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OPTIMIZING MILK MARKETING SYSTEM IN ORGANIZED SECTOR

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Milk marketing in India has witnessed a structural change in the recent past and the organized dairy sector is fast gaining in importance in this process. The extreme perishability and bulkiness of milk, available from thinly and widely scattered rural sources, require different methods of milk assembly, its modernized processing into milk and milk products and their efficient selling and distribution to the urban consumers. The marketing system in the organized sector thus links the milk producers in the rural area and the consumers in the distant urban area. Its efficiency is essential to achieve the goal set for the dairy industry as an instrument of economic and social change.[1]

Of late, considerable interest has been shown by the planners in India to effect consistently economic viability in the dairy industry through optimizing organized milk marketing processes, procurement, processing and distribution, the interdependent operations of the dairy plant, to achieve the desired objectives. The present investigation was directed towards optimizing the milk marketing operations through systems analysis by taking a case study of a dairy plant in the organized dairy sector.

METHODOLOGY

Data Collection

The data for the present investigation were collected from a composite milk plant purposively selected from the North-West India. The plant had a well developed milk-shed area with vastly dispersed milk assembly and chilling centres, a factory with multiproduction system and a well set network for the distribution of its products. The plant represented an average milk plant of the country as it operated under common characteristic conditions and bottlenecks of operational constraints. The records, personal interview and observations were used to collect data for the year 1979-80 on various parameters of procurement, processing and distribution.

The Milk Marketing System

The operations of the dairy plant represent the processes of milk marketing system in the organized sector. Each marketing process is one of the movements, it is a series of actions and events that take place in some

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1. The importance of dairy development in India was recognized internationally when the XIX International Dairy Congress held in New Delhi in 1974, declared as its theme "Dairying as an instrument of social and economic change" which was of particular significance to India and this thinking was portrayed in the Interim Report (1976) of the National Commission on Agriculture on milk production through small and marginal farmers and agricultural labourers.

sequence involved in the flow of goods and services from the point of initial production until they reach the ultimate consumer.[2] The dairy plant as a marketing system was divided into three sub-systems, namely, procurement, processing and distribution. The milk was collected through the procurement sub-system from the village level collection centres and milk producers co-operative societies, widely scattered in the rural milk-shed area of the milk plant. The village level collection centres and the societies supplied milk twice daily in the morning and evening to the milk assembling centres and milk chilling centres. Further, the milk was collected in cans from the milk assembling centres in tankers from the milk chilling centres and transported to the central dairy. The whole system operates within certain boundaries which to a large extent are set by external independent conditions and stimuli. While optimizing the marketing system, the external conditions and stimuli were considered to be given during a particular period of the reference year.

The Models

The procurement, processing and distribution - sub-systems were considered collectively, not in isolation of one another, for optimization of the marketing system with given infrastructure and the external conditions and stimuli. The efficient milk pick-up routes were designed by the use of vehicle scheduling model based on savings' concept subject to various conditions and restrictions. To formulate the optimum milk pick-up route system, vehicle scheduling model has been extensively applied by the researchers and plant management.[3]

The milk procurement with efficient route system was linked in the form of milk purchasing activity to linear programming model used for optimization of processing and distribution sub-systems. Linear programming technique is generally used either for minimization or maximization problem at a time. The optimization model was designed to determine how much intermediate products should be manufactured and individually be used at least cost for the standardisation of milk or mix for the other dairy products subject to prevention of food adulteration act. This minimization problem was linked to the maximization problem to determine the optimal product-mix, packaging line and selling and distribution channels for maximization of the total

2. R.L. Kohls: Marketing of Agricultural Products, Third Edition, The Macmillan Company, New York, 1968, pp.20-22.

3. G. Clarke and J.W. Wright, "Scheduling of Vehicles from a Central Depot to a Number of Delivery Points", *Operational Research,* Vol.12, No.4, 1969, pp.568-581; H. Lattenmayer, "Solution of Transport Problems in the Distribution Sector of the Dairy Industry", *Dte. Molkzty,* Vol.88, No.40, 1967, pp.1629-1633; International Business Machines Corporation: System/360 Vehicle Scheduling Program (360 A-ST-06 X)—Application Description, IBM, Technical Publications Department, New York, 1968; M.C. Hallberg and G.T. Gentry: Efficient Routing Systems for Retail Milk Delivery, Department of Agricultural Economics and Rural Sociology, The Pennsylvania State University, Philadelphia, U.S.A., 1970; E. Rupf, "Optimisation of Milk Collection", *Dentsche Molkerei-Zeiting,* Vol.94, No.15, 1973, pp.560-562 and 564; K.H. Haisch, "Maximisation of Transport Costs in Collecting and Marketing", *Molkerei-Zeiting welt des Milch,* Vol.31, No.23, 1977; J.P. Stockl: Use of Computers to Solve Problems in the Dairy Industry, EDV Varlang Eugen Ulber, 1981, pp.295-300; and K.K. Kalra: Optimising Operations of Dairy Plant through Total System Approach, Ph.D. Thesis, Division of Dairy Economics, Statistics and Management, National Dairy Research Institute, Karnal 1983 (unpublished).

contribution value subject to various bottlenecks and constraints. Further, the interval programming[4] was incorporated in the same model to take care of specified upper and lower limits of certain restrictions.

RESULTS AND DISCUSSION

The total cost of milk procurement was estimated and found to be Rs.198.08 per 100 kg. It constituted payment to milk suppliers, Rs.175.19 (88.45 per cent of the procurement cost); field level activities, Rs.14.67 (7.34 per cent); factory level activities Rs.8.32 (4.21 per cent); and milk purchase tax, Rs.7.01 (3.54 per cent). The trucks and road milk tankers covered a distance of about 1,014 km. per day (Table I) on an average in the existing vehicle

TABLE I—EXISTING AND EFFICIENT MILK PICK-UP ROUTES, 1979-80

Types of vehicle	Time	Per day average distance travelled by the vehicles under		Savings in km. obtained	Percentage savings.
		Existing system (km.)	Efficient system (km.)		
Trucks	Morning	315.58	297.71	17.87	5.66
Trucks	Evening	266.00	250.79	15.21	5.72
Road milk tankers	Day	432.38	405.76	26.62	6.16
	Overall	1,014.21	954.26	59.95	5.91

scheduling system for lifting milk from the milk-shed area. The efficient routes developed using the savings' concept reduced the daily travel distance to 954 km. per day leading to an absolute savings of 60 km. per day. Thus, savings through rationalised routes were only about 6 per cent of the distance covered by the vehicle in the existing route planning system. This showed that even the existing route planning of the plant which was most of the time in circular path was reasonably good and quite near to the rationalised ones. Though there was only a small savings in the distance through rationalised vehicle scheduling, however in aggregate terms, it could save an amount worth Rs.24,194.86 per annum or it reduced the milk transportation cost and procurement cost by Re.0.12 per 100 kg.

In the existing production programme, the plant was manufacturing 18 products (Table II). The optimization indicated that some of the products which were comparatively less profitable could not enter in the optimal product-mix. As such, the number of products manufactured decreased to 14. The products eliminated from the optimal production programme were *paneer,* milk cake, *peda* and cheese. The readjustment in the types and size of production by virtue of optimization showed that the production of skim milk

4. P.D. Roberts and A. Ben, "Interval Programming: New Approach to Linear Programming with Application to Chemical Engineering Problems", *Journal of I & EC Process Design and Development,* Vol.8, No.4, 1969, pp.496-501; and Kalra: *op.cit.*

TABLE II — EXISTING AND OPTIMAL PRODUCTION PROGRAMME, 1979-80

Sr. No.	Name of product	Production programmes	
		Existing (kg.)	Optimal (kg.)
1.	Skim milk powder		
	(*a*) Good	5,24,145.50	6,07,486.77
	(*b*) Floor sweepings	691.40	777.77
2.	Whole milk powder		
	(*a*) Good	4,92,519.00	4,02,259.53
	(*b*) Floor sweepings	566.00	411.34
3.	Baby food		
	(*a*) Good	1,20,318.50	1,15,120.43
	(*b*) Floor sweepings	3,025.00	2,631.90
4.	White butter for ghee	5,90,484.26	7,50,550.17
5.	White butter for packing	73,437.00	88,694.70
6.	Table butter	1,91,947.00	2,882.79
7.	Sterilised flavoured milk	1,64,300.00	2,24,066.26
8.	*Lassi*	22,760.00	29,428.43
9.	Milk cake	4,700.50	—
10.	*Paneer*	4,955.00	—
11.	Standard milk	12,53,566.00	18,16,817.00
12.	Double toned milk	3,67,287.00	3,74,139.74
13.	Ice cream	126.80	259.20
14.	Milk transfer to other plants	54,80,705.00	44,43,398.00
15.	Ice cream powder		
	(*a*) Good	2,814.50	6,135.00
	(*b*) Floor sweepings	150.00	170.00
16.	Cream	137.75	137.75
17.	Milk for cheese	2,070.00	—
18.	*Peda*	1.80	—
	Unutilized milk	—	3,77,359.00

powder, white butter for ghee manufacture and packing, table butter, standard milk, double toned milk, ice cream and ice cream powder has increased over the existing production programme and the size of production of the other products has decreased.

Under the minimization problems of least cost mix formulation for different products, the results suggested that the returned standard milk should be used first for the preparation of certain products like *lassi,* ice cream, etc., rather than sending it for cream separation as is being done in most of the dairy plants. Amongst intermediate products which were rich in SNF, skim milk powder (chamber sweepings), and whole milk powder (chamber sweepings) appeared first to be least costing for mix formulation (standardisation) to meet desired quality standards of different products. After all the quantities of these products were exhausted, condensed whole milk

TABLE III — TOTAL MILK MARKETING ECONOMY AT EXISTING AND OPTIMAL LEVELS, 1979-80

Sr. No.	Items	Existing levels			Optimal levels		
		Total variable cost/Revenue (Rs.)	Cost/Revenue per 100 kg.milk (Rs.)	Percentage to total cost	Total variable cost/Revenue (Rs.)	Cost/Revenue per 100 kg.milk (Rs.)	Percentage to total cost
1.	Milk Procurement						
	(a) Milk suppliers payment	3,46,26,738.44	175.19	74.19	3,39,64,754.53	175.19	74.81
	(b) Field level activities	28,78,055.35	14.56	6.17	27,97,599.22	14.44	6.16
	(c) Factory level activities	2,60,247.60	1.32	0.56	2,55,913.44	1.32	0.56
	(d) Milk purchase tax	13,85,069.54	7.01	2.97	13,59,055.48	7.01	2.99
	Sub-total	3,91,50,110.93	198.08	83.89	3,83,77,322.67	197.96	84.52
2.	Processing						
	(a) Processing	72,30,021.66	36.58	15.49	67,78,145.91	34.96	14.93
	(b) Casual labour	1,13,346.93	0.57	0.24	29,760.17	0.15	0.06
	Sub-total	73,43,368.59	37.15	15.73	68,07,906.08	35.11	14.99
3.	Selling and distribution	1,78,144.07	0.90	0.38	2,17,758.25	1.12	0.48
4.	Total variable cost	4,66,71,623.59	236.14	100.00	4,54,02,982.00	234.19	100.00
5.	Total revenue	5,21,67,215.68	263.94	111.77	5,28,22,038.14	272.46	116.34
6.	Total contribution value	54,95,592.09	27.80	11.77	74,19,056.14	38.25	16.34
	Total quantity of milk handled (kg.)	1,97,64,741			1,93,87,382		

was only used. The use of condensed skim milk (except for skim milk powder) was not cost saving. Certain other surplus intermediate products like baby food (chamber sweepings), ice cream powder (chamber sweepings), butter milk, returned double toned milk and part of the returned standard milk, which could not find place in least cost mix formulations, were supplied to processing section according to the optimal results.

The optimal packaged product-mix suggested complete readjustment of the existing product line and the number of 46 bulk/minor packaging activities were reduced to only 36. Market milk in sachets and cans should be filled and not in bottles. Filling skim milk powder in 25 kg. bags and 500 gm. cartons was preferable to that in 450 and 100 gm. cartons. Ghee in 1/2 kg. tins was not filled at all under optimal programme. Ghee packed in 16.5 and 17 kg. tins and table butter in a variety of consumer's packs were considerably reduced to small quantities. The production of whole milk powder in 25 kg. bags was also reduced. All other products in different packs appeared in more quantities under optimal programme as compared to the existing one.

Rationalisation of the distribution system indicated that selling of all the milk products through milk bars appeared at the maximum demand limit. Selling ghee in 16.5 and 17 kg. tins and table butter was only profitable through milk bars. As far as selling through other marketing channels was concerned, second priority was given to the sale at the factory despatch dock. If there were any surplus unsold products, they were sold through sales dealers located in different cities and towns of the State according to optimal results. These findings corroborated with the distribution policy actually being followed by the dairy plant.

Selling market milk in sachets and cans was profitable through all marketing channels at their respective maximum demand. The results suggested that the mixed system of milk distribution through milk booths and private sales agencies should be retained by the plant.

Optimum sales programme also suggested that the transfer of surplus milk was profitable to the Delhi Milk Scheme, the Mother Dairy and sister plants and not to the private milk plants. Optimizing procurement, processing and distribution consistently would reduce the total variable cost by Rs.1.93 and increase the gross revenue and total contribution value by Rs.8.52 and Rs.10.45 respectively per 100 kg. of the milk handled by the plant (Table III). A considerable quantity of milk (3.77 lakh kg.) remained unutilized under the optimal production programme, suggesting that it should be sold to the Mother Dairy and the Delhi Milk Scheme by modifying the clauses of milk supply contract during different seasons. This would further increase the total contribution value at the rate of Rs.39.73 per 100 kg. or Rs.1.55 lakhs. It may be concluded that optimizing the milk marketing system through total system approach decreased the cost of handling milk and also simultaneously increased the revenue and total contribution of the plant.