CHAPTER 4
IT at Milk Collection Centers in Cooperative Dairies: The National Dairy Development Board Experience

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In recent years the National Dairy Development Board-initiated cooperative movement has led to a substantial increase in milk production in India. The two main reasons for this increase are the efficient collection of milk and higher profit for the producers, both of which have to some degree been influenced by information technology. The appropriate information technology described in this paper helped to make information symmetric in the market, thereby minimizing problems of adverse selection and corruption.

Introduction

The farmer-owned Amul Co-operative in Anand, Gujarat, has become a model for all dairy development projects in India. This model showed that an integrated approach along cooperative lines could enhance production, procurement, processing and marketing of milk. Based on this success story of the 1960s, the Government of India launched Operation Flood nationwide in 1970. This project was modeled on the Anand Pattern Co-operative and established organizations similar to Amul in other states of India. The purpose was to provide a regularized and standardized link between the rural milk supply centers and the urban demand centers.

The core of the project is the village milk cooperative. According to the Anand Pattern, a village cooperative society of primary producers is formed under the guidance of a supervisor or milk supply officer of the Co-operative Dairy Union (district level cooperative owning the processing plant). A milk producer becomes a member by paying a nominal entrance fee. He must then agree to sell milk only to the society. The members elect a managing committee headed by a chairman. This committee is responsible for the recruitment of
The National Dairy Development Board Experience

staff who is in charge of the day-to-day operations of the society. Each society has a milk collection center to which the farmers take their milk in the morning and evening.

Starting with 18 milk sheds or collection centers in the first phase, Operation Flood now organizes marketing of milk from 179 milk sheds in over 500 towns. These milk sheds form the catchment area from where milk is brought into the cities. In addition to organizing milk collection and marketing, the cooperative also standardizes methods of procurement, processing and quality control of milk, assuring the producer/farmers of fairness in these procedures. The number of farmers organized into village milk producers’ cooperative societies is now 1,000,000 and the daily procurement of milk by the cooperatives is 13,000,000 liters per day.

Milk is procured from the farmers at the village cooperative societies and is then sent to the district cooperative dairy union by trucks in cans or by tankers from the bulk coolers located at the villages. It is weighed and tested for fat at the dairy docks and then the milk is pasteurized. The dairy then converts the milk into liquid milk for sale and various milk products as per the product mix provided by the state-level Dairy Federation which markets the products of all the dairies in the state. Surplus milk from the dairies, after meeting the local liquid milk requirement and converting into various products, is then sent to the Mother Dairies situated in metro cities by road milk tankers or rail milk tankers (40,000 liter capacity). Liquid milk is generally sold in urban centers in plastic pouches, which is packed at the district dairies. In metros, milk is also sold through bulk vending booths, where consumers can obtain a measured quantity of milk by inserting a coin in an automatic machine.

A National Milk Grid has been formed by linking deficit areas with the surplus areas thus assuring proper marketing of the milk and hence an assured return to the rural producers. For example, milk is sent across a distance of 2,200 km (3,498 miles) from Anand in Gujarat to Calcutta in West Bengal by rail tankers.

Problems in the Conventional System

1. Quality control was a major problem that confronted the cooperatives. The National Dairy Development Board (NDDB) worked to reduce quality variations among sellers by upgrading the technology of milk production by improving cattle feed and the milk processing and delivery infrastructure.

2. Fair and efficient markets do not occur by accident, but are created. Thus, the cooperatives had difficulties to ensure accuracy in measuring quantity and fat content of milk and in making fair payments to the farmers.

3. Before automation, the farmer was paid only every 10 days. Therefore, even though at times he or she delivered milk each day the farmer was not sure of the reliability of the manual calculations of quality and quantity by cooperative society staff.
4. Milk for testing was stored in plastic bottles and tested only after the milk collection process was over. This led to unhygienic conditions and fear of contamination at the center.

5. The conventional Gerber method for testing the fat content of milk is a cumbersome multi-step method. It has various disadvantages including chances of human error, handling of corrosive chemicals, and use of different types of glassware. All these processes added to the cost and the time taken to test the milk.

**Technology Used**

The importance of speed of operations should be emphasized, because 600 milk collection centers receive milk from 60,000 farmers daily. On an average, if the saving in time per farmer were 10 minutes every day, it would amount to a huge saving to the tune of 10,000 hours per day! The deployment of technology was considered instrumental to realize such savings.

**Electronic Milko-Tester**

The conventional Gerber method takes 2 to 3 hours to ascertain the fat content of milk. This in turn leads to a delay in the payment to the farmer as the payment is made strictly on the quality of milk. To overcome this, Milko-tester was developed by a Danish firm that was later modified to Milko-tester Minor, a less complicated version of the Milko-tester III. This model is not only economical but also simple to operate. Moreover, it is suited to village conditions. The greatest advantage of this tester is the accuracy coupled with the rapidity of analysis of fat content. It works on the principle of light scattering with manual homogenization. It operates on AC-mains as well as on battery, with a built-in battery charger and an automatic switch-over to the battery in case of power failure. Rajasthan Electronics and Instrumentation Ltd. (REIL), in collaboration with M/s.A/SN Foss Electric, Denmark started the commercial production of milko-testers in 1981 and sold about 26,000 units to dairy cooperatives all over India.

**The Micro-Processor-Based Milk Collection System**

Milko-testers reduce the time taken to ascertain the quality and the fat content of milk which in turn helps in overcoming all associated problems of the traditional method of testing such as storage of samples, and handling of corrosive chemicals. However, the calculation and payment of bills remained as cumbersome as ever since the bills were still being calculated manually. The NDDB, in 1988, took up a project to develop an integrated milk collection system
to effect immediate calculation and payment of bills to the farmer. For this REIL and M/s ATE Enterprisis Ltd. developed prototypes that were tested in two villages in Kheda district, namely Mogri and Bedwa.

*REIL-developed milk collection system:* (See Annex for technical specifications.) This system has been operational in Mogri for the past several years. It consists of three pieces of equipment, as shown in Figure 4.1, placed along side each other: (a) the Electronic Milk Tester (EMT); (b) the Milk Weighing System (MWS); and (c) the Data Processor (DP). The printer is a supplementary piece of equipment.

The EMT and the MWS are interfaced with the Data Processor (DP). This system needs only three operators. Under this system each farmer is given a plastic card with a code number as his or her identification. The DP reads the identification on the card and the farmer pours his milk into a steel trough over a weigh-bridge. The weight of the milk gets displayed to the farmer and instantaneously gets transferred to the DP in liters. One man is required to fill the cans after the milk has been weighed, while the second operator takes a 5ml. sample of the milk and holds it up to a tube of a fat testing machine. The hand lever of a machine is then moved thrice and the fat content of the milk sample is displayed on the monitor and also transferred to the DP. A small printer attached to the DP gives a slip that reads the farmer’s name, quantity of milk, percentage of fat and the amount of the payment to be made. The calculations of the payment are made on the basis of a rate chart as the price of the milk depends on its fat content. With this slip the farmer can collect his or her money from an adjoining window. The payment is rounded to the closest rupee value and the balance is credited to his account the next day. The entire process takes about 20 seconds. The DP has the added advantage of storing the transaction of milk collection of all farmers of the shift. At the end of the shift the machine prints out the individual transactions along with the grand totals.

![Figure 4.1 Micro-Processor-Based Milk Collection System](image-url)
Other functions made possible by this system are:

- Entry of year, date, cow/buffalo milk fat rate, shift and membership number into the DP at initialization;
- Erasing and rectifying any incorrect data that may have been fed in inadvertently;
- Independent displays of the weight and fat content by the MWS and the EMT on individual display ports;
- Storage of weight and fat content figures in the memory of the DP and immediate printout of all the necessary details to each farmer;
- A memory capacity to hold the data for up to 1,000 farmers; and
- Data can be sent online to a PC via RS232C serial communication at the end of a shift.

**ATE Enterprises Ltd. developed milk collection system:** This system has been operational in the Bedwa district for the past several years. The system is similar to the one developed by REIL except for some additional functions such as:

- A digital display port facing the farmer showing the farmer’s code number, quantity of milk, the fat percentage and the total amount of money to be paid to the farmer;
- A battery backed RAM for the DP to enable storage of all transactions for a period of 11 days. After this the DP can be attached to a standard dot matrix printer which prints out all the transactions. This ledger is then sorted and processed by a ROM-based program.

**PC-based milk collection system:** The micro-processor based milk collection system facilitates speedy collection of milk, an efficient and accurate measurement of fat content and quick payment to the farmer. The PC-based system not only enhances the speed of services at each cooperative, but also increases the efficiency and reliability of overall operations. Among other things, it:

- Stores individual milk collection details on a suitable storage device for yearly analysis;
- Facilitates the complete financial accounting of the cooperative society;
- Maintains records of cattle feed, ghee¹ and other local milk sale of the society;
- Monitors the animal breeding, health and nutrition programmes; and
- Maintains records of the members, for instance, details of their land holdings and animals.

The benefit of information technology (IT) to the societies is manifold. The number of people required for the manual procedure has come down. Daily accounts can be obtained immediately. The computer can, within moments,

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¹. *Ghee* is fat prepared from butter.
calculate the profits of the society on the basis of the data received from the dairy regarding the payment made to the milk society for the previous day’s collection. The income and expenditure incurred by the society can also be incorporated. Perhaps most significantly, the farmers are now ensured of correct and honest payments.

**Implementation Problems**

The project to develop a PC based integrated system that the NDDB took up in early 1991 was initiated in Ranu, a village in Baroda district. This system, however, did not function for long because of particular problems. First, the PC/XT failed as it could not withstand the excessive dust and the extreme climatic conditions. And the weighing system failed frequently.

However, with improvements in technology the PCs have become more rugged and can now be operated in village conditions. This underlines an important aspect of IT applications that needs attention i.e., our heavy reliance on imported technology. The desire to develop a region-specific technology has now been felt.

**Technological and Financial Support**

When the NDDB financed the project in the early 1990s for the micro-processor based automatic milk collection stations (AMCs) the cost was about $2,250 (approximately Rs 96,800), which included the micro-processor, weighing machine, milko-tester, an 80 column dot-matrix printer, and an uninterrupted power supply. Prices have now come down, and the entire set is available for about $1,800 (approximately Rs 77,400).

In terms of technological support, intensive training was given to the operators. Service engineers on motorcycles provided quick maintenance whenever required. Virus-proofing of the systems was also taken care of and back-up procedures for data were defined.

The NDDB has financial support from the untied foreign assistance funds and the government budget in addition to other sources to sustain technological upgradation requirements. NDDB has financed 200 such units under a scheme of 30 percent grant and 70 percent loan under Operation Flood III, with a view to popularize this system in villages.
Private-Sector Development

Two Indian entrepreneurs gave a considerable impetus to this project. They offered the integrated system to the societies and at times even offered to install the system free of cost until the customer was convinced of the utility and satisfied with the performance of the system.

Many new entrepreneurs have now started manufacturing these instruments with improved features. In the initial stages the cooperative dairy unions also provided loan facilities to the village societies for the purchase of the system. REIL has also supplied a large number of AMCs to milk cooperatives in Rajasthan and Punjab. The IT-based systems have now become so popular that the village societies are buying systems with their own funds.

However, the uphill task of developing the market was left to a few private enterprises. Only if a large number of private sector enterprises are involved can the application of this technology be adopted all over India.

Implementation Benefits of the Automatic Milk Collection Station

Farmers were the main beneficiaries of this project. Figure 4.2 shows farmers queuing up at the AMCs.

The main benefits of the automatic milk collection systems as compared to the conventional methods are as follows:

- Immediate payment for the milk delivered;
- Accurate information about the fat content, quantity of milk and the payment due to the farmer is displayed;
- Accuracy in weighing the milk on the MWS as against the manual process where milk was weighed using measuring containers which very often led to a financial loss to farmers;
- Immediate testing of the quality of milk as against testing after 2 to 3 hours of collection;
- The card reader unit ensures speed of operation and an error-free entry of identification number of the farmer; and
- The elimination of manual registers for all kinds of information and data storage.
Conclusion

In Gujarat, 573 AMCs are currently in operation with Kheda having the highest number of AMCs (278), followed by Sabarkantha (74), Surat (68), and Mehsana (53), Banaskantha (29), Panchmahal (18), Bharuch (15) and Vadodara (15) each. Gandhinagar, Ahmedabad and Rajkot have 10, 8 and 5 AMCs respectively.

The cheap and credible technology described in this paper illustrates how the delivery system has been improved by ensuring prompt payment to the farmers and instilling their confidence in the cooperatives set-up, and also minimizing the problem of adverse selection and defeating corruption. It is one of the several ways in which the NDDB has dealt with problems by using state-of-the-art technology. Other improvements and innovations have been in breeding and feeding technologies, and in processing and delivery infrastructure.
Annex

Equipment Specifications

1. ELECTRONIC MILK TESTER (EMT)

A. ELECTRONICS : STATE-OF-THE-ART MICROCONTROLLER BASED ELECTRONICS.

B. MEASURING RANGE : 0-13% FAT

C. CAPACITY : 120-150 SAMPLES/HR

D. ACCURACY (Sd) :
   - 0-5% FAT -0.06%
   - 5-8% FAT -0.10%
   - 8-13% FAT -0.20%

E. REPEATABILITY :
   - 0-5% FAT -0.03%
   - 5-8% FAT -0.04%
   - 8-13% FAT -0.08%

F. SAMPLE VOLUME : 0.5 ml / TEST

G. DILUENT VOLUME : 6.5 ml / TEST

H. CALIBRATION :
   ONE CALIBRATION CHANNEL ADJUSTABLE WITHIN THE RANGE 0-13%

I. POWER SUPPLY :
   AC-220/240 v MAXIMUM +10% MINIMUM -15% DC-12V, MOTOR CAR BATTERY
   A FULLY CHARGED BATTERY WILL LAST FOR AT LEAST 10 HRS.

J. INTERFACE :
   PARALLEL DIGITAL PORT PROVIDED ON REAR PANEL 9-PIN D-TYPE CONNECTOR
   FOR DATA PROCESSOR

K. AUTO ZERO FACILITY :
   ZERO SETTING AT THE PUSH OF A BUTTON. AUTO ZERO INHIBIT FUNCTION TO
   PREVENT MANIPULATION OF % FAT DISPLAY

L. AMBIENT TEMPERATURE : 5°C TO 45°C
2. MILK WEIGHING SYSTEM (MWS)

A. ELECTRONICS : STATE-OF-THE-ART
   MICRO CONTROLLER
   BASED ELECTRONICS

B. PRINCIPLE OF : LOAD CELL BASED
   OPERATION

C. MEASURING RANGE : 0 TO 20 kg

D. RESOLUTION : + 10 gms

E. ACCURACY : + 20 gms

F. REPEATABILITY : + 1 DIGIT (+10 GMS)

G. LINEARITY : 0.02%

H. POWER : 230v 50 Hz AC/12 V. DC

I. INTERFACE : PARALLEL DIGITAL PORT
   PROVIDED ON REAR
   PANEL VIA 15-PIN D-TYPE
   CONNECTOR FOR RANSFER
   OF DATA TO DATA
   PROCESSOR

J. CONTAINER : STAINLESS STEEL
   CONTAINER OF CAPACITY
   15 Kgs FOR WEIGHING MILK

K. OPERATING TEMP : +5 C TO 50 C RANGE

L. DISPLAY : 7-SEGMENT LED DUAL
   DISPLAY ON FLAG STAFF

M. OVERLOAD : SAFE MAX LOAD: 150% OF
   RATED LOAD. ULTIMATE
   OVER LOAD: 200% OF
   RATED LOAD.

3. DATA PROCESSOR (DP)

A. ELECTRONICS : STATE-OF-THE-ART
   MICRO-CONTROLLER
   BASED ELECTRONICS

B. INPUTS/OUTPUTS : TWO 8-BIT DIGITAL INPUT
   CHANNELS, ONE RS 232C
   PORT FOR PC INTERFACE.
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<tr>
<td>C. DATA DISPLAY</td>
<td>6-DIGIT 7-SEGMENTED DISPLAY / DUAL DISPLAY ON FLAG STAFF OPTIONAL</td>
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<tr>
<td>D. CONTROL INPUTS</td>
<td>THROUGH 4X4 HEX KEYBOARD WITH SPECIAL KEYS &amp; STANDARD NUMERIC KEYS, 0-9.</td>
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<tr>
<td>E. PRINTER</td>
<td>21 COLUMN DOT MATRIX PRINTER</td>
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<tr>
<td>F. POWER</td>
<td>230V, 50HZ, AC, +10% / 12 VDC</td>
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<tr>
<td>G. MEMORY</td>
<td>16 K RAM 16 K EPROM</td>
</tr>
<tr>
<td>H. BATTERY BACK-UP</td>
<td>3V, NICAD BATTERY</td>
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<tr>
<td>I. AMBIENT TEMPERATURE</td>
<td>+5 C TO 45 C</td>
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<tr>
<td>J. DIMENSIONS (LXWXH)</td>
<td>47X30.7X17.2 cms.</td>
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