ECONOMICS OF MANUFACTURING OF DAIRY PRODUCTS AND RELATIONSHIP BETWEEN PRODUCTION AND AUXILIARY UNITS OF A DAIRY PLANT

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(I. C. A. R.)
KARNAL. (Haryana) INDIA
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DISSERTATION

Submitted in Partial Fullfilment of
the Degree of Master of Science
(Dairy Economics)

to the
KURUKSHETRA UNIVERSITY, KURUKSHETRA

By

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DEDICATED

TO

MY BELOVED

PARENTS

Prof. N.K. Verma

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National Dairy Research Institute
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This is to certify that the thesis entitled "ECONOMICS OF MANUFACTURING OF DAIRY PRODUCTS AND RELATIONSHIP BETWEEN PRODUCTION AND AUXILIARY UNITS OF A DAIRY PLANT" submitted by Mr. NARESH KUMAR in partial fullfilment of the requirement for the degree of Master of Science in Dairy Economics, embodies the results of bonafide research work carried out by him under my guidance and supervision.

NKVerma

(N.K. Verma)
Scientist, S-2.

KARNAL
May 2, 1987.

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(Naresh Kumar)

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CHAPTER - 1.

INTRODUCTION

INTRODUCTION

Dairying forms an integral part of enterprise mix in Indian agrarian sub-system. Dairying, which was hitherto neglected, received an impetus after independence when planned dairy development programmes in the country were undertaken. It was realised that promotion of dairying not only contributes towards national health building but also creates substantial employment opportunities. The initial stages of dairy development were characterised by creation of milk marketing facilities for milk produced in rural areas as lack of adequate marketing infrastructure was felt to be one of the inhibiting factors for milk production. Consequently many dairy plants in the country were established. Commissioning of dairy plants was supposed to channelise the milk produced in rural areas towards 'consumption pockets', reduce demand- supply imbalance and serve as an incentive for enhanced milk production on scientific lines.

The dairy plants are capital intensive in nature demanding an outlay of Rupees 195 to 300 per litre of installed capacity depending upon system of milk procurement and distribution[1]. The massive allocation of funds that have been injected to build dairy infrastructure and

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1. Dairy Industry in India: Dairying India-1983. pp 8.

2. Bardhan, P.C. (1986) 'Dairying Today' XXI Dairy Industry Conference Anand, 1986.

launch various dairy development programmes in the country have brought today India's dairying in a state of dynamic transition with rapid developments in milk production, processing and marketing. From a milk deficient economy the scenario is changing.

The per capita daily milk availability is now on the upswing touching all time high figure of 144 gm after it had dipped low to 107 gm in 1969-70. It is estimated that over 74% of households in the urban areas and 52% in rural areas consume liquid milk daily[2]. With the rising urbanisation, the demand for milk and milk products will continue to rise due to increase in population size and change in food habits of people from subsistence food intake to luxurious foods, the general tendency associated with rise in income as development proceeds. Moreover income elasticity of demand for milk and milk products in India is more than unity. Seventh five year plan milk production target has been fixed at 51.00 million tonnes, implying annual growth rate of 6.8 percent as compared to 4.6 per cent in the Sixth plan and 1.1 per cent between 1951 to 1965.[3]

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3. Dairy Industry Profile
Dairy India, 1985, page 4.

4. Sehla, V.S. "Aseptic packaging of Milk in India"
XXI Industry Conference, Anand, 1986 page 93.

With the increase in demand for milk and milk products the role of organised sector dairies is likely to enlarge. The organised sector shall have to share a greater responsibility in the dairy development. The organised dairy plants which are tapping barely 10.00 per cent of total milk production, and processing only 5 per cent of milk production for fluid milk marketing (50.89 lakh litres/day) are expected to process 124.00 lakh litres per day for fluid consumption by the end of 1990[4].

Creation of milk marketing infrastructure in the form of commissioning of dairy plants demands that the interest of producers and consumers are protected. The producers are paid remunerative price of milk and consumers get the milk at low price within their reach. The equilibrium between these strong pulls can be established only when the plants are run efficiently and made financially viable.

It has been found that most of the dairy plants are running below their installed capacity (average through-put is 68 per cent of I.C.). One of the reasons is that the milk is seasonal, perishable and subject to output fluctuations, whereas basic processing facilities are complementary in nature and their investment and recurring operational ~~fixed~~ costs are high. As a result it leads to high cost of milk processing. Under these impelling reasons the need to work out the economics of processing of milk and cost of manufacturing of different dairy products becomes pertinent so that relevant decisions

pertaining to product mix, price policy are taken rationally. The present investigation is, therefore, an attempt to:

1. Analyse the economic relationship between production and auxiliary units.
2. Estimate the cost of processing of milk and manufacturing of different dairy products.
3. To work out the break even level of output.

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CHAPTER - 2.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The organised dairy sector has to face the challenge of competitive environment and fluctuations in milk availability due to seasonality in milk production. These factors have additionally attracted the attention of researchers and plant managers in finding out the optimal milk utilisation pattern, estimation of cost of manufacturing of different dairy products so that relevant rational decisions can be taken. The present chapter is devoted to document some of the important studies in India and abroad which have a bearing on the present investigation.

Erche, et al (1952) in a study of six dairy plants with daily output of 7350-42230 bottles in West Germany analysed the cost of botteling. A comparasion was made between theoretical costs and actuals obtained which included (i) cost of bottles, caps, crates (ii) cost independent of output e.g. cleaning; (iii) cost dependant on output e.g. running cost of bottles and (iv) other miscellaneous costs. They found that capacity utilisation had significant impact on the cost of bottled milk and the actual cost figures varied from 23.9 marleas to 47.79 marleas per thousand bottles.

Weikowske (1954) studied the cost-output relationship in 13 small milk plants in Pensylvania by using budgetary cost analysis. He used simulation technique to build four imaginery plants with capacities 800, 1500, 2500 and 4100 quarts of milk and found that labour cost was the major cost

item followed by equipment, containers, and vehicle operation. He further reported that in all the plants costs declined with the increase in output and he suggested that the intensive use of equipment will lower the processing cost to a considerable extent.

Aggarwal (1954) studied the system of costing milk and milk products using the data of Allahabad Agricultural Institute Dairy. He included inventory brought forward, raw milk, cream, wages, losses in handling depreciation and miscellaneous expenditure in the cost of manufacturing. For apportionment of the total expenditure he first distributed it on the different processes and finally allocated it to the products manufactured. For allocation of raw material cost, the quantity of milk used for different products was taken as basis. For apportionment of the supervisory charges he suggested that the time devoted by the manager for the individual product would be most accurate method. The man hours put in each operation by the employees were suggested to apportion the wages and salaries. The depreciation on machine was taken as a fixed percentage of initial investment on machine. Repair charges were apportioned on the basis of quantity of products manufactured.

Nelson (1955) analysed input output relationship in a specialised butter powder and cheese plant and found that the manufacturing cost per 1000 lb of milk used was $ 6.42-$ 7.77 in butter plant, $6.23- $9.51 in a spray dried butter powder

plant and $4.68 -$8.51 in the cheese factory. He found an inverse relationship between plant size and cost per unit. In butter plus roller dried skim milk plant, supplies, labour and capital equipment accounted for 45 per cent, 30 per cent and 21 per cent of total cost whereas in butter plus spray dried plant these cost components accounted for 50 per cent, 22 per cent, and 25 per cent. He attributed cost differential in different dairy plants to capital equipment cost. He also observed that the butter dried milk plant has a greater profit than the cheese factories of the same size.

Commer et al (1957) used budgetary method of analysis to study cost involved in pasteurising and bottling liquid milk in four hypothetical dairies of capacity 1097, 2730, 6624 and 15415 quarts per day. They found that as the plant size increased the fixed costs per package of labour, building space and total investment per unit of output decreased. They observed that the expenses per unit of the product were lower in large plants when operating at full capacity. They recommended the use of HTST pasteurizer over vat pasteurizer because it was economical for daily output exceeding 3000 packages.

Owen and Butz (1957) attempted to compare the cost of two market milk model plants at full, 75 per cent and 50 per cent practical capacity. They found that unit costs decreased as volume of output increased towards full capacity

but the decrease was less rapid above 75 percent practical capacity. They concluded that these plants should utilize labour and other facilities fully for their existence in the competitive market.

Locasse (1960) made an empirical analysis of manufacturing operations for eight plants producing principally cream and spray dries skim milk for the year 1956-57 with capacities varying from 2,00,000 litres to 7,60,000 litres per day. Unit cost of operation varied widely. A budgetary analysis of model plant designed to convert 6,00,000 lbs of milk into 40 percent cream and spray dried skim milk was also made. Operating costs were much lower in their plant than the comparable plant included in the empirical study. It was suggested that costs in the existing plants could be reduced further.

Haisch et al (1966) demonstrated the use of linear programming in determining the optimum production programme in dairy factories. Decision model based on various quantities of production units and products were presented and analysed for existing capacities and several limited capacities in short run and for change of capacities arising in the long run involving investment planning. Details were also given of decision models based on prices showing the use of opportunity costs calculating maximum and minimum prices on the basis of marginal costs.

Imbs et al (1966) analysed milk utilisation pattern of 633 regional cooperatives out of 655 regional cooperatives of Poland in 1959. These cooperatives processed 3706 million litres of milk, 23.45 per cent was used for liquid milk, 47.28 per cent for butter, 4.43 per cent for cheese, 4.85 per cent for casein and 20.25 per cent for other purposes.

The relative cost structure of different dairy products were worked out and values were given for each province and related with size of production and degree of utilisation of production capacity. The study revealed that in the total cost of the dairy products under study raw milk accounted for 77.07 per cent and the relative share of items of the remainder were wages 29.8 per cent, transport 12.0 per cent materials other than fuel 11.5 per cent, maintenance 10.0 per cent depreciation 9.0 percent fuel 6.4 per cent.

Hanson et al (1969) studied the relationship between processing costs and plants size in four butter-non-fat dry milk plants with capacities of 140.9, 211.3, 355.8 and 470.6 million lb. per year in Minnesoto. For inter plant comparision they adjusted the dried skim milk production data on a whole milk equivalent basis. They observed that labour overhead and utilities were the main cost components which constituted 35-38 per cent, 24.37 percent and 16-20 percent respectively of the total cost. It was further reported that in Minnesota butter/dried skim milk factories

should have an annual whole milk capacity of atleast 210 million pound for the successful competition.

Ram and Singh (1971) studied the creameries in Karnal market and found that Channa based products like Rassogulla and Gulab Jamun offered highest economic opportunities. The net returns for these products were Rs.120/- and Rs.113/- per Rs.100/- of investment. Burfi also found a promoninent position in milk utilisation pattern by creameries consuring one fourth of total milk. Dahi ranked third in profitability indicating 69.7 per cent margin. Sweetened milk also commanded a good market for sale and carried 41.5 percent margin of profit. In case of creameries Butter carried comparatively more margin of profit (41 per cent) as compared to cream (24.6 per cent) and Ghee (17.6 per cent). The authors mentioned sufficient potentiality for maximisation of profit in the business through alternative use at various product combinations and together with the marketing of new products like flavoured milk, ice cream etc.

Mit wally (1973) observed diminishing unit costs with output increaments in butter production in butter factories operating in New Zealand. The study further pointed out that the amount of decrease in unit cost was found to be insignificant beyond 12000 tonnes. Economies of scale were prevalent in the output range of 9000 tonnes to 12,000 tonnes.

Gruble (1973) reported in a study an milk plant operation in USA that labour productivity increased and per unit cost of labour in general decreased as plant volume increased as the number of items processed decreased.

Tompa (1973) made a comparative cost analysis of butter production by two different methods, the churning method and continuous butter making method. He decomposed the costs into fixed and variable costs and compared the costs arrived on the two methods. He found that at 3400 kg level of output continuous butter making was more economical.

Somasekhara (1974) studied pricing and investment practices in public sector dairy in Bangalore. Procurement costs, handling and processing costs distribution cost were analysed and bifucated these into fixed and variable costs so that managerial techniques for rational decision making could be applied. He observed that fixed costs were vary 16% of total cost. Seasonal prices were also worked out for various dairy products. Optimum prices and optimum products mix were determined.

In a temporal study on input and output price movements for Allahabad Municipal Dairy Krishan and Bandyopadhya (1975) found that raw materials alone constituted more than 80 per cent of the total expenditure followed by establishment and commission charges. The cost and returns per litre of

milk were Rs.0.40 and Rs.0.41 respectively for 1972-73. The cost increased to Rs.1.14 per litre in 1973-74 due to rise in prices of raw materials and increase in sales expenditure. The cost per litre of milk was higher than the selling price by Rs.0.05.

Kumar et al (1975) worked at the economies of milk processing in management, dairies under cooperative management and public sector unit respectively. The study indicated that processing cost in public sector was 1.5 times higher than the cooperative units. Low quantity of milk handled and emphasis on R and D in public sector unit were the plausible reasons for higher costs in this unit. The processing cost per litre of milk in public sector unit and the cooperative unit were Rs.0.36 and Rs.0.24 respectively.

Longget, D. (1975) used special form of cost accounting technique to determine the production cost of market milk packed by three different systems. Each system packing had two throughput rates. Bottle pack 3349 and 6696, tetra pack 3300 and 6600 poly pack 3060 and 6120. Depending on the degree of capacity utilisation he found that cost per unit ranged from 13.07 to 9.96 for bottle pack, 13.64 to 9.91 tetra pack and 8.64 to 4.75 for poly pack.

Venkatakrishna (1975) estimated the short run and long run cost relationships for plants processing whole milk. The long run average cost curve was derived from long run cost relationship showed that this curve slopes downwards as the volume of milk processed increases. He attributed this phenomenon to economies of scale. If the shape of long run average cost curve is horizontal then there are constant returns to scale whereas rising part of long run, average cost curve is due to diseconomies of scale. The short run average cost curve was derived from short run cost relationship. The cost curve so arrived helps in explaining what would be the cost when a plant of given size processes various quantity of milk. The study also analysed for different methods of cost estimation and economies of scale determination viz. i) surviorship technique; ii) statistical method; iii) accounting methods and iv) economic engineering approach. The author concluded that among all the four approach economic engineering approach yielded the best results. It had additional advantage in selecting a dairy plant of an optimum size as it eliminated the influence of all other variables except that of plant size. The only limitation of this technique was its inability to predict the managerial efficiency at high level of production.

Cammer et al (1976) conducted a study on economies of size in processing and manufacturing dairy products for Southern Dairy Industry in United States by economic engineering cost procedure. Theory estimated an inverse relationship between the volume of milk processed and cost of processing. The manufacturing cost of check and butter powder decreased by $ 0.8 per cost and $ 0.9 cost respectively at the quantity of milk processed increased from 3.5 million pounds to 10.5 million pounds per month. Additional reduction in costs to the tune of $ 25 and 0.35 $ was observed to the volume of milk processed increased to 26 million pounds and 30 million pounds respectively. It was inferred that efficient technical conversion of milk into various products shall help in reducing the processing costs.

The study has high lighted the principle important characteristics at milk product factories in India during the period 1960 to 1976. Labour and capital productivity were worked out. The indicies at labourer and capital productivity had gone down by about 25 per cent whereas it rose to 160 per cent in case of capital productivity compared to the base year. The share of different component in total cost of production were fuel and electricity 1.60 percent, materials consumed 89.88 percent other inputs 2.66 percent, wages and salaries 3.82 percent and depreciation of assets 2.04 percent.

In the year 1960-61 it was observed to be fuel and electricity 2.71 materials consumed 86.45 percent other inputs were 5.00 per cent.

Wages and salaries 4.12 percent and depreciation of assets 1.72 percent in the year 1975-76.

Diez Patier, F. (1978): The study aims to i) suggest a procedure for analysing processing costs in Spainish Dairy processing centres; ii) demonstrate this procedure using of processing centres models of different size and iii) supply information about the relations between size and costs and about other factors affecting processing efficiency.

Short, J.L. & Matheus, M.E. (1979): In the New Zealand dairy industry the market seasonal variation in milk flow means that both the choice of plant size in relation to the proportion of total feed material processed annually (F) and the annual average plant utilization U are important, A curve plotted to show the seasonal variation in milk fat processed during 1973-77 may be represented by the cubic equation;

$$V = -20.28 + 13.33\ T - 1.55\ T^2 + .05\ T^3$$

where, V is the % of annual production and
T is the months number.

Lough (1979) analysed the operating characteristics of 169 large dairy plants in the North, Central-West and

North East regions of USA. He observed that the plants in North East were operating on a loss intensive scale. It was observed that the plants had adequate capacity to process and handle seasonal peaks of milk production. Cheese and dried milk factories had more days/week and more hours/days than butter factories which run an average at only 40% of capacity. Largner plants operated near installed capacity than the small plants.

Singh, Rajvir & Sharma, S.K. (1979) conducted an analysis of toned milk processing for a liquid milk plant situated in a North Western state at India. They estimated the component wise and process wise cost of production of toned milk. From these estimates break even outputs for the year 1976-77 were also generated. In the total cost of milk manufactured of Rs.2.071/ kg the share of raw material was reported to be highest follow by steam (over 5%) and milk losses (2.53 per cent). Remaining items contributed less than 12 per cent of the total cost incurred on the production at toned milk.

Singh, Rajvir & Sharma, S.K. & Kalra, K.K. (1979) conducted a study based on the data collected for the financial year 1976-77 from a public sector milk plant situated in North Western India estimated the cost of production of lassi which worked out to be 79 paisa per bottle of the total 57 per cent was accounted for by processing costs.

Raw material accounted for by processing costs, raw material accounted for about 43 per cent. It was further pointed out that because of low quantum of products manufactured the depreciation and interest on equipment accounted for about is paisa per bottle. The other cost components like labour (7 paise) packing material(6 paise) and Steam (3 paise) accounted for most of total unit cost of manufacturing of lassi.

Singh, Rajvir & Kalra, K.K. (1980) reported that the cost on different components and on different processes relevant to varied operations and products manufacture in the experimental dairy at NDRI Karnal for the year 1975-76. The component wise cost of different products revealed that the share of raw material in the total cost of production varied from 44.40 per cent to 93.89 per cent. The process wise cost of production of different products indicated that the share of raw milk varied between 26.02 percent to 93.89 per cent bring minimum for sweetened condensed milk and maximum for skim milk. The study further pointed out that among all the process involved in manufacturing of milk products botteling/ packing commanded maximum expenditure with an exception in the case of skim milk powder where preneating and condensing shared maximum expenditure level among all the operations employed in there manufacture followed by the expenditure on dairying through a roller

or spray drier. The results of this study may not be applicable as such in the commercial situation as the case plant is set up basically to provide research and training facilities to the institute.

Raju, G.R.M. (1980) worked out the cost of milk processing and products manufacturing for Vijayawada milk products factory. It was reported the share of raw materials for manufacturing at loose ghee, loose baby food, tone milk and doodh powder in the total costs was as 86.94 percent, 59.04 per cent, 82.15 percent and 63.77 percent of total cost at there products respectively. The share of processing cost to the total costs for these products were found to be 13.06, 12.97, 17.84 and 21.39 percent respectively. It was pointed out that cost effective management of milk processing at the factory may be considerably improved it large scale improvements in milk procurement and energy transfer are effective. The results at the study suggested that increasing volume of raw milk and proper maintenance at utilities generated at factory level will help in minimising the total cost of processing and manufacturing at milk products at the factory.

Hedrik and Chandan (1980) suggested that the major factors involved in reducing cost and improving efficiency at dairy plants, they stressed that maintenance of good records showing total of materials, supplies, fat and SNF received improvement in labour efficiency through proper incentives reduction in handling losses, control of water and preneating breakdowns, proper storage of supplies control at laboratory costs and improvement in office and sales efficiency are very helpful in increasing net returns of dairy plants.

Sharma (1981) estimated the cost of manufacturing of different indegenous dairy products namely Kulfa, Softy, Kulfi, Ice cream, Cream, Skim Milk, Paneer, Butter & Ghee. Using regression equation he analysed the cost functions of different products under the study and estimated break even levels of output. It was observed that all the units were operating above the break even level and earning profits. The cost of Kulfa, Softy, Kulfi, Ice-cream, Cream Ghee, Butter, Paneer, Skim milk was 0.7837, 1.1232, 1.1668, 0.9041, 2.1130, 11.135, 22.066, 16.94, 11.3086 and 0.8301 respectively.

Srinivasan, M.R. (1983) found that differences in processing characteristics between milk from buffaloes and cows are summarized and new milk products being developed

in India briefly discribed. Tables give the names of 26 Indian companies processing milk lost the capacity and through put of dairy factories by state and show the production of modified milk and butter in 1972-74.

Bide, J.(1983) reported that economic aspects of farm manufactures of various milk products are discussed, and the current upsurge of interest in the UK in this type of operation is considered. Outline costing are given for double cream natural and fruit yoghurt, flavoured skim milk and lactic curd. The importance of maintenance of high, consistent product quality and the use of suitable retail packaging are stressed. Approximate 1.15% at registered milk producers in the UK are engaged in farm house manufacture of milk products including cream soft cheese, butter, yoghurt, dairyice cream and many other related products such as cheese cake and cultured butter milk.

Rodriguezregueiro, M. (1984) revealed that the increments de production de derivedes lactroseen 1981, Aral (1982) No. 710, 19-24 (ES) Ministers de Agric. Pses Y Almentacion, Madnid, Spain.

10 tables give details at Spanish output of cows and goats milk and products derived from them together with details of exports and imports for 1981 and earlier years.

Lechner, K. (1984) concluded three methods for assessing the utilization of milk products in Austria are compared with reference to the earlier articles of Lahnca and Sctneeberger on the same subject. The approach that is considered most suitable is one in which the total financial support needed for milk product is minimised by linear programming sub ect to constraints relating to utilization of fat and SNF.

Stockl, J.P. & Walf, H. (1985) found that in the German Federal Republic, raw milk is tested both by milk testing associations and by dairies. Typical cost in the laboratories of milk testing associations are fat/protein ploctase/ milkosean, 1.10/ Pyrmati, Auto-analyzes 1.49 inhibitary substances, inafos, 0.58 cells counts Fosso-mautie 90, 0.73 costs in the laboratory of a medium size dairy are fat Gerber 3.18 milkatester 2.33 protein kjeldahi 16.80 fat/protein/TS/lactose, infra-alyzer, 3.99 inhibitary substances brilliant Black reduction 1.90 plate count 7.89 PM meter 1.19 f.p. cryostar, 4.98 density lactodensimeter 1.92 titratable acidity SH 2.05 clastridia 7.52 variable costs are relatively small preparation of costs for mechanized tests but make up over 90% of costs for the labour intensive operations of altermining PH and acidity.

Randhir Singh, Srivastava, D.N. (1985) reported monthly data recorded at Hissar, Bhoona and Sirsa milk

cooling centres during 1980-81 were analysed break even output (BEo) was calculated as the total fixed cost divided by the difference between the average prevailing price at milk/kg and the average variable cost of milk/kg AN extension programmes has been recently initiated in this area to stimulate milk production. BEo values calculated i) with and ii) without the inclusion of DDP costs in the fixed cost values were respectively 89000 and 55000 kg in Hissar, 57000 and 28000 kg at Bhoona and 86000 and 54000 kg in Sirsa, BEo values were also calculated for milk collection centres and routes involved in the supply of these 3 cooling centres. In calculation excluding DDP costs output exceeded BEo in 34.71 percent of the 76 collection centres and 56.25 percent of the 16 collection routes, studied inclusion of DDP cost reduced these percentage values to 19.74 and 18.75 percent respectively. Results indicate that 80 percent at collection centres did not meet DDP expenses and about 66 percent were not meeting the basic fixed cost.

Oterholm, B. (1986) found in Norway 99 plants produce market milk products 6 provide approximate 35 % of the total sales and have an annual output of 20 million while 51 produce 4 million. All but 2 of the plants make

the 5 standard products homoginized milk, skim milk, kultur milk, kefir and cream 27 other speciality products are also manufactured including various culture milk and cultured creams, UHT products, 13 factories produce direct milk products of which dried skim milk is the most important and to make UHT products, consumption figures, packaging quality control and product development are discussed.

Krasnow, S.E. and Lipatova, L.N. (1986) concluded in an attempt to find optimal methods for increasing economic efficiency at production of milk based infant formulas methods economic analysis, were devised and used. Reducing the preparation of milk based formulas in Kithenes by constructing and using special dairy plants increase labour productivity 3.2x for other manufacture of liquid formulas, wage costs are reduced 1.9 x other ways of enhancing the economic efficiency include changes of the wholesale prices for milk based liquid formulas and production of dried formulas. For the latter, measures are required which would limit the amount of substandard products.

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CHAPTER - 3.

METHODOLOGY

METHODOLOGY

The present study is aimed to estimate economics of manufacturing of different dairy products and analyse the relationship between production and auxiliary units of dairy plant. This chapter explains the methodology employed in the study. It starts with the selection of the dairy plant. Next follows the description of the plant and its organisational structure alongwith its functional divisions into product manufacturing units and Auxiliary units. Following this the nature of data collected and costing procedures are elucidated. Finally it explains the methodology to work out break-even levels of output for different dairy products.

3.1. Selection of the dairy plant:

Commensurate with the objectives of the study it was decided to select a plant which handles milk of different types and manufactures different dairy products. Keeping this in view, a dairy plant situated in North West India was purposively selected. It was prompted by its diverse activities and product mix, maintenance of detailed data records and easy accessibility of the researcher to the data.

3.2. Description of the plant:

The case plant situated in North West of India was set up in 1961. It was equipped with modern plant facilities for processing of milk and manufacturing of different dairy

products. The main aim of the plant is to provide facilities for teaching, training and research needs of the students and scientists. The plant was rennovated in 1984 to modernise and streamline the processing facilities and enhance its capacity. The total working space of the dairy is 2314.5 sq.m. The average throughput of the dairy is about 5189 litres of milk per day and ranges from 4532 litres/ day in lean season to 5863 litres/ day in flush season. The plant depends upon the milk produced at the farm of the institute and doesn't procure milk from outside agencies. During the study period 18,93,987 litres of milk was received at the dock of the plant. In the total milk inflow 85.55 per cent was cow milk and the rest was buffalo milk. After meeting the fluid milk demand for research and teaching, the dairy converts surplus milk into different dairy products in addition to processing of market milk. During the period under reference 34 milk based products were prepared. The quality of these products is maintained according to plant's own standards kept above PFA standards. The major products are toned milk, ghee, paneer, SMP, table butter, lassi, flavoured milk, ice-cream, kalakand, processed cheese.

Fluid milk is sold through its own distribution network inside the campus at pre-determined sale points whereas products are retailed through milk parlour. The organisational structure of the dairy plant is of functional form for accomplishing various activities (Chart-I).

ORGANISATIONAL STRUCTURE OF THE DAIRY

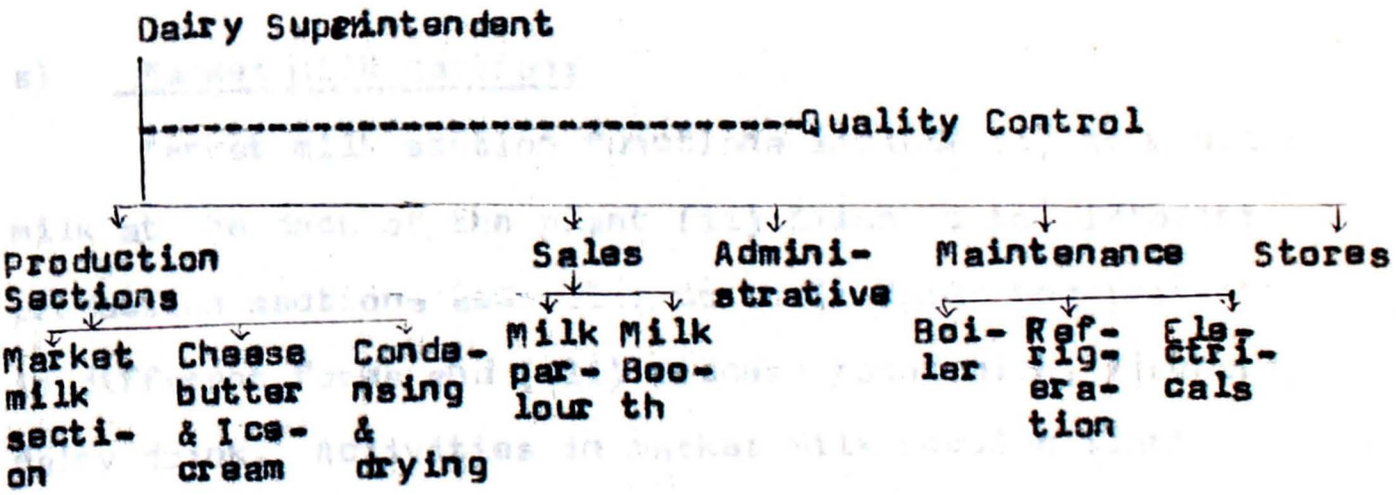

CHART - I

Dairy suprintendent is overall incharge of the dairy and heads various sections which can be broadly grouped into two categories depending upon the operations performed and services rendered.

I. Processing/manufacturing department

II. Auxiliary units.

I. Processing/manufacturing department:

Processing of milk and manufacturing of different dairy products is the responsibility of this department. On the basis of products manufactured, this department is further divided into three sections. Each section is supervised by section incharge and routine matter decisions are taken by him.

a) Market Milk Section:

Market milk section functions include (i) to receive milk at the dock of the plant (ii) issue it to different production sections according to their daily requirements in different forms and (iii) process toned milk, flavoured dairy drink. Activities in market milk section start daily with sterilisation of equipment for processing. Milk is received at the dock. Milk samples are taken for analytical testing of raw milk. After meeting the demand of various production sections, its own requirements and for research, teaching purposes, the balance raw milk is separated to obtain skim milk and cream which are joint products and serve as one of the inputs for various other dairy products.

b) Cheese, Butter and Ice-cream Section:

The products of this section include cooking butter, table butter, table cream, ghee, paneer, lassi, dahi, green cheese, processed cheese, ice cream, whey drinks, yoghurt etc. The basic raw material is milk and ice cream which is supplied by the Market Milk Section. All the products are manufactured in this section by adopting scientific procedure given for them.

c) Condensing and Drying Section:

This section manufactures mainly Kalakand, Gulab Jamun, SMP (Roller), SMP (Spray), kheer. Other dairy products like tea complete and coffee complete are also manufactured but in small quantities. The established practices on scientific lines are carried out to manufacture the products in this section.

d) Ayxiliary Units:

The efficient working of manufacturing sections is directly related to by contribution from auxiliary units which provide vital facilities like steam, electricity, water, refrigeration, maintenance and quality control. On the basis of the type of services rendered these units have been classified into:

1. Administrative section
2. Stores section

3. Maintenance Section.

4. Quality Control.

5. Sales Section.

1) Administrative Section:

This section functions under the direct control of dairy superintendent and comprise of ministerial staff and a technician of supervisory cadre. Dairy superintendent discharges all his duties with the help of production incharge of different manufacturing and service units. Major production and maintenance decisions are taken by him.

Technician (records) maintains daily records of all milk inputs, outputs, production etc. Ministerial staff renders secretarial help to Dairy Superintendent and attends to other routine matters in administration.

2) Stores Section:

Stores section provides inventory needs of various production and auxiliary sections against indents. It helps in procurement of stores material and its warehousing till it is requisioned by the indenting officer.

3) Maintenance Section:

Maintenance section undertaken maintenance and repair jobs of machinery and equipments in the dairy plant.

Steam, refrigeration, chilled water, soft water, ordinary water, are provided by this section through its sub-sections. To produce steam this section has two oil fired boilers each having water evaporating capacity of 3000 kg per hour and 1000 kg perhour respectivaly. Refrigeration section is equipped with thrae 6" x 6" compressors and one 5" x 5" compressor. It is sufficiant to meet heat load of chilled water, 4 cold stores and two production laboratories, and chilled water. Chilled water requirements are met through Ice Bank Tank which supplies chilled water to the production units and for cooling of two production laboratories cold water is circulated.

Electricity requirements are met from power supply from state electricity board but its maintenance comes under this section and all electrical faults, wherever feasible, are rectified by this section.

4) Quality Control Section:

Quality control section plays a crucial role in the dairy. It has service role by providing timely information on quality of milk, intermediatory products in the initial stage to start manufacturing of any dairy product. It assumed supervisory role in finally clearing the product for sale if it meets organisations

standard kept above PFA standards. The quality control laboratory is well equipped to undertake chemical and bacteriological testing of milk and milk products.

5) Sales Section:

Sales section serves an important link in producer-consumer chain. The products which are processed/ manufactured in manufacturing sections are handed over from the stock twice a day to sales section depending upon latter requirements. The plant has its own distribution network. Fluid milk is sold directly to consumers from the booth twice a day in addition to about 11 predetermined sale points covered through mobile vehicles. Milk products are sold from the milk parlour kept open for specified period approximately 12 hours/ day.

3.3. Data and its source:

Data for one year period ending March, 1986 were collected from the records of the case dairy plant. It was supplemented by actual observations and personal interviews with plant personnel. Data on milk inflow, its utilisation pattern, output of products were taken from the master table register of the plant where entries are made daily. The quantities of raw materials and their prices and value of other items used for production on maintenance were recorded from stores section of the plant.

Separate log books are maintained for steam boilers and refrigeration system, vehicles which were utilised to obtain this information. Salaries and expenditure on other benefits associated with permanent employment like Leave Travel Concession for Home Town, Liveries, Medical reimbursement facilities etc. were collected from cash and bill section of the institute. Time study to estimate time scale to prepare a unit of the product was conducted to opportion labour cost among products. Engineering Division has helped in analysing the steam and water consumption in different operations and by various machines per unit of production and or time.

3.4. Analytical Procedure:

To accomplish the objectives of the study the following analytical procedure was adopted:

i) To examine the relationship between production units and auxiliary units, the monthly expenses incurred on these departments by the plant were segregated. Regression and tabular analysis methods were used as analytical tools. But finally tabular analysis was selected to draw the inferences.

ii) The dairy plant has unique characteristics of multi-product, multi-resource nature. Steam, water,

refrigeration system, electricity detergents etc. are multiutility resources used for various products. To apportion joint costs on different cost centres and allocate other cost items the following criteria was adopted:

a) Raw Materials:

Raw materials comprise such items which can be identified with the final product. Milk is the basic ingredient to start with for processing. The value of milk was worked out on fat and SNF basis at then prevailing procurement prices. Raw material cost component on milk was charged on the quality of milk used for the product. Where semi-finished intermediary products were used, its cost of processing was calculated first and then loaded on the product. Other raw materials cost was allocated directly to the product specific use.

b) Labour:

Salaries, allowances and other benefits and facilities available to employees fall under this head. To apportion this expenditure, time study were conducted to arrive at labour time spent in making the individual product.

c) Utilities:

Expenditure on fuel and oils, power, water, steam, refrigeration were taken under this category. Electricity charges were estimated on KWH electricity consumption basis. Where the machinery was used for multi-products, it was apportioned on time scale basis. Rest in all other items of utilities the joint costs were apportioned on benefits taken criteria by the product.

d) Administration and Supervision:

The wages and salaries of personnel employed in the administrative section and Dairy Superintendent expenses on stationary, stamps, telephone bills, electricity expenditure on building were included in this category. Administrative section performs auxiliary functions to personnel employed in the dairy. The cost on administration and supervision was apportioned on manpower employed basis in different production centres. Afterwards the production section cost was divided among products on the basis of man hours put in preparing the product.

e) Repairs and Maintenance charges:

The salaries of staff employed to redner this services, cost of spare parts fitted, electricity

used comprised this cost centre. Where the machinery is used exclusively for a particular product, the cost of spare parts fitted where allocated directly to the product. In multi-product use machinery, cost was apportioned on quantity of milk used for different products. Maintenance charges were also apportioned in milk input basis.

f) Stores Maintenance:

Salaries and other benefits provided to stores officials, depreciation on stores building were taken in this cost group which were apportioned on the basis of value of items directly used for particular product.

g) Quality Control:

Quality control section doesn't maintain details of chemical used, time taken in performing the chemical and bacteriological tests on individual products. In the absence of such records, the total expenditure on quality control section was apportioned among different products according to number of samples analysed.

h) Packaging:

Good packaging enhances marketability of the product and also keeps the product without much quality deterioration. Direct allocation was done for the cost of packaging materials to the products.

i) Sundries:

It included all such items which are of general nature and couldn't be identified with particular product. Duster, soaps, detergents, washing soda etc. fall under this category. The quantity of milk used for different products was taken as the basis to apportion the cost on these items.

j) Depreciation of building and equipments:

Wear and tear of equipments and building due to their use is unavoidable in any production unit. Depreciation of building was worked out by changing @ 2.5 percent of original value of building and later on it was apportioned to different products on the basis of space occupied by the machinery used for manufacturing the products. Equipments and machinery depreciation charges were worked out on machine hour basis.

k) Selection of Products:

The products which had contributed more than one percent to total output during the study period except processed cheese were chosen for detailed analysis of cost of processing/manufacturing. The products finally selected were toned milk, ghee, paneer, skim milk powder (spray), table butter, lassi, F.D.D., ice-cream, & Kalakand.

iii) In order to work out break even level of output of different products, the total cost of production of individual products was bifurcated into fixed costs and variable costs. Break even output level was determined by applying the formula.

$$\text{Break Even Quantity(BEQ)} = \frac{\text{Total fixed cost for the product}}{\text{Price - Average Variable Cost}}$$

BEQ shall bring out at what level of production the plant shall recovering its full fixed costs and all variable costs i.e. it is neither earning profits nor bearing losses.

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CHAPTER - 4

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The economic analysis was performed to meet the objectives of the study. The results of the study are presented and discussed in the following three major sections;

1. Analysis of relationship between production and auxiliary units.
2. Estimation of componentwise cost of processing of different products.
3. Determination of Break Even Level of output.

Section-1 Relationship Between Production And Auxiliary Units:

Auxiliary units provide basic processing services to production units and therefore, production units are functionally dependent upon auxiliary units. The total processing cost in a dairy plant consists of costs on auxiliary units and productions units. The cost of production of auxiliary units services strongly affect the total cost of processing. The cost of generating auxiliary services in the case dairy plant is set out in Table-1.

Table - 1

Factorwise Cost of Generating Auxiliary Services
(April, 85 to March, 86)

Sl.No.	Cost Items	Amount(Rs)	% total Auxiliary units cost
1.	Fuel	537102.40	39.99
2.	Salaries of Staff	504658.00	37.58
3.	Electricity	203324.20	15.14
4.	Depreciation on machinery equipments and building	58924.45	4.39
5.	Maintenance and repairs	15296.00	1.13
6.	Chemicals & other materials	16102.15	1.20
7.	Sundries	3399.00	0.25
8.	Secretarial use items	2639.40	0.20
9.	Water	1592.55	0.12
	Total	1343038.15	100.00

cent

cent.

93 per

achinery

Table - 2

Factorwise cost in production Units

(April, 85 to March, 86)

Sl.No.	Cost Items	Amount(Rs.)	% to total production units cost
1.	Salaries of Staff	421153.00	37.29
2.	Packaging	396372.00	35.09
3.	Raw Materials (other than milk)	112228.00	9.93
4.	Depriciation on machinery, and equipments and Building.	107744.40	9.54
5.	Electricity	42320.75	3.75
6.	Sundries	35186.00	3.12
7.	Maintenance and repairs	10943.00	0.97
8.	Water	3475.00	0.31
	TOTAL	11,29,422.15	100.00

equipments and building registered a high figure of 9.54 per cent compared to 4.39 per cent in auxiliary units. Sundries items which are mostly used for house keeping job cost 3.12 per cent. Maintenance and repairing cost in machinery and equipments was Rs.1,0943.00 corresponding to figure of 0.97 per cent to total cost in production units. Water, though most essential in the dairy plant didn't add to the cost figure as its own contribution was low to the tune of 0.31 per cent to total cost in production department.

Service generating capacity of various sections of auxiliary units like Boiler and refrigeration is almost fixed. Unless these units are utilised efficiently, it shall affect adversely the economy of the plant. In the long run it shall prove suicidal to the plant as its products may be forced out of the competition due to their high costs. A probe into milk intake and processing cost was made. The results of analysis are presented in Table-3.

Table - 3

Relationship Between Processing Cost, its Constituents and Throughput

Period	Total cost on Auxiliary units (Rs.)	Total Cost on Production units (Rs.)	Total Cost of processing (Rs.)	Throughput (Rs.)	processing cost per lit. (Rs.)	Auxiliary Units cost per lit. (Rs.)	Production Units cost per lit. (Rs)
1	2	3	4	5	6	7	8
April,85	88596.00	101665.25	190261.25	172391.50	1.1036	0.5139	0.5897
May,85	86440.05	105044.25	191484.30	166066.5	1.1530	0.5205	0.6325
June,85	96577.45	101529.75	198107.20	157011.00	1.2617	0.6151	0.6466
July,85	98091.20	92128.45	191219.65	168199.00	1.1368	0.5832	0.5536
Aug.,85	93741.55	91954.75	185696.30	149845.5	1.2392	0.6256	0.6136
Sep.,85	97247.30	90476.35	187723.65	135963.00	1.3806	0.7156	0.6653
Oct.,85	108906.45	88061.50	196967.95	132126.5	1.4907	0.8243	0.6664
Nov.,85	117265.40	93171.60	210437.00	138914.5	1.5148	0.8442	0.6706
Dec.,85	124133.10	87095.40	211228.50	160328.5	1.3174	0.7743	0.5431
Jan.,86	126100.75	85866.05	211966.82	169774.0	1.2485	0.7427	0.5058
Feb.,86	152190.75	95214.35	247405,10	161491.5	1.5320	0.9425	0.5895
March,86	153748.15	97214.40	250962.55	181775.00	1.3806	0.8458	0.5348
Overall	1343038.15	1129422.10	2472460.25	1893886.5	1.3055	0.7091	0.5964

It may be observed from the Table-3 that total cost on auxiliary units (Col. 2) ranged from Rs.86,440.05 in May, 85 to Rs.1,53,748.15 in March,86 whereas total cost in production units (Col. 3) ranged from Rs.85,866.05 in Jan., 86 to Rs.1,01,665.2 in April, 85. The total cost of milk processing was lowest in August,85 and highest in March, 1986. The picture got changed when milk throughput was also considered and processing cost per unit of milk intake was analysed. Col. 6 depicts the results of analysis. It is evident from this col. that total milk processing cost per litre was Rs.1.1036 in April, 85 when milk intake was 1,72,391.5 litres during the month. It was highest in Feb., 86 corresponding to milk throughput of 1,61,491.5 litres. Columns 7 and 8 which were generated show the contribution of auxiliary units and the production units in total processing cost during different months of the study period. Overall the auxiliary units' share in total processing cost during the entire study period was found to be Rs.0.7091 per lit. (54.32% of total cost) while that of production units was Rs.0.5964 per lit. (45.68%) of total cost.

To analyse the functional relationship between milk input as independent variable and costs as dependent variable regression equations were fitted. Results of regression equations had revealed that auxiliary units' cost wasn't significantly related to milk intake whereas milk throughput and production units cost/lit. were found to be correlated and statistically significant.

Section -2: Estimation of Cost of Production of Dairy Products

The costs of all the dairy products which had contributed more than 1 per cent to sales turnover during the study period except processed cheese were estimated. The detailed break-up of components of cost of various products into fixed and variable , total and per unit cost are presented and discussed in the subsequent sections.

4.2.1. Toned Milk:

Toned milk is a major product line of the dairy plant. During the study period the plant processed 9,84,428.5 litres of toned milk with a total expenditure of 26,41,862.2 resulting in cost of Rs.1.34 for processing and filling milk in 500 ml polythelene sachets (Table-4).

Table - 4

Cost of Production of Toned Milk

Sr.No.	Cost Components	Fixed Cost (Rs.)	Ratio of Fixed cost to total cost(%)	Variable Cost (Rs.)	Ratio of Variable cost to total cost(%)	Total Cost (Rs.)	per Unit cost	Percentage cost
1.	Raw Materials	-	-	2066198.90	78.21	2066198.90	1.0494	78.21
2.	Labour	78195.35	2.96	-	-	78195.35	0.0391	2.96
3.	Electricity	-	-	4009.35	0.15	4009.35	0.0020	0.15
4.	Water	-	-	149.60	0.01	149.60	-	0.01
5.	Steam	2224.95	0.08	13863.10	0.52	16088.05	0.0081	0.61
6.	Refrigeration	36892.60	1.40	58932.35	2.23	95824.95	0.0485	3.63
7.	Adm. & Supervision	16172.95	0.61	1279.25	0.05	17452.20	0.0087	0.66
8.	Repairs & Maintenance.	-	-	30674.80	1.16	30674.80	0.0154	1.16
9.	Stores Maintenance	20563.80	0.78	95.05	-	20658.85	0.0104	0.78
10.	Quality Control	31472.25	1.19	4013.45	0.15	35485.70	0.0180	1.34
11.	Packaging	-	-	242070.45	9.16	242070.45	0.1228	9.16
12.	Sundries	-	-	14786 .75	0.56	14786.75	0.0074	0.56
13.	Depreciation on Equip. & Building	20267.65	0.77	-	-	20267.65	0.0102	0.77
	Total cost	205789	7.79	2436072.60	92.21	2641862.20	1.34	100.00
	Cost per unit(Rs)	0.10	-	1.24	-	1.34	-	-

Final Product = 1968857 Sachets of 500 ml.

Component-wise cost analysis revealed that raw material alone accounted for about 78 per cent of total expenditure. Expenditure on packaging material was next in importance (9.16 per cent) followed by refrigeration (3.63 per cent) and labour cost (2.96 per cent). The remaining items contributed less than 9.00 per cent and the individual share of each component was less than 1.00 percent except quality control and maintenance and repairs with the irrelative share being 1.34 per cent and 1.16 per cent respectively. Dissection of total cost into fixed and variable costs showed that in the total cost structure fixed costs were 7.79 per cent, the rest 92.21 per cent were variable costs.

4.2.2. Ghee:

Next only to fluid milk sale, ghee is another major product in the case dairy plant. For the period under observation approximately 27 % of milk inflow was diverted for ghee manufacturing. The cost of production of ghee is set out in Table -5.

Table -5

Cost of Production of Ghee

Sr.No.	Cost components	Fixed cost (Rs.)	Ratio of Fixed cost to total cost(%)	Variable Cost (Rs.)	Ratio of Variable cost to total cost(%)	Total Cost (Rs.)	Per Unit cost	Perce-ntage cost
1.	Raw Materials(Milk)	-	-	1030282.80	93.08	1030282.80	45.7846	93.08
	Other than Milk	-	-					
2.	Labour	30561.55	2.76	-	-	30561.55	1.3582	2.76
3.	Electricity	-	-	110-00	-	110-00	0.0048	-
4.	Water	-	-	281.15	.02	281.15	0.0125	.02
5.	Steam	544.10	0.05	3390.05	.30	3934.15	0.1748	0.35
6.	Refrigeration	1546.96	0.14	2471.14	.22	4018.10	0.1786	.36
7.	Adm. & Supervision	4102.70	0.36	324.50	0.03	4427.20	0.1968	.39
8.	Repairs & Maintenance	-	-	3557.65	0.31	3557.65	0.1581	0.31
9.	Stores Maintenance	1812.98	0.16	8.37	-	1821.35	0.0809	0.16
10.	Quality Control	2300.85	0.20	293.40	.03	2594.25	0.1153	0.23
11.	Packaging	-	-	16955.00	1.50	16955.00	0.7534	1.50
12.	Sundries	-	-	801.90	0.07	801.90	0.0357	0.07
13.	Depreciation on Equip, and Building	7517.15	0.66	-	-	7517.15	0.3340	0.66
	Total cost	48386.20	4.37	1058475.70	95.63	1106861.90	49.1876	
	Cost per Unit	2.1502	-	47.0374	-	49.1876	-	

Final product = 22502.85 kg

It can be seen from the table that in the production of ghee from butter, raw material contributed about 93 per cent to the total cost. Labour cost was 2.76 per cent followed by packaging cost, 1.50 per cent. Rest all costs were individually less than 1.00 per cent, their aggregate figure was also meagre aggregating to less than 5.00 per cent. The fixed costs were only 4.37 per cent whereas variable costs were as high as 95.63 per cent. Average cost of ghee production was found to be Rs.49.19 per kg.

4.2.3. Paneer:

A perusal of table-6 shall reveal that paneer manufacturing cost was Rs.19.56 per kg of final product. Processing activities added cost by Rs.3.37 to raw materials of Rs.16.19. Processing cost thus worked out to be 17.23 per cent of total cost. Break up of processing cost into its constituents showed that expenses on labour were 5.01 per cent. Refrigeration accounted for 2.38 per cent followed by steam 2.23 per cent. Packaging added 1.87 to the total cost. Expenses incurred on chemical and bacteriological tests were of order of Rs.8825.10 which correspond to 1.47 per cent of total cost. Share of depreciation

Table - 6

Cost of Production of Paneer

Sr.No.	Items	Fixed Cost (Rs.)	Ratio of fixed cost to total cost(%)	Variable Cost (Rs.)	Ratio of variable cost to total cost(%)	Total Cost (Rs.)	Per Unit cost	Percentage cost
1.	Raw materials	-	-	496655.30	82.76	496655.30	16.1942	82.77
2.	Other than Milk	-	-	721.00	0.12	721.00	0.0236	0.12
2.	Labour	30041.85	5.01	-	-	30041.85	0.9795	5.01
3.	Electricity	-	-	132.20	0.02	132.20	0.0044	0.02
4.	Water	-	-	3208.60	0.54	3208.60	0.1046	0.54
5.	Steam	1853.85	0.31	11550.60	1.92	13404.45	0.4370	2.23
6.	Refrigeration	6225.00	1.04	8067.80	1.34	14292.80	0.4660	2.38
7.	Adm. & Supervision	3038.65	0.51	240.35	0.04	3279.00	0.1069	0.55
8.	Repairs & Maintenance	-	-	5331.00	0.89	5331.00	0.1738	0.89
9.	Stores Maintenance	5470.33	0.91	25.27	0.01	5495.60	0.1792	0.92
10.	Quality Control	7826.99	1.30	998.11	0.17	8825.10	0.2878	1.47
11.	Packaging	-	-	11218.4	2.51	11218.4	0.3657	2.51
12.	Sundries	-	-	1122.95	0.99	1122.95	0.0366	0.19
13.	Depreciation on equip. & Building	6327.35	1.05	-	-	6327.35	0.2062	1.05
	Total cost	60784.00	10.13	539271.60	89.87	600055.60	19.5655	100.00
	Cost per unit	1.9819		17.5836		19.5655		

Quantity of Final Product = 30669 kg

was 1.05 per cent. Rest all other components of total cost were individually less than 1.00 per cent. Segregation of total cost into fixed and variable costs indicated that fixed costs were only 10.13 per cent and the rest were variable costs.

4.2.4 Table Butter :

Table butter incurred a cost of production of Rs.41.44./ Tab.-7 The relative contribution of fixed and variable costs to total cost was 7.70 per cent and 92.30 per cent respectively. Packing of Table Butter is labour intensive activity which had resulted in comparatively escalation in labour cost which was 5.27 per cent. Repairs and maintenance was another item of cost sharing more than 1.00 per cent. Auxiliary services accounted for 2.28 per cent of total cost. Packaging electricity, water and depreciation had combined share of 2.21 per cent.

4.2.5 Skim Milk Powder(Spray):

Two types of milk powders i.e. spary and Roller are manufactured from skim milk supplied from Market Milk Section. Economics of SMP (Spray) was worked out which has been displayed in Table-8.

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Table- 7

Cost of Production of Table Butter

Sr.No.	Items	Fixed cost (Rs.)	Ratio of fixed cost to total cost(%)	Variable Cost (Rs.)	Ratio of variable cost to total cost(%)	Total Cost (Rs.)	Per Unit cost	Percentage cost
1.	Raw materials Milk	-	-	340305.05	87.87	340305.05	36.4169	87.87
	Other than milk	-	-	750.40	0.19	750.40	0.0803	0.19
2.	Electricity	-	-	854.40	0.22	854.40	0.0914	0.22
3.	Water	-	-	25.00	0.01	25.00	0.0026	0.01
4.	Labour	20404.80	5.27	-	-	20404.80	2.1835	5.27
5.	Steam	245.50	0.06	1529.80	0.40	1775.30	0.1899	0.46
6.	Refrigeration	1004.28	0.26	1604.22	0.41	2608.50	0.2791	0.67
7.	Adm. & Supervision	2063.90	0.54	163.25	0.04	2227.15	0.2383	0.58
8.	Repairs & Maintenance	-	-	6869.00	1.78	6869.00	0.7350	1.78
9.	Stores Maintenance	2201.83	0.57	10.17	-	2215.00	0.2370	0.57
10.	Quality control	20.54		2.61	-	23.15	0.0024	-
11.	Packaging	-	-	3810.58	0-98	3810.50	0.4077	0.98
12.	Sundries	-	-	1544.35	0.40	1544.35	0.0582	0.40
13.	Depriciation on Equip. & Building	3865.05	1.00	-	-	3865.05	0.4136	1.00
	Total cost	29805.90	7.70	357468.75	92.30	387274.65	41.4432	100.00
	Per unit cost	3.1986		38.2536			41.4432	

Final Product 9344.70

Table - 8

Cost of Manufacturing of Skim Milk Powder(Spray)

Sr.No.	Items	Fixed Cost (Rs.)	Ratio of fixed cost of total cost(%)	Variable cost (Rs.)	Ratio of variable cost of total cost(%)	Total cost (Rs.)	Per Unit cost (Rs.)	percentage cost
1.	Raw material Milk	-	-	148158.75	50.18	148158.75	9.5958	50.18
	Other than milk	-	-	-	-	-	-	-
2.	Labour	17411.50	5.90	-	-	17411.50	1.1276	5.90
3.	Electricity	-	-	48539.50	16.44	48539.50	3.1438	16.44
4.	Water	-	-	176.86	0.06	176.86	0.0115	0.06
5.	Steam	5439.75	1.84	33893.15	11.48	39332.90	2.5475	13.32
6.	Refrigeration	305.50	0.10	488.00	0.17	793.50	0.513	0.27
7.	Adm. and Supervision	4330.80	1.47	342.55	0.11	4673.35	0.3026	1.58
8.	Repairs & Maintenance	-	-	1166.00	0.39	1166.00	0.0755	0.39
9.	Stores maintenance	2849.68	0.97	13.17	-	2862.85	0.1854	0.97
10.	Quality control	1520.15	0.51	193.85	0.07	1714.00	0.1110	0.58
11.	Packaging	-	-	7111.00	2.41	7111.00	0.4605	2.41
12.	Sundries	-	-	4877.90	1.65	4877.90	0.3159	1.65
13.	Depreciation on Equip. & Building	18461.95	6.25	-	-	18461.95	1.1958	6.25
	Total cost	50319.33	17.04	244960.72	82.96	295280.05	19.1243	100.00
	Cost per unit	3.2590		15.8653		19.1243		

Final Product = 15440 Kg

It is significant to observe that the processing cost increased pronouncly to 49.82 per cent of total cost of Rs.19.1243 per kg of the product. Fixed cost was Rs.3.2590 per kg of final product while variable cost was Rs.15.8653 per kg. In the total processing cost contribution of utilities was different than the earlier products. Utilities touched a higher figure of 60.39 per cent in the processing cost. Expenditure on electricity, steam, refrigeration and water were 16.44 percent, 13.32 per cent and 0.27 per cent and 0.06 per cent respectively. Packaging, Depreciation sundries, repairs and maintenance were areas which individually added more than 1.00 per cent to the total cost of product manufacturing.

4.2.6 Lassi:

Lassi, a milk based sweetened beverage, is popular indigenour product. Its demand in summer season picks up considerably. The componentwise cost analysis of this product is presented in Table-9.

The cost of production of lassi turned out to be Rs.1.1818 per 250 ml. sachet. The contribution of fixed and variable costs in the total cost was 16.36 per cent

Table - 9

Cost of Manufacturing of Lassi

Sr.No.	Items	Fixed cost (Rs.)	Ratio of fixed cost to total cost(%)	Variable cost (Rs.)	Ratio of variable cost to total cost(%)	Total Cost (Rs.)	Cost per Unit	Percentage cost
1.	Raw Materials Milk	-	-	68085.45	64.32	68085.45	0.7601	64.32
2.	Other than milk	-	-	8960.00	8.46	8960.00	0.1000	8.46
2.	Labour	5338.55	5.04	-	-	5338.55	0.0596	5.04
3.	Electricity	-	-	1870.00	1.77	1870.00	0.0208	1.77
4.	Water	-	-	106.60	0.10	106.60	0.0011	0.10
5.	Steam	105.48	0.10	657.22	0.62	762.70	0.0085	0.72
6.	Refrigeration	666.90	0.63	1065.30	1.01	1732.20	0.0194	1.63
7.	Quality control	3225.30	3.05	411.30	0.39	3636.6	0.0406	3.44
8.	Packaging	-	-	6308.60	5.96	6308.60	0.0704	5.96
9.	Sundries	-	-	188.50	0.18	188.50	0.0022	0.18
10.	Adm. & Supervision	539.99	0.51	42.71	0.04	582.70	0.0065	0.55
11.	Store maintenance	1751.75	1.65	8.10	0.01	1759.85	0.0196	1.66
12.	Repairs & Maintenance	-	-	836.15	0.79	836.15	0.0094	0.79
13.	Depreciation on Equip. and building.	5688.55	5.37	-	-	5688.55	0.0636	5.37
	Total Cost per unit	17316.52 0.1993	16.36	88539.93 0.9885	83.64	105856645 1.1818	1.878 1.1878	100.00

Final Product= 89568 sachets of 200 ml.

and 83.64 per cent respectively. In the total cost the processing cost was 27.28 per cent and the rest was raw materials cost. In processing cost the share of packaging, depreciation on equipments and building, labour were significant and more than 5.0 per cent each. Expenses on quality control, electricity, stores maintenance and Refrigeration were 3.44 per cent, 1.77 per cent, 1.66 per cent and 1.63 per cent respectively. The addition to total cost from other items of costs namely water, steam, Adm. & Supervision, repairs and maintenance and sundrais was only 2.35 per cent.

4.2.7. Flavoured Dairy Drink:

Like Lassi, demand for flavoured dairy drink is affected by season. During summer months its demand expands while in winters it shrinks. The compositional cost figures to manufacture flavoured dairy drinks are given in table-10.

The cost of manufacturing F.D.D. was found to be Rs.1.2582 per sachet of 250 ml. The processing cost was 27.16 per cent of total cost. In the processing cost, packaging cost was highest 6.54 percent followed by labour charges 6.33 per cent, quality control 3.65 percent, refrigeration 3.62 per cent and depreciation 1.97 per cent. Stores maintenance was marginally higher than 1.00 per cent. All other components of cost were less than 1.00 per cent. The ratio of variable cost to total cost was 16.12 per cent.

Table- 10

Cost of Manufacturing of F.D.D.

Sr.No.	Items	Fixed cost (Rs.)	Ratio of fixed cost to total cost(%)	Variable Cost (Rs.)	Ratio of variable cost to total cost(%)	Total cost (Rs.)	Cost per unit	Percentage cos
1.	Raw material Milk	-	-	90434.25	61.41	90434.25	0.7696	61.41
	Other than milk	-	-	16853.80	11.44	16853.80	0.1434	11.44
2.	Labour	9332.30	6.34	-	-	9332.30	0.0794	6.34
3.	Electricity	-	-	119.05	0.08	119.05	0.0010	0.08
4.	Water	-	-	212.10	0.14	212.10	0.0018	0.14
5.	Steam	1824.10	1.24	232.60	0.16	2056.70	0.0175	1.40
6.	Refrigeration	2049.20	1.39	3273.40	2.22	5322.60	0.0453	3.61
7.	Adm. & Supervision	1150.25	0.78	91.00	0.06	1241.25	0.0105	0.84
8.	Repairs & Maintenance	-	-	1387.85	0.94	1387.85	0.0118	0.94
9.	Store Maintenance	1709.00	1.16	7.88	-	1716.90	0.0146	1.19
10.	Quality control	4766.02	3.24	607.78	0.41	5373.80	0.0458	3.65
11.	Packaging	-	-	9631.5	6.54	9631.5	0.0819	6.54
12.	Sundries	-	-	679.60	0.46	679.60	0.0058	0.46
13.	Depreciation on Equip. and building.	2905.40	1.97	-	-	2905.40	0.0248	1.97
	Total	23736.27	16.12	123530.83	83.88	147267.10	1.2532	100.00
	Cost per unit	0.2020		1.0512		1.2532	1.2532	

Final product = 117505 sachets of 250 ml.

4.2.8 Ice Cream:

The high value product having long shelf like like Ice Cream at present has good market with potential for growth in the future as well. The costs and retruns associated with Ice Cream have attracted many enterpreneurs, to initiate dairy business with this product line.

Table-11 gives the economic analysis of Ice cream manufacturing. The table reveals certain discernible features. Ice cream manufacturing involves processing the cost of which is high in relation to total cost (48.32 per cent). The cost of packaging is also high, 20.98 per cent. Cost figures an refrigeration expenses were also on the higher side compared to products already analysed. The cost of ice cream manufactureing was observed to be Rs.2.5036 per cup of 120 ml. The relative contribution of fixed and variable costs to total cost was 16.20 per cent and 83.80 per cent respectively.

Table-11

Cost of Ice-Cream Manufacturing

Sr.No.	Items	Fixed cost (Rs.)	Ratio of fixed cost to total cost(%)	Variable Cost (Rs.)	Ratio of variable cost to total cost(%)	Total Cost (Rs.)	Cost per unit	Percentage cost
1.	Raw material milk	-	-	64383.50	49.95	64383.50	1.2505	49.95
	other than milk	-	-	2228.30	1.73	2228.30	0.0432	1.73
2.	Electricity	-	-	3933.75	3.05	3933.75	0.0764	3.05
3.	Water	-	-	1012.10	0.78	1012.10	0.0196	0.78
4.	Labour	5421.55	4.21	-	-	5421.55	0.1053	4.21
5.	Steam	270.30	0.20	1684.10	1.31	1954.40	0.0379	1.51
6.	Refrigeration	3346.40	2.60	5345.50	4.15	8691.90	0.1688	6.75
7.	Adm. & Supervision	548.43	0.43	43.37	0.03	591.80	0.0114	0.46
8.	Repairs & maintenance	-	-	1774.90	1.38	1774.90	0.0344	1.38
9.	Store maintenance	1171.45	0.91	5.40	-	1176.85	0.0228	0.91
10.	Quality control	2423.25	1.88	309.00	0.24	2732.25	0.0530	2.12
11.	Packaging	-	-	27045.00	20.98	27045.00	0.2525	20.98
12.	Sundries	-	-	261.45	0.20	261.45	0.0050	0.20
13.	Depreciation on Equip. and building	7695.20	5.97	-	-	7695.20	0.1494	5.97
	Total	20876.58	16.20	108026.37	83.80	128902.05	2.5036	100.00
	Cost per unit(kg)	0.4055		2.0982		2.5037	2.5036	

Final product 51485 cups of 120 ml.

4.2.9 Kalakand:

Commercial production of this traditional dairy product in the organised dairy sector was long over due. Economic appraisal of its production was done which is set out in table-12.

It is evident from the table that the cost of Kalakand manufacturing was Rs.21.3244 per kg out of which raw materials alone accounted for Rs.13.5904 per kg of the product. Labour cost to make per kg of the product was Rs.4.495 followed by steam, Rs.0.9689 quality control, Rs.0.6344; Adm. & Supervision, Rs.0.5485; Refrigeration, Rs.0.2861. All other items constituting the total cost were minor ones aggregating to 3.93 per cent of total cost.

Section-3: Determination of Break Even Level of Output:

Break even analysis was done according to procedure already explained inmethodology to find out the quantity of the output at the prevailing price of the product where total revenue (T.R.) would be equal to the total cost (T.C.) and the firm would neither be earning profits nor bearing losses. Results of the analysis are presented in Table-13.

Table - 12

Cost of Manufacturing of Kalakand

Sr.No.	Items	Fixed cost (Rs.)	Ratio of fixed cost to total cost(%)	Variable Cost (Rs.)	Ratio of variable cost to total cost(%)	Total Cost (Rs.)	Cost per unit	Percentage cost
1.	Raw materials Milk	-	-	59002.15	57.69	59002.15	12.3014	57.69
2	Other than milk	-	-	6182.70	6.04	6182.70	1.2890	6.04
2.	Electricity	-	-	453.65	0.45	453.65	0.0945	0.45
3.	Water	-	-	116.05	0.11	116.05	0.0241	0.11
4.	Labour	21389.85	20.91	-	-	21389.85	4.4595	20.91
5.	Steam	819.20	0.80	3828.15	3.74	4647.35	0.9689	4.54
6.	Refrigeration	528.30	0.52	843.90	0.82	1372.20	0.2861	1.35
7.	Adm. & Supervision	2437.87	2.38	192.83	0.19	2630.70	0.5485	2.57
8.	Repairs & maintenance	-	-	780.95	0.77	780.95	0.1628	0.77
9.	Store maintenance	918.60	0.90	4.25	-	922.85	0.1925	0.90
10.	Quality control	2698.49	2.64	344.11	0.34	3042.60	0.6344	2.97
11.	Packaging	-	-	733.00	0.72	733.00	0.1529	0.72
12.	Sundries	-	-	492.50	0.48	492.50	0.1026	0.48
13.	Depreciation on Equip. and building	513.50	0.50	-	-	513.50	0.1072	0.50
	Total	29305.81	28.65	72974.24	71.35	102280.05	21.3244	100.00
	Cost per unit(kg)	6.1099		15.2145		21.3244	21.3244	

Final product = 4796.375 kg

Table-13

Break-even Analysis for Different Products

Sr.No.	Products	Units	Total fixed cost(Rs.)	Contributory margin (Price-AVC) (Rs.)	Break-even output	Actual output	Prevailing price(Rs.)
1.	Toned Milk	500 ml. Sachet	205789.60	0.03	6859653.33	1968857	1.25
2.	Ghee	kg	48386.20	(-)3.53	*	22502.85	43.50
3.	Paneer	kg	60784.00	2.4163	25154.82	30669.00	20.00
4.	Table Butter	kg	29805.90	(-)0.50	*	9344.70	37.75
5.	Skim Milk Powder	kg	50319.33	5.63	8937.70	15440	21.50
6.	Lassi	250 ml Sachet	17316.52	0.532	32549.85	89568	1.52
7.	Flavoured Dairy Drink	250 ml Sachets	23736.27	0.20	118681.35	117505	1.25
8.	Ice Cream	120 ml cup	20876.59	0.50	41753.16	51485	2.60
9.	Kalakand	kg	29305.81	6.79	4316.03	4796.375	22.00

* Non determinate at previaling prices

A glance at Table-13 will show that the contributory margin (Price- Average Variable Cost) was highest (Rs.6.79 per unit) in case of Kalakand followed by skim milk powder (Rs.5.63), Paneer (Rs.2.4163). It was less than one rupee in respect of products lassi, ice cream, flavoured dairy drink, toned milk. Contributory margin was found to be negative in case of ghee and table butter unplying that their price structure is such that it is not possible to recover their respective average variable costs. Under the prevailing prices of these products it was uneconomical to continue production at all. Rather it the production should be stopped to reduce losses from these products.

A comparison between break even output and actual output (Col.6 and Col. 7 respectively) showed that actual output in all products except toned milk and flavoured dairy drink exceeded the break even output. Milk products- S.M.P.(S), Kalakand, paneer, lassi, ice cream were adding a profit of Rs.2.38, 0.68, 0.40, 0.34 and 0.10 per unit of the product. At the prevailing price of 43.50 for ghee and Rs.37.75 for table butter the break even output

becomes indeterminate. The break even price at previaling level of output was determined which was Rs.49.18 for ghee and Rs.41.44 for table butter.

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CHAPTER -5

SUMMARY

SUMMARY

Organised dairy industry is capital intensive in nature. Rational decision making process about product mix, price policy demand a prior information into economics of processing of milk and manufacturing of different dairy products. The present study was undertaken with the specific objectives to:

i) Analyse the relationship between production and auxiliary units.

ii) Estimate the cost of processing of milk and different milk products.

iii) To work out the break even level of output.

A multi product dairy plant in North West India was purposively selected for the study due to its diverse activities andproduct mix. Data for one year period ending March, 1986 were collected on all aspects concerning input and output, inventory levels, sales, distribution and expenses incurred on processing milk and manufacturing of different dairy products. To meet the first objective regression and tabular method were employed as the analytical tools but finally tabular analysis was selected.

Methodology based on time scale was developed to apportion joint costs component-wise cost of production of various products which had contributed more than 1.00 percent to sales revenue except processed cheese was estimated. Break even analysis was performed in respect of these products by using the formula.

Break even quantity= Total fixed cost/(Price-Average variable Cost)

It was observed that during the study period milk intake was 1893.987 Litres which averaged to 5188.7 Lit per day. In this quantity cow milk was 85.55 per cent and the rest was buffalo milk.

To process milk and manufacture different during prdducts, an expenditure of Rs.24,72,460.25 was incurred. The processing cost per lit. of milk was found to be Rs.1.3055. It was found that in the total cost of processing, cost on account of auxiliary units was Rs.1343038.15 (54.32 per cent) while that of production units was Rs.11,29,422.10. Monthly variation in auxiliary units' cost was observed ranging from Rs.0.5139 per lit of milk handled to Rs.0.9425 per lit with an overall figure of Rs.0.7091 per lit. The production units' cost ranged form Rs.0.5348/ lit to Rs.0.6706 lit. The average production units' cost was Rs.0.5964/ lit. Taking costs

as dependent variable and milk intake as independent variable results of regression equations had revealed that auxiliary units' cost wasn't significantly related to milk intake whereas milk throughput and production units' cost/lit were found to be correlated and statistically significant.

Table 14 sums up the detailed analysis carried out in table 4 to 12. It was interesting to observe that for all the products analysed the relative share of raw materials cost and processing cost varied. In ghee making raw material cost was highest (93.08 per cent) while it was lowest in Ice cream (49.95). Similarly variation in ratio of fixed cost to total cost was found in various dairy products. But it wasn't as pronounced as it was the ratio of raw materials cost to total cost. Fixed cost as proportion of total cost ranged from 4.37 per cent in case of ghee to 28.65 per cent in case of kalakand. The average cost of processing toned milk and manufacturing ghee, paneer, table butter, SMP(S), lassi, FDD, ice cream and kalakand were Rs.1.3400/ 500 ml sachet, Rs.49.1876/kg, Rs.19.5655/kg, Rs.41.4432/kg, Rs.19.1243/kg, Rs.1.1878/250 ml. sachet, Rs.1.2532/250 ml sachet, Rs.2.5036/120 ml cup and Rs.21.3244/kg respectively.

Table-14

Cost Of Manufacturing Of Dairy Products.

Sr. No.	Product	Total cost/ unit (Rs.)	Raw-materials cost/unit	Agerage processing cost/unit (Rs.)	Share at fixed cost in total cost (%)	Share of variable cost in total cost (%)
1	Taned Milk	1.3400 (100.00)	1.0494 (78.21)	0.2906 (21.72)	7.79	92.21
2.	Ghee	49.1876 (100.00)	45.7845 (93.08)	3.4031 (6.92)	4.37	95.63
3	Paneer	19.5655 (100.00)	16.2178 (82.76)	3.3477 (17.24)	10.13	89.87
4	Table Butter	41.4432 (100.00)	36.4972 (87.87)	4.9460 (12.13)	7.70	92.30
5	SMP	19.1243 (100.00)	9.5958 (50.18)	9.5285 (49.82)	17.04	82.96
6.	Lassi	1.1878 (100.00)	0.8601 (64.32)	0.3277 (35.68)	16.36	83.44
7.	F.D.D.	1.2532 (100.00)	.913 (61.41)	0.3402 (38.59)	16.12	83.88
8.	Ice-cream	2.5036 (100.00)	1.2937 (49.95)	1.2099 (50.05)	16.20	83.80
9.	Kalakand	21.3244 (100.00)	13.5904 (57.69)	7.7340 (42.31)	28.65	71.35

Figures in parenthesis indicate percentage cost to total cost of ~~productive~~ respective product.

Analysis made to determine breakeven output level showed that contributory margin (price- average variable cost) was highest (Rs.6.79 per kg) for kalakand followed by skim milk (Rs.5.63/ kg), paneer (Rs.2.4163/kg) lassi (Rs.0.532/unit), Ice cream (Rs.0.50/ unit), FDD (Rs.0.20/ unit) and toned milk (0.03/unit). Contributory margin for ghee and table butter was negative. Given the prevailing price structure it was uneconomical to continue production of these products.

To restore production of these products price and cost structures should be rationalised. Break even analysis established that actual output, of all the products except toned milk and flavoured dairy drink exceeded break even output. Milk products SMP(S) kalakand, paneer,lassi and ice cream were earning a net profit of Rs.2.38, Rs.0.68, Rs.0.40, Rs.034 and Rs.0.10 per unit of the product.

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