

Procurement, Production and Marketing at Supply-Driven Milk and Milk Products Cooperative

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MMPC - Milk and Milk Products Cooperative - is a cooperative organization with its shareholders as milk producing member farmers in India. The company is supply-driven in a way that as per its by-laws the cooperative is obliged to buy all the raw milk supplied by its member farmers, and also it does not buy any milk from farmers who are not members of the cooperative. It sales a portion of the milk procured to many consumers on daily basis as liquid milk, and the remaining part of the milk is used to produce output products such as milk powder, *ghee* (clarified butter popular, particularly, in India), butter, ice-cream, etc. to sell in India and also in several foreign countries.

The products made by the cooperative can be broadly classified into two categories on the basis of profitability: high return products (ghee, butter, ice-cream), and low return products (liquid milk, milk powder). All the high return products are nonperishable and can be stored for long periods under refrigeration. Among the low return products, liquid milk is perishable, and milk powder is nonperishable and requires no refrigeration. In addition, milk powder can be reconstituted into liquid milk that can be used as a basic raw material for the cooperative any time.

The planning horizon is a year divided into two seasons: winter and summer; each approximately half a year long. Planning for the entire year is always carried out at the beginning of the winter season because the raw material supply peaks during that season, but demand has its peak in the summer season. Only the inventory

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of the nonperishable products can be carried from one season to the next.

While the cooperative competes in the market for high return products, one of its strategies is to not lose market share for any of the low return products. This is achieved by setting sales prices for its products within a predetermined price range, and also through its policy of meeting minimum customer demand - referred to as target sales levels - for each of the products for each season. The cooperative requires that the actual sales performance for a product is above the target set for it. Consumption of liquid milk daily is considered essential by domestic customers, and the cooperative tries to meet their need at all cost. Similarly, it wins loyalty of member farmers by offering uniform and reasonable procurement prices for their produce throughout the year. The cooperative sets the procurement prices for the planning year within prescribed price bounds that are determined on the basis of procurement prices offered in the preceding year and the expected procurement prices of the competitors in the planning year. Liquid products - such as raw milk and liquid milk - are measured in litres, and solid products - such as ghee, butter, ice-cream - are all measured in terms of their weight in kilograms (kg.).

MMPC's problem for the planning year (2012) involves decision making in procurement, production and marketing of milk and milk products. In this regard, help the cooperative make aggregate plans for the year 2012. The primary product categories that we focus on in this chapter are given in Table 1.

Table 1 Procured and Output Products of MMPC

Product Number	Product Name	Profitability	Perishability	Units for Measuring
0	Raw milk procured	n/a	Perishable	Litre
1	Liquid milk	Low	Perishable	Litre
2	Milk powder	Low	Nonperishable	Kilogram
3	Ghee	High	Nonperishable under refrigeration	Kilogram
4	Butter	High	Nonperishable under refrigeration	Kilogram
5	Ice-cream	High	Nonperishable under refrigeration	Kilogram

Note: By the operational considerations, cheese - one of the major milk products - is subsumed in *Butter*.

The decisions to be made are: determining for each of the winter and summer seasons of the planning year

1. procurement price for raw milk
2. sales price for each of the output products in the market
3. sales volume of each of the output products
4. production level for each of the output products

5. volume of milk powder to be reconstituted into liquid milk

In order to help the cooperative make these decisions, data are provided as follows. Here, **sales prices** refers to **prices in the retail market**. Similarly, **National average sales price** for liquid milk refers to average price in the retail market in the country. Also, **sales volumes** refers to those in the retail market for all output products.

- Table 2 gives the data on the amount of raw milk (in litres) procured, procurement price (in Rs. per litre) of MMPC, and national average sales price of liquid milk in the consumer market since 2001.
- Tables 3 and 4 give the data reflecting the trend in sales of the output products of MMPC.
- Table 5 gives the desired ranges for the procurement and sales prices and the target sales levels for the output products in the year 2012.
- Table 6 gives the data on the cooperative's production capacities (in units per season) and cost parameters - production cost, inventory holding cost from one season to the next - for each of the output products during the planning year. The costs and capacity parameters are the same for both seasons of the planning year. The table also provides information on the units of raw milk required to produce one unit of the output product.

Table 2 Trend in Milk Procurement at MMPC and Sales Prices of Liquid Milk in India

Year	Season	MMPC Procurement Volume (million litres)	MMPC Procurement Price (Rs. per litre)	National Average Sales Price for Liquid Milk ^a (Rs. per litre)
2001	1	967.20	5.76	18.67
	2	644.80	7.37	18.67
2002	1	1,038.50	5.92	19.32
	2	636.50	7.28	19.32
2003	1	1,020.80	5.76	20.14
	2	835.20	7.35	20.14
2004	1	1,053.28	5.96	21.06
	2	762.72	7.19	21.06
2005	1	1,314.18	6.77	22.45
	2	771.82	8.15	22.45
2006	1	1,369.80	6.75	24.11
	2	913.20	8.42	24.11
2007	1	1,407.15	7.44	27.96
	2	977.85	9.69	27.96
2008	1	1,564.84	8.95	29.08
	2	1,133.16	11.31	29.08
2009	1	1,957.76	9.49	29.83
	2	1,101.24	12.10	29.83
2010	1	2,154.10	10.85	31.24
	2	1,159.90	13.55	31.24
2011	1	2,133.81	12.88	33.57
	2	1,253.19	15.91	33.57

^a National average sales price for liquid milk - an output product in the consumer market - specifies the average of sales prices for liquid milk supplied by many milk and milk products producing companies in India. The Indian dairy industry is governed under a provision of Essential Commodity Act, 1955, and the national average sales prices of liquid milk reflect economic implications of inflation for consumption of milk and milk products in India.

Table 3 Trend in Sales of Liquid Milk of MMPC

Year	Sales Volume (million litres)	Sales Price (Rs. per litre)
2001	431.97	23
2002	457.24	23
2003	491.99	24
2004	504.18	24
2005	535.70	25
2006	579.58	27
2007	601.45	31
2008	722.56	32
2009	915.14	33
2010	982.86	35
2011	1,005.13	38

The sales of liquid milk of MMPC are typically identical in both winter and summer seasons in a year, and they can be considered to be equal in analysis.

Table 5 Sales Price Ranges and Target Sales Levels for Output Products and Range for Procurement Prices for Raw Milk in the Planning Year of MMPC

Product Number	Product	Season	Minimum Price (Rs. per unit ^a)	Maximum Price (Rs. per unit)	Target Sales (million units)
0	Raw milk	1	12.50	13.00	n/a
		2	15.50	16.00	n/a
1	Liquid milk	1	39	42	525
		2	39	42	525
2	Milk powder	1	170	175	65
		2	205	207.5	40
3	Ghee	1	350	355	13
		2	270	275	8
4	Butter	1	315	325	22
		2	245	252.50	13.50
5	Ice-cream	1	115	117.50	22
		2	130	132.50	32.50

^a For raw milk and liquid milk the unit adopted is litres and for other products it is kilogram (kg.).

Table 6 Capacity, Cost and Raw Material Requirements for Output Products of MMPC

Product Number	Output Product	Production Capacity ^a (million units ^b)	Production Cost (Rs. per unit)	Inventory Holding Cost ^c (Rs. per unit)	Raw Milk Required (litres per unit)
1	Liquid milk	600	2.30	n/a	1
2	Milk powder	100	11.72	1.41	6.40
3	Ghee	25	32.20	3.86	14.80
4	Butter	27.50	26.45	3.17	10.50
5	Ice-cream	27.50	17.60	2.11	3.75

^a Production capacity is in number of production units per season.

^b For liquid milk the unit adopted is litres and for other products it is kilogram (kg.).

^c Inventory holding cost is per season.

The cost of reconstituting milk powder into liquid milk is Rs. 1 per kg. The expected national average sales price for liquid milk in India in 2012 is Rs. 37 per litre.

The objective of MMPC is to maximize annual net profit (total sales revenue - raw material procurement cost - production cost - inventory holding cost - cost of reconstituting milk powder into liquid milk).