# *Interventions in the Food Value Chain to Improve Quality and Competitiveness: A Case Study of Dairy Cooperative in India*

A Case Study on Food Chain Management

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## I. Introduction

India is the largest producer of milk in the world with a total production of 84 millions tonnes in 2001 (Hemme et al 2003). It also has the world's largest livestock population, housing 57% and 16% of the globe's buffalo and cattle respectively. However, a majority of its primary producers involved in dairying activities are small and marginal farmers, with 80% of the animals kept in small farms with an average of 2-8 animals [1](Hemme et al 2003). About 18 million people (5.5% of the workforce) are engaged in dairy activities. Dairying is an important economic activity in India as livestock distribution is more equitable than land distribution and thus it is considered an area that can be the focus of anti-poverty and equity-oriented programs (Staal et al, 2009).

Ninety two percent of the primary producers are concentrated in rural areas and have limited access to marketing and infrastructural facilities. Only 15% of milk produced is marketed through formal systems, thus limiting the scope of processing, value addition and better market penetration in the regional and international markets. Most States (sub nationals) in India have producer cooperative unions, where members sell their milk to be processed and marketed.

The birth of cooperative movements in India was in the dairy sector, which began as a humble initiative began in 1947 in the village Anand in Gujarat, where milk producers with State support joined hands to have a stake in their produce and share the profits gained by selling their produce. Such societies federated at the district level to form a cooperative union which helps to add value to the milk through processing and market milk products in distant markets. The success of Kaira District Milk Cooperative Union, known as Amul where Anand village society is a member, led to the adoption of the Kaira model as a blueprint in all milk cooperatives in the country under the three phases of "Operation Flood". Today almost all states in the India have their own dairy cooperatives supporting millions of small and marginal farmers.

In Karnataka, the Karnataka Cooperative Milk Producers' Federation Limited (KMF), a state-level cooperative, was setup in 1974. It was India's first World Bank funded dairy development program modelled on the Anand pattern. The KMF today is the third largest milk cooperative in India and the largest in South India in terms of procurement and sale. The KMF markets its products under the brand name *Nandini* and unlike Amul its markets are limited to Karnataka.

During its initial years, the focus of these cooperatives was primarily on liquid milk. Overtime they progressively moved onto higher value milk based products. Quality and price competitiveness have helped these cooperatives remain competitive in the wake of

[1] The average animal size on farms in the United States is 88 and 236 in New Zealand (Hemme et al, 2008)

emerging competition from multinational companies like Unilever, Nestle and Britannia. A key source of competitive advantage has been their ability to implement best practices across all levels of the network: the federation, the unions, the village societies and the distribution channel.

Due to its high perishability, milk and milk products have one of the most stringent codes of standards. Conforming to standards depends much on how milk is handled throughout the supply chain, through technology and good supply chain management, particularly in the context of a cooperative setup, where producers are many.

Technological intervention at the grassroots through the adoption of Bulk Milk Coolers (BMC) at the village society level have helped increase the scope for the improving milk quality in the cooperatives. In their efforts to diversify to higher value products, this intervention can help reduce sour milk content and spoilage during transportation and storage. However, in order for these benefits to materialize, there is a need to bring about parallel changes in operational practices. Therefore, improvement in the quality and competitiveness of milk and milk products depends on the synergy of technological and organisational improvements coupled with operational changes at all levels of the value chain. This case primarily focuses on the aspects of technological change and operational improvement and the changes brought about in the supply chain and the scope for improvement.

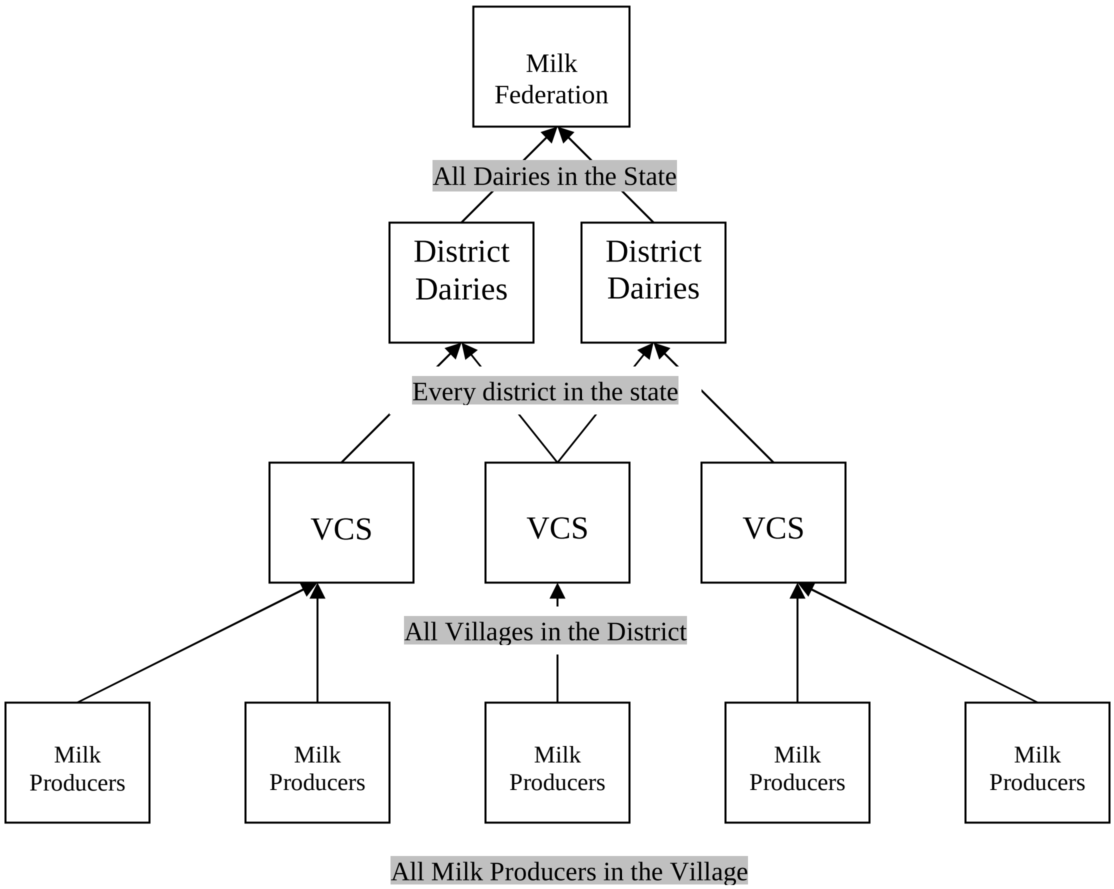
## II. The Milk Cooperative Structure and Supply Chain

The structure of the KMF (Figure 1) supply chain is based on the three tier model, which comprises of the milk producer and the village cooperative at the village level, the district dairy and the district unions at the district level and the state marketing federation representing all dairies at the state level.

The Milk Producers Co-operative Society (MPCS) on an average have about 200 members each from whom milk is collected every day. Each member of the MPCS has a commitment to supply a certain amount of milk to the society. Payments are made based on test results used to determine quality of milk supplied. The procured milk is then sent to the district dairy for processing. The role of the federation at the state level is to market the products under their respective brands and plan strategies and investments for the market as well as the cooperative.

Milk collection from farmers is done according to the nature of the village cooperatives' infrastructure. Cooperatives without BMCs collect their milk in cans of 40 kilos each, before transporting them to chilling centres at the district level. From the chilling plants, the milk is sent to the processing and packaging centre. Milk under normal conditions, especially in tropics spoil faster, therefore, milk in non-BMC centres are collected twice a day. Villages with BMC facilities have their milk collected once a day as milk is refrigerated. The milk collected from these centres is sent directly to the processing plants.

**Figure 1: The Structure of the Cooperatives**




## 2.1 Implementation and Benefits of BMCs

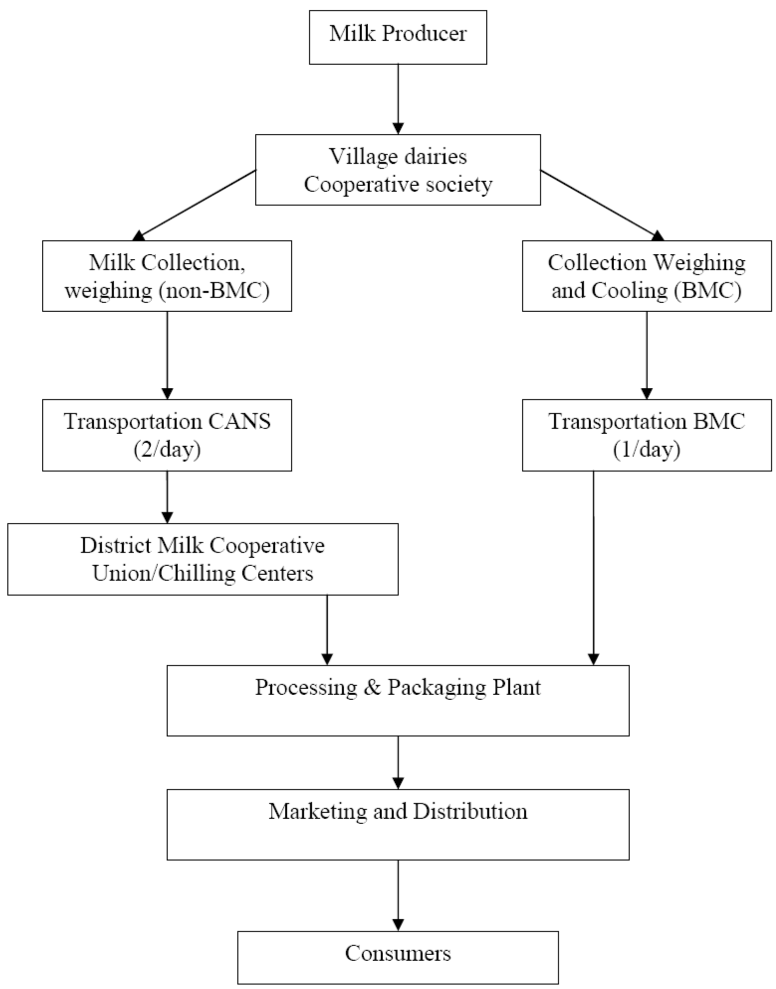
The supply chain in these cooperatives consists of two patterns of procurement, the cans and bulk milk coolers (BMC) procurement. Over the years, the number of MPCS having BMCs has increased drastically though cans are still used for transportation. Figure 2 shows the supply chain of these two methods of procurement from the village level to the final marketing stage at the state federation.

Bulk Milk Coolers at the village level were introduced in 1993 in Anand and 2003 in Bangalore Dairy for storage and preventing milk from turning into curd or getting sour. Table 1 show the composition and production figures of Bangalore Dairy. In the Bangalore Dairy of the KMF, there are 85 BMCs and 172 MPCS's attached to them, giving 15% of the total number of producer cooperatives access to BMCs. The percentage of milk produced by BMCs to the total production per day is 16.5% in the Bangalore Dairy.

**Table 1: Capacity and Production Figures of Amul and Bangalore Dairy**

| | **Bangalore Dairy** |
|---|---|
| Total Number of VCS/DCS | 1675 |
| Number of VCS/DCS with BMC | 85 plus 172 (total 257) |
| Number of VCS/DCS without BMC | 1418 |
| Average production of VCS/DCS per day | 540 |
| Average Production of BMC VCS/DCS | 100,000 |
| Average Production of non-BMC VCS/DCS | 800,000 |
| Total Milk Production per Day | 900,000 |

**Figure 2: Milk procurement through CANS and BMC**



### 2.1.1 BMCs and Improvement in Quality

The introduction of BMCs has brought about considerable change in quality of milk collected and transported for processing by the village cooperatives. Changes can be observed in the reduction of sour milk content, flavour and bacterial count. Table 2 compares various characteristics of BMC and non-BMC milk collected by the Bangalore Dairy. As the temperature of milk in BMCs is kept at 6-7 °, the milk stays fresh and acidity and alcohol free as fermentation levels are low. The Methylene Blue Reduction Test (MBRT), which reveals the level of bacteria in milk, has a timing of 180-240 minutes in BMC milk compared to 15-30 minutes in milk collected in cans showing reduced bacterial formations. The standard plate count (SPC) and the coliform count in BMC milk is also low as a result of cooling.

**Table 2: Comparison of Quality Characteristics of BMC and Can Milk**

| **Parameters** | **Can Milk Quality** | **BMC Milk Quality** |
|---|---|---|
| *Temp. of Milk* | 25-32°C | 6-7°C |
| *Flavour* | Slightly Acidic | Fresh |
| *Acidity* | 0.16-0.18 | 0.15 |
| *MBRT** | 15-30 mins | 180-240 mins |
| Bacteriological Quality | | |
| *SPC,cfu/ml*+ | 1-2 crores | 10-20 lakhs |
| *Coliform* | 2-10 lakhs | 20-40 thousand |
| *Alcohol Test* | Positive | Negative |

Source: Karnataka Cooperative Milk Producers' Federation Limited
* = Methylene Blue Reduction Test
+ = Standard Plate Count, Colony Forming Unit/millilitre

While collection practices of BMCs have given the milk union the advantage of bacteria free, fresh and adulteration free milk, there are many processing advantages dairies able to reap as a result of this. For example, milk free of alcohol is suitable for the preparation of products that require sterilization. The processing of milk determines the quality and shelf life of milk only to a certain extent. The improvement of quality before the processing stages has helped improve the shelf life of milk in the market.

### 2.1.2 Benefit to Farmers

The introduction of BMCs can bring about considerable benefits to farmers supplying milk to the village cooperatives in terms of quality, yield and returns. The normal shelf life of milk that is not refrigerated is normally four and a half hours after milking. During this period, farmers need to get their produce to the village cooperatives from where it is sent to chilling plants. Often this time constraint leads souring and curdling of milk affecting its quality.

Yield is another important aspect in milk production which is determined by a number of factors ranging from health and breed of the livestock to feed. According to the International Livestock Research Institute, the timing between milking also has an effect on yield and quality. In the can system of procurement, there are normally two procurements a day from each village cooperative. The producer has to time the milking according to the collection timings, reducing the time between each milking. This drastically influences the solid non-fat (SNF) content in milk as well as yield, which is reduced by almost a litre if the timing between milking is less than 12 hours. The premium price paid to farmers in Karnataka, for milk with 3.5% fat content and 8.5% SNF is 12.95 Rs. This premium increases by .05 Rs for every .01% of SNF giving farmers better returns. However, at the MPCS's of the Bangalore Dairy, there have not been any noticeable changes in quality (SNF %) or quantity of milk. This is primarily due to the lack of any initiatives in creating awareness among farmers about the benefits of increased milking intervals.

### 2.1.2 Cost Analysis and Possible Benefits to Milk Producers Cooperatives

Though the initial implementing and maintenance costs of BMCs are high the streamlining of the supply chain can help cut costs while bringing benefits to the cooperatives as well as the primary producer.

*Initial Costs and Maintenance*

The cost of BMCs according to the size of the plant in the Bangalore dairy along with the computed user cost of capital (UCC) is given in table 3. At 10% depreciation and 10% interest per annum the UCC per litre of milk is analysed for 67% and 80% capacity utilization. As the present capacity utilization in the Bangalore Dairy is 67% the UCC for 5000 kg capacity BMC is Rs .27 per litre and Rs.54 per litre for 1000 kg capacity. This cost can be reduced in all capacities by Rs .04-.09 if the capacity utilization is increases to 80%.

**Table 3: Cost of BMCs in Amul and Bangalore Dairy (per Litre)**

| BMC Capacity (Kg) | Price of BMC (Rs) | Capacity Utilization@ | | Depreciation @ 10% | | Interest@10% | | User cost of Capital | |
|---|---|---|---|---|---|---|---|---|---|
| | | @80% | @67% | @80% | @67% | @80% | @67% | @80% | @67% |
| 1000 | 600000 | 800 | 670 | 0.21 | 0.25 | 0.25 | 0.29 | 0.45 | 0.54 |
| 2000 | 800000 | 1600 | 1340 | 0.14 | 0.16 | 0.16 | 0.20 | 0.30 | 0.36 |
| 3000 | 1200000 | 2400 | 2010 | 0.14 | 0.16 | 0.16 | 0.20 | 0.30 | 0.36 |
| 5000 | 1500000 | 4000 | 3350 | 0.10 | 0.12 | 0.12 | 0.15 | 0.23 | 0.27 |

The other expense incurred with the implementation of BMCs is its running and maintenance. The rate of maintenance would vary depending on the power supply situation, the use of generators, oil and servicing of the machine. Using electricity the cost of power is Rs 0.10- 0.12 per litre, whereas running the BMC on a generator can incur a cost of .25-.27 Rs a litre. On an average, the BMC centre incurs a cost of .49 Rs per litre of milk in maintenance in Bangalore Dairy and a major proportion of the cost is accounted for diesel costs in running the generator as power supply has been poor. Though general maintenance of village cooperatives using cans is low there are other expenses incurred for purchasing and also maintenance and cleaning of cans. The average cost of a stainless steel can is Rs 3000 and its aluminium cap is 300 Rs. The average life span of a can is a year although rough and continuous handling sometimes reduces it to 7-8 months. With the help of BMCs this expense has been reduced along with expenses of cleaning and storage, which requires manpower and boilers for steam and hot water.

*Transportation*

The introduction of BMCs has made the transportation of milk easier while reducing transportation costs. The average transportation cost of the Bangalore Dairy is given in table 4. A major transport cost reduction is achieved as a result of lower collection frequency. The non BMCs use two types of trucks, the 6 ton truck that can carry 140 forty litre cans and a 3 ton truck with the capacity of 80 cans, twice a day. BMCs in its place use insulated tankers of 9000 litres to transport milk to processing units only once a day.

**Table 4: The Cost per litre Milk Transportation in BMC and non-BMC Centres**

| | Bangalore Dairy |
|---|---|
| Non BMC | .32 |
| BMC | .20 |

The other advantage of using tankers for transportation is that there is a reduction in spoilage if the vehicle breaks down, absence of theft and loss from leakage, thus reducing the weight volume mismatch between the village cooperatives and the processing plants.

*Processing Costs*

A major reduction in the cost of processing is the chilling cost at the chilling plants, where can milk incur a cost of .32 Rs per litre. Although BMC milk needs to be chilled before processing the temperature reduction is only 2-3 degrees compared to can milk, which requires a drop in temperature from 35 degrees to 3 degrees. The advantages of pre chilled milk is that at the pasteurization stages, milk is heated only to 72-75 degrees while can milk need 80-85 degrees of heat as a result of high bacterial count. The costs of processing are given in table 5. In practice however, after the chilling stage milk from cans as well as BMCs are mixed together taking away the advantages it has in terms of cost of processing. If a viable number of BMCs are established in village cooperative, processing can be separately done for BMC milk which will help reduce costs.

**Table 5: Processing Cost of Milk**

| **Activities** | **Cost Rupees/litre** |
|---|---:|
| **Consumption of Furnace oil** | 0.17 |
| **Electricity** | 0.2 |
| **Water** | 0.09 |

| | |
|---|---|
| **Packaging** | 0.65 |
| **Conversion (Fat Extraction, Skimming)** | 0.02 |
| **Store Consumables ( Refrigeration etc)** | 0.06 |
| **Miscellaneous** | 0.3 |
| **Total** | 1.49 |

*Reduced Damages and Bonus*

Bonuses are incentives given yearly to farmers for their produce according to the quality of the milk they produce. The introduction of BMC can help farmers get a higher bonus premium for their produce as the quality of milk sent to the processing centres improve. In the Bangalore Dairy, the final profit to the district cooperative society is shared among producers at the end of the year. The imbursement structure of the profits is given in table 6.

**Table 6: Bonus Structure of the Bangalore Dairy at all Levels**

| **Particulars** | **Percentage of Profit** | **Assessment = 100** |
|---|---|---|
| *Reserve Fund* | 25% | 25 |
| *Building Fund* | 10% | 10 |
| *Share Divident* | 10% | 10 |
| *Education Fund* | 2% | 2 |
| | | **47** |
| *Balance* | | 53 |
| *Bonus* | 65% | 34.45 |
| *Charity Fund* | 10% | 5.3 |
| *Cattle Development Fund* | 10% | 5.3 |
| *Employee Bonus* | 10% | 5.3 |
| *Propaganda Fund* | 5% | 2.65 |

Along with technological changes brought about to improve the quality of milk there have been initiatives to improve practices and production methods through information dissemination to farmers. Apart from technical assistance given to the MPCS's, farmers are trained in the health and hygiene practices for animals and milk production. Information regarding the benefits and technicalities of technological innovation along with information regarding standards are given to farmers to improve practices.

The success story of the Bangalore Dairy as a cooperative accomplishment has innovation, technological development and strategy as an integral part of it. In order to compete in the market with other established multi national brands quality standards have become a priority and the GCMMF has adapted well to it. The GCMMF and KMF adheres to the certification of the International Standards Organization (ISO) and has also implemented Hazard Analysis and Critical Control Point (HACCP) certification and process and has since established a traceable system.

## III. Economics of Quality in Bangalore Dairy

In order to analyse the difference between BMC and non-BMC procurement practices that are presently in function and changes that can be brought about to improve operations, we have compared the costs and benefits at the BMC and non-BMC levels with an hypothetical best case scenario. In Table 7 we have given these details at three levels: farmer's level, MPCS level as well as the District dairy level. The cost analysis is done on a per animal basis.

Considering the present situation, at the farmer's level there has not been any change brought about by the implementation of BMC's with reference to yield or quality. In the best-case scenario, improved milking intervals can bring about better yield and improve quality of milk by improving the SNF content if practices at the grassroots are improved.

At the MPCS level, the use of BMC's is a loss making system because of the high cost of maintenance, which mainly results from high power costs. In the best-case scenario, good power supply can help reduce the power costs by as much as .12 Rs a litre. Another reason for poor benefits to MPCS is due to poor quality of milk resulting from *contamination and malpractices like adding of water to increase volume. Improvement of* practices and monitoring at the MPCS levels can help maintain the quality benefits gained at the farm level in the best-case scenario, increasing the price realised. Presently, the loss at the MPCS is as high as six Rs a litre.

The analysis at the district dairy level takes into account operations and not the benefits that can be got at the final product and value addition stages because of using better quality milk. The major cost reductions seen at this stage is in transportation and chilling. As milk collected from BMCs are already chilled it can be transported directly to the main dairy instead of chilling plants. This reduces the cost of chilling as well as cost of transportation by almost 0.45 Rs per litre. Reduced spoilage also helps in conserving volume.

**Table 7: Cost Comparisons between BMC, Non-BMC and the Best Case Scenario**

| Particulars | BMC | Total | Best case Scenario | Non BMC | Total | Descriptions |
|---|---|---|---|---|---|---|
| *Farmers* | | | | | | |
| *Average Yield* | 9.4 | | 10.4 | 9.4 | | **There is no apparent increase in the quantity of milk from the farmer.** According to the international livestock research institute, the time intervals between milk have an effect on quantity and quality of the milk. As milk collection happens only once a day from BMCs, farmers using this facility have an advantage of prolonging milking intervals. |
| *FAT/SNF content* | 3.8-4.1/8.3 | | 1.5 Rs/ltr result of increased SNF | 4.0-4.3/8.4-8.5 | | According to the data collected from the Bangalore Dairy, the milk collected in BMCs show a lower FAT/SNF count than milk collected in cans. Interviews with officials at the Bangalore dairy revel that this is due to adulteration at the village cooperative level as well as the transportation level. This is however lower at the non-BMC level because the milk is transported to chilling centres where the milk is tested again, whereas in the case of the BMC centres the milk is transported directly to the main dairy. |
| *Price of Yield* | 12.98 | 122.01 | @14.48 Rs/litre 150.5 | 12.98 | 122.01 | |
| *MPCS* | | | | | | |
| *Price to society (3.5%)* | (12.79) 13.24 | 120.22 | 14.98 Rs/liter as a result of good FAT/SNF 155.79 | 13.43 | 126.24 | Because of lower fat and SNF in milk, the non-BMC centres get better remuneration for their milk as compared to BMC members. |
| *Maintenance* | 0.49 per litre | 124.82 | @.37Rs/litre (3.84) 159.63 | - | 126.24 | The maintenance of BMCs run up an average cost of .90 Rs a litre in the case of BMCs. The maintenance cost adds up the electricity and diesel costs, which is basically the **cost of chilling (0.18 Rs/Litre)**, internal transportation costs as well as incentives paid (which is based on the capacity of the BMC) |
| *Revenue* | (Price to Farmers + 3.5% - Cost) | -6.39 | 1.45 | | 4.23 | |
| *District Dairy* | | | | | | |
| *Transportation* | 0.20 per litre | 126.82 | 161.71 | 0.32 per litre | 129.24 | The cost of transportation in non BMCs are higher as milk is collected twice a day, while this is only once in the case of BMCs. The cost of transportation is marginally higher in the case of non-BMCs than stated here, as it does not take into to account the transportation costs from chilling plant to main dairy (data unavailable) |
| *Spoilage* | - | 126.82 | 161.71 | .05% per litre or 0.01 Rs. per litre | 129.33 | |
| *Shortage* | 0.16% or 0.03 Rs/ltr. | 128 | | - | 129.33 | |
| *Chilling* | | | | .32 Rs/litre | 132.33 | |
| *Total* | | 128 | 161.71 | | 132.33 | |
| *Revenue Dairy* | | -1.92 | -2.85 | | -6.1 | |

## V. Conclusion

Technological innovation and operational changes are important to bring about transformation in the production practices and supply chain management. This case on the Karnataka Cooperative Milk Producers' Federation Limited is an example of how important the synergy between the two is to bring about quality and competitiveness at all levels of the food value chain. Especially in the context of a cooperative setup, where resources are limited and stakeholders are many, appropriate operational changes need to be implemented along with technological innovations to bring about awareness and benefits to all levels of the supply chain.

Good quality milk low in bacteria and pathogens and high in FAT and SNF content is a product of a well functioning cold chain, where systems are in place at all levels to maintain quality. Only then will the benefits percolate to all levels of the supply chain and to all stakeholders. In the KMF, the absence of operational changes with the introduction of BMC have led to the milk union incur losses and additional costs at the MPCS and district dairy levels. This has led to the union not being able to reap the benefits of technological changes, making it into costly enterprise.

The case also emphasises on a best-case scenario inferring the benefits of technological innovations if operational systems were in place to enable its proper functioning. It emphasises the benefits farmers could get through better prices because of improved quality and yield. Through better functioning cost of production could be reduced sharing the benefits with all participant of the value chain. At the final stages of production, better quality milk can help in product diversification and higher value addition helping the Union earn better revenue by producing high quality competitive products to the markets.

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