative sugar factories in Maharashtra,

(2) the possibility of deriving economies of scale

is however, limited because of underutilization of installed capacity, and

(3) limitation on supply of sugarcane to the factories is the major constraint on full utilization of installed capacity.

1.7 Objectives of the Study :

In order to examine the above hypotheses, the empirical study has been undertaken with the following major objectives.

(1) To estimate costs, returns and net returns from sugar production in different size groups of co-operative sugar factories.

(2) To determine relative efficiency of different size groups of co-operative sugar factories.

(3) To determine the optimum production capacity for the co-operative sugar factories.

(4) To estimate the extent of underutilization of installed capacity of the co-operative sugar factories, and

(5) To find out reasons for underutilization of installed capacity of the co-operative sugar factories.

1.6 Utility and Scope of the Study :

As the study is centred around the economies of scale in co-operative sugar factories and other related aspects, the findings of the same will be useful to the planners, management personnel of the sugar factories and sugarcane producers. Based on the findings of the study, the planners can formulate suitable policies for the development of sugar industry in the State. These policies would be in respect of granting licenses either for establishment of new sugar factories or for expansion of existing plant size. The management personnel can get detailed idea about the profitability of the sugar factories. On the basis of findings of the study, they can determine and adopt ways and means for economizing sugar production. The root cause of low profitability in sugar production is the underutilization of installed capacity resulting from limited supply of sugarcane. The management personnel as well as the sugarcane producers can realize the importance of increasing productivity of sugarcane in their respective areas for deriving higher returns both from sugar and sugarcane production.

The study is based on the information obtained from 30 co-operative sugar factories for the years 1973-74 and 1974-75. Since then a few more co-operative sugar factories have gone into production. But they have not been considered in the present study. The sugar factories working in the private sector have also been excluded from the present study because of some difficulties in obtaining the information. The findings of the study, therefore, cannot be taken as that of the total sugar industry in the State. Besides, any changes in the prices of inputs and output, and seasonal effects may affect profitability of the sugar factories. The results of the study may, therefore, be viewed accordingly.

CHAPTER II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

An attempt is made in the present chapter to review literature on sugar industry, in general and economies of scale in co-operative sugar factories and related aspects, in particular. The review of literature gives an idea about the research work carried out by other research workers and authorities in the field. Their research findings and observations benefit new research worker in planning his research work on appropriate lines.

For the sake of convience, the available reviews have been classified into three broad groups viz.,

1. General studies on sugar industry;
2. Economies of scale and problems of capacity utilization.
3. Reasons for underutilization of installed capacity.

2.2 General Studies on Sugar Industry :

The growth of sugar industry in India has helped the economy in many ways. The co-operative sugar factories have got Loin's share in the total contribution made by the industry to the Indian economy .

Fuss (1968) has rightly pointed out that the co-operative sugar factories which have started in India in larger number during last 10 years generally have proved to be successful and showed positive effect of extensive Government aid at the time of establishment. The co-operative sugar factories have influenced the economic development of the farmers. Their success in their respective regions is shown by increased agricultural production, increased income and employment, changes in the cropping pattern, introduction of new agricultural techniques and improved infrastructure and overall change in the rural society.

In addition to the above Hon,ble Mohite (1974) has stated that the rapid growth of sugar industry has been helpful to a great extent in stabilising sugar production and in reducing chronic shortage of sugar in the country. Further he said that the co-operative form of organization lent itself as a powerful instrument in the development and mobilisation of natural, human and financial resources of the state towards sugar industry and have helped in reducing the backwardness of the country by improving the condition of backward areas in the State.

Similar observation was made by Kamat (1975), according to him co-operative sugar factories have not only brought the economies of large scale production to the members but also provided them with opportunities to organise and manage their own business. The members are trained in democratic and business procedures.

Though the sugar industry has proved to be one of the great adventures for transformation of Indian economy, it is faced with many problems of its own.

Anand (1971) gave one of the special features of sugar industry as of recurring five yearly cycle two years of rising trend, one year of peak production, followed by two years of decreasing production. Further he stressed the importance of cane development programme for reducing intensity of this phenominon.

According to Thaper (1976), some of the peculiar features of the sugar industry are as fallows :

(a) the industry is seasonal,

(b) duration of season varies from one factory to other and also from year to year,

(c) sugar content in cane and it's recoveries also varies at random between one factory to another, and

(d) variation in capital investment.

Apart from the problems of cyclical nature of production of sugar and variations in capital investment and sugar recovery, the sugar industry experiences interstate differences in the cost of production per unit of sugar. The cost of production of sugar as estimated by Pothuwal (1972) in Uttar Pradesh, Jagannathrao K. Pawar

(1977) and Kolhe (1976) in Maharashtra, and O.P. Dhanuka (1975) in Bihar varied between Rs. 107.05 and Rs. 270.00 per quintal, the highest and the lowest being in Uttar Pradesh and Bihar respectively.

2.3 Economies of scale and problem of capacity utilization :

Unlike any other industry, the sugar industry is also able to derive economies of scale. It is however, limited due to many factors among which under-utilization of production capacity is the important one.

While stressing this point P. Narang (1973), has stated that despite steady increase in capacity in recent years, there is a gradual decline in capacity utilization which ultimately leads to diseconomies of scale in sugar industry.

According to Kharkar (1976), now a days though there is an emphasis on increasing production capacity of the factory, it leads to push the factory in loss due to underutilization of capacity. The economies of scale are therefore too obvious to be emphasised in any processing industry.

Ferran Olira J. (1976), rightly said that there is a necessity of determining the most economic size of sugar mills in order to safeguard the industry from the problems of diseconomies of scale. The basic considerations in determining milling capacity of sugarcane mills must therefore be illustrated on the basis of production costs and performance figures of factory.

Auty (1973) has spelled out the problem on the basis of empirical data and concluded that real costs of production and rates of factory expansion tend to support the theory that scale economies in manufacturing have acted as a catalyst in changing size and spatial distribution of product.

Sachdeva and Sachdeva (1975), in the reference book "Economics of sugar industry" stated that there is a necessicity of large scale production in order to attain economies of scale. Further they described the role of capital in achieving economies of scale i.e., for large scale production, it requires huge amount of capital.

While stressing the need for optimum capacity, Phadnis (1976) rightly said that as size of plant increases beyond a certain limit, there exists diseconomies of scale due to inefficient management of the plant. Further he said that if the factory is run at optimum capacity, there will be efficient management which ultimatly leads to reduce the cost of production and also to maintain consistantly high price to cane growers.

Kirilyuk and Kirilyuk (1970) have indicated with empirical evidences the need to increase production capacity of the factory from 900 - 1650 to 1700 tonnes per day in order to achieve economies of scale. Further they suggested the optimum campaign length of 110 to 115 days.

Nandi (1972), while studying the cost-output analysis of sugar industry stated that the capital-output ratio must be at 2.2 to 2.4 for construction of new sugar plants in the south and 3.6 for the same in the north. The ratio for expansion was found to be 1.5 in the south and to be 1.7 in the north. With this ratio virgin period of operation is 200 days in the south and 120 days in the north zone.

Jagannathrao K.Pawar (1977), while studying economies of scale in co-operative sugar units in Maharashtra concluded that per unit profitability of sugar production was low in large sized factories as compared to smaller ones. Large sized factories however, were at advantage in economising manufacturing expenses and overhead costs provided cane price and excise duty remain the same for all the factories. Further he stated that large sized factories could derive economies of scale by utilizing their capacities to a higher level. These factories were in loss due to short supply of cane. According to him the problem of short supply of cane could be corrected by increasing area under cane as well as by increasing productivity of cane. Limitation on irrigation supply however, brings about restraint on expansion of area under cane cultivation. The only alternative left is therefore to increase sugarcane yield per unit of area. The "Sugarcane Pilot Project" sponsored by the State Government therefore, keep great promises in this regard.

There are a very few empirical studies on determination of optimum capacity in sugar industry. The studies on other agro-based industries are, however, useful for the researchers in deciding methodological approach to tackle the problem. The study conducted by Singh B. and Sidhu D.S. (1976) in groundnut processing industry revealed that there existed economies of scale. The Budgeting technique was used for analysing costs and returns in respect of the industry. Another study was attempted by Singh B. and Sidhu D.S. (1965) in rice processing mills on similar lines. In case of rice processing mills also, they observed economies of scale.

Similar conclusions were drawn by J.Hirnandez, F. Denabaz and M. Codina (1970) in sugarcane processing industry.

All the above economists have used simple tools i.e., arithmetic averages for estimating economies of scale on the basis of emprirical data. Such an attempt gives rough estimation about the most optimum capacity size group in the respective industry. It is however, difficult to conclude exactly as to at what particular point the profits will be maximum. For this, it is necessary to estimate either profit functions or cost functions from the available data. These functions enable us to determine the optimum capacity as the one having the highest profit or the lowest cost.

Comitini and Haung (1975) have estimated optimum size of Japanese Tuna Fishing industry by regressing the the data on average total cost (ATC) and average variable cost (AVC) on gross tonnage (T) and obtained the following empirical relations :

1. $ATC = 390.3 - 5.790\ T + 0.0005584\ T^2$

$(22.76)\ (0.1969)\ (0.0003214)$

$R^2 = 0.358,$

2. $AVC = 259.6 - 0.5752\ T = 0.0005447\ T^2$

$= (10.02)\ (0.06663)\ (0.0001414)$

$R^2 = 0.745$

They have fitted quadratic equations of the type

$Y = a - b_1 T + b_2 T^2$ and showed the minimum cost points at 516 and 526 tonnes respectively for ATC & AVC cost curves. From this analysis, it appears that the Japanese Tuna Fishing Industry was characterised by decreasing costs relative to vessel size.

2.3 Reasons for underutilization of capacity :

Narang (1973) identified the problem of underutilization of installed capacity in the sugar industry on the basis of time-series data for the period from 1968-69 to 1971-72. During this period though the installed capacity increased from 7.50 lakh tonnes to 9.97 lakh tonnes, the index number of capacity utilisation decreased continuously to 77 from the base year (1968-69) index number at 100.

Patel (1976) noticed that 27.5 per cent factories are utilising less than 70 per cent of their installed capacity, while 12 per cent factories are able to utilise their full installed capacity. Further he noticed the reasons for underutilization of capacity as (1) lack of planning for cane development, (2) drought condition, (3) diversion of cane to Gur and Khandsari (because of comparatively low return to cane if it is sold to the factory) and (4) high percentage of crushing time lost due to cane shortage and lack of transport arrangement.

Pittie (1975), while discussing the problem of new sugar units concluded that production of sugar from newly units is "uneconomical" as setting up of new units is highly capital intensive and fuller capacity utilization is the only solution for overcoming the problem of low returns from new sugar units.

Hon'ble Mohite (1976) expressed that inadequate supply of cane to the factory is the main reason for under-utilization of capacity. He further observed that the supply of sugarcane largely depended on the productivity of sugarcane which, over a period of time, showed declining trend due to (1) un-balanced fertilization, (2) inadequate measures of seed protection, (3) poor facilities of pest control, (4) lack of proper crop planning, (5) dependence on only one variety, and (6) too much shift towards Adsali plantation. Finally he has suggested several measures to improve the productivity of sugarcane in order to stabilise supply of sugarcane to the factories.

Kharkar (1975), Jagannathrao R. Pawar (1977), and D.V.Kasar (1977) are also of the opinion that low productivity is the major factor responsible for inadequate supply of sugarcane to the factories and efforts are therefore needed to increase the productivity.

Bhargava Commission (1976) has reported the following inadequacies of sugar industry :

(1) Short supply of cane to the factory,

(2) Inadequate credit facilities,

(3) Delay in payment,

(4) Lack of professional management,

(5) Poor condition of plant and machinery,

(6) The practice adopted by the factories in marketing sugar during period of partial decontrol.

The commission has further stated that these inadequacies directly or indirectly lead to diseconomies of scale and underutilization of installed capacity.

Raghwendrarao (1976) stated that the growing problem of sugar industry in India is due to the fact that the sugar industry has been paralysed by political pressures and has been the doll in the hands of politicians for their game. Again he reported that the present policy of setting more and more sugar factories with the expectation of increased production is absolutely wrong because of low productivity of sugarcane.

Kharkar (1975) has specifically pointed out that economics of sugar factory is distrubed largely because of low ~~pre~~ productivity and crushing of sugarcane of non-share holders who produce the cane of poor quantity. This statement however seems to be partially invalid for the reason that the recovery percentage of private factories, where non-share holders are the main source of sugarcane to factory, is quite encouraging.

Mittal (1976) has given some of the suggestions for improving economics of sugar industry as follows :

(1) Adoption of techniques to reduce losses of sugar.

(2) Utilization of by-products.

(3) Increasing productivity of sugarcane.

(4) Reduction in store consumption.

(5) Changing formula of levy price fixation.

(6) Payment to cane growers according to cane quality rather than weight.

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CHAPTER III

METHODOLOGY

CHAPTER III

METHODOLOGY

In his endeavour in arriving at meaningful conclusions from the research study, the researcher has to adopt appropriate research methodology. In fact research methodology is regarded as a foundation of every scientific study and needs to be elaborated in detail in order to facilitate the readers and other research workers to understand the conclusions drawn from such study. In view of this, the present chapter discusses in detail the research methodology adopted for the study. It deals with the sources of empirical data used in the study, the analytical procedure adopted for arriving at meaningful results for accomplishing the objectives of the study and various concepts underlying the study.

The chapter is therefore divided into four main parts viz., sources of the data, selection of the sugar factories, collection of the data, and the analysis of the data and the concepts.

3.1 Sources of the Data :

As the study is directed towards determination of economies of scale in co-operative sugar factories in the State, it was necessary to obtain data on various aspects of the sugar industry in the State, the production performance of the individual co-operative sugar factories, their costs, returns and net returns and other relevant statistics determining the economies of scale. As far as the details of the sugar industry at the State level are concerned, the Directorate of Sugar, Maharashtra State, and the Deccan Sugar Technologists' Association, Pune were the important sources of the data. These two organizations compile and publish statistics of sugar industry regularly. The Annual Reports of the individual co-operative sugar factories, however, proved to be the main source of information on sugar production and other related aspects. In order to show the prominant role played by the State in the Indian Sugar industry it was felt necessary to obtain relevant statistics of the industry at the national level. Such information was obtained from the two journals viz., 'Sugar News' and 'Indian Sugar' published by Smt. Gulab Joshi, 3 Sita Sadan, Senapati Bapat Marg, Bombay-4S and Indian Sugar Mills Association, 39, Nehru Place, Sugar House, New Delhi, respectively.

3.2 Selection of the Sugar Factories :

The sugar industry of the Maharashtra State is composed of 10 private and 45 co-operative sugar factories. Of the 45 registered co-operative sugar factories (only) 36 co-operative sugar factories have been commissioned into production of sugar, while rest of the registered sugar factories are either in the trial stage or in the erection stage.

All the co-operative sugar factories that have actually gone into production have been considered for the present study.

3.3 Collection of the Data :

The present investigation of study the economics of size and returns to scale in co-operative sugar factories is based on the data obtained from the annual reports of the individual sugar factories. These annual reports contain detailed information on all aspects of the sugar factories.

The major task involved in the work of data collection, therefore, was to obtain annual reports of the individual factories. In anticipation that the officials of the factories would supply required information by way of sending annual reports, letters were sent to the Chairmen and Managing Directors of all the co-operative sugar factories in the State requesting them to send annual reports of their factories for the year 1973-74 and 1974-75. The officials of the majority of the factories responded to our request and sent annual reports of both the years.

The officials of the factories who did not respond to this letter, were contacted personally and the annual reports were collected after convincing them about the purpose of the study. Likewise we obtained the annual reports of all the co-operative sugar factories in the State. After the receipt of the reports of each factory, only those factories which were in production during the period have been considered for the study purpose.

3.4 Analysis of the Data and the Concepts :

The study is based on the data obtained from annual reports of 36 co-operative sugar factories for the years 1973-74 and 1974-75. These sugar factories have been grouped in to three size groups viz., small, medium and large depending upon the crushing capacity as upto 1,250 tonnes, between 1,251 to 2,500 tonnes, and above 2,500 tonnes per day respectively. Size groupwise distribution of these factories has been shown in Table 3.1.

The data contained in the annual reports of the years 1973-74 and 1974-75, have been compiled according to three size groups. Simple averages have been estimated for the individual size groups as well as at the overall level for studying various aspects of sugar factories.

The various concepts used and the analytical procedure applied are discussed below :

Table 3.1 : Size groupwise distribution of the co-operative sugar factories.

Sr. No.	SMALL Upto 1,250 tonnes	Sr. No.	MEDIUM 1,251 to 2,500 tonnes	Sr. No.	LARGE 2,500 and above tonnes
1.	Vishwas SSK Sirala, Sangli. (1250)	1.	Pravara SSK Loni, Ahmednagar (2200)	1.	Shri Satpuda Tapi Parisar SSK Shahada, Dhule (2500)
2.	Shetakari SSK Killari, Osmanabad. (1250)	2.	The Bhogawati SSK Parite, Kolhapur. (2000)	2.	Ashok SSK Shrirampur, Ahmednagar. (2600)
3.	Walwa Taluka SSK Sakharale, Sangli. (1250)	3.	Warna SSK Warnanagar, Kolhapur. (2000)	3.	Krishna SSK Rethare (BK), Satara. (3200)
4.	Shanker SSK Malshiras, Solapur. (800)	4.	Shri Dudhaganga-Vedganga SSK Bidri, Kolhapur. (1750)	4.	Rahuri SSK Rahuri, Ahmednagar. (3250)
5.	Datta Shetakari SSK Sirol, Kolhapur. (1250)	5.	Sahyadri SSK Karad, Satara. (1500)	5.	Panchaganga SSK Ichalkaranji, Kolhapur. (4000)
6.	The Saswad Mali SSK Malinagar, Solapur. (1250)	6.	Kumbhi-Kasari SSK Kuditre, Kolhapur. (1750)	6.	Shetakari SSK Sangli, Sangli. (3500)
7.	Terna Shetkari SSK Dhoki, Osmanabad. (1250)	7.	Shri Rama SSK Phaltan, Satara. (2000)		
8.	Shri Panzara-Kan SSK Bhadne, Dhule (1250)	8.	Sanjiwani SSK Kopergaon, Ahmednagar. (1600)		
9.	Shri Siddheswar SSK Kumthe, Solapur. (1250)	9.	Shri Ganesh SSK Ganeshnagar, Ahmednagar. (1750)		

	SIZE GROUPS				
Sr. No.	SMALL Upto 1,250 tonnes	Sr. No.	MEDIUM 1,251 to 2,500 tonnes	Sr. No.	LARGE 2,500 tonnes and above
10.	Kalamber Vibhag SSK Kandhar, Nanded. (1250)	10.	The Kopergaon SSK Kolpewadi, Ahmednagar. (1750)		
11.	Yeshwant SSK Theur, Pune. (1250)	11.	The Malegaon SSK, Malegaon, Baramati, Pune (2000)		
12.	Sangamner Bhag SSK Sangamner, Ahmednagar(800)	12.	Yeshwant SSK Akluj, Solapur. (2000)		
13.	Girna SSK Dabhade, Nasik. (1250)	13.	Shri Chattrapati SSK Baramati, Pune. (2000)		
14.	Satara SSK Satara, Satara. (1250)	14.	Niphad SSK Niphad, Nasik. (2000)		
15.	Vasant SSK Pusad, Yeotmal. (1250)				
16.	Shri Siddheswar SSK Sillod, Aurangabad. (1250)				

N.B. : Figures in parentheses indicate the installed crushing capacity of each factory.

(i) Production performance of the sugar factories :

The production performance of sugar factory of different sized groups could be judged on the basis of average installed capacity, quantity of cane crushed, quantity of sugar produced and average recovery percentage.

(ii) Cost of production of sugar :

The cost of production of sugar has been estimated on the basis of the data contained in the "Manufacturing Account" of the annual reports. Following items of cost have been considered for estimating the cost of production of sugar.

1. Price of cane
2. Cane purchase tax
3. Harvesting, transport and other related expenses
4. Manufacturing expenses
5. Salaries and wages
6. Depreciation
7. Repairs and maintainece
8. Other expenses.

The cost thus estimated is in fact the gross cost of production. In order to arrive at the net cost of production of sugar, the value of by-products viz., sugar in process, molasses, bagasse and press mud has been deducted from the gross cost of production. The net cost of production of sugar has been estimated on per factory and per quintal basis. The per quintal cost of production of sugar is worked out by dividing net cost of production by the total quantity of sugar produced.

iii) Comparative Economics of the Different Sized Sugar Factories :

The comparative economics of sugar factories belonging to different size groups has been studied on the basis of size groupwise total costs, gross returns and net returns of the factories.

(a) Total Costs :

While working out economics of sugar production, all the costs were classified under two main categories such as -

I. Variable cost, and

II. Fixed cost

Variable cost is that cost which varies directly with the level of production and includes all the items of total cost of production except depreciation. It also includes the cost on account of Excise-duty and marketing of sugar.

Fixed cost is that cost which does not vary with the level of production. It is fixed in nature irrespective of the level of production. Fixed cost includes the following items -

1. Interest
2. Bank charges and commission
3. Salaries and wages of permanent staff
4. Travelling expenses and attendent fees
5. Provident fund and gratuity
6. Rent, rates and taxes
7. Postage, telegram and stationery expenses
8. Audit and legal fees
9. General expenses
10. Development rebate and other provisions
11. Depreciation.

The costs on account of above items were available from the "Profit and Loss Account" of the annual reports.

(b) <u>Gross Receipts</u> :

The Gross Receipts included the value of sugar produced, interest received and divident realized from the shares of other institutions and the receipts from other activities undertaken by the sugar factories.

(c) <u>Net profitability</u> :

Net profitability has been estimated by deducting total costs from gross receipts of the sugar factories, i.e. Profit = Gross receipts - Total costs

In order to judge relative efficiency of individual size groups, the costs, gross receipts and net profits have been estimated on per 100 tonnes of installed capacity basis.

iv) Capacity utilization :

The profitability of any industry depends on its capacity utilization. If capacity is not utilized properly, there is possibility of reduction in the profits. In fact, possibility of deriving economies of scale is largly dependent on the ability of the industry in utilizing its installed capacity to the fullest possible extent. Therefore an attempt is made to estimate capacity utilization in each of the size groups on the following lines.

Percentage capacity utilization =

$$\frac{\text{Quantity of cane crushed per day}}{\text{Installed capacity}} \times 100$$

where,

quantity of cane crushed per day has been worked out by dividing total quantity of cane crushed by the number of actual crushing days. The problem of underutilization of production capacity is faced by majority of the sugar factories. It becomes therefore, imperative to know as to, under the existing cost structure and price expectation, what should be the minimum capacity utilization for breaking even and what would be the level of profits if the potential capacity is put to its maximum use. These have been estimated on the following lines -

a) Break-even analysis in sugar production :

The capacity at which the total returns equalized the total costs was taken as break-even point for different size groups.

Quantity of sugar to be produced for breaking even is estimated as $Ps. \; Q = F.C. + AVC \times Q$

where,

Q = Quantity of sugar in quintals required for breaking even.

F.C. = Fixed cost (Rs.)

Ps. = Price per quintal of sugar

AVC = Average variable cost per quintal of sugar.

By transposing the terms, and solving for Q we get

$$Q = \frac{F.C.}{(Ps - AVC)}$$

After estimating the quantity of sugar reqδired to be produced for break-even, the quantity of sugarcane to be crushed is calculated on following lines -

$$= \frac{\text{Quantity of sugar produced}}{\text{Recovery percentage}} \times 100.$$

Likewise, the quantity of cane required to be crushed and the crushing period at full capacity utilization, as well as at existing level of capacity utilization have also been worked out at break-even point.

b) Profitability potential at full capacity utilization :

The profitability potential at full capacity utilization has been estimated; given that the existing crushing period, the cost structure, the price levels, and the recovery per cent remain the same and sufficient cane supply is possible for full utilization of installed capacity in all the three size groups.

v) Per acre sugar production :

The per acre sugar production is estimated as

$$= \frac{\text{Average yield of sugarcane/acre}}{\text{Recovery percentage}} \times 100.$$

vi) Rate of return on capital investment :

The rate of return on capital investment has been estimated by finding out the value of i from the equation

$$C = \frac{R_1}{(1 + i)} + \frac{R_2}{(1 + i)^2} + \ldots + \frac{R_n}{(1 + i)^n}$$

where,

C = initial capital investment in sugar factory. It includes investment in both productive as well as non-productive assets.

R_{is} = Annual income flow assumed to be constant and is estimated as gross receipts less gross costs (Excluding depreciation and interest on fixed investment chargeable during the year).

i = Rate of return on capital investment or in Keyne's words marginal efficiency of capital i.e., MEC. The value of i has been found out on the basis of the "tables for capital investment analysis" by V.L. Mote and others.

n = Period in years for which capital investment is going to remain productive. This has been assumed as 10 years, 15 years or 20 years.

The value of i is compared with the market rate of interest at the time of investment in order to judge efficiency of the capital investment.

vii) Determination of Optimum Capacity :

The optimum capacity of the sugar factory can be determined on the basis of the industry's short-run cost functions. Such an attempt would useful for assessing an rationality of management policy in the light of the cost structure.

Since we are interested in behaviour of operating costs relative to factory size, we processed the data to represent the following variables : average total cost (ATC) per quintal of sugar, average variable cost (AVC) per quintal of sugar and installed capacity of factory (T). The average total cost and the average variable cost are regressed on installed capacity. The regression equations used are

$$ATC = a - b_1 T + b_2 T^2$$

$$AVC = a - b_1 T + b_2 T^2$$

where,

ATC = Average total cost per quintal for sugar.

AVC = Average variable cost per quintal of sugar.

T = Installed capacity of a factory.

b_1 & b_2 = Regression coefficients

a = Constant.

The optimum capacity has been determined at the minimum cost points.

viii) Reasons for Underutilization of Capacity :

An attempt is made to find out the reasons for underutilization of installed capacity in the individual size groups. This has been contemplated by comparing average membership, acreages under sugarcane, supply of cane by the members, availability of cane from non-members of the individual size groups on per factory and per 100 tonnes of installed capacity basis.

Two relationship, viz., (i) between profitability, capacity and capacity utilization has also been determined by estimating linear regression equation of the following form

$$P = a + b_1 C + b_2 Cu$$

where,

P = profit

C = installed capacity

Cu = Percentage capacity utilization

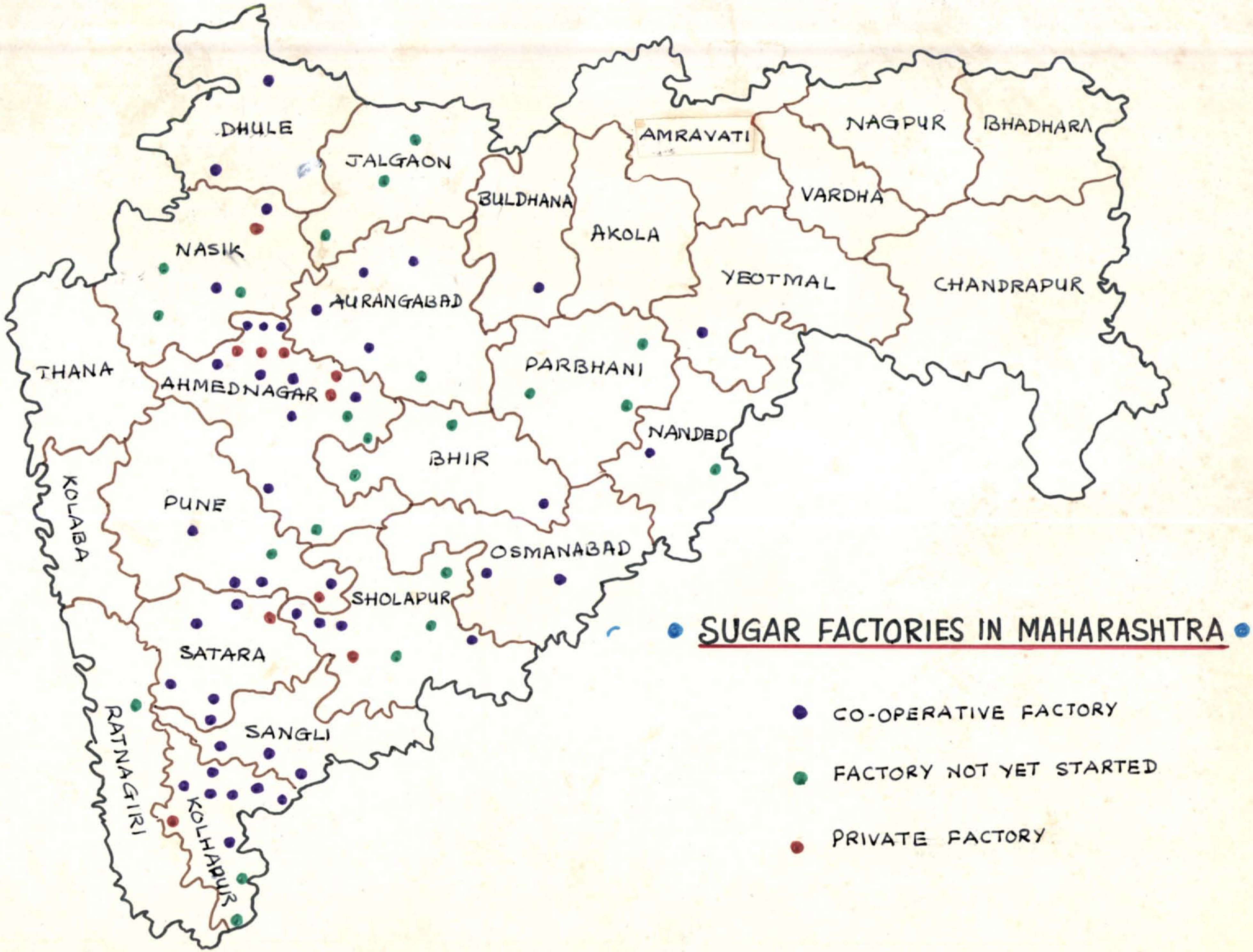
a = constant

b_1 & b_2 = Regression coefficients.

It is expected that such relationship would throw light on severity of the problem of underutilization of capacity.

CHAPTER IV

SUGAR INDUSTRY IN MAHARASHTRA


SUGAR FACTORIES IN MAHARASHTRA
CO-OPERATIVE FACTORY
FACTORY NOT YET STARTED
PRIVATE FACTORY
DHULE
JALGAON
BULDHANA
AKOLA
AMRAVATI
NAGPUR
BHADHARA
VARDHA
YEOTMAL
CHANDRAPUR
NASIK
AURANGABAD
PARBHANI
THANA
AHMEDNAGAR
NANDED
BHIR
KOLABA
PUNE
OSMANABAD
SHOLAPUR
SATARA
RATNAGIRI
SANGLI
KOLHAPUR

CHAPTER IV

SUGAR INDUSTRY IN MAHARASHTRA

It is well-know that India is the home of sugarcane to which one can find references even in 'Vedas'. Today, India is the largest producer of sugarcane in the world. Similarly it has the largest number of sugar factories in the world. Sugar industry is the third largest industry in the country with a weight of 3.5 per cent in the general index of the industrial production and of nearly 10 per cent in its consumer non-durable goods segment. The importance of this industry is not only due to its agro-based nature in an agriculturally dominated country, but also due to the fact that it is one of the biggest foreign exchange earning industries in the country.

4.2 Maharashtra on the Sugar Map of the Country :

The sustained application of scientific methods to agriculture has enabled Maharashtra to occupy anunique place on the sugar map of India. The area under sugarcane in Maharashtra State during 1975-76 was 2.17 lakh hectares out of the total of 27.90 lakh hectares for all India and the production of cane was 19.17 million metric tonnes out of the total of 142.70 million tonnes for all India.

Maharashtra thus accounts for 13 per cent of the total sugarcane production in the country, although its share in acreage is only 7.78 per cent. Similarly in regard to production of sugar, out of every 100 tonnes of sugar produced in the country, Maharashtra contributes almost 20 tonnes i.e., one-fifth of the national output of sugar is contributed by Maharashtra alone. Among the different sugar producing states in the country, Maharashtra has been on the forefront in recent years. This could be revealed from the figures given in Tables 4.1 and 4.2 in respect of area under sugarcane, production of sugarcane, sugarcane crushed, sugar produced and other related aspects of some important sugarcane growing states in India.

It could be seen from the table that though Maharashtra ranked second in respect of acreages and production of sugarcane, it stood first in the production of sugar during the years 1974-75 and 1975-76.

The State also ranks first in respect of average recovery percentage and duration of crushing season. Besides this, there has been steady increase in area, production and productivity of sugarcane in Maharashtra as against the widespread fluctuations in other states. There has also been meaningful and profitable utilisation of sugarcane in Maharashtra as compared to the all India pattern. During 1974-75 season, at the all India level only 30.5 per cent of the total sugarcane produced was

Table 4.1 : Area under sugarcane, production of sugarcane and sugarcane crushed of some important sugarcane growing states in India

Sr. No.	State	Sugarcane acreage (Thousand hectares)			Sugarcane production (Thousand metric tonnes)			Sugarcane crushed (Thousand metric tonnes)		
		1973-74	1974-75	1975-76	1973-74	1974-75	1975-76	1973-74	1974-75	1975-76
1.	Uttar Pradesh	1473	1492	1450	60773	61479	58214	14421	15170	1296
2.	Bihar	139	141	5157	5568	4907	2554	2452	2452	1950
3.	Andhra Pradesh	144	195	136	10907	11496	9421	2977	3938	3290
4.	Karnataka	110	124	131	8563	8629	9965	2852	3124	3399
5.	Gujrat	150	161	159	2227	1999	2080	1792	1578	1075
6.	Tamil Nadu	186	160	155	16298	14593	14766	5287	4546	1960
7.	Maharashtra State	165	165	217	12943	17178	19168	8944	13566	14255
	All India	2752	2894	2790	140805	144289	142704	42263	48435	41849

Source :- "Indian Sugar", March,1977.

Table 4.2 : Sugar production, average recovery, average duration of crushing season and no.of sugar factories of some important cane growing states in India

Sr. No.	States	Sugar produced (In 000 metric tons)			Average Recovery %			Average duration of curshing season			No. of sugar factories in operation		
		73-74	74-75	75-76	73-74	74-75	75-76	73-74	74-75	75-76	73-74	74-75	75-76
1.	Uttar Pradesh	1296	1431	1164	9.15	9.40	9.66	147.33	152.34	116.67	74	74	77
2.	Bihar	223	212	177	8.72	8.63	9.06	93	80	67	27	28	27
3.	Andhra Pradesh	283	397	326	9.50	10.07	9.91	121	127	102	17	21	21
4.	Karnataka	284	336	361	10.06	10.80	10.67	161	140	127	14	17	19
5.	Gujrat	176	161	115	9.83	10.72	10.70	144	134	83	6	6	6
6.	Tamil Nadu	443	384	182	8.63	8.43	9.23	226	169	80	16	17	16
7.	Maharashtra State	957	1515	1606	1068	11.17	11.28	140	160	164	45	52	55
	All India	3949	4794	4262	9.34	9.90	10.19	137	140	115	229	247	253

Source - "Indian Sugar", March, 1977.

utilized in production of sugar, while in Maharashtra 71 per cent of the total sugarcane was utilized for this purpose.

Among the tropical states Maharashtra gets the pride of place because of many reasons.

(1) Agro-climatically Maharashtra is suitable for sugarcane cultivation and has got tremendous potential for further improvements in yields and recovery.

(2) The cost of production of sugar in Maharashtra is the cheapest in the country.

(3) The state has got an ideal position for supporting the whole export programme in sugar.

The Sen Commission has recommended that Maharashtra is the most suitable state to increase sugar production in the country, to increase per hectare yield of the crop and that it is relatively more profitable to cultivate sugarcane in this state than elsewhere.

4.3 <u>Progress of the Sugar Industry in Maharashtra</u> :

The first phase of the sugar industry in Maharashtra was started in 1930s with the setting up of a dozen sugar factories by private enterprenuers. But the real boost to the sugar industry came with the setting up of the first co-operative sugar factory in 1949 under the imaginative leadership of Dr.D.R.Gadgil and Shri.V.R.Vikhe-patil. The success of this co-operative sugar factory created tremendous upsurge amongst the sugarcane growers in the state to organize more and more co-operative sugar factories. Realizing the uniqueness of the sugar factories, the State Government also adopted liberal policies for the growth of sugar industry in the State. The sugar industry in Maharashtra has always remained progressive because of favourable environmental conditions, establishment of sugar factories in co-operative sector and liberal policies of the Government. Some of the broad indicators of the progressiveness of the sugar industry in Maharashtra are given in Table 4.3 for the quinquennial period beginning from 1950-51 to 1975-76.

It could be observed from the table that during the period from 1950-51 to 1975-76, the area under sugarcane increased almost by 334 per cent, while the production of sugarcane increased by 422 per cent. These increases in acreages as well as production of sugarcane have proved to be conducive for establishment of additional sugar factories in the state. The number of sugar factories, which was 15 at the beginning of the period, increased to 55 in the year 1975-76. As a result, the quantity of cane crushed and sugar produced in the state increased by 1342 per cent

Table 4.3 : Area under sugarcane, yield of sugarcane, production of sugar, average recovery, average duration and no. of sugar factories in Maharashtra State

Year	Sugarcane acrage (Thousand hectares)	Sugarcane Production (Thousand metric tonnes)	Sugarcane crushed (Thousand metric tonnes)	Sugar production (In '000' metric tonnes)	Recovery percentage	Average duration of crushing season	Number of factories in operation
1950-51	65 (100.00)	4539 (100.00)	1062 (100.00)	120 (100.00)	11.62	117 (100.00)	15 (100.00)
1955-56	65 (100.00)	4397 (96.87)	1700 (160.07)	199 (176.83)	11.67	138 (117.95)	15 (100.00)
1960-61	155 (238.46)	12089 (266.34)	4490 (422.79)	523 (435.85)	11.65	166 (141.88)	27 (180.00)
1965-66	171 (263.08)	10979 (241.88)	6875 (647.36)	780 (650.00)	11.32	186 (158.97)	32 (213.33)
1970-71	217 (333.85)	14770 (325.40)	9353 (880.70)	1055 (869.17)	11.25	164 (140.17)	41 (273.33)
1975-76	217 (333.85)	19168 (422.30)	14255 (1342.28)	1606 (1338.33)	11.28	164 (140.17)	55 (366.67)

N.B. :- Figures in parentheses indicate the percentage increase over base year i.e.50-51

Source :- "Indian Sugar", March, 1977.

and 1336 per cent, respectively. The recovery percentage however, remained almost constant during this period.

It could also be noticed from the table that in the year 1950-51 only 23.40 per cent of the total sugarcane was utilized for manufacture of sugar. In the year 1975-76 however, almost 74.37 per cent of the total sugarcane produced was utilized for manufacturing sugar. The sugar industry in Maharashtra has thus made tremendous progress during the plan period.

4.4 Special Features of the Sugar Industry in Maharashtra State :

As discussed earlier, there has been remarkable progress in sugar industry in Maharashtra during the post-independence period. It will not be out of place if a mention is made about the special features of the sugar industry in Maharashtra. On the contrary it will aid proper understanding of the factors responsible for speedy development of the sugar industry in the State. The features are as under :

(a) Sugarcane Cultivation in Maharashtra :

Sugarcane is one of the most important cash crops of the state and stands next to cotton. Although total area under sugarcane forms 1.1 per cent of the total cropped area, it contributes more than 7.5 to 8 per cent of the total agricultural income for the State from various crops

The present sugarcane areas in the state can be classified into three different zones on the basis of present cultivation practices and yield potentials.

(1) Kolhapur zone : It comprises of Kolhapur, Sangli, Satara districts (Excluding Phaltan taluka) and extends into the adjoining districts of the Karnataka State.

(2) Deccan Canal zone : It includes Pune, Ahmednagar, Nasik districts, parts of Solapur district and Phaltan taluka of Satara district.

(3) Marathwada and Vidarbha region : It comprises of Marathwada and Vidrabha regions and newly developing areas of Jalgaon and Dhule districts.

The relative position of area and production of sugarcane in different zones is presented in Table 4.4. It could be revealed from the table that the Deccan Canal zone tanks first both in respect of area under sugarcane and production of sugarcane and is followed by Kolhapur and Marathwada and Vidarbha zones respectively.

(b) Different Periods of Planting :

According to different agro-climatic regions, the system of sugarcane planting in Maharashtra is as under :

Table 4.4 : Zonewise area and production of sugarcane in Maharashtra

Sr. No.	Zone	1972–73 Area ('00' ha)	1972–73 Production ('00' m. tonnes)	1972–74 Area ('00' ha)	1972–74 Production ('00' m. tonnes)	1974–75 Area ('00' ha)	1974–75 Production ('00' m. tonnes)
1.	Kolhapur zone	726	48963.74	653	41163.52	925	65430.95
2.	Deccan canal zone	1016	56169.19	971	54203.31	996	66381.77
3.	Marathwada, Vidharbha & Dhule, Jalgaon	309	15302.21	404	22099.49	484	25481.47
	Total Maharashtra State	2055	120693.37	2052	117727.89	2319	159786.06

N.B. : Total may not talley as the engligible share of Konkan region is included in the grand total.

Source : "Season and crop Reports", published by Government of Maharashtra.

System		Duration of crop		Planting season
Adsali cultivation		17-18 months		June-August
Preseasonal	"	15-16	"	October-November
Seasonal	"	12-13	"	January-February
Ratoon	"	12	"	--

(c) Varietal Distribution :

The varieties recommended for Maharashtra State are as given below :-

Early varieties	....	Nil
Mid-season "	....	CO-419, Co-678, CO-740, CO-775
Late varieties	....	CO-796, CO-653, CO-997

It would be seen that there is no single early maturing variety. Though seven varieties are recommended and grown in the state, the most dominant variety is CO-740 (i.e., mono-variety economy).

With regards to irrigation pattern, it would be seen that 60 per cent of the area under sugarcane is irrigated on privately owned wells and the area under sugarcane in canal area is limited to 4 to 25 per cent of the total irrigable area.

(d) Productivity of Sugarcane :

The productivity of sugarcane in different zones is presented in Table 4.5 for the period from 1972-73 to 1974-75.

Table 4.5 : Zonewise Productivity of Sugarcane in Maharashtra

(Tonnes per hectare)

Sr. No.	Zone	Average yield of sugarcane		
		1972-73	1973-74	1974-75
1.	Kolhapur zone	67.44	63.06	73.97
2.	Deccan canal zone	55.26	55.82	66.64
3.	Marathwada zone (including Dhule and Jalgaon Districts)	49.52	54.70	52.64
	Total for Maharashtra State	58.73	57.97	68.90

N.B. :- 'Total may not talley as the negligible share of Konkan region is included in the grand total'.

Source :- "Season and crop reports" of the year 1972-73, 1973-74 and 1974-75 published by the Government of Maharashtra.

It is sad to notice that there has been perceptible fall in the productivity of sugarcane in the State during the year 1973-74 in all the zones. The situation however, improved slightly during the year 1974-75.

Looking to the zonewise productivity figures, it is seen that the productivity of sugarcane is the highest in the Kolhapur zone and the lowest in the Marathwada-Vidarbha zone.

During the year 1963-64 Maharashtra was leading all other states in per hectare yields. Its position has been now surpassed by the states like Andhara Pradesh, Karnataka and Tamil Nadu. This is all the more regrettable in view of the fact that Maharashtra State grows CO-740 variety, which is recognised to be very high yielding variety, on a much greater proportion than in other states. It appears that qualitative aspects have given place to quantitative aspects like expansion of area under sugarcane. The reasons for fall in productivity as identified by the Gupta Committee Report are :-

(1) un-balanced fertilization,

(2) non-adoption of proper measures for seed protection,

(3) inadequate pest control,

(4) lack of proper crop planning,

(5) dependence on one variety and,

(6) too much shift towards Adsali planting.

(e) Structure of the Sugar Industry in Maharashtra :

The sugar industry in Maharashtra, as it stands today, is comprised of 45 sugar factories in co-operative sector and 10 sugar factories in private sector. The zonewise distribution of private and co-operative sugar factories is presented in Table 4.6 alongwith their total installed capacities.

Table 4.6 : Zonewise and Sectorwise Composition of Sugar Factories in Maharashtra State in the year 1975-76

Sr. No.	Zone	Private-Sector		Co-operative Sector		Total	
		No.	Crushing capacity (Tonnes/day)	No.	Crushing capacity (Tonnes/day)	No.	Crushing capacity (Tonnes/day)
1.	Kolhapur zone	2	4200	14	17300	16	21500
2.	Deccan Canal zone	8	9900	18	32462	26	42362
3.	Marathwada Vidarbha (including Dhule and Jalgaon Districts)	-	-	13	21750	13	21750
	Total	10	14100	45	71532	55	85632

It could be observed from the table that over three-fourth of the total number of sugar factories are concentrated in Western Maharashtra comprising of Kolhapur and Deccan Canal zones.

The licensed size (i.e. installed capacity) of individual units varies from 800 tonnes to 5,000 tonnes of sugarcane per day. The classification of sugar factories according to different size groups of installed capacities is presented in Table 4.7.

Table 4.7 : Classification of Sugar Factories According to Different Size Groups of Installed Capacities

Size groups		No.of sugar factories		
		Private	Co-operative	Total
Less than 1,250 tonnes/day		2	5	7
1,250 to 1,750	"	5	21	26
1,750 to 2,200	"	2	10	12
2,200 to 2,700	"	-	4	4
2,700 to 3,200	"	1	1	2
3,200 to 3,700	"	-	2	2
3,700 to 4,200	"	-	1	1
4,200 to 5,000	"	-	1	1
		10	45	55

It may be seen that 26 out of the total of 55 sugar factories fall in the size group of installed capacity of 1,250 to 1,750 tonnes per day.

(f) Export of Sugar from Maharashtra :

India made an impressive entry into the arena of world market in the year 1957. By now the sugar exports should have normally come to an age, but there have been ups and downs as a result of which though India has come to stay as a net exportor of sugar in the world market, even those who are closely linked with the destiny of the industry in India are always left guessing whether India will account as an exporter in a particular year. As sugar industry is an agro-based industry, some fluctuations on the quantum of exports are bound to take place.

Maharashtra state occupies an unique position in the sugar exports from India. The figures given in Table 4.6 would show the position of exports of sugar from India and the contribution of Maharashtra state in the total export of sugar. In view of its lowest cost of production and nearness to the port of Bombay and the importing countries, Maharashtra has come to stay as a leader in exports of sugar. Most of the sugar exported is in the form of raw sugar which is manufactured by almost all the sugar factories spread thoughout length and breadth of Maharashtra. Two grades, namely High Pol Raw Sugar and Low Pol Raw Sugar are manufactured depending upon the demand from world market.

Table 4.8 : Share of Maharashtra in the total export of sugar

(Metric tonnes)

Year	Export		Percentage share of Maharashtra in total export of sugar from India
	India	Maharashtra State	
1969-70	3,18,000	3,18,000	100
1970-71	3,31,000	3,31,000	100
1971-72	1,25,000	1,00,000	80

Source : Book "Sugarcane Industry of Maharashtra- A Blue-print for Progress", By Y.J.Mohite, Minister for Finance, Maharashtra State.

In view of its locational advantages and low cost of production, Maharashtra thus plays the leading role in foreign exchange earning for the country through exports of sugar.

(g) Efforts of State Government :

The state Government deliberetly helped the setting up of more and more co-operative sugar factories and actively participated by evolving the concept of state partnership and by granting liberal share capital to the co-operative sugar factories. The emphasis has been on the elimination of middlemen and to enable the producer to become the owner of the manufacturing process. Realizing the problem of low productivity of sugarcane consequently leading to problems of insufficient supply of sugarcane and underutilisation of installed capacities of the sugar factories, the State Government has always been on the forefront in adopting appropriate policies for increasing sugarcane yields per unit of land. The policies with regard to liberal credit supply to sugarcane producers through co-operatives, undertaking research for evolving high yielding varieties of sugarcane through agricultural universities, fixation of price of sugarcane, execution of 'Sugarcane Pilot Projects', and financing the sugar factories, have always been helpful for the speedy development of sugar industry in the State.

(h) <u>Profitable Utilization of By-products</u> :

Apart from sugar, the sugar factories produce by-products like Bagasse, Molasses, Press mud and Furnace ash. The profitability of sugar industry can be improved and the cost of sugarcane be brought down to a greater extent by profitable utilization of these by-products. Accordingly, a large number of sugar factories have attempted profitable utilization of these by-products for manufacture of other products. The utilization of bagasse, molasses and press-mud is as under :

(i) Bagasse : Bagasse accounts for about 24 to 30 per cent of cane in Maharashtra State. The annual production of bagasse in the State is about 15 to 17 lakh tonnes. At present bagasse is mostly used as fuel for boilers in the sugar factories. It also constitutes as a raw material for manufacture of paper, pulp, news print, insulation and chipboards.

(ii) Molasses : It is used for the manufacture of industrial alcohol and potable spirit, polythene and plastics. It is also used as tobacco curing material, manure, cattle feed, etc. In Maharashtra State almost entire quantity of Molasses produced (2 to 2.50 lakh tonnes evey year) is consumed as a raw material by the 10 distillaries and a little quantity is used as cattle feed.

(iii) Press-mud and furnace ash : The proportion of press-mud is about 3 to 4 per cent of sugarcane in Maharashtra State. The entire press-mud is being used as manure in the sugarcane fields. Same is the case with furnace ash.

(i) Socio-Economic Transformation of Rural Maharashtra :

The co-operative sugar factories have themselves lent as a powerful instrument in the development and mobilization of the natural, human and financial resources of the State. They have been proved to be the prime force behind augmentation of investments in the manufacture and exploitation of flow and underground water resources for bringing additional acreages under irrigation. These sugar factories provide gainful employment to many persons. Besides, since they are located in different regions of the State, they help in attaining balanced regional development in the rural areas. The co-operative sugar factories thus play catalytic role in socio-economic transformation of the rural areas by tapping the initiative, the enthusiasm and the resourcefulness of local people. Many sugar factories have helped to usher a heritable rural growth revolution of both green and white type. In due course of time it is hoped that even a red Revolution-development of meat, poultry, and eggs industries would be ushered by the co-operative sugar industry in the rural areas.

Again, co-operative sector in sugar production has played good role in regard to economic upliftment of farmers in dry farming areas, development of educational facilities, organisation of scheme for the benefit of small farmers, provision of drinking water and such other provisions.

4.5 Some Problems of Co-operative Sugar Factories :

Though the co-operative sugar factories have made remarkable progress in respect of increased sugar production and socio-economic transformation of rural areas in the State, they are faced with certain problems of their own. Some of the important problems of the co-operative sugar factories are enumerated below :

(a) Underutilization of Installed Capacity :

Though the actual installed capacity as at the end of the 1972-73 season was 13.36 lakh tonnes of sugar per year, the actual production of sugar was only 10.65 lakh tonnes, accounting for 79.5 per cent utilization of the installed capacity. The utilization of installed capacity was 91.1 per cent in the private sector and in the co-operative sector it was 76.9 per cent. The shortfall in capacity utilization was due to the fact that the sugarcane development work suffered and did not keep pace with licensing of new sugar factories; partly due to continuous drought for three years and partly due to the neglect and indifference of the management.

(b) Supply of Sugarcane to the Sugar Factories :

India is the only sugar producing country where the sugarcane grown is utilized in the manufacture of three sweetening agents viz., sugar, Gul and Khandsari. Sugar industry is a highly controlled industry right from the fixation of minimum cane price to the fixation of price of sugar and price of by-products like molasses. As against this, there have been no controls, whatsoever, on Gul making (which is a cottage industry) and on a khandsari making (which is a small scale industry). The fluctuations in sugarcane production and the irrational distribution of sugarcane between the three sweetening agents have been the curse of the sugar industry. The basic reason of diversion of cane to Gul-making is the delay involved in payment of cane price by the sugar factories.

(c) <u>Productivity of Sugarcane</u> :

It is sad to notice that there has been perceptible fall in the productivity of sugarcane in the State. The reasons for fall in productivity as identified are :-

(1) Lack of proper crop planting
(2) Dependence on one variety
(3) Too much shift towards Adsali plantation
(4) Inadequate irrigation facilities

(d) <u>Machinery Supply and Investment</u> :

Now-a-days, there is a short supply of machinery.

There are at present seven companies licensed to manufacture sugar machinery in the country. The installed capacity of these units is about 13 sugar plants per year, but the companies could manufacture a maximum of 6-8 units only. Besides the short supply of machinery, the prices of machineries have also increased tremendously during recent years. This has led to increase in investment in setting up of new units as well as in replacement of old machines.

(e) <u>Fixation of Sugarcane and Sugar Prices</u> :

Sugarcane is grown almost in all the states in the country. The cost of cultivation varies widely from state to state. Similarly recovery also varies from state to state. In such circumstances, Government of India fixes the price every year under statute after consultation with the Agricultural Prices Committee. The following factors are considered while fixing the price -

(a) cost of production of sugar,

(b) the return to the grower from alternative crop,

(c) the availability of sugar to consumers at fair price, and

(d) the recovery of sugar from sugarcane.

It is suggested that the price should be paid to the producer according to recovery percentage rather than weight. However, it has been observed that the levy price was substantially raised in central Uttar Pradesh, Estern Uttar Pradesh, Madhaya Pradesh, Bihar, Haryana, Rajastan, Assam, Orissa and West Bengal, while recovery of sugar is relatively at a low level. As against this, the levy price was reduced in Western Uttar Pradesh, Maharashtra State, Andhara Pradesh, Karanatka, Tamil Nadu, Punjab, Gujrat and Kerala inspite of the fact that the recovery of sugar was quite high in some of these states. The sugar industry in Maharashtra has been clamouring for revision of levy prices in order to ensure an adequate return to it. It is claimed that the present return of 12.25 per cent as recommended by Tarrief Commission is highly inadequate and unrealistic and therefore, should be revised suitably.

CHAPTER V

ECONOMICS OF SIZE AND RETURNS TO SCLE IN CO-OPERATIVE SUGAR FACTORIES IN MAHARASHTRA

CHAPTER V

ECONOMICS OF SIZE AND RETURN TO SCALE IN CO-OPERATIVE SUGAR FACTORIES IN MAHARASHTRA

In order to study the economics of any enterprise, one has to go for costs and returns analysis. The study of costs and returns of an enterprise forms an important base in determining the profitability of a particular activity, so also, such an attempt provides economic criterion for reorganizing the business on profitable lines.

The present chapter deals with empirical analysis regarding production performance of the co-operative sugar factories, cost of production of sugar, costs, returns and net returns from sugar production, and total costs, total returns and net profits of co-operative sugar factories. Such an analysis has been attempted for the three size groups of the co-operative sugar factories in order to determine relative efficiency of the individual size groups. In addition to the above the chapter also deals with estimation of returns to scale, extent of capacity utilization, determination of optimum capacity and reasons for underutilization of installed capacity of the co-operative sugar factories belonging to different size groups.

5.2 Production Performance of the Coperative Sugar Factories :

The production performance of different sized sugar factories could be judged on the basis of average installed capacity, quantities of cane crushed and sugar produced during the year, as shown in Table 5.1.

Table 5.1 : Per Sugar Factory Installed Capacity, Quantity of Sugarcane Crushed and Quantity of Sugar Produced

Sr. No.	Particulars	Size groups			
		Small Upto 1250 tonnes	Medium 1251 to 2500tonnes	Large 2500 tonnes and above	Overall
1.	Installed capacity (tonnes)	1172.36	1900.00	3175.00	1842.47
2.	Quantity of cane crushed (tonnes)	157876.50 (13470)	290366.87 (15262.46)	474318.75 (14939.17)	270726.76 (14689.46)
3.	Quantity of sugar produced (Qtls)	170457.96 (14544.19)	326501.48 (17184.28)	530932.83 (16722.29)	30140.87 (16334.33)
4.	Recovery percentage	10.81	11.13	11.00	10.96

It is obvious that quantities of cane crushed and sugar produced largly depended on the installed capacity of the sugar factories. However, when considered on per unit installed capacity (i.e., per 100 tonnes of installed capacity) basis, it is observed that because of insufficient supply of sugarcane to the large factories the production of sugar per 100 tonnes of installed capacity was relatively low in case of large sugar factories inspite of the fact that their recovery percentage was quite encouraging. In case of small sugar factories also the production performance was relatively poor; mainly due to insufficient supply of sugarcane and low recovery of sugar. Among the three size groups, the medium sugar factories have been observed to be at advantage in respect of availability of sugarcane of better quality.

5.3 Economics of Size in Co-operative Sugar Factories :

The restraint on supply of cane to the factories, in relation to the installed capacity, ought to have influenced the per unit cost of production of sugar, the structure of total production cost, and returns to the sugar factories. This particular point could be made more clear by estimating per quintal cost of production of sugar and per sugar factory total costs, total returns and net returns from sugar production.

a) Per Quintal Cost of Production of Sugar :

The total cost of sugar production includes cost of sugar manufacture, excise duty and marketing expenses.

The itemwise per quintal cost of manufacture of sugar is presented in Table 5.2 for the individual size groups of the co-operative sugar factories.

Table 5.2 : Per Quintal Cost of Manufacture of Sugar

(Rupees)

Sr. No.	Items of cost	Size groups			Overall
		Small Upto 1,250 tonnes	Medium 1251 to 2,500 tonnes	Large 2,500 tonnes and above	
1.	Cost of sugar-cane	109.34 (66.79)	144.17 (71.00)	139.62 (70.97)	13[illegible].41 (70.02)
2.	Sugarcane purchase tax	8.46 (5.16)	12.67 (6.25)	11.80 (6.00)	10.12 (5.27)
3.	Harvesting, transporting & other related expenses	19.85 (12.12)	20.85 (10.26)	21.36 (10.87)	19.21 (10.00)
4.	Manufacturing expenses	9.22 (5.63)	10.91 (5.48)	11.54 (5.67)	10.58 (5.50)
5.	Salaries and wages	6.57 (4.01)	5.28 (2.60)	4.22 (2.14)	5.39 (2.80)
6.	Repairs and maintenance	2.63 (1.60)	2.47 (1.22)	1.74 (0.88)	1.91 (1.50)
7.	Other expenses	0.80 (0.56)	1.05 (0.52)	1.28 (0.65)	1.13 (0.59)
8.	Depreciation on manufacturing assets	6.73 (4.11)	5.67 (2.79)	5.54 (2.82)	5.34 (3.32)
	Gross cost of manufacture	163.70 (100.00)	203.07 (100.00)	196.74 (100.00)	192.19 (100.00)
	Less value of by-product	0.53	0.65	1.41	0.93
	Net cost of manufacture	163.27	202.42	195.33	191.26

N.B. : Figures in parentheses are percentages to gross cost of manufacture.

As revealed from Table 5.2 the per quintal gross cost of manufacture of sugar worked out to Rs. 192.19 at the overall level and the net cost of manufacture came to Rs. 191.26 per quintal. The gross, as well as, net cost of manufacture per quintal of sugar however, varied considerably over the size groups. The gross cost of manufacture per quintal of sugar worked out to Rs. 163.70, Rs. 203.07 and Rs. 196.74 in case of small, medium and large sugar factories, respectively. The per quintal net cost of manufacture of sugar came to Rs. 163.27, Rs.202.42 and Rs. 195.33 for the respective size groups.

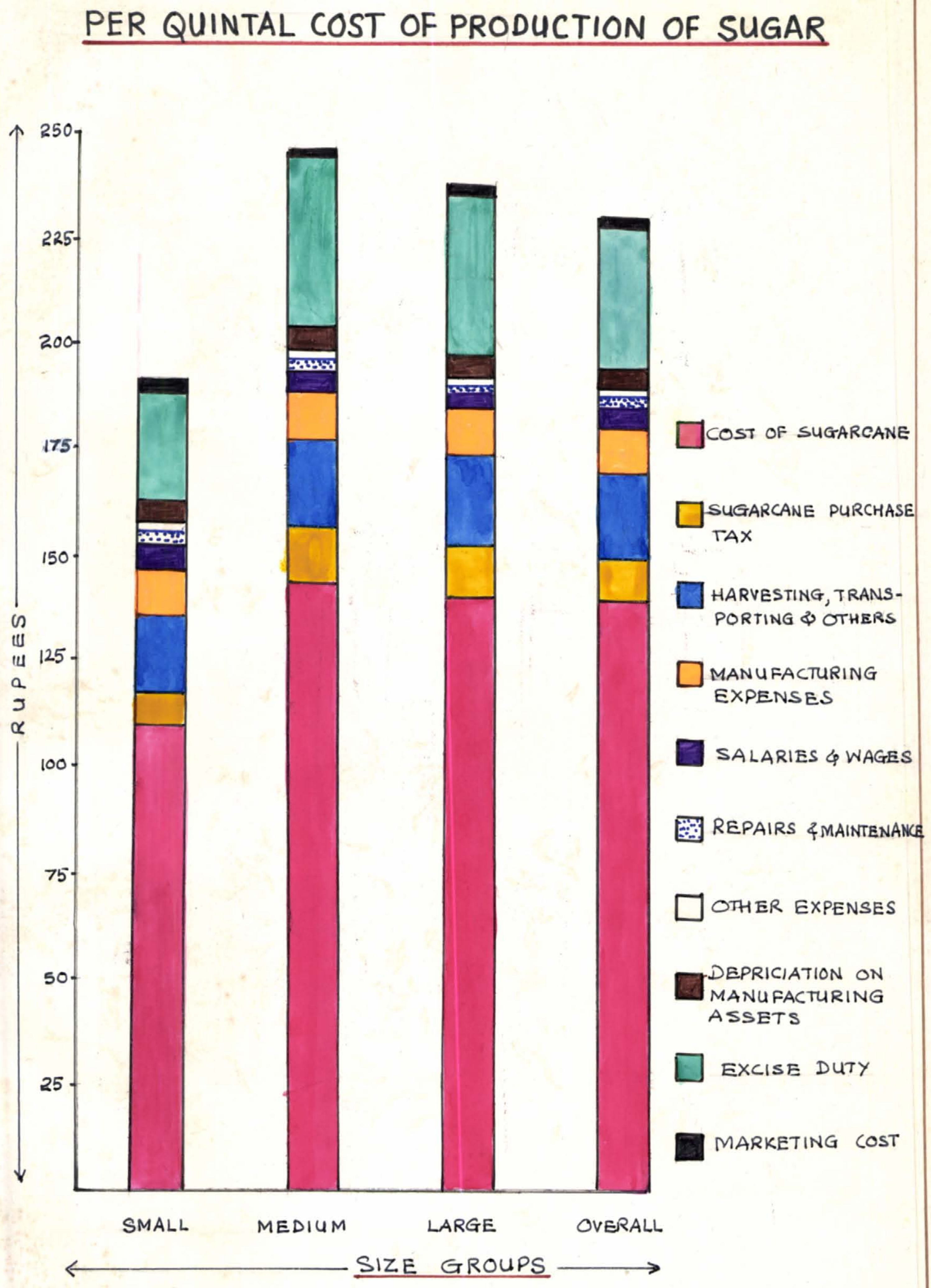
Though these figures broadly indicate that the per quintal cost of sugar manufacture was relatively high in case of medium and large sugar factories, it is rather difficult to conclude that there existed diseconomies of scale in sugar production. Looking to the item-wise cost of sugar manufacture, it is seen that the per quintal costs on account of different items, excepting purchase price of sugarcane, varied within a narrow range. The cost on account of purchase of sugarcane was Rs. 109.34 per quintal of sugar for small sugar factories; as against Rs. 144.17 and Rs. 139.62 per quintal of sugar for the medium and large sugar factories, respectively. This clearly indicates that the small factories were able to keep the cost of sugar manufacture low by paying relatively lesser price to the sugarcane producers. On the other hand it could be seen that the per quintal costs on account of salaries and wages, repairs and maintenance and depreciation declined continuously as the size of the factories increased. However, the share of these costs in the total cost of sugar manufacture was relatively very low. The wide difference in the purchase price of sugarcane therefore, led to higher cost of manufacture of sugar for the large sugar factories.

In addition to the above cost, the sugar factories were required to pay excise duty and to incur expenditure on marketing of sugar. Table 5.3, therefore, presents the cost of sugar manufacture, exise duty and marketing expenses per quintal of sugar for all the three size groups.

Table 5.3 : Per Quintal Cost of Production of Sugar (Rupees)

Sr. No.	Items of cost	Size groups			Overall
		Small Upto 1250 tonnes	Medium 1251 to 2500 tonnes	Large 2500 & above	
1.	Net cost of manufacture	163.27 (85.07)	202.42 (82.20)	195.33 (82.43)	191.26 (83.15)
2.	Excise duty	26.22 (13.65)	42.27 (17.18)	38.81 (16.37)	35.94 (15.62)
3.	Marketing cost	2.47 (1.29)	1.54 (0.62)	2.86 (1.20)	2.29 (1.23)
	Total cost of production	191.96 (100.00)	246.23 (100.00)	237.00 (100.00)	229.49 (100.00)

N.B.: Figures in parentheses are percentages to the total cost of production of sugar.


PER QUINTAL COST OF PRODUCTION OF SUGAR
250
225
200
175
150
125
100
75
50
25
RUPEES
SMALL
MEDIUM
LARGE
OVERALL
SIZE GROUPS
COST OF SUGARCANE
SUGARCANE PURCHASE TAX
HARVESTING, TRANS-PORTING & OTHERS
MANUFACTURING EXPENSES
SALARIES & WAGES
REPAIRS & MAINTENANCE
OTHER EXPENSES
DEPRICIATION ON MANUFACTURING ASSETS
EXCISE DUTY
MARKETING COST

It could be revealed from the table that at the overall level, the total cost of production of sugar was Rs. 229.49 per quintal. It worked out to Rs. 191.96, Rs. 246.23 and Rs. 237.00 per quintal for the small, medium and large sugar factories, respectively. As seen earlier, the gap between the highest and the lowest cost of manufacture per quintal of sugar was Rs. 39.15 among the size groups. This gap widened still further to Rs. 54.27 when the total cost of production of sugar was taken into account. The reason for such widening of gap could be seen in the excise duty paid by the sugar factories. It was reported that the excise duty paid by the medium and large sugar factories was unusually high, since some of the sugar factories belonging to these groups could not obtain rebate in excise duty during the accounting year although their entitlement for such rebate was already declared. If the purchase price of sugarcane and the excise duty had remained the same for ~~the~~ all the sugar factories then perhaps, the variation in per quintal cost of production of sugar would have been narrowed to greater extent.

b) <u>Per Sugar Factory Net Receipts From Sugar Production</u> :

Per sugar factory value of sugar, manufacturing costs, excise duty, marketing costs and net receipts from sugar production are given in Table 5.4 for all the size groups of the sugar factories.

Table 5.4 : Per Sugar Factory Net Receipts from Sugar Production

(Rupees in lakhs)

Sr. No.	Particulars	Size groups			Overall
		Small Upto 1,250 tonnes	Medium 1,251 to 2,500 tonnes	Large 2,500 tonnes & above	
	Value of sugar	365.22 (31.16)	864.22 (45.48)	1347.14 (42.42)	746.09 (40.50)
	Costs				
1.	Manufacturing cost	277.92 (23.71)	661.28 (34.80)	1037.00 (32.66)	575.74 (31.25)
2.	Excise duty	44.69 (3.81)	138.01 (7.26)	206.06 (6.49)	108.20 (5.87)
3.	Marketing expenses	4.22 (0.35)	5.03 (0.26)	15.23 (0.47)	4.63 (0.28)
	Total costs	326.83 (27.87)	804.32 (42.32)	1258.31 (39.62)	688.57 (37.40)
	Net receipts from sugar production	38.39 (3.29)	59.90 (3.16)	88.83 (2.80)	57.52 (3.10)

N.B. :- Figures in parentheses indicate the value of sugar, total costs and net receipts from sugar production per 100 tonnes of installed capacity.

It is observed from the table that the per factory value of sugar, costs and net receipts from sugar production showed increasing trend over the size groups. When viewed on per 100 tonnes of installed capacity basis, it is however, observed that even though the total value of sugar per 100 tonnes of installed capacity was higher in case of large sugar factories, the net receipts from sugar production per 100 tonnes of installed capacity declined from Rs. 3.29 lakhs to Rs. 2.90 lakhs as the size of sugar factory increased. The major reason for this was, of course, the higher cost of sugar production in case of larger sugar factories resulting from high price paid to sugarcane growers and high excise duty.

c) Per Sugar Factory Total Receipts, Total Costs and Net Profits :

Apart from sugar production activity, the total receipts of sugar factories also comprised of the receipts from other sources as well. Similarly they had to bear over head costs on account of management staff, interest, Bank-charges and commission, provident fund and gratuity, rent, rates and taxes, postage-telegram and stationery expenses, audit and legal fees, general expenses, development rebate and depreciation on other fixed assets. The details of per factory total receipts, total costs and net profits are presented in Table 5.5, 5.6 and 5.7, respectively, for all the three size groups.

(i) Total Receipts :

At the overall level, total receipts amounted to

Table 5.5 : Per Sugar Factory Total Receipts

(Rupees in lakhs)

Sr. No.	Particulars	Size groups			Overall
		Small Upto 1,250 tonnes	Medium 1,251 to 2,500 tonnes	Large 2,500 tonnes & above	
	Net receipts from sugar production	38.39 (3.29)	59.90 (3.16)	86.63 (2.80)	57.52 (3.10)
	Other receipts				
1.	Interest and dividend received	0.69 (0.05)	1.60 (0.08)	6.04 (0.19)	2.13 (0.11)
2.	Miscellaneous income	2.68 (0.22)	13.40 (0.70)	16.33 (0.51)	9.94 (0.53)
	Total receipts	41.76 (3.56)	74.90 (3.94)	111.20 (3.50)	69.59 (3.74)

N.B. :- Figures in parentheses are on per 100 tonnes of installed capacity basis.

Rs. 69.69 lakhs per sugar factory. These total receipts increased from Rs. 41.76 lakhs to Rs. 111.20 lakhs from small to large size groups. It is further observed that the contribution made by net returns from sugar production was more than 90 per cent of the total receipts of the sugar factories. The total receipts worked out to Rs. 3.56 lakhs, Rs. 3.94 lakhs and Rs. 3.50 lakhs per 100 tonnes of installed capacity of the small, medium and large sugar factories, respectively.

Table 5.6 : Per Sugar Factory Total Overhead Costs

(Rupees in lakhs)

Sr. No.	Particulars	Size groups			Overall
		Small Upto 1,250 tonnes	Medium 1,251 to 2,500 tonnes	Large 2,500 tonnes & above	
1.	Interest	20.66	32.55	44.46	29.32
2.	Bank charges and commission	0.14	0.16	0.94	0.52
3.	Salaries and wages	6.06	6.47	9.60	5.92
4.	Travelling expenses and attendent fees	0.57	0.99	1.16	0.87
5.	Provident fund and gratuity	2.07	3.47	4.23	3.06
6.	Rent, rates and taxes	0.36	0.47	0.62	0.68
7.	Postage, telegram and stationery expenses	0.92	1.34	2.46	1.34
8.	Audit and legal fees	0.16	0.43	0.81	0.47
9.	General expenses	6.09	12.51	24.58	13.34
10.	Development, rebate and other provisions	3.31	9.59	14.36	9.08
11.	Depreciation	1.10	4.67	5.43	3.37
	Total	41.50 (3.54)	72.37 (3.80)	108.66 (3.43)	67.98 (3.69)

N.B :- Figures in parentheses are on per 100 tonnes of installed capacity basis.

Table 5.7 : Per Sugar Factory Net Profits

(Rupees in lakhs)

Sr. No.	Particulars	Size groups: Small Upto 1,250 tonnes	Size groups: Medium 1,251 to 2,500 tonnes	Size groups: Large 2,500 tonnes & above	Overall
1.	Total receipts	41.76 (3.56)	74.90 (3.94)	111.21 (3.50)	69.59 (3.77)
2.	Total costs	41.50 (3.54)	72.37 (3.81)	108.86 (3.43)	67.98 (3.69)
3.	Net profit	0.26 (0.02)	2.53 (0.13)	2.35 (0.07)	1.61 (0.08)

N.B. :- Figures in parentheses are on per 100 tonnes of installed capacity basis.

(ii) Total overhead Costs :

As seen from Table 5.6, the per sugar factory total overhead costs increased from Rs. 41.50 lakhs to Rs. 108.67 lakhs over the size groups. On the basis of per 100 tonnes of installed capacity, these costs came to Rs.3.54 lakhs Rs.3.81 lakhs and Rs.3.43 lakhs in case of small, medium and large size groups, respectively. At the overall level, the overhead costs worked out to Rs.67.98 lakhs per sugar factory and Rs. 3.69 lakhs per 100 tonnes of installed capacity.

Among the different items of overhead costs, interest, salaries, wages and other benefits of management staff and general expenses were the major items the expenditure which did not increase in the same fashion as the installed capacity. The larger sugar factories were found to be at advantage in deriving economies of scale in respect of overhead costs.

(iii) Net Profits :

The net profits worked out to Rs. 0.26 lakhs, Rs. 2.53 lakhs and Rs. 2.35 lakhs per sugar factory and to Rs. 0.02 lakhs, Rs. 0.13 lakhs and Rs. 0.07 lakhs per 100 tonnes of installed capacity in case of small, medium and large size groups respectively. At the overall level, the net profits worked out to Rs. 1.61 lakhs per sugar factory and to Rs. 0.08 lakhs per 100 tonnes of installed capacity.

On the whole it may be said that though the large sized sugar factories could realise the economies of scale as shown in table 5.7, the net profitability per 100 tonnes of installed capacity was observed to be largely influenced by the net returns derived from sugar production. It is however true that medium sugar factories derived comparatively higher profits per 100 tonnes of installed capacity as they could get relatively higher receipts from various activities other than sugar production.

5.4 Returns to Scale in Co-operative Sugar Factories :

From the foregoing analysis, it has been observed that the profitability of sugar factory increased with the increase in the installed capacity. However, when considered on per 100 tonnes of installed capacity basis, the medium sugar factories have been observed to be relatively more profitable followed by large and small sugar factories.

The criterion of profitability per unit of installed capacity is however, a rough measure for judging relative efficiency of different sized sugar factories. This is so because establishment of sugar factories is a highly capital intensive proposition and there is variability in total investment in relation to size of the sugar factories. Under these circumstances, the relative efficiency of different sized sugar factories could be judged on the criterion of rate of return on capital investments. The details of investment in different capital assets are presented in Table 5.6 for the individual size groups.

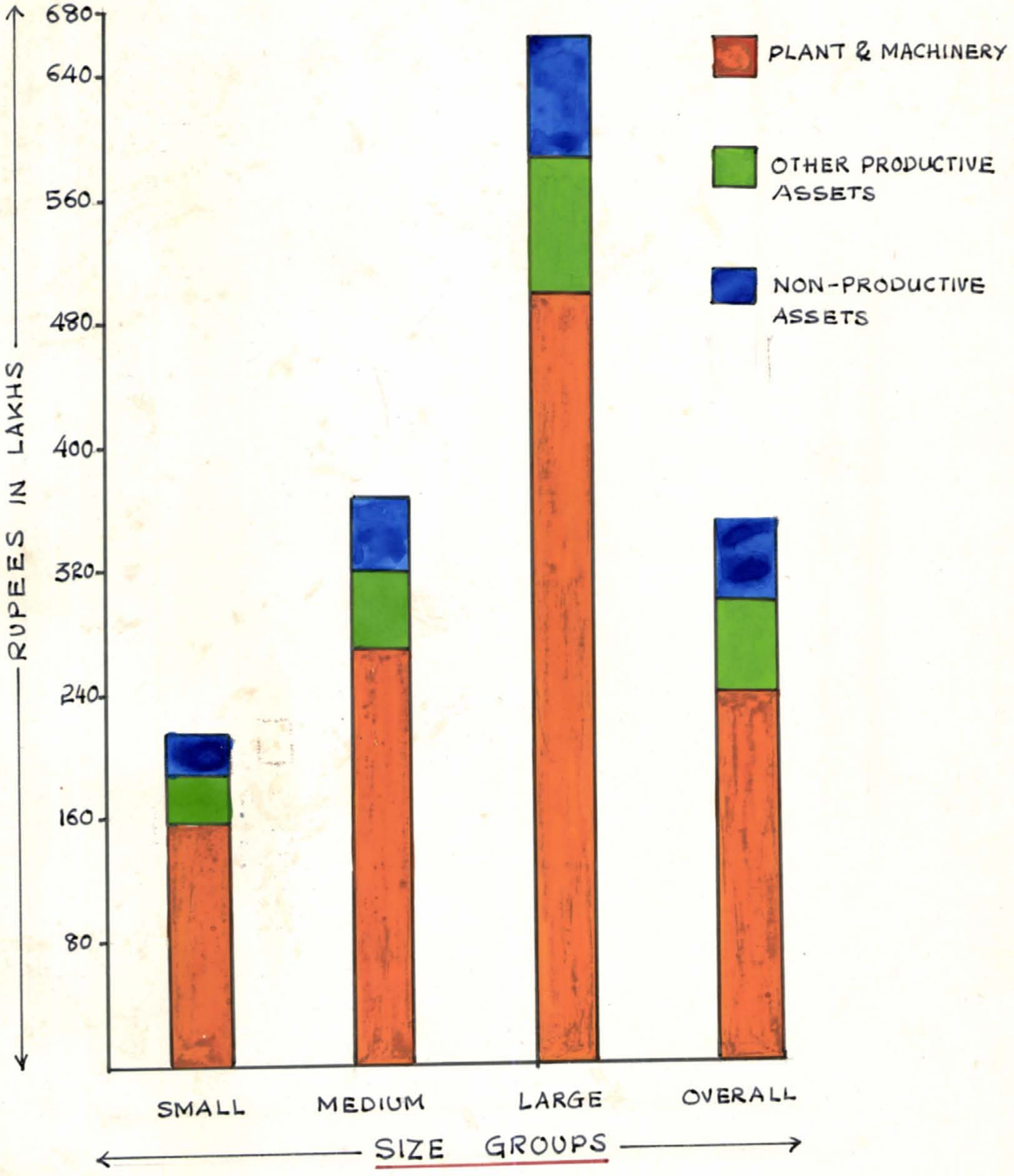
It could be revealed from the table that though the investment in different capital assets increased with the increase in size of the sugar factories, the fixed proportionality between the investment and the size of

Table 5.6 : Per Sugar Factory Capital Investment

(Rupees in lakhs)

Sr. No.	Particulars	Size groups: Small Upto 1,250 tonnes	Medium 1,251 to 2,500 tonnes	Large 2,500 tonnes & above	Overall
I)	Land	1.56	1.69	2.47	1.91
II)	Productive Assets				
a)	Buildings	13.65	24.16	30.33	22.47
b)	Plant & Machinary	155.48	267.56	499.88	240.31
c)	Elctric installation	2.66	7.65	19.72	10.01
d)	Water supply scheme	6.11	6.55	19.91	10.65
e)	Farm impliments	0.54	0.75	3.64	1.64
f)	Lab. apparatus	0.37	0.63	0.93	0.64
g)	Tools, tackles, weigh bridges and other machinary	8.99	8.88	12.72	10.19
III)	Non-productive Assets				
a)	Buildings	21.26	35.97	48.10	35.12
b)	Vehicles	3.07	6.02	14.57	7.88
c)	Library books	0.04	0.12	1.01	0.39
d)	Medical instruments	0.02	0.06	0.09	0.05
e)	Dead-stock furniture & others	1.94	3.38	4.56	3.28
f)	Roads	1.42	3.40	5.82	3.54
g)	Live-stock	0.03	0.11	0.12	0.08
h)	Lift irrigation scheme & others	0.34	1.03	1.53	0.96
	Total	217.66	367.96	665.41	349.32

PER SUGAR FACTORY CAPITAL INVESTMENT



the sugar factories was not observed in majority of capital assets.

The rate of return on capital investment has therefore, been estimated taking into account variable proportionality between the profits, capital investment and size of the sugar factories. As mentioned in the chapter on Methodology, the rate of return has been estimated by equating present value of future income flow with the total capital investment in sugar factories as shown below :

$$C = \frac{R_1}{(1 + i)} + \frac{R_2}{(1 + i)} + \text{------} + \frac{R_n}{(1 + i)^n}$$

where, C = total capital investment

R_{is} = Annual income flow which is assumed to be constant for the entire productive life period of the capital as 10 years, 15 years and 20 years.

i = The rate of return on capital investment expressed in percentage.

The estimated rates of returns on capital investment are presented in Table 5.9 for the invididual size groups.

It could be revealed from the table that at the overall level, the rate of return on capital investment

Table 5.9 : Rate of Return on Capital Investment in Different Size Groups of Co-operative Sugar Factories.

Sr. No.	Size group	Total capital investment (Rs. in lakhs)	Annual income flow (Rs. in lakhs)	Percentage rate of return for the productive life period of capital investment at			Market rate of interest
				10 years	15 years	20 years	
1.	Small size	217.66	33.50	6.66	12.88	14.33	8
2.	Medium size	367.98	58.28	9.33	13.55	14.82	8
3.	Large size	665.41	81.66	4.00	9.20	10.60	8
	Overall	349.32	50.40	6.28	11.65	13.75	8

worked out to 6.28 per cent, 11.65 per cent and 13.75 per cent for the productive life period of capital investment assumed at 10, 15 and 20 years, respectively. The estimated rate of return on capital investment exceeded the market rate of interest (which is assumed to be at 8 per cent at the time of establishment of majority of the co-operative sugar factories) only for the productive life period of capital investment at 15 and 20 years.

Looking to the size groupwise estimated rates of returns on capital investment it was observed that these returns were maximum for medium size group and the minimum for the small size group of sugar factories. Besides, the rates of return on capital investment exceeded the market rate of interest for all the three productive periods in case of small and medium sugar factories. In case of large sugar factories however, the capital investment has been observed to be profitable only when the productive life period of capital investment remained 15 years and above.

5.5 Profitability Potential and Problem of Under-utilization of Installed Capacity :

On the basis of the analysis attempted so far, it may be concluded that there existed economies of scale as the size of an average sugar factory increased from small to medium size group. At the same time there existed diseconomies of scale in case of large sugar factories. The economies of scale in fact depends directly on the ability of the sugar factories in making fuller utilization of installed capacity. In order to understand this relationship in its right perceptive, an attempt is made to estimate the extent of utilization of installed capacity, the break-even point and the profitability potential of all the three size groups of the sugar factories.

5.5.1 Utilization of Installed Capacity :

The details of utilization of installed capacities of the co-operative sugar factories belonging to different size groups are, therefore, presented in Table 5.10.

Table 5.10 : Particulars of Capacity Utilization in Different Size Groups of Co-operative Sugar Factories

Sr. No.	Particulars	Size groups			Overall
		Small Upto 1,250 tonnes	Medium 1,251 to 2,500 tonnes	Large 2,500 tonnes & above	
1.	Installed capacity (metric tonnes)	1172.36	1900.00	3175.00	1842.57
2.	Total cane crushed in ('000' metric tonnes)	157.68	290.37	474.32	270.73
3.	Actual crushing days	150.95	169.49	200.75	167.79
4.	Cane crushed/day	1045.89	1713.16	2362.73	1613.49
5.	Percentage utilization of installed capacity	69.21	90.16	74.41	87.58

It could be observed from the table that although the average installed capacity of the sugar factories was 1172.36 tonnes, 1900.00 tonnes and 3175.00 tonnes per day in case of small, medium and large size groups, the actual quantity of cane crushed was 1045.69 tonnes, 1713.16 tonnes and 2362.73 tonnes per day respectively. That means the average sugar factories belonging to small, medium and large size groups were able to utilize 69.21 per cent, 90.16 per cent and 74.41 per cent of the installed capacity, respectively. It may therefore, be concluded that the ability of the medium sugar factories in deriving economies of scale largely depended on relatively high utilization of installed capacity.

It is however, true that the crushing period of the sugar factories extended from 150 days to 200 days over the size groups. The picture of capacity utilization could have been different if the crushing period in all the size groups had remained the same. On the contrary, the extended crushing period of large sugar factories might have unnecessarily added to increased costs on account of several items having close relationship with the crushing period.

At the overall level, the utilization of installed capacity was 67.55 per cent during the year.

The problem of underutilization of installed capacity is in fact of crucial importance in determining profitability of the sugar factories. In view of this, the data on profits (P), installed capacity (C) and percentage utilization of installed capacity (Cu) were processed to estimate linear profit function for all the sugar factories. The empirical linear profit function was estimated as

$$P = -3934692.76 + \underset{(314.39)}{2667.09} + \underset{(1379?.89)}{48281\ Cu}$$

$$R^2 = 0.7284$$

The tests of significance of the coefficient estimates are given in Appendix 1.

On the basis of the estimated relationship, it appears that profitability of sugar factories is influenced greatly by percentage utilization of installed capacity.

5.5.2 Break-Even Analysis :

The break-even analysis has been attempted to estimate the minimum quantity of sugar required to be manufactured and the minimum quantity of sugarcane required to be crushed such that the sugar factory could neighter sustain any loss at the same time not make any profit. Table 5.11 presents the estimated quantities of sugar to be produced and sugarcane to be crushed for breaking-even for all the three size groups alongwith required number of crushing days at existing capacity utilization and full capacity utilization levels.

Table 5.11 : Break-even analysis

Sr.No.	Particulars	Size groups: Small, Upto 1,250 tonnes	Size groups: Medium, 1,251-2500 tonnes	Size groups: Large, 2,500 tonnes and above	Overall
1.	Quantity of sugar to be produced ('000' quintals)	169.61 (170.46)	316.24 (326.50)	520.45 (530.93)	294.50 (301.04)
2.	Quantity of cane to be crushed (metric tonnes) ('000' metric tonnes)	156.90 (157.67)	284.14 (290.37)	473.14 (474.31)	268.21 (270.73)
3.	No. of actual crushing days required with exising capacity utilisation	150.01 (150.95)	165.65 (169.49)	200.25 (200.75)	166.23 (167.79)
4.	Estimated number of crushing days for 100 per cent capacity utilization	133.63 (134.66)	149.55 (152.82)	149.02 (149.39)	145.61 (146.92)

N.B. :- Figures in parentheses indicate the actual quantity of sugar produced, quantity of sugarcane crushed and number of crushing days.

ii) Recovery percentage remains the same.

It could be observed that the quanties of sugar to be manufactured and sugarcane to be crushed for breaking-even were lower than the actual quantities of sugar manufactured and sugarcane crushed. However, this difference was of lower order.

5.5.3 Profitability Potential of the Sugar Factories :

As stated above, there was not much difference between the actual quantity of sugar manufactured and the quantity of sugar required to be produced for breaking-even. The limited supplies of sugarcane to the factories was the prime reason for this situation. In fact all the size groups of sugar factories have got much higher profitability potentials. Table 5.12 presents per sugar factory profitability potentials of individual size groups. Here the profitability potentials have been estimated on the assumptions that sufficient supply of sugarcane is possible for running the sugar factories at full capacity utilisation level for the prevailing crushing period and the existing cost structure and prices remain the same.

The per factory profitability potentials have been estimated at Rs. 6.36 lakhs, Rs. 10.10 lakhs and Rs.40.25 lakhs as against existing profits of Rs. 0.26 lakhs, Rs.2.54 lakhs and Rs. 2.34 lakhs in case of small, medium

Table 5.12 : Estimation of per Sugar Factory Profitability Potential in Different Size Groups of Co-operative Sugar Factories

Sr. No.	Particulars	Size groups			Overall
		Small upto 1,250 tonnes	Medium 1,251 to 2,500 tonnes	Large 2,500 tonnes and above	
1.	Quantity of sugarcane required for full utilisation of installed capacity ('000' metric tonnes)	176.97 (15.99)	322.03 (16.95)	637.38 (19.46)	309.16 (16.78)
2.	Estimated quantity of sugar produced ('000' quintals)	191.31 (16.32)	358.42 (18.86)	701.12 (21.41)	339.46 (18.43)
3.	Total returns (Rs. in lakhs)	409.90 (34.97)	948.72 (49.93)	1778.97 (54.32)	841.32 (45.67)
4.	Total cost (Rupees in lakhs)	403.54 (34.43)	938.62 (49.40)	1738.72 (53.09)	830.31 (45.08)
5.	Net profit (Rupees in lakhs)	6.36 (0.54)	10.10 (0.58)	40.25 (1.23)	11.01 (0.60)

N.B. :- Figures in parentheses are per 100 tonnes of installed capacity.

and large sugar factories, respectively. When compared on per 100 tonnes of installed capacity basis, it is observed that the large sized sugar factories have got relatively high profitability potential than that of small and medium sized sugar factories.

5.5.4 <u>Per Hectare Sugar Production</u> :

In order to estimate the efficiency of sugar factory, an attempt is made to calculate sugar production per hectare of land. Table 5.13 presents production of sugar per hectare of land.

Table 5.13 : Per Hectare Sugar Production in Different Size Groups of Co-operative Sugar Factories

Sr. No.	Particulars	Size groups			Overall
		Small Upto 1,250 tonnes	Medium 1,251 to 2,500 tonnes	Large 2,500 tonnes & above	
1.	Per hectare yield of sugarcane (tonnes)	66.45	80.00	76.53	72.05
2.	Average recovery percentage	10.81	11.13	11.00	10.96
3.	Per hectare production of sugar (quintals)	71.83	89.02	83.62	79.10

The figures presented in the table indicate that medium factories have manufactured maximum quantity of sugar per hectare than small and large ones. The productivity of sugarcane and the recovery percentage were quite encouraging in case of the medium sugar factories.

5.6 Determination of Optimum Size of Sugar Factory :

Eventhough the large sugar factories have got high profitability potential, the same could not be harnessed for want of sufficient supply of sugarcane to the factories. Similarly, when only small and medium size groups are considered, it could be seen that there exists economies of scale in production. The medium size group however, ranges between 1,251 to 2,500 tonnes of installed capacity per day and therefore, every sugar factory falling in this size group cannot be considered as the one having optimum capacity. Under these circumstances it becomes imperative on the part of the researcher to determine the most optimum capacity of the sugar factory. The optimum capacity of sugar factory could be determined on the basis of behaviour of operating costs relative to installed capacity of the sugar factories. Accordingly, two operating cost functions have been estimated on the basis of the data on average total cost (ATC) per quintal of sugar, average variable cost (AVC) per quintal of sugar and installed capacity of the sugar factory (T).

When the average total cost and average variable cost are regressed respectively, on the installed capacity the following empirical relations were obtained.

$$ATC = 246.24 - 0.010053\ T + 0.000003467\ T^2$$
$$(0.003052) \quad (0.00000066)$$
$$R^2 = 0.7627$$

$$AVC = 226.02 - 0.01044\ T + 0.00000\ T^2$$
$$(0.002357) \quad (0.0000005114)$$
$$R^2 = 0.8406$$

The values in the parentheses represent standard errors of the co-efficient estimates. The tests of significance of the coefficient estimates are presented in Appendix II. Both the estimated relationships have been found to be statistically significant with high values of coefficient of multiple determination (R^2).

By making use of the estimated relationships, the ATC and AVC have been worked out at different levels of installed capacity of the sugar factories and the same are presented in Table 5.14.

On the basis of the estimated values of ATC and AVC it is observed that both ATC and AVC firstly decrease and then increase with installed capacity. The minimum cost points appear at 1455 tonnes 1482 tonnes of installed capacity per day, respectively, for the ATC and AVC cost curves.

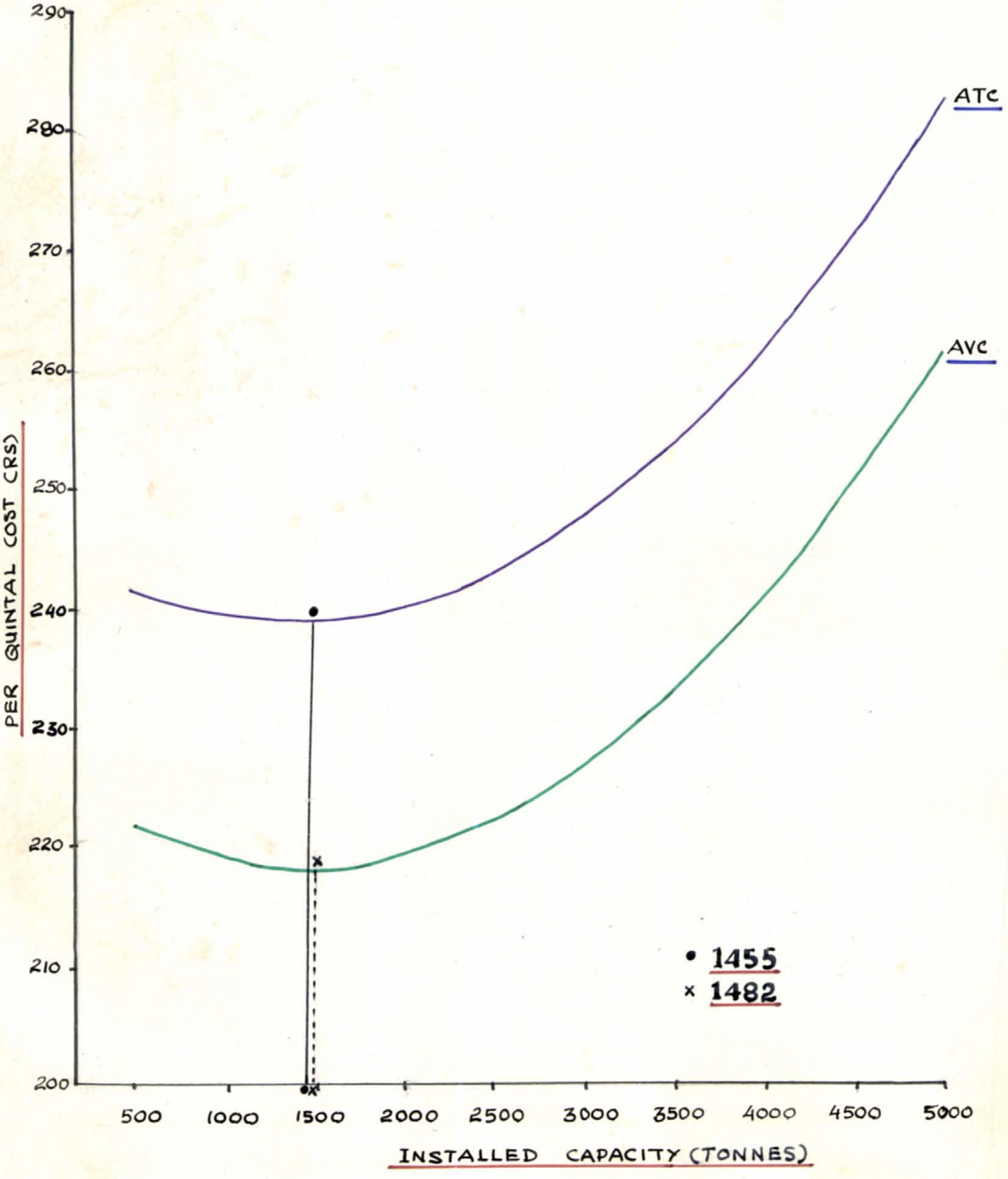
Table 5.14 : Estimated per Quintal ATC and AVC of Sugar Production at Different Levels of Installed Capacity

Installed Capacity	Per quintal	
	ATC (Rs.)	AVC (Rs.
500	242.06	221.66
1,000	239.66	219.10
1,455	238.95	—
1,482	—	218.28
1,500	238.96	218.29
2,000	240.00	219.22
2,500	242.78	221.93
3,000	247.28	226.40
3,500	253.52	232.63
4,000	261.50	240.62
4,500	271.21	250.37
5,000	282.65	261.89

5.7 Reasons for Underutilisation of Installed Capacity of the Sugar Factories :

It has already been observed that because of limitation on the supply of sugarcane, the large sugar factories had to face the problem of underutilization of installed capacity resulting into diseconomies of large scale sugar production. An attempt is therefore

ESTIMATED PER QUINTAL ATC AND AVC OF SUGAR PRODUCTION AT DIFFERENT LEVELS OF INSTALLED CAPACITY



made to investigate some of the reasons for under-utilization of installed capacity on the basis of the available data. These reasons could be found in per sugar factory number of share holders, area under sugarcane and quantity of sugarcane supplied by the share holders and non-share holders and productivity of sugarcane in relation to the installed capacity of the sugar factories. These figures are presented in Table 5.15 for all the three size groups.

The figures given in Table 5.15 in respect of the number of share holders, area under sugarcane and quantity of sugarcane supplied per sugar factory and per 100 tonnes of installed capacity clearly depict that the supply of sugarcane to the small and large sugar factories was relatively low because of limitations on the area under sugarcane and number of sugarcane producers in relation to the production capacities of the sugar factories.

Besides this, productivity of sugarcane was another important factor limiting the supply of sugarcane to the sugar factories, thereby causing underutilization of installed capacity and low profitability from sugar production. The productivity of sugarcane ranged between 60 tonnes and 70 tonnes per hectare,

Table 5.15 : Per Sugar Factory Number of Share Holders, Area under Sugarcane, Supply of Sugarcane and Yield per Acre in Different Size Groups of Co-operative Sugar Factories

Sr. No.	Particulars	Size groups: Small upto 1250 tonnes	Size groups: Medium 1251 to 2500 tonnes	Size groups: Large 2500 tonnes and above	Overall
1.	Number of share holders	3829.32 (326.73)	5558.00 (292.52)	6508.13 (204.98)	5270.79 (286.14)
2.	Area under sugarcane(acres)				
	a. Share holders	4961.96 (421.94)	7714.56 (406.02)	13011.43 (409.81)	7706.05 (418.35)
	b. Non-share holders	1124.64 (95.63)	1277.16 (67.22)	2615.96 (82.39)	1502.79 (81.58)
	Total	6086.60 (517.60)	8991.72 (473.24)	15627.39 (492.20)	9208.64 (499.93)
3.	Supply of sugarcane(tonnes)				
	a. Share holders	133397.91 (11343.36)	261527.92 (13764.63)	394573.91 (12427.52)	232601.66 (12627.67)
	b. Non-share holders	24478.59 (2081.51)	28838.95 (1417.84)	79734.84 (2511.33)	38125.10 (2069.77)
	Total	157876.50 (1342.49)	290366.87 (15182.47)	474308.75 (14938.85)	270726.76 (14697.44)
4.	Yield per acre				
	a. Share holders	26.88	33.90	30.32	30.18
	b. Non-share holders	21.76	22.58	30.48	25.37
	Average	24.32	26.24	30.40	27.77

N.B. :- Figures in parentheses indicate the number of share-holders, area under sugarcane and supply of sugarcane per 100 tonnes of installed capacity.

the lowest and the highest being in the operational areas of the small and medium sugar factories, respectively. The productivity of sugarcane is observed to be relatively low in case of non-share holders.

The low productivity of sugarcane has really become a serious problem in acquiring sufficient quantity of sugarcane. Because of limitations on acreages under sugarcane and less possibility of increasing the same in near future due to limited irrigation supply, the only alternative to increase the supply of sugarcane to the sugar factories is to be found in increased productivity of sugarcane.

CHAPTER VI

SUMMARY AND CONCLUSION

CHAPTER VI

SUMMARY AND CONCLUSION

The India sugar industry has made tremendous progress since independence. A large number of joint--stock and co-operative sugar factories have been established in various states. In the year 1975-76, the Indian sugar industry had under its fold 253 sugar factories. The establishment of large number of co-operative sugar factories has enabled the country not only self-sufficient in sugar but also a net exporter of the commodity.

Among the various sugar producing states, Maharashtra occupies an unique position because, relatively, a large quantity of sugar is produced by the co-operative sugar factories. During 1975-76, of the 55 sugar factories, 45 were in the co-operative sector. These sugar factories have got different crushing capacities ranging from 800 tonnes to 5000 tonnes of sugarcane a day.

The variation in the crushing capacities of co-operative sugar factories in Maharashtra has got significant economic importance. Because of many reasons, the co-operative sugar industry in Maharashtra witnesses both economics and diseconomies of scale. In view of the fact that the size of the co-operative sugar factories varies considerably and there exists economies as well as diseconomies of scale, it is imperative to determine empirically the most optimum size of the sugar factory within the framework of the existing situation. An attempt was therefore, made to study in detail the "economics of size and returns to scale in co-operative sugar factories in Maharashtra State".

The following were the major objectives of the study :-

(1) To estimate costs, returns and net returns from sugar production in different size groups.

(2) To determine relative efficiency of different size groups.

(3) To determine optimum capacity for the co-operative sugar factories.

(4) To estimate extent of underutilization of installed capacity, and

(5) To find out reasons for underutilization of installed capacity of co-operative sugar factories.

The study was based on the data obtained from the annual reports of the co-operative sugar factories for the year 1973-74 and 1974-75. In all 36 co-operative sugar factories, which were in production during the period under reference, were selected for the study. These sugar factories were grouped into three size groups - small, medium and large - depending upon the crushing capacity upto 1250 tonnes, between 1251 and 2500 tonnes and above 2500 tonnes a day, respectively. The annual average of different aspects of sugar production were estimated from the pooled data of the two years.

Summary of the Findings :

The findings of the study have been summarized as below :

(1) The quantities of sugarcane crushed and sugar produced by the factories largely depended on the installed capacity. However, when considered on per unit installed capacity (i.e., per 100 tonnes of installed capacity) basis, it was observed that because of insufficient supply of sugarcane to the large factories, the production of sugar per 100 tonnes of installed capacity was relatively low in case of the large factories inspite of the fact that their recovery percentage was quite encouraging.

(2) The net cost of manufacture per quintal of sugar worked out to Rs. 163.27, Rs. 202.42 and Rs. 195.33 in case of small, medium and large factories, respectively. After adding the excise duty and marketing cost to the net cost of sugar manufacture, the total cost of production was estimated as Rs. 191.96, Rs.246.23 and Rs. 237.00 per quintal of sugar, respectively, in case of small, medium and large factories.

(3) From the itemwise cost of production of sugar it was observed that (i) the price paid for sugrcane by the small factories was relatively low as compared with that paid by the larger ones, and (ii) the excise duty paid by the large factories was unusually high since some of the factories belonging to these size groups could not obtain rebate in excise duty during the period although they were entifed to such rebate. Had the sugarcane purchase price and excise duty remained the same for all the factories, the variations in per quintal cost of production would perhaps have been narrowed to a greater extent.

(4) The per sugar factory costs, returns and net returns from sugar production revealed that even though total returns from sugar production per 100 tonnes of installed capacity were higher in medium and large sized sugar factories, the net returns from sugar production

per 100 tonnes of installed capacity declined from Rs. 3.27 lakhs to Rs. 2.79 lakhs as the size of sugar factories increased.

(5) After deducting total costs from the total receipts of the sugar factories, the net profits worked out to Rs. 0.26 lakhs, Rs. 2.53 lakhs and Rs. 2.35 lakhs per sugar factory, and Rs. 0.02 lakhs, Rs. 0.13 lakhs and Rs. 0.07 lakhs per 100 tonnes of installed capacity, respectively, in case of small, medium and large sugar factories. The medium factories derived comparatively higher profits per 100 tonnes of installed capacity as they were able to realize additional income from various activities other than sugar production.

(6) The rate of return on capital investment was comparatively high in medium sugar factories. In case of large sugar factories the capital investment has been observed to be profitable only when the productive life period of capital investment remained 15 years and above.

(7) The utilization of installed capacity was estimated as 89.21 per cent, 90.18 per cent and 74.41 per cent in small, medium and large sugar factories, respectively. Relatively low utilization of installed

capacity was observed to be the basic cause for low profitability and low rate of return on capital investment in case of large factories.

(8) From the break-even analysis it was observed that the actual quantities of sugarcane crushed and sugar produced were quite nearer to those required for breaking-even in case of small factories.

(9) The profitability potential at full utilization of installed capacity were estimated at Rs. 6.36 lakhs, Rs. 10.10 lakhs and Rs. 40.25 lakhs per sugar factory and Rs. 0.54 lakhs, Rs. 0.58 lakhs and Rs. 1.23 lakhs per 100 tonnes of installed capacity, respectively, in case of small, medium and large sugar factories.

(10) On the basis of the operating cost functions, the minimum cost points have been determined at 1455 tonnes and 1482 tonnes of installed capacity per day, respectively for the average total cost (ATC) and average variable cost (AVC) curves.

(11) The number of share holders and area under sugarcane per 100 tonnes of installed capacity were relatively high in case of small sugar factories as compared to the larger ones.

(12) The productivity of sugarcane worked out to 25.93 tonnes, 32.29 tonnes and 30.35 tonnes per acre in the operational areas of small, medium and large factories, respectively. At the overall level, the productivity of sugarcane worked out to 25.37 tonnes per acre in case of non-share holders as against 30.18 tonnes per acre in case of share holders.

Conclusions :

The following conclusions could be drawn from the study :

(1) The small sugar factories were able to keep the per quintal cost of production of sugar relatively low, because the price paid for purchase of sugarcane and the excise duty paid by these factories were low as compared to those of medium and large sugar factories. Had the purchase price of sugarcane and excise duty remained the same, the per quintal cost of production of sugar would have been almost the same for small, medium as well as large sugar factories.

(2) The medium sugar factories have found to be relatively more profitable as compared to small and large sugar factories. The rate of return on capital investment is also high for medium sugar factories. On thescore of per unit profitability of sugar

factories and the rate of return on capital investment, the medium size of sugar factories could be considered the optimum one under the existing cost and price structure and sugarcane supplies.

(3) The supplies of sugarcane to the large factories are found to be insufficient in relation to installed capacity; thereby resulting into underutilization of installed capacity, low rate of return on capital investment and diseconomies of scale.

(4) In order to effect economies of scale and increase profitability, the large factories must try to acquire additional sugarcane. This could be achieved either by increasing the area under sugarcane cultivation or increasing the productivity of sugarcane per unit of land or by both these means. Irrigation supply constraints, however, restrict expansion of the area under sugarcane cultivation. The only alternative is to increase the productivity of sugarcane per unit of land. This may be attempted by extending "Sugarcane Pilot Projects" on wider areas.

(5) The economy in overhead costs, if resorted, may help in increasing profitability of large sugar factories.

Recommendations :

The following recommendations could be made on the basis of findings of the present empirical study :

(1) The price of sugarcane may be fixed on the basis of recovery percentage and it should be uniform for all the sugar factories in order to provide incentives to the sugarcane producers.

(2) While licensing the establishment of new sugar factories and granting permission to expand existing installed capacity, the utmost care may be taken to assess correctly the potential sugarcane supply in the operational area of the sugar factories.

(3) Attempts be made to increase productivity of sugarcane per unit of land.

(4) The factories may resort to economic measures in reducing overhead costs, wherever possible.

(5) The excise duty may be charged at uniform rate irrespective of size of the sugar factory.

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APPENDICES

APPENDIX I

Profit Function-Linear Model

Regression coefficients and tests of their significance

	Variables	Means	Regression coefficients	Standred error	't' test	Remarks
C	Installed capacity (tonnes)	1819.4242	2887.0930	314.3916	9.1831	**
Cu	Percentage utilization of installed capacity	86.4354	48281.2956	13798.8908	3.4989	**

$n = 33$ $\bar{y} = 5419169.734$

$R = 0.853448$ $R^2 = 0.728374$

** Significant at 1 per cent level.

APPENDIX 11

Cost Function - Quadratic Model

Regress coefficients and tests of their significance

(Average Total Cost (ATC)

	Variables	Means	Regression coefficient	Standred error	't' test	Remarks
T	Installed capacity (tonnes/day)	1623.2647	-0.0100535	0.00305276	3.293234	**
T^2	Square term	3692217.06	0.000003467	0.000000242166	5.234836	**

n = 33 $\bar{y}$ = 241.4050

R = 0.673340 R^2 = 0.762723

Average Variable Cost (AVC)

	Variables	Means	Regression coefficient	Standred error	't' test	Remarks
T	Installed Capacity (tonnes)	1623.2647	-0.0104427	0.00235710	4.4303	**
T^2	Square term	3692217.06	0.00000352294	0.000000511496	6.8875	**

n = 33 $\bar{y}$ = 220.6941

R = 0.916843 R^2 = 0.840601

** Significant at 1 per cent level.